Book of Posters

Emerging scholars Program (ESP) – Spring 2022

Genotype Distribution in a Population

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Abstract

Genetic adaptations occur over many generations as a result of a mix of subtle, random changes in features and natural selection of the variations that are best adapted for their environment. The purpose of this study is to analyze the propagation of inherited traits in autosomal dominant and recessive inheritance in a farmers' large population of plants and an animal breeder population of animals by computing the powers of a matrix. We create a matrix with entries representing the probability of potential offspring genotypes based on all possible combinations of the parents' genotypes. Then, by the use of SageMath on the CoCalc platform, we compute the powers of the matrix to estimate how inherited traits are transmitted down through the generations. When the matrix is diagonalizable, these calculations may be done more efficiently. Using the concept of limits, we are able to estimate the probability of inherited traits in the future. This approach allows us to forecast in which generation a genotype will be the only one left or when the other genotypes will vanish from the family's pedigree inheritance patterns. Finally, we are able to examine the pattern in a population and determine the frequency of the trait after each generation in the farmers' large population of plants and the animal breeder population of animals, as well as the likelihood that the trait will be passed down to the next generation.

Introduction

In this project we examine the inheritance from parents to offsprings in animals or plants. A genome is an organism's full collection of genetic instructions. This genome includes all of the information required to produce and sustain this organism. Our genome is around 3.2 billion bases long and is divided into 23 chromosomal pairs. One of our parents gives us a copy of our genome. Genetic inheritance is the process of passing genetic material from one parent to the next. The hereditary trait in question is thought to be regulated by a pair of genes, denoted by the letters A and a. Under autosomal inheritance, every person in the population, regardless of gender, has two of these genes, with the potential pairings denoted by the letters AA, Aa, and aa. Individuals will inherit one gene from each of their parents' pairs of genes to generate their own unique pair. The probabilities of the probable genotypes of the offspring are listed in Table 1 for all conceivable combinations of the parents' genotypes.

	Genotypes of Parents					
Genotype of Offspring	AA-AA	AA-Aa	AA-aa	Aa-Aa	Aa-aa	aa-aa
AA	1	1/2	0	1/4	0	0
Aa	0	1/2	1	1/2	1/2	0
aa	0	0	0	1/4	1/2	1

Table 1. Genotype Probability Tables.

Methods and Analysis

We go through the two forms of inheritance and how the parents' genes are passed down to their children. We also create matrix models that predict the genotypes of children as a function of the genotypes of the parents, and we use them to track the distribution of genotypes in a population through generations. After a certain number of generations, we wish to get an expression for the distribution of the three potential genotypes in the population.

- The calculation of powers of a matrix can be computationally expensive. However, if the matrix is diagonal, the cost is significantly reduced.
- We take advantage that our matrix M is **diagonalizable** to find its **eigenvalues and eigenvectors**, and rewrite M as PDP^{-1}, where D is a diagonal matrix. Then, for any integer n, instead of evaluating M^n, we evaluate PD^nP^{-1}.

Example of Autosomal Dominant Traits Inheritance

Consider a farmer who has a vast population of plants with a distribution of the three genotypes, AA, Aa, and aa. The farmer wants to create a breeding program in which every plant in the population is crossed with a genotype AA plant, and subsequently replaced by one of the offspring. In this example the population has 50% of AA, 40% of Aa, and 10% of aa. We use Table 1 and the expressions below to calculate the genotype distribution of each generation based on the genotype distribution of the previous generation. We set:

$$\begin{aligned}
&\text{Fraction of plants of genotype AA in } n\text{th generation:} && a_n = a_{n-1} + \frac{1}{2}b_{n-1},\\
&\text{Fraction of plants of genotype Aa in } n\text{th generation:} && b_n = c_{n-1} + \frac{1}{2}b_{n-1},\\
&\text{Fraction of plants of genotype aa in } n\text{th generation:} && c_n = 0,
\end{aligned}$$

for $n = 0, 1, \ldots$. We assume $a_n + b_n + c_n = 1$. We can rewrite the three above expressions in the matrix format: $\mathbf{x}^{(n)} = M\mathbf{x}^{(n-1)}$ for $n = 1, 2, \ldots$, where

$$\mathbf{x}^{(n)} = \begin{bmatrix} a_n \\ b_n \\ c_n \end{bmatrix}, \quad \mathbf{x}^{(n-1)} = \begin{bmatrix} a_{n-1} \\ b_{n-1} \\ c_{n-1} \end{bmatrix}, \quad \text{and} \quad M = \begin{bmatrix} 1 & \frac{1}{2} & 0 \\ 0 & \frac{1}{2} & 1 \\ 0 & 0 & 0 \end{bmatrix}.$$

We observe that

$$\mathbf{x}^{(n)} = M\mathbf{x}^{(n-1)} = M^2\mathbf{x}^{(n-2)} = \cdots = M^n\mathbf{x}^{(0)}.$$

To calculate M^n, we take advantage of the fact that M is diagonalizable, so $M = PDP^{-1}$. We have

$$\mathbf{x}^{(n)} = M^n\mathbf{x}^{(0)} = PD^nP^{-1}\mathbf{x}^{(0)} = \begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & -2 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 \\ 0 & \left(\frac{1}{2}\right)^n & 0 \\ 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 & 1 \\ 0 & -1 & -2 \\ 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} a_0 \\ b_0 \\ c_0 \end{bmatrix}.$$

Since $a_0 + b_0 + c_0 = 1$, we obtain that

$$\begin{aligned}
a_n &= 1 - \left(\frac{1}{2}\right)^n b_0 - \left(\frac{1}{2}\right)^{n-1} c_0,\\
b_n &= \left(\frac{1}{2}\right)^n b_0 + \left(\frac{1}{2}\right)^{n-1} c_0,\\
c_n &= 0,
\end{aligned}$$

for $n = 1, 2, \ldots$. These are specific formulas for the numbers of plants of the three genotypes in the nth generation, expressed as fractions of the original genotype. When n approaches infinity, $(1/2)^n$ approaches 0, therefore $a_n \to 1$, $b_n \to 0$, and $c_n = 0$. We conclude that eventually all plants will have genotype AA.

Example of Autosomal Recessive Trait Inheritance

Let's say an animal farmer has a herd of animals who have an autosomal recessive illness. Assume that the animals who are affected do not reach maturity. One strategy to manage this condition is to always couple a female with a normal male, regardless of her genotype. As a result, every future offspring will have either a normal father and a normal mother (AA-AA), or a normal father and a carrier mother (AA-Aa). Because animals with the aa genotype do not reach maturity, AA-aa mating is not possible. There will be no disease-affected kids from this form of marriage. However, we may identify carriers in future generations. In this example the population has 60% of AA and 40% of Aa. Let's figure out how many carriers there will be in future generations.

$a_n =$ Fraction of population of genotype AA in nth generation
$b_n =$ Fraction of population of genotype Aa (carriers) in nth generation

Since every offspring will have at least one normal parent, the controlled mating program can be viewed as a continuous mating program with genotype AA.

As a result, the equation governs the shift of genotype distribution from one generation to the next:

$$\mathbf{x}^{(n)} = M\mathbf{x}^{(n-1)} \quad \text{where} \quad M = \begin{bmatrix} 1 & \frac{1}{2} \\ 0 & \frac{1}{2} \end{bmatrix}.$$

Since M is diagonalizable, we compute

$$\mathbf{x}^{(n)} = M^n\mathbf{x}^{(0)} = PD^nP^{-1}\mathbf{x}^{(0)} = \begin{bmatrix} 1 & 1 \\ 0 & -1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 0 & \left(\frac{1}{2}\right)^n \end{bmatrix} \cdot \begin{bmatrix} 1 & 1 \\ 0 & -1 \end{bmatrix} \cdot \begin{bmatrix} a_0 \\ b_0 \end{bmatrix}.$$

Using the fact that $a_0 + b_0 = 1$, we obtain that

$$\begin{aligned}
a_n &= 1 - \left(\frac{1}{2}\right)^n b_0,\\
b_n &= \left(\frac{1}{2}\right)^n b_0.
\end{aligned}$$

for $n = 1, 2, \ldots$. As a result, as n goes to infinity, $a_n \to 1$ and $b_n \to 0$, that is, we will not have carriers.

Results

After the implementation of some code, we are able to appreciate the different results of the inherited traits depending if it is autosomal recessive or autosomal dominant. The results are shown in the table below.

	Dominant Example Genotypes			Recessive Example Genotypes	
Generation	AA	Aa	aa	AA	Aa
1st	0.70000	0.30000	0	0.80000	0.20000
2nd	0.85000	0.15000	0	0.90000	0.10000
3rd	0.925000	0.07500	0	0.95000	0.05000
4th	0.962500	0.037500	0	0.97500	0.02500
5th	0.98125	0.018750	0	0.98750	0.012500
6th	0.990625	0.0093750	0	0.993750	0.0062500
7th	0.995312	0.004687	0	0.996875	0.0031250
8th	0.997656	0.002343	0	0.9984375	0.0015625
9th	0.998828	0.0011718	0	0.9992187	0.00078125

Table 2. Genotype Probability Results from Examples 1 and 2.

We are able to evaluate the pattern of autosomal dominant inheritance in a population of plants after a certain amount of generations. We can see that around the 5th generation the Aa genotype will have a small probabilty to be present, given that $a_n \to 1$, $b_n \to 0$, and $c_n = 0$ as n goes to infinity. We are able to evaluate the pattern of autosomal recessive inheritance in a population of animals after a certain amount of generations. We can see that around the 6th generation the Aa genotype will completely disappear.

Conclusion

Using linear algebra methodologies, we are able to evaluate the pattern in a population of plants and animals, and to determine the percentage of inherited trait likelihood after different generations as well as the probability for the offspring to receive the trait. We analyze how linear algebra is used in genetics by adapting matrix models that give us the probabilities we need depending on the genotypes. Given that linear algebra is beneficial in a range of real-world applications, it would be a good idea to employ alternative linear algebra methodologies and matrix combinatorics of matrices for additional approaches in genetics like decomposition of the Hamming Distance matrices in terms of permutation matrices.

References

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Automated Robotic Light Bulb Testing Platform

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Emerging Scholars Program

Abstract

The main purpose of this project is to create a functional prototype of a multilayered system that incorporates aspects of electrical, mechanical, and computer engineering technology. The main objective of the system is to be able to determine whether a light bulb is working or not. The building blocks of this system are a robotic arm that is able to slide along a rail (for added mobility), a conveyor belt, and an electromechanical device that holds and tests light bulbs. Initially, the robot arm picks up a light bulb and places it into the holder which then tests it. A photoresistor is used to detect whether the light bulb turns on; if the bulb lights up, then it works. The robot arm then places the light bulb on the conveyor belt which moves the bulb to the other end of the conveyor belt (sensors are used at either end of the conveyor belt to determine the location of the light bulb). Next, the robot arm slides along its rail into a new position, allowing it to pick up the light bulb which is now at the other end of the conveyor belt. After picking up the light bulb, the robot arm places it in one of two locations depending on if the light bulb works or not. Digital and analog control circuits are used in conjunction with sensors to detect measurands which are then fed into a CPU as data.

System Run Through

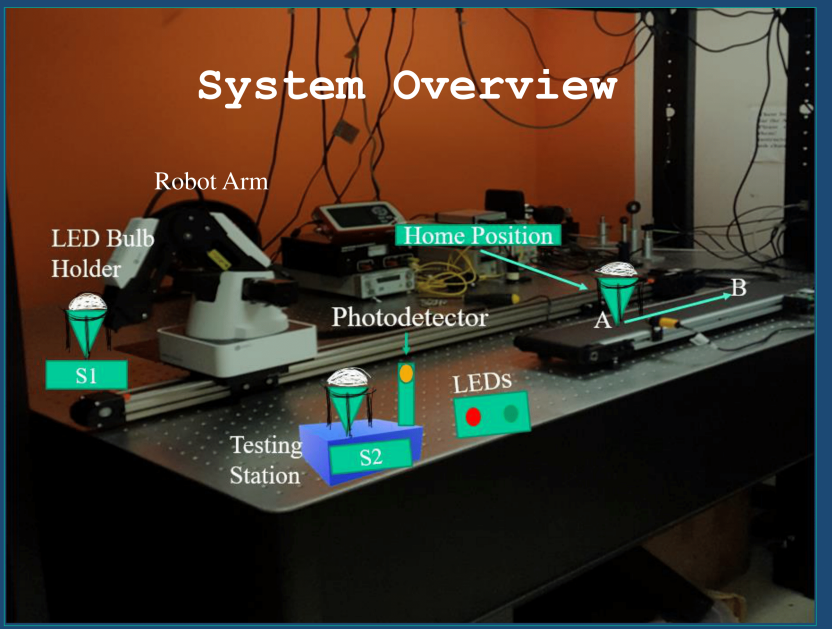
1. The robot arm moves along the slider from its home position into position S1
2. It picks up the bulb and holder and places on the testing station at position S2
3. The Green LED turns on if the bulb is working
4. The Red LED turns on if the bulb is not working
5. The robot arm places the bulb and holder onto the conveyor belt
6. The bulb is transported from point A to B
7. The robot slides back into home position
8. It then places the bulb and holder into working or not working sections

Progress

Our initial goal was to design the entire system. This included the following:

- Determining what components and devices would be needed
- How they would all function together to achieve the task of testing light bulbs
- Purchasing the items required
- Assembling and setting up

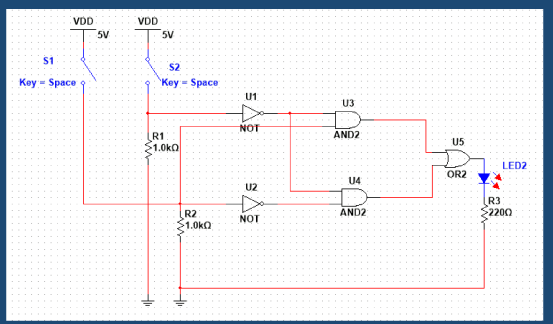
Next, we had to design and test the various sub-systems needed to perform each step of the light bulb testing process.



The image above shows the initial stages of the automated robotic light bulb testing platform prototype. The components include: **Robot arm** - **Slider for robot arm** - **Conveyor belt** - **Light bulb holder** - **Testing station** - **Indicator LEDs** – **Photodetector** - **Motion sensors** (mounted onto the conveyor belt at point A and B).

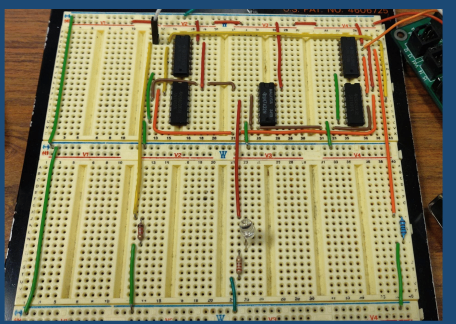
Digital Logic Circuit

The schematic below shows the digital logic circuit needed to operate the conveyor belt.
S1 and S2 represent the signals that are transmitted by the motion sensors mounted on the conveyor belt.



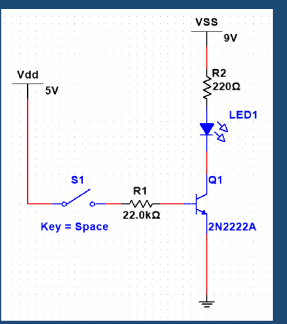
Digit Logic Circuit Prototype

The Image below shows the breadboarded prototype of the digital logic circuit used to operate the conveyor belt.
We tested and verified its functionality.



LED Indicator Circuit

The schematic below shows how an LED is switched on via S1, using a transistor.



Summary

The overall system has been designed and is now being implemented step by step. Each phase requires prototyping and testing. Once all the sub-systems are prototyped and validated, we can move on to integrating the entire system.
Integration will require using a microcontroller and a computer capable of handling all the input and output signals required in actuating the robotic arm and conveyor belt, as well as controlling the LEDs.

Robotic Manipulation: A Practical Application of Linear Algebra in Perception and Path Planning

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Objective

In this project, we describe the mathematics that informs the decision making of a SCARA robotic manipulator by performing a simple pick-and-place operation within a controlled workspace. The intent is to showcase a practical implementation of concepts within linear algebra, differential equations and trigonometry as the basis of this type of robotic control algorithm, allowing the reader to build a more intuitive understanding of these disciplines.

Implementation: Target Localization

The system is comprised of a 3 joint SCARA assembly (the arm) with two revolute (rotating) joints and a prismatic (linearly translating) joint. The assembly is mounted to a baseboard that also serves as the 2D plane representing the workspace.

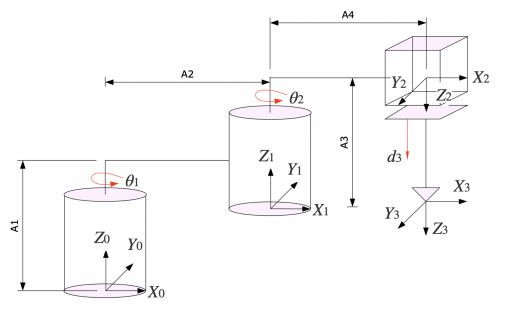

Figure 1:Denavit-Hartenburg representation of the SCARA manipulator.

Target objects are placed on the workspace and a combination of background subtraction and center-of-brightness computer vision techniques are used to determine the object coordinates in the physical space. The raw camera coordinates are then passed into a homogeneous transformation matrix (HTM), to account for the difference in camera and physical frame orientation and origin displacement [3].

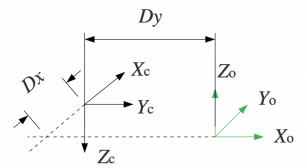

Figure 2:A graphical representation of the camera (C) frame and the physical (O) frame.

$$\begin{bmatrix} X_o \\ Y_o \\ Z_o \\ 1 \end{bmatrix} = H_c^o \begin{bmatrix} X_c \\ Y_c \\ Z_c \\ 1 \end{bmatrix} = \begin{bmatrix} R_c^o & D \\ 0\ 0\ 0 & 1 \end{bmatrix} \begin{bmatrix} X_c \\ Y_c \\ Z_c \\ 1 \end{bmatrix}$$

The rotation matrix in the HTM is the result of two rotation operations performed consecutively on the O-frame [1, 4]:

$$\begin{aligned} R_c^o &= R(180°, x)R(-90°, z) \\ &= \begin{bmatrix} 0 & 0 & 0 \\ 0 & \cos(180°) & -\sin(180°) \\ 1 & \sin(180°) & \cos(180°) \end{bmatrix} \begin{bmatrix} \cos(-90°) & -\sin(-90°) & 0 \\ \sin(-90°) & \cos(-90°) & 0 \\ 0 & 0 & 1 \end{bmatrix}. \end{aligned}$$

Implementation: Motion Control

The target coordinates (with respect to the O-frame) are used to determine the requisite joint angles using inverse kinematics following the Denavit-Hartenburg parameters for defining reference frames. It should be noted that the joint θ_2 is placed in the 'elbow-up' orientation for this assembly, therefore always moving clockwise.

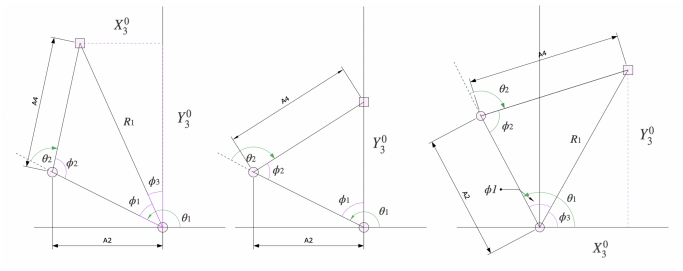

Figure 3:(from right to left): Top-down schematics describing the assembly orientation to navigate to target points on the first and second quadrants, respectively.

The joint angles θ_1 and θ_2 can therefore be calculated [2], given the target coordinates X_3^0 and Y_3^0, as shown below.

$$R_1 = \sqrt{(X_3^0)^2 + (Y_3^0)^2}$$

$$\theta_1 = \tan^{-1}\left(\frac{(A_2)^2 + (R_1)^2 - (A_4)^2}{2A_2R_1}\right)$$

$$\theta_2 = 180° - \cos^{-1}\left(\frac{(A_2)^2 + (A_4)^2 - (R_1)^2)}{2A_2A_4}\right)$$

Results and Conclusion

The object localizer was relatively accurate, locating the target object within approximately 0.3 cm in the X- and Y-axes. Likewise, the motion control algorithm produced repeatable results, although this approach was less accurate, placing the end-effector only within around 2 cm of the target coordinates. This error can mostly be attributed to being unable to accurately calibrate the requisite duty cycle to achieve a specific servo angle, an issue outside the scope of this project.

Many improvements could be made to both the localization and motion control approaches. For example, a next iteration of the inverse kinematic implementation could include numerical approaches to solve non-linear equations generated for larger workspaces or to include elbow-down orientations as well.

References

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More Information

- Contact: Akhil.Sankar@mail.citytech.cuny.edu
- Live demonstrations of the implementation @ YouTube
- Project codebase @ GitHub

Forensic Analysis of Local HIV Isolates

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Abstract

HIV-1 is a rapidly evolving virus that is subject to great genomic diversity. A forensic analysis was conducted on locally obtained HIV-1 reverse transcriptase sequences. Viral sequences of infected patients in the states of New York and New Jersey were obtained from NCBI Virus, aligned, and constructed into phylogenetic trees. An outgroup ancestral sequence was aligned with them as a reference. A sequence from a historical criminal case (1998) was aligned with the local sequences. From a historic perspective, a forensic criminal case involving a gastroenterologist who injected a former girlfriend with HIV-1 marked the first instance of using these data as evidence to track the evolution and divergence of the sequences. These analyses illustrate geographic and temporal differences in prevalent HIV strains. The variation of the reverse transcriptase sequences exhibits a viral life cycle comparably longer to other rapidly evolving viruses. The immune evasiveness of HIV enables a longer life-cycle and fewer active replication cycles while seasonal and acute infections that actively trigger immune responses must replicate at higher rates to spread. These higher rates of replication result in greater diversification into new strains.

Introduction

In 1998, a physician was convicted of attempted second-degree murder for injecting his former girlfriend with blood from an HIV-1 patient. A phylogenetic relationship was constructed based on the viral DNA of the patient and victim, marking the first time phylogeny was accepted as evidence in criminal court. The rapid evolution rate of HIV-1 makes it suitable to study and predict evolutionary links between different subtypes. It is quick to evolve due to its propensity to mutate and recombine. Thus, a phylogenetic analysis was conducted on HIV-1 reverse transcriptase isolates from New York State and New Jersey. The goal of this study was to determine if HIV-1 is as diverse as it was indicated in the victim's HIV-1 sequences in the original criminal case.

Methodology

➪ HIV-1 sequences were taken from NCBI Virus and aligned. (Patient & Victim: **AY156734-AY156803**; NY: **AY701373-AY70139**, **AY453025-AY453063**; NJ: **AF444170-AF444192**; Ancestral: **M93002**)
➪ Phylogenetic trees were constructed using the Maximum Likelihood method through Substitution Model HKY85.
➪ A HIV-1 reverse transcriptase molecular model was generated through https://www.rcsb.org/structure/1RT1.

Results

Figure 1: Local Sequences Aligned with MUSCLE

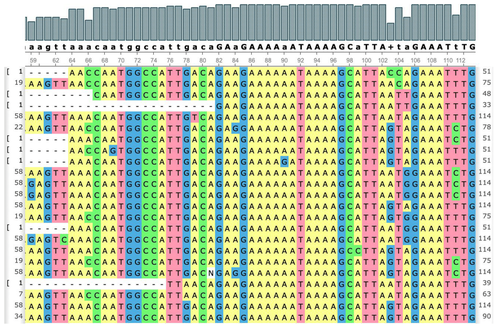

Figure 2: Phylogenetic Tree of Victim & Patient's HIV-1 Reverse Transcriptase Isolates (Ancestral Sequence Included)

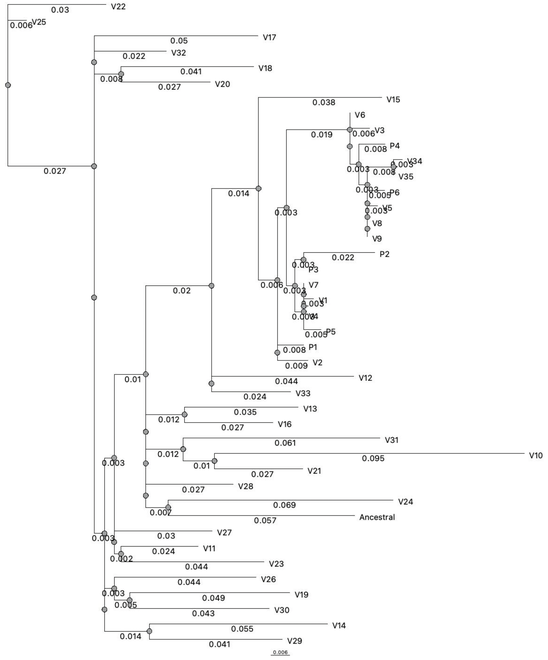

Figure 3: Phylogenetic Tree of Local NY and NJ HIV-1 Reverse Transcriptase Isolates (Ancestral, Victim, Patient Sequence Included)

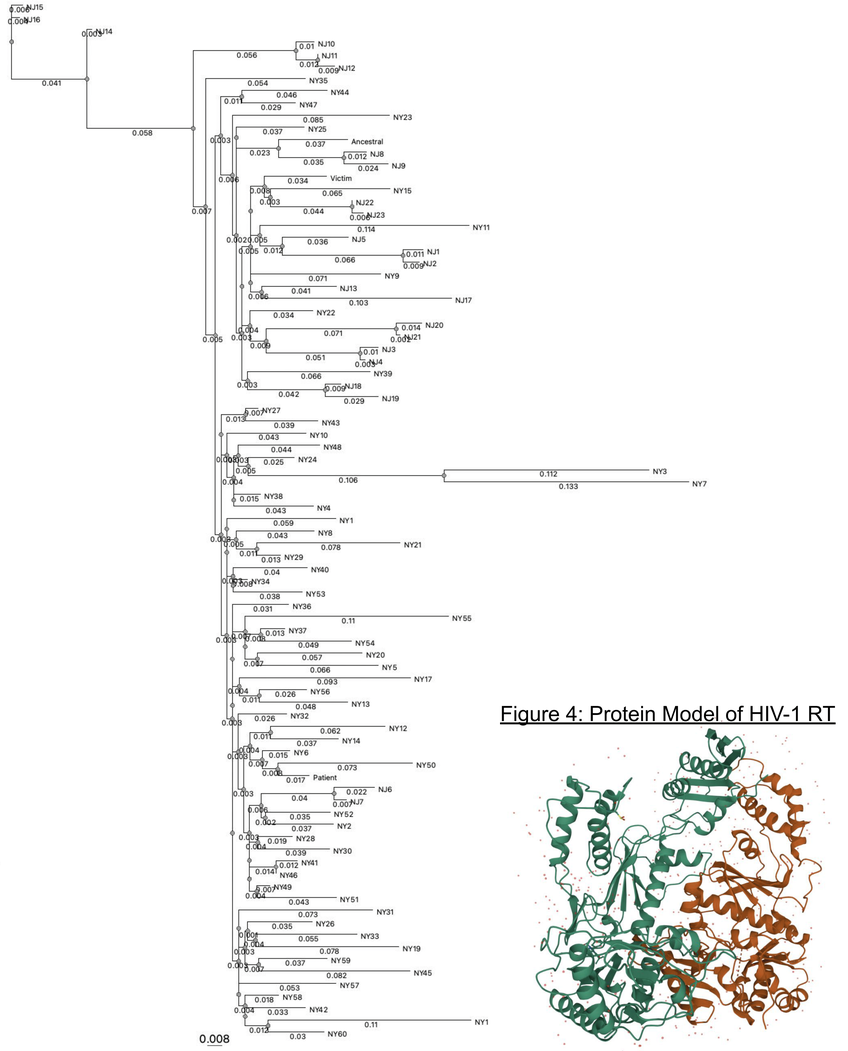

Figure 4: Protein Model of HIV-1 RT

Discussion

➪ When aligned, the sequences are distinct from each other but may differ by a single nucleotide. These singular alterations of the genome may not appear to offer much genetic variation, but when several are observed in a sequence, the variance is unmistakable. These changes may account for the diversity hypothesized by the phylogenetic trees.
➪ The scale bar in Figure 2 (0.006) represents a lesser amount of genetic variation according to the length of the branches. This could be due to the higher sample size as opposed to Figure 3, whose genetic variation by length is 0.008.

Conclusion

Based on the relationships presented in the phylogenetic trees, HIV-1 is capable of producing highly diversified subtypes. This is indicated by the complex branching of the trees, the values of the scales, and the relationships between the outgroup and tested sequences. The relationships hypothesized by the trees show that the local sequences are distinct from each other, but still exhibit high variance. Thus, the high genetic variation observed in the victim's reverse transcriptase isolates is consistent with that of the local isolates collected for this study.

Acknowledgements

➪ New York City College of Technology: Emerging Scholars Program
➪ Professor Jeremy Seto

References

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ESP Project Title: Characterization of Fe(II)/Fe(III) Cycling due to Thermo-mechanical Stress in Carbohydrate Model Systems: Low vs High Field MR Feasibility Testing

ESP Scholars: Analia Basilicata (1,3) and Jian Wang(1)

Mentors: *Subhendra Sarkar(1); Lazar Fleysher(1,2,3); Duke Shereen(4)*

Departments of Radiologic Technology & Medical Imaging 1, Physics 2, New York City College of Technology; Icahn Sch of Medicine, Mount Sinai Hospital, NY 3, CUNY Graduate Center 4

Abstract

Environmental pollutants (exogenous micro-contaminants) have significant impact on ecological and human health. There exist no imaging tools to directly visualize the transformation reactions or products generated in the host tissue affected by such exogenous micro-contaminants. Our research team is using magnetic resonance imaging (MRI), particularly the high degree of sensitivity of MR signal to the presence and chemical states of iron, manganese and several lanthanides to detect and characterize at the atomic and molecular scale the metal-metal or metal-chelator interactions in biologically active model host tissues that are rich in various minerals. MRI experiments involving those minerals seem to provide insights about various macromolecules (proteins and carbohydrates) that depend on endogenous metal ions and hydrating water to maintain biologically viable macromolecular structure and functions. Using both low and high fields (1.5T and 3T) we observed that such exogenous/endogenous interacting species modify the paramagnetic properties locally within the samples that not only affect the sample images but also alter the image noise. While the resulting MR signal change has been extensively studied in literature the later effects involving the image noise have not been adequately explored.

Materials & Methods

MR hardware and Sequences used: One 1.5T GE at Mt Sinai, NY and two 3T Siemens Prisma systems (from ASRC, CUNY, NY & from McLean, HMS, Boston) were utilized. Tx/Rx Body coil, CP Head RF coils were used to estimate systemic and random background and sample image noise for the below sequence and hardware combinations. Multichannel receiver arrays and Parallel imaging were avoided for preserving true image noise.

T1 and T2w Spin Echo imaging with manual ROI based T1 and T2 estimates and 3D T2*w FLASH for T2* estimates in mineral rich and mineral deficient regions were performed.

Samples: Mineral rich fresh fruits (Apples as low pH system and sweet potatoes as higher pH matrix from the same suppliers were imaged without any heat shock followed by a fixed 10-20 sec uniform microwaving step, ambient cooling and repeat imaging.

Figure 1: Mineral rich fruit phantom:

Golden, Fuji, Granny Smith apples and Sweet Potato, clockwise view, starting at radiologic right

Results & Discussions

Figure 2: Four point T1 weighted example, pre heat-shock at 1.5T.

TR 3s, 1s (Left top, bottom) and TR 100 ms, 30 ms (Right top, bottom) for Golden, Fuji, Granny Smith, Sweet Potato, clockwise view, starting at radiologic right.

Note bright tracks and layers presumably due to mineral deposits in bio-reservoirs that can influence proton MR signals, i.e. Fe or Mn, as T1 MR contrast agents (Only Fe rich areas for Apple as it does not have Mn while for Sweet potatoes both Fe and Mn are a possibility).

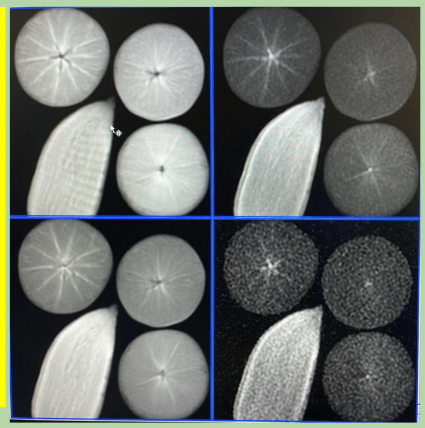


Figure 3: Four point T1 weighted example, post heat-shock:
8 hr post Heat Shock repeat imaging as in Fig 2 at 1.5T.

Note, high signal tracks are still present but only in Granny Smith while those sources have diffused away in all other fruits after heat shock.

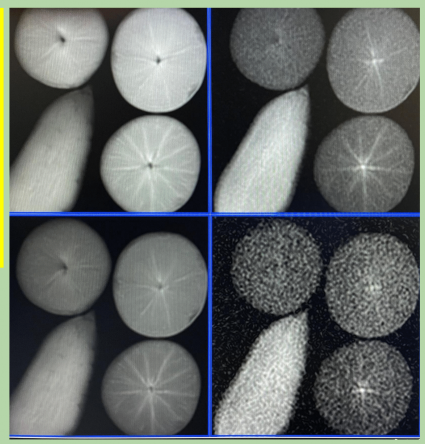


Figure 4:Four point T1 weighted example, 30 day post heat-shock at 3T
TR 3000, 300 ms for top panels; 75, 20 ms for bottom panels). Note the minerals (Fe in particular, are back on track as seen by the TR=75 ms panel, bottom, left), as near the skin layers for sweet potato. TR/TE/Resolution/BW = TR/9ms/1.5x1.5x10 mm voxels/200 Hz/pix.

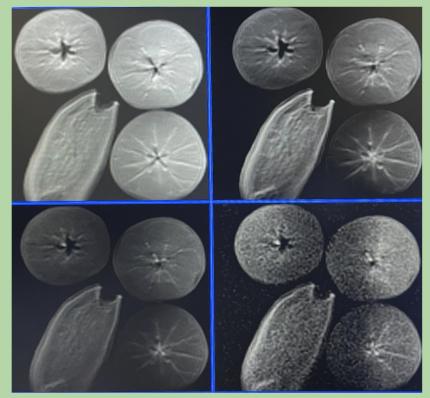
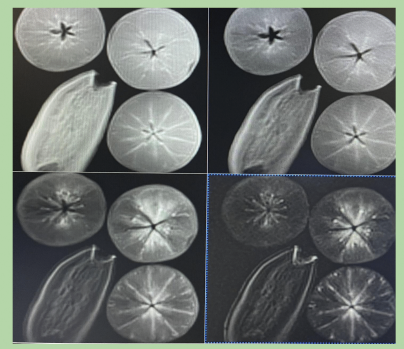


Figure 5: Four point T2 weighted example, 30 day post heat-shock at 1.5T:

(TE 4.8, 12.8 at top panels; 40.8 ms and 80.8 ms at bottom panels at TR=2s) Resolution=1.5x1.5x10 mm3 voxels; BW = 550 Hz/pix.
Note that minerals that caused T1 shortening (tracks in apples and skin layer in sweet potato) also have created T2 lengthening, evident from hyperintensity in T2 weighted images. The redistribution is perfect in Granny Smith while the minerals re-accumulated in the central region for Golden and Fuji apples



Discussion

Imaging characterization of minerals such as iron Fe(II), Fe(III) and manganese (Mn) within apples and sweet potatoes demonstrate native biometal redistribution under thermo-mechanical stress. Spin Echo and Gradient Echo sequences in both 1.5T and 3T scanners show a complex set of T1, T2 and T2* values depending upon specific fruit brands. One may conjecture that the structural reorganization of hydration water may influence some of the biometal release due to heat stress and consequent mineral redistribution responsible for T1 shortening and T2 lengthening post heat shock as also seen by Orellana et al by X-ray imaging in this symposium,

Acknowledgments

We would like to acknowledge valuable help from ASRC, CUNY, The Mount Sinai Hospital and The Mount Sinai West Hospital, NYC and the Research Imaging Center, McLean Hospital, Belmont, MA for access to MRI Scanner and for collaboration opportunities. This work was made possible with stipends from City Tech to the above student researchers under Emerging Scholars Program.

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High-Field MR Microscopy of Paramagnetic Biometals in Heat-shocked Phantoms

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Faculty Mentor: Subhendra Sarkar (RAD Tech) and Duke Shereen, ASRC, CUNY Graduate Center

ABSTRACT

Paramagnetic susceptibility can affect MR imaging, particularly at high field magnets. This is the basis of susceptibility-weighted MR imaging of microbleeds in brain trauma as well as in paramagnetic contrast spread in vascular tumors. Our laboratory is working with various mineral-rich phantoms prepared from fresh fruits that undergo redox reactions depending upon their bulk pH environments and external stressors. Heat shocks allow starch polymerization and alter iron and manganese homeostasis. Browning of freshly cut apples is an example of changes in oxidation states during disturbed iron homeostasis. In this project we studied potential changes in chemical species at the stressor sites from changes in proton MR relaxation times and associated MR images.

INTRODUCTION

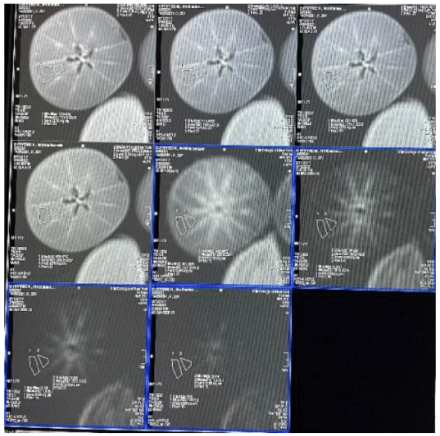
MRI Is an advanced magnetic resonance imaging that records and generates images of the organs in the body using strong magnetic fields. The MRI uses electrical currents and radiofrequencies where the protons align with the body. The foundation of chemistry and physics can be applied to the structure of MRI and NMR. With the high-resolution medical imaging, NMR and MRI materials in chemistry have an advanced application that has polymers, composites, and non-destructive testing. The polymerization of MRI includes a strong combination of metal ions. Gadolinium is used as a contrast medium to enhance the quality of MRI. NMR on the other hand is a nuclear magnetic resonance which is an instrument measuring the interaction of molecules in a magnetic field. Scientists use NMR spectrometers as a reading in scientific research such as cancer. There are many ways the particle behaves. "Application of NMR to composites and polymers involves measurement of the hydrogen nucleus (proton) NMR signal" (Matzkanin). The energy between these nuclear levels is explored by our NMR or MR systems using external radiofrequency excitations and by detecting sample signal in terms of proton magnetic spin and surrounding lattice relaxation (T1) and by proton-proton near neighbor spin-spin relaxations (T2 processes). To get MRI images, the NMR signal is processed to generate images of the samples of interest. We have studied various fruits with image intensity decided by the iron, water, other mineral constituents and our MRI methods (pulse sequences used). From invasive chemical analysis the whole fruit mineral content is known while MRI shows spatial distribution of such paramagnetics and their redistribution during crop development or food processing steps.

MATERIALS AND METHODS

Non-invasive imaging using a 3T MRI Siemens Prisma, from ASRC/CUNY) and various spin echo and gradient echo pulse sequences, apple slices were characterized as models (phantoms) to display the multiple cross sections in orthogonal planes. The presence of iron are evident in MRI signal since the magnetic field distribution is directly affected by magnetic materials like iron (other minerals like potassium, calcium etc are non magnetic). Important to distinguish between biometals present within biochemical pathways versus minerals excreted out due to chelating industrial chemicals like EDTA or free metal deposits from external contaminants like industrial waste product uptake by our food sources. Various MRI sequences could be promising to describe the biometal environments, for example, free industrial metal Gadolinium from medical waste, can be highly toxic and should be detectable due to strong paramagnetism when deposited out from its intended, protected molecular complex. Similarly, iron and manganese in the fruits are weakly paramagnetic when intact in their biochemical moieties but should be more paramagnetic in their inorganic forms and shows up with altered intensity of the MRI signal. The parameters that are affected are T1,T2, and T2*. These variables follow exponential kinetic patterns and serve as biomarkers when the exponential kinetics are changed as shown in plots here.

EXPERIMENTAL RESULTS

Fig 1. First 4 images in this figure maintain high signal due to slow signal loss by T2 process followed by 4 more that decay faster by influence of T2* for the Granny Smith Apple slice by 3T MR image.



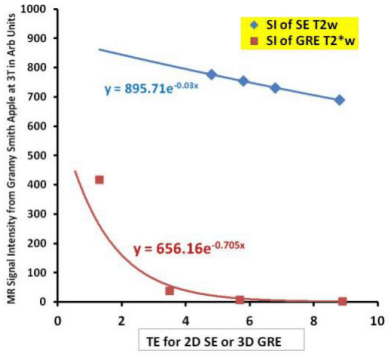


Fig 2. In this graph the slow decay from Region of Interest 1, ROI 1(**4 diamond shaped blue data points**) show a slow exponential decay, almost a straight line: exponent for e is almost 0; but the fast decay has **4 square red data** points with a strongly decaying exponential fit. The spin echo (First 4 images of T2 weighted sequence) and the Gradient Echo or T2* weighted sequence (last 4 images) show imaging parameters at the bottom of each panel.

DISCUSSIONS

Fig 1 shows T2 weighted MR images based on normal amount of susceptibility of the protons in relatively bright regions as well as excess magnetic susceptibility represented by low signal areas. In T2 weighted images (first 4) the excess susceptibility is not conclusive but in the next 4 images, T2* weighting demonstrated a faster signal loss, indicative of more paramagnetic build up.

This is plotted in Fig 2 with the slow decay curve (in blue) as well as the excessive decay from the same regions (in red). Perhaps in the same region there exist species with signal decaying at normal rate and signal from other species (inorganic iron, for example) decaying at faster rate. Relatively bright areas have a greater concentration of the first "biometal" species while darker areas are dominated by inorganics.

This kind of T2 and T2* mapping may be useful for quality control of fruits as well as map out the heavy metal contamination of land or seabed, for example, as well as in human organ contamination, like in liver or splenic metal toxicity. Using the parametric MRI and proton relaxation maps MRI and NMR will continue to be a useful noninvasive tool in agricultural, environmental and in medical science.

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Relational vs Non-Relational Database Technologies: How And Why They Are Different

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Abstract

The use of relational databases such as Oracle provides time tested solid integrity and consistency. However, in recent years data has grown as a result of the Big Data revolution. More data has been created in the last two years than in the entire history of databases. This shear volume cannot be effectively managed by traditional relational database systems. Non-relational databases or NoSQL (Not Only SQL) database have been developed to manage Big Data. The purpose of this project is to compare and contrast the use of these relational and non-relational database systems through the use of tools such as Oracle, MongoDB and Neo4j. Through the use of these tools, we can understand why users utilize each of these systems, what are the different uses for each of these system and what are the benefits of using these systems

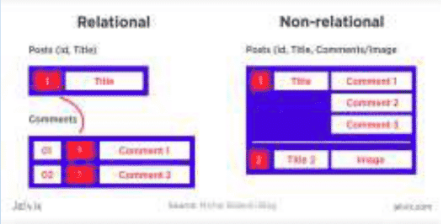

Figure 1.1 – shows the differences between the two database management systems. Relation uses SQL and Non-relational uses NoSQL. Key take away is the structure difference between the two.

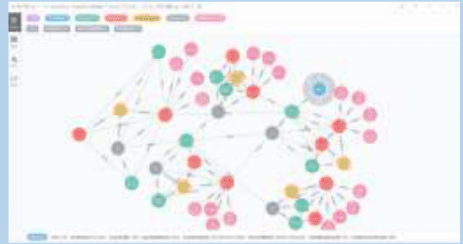

Figure 1.3 – shows the visualization of the graph database Neo4j. Each circle is a "node" that holds data and the lines represent the relationship. It entirety is the whole database itself.

Process

Oracle

Oracle is a relational database system that uses SQL. SQL stands for Structured Query Language and it's the language used to insert and extract information in a relational database. Relational Database System is a type of database that stores data related to each other via primary and foreign keys in tables. Oracle does not have any flexibility in how the data is stored. Tables are the default. In SQL there are 3 main groups of queries: creating, inserting, extracting.

Creating

```
CREATE TABLE Library (book_id CHAR (2)
PRIMARY KEY, book_title VARCHAR(15));
```

Inserting

```
INSERT INTO Library VALUES ('1', 'Cinderella');
```

Extracting

```
SELECT book_title FROM Library;
```

Everything in the purple is part of the SQL language. Notice the primary key is related to an "ID". If we were to create another table that has a relationship to this for example a checkout table where it grabs the user id and match it with the book_id that they took out. When creating the new table, it is crucial that it has the information of the book_id because that is what is being used to create a relationship between the two tables. In table 2, the book_id is now the foreign key, which will relate back to the primary key in table 1 and then connects the two tables. This structure of tables and keys make it a headache when using large amounts of data. Figure 1.1 shows how non-relational databases can hold more info in a nonlinear fashion.

MongoDB

MongoDB is a non-relational database that stores data in flexible document-like formats which means the fields can vary from document to document and the structure itself can be modified over time. The data types can also vary without the worry of structure. What this means is that unlike SQL, NoSQL can store different types of data forms such as inserting a video, text, numbers and more into a single document. Relational database management systems (RDBMS), does not support this. Only strings and numbers are allowed. MongoDB can hold up to 100MB of video footage in a database without a problem. The benefit of MongoDB is that not only can it hold big data, but different forms of data as well. MongoDB is a document type of database. When it comes to querying, it has a very different format and syntax compared to SQL. Although all SQL is similar, NoSQL languages can differ and look different from different types of database management systems. In MongoDB, the same 3 concepts of SQL are still present. There is creating, inserting and then extracting.

Creating

```
USE library
```

Inserting

```
Db.library.insertOne({book_id:1, book_title:"Cinderella"});
```

Extracting

```
DB.library.find();
```

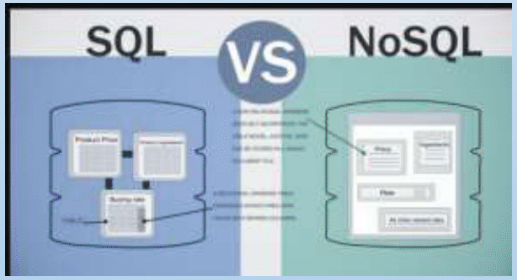

Figure 1.2 – Shows the difference between SQL and the way MongoDB (on the right) stores information in a document like fashion.

Neo4j

Neo4j is also a non-relational database that stores data in a flexible way however it differs from most because it is a graph database. Oracle uses tables and rows in a structured format. MongoDB uses a document-like format. Neo4j uses graphs where each set of data is represented by nodes. These nodes can then have a relationship with each other. Neo4j is highly preferable to store data that contains multiple connection between sets of information. Neo4j combines the query of creating and inserting. It also has an extraction query.

Creating & Inserting

```
Create(Cinderella:library{book_title:"Cind
erella", book_id:1});
```

Extracting

```
Match (n) WHERE n.book_title =
"Cinderella" Return n;
```

Notice how the creation involved both the creation of the node with the "create" command followed by the values in it. After the creation part, you create relationship between nodes. An example would look like:

Relationships

```
Match(a:library), (b:author) where
a.book_title="Cinderella" and
b.author_name ="John Doe" create (a)-
[r:written_by]->(b) return a,b;
```

This code now links the node of "library", specifically the book title with the node that contains data about the "author." When querying, we use the relationship "written_by" to find the information we need.

Results

When comparing the three different types of databases, the biggest take away was the contrast of structure and flexibility. In Oracle, using SQL, All the information you put has to remain consistent throughout. Notice how when "creating" in Oracle I put two field and then in the inserting I inserted 2. In the NoSQL databases, it didn't matter. Inserting in both MongoDB and Neo4j was limitless, and it did not have to remain consistent. Another concept that must be taken into consideration is how the data is stored. In Oracle, as you can see in the SQL section of figure 1.2, it's all table and rows whereas NoSQL was different. MongoDB has a more document like way of storing information and Neo4j uses graphs along with nodes. Although I had to query the same concept in all 3 databases, my mindset had to shift in order to understand how I was going to store the data. If one had a lot of random information that changes overtime, MongoDB would be the best choice. If these pieces of information have a great correlation with each other, then Neo4j would be recommended. Lastly, if one is dealing with smaller amount of information and/or want to represent relationships in tables, then Oracle would be best.

Conclusion

In all, having to code the same process in three different databases posed a great challenge. Each had their own way of storing data along with syntax. The biggest difficulty was shifting the mindset to know why and when to use each one. Although I used small amounts of data, the effect of not having a specific structure like Oracle makes storing information a lot easier to understand and keep track of. Because Oracle uses "keys" to relate to each table, it can be difficult to find them when large amounts of data must be stored. MongoDB and Neo4j is fast and with the way they query to find information, its easier as well. In MongoDB, you just look for the specific information that was stored. In Neo4j, although the syntax looks scary, the concept is quite simple. Based on relationships given prior, we can use that to find the information we need. Relationships could be "married_to" or "big_fan_of". These are relationships that won't be forgotten. Plus, the way the information is displayed visually also makes it easier to see which node related to which and how. Figure 1.3 shows the different nodes which holds information, and the lines are the relationships between them. It's very organized and methodical, and when large amounts of data are used, it can come in handy. Although the syntax took a while to get used to, it felt a lot easier and more comfortable to query with the non-relational databases. Overall, I have fully understood the concept of non-relational databases and how beneficial they are when handling big data.

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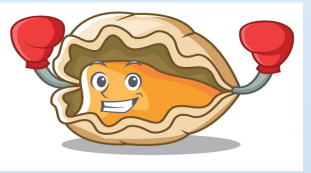

Abstract

On October 29, 2012, Superstorm Sandy caused nearly $19 billion in damages in New York City including to 69,000 residential units across the five boroughs. This disaster precipitated a post-disaster-rebuilding (PDR) project including roughly $4.2 billion in a Community Development Block Grant allocated towards PDR projects. A portion of the grant was used to construct a living breakwater in Tottenville, Staten Island, consisting of a resiliency approach to risk reduction through erosion prevention, wave energy attenuation, and enhancement of ecosystems and social resiliency to improve resistance to storms for the community of Tottenville. The ridges of each breakwater are designed with intertidal saddles filled with precast ecological concrete tidal pool units that interlock with armor stones. The armor stones and artificial intertidal pools made of ecologically enhanced concrete act as structural armor, imitating natural rock pools supply a haven for multiple marine life by creating an artificial habitat. Extrapolated from the publicly available information related to timing and procurement of the project including the shoreline restoration phase, scheduled construction around the migration patterns of certain marine life, and the specific times in the day when construction is allowed, a conceptual timeline of the schedule was generated. The research methodology included reviewing, compiling, and using the available information to create a conceptual project schedule for the living breakwater portion of the construction. This project builds on the review of literature and project success factor analysis conducted "**Investigating Project Success Factors in Post-Disaster Rebuilding Efforts in NYC"**.

Background

Initiated in June 2014, President Obama's Hurricane Sandy Rebuilding Task Force, Rebuild by Design (RBD), was a contest that responded to the devastation enacted by Superstorm Sandy in the northeast. It promoted a design-led method to create a strategy for durable sustainability and climate change adaptation. As a result, the U.S. Department of Housing and Urban Development (through the Community Development Block Grant Disaster Recovery Program (CDBG-DR) granted $60 million for the project – The Living Breakwaters in Tottenville. The project included the efforts of various architects, engineers, and contractors, employed to design and construct living breakwaters off the coast of Tottenville. A breakwater is an offshore barrier or barricades built out into a body of water to safeguard a coastline or harbor from the force of waves. These waves may stem from surges, currents, or as a result of storms. What makes a breakwater "living" or "alive" is incorporating natural habitat components that supply possibilities for various marine settlements and restoration of the coastline while providing protection. The Living Breakwater project (FIG 1) consisted of eight breakwater structures constructed of rock and concrete. The project's construction began in September 2021. At the Western-most end of the Living Breakwaters system, Breakwaters A and B are being constructed first. In general, breakwaters are being constructed from west to east. Breakwaters A and B are in the shallowest area of the site, so construction barges can move in and out with the tides, working mostly at mid-tide and above. Breakwaters A-D are designed to prevent shoreline erosion and provide habitat. They have lower crests elevations (about 2.5' above mean high water) than the breakwaters further east. This is because the shoreline here is at higher risk from erosion but less exposed to storm wave attacks due to the wide, shallow area adjacent to the shore. Breakwaters E-H include reef ridges and reef streets in their construction to provides a multifarious habitable area that imitates natural systems such as coral reef.

FIG 1: Living Breakwater construction project zone, adapted from Governor's Office of Storm Recovery

Methodology

There is publicly available information related to timing and procurement of the project including the shoreline restoration phase, scheduled construction around the migration patterns of certain marine life, and the specific times in the day when construction is allowed. The research methodology includes reviewing, compiling, and using this available information to create a conceptual project schedule. The schedule will be created according to the steps below (FIG 2) and using Oracle's Primavera P6 Professional scheduling software.

Making a Conceptual Schedule

Step 1: Identify Key Activities	Step 2: Identify Key dates and durations	Step 3: Sequence activities	Step 4: Schedule (P6)
Review available documents to find required activities and project milestones	Include associated dates and durations	Refine and sequence activity list to correct specificity and make activities parallel, while still accounting for the whole project	Migrate schedule activities to Primavera P6 Professional

FIG 2: Steps Identified for making a conceptual schedule from available project details

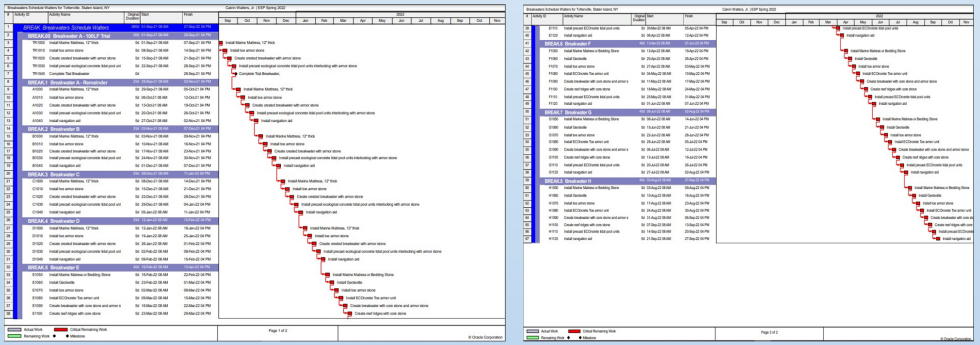

FIG 3: Step 4 schedule created using P6 software for the breakwater portion of The Living Breakwaters project

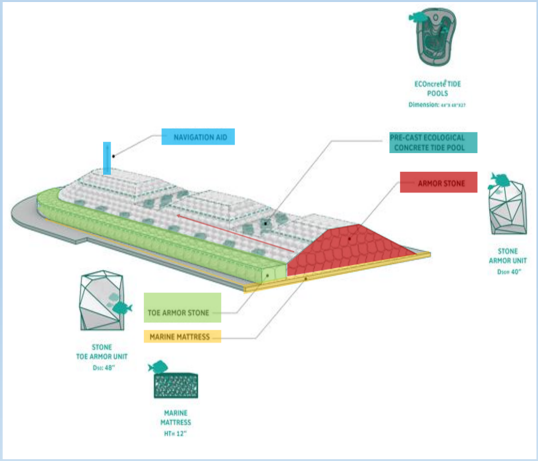

FIG 4: Detail for construction of breakwaters A-D , adapted from The Living Breakwaters project

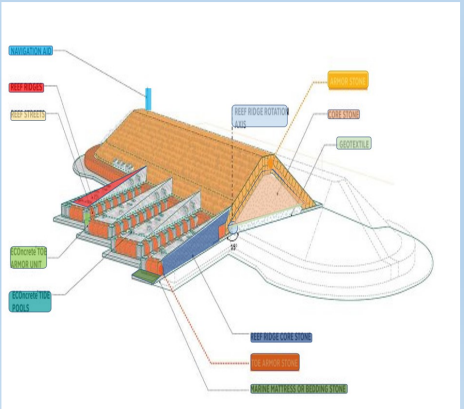

FIG 5: Detail for construction of breakwaters E-H, adapted from The Living Breakwaters project

Results

Using the case study of the Living Breakwaters, schedule processes were explored according to the conceptual schedule creation steps.

The researchers used publicly available information on the project to gather information on schedule activities and conceptual Work Breakdown Structure (WBS). Information for activity scheduling was drawn from the Living Breakwater project's published construction status updates. From "Living Breakwaters Construction Update - January 2022," we gathered information used for scheduling breakwaters E-H. This content was adapted in FIG 4 for use in scheduling.

From "Living Breakwaters Construction Update - March 2022," we gathered information used for scheduling breakwaters A-D. This content was adapted in FIG 5 for use in scheduling.

The schedule activities were created using Excel and then sequenced using P6. Schedule activities were created after appropriate details were identified for each of the breakwater structures. The final sequenced conceptual schedule can be seen in FIG 3.

Conclusions

Creation of a conceptual project schedule that corresponds to known project details is critical to ensure constructability, avoid errors and omissions in construction administration, and in simplifying the communication of project deliverables. Scheduling is an iterative process that is improved as better information is gathered. This research used available construction details to explore the process of creating a conceptual project schedule that incorporates real project information.

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Structural Analysis of Calpains in *Tetrahymena thermophila*

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Background Information or Abstract

Calpains are a family of ubiquitously expressed calcium-dependent, non lysosomal cysteine proteases. Calpains are involved in apoptosis, cellular proliferation, and cell motility. While mostly calcium-dependent, calpains may also be activated through ERK-mediated phosphorylation. Calpains are found in a few eubacteria and almost all eukaryotes, but not found in archaebacteria. *Tetrahymena thermophila* is a ciliate found in fresh water. Remarkably, these cells have two nuclei, one is the germline nucleus, and the other is the somatic nucleus. The germline, the micronucleus, is silent during vegetative growth, while the macronucleus is very active during vegetative growth. Conserved eukaryotic mechanisms have been modified in ciliates to selectively deal with the two genomes. *T. thermophila* has been used as a model to study many cellular processes. However, the role of calpains in these cells is yet to be examined. The purpose of this project was to characterize ***TTHERM_00486970***, a calpain family member from *T. thermophila,* using bioinformatics tools such as MUSCLE (MUltiple Sequence Comparison by Log-Expectation), MAFFT (MUltiple Alignment using Fast Fourier Transform), T-Coffee (Tree-based consistency objective function for alignment evaluation), BLASTp (Basic Local Alignment Search Tool), Phylogeny.Fr, SWISS-MODEL and PHYRE2 (Protein Homology/AnalogY Recognition Engine). Calpains are remarkable proteins that have similar genes with Tetrahymena thermophila, which concludes that these are related to human genes using bioinformatic tools. VMD, which stands for Visual Molecular Dynamics, utilizes the proteins for a better visualization. By determining which models: Swiss and Phyre, had the highest QH, RMSD, and ID. Swiss models were compared to each other, continuing with, Phyre models were compared to each other. However, more analysis is needed to confirm which of these two human Calpains is THERM 00486970 more related to and also to begin predicting the function of this particular calpain in T. thermophila.

Objective

One of the objectives of his project was to begin characterizing calpains in *T. thermophila.* Specifically, the structure of one of *T. thermophila* calpains was examined using bioinformatics.

Materials and Methods.

To identify calpains in *T. thermophila*, human calpain 1,CAPN1, amino acid sequence was used to do a search through Ciliates genome database, www.ciliates.org. From the results TTHERM_00486970 was selected to be included in this project.

Multiple Sequence Alignment
MUSCLE (MUltiple Sequence Comparison by Log- Expectation), MAFFT (Multiple Alignment using Fast Fourier Transform), T-Coffee (Tree-based consistency objective function for alignment evaluation), BLASTp (Basic Local Alignment Search Tool) were used for sequence alignment of human calpains with TTHERM_00885870 amino acid.

Phylogenetic Tree Analysis
To examine evolutionary relatedness Phylogeny.fr and MEGA (Molecular Evolutionary Genetics Analysis) were used.

Protein Structure Modeling
Online tools like SWISS-MODEL and Phyre2 were used to model protein structures. The PDB files generated were used in VMD analysis. With VMD the predicted protein structures were compared for similarities using Q_h and RMSD values.

Results

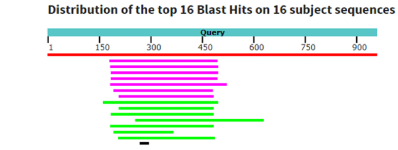

Figure 1. Graphic Summary of human calpains and TT_00486970. CAPN16, the last alignment colored black, showed the lowest alignment score.

Figure 2: Comparison of TT_00486970 and human calpains. TT_00486970, CAPN7, CAPN10, CAPN15 and CAPN16 show less conserved regions. "*" indicates fully conserved regions, ":" highly similar regions, "." weakly similar regions.

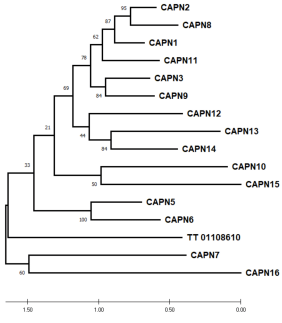

Figure 3 Phylogenetic tree. TT_00486970 is more similar to CAPN7. Tree was drawn with MEGA using the Minimum Evolution method.

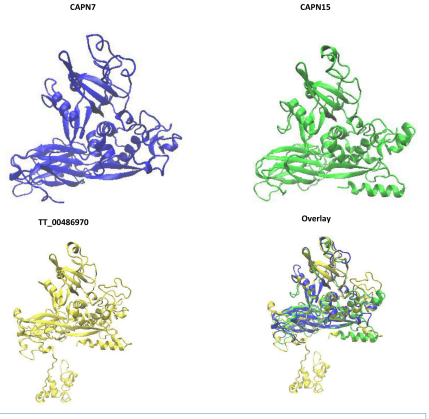

Figure 4. Protein models. Protein structures were predicted using SWISS-MODEL online tool. VMD was used to compare and overlay models. *TTHERM_00486970 and CAPN7 showed higher Q_H and lower RMSD values compared to TTHERM_00486970 and CAPN15.*

Summary of Results

- ❑ CAPN16 showed the least alignment score when TT_00486970 is compared to human calpains.
- ❑ TT_00486970 is a member of *T. thermophila* calpain family.
- ❑ Multiple sequence alignments showed TT_00486970, CAPN7, CAPN10 and CAPN15 with less conserved regions, compared to other CAPNs.
- ❑ Based on phylogenetic analysis TT_00486970 seems to be more similar to CAPN 7.
- ❑ SWISS-MODEL and VMD analysis confirmed TT_00486970 to be more similar to CAPN7.

CONCLUSION

TT_00486970 is a member of *T. thermophila* calpain family. When compared to human calpains it is more similar to CAPN7.

Future Directions

We will continue to use Cellular Biology and Bioinformatics techniques to observe the gene expression of human calpains. Continue to examine structural conformation of the *T. thermophile* calpains using Bioinformatics and Molecular Modelling techniques.

Acknowledgement

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Professor Ralph Alcendor PH. D., Department of Biological Sciences

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Substance Use by LGBTQ Youth during COVID Pandemic

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Abstract

This cross-sectional research study aims to examine patterns of substance use among a sample of LGBTQ youth between the ages of 18-25 years during the COVID pandemic. Research participants were recruited from formal and informal LGBTQ networks through snowball sampling. Substance use trends are examined in three phases- Pre-COVID, COVID phase-1 and COVID phase-2. Participants completed an electronic survey to self-report on the use of substances during these three phases and identify a series of COVID related economic and social stressors that affected them during the pandemic. Data were analyzed to examine if there is a relationship between the stressors and changes in the patterns of substance use. Implications for human services professionals are discussed.

Introduction

The LGBTQ community has historically experienced substance use problems at a higher rate than their non-LGBTQ peers. The COVID pandemic has presented unique proposition for this population there by affecting the patterns of substance us in this community. Stress for LGBTQ youth is unique compared to non-LGBTQ youth and has been known to be a catalyst for substance use.

Literature Review

According to recent studies substance use during COVID increased to deadly rates (CDC, 2020, Sachdeva et.al., 2021). LGBTQ people have historically faced discrimination and experience fear of personal safety and prejudice-related life situations (Frost, Lehavot, & Meyer, 2013). Research has indicated that pandemic related stressors have resulted in many negative mental health outcomes and an increase substance use among adolescents in Canada (Craig et.al 2022). A study by CDC examined substance use by adolescents and found that youth who used substances before the pandemic increased the frequency of use during 2021 (Brenan, et.al 2022).

Research Aims

This study aimed to examine the following for LGBTQ youth:

1) Identify types of substances used before and during the pandemic;
2) Identify types of pandemic related stressors;
3) Examine the relationship between COVID stressors and substance use?

Methodology

Study Design: Descriptive study using a cross-sectional design

Sample: Snowball sampling was used to generate a non-probability sample of LGBT youth between the ages of 18-25.

Measures: Survey questions were created drawing from recent studies related to substance use and pandemic related stressors. The survey contained ----- questions, most of which were multiple choice questions or had Likert-scale responses.

Data Collection: The survey was created using Qualtrics and a link with the informed consent form and the survey was sent to eligible participants. Participants were asked to share this survey link with anyone that they know who will fit eligibility criteria.

Data Analysis: Data were exported into a SPSS data file to conduct the analysis.

Research Ethics: This study was approved by the City Tech IRB

Limitations

The LGBTQ Youth community is a unique population to seek out and was a challenge to reach participants that are not "out" about their sexual identity. We currently have data from a small sample size and the data collection process for this study is currently ongoing. No bivariate analysis were conducted due to the small sample size. Findings in this poster are reported from only two days of data collection.

Results

Table 1 - Sample Demographics (n= 10)

	N	%
Sex Assigned at Birth		
Male	2	20%
Female	8	80%
Sexual Identity		
Heterosexual	2	20%
Bisexual	3	30%
Pansexual	5	50%
Education Level		
High school graduate	3	30%
Some college	4	40%
Associate's degree	2	20%
Bachelor's degree	1	10%
Borough		
Brooklyn	3	30%
Queens	2	20%
Staten Island	2	20%

Table 2 - Prevalence of Substances used by participants

	N	%
Alcohol	10	100%
Tobacco	3	30%
Cannabis	10	100%
Synthetic Cannabinoids	2	20%
Inhalants	2	20%
Pain Reliever NOT Prescribed	3	30%
Psychedelic/Hallucinogen	2	20%
Mushrooms	3	30%
LSD	2	20%

Table 3 - I use substances because-

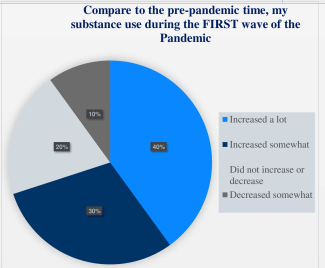
	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I find it pleasant/fun/mind-expanding	10%	10%	10%	30%	40%
I find it makes social moments more fun/cozy	30%		10%	30%	30%
I needed an outlet now that there are few other options	40%		20%	10%	30%
I want to feel less worried/afraid/angry/stressed		20%	20%	30%	30%
I want to feel less lonely	30%	20%	30%		20%
I cannot resist, even when I actually do not want to use it	60%			40%	
I already have it at home	40%	20%	20%		20%
I use substance(s) out of habit	30%	10%	20%	30%	10%
I believe it's better for my state of mind	10%	20%	30%	30%	10%
I believe it's better for my health/fitness	50%	30%		20%	
I was ill/did not feel well	50%		30%	10%	10%

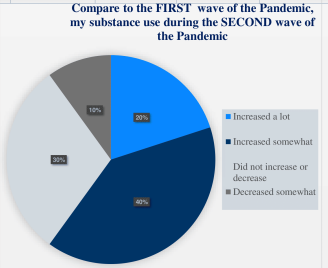
Table 4 Substances used by participants

	PRE-COVID					COVID-PHASE 1					COVID PHASE 2				
	Every day	3 or 4 times/ week	1 or 2 times/ week	Few times/ month	Never	Every day	3 or 4 times/ week	1 or 2 times/ week	Few times/ month	Never	Every day	3 or 4 times/ week	1 or 2 times/ week	Few times/ month	Never
Alcohol		**20%**		**40%**	**40%**	**10%**	**20%**	**10%**	**40%**	**20%**	**10%**	**10%**	**10%**	**60%**	**10%**
Tobacco	10%		10%		80%	10%	10%			80%	10%	10%			80%
Cannabis	**10%**	**20%**	**30%**	**30%**	**10%**	**40%**	**20%**	**20%**	**10%**	**10%**	**40%**		**20%**	**30%**	**10%**
Synthetic Cannabinoids	10%			10%	80%			10%	10%	80%		10%		10%	80%
Inhalants			10%		90%		10%			90%		10%			90%
Pain Reliever NOT Prescribed		10%		20%	70%	10%				90%		10%	10%		80%
Psychedelic			10%		90%			10%	10%	70%		10%	10%		80%
Mushrooms	10%				90%			20%		80%		20%			80%
LSD			10%		90%				10%	90%		10%			90%

Table 5 How did you perceive the following pandemic related stressors?

	Not stressful at all	Somewhat stressful	Moderately stressful	Very stressful	Extremely stressful
Risk of getting infected	10%	30%	40%	10%	10%
Inability to leave home	20%	10%	20%	30%	20%
Management of Non-COVID health	20%	20%	40%	20%	
Health problems affecting my family	**10%**	**10%**	**30%**	**20%**	**30%**
Living with family members	**10%**	**10%**		**50%**	**30%**
Inability to meet family members	40%	20%	30%	10%	
Inability to meet friends	30%	20%	20%	30%	
Inability to exercise	30%	30%	10%	10%	20%
Working from home	50%	30%		20%	
Working from workplace	20%	20%	30%	10%	20%
Inability to participate in community activities	20%	20%	50%	10%	
Inability to visit place of worship	70%	10%	10%		10%
Obtaining food for self and family	**20%**	**30%**	**10%**	**10%**	**30%**
Inability to pay rent/mortgage	**10%**	**20%**		**30%**	**40%**
Income related changes (negative changes)	**20%**		**30%**	**20%**	**30%**
Attending online school	**10%**	**10%**	**10%**	**40%**	**30%**
Personal safety		20%	60%	10%	10%
Discrimination	50%		40%		10%





Findings

- **Demographics**: Majority of the sample identified as female as their assigned sex at birth. 50% identified as pansexual, 30% identified as bisexual and 20 percent identified as heterosexual. "Heterosexual" was an option in our study as the "questioning" part of the LGBTQ population may choose to identify as heterosexual, while still being part of the LGBTQ group. 70% of respondents had completed some college or higher. (Table 1)
- **Substance Use**: Most respondents reported mostly using alcohol and cannabis, with 30% reporting use of tobacco, non-prescribed pain relievers and mushrooms. (Table 2)
- **Reasons for Substance Use**: 60% of the sample strongly agreed with the statement that they take drugs to feel less worried, afraid, angry or stressed. 40% stated that they use drugs out of habit. 60% stated that they use substances just for the experience and socializing. (Table 3)
- **Pandemic Related Stressors**: Respondents reported moderate or lower stress levels for the "risk of getting infected" and "Obtaining food for self and family." They reported having very high to extreme stress levels when it came to "family health problems," "negative income changes," "attending online school" and "living with family." (Table 5)
- **Trends in Substance Use**: Consumption of alcohol and cannabis saw the biggest increase over the two phases of the pandemic (Table 4)
- 70% of the sample stated that compared to pre-pandemic time their substance use increased a lot or somewhat increased. Compared to the first wave, participants reported that their substance use decreased slightly from 70% to 60%.

Discussions and Recommendations

Overall, we found that substance use increased among LGBTQ youth during phase one and two of the COVID pandemic. A review of the pandemic related stressors also indicated that their stressors were more economic stressors dominated the lives of LGBTQ youth as well.

Results also indicate that there are implications for LGBTQ youth that living with family may be more of a stressful experience for LGBTQ youth compared to their non-LGBTQ peers. The Human Services profession needs to take into consideration these patterns of substance use and pandemic related stressors while developing policies and programs.

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Acknowledgements

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Characterize a calpain of choice from Tetrahymena *thermophila* using bioinformatics tools

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Background

Tetrahymena *Thermophila* is a unicellular ciliated Protozoan. It is commonly found in many freshwater habitats globally. *T. thermophila* has two nuclei, a macronucleus and a micronucleus. The macronucleus is the vegetative nucleus involved in gene expression while the micronucleus is the germline nucleus involved in sexual reproduction. These cells serve as model organisms for the discoveries and the broadening of information on many biological processes such as cell division, evolution, histone acetylation and DNA elimination.

Calpains are calcium-dependent, non-lysosomal cysteine proteases that are prevalent among eukaryotes and bacteria. In the human genome, there are 15 calpain genes that convert into a calpain like proteases. Of the 15 calpain genes, there are nine that are classical calpains and there are six that are nonclassical calpain. Classical calpains have a PEF domain, while non-classical calpains do not have this domain. Studies have shown that calpains are involved with programmed cell death, cell motility, and cell proliferation. Other studies suggest that uncontrolled regulation of calpains may be linked to various diseases such as, Alzheimer's disease, retinal cellular dysfunction, and many others. *T. thermophila* has about 27 calpains, however, very little is known about these calpains in *T. thermophila*. Therefore, the goal of this research project was to characterize TTHERM_01108610, one of *T. thermophila* calpain family members, using bioinformatic tools. NCBI Basic Local Alignment Tool (BLAST), Multiple Sequence Comparison by Log- Expectation (MUSCLE), Tree-Based Consistency Objective Function for Alignment Evaluation (T-COFFEE), and Multiple Alignment using Fast Fourier Transform (MAFFT) were used for multiple sequence alignment. Phylogenetic trees were drawn by Molecular Evolutionary Genetics Analysis (MEGA).

Objective

The purpose of this project is to characterize TTHERM_01108610, one of Tetrahymena *thermophila* calpain family members, using bioinformatics tools.

Materials and Methods

Selecting Gene of Interest A BLAST (search of Tetrahymena Genome Database (www.ciliate.org) was done using Human calpain 1 amino acid sequence. From the results TTHERM_01108610 was selected as the gene of interest. An NCBI BLASTp search was done using the amino acid sequence of TTHERM_01108610 with *Homo sapiens* as the organism of choice.

Multiple Sequence Alignment

Multiple sequence alignments, with ClustalW as the output format, were done using **MU**ltiple **S**equence **C**omparison by **L**og- **E**xpectation, MUSCLE. However, to compare results alignments were also done using **T**ree based **C**onsistency **O**bjective **F**unction **F**or alignment **E**valuation, T-COFFEE, and **M**ultiple **A**lignment using **F**ast **F**ourier **T**ransform (MAFFT). All alignments were done using TTHERM_01108610 amino acid sequence and all 15 human calpain sequences.

Phylogenetic Tree Analysis

Phylogenetic trees were drawing using MAFFT and **M**olecular **E**volutionary **G**enetics **A**nalysis, MEGA. The methods used were Neighbor-Joining and Maximum Likely.

Results

Figure 1. TTHERM_01108610 conserved domain architecture. Presence of a cysteine proteinase, calpain-type domain. The active sites are depicted by red symbols. Prediction came from Prosite https://prosite.expasy.org/

Description	Max Score	Total Score	Query Cover	E value	Per. Ident
calpain-15	153	153	24%	5.00E-36	27.23%
Similar to small optic lobes homolog	135	135	16%	1.00E-31	28.66%
Calpain-5 (CAPN5) Protease Core (PC)	126	126	18%	7.00E-30	27.53%
calpain 2, (m/II) large subunit, isoform CRA_c	126	126	20%	3.00E-29	25.58%
calpain-2 catalytic subunit isoform X1	125	125	20%	1.00E-28	25.84%
calpain 3	127	127	19%	3.00E-28	28.21%
Crystal Structure of Human m-Calpain Form II	126	126	20%	3.00E-28	26.29%
calpain-5 isoform X1	126	126	23%	3.00E-28	24.95%
neutral protease large subunit	126	126	20%	3.00E-28	26.29%
calpain large polypeptide L2	126	126	20%	3.00E-28	26.29%

Table 1. NCBI BLASTp results using Homo sapiens as organism of choice. Calpain 15 has the highest Max score and lowest E-value, suggesting TTHERM_01108610 (TT_01108610) may be closely related to human calpain 15.

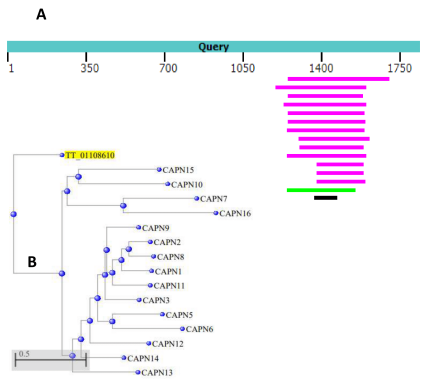

Figure 1. NCBI BLASTp graphic summary (A) results of human calpains and TT_01108610 alignment. Green bar represents calpain 10 and black bar represents calpain 16. (B) Distance tree drawn using minimum Evolution method. Calpain 10 and calpain 16 share the least in common with TT-01108610. The top bar represents human calpain 15.

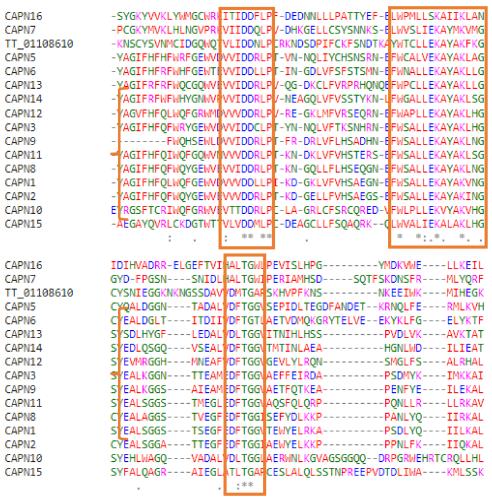

Figure 2. Results of MUSCLE alignment of human calpains and TT_01108610. Highly conserved regions are boxed in red. Left braces indicate sequences less conserved in CAPN7, 10, 15 and16.

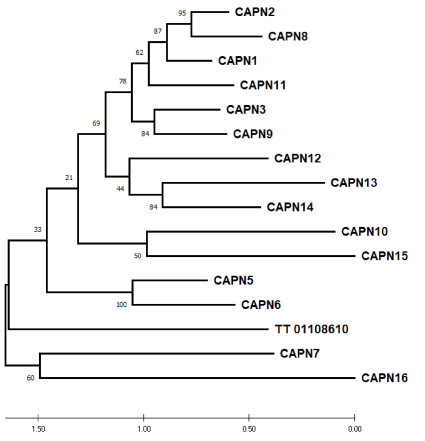

Figure 3. MEGA phylogenetic tree. TT_01108610 is more closely related to CAPN7 and CAPN16. Tree was drawn using the Minimum Evolution method. Numbers represent Boostrap values.

Discussion and Conclusion

- TTHERM_01108610 belongs to the calpain family cysteine protease.
- TTHERM_01108610 has a CysPc domain with three active sites.
- BLASTp alignment of TTHERM_01108610 and human calpains suggests TTHERM_01108610 to be more closely related to human calpain-15 based on the Max Score and E-value.
- MUSCLE, MAFFT and T-Coffee showed TTHERM_01108610 to be more closely related to human calpain 7 or 15 when different tree drawing methods were used.
- MEGA analysis using different tree drawing methods suggests TTHERM_01108610 is more closely related to human calpain 7.

Conclusion

TTHERM_01108610 is a calpain family member which may be more similar to human calpain 7. More analyses are required to support and confirm these results.

Future Directions

To confirm whether TTHERM_01108610 is more closely related to human calpain 7 as suggested by MEGA and others, protein structure modeling will be performed.

Acknowledgements

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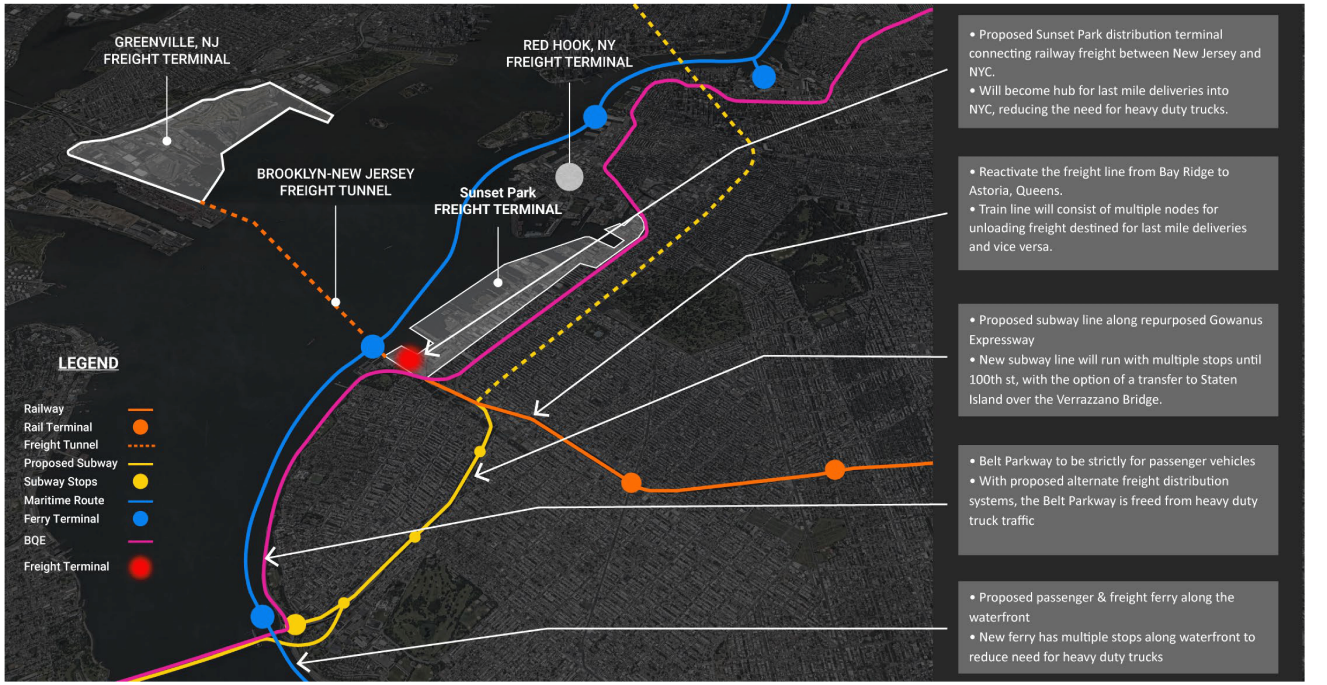
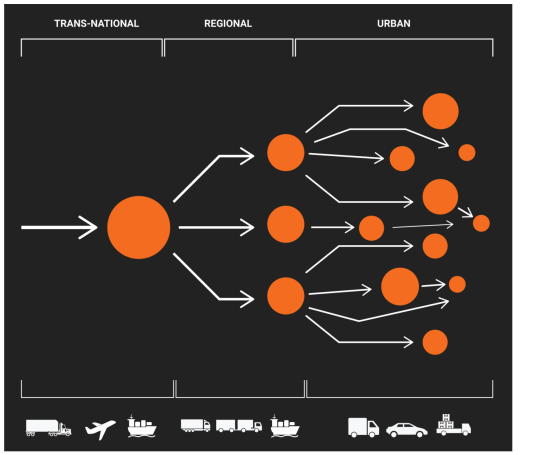
THE BROOKLYN-NEW JERSEY FREIGHT TUNNEL: AN ALTERNATIVE TO TRUCK DISTRIBUTION

Farai Matangira

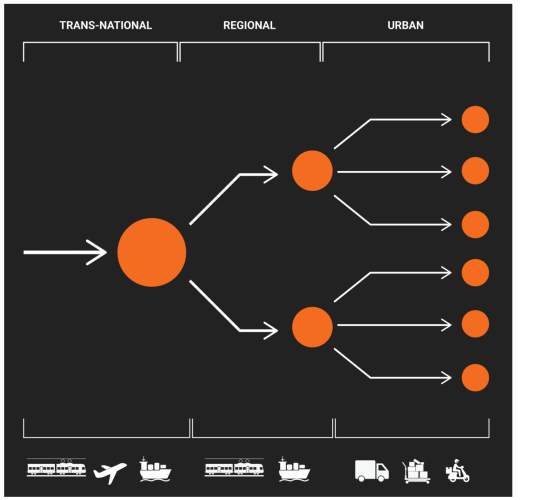
Professor Michael Duddy



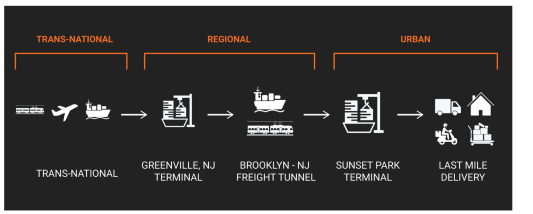
Map showing proposed freight system based on rail, freight, maritime, truck and distribution centers



Existing convoluted NYC freight network



Proposed streamlined NYC freight network



Summary of proposed streamlined freight network

Abstract

For decades, New York City has been an international trade gateway and regional hub for logistics and freight transportation. The growth of E-commerce has put pressure on its urban freight system. Particularly, there has been an increase in truck deliveries, which has contributed to pollution, and pressure on transportation infrastructure and city streets. The roads today were simply not designed to handle additional freight and delivery trucks. This has led to calls for improvements to the city's freight system and proposals to integrate tunnels, waterways, and micromobility systems, which have been underutilized in favor of trucks. For over a century, a Brooklyn-New Jersey tunnel has been proposed as a potential solution to alleviate congestion by reducing the need for freight trucks that put pressure on the city's road network.

This study investigates how the Brooklyn-New Jersey freight tunnel, along with a shift towards alternative and more efficient freight systems has economic, environmental, and logistical benefits to the city. It investigates how freeing city streets from freight trucks presents an opportunity to revitalize neighborhoods that have been impacted by this urban mobility problem.

A One-Hundred-Year-Old Problem

According to the New York City Economic Development Corporation, New York City relies on trucks to move nearly 90 percent of freight in and around neighborhoods, which could cost the local community $27 billion over the next 30 years, hurting local businesses and commerce. Additionally, freight infrastructure has been severely under-invested while some systems have been underutilized.

The Brooklyn-New Jersey Tunnel, a proposed freight connection between distribution centers across the Hudson River, has been regarded as a potential solution to alleviate the pressure on the freight system by freeing local streets from heavy duty trucks. Planning for this freight tunnel has been on the pipeline since the 1920s but has never come to fruition due to funding and lack of political will.

A Case For Open NYC Streets

The proposed Cross-harbor tunnel would connect a distribution terminal in Greenville Jersey City, with a new terminal in Bay Ridge, Brooklyn. The terminal will serve as a gateway for deliveries to New Yorkers. It would eliminate thousands of trucks which currently ravage through neighborhoods. The Bay Ridge terminal, along with proposed new terminals could serve as warehouses for "last-mile" deliveries. A reduction in truck traffic will lead to more free and open streets

Development of an Assistive App on Girls Who Code

Author: Isory Santana - Computer Systems - BTECH

Mentor: Professor Farrukh Zia - Computer Engineering Technology

ABSTRACT

This research project involves using the software development and programming tools, lessons, and tutorials on the Girls Who Code website to develop an App for Social Good such as assisting a person with a disability.

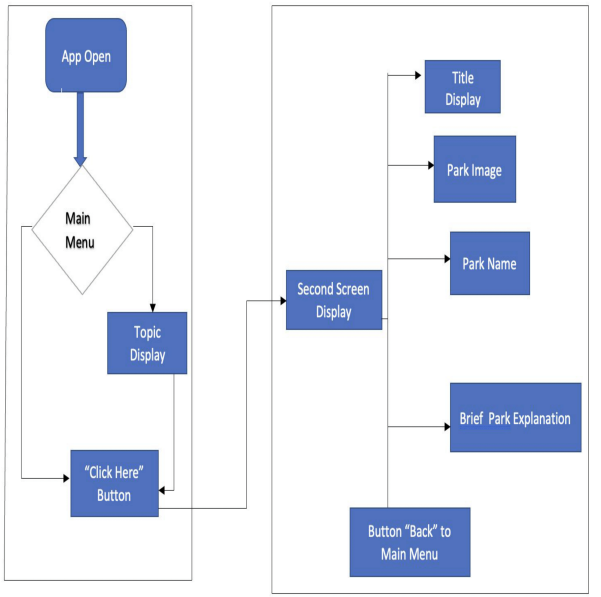
INTRODUCTION

Most Families are out in the public now that the pandemic has ended. To promote the enjoyment and well-being of children with special needs, park resources are made more accessible. My project involves Flutter, Kotlin, iOS, Android and Swift to develop an App for Social Good such as assisting children by providing information about inclusive playgrounds for kids with special needs in New York.

METHODOLOGY

- Researched different features including lessons, and tutorials on the Girls Who Code website.
- Flutter, Kotlin, iOS, Android, and Swift were used to create a social good app that supported children by providing information on accessible playgrounds for children with special needs in New York.
- Researched New York City parks, locations and facilities information for comparison and evaluation.
- Ten accessible playgrounds for children with special needs were included.
- "SpecialNeeds&Park," a mobile application, was developed.

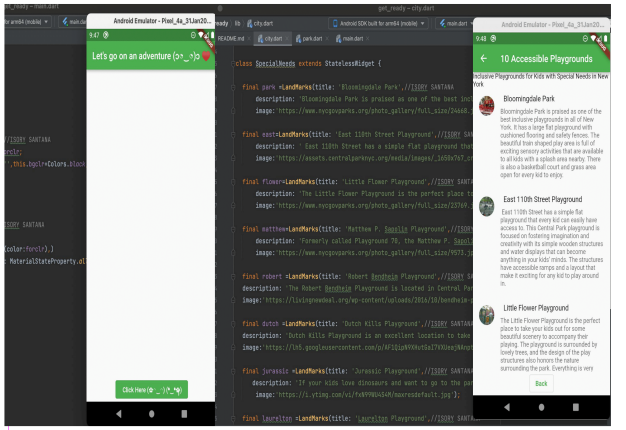
DIAGRAMS



ACKNOWLEDGEMENTS

- Emerging Scholars Program 2022 Spring
- Computer Systems - BTECH
- Computer Engineering Technology Dept.
- Thank you very much for all of your support Prof. Farrukh Zia.

SAMPLE CODE



CONCLUSION

This application provides information about 10 accessible playgrounds for special needs children where your children may have fun in the sun. All of these playgrounds have aspects that are suitable for youngsters of all abilities. They incorporate safety features to help avoid injuries and guarantee that everyone enjoys their holiday. Their play structures will spark your child's creativity while also giving a fun activity that allows them to be themselves and run about freely.

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https://www.newyorkfamily.com/inclusive-playgrounds-kids-special-needs-new-york/

Smart Physics: Bouncing from the Board to the Screen

Jake Postiglione
Mentor: Prof. Giovanni Ossola
New York City College of Technology

Abstract

As our society continues to venture into a newfound age of technology, educators must continuously adapt to the ever-changing lens through which students learn. Due to the COVID-19 pandemic the need for such a paradigm shift has been made abundantly clear. The Smart Physics project aims to provide educators and students new ways of investigating the physical world through common sensors built into almost every smart device. These investigations can be performed in both traditional classroom settings and in asynchronous online courses. We analyze the way in which our team has gone from "board to screen" and follow the process of developing an investigation that can be conducted by students in introductory physics courses. Specifically, we look at the development of an investigation measuring the time intervals between the bounces of an object using an acoustic stopwatch in order to measure the energy lost through a series of inelastic collisions.

Ever Growing Needs

As we venture further into the Digital Age and technology becomes ever more engrained in our society, we must make the conscious effort to not only upgrade our devices, but also upgrade the way of think.

However, what might have been a natural process of growth for both educators and students has been quickly accelerated by the COVID-19 pandemic. The shortcomings of remote learning, and current standards of education were sorely felt by both students and educators. According to a survey conducted by the National Student Clearinghouse Research Center, the 2020 fall semester saw an 3.6% decrease in the enrollment rate of undergraduate students in the United States. Furthermore, the physical sciences saw a 5.2% decrease in enrollment numbers. [2]

Coming back to in-person learning, we have the opportunity to adjust the way we interact with technology in educational settings based on what we learned about technology during the pandemic. Specifically, regarding what our team has worked on, this meant bringing some aspects of physical investigations conducted in asynchronous laboratory classes into an in-person classroom environment.

Our team made use of an app called `phyphox` [1], a software toolbox that makes use of several sensors found in smart devices to measure various physical quantities. One of the most dynamic tools we've come to use is the acoustic stopwatch. For example, we were able to measure the speed of sound using two smart phones as some distance apart and two people clapping to create unique acoustic events to trigger the stopwatches.

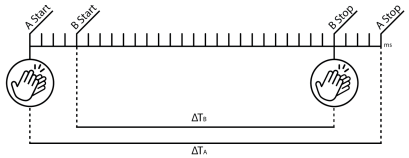

Fig. 1: Two time intervals measured in an investigation to measure the speed of sound with acoustic stopwatches.

Investigation Design

To design investigations using the phyphox tool set, we initially identified several topics for which traditional lab materials already existed. These include topics like the free fall of an object due to gravitational acceleration, measuring gravitational acceleration with a pendulum, and calculating the centripetal force based on angular velocity.

There are also several experiments that are not traditional taught due to limited materials or lack of resources to conduct the experiment. This includes experiments like measuring the speed of sound in air and measuring the coefficient of restitution and energy lost due to inelastic collisions between a bouncing object and a hard surface.

As previously mentioned, one of the main tools we made use of in the development of experiments was the acoustic stopwatch. The tool makes use of the microphone on your smart device to record sonic events caused by some action. In the case of a bouncing object, a sound is made each time the object bounces. By measuring the interval between two events, several conditions of the bounce can be assumed, such as the max height between each bounce, as well as the extrapolation of the initial height of the drop.

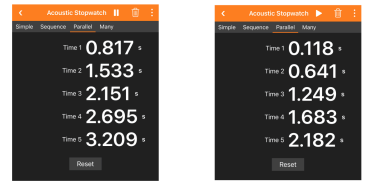

Fig. 2: Two runs of the acoustic stopwatch measuring the time of each bounce of different objects. Basketball(L) Ping Pong(R)

Data Analysis

Once we had our investigations chosen, we then spent some time discussing the physics of these experiments. Specifically, we talked about the mathematical methods one could use to analyze the collected data.

We also considered the method through which students would input this data for it to be used in a calculation. Ultimately, we decided on create an excel workbook as apposed to creating a website or a python script that would automatically calculate the answer.

Section 1.
Collecting DATA

Initial Height (m)	
h0	1.00

Mass of the Ball (g)	
M	0.04

Time Collisions (s)	
t1	2.03533
t2	2.77935
t3	3.41700
t4	3.97350
t5	4.46854
t6	4.91794
t7	5.32671

Section 2.
Height and Energy

Time Interval (sec)	Height (m)	Energy (J)
-	1.00	0.392
0.74402	0.679	0.266
0.63765	0.499	0.195
0.55650	0.380	0.149
0.49504	0.301	0.118
0.44940	0.248	0.097
0.40877	0.205	0.080

Section 3.
Energy Loss and Coefficient of Restitution

Bounce Number	Energy Lost	Coefficent Rest.
1	32.1%	0.824
2	26.6%	0.857
3	23.8%	0.873
4	20.9%	0.890
5	17.6%	0.908
6	17.3%	0.910

Fig. 3: Tables showing sample data and calculations based on the measured bounce times of the object.

International Collaboration

Through this project, we have also had the opportunity to work with faculty and student teachers at the University of Padova in Italy. The student collaborators from both groups met several times to discuss the investigations we had been designing and had conversations about the considerations we made in the design of our respective experiments.

The main investigation we focused on was the bouncing ball experiment, and the main investigation the Padova team focused on was measuring gravitational acceleration using a pendulum. They did this through the use of the proximity sensor in your phone which is normally used to turn off the screen when you raise your phone to your ear during a phone call.

In order to trigger the proximity sensor, a plumb bob of the right shape needed to be used. During our testing of the experiment, we ended up using a kilogram weight suspended from a string with enough distance between the weight and the floor to place your phone under the pendulum.

Fig. 4: A simple pendulum setup used to test the investigation write-up provided by the Padova team.

Conclusion

Throughout this multi-semester project, we have had to opportunity to bring an investigation through fruition, from board to screen. As we look towards the future, we hope to continue to build different investigations for a wide range of students studying an array of different physical quantities in the pursuit of upgrading the way students learn about physics and the way it is taught.

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Ferrate VI: An environmentally friendly oxidant for water treatment

STUDENT: LE VAN LA—MENTOR: PROF. VISHWAS JOSHI, MS., PHD./ DEPARTMENT OF CHEMISTRY
NEW YORK CITY COLLEGE OF TECHNOLOGY (CUNY)

ABSTRACT

Water contamination is a common problem all over the world. Safe drinking water, sanitation, and hygiene are crucial to human health and well-being. Some of the common water purification methods are sedimentation or settling, boiling/distillation, chemical treatment, disinfection, and filtration. Chlorine and its compounds can kill waterborne bacteria and viruses, and they are used as disinfectants in water treatment. However, some of their byproducts can cause harmful health effects. The higher oxidation state of iron i.e., Ferrate (VI) possesses relatively higher redox potential as compared to other commonly used oxidants (chlorine dioxide, iodine, bromide, ozone), in water treatment. Further, Ferrate (VI) forms non-toxic, non-mutagenic, and non-carcinogenic byproducts during water treatment processes [1].

This research focuses on three important aspects that make Ferrate (VI) a preferred environmentally friendly oxidant for water treatment; namely: i) removal of toxic heavy metals like Cadmium - Cd (II) [2]; ii) destruction and removal of antibiotics, such as tetracycline; and iii) destruction of bacteria such as tetracycline-resistant *E. coli* from wastewater [1]

FERRATE(VI): REMOVAL OF CADMIUM (II)

Cadmium (Cd) is known as a non-biodegradable and corrosion resistant heavy metal that was used widely in various industries including painting, alloying, and electroplating (Pérez-Rama, Alonso, López, & Vaamonde, 2002; Solisio, Lodi, Soletto, & Converti, 2008) [4],[5].

As being used and released into the environment, an overabundant amount of Cd become a significant threat to human and other living organisms in the ecosystem. An excessive amount of Cd may cause chronic exposure, which leads to kidney failure or liver damage, bone degeneration, and even cancers (Muehe et al., 2013)[6].

With high oxidation potential, Ferrate (VI) could be reduced to Fe(III) oxides which were popularly used to remove diverse contaminants via coagulation or absorption [2].

According to an experimental research project conducted by Wang, Zhang and others in 2019, efficiency of removing Cadmium- Cd(II) from aqueous solution by potassium ferrate (K2FeO4, as a source of Fe(VI)) is as high as 98.97%[2]. The results of this experimental research [2] were shown in **Figure 1; Ref 2.** The result data charts in **Figure 1** illustrate the rate of Cd removal by potassium ferrate as a function of Fe(VI) dosage (**A**); initial pH (acidity) of the Cd solution (**B**); and initial concentration of Cd (**C**). As shown in **figure 1**, higher doses of Fe(VI), basic [pH] conditions, and higher Cd(II) concentration results in efficient removal of Cd(II) from the solution.

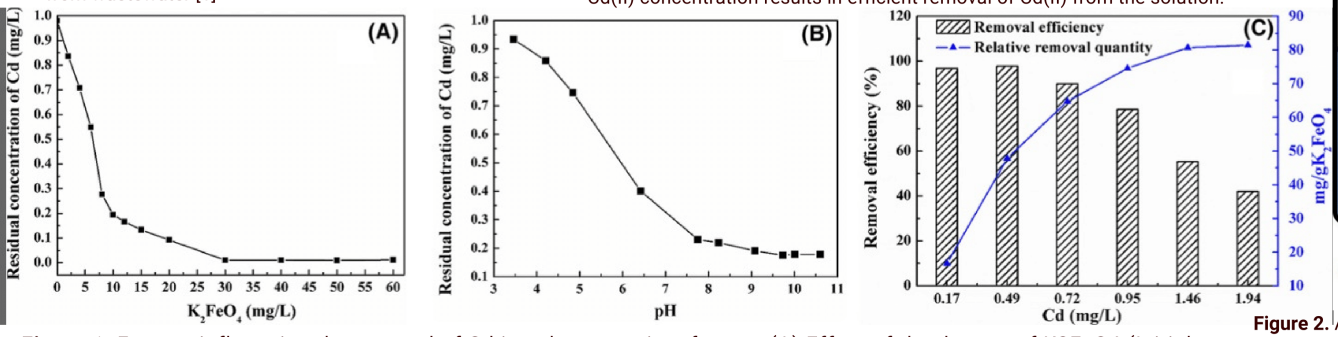

Figure 1. Factors influencing the removal of Cd ions by potassium ferrate: (A) Effect of the dosage of K2FeO4 (Initial concentration of Cd(II) = 1 mg/L; pH≈6.9); (B) Effect of initial solution pH (Dosage of Fe(VI) = 10 mg/L; initial concentration of Cd(II) = 1 mg/L); (C)Effect of the initial concentrations of Cd(II) (Dosage of Fe(VI) = 10 mg/L; pH≈6.9) (Wang et al., 2019). [2] ***Note: figure 1** came from the research project (Wang et al., 2019) [in reference 2].

FERRATE(VI): REMOVAL OF TETRACYCLINE AND TETRACYCLINE RESISTANT *E. COLI* BACTERIA

Tetracycline is a type of antibiotic that has been used widely in medical treatment and was released into the environment via urine and wastewater [3],[8]. This antibiotic consumption and excessive release have become a serious concern to public health since they contaminated the aquatic environment, and has resulted in antibiotic-resistant bacteria [7],[3].

During water treatment, one of the properties of Ferrate (VI) is its ability to degrade an antibiotic substance named tetracycline and tetracycline resistant bacteria *E.coli* and related genes, viz., *tet*A/ *tet*R simultaneously [3].

According to scientific research conducted by Zhang, and others (Zhang et al., 2021) [3], Ferrate (VI) was confirmed to have the ability to remove tetracycline and its resistant bacteria *E.coli* simultaneously. Moreover, the oxidized byproduct of tetracycline appears to be less toxic than the parent antibiotic.

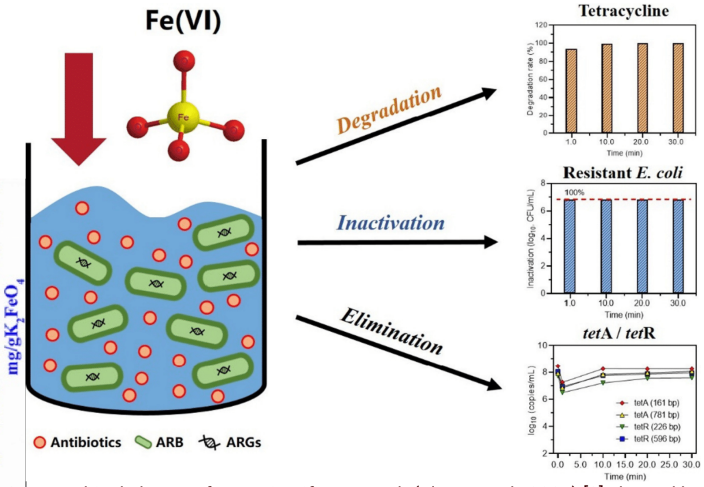

Figure 2. A graphical abstract from scientific research (Zhang et al., 2021) [3] showed how Ferrate(VI) helps remove tetracycline via degradation, inactivate resistant *E.coli*, and eliminate related antibiotic-resistant genes *tet*A/ *tet*R in a sample solution.

***Note: figure 2** came from the research project (Zhang et al., 2021)[in reference 3].

CONCLUSION

Based on the potential and promising properties of Ferrate (VI) as a green oxidant, the application of Ferrate (VI) should be considered as an environmentally friendly and effective method in the water treatment process.

Thanks to other experimental research, Fe(VI) was confirmed to have the ability to react with other contaminants to form non-toxic compounds, non-mutagenic, non-carcinogenic by-products during water treatment processes [1].

CONCLUSION

Those figures, data and information also demonstrate how Ferrate (VI) behaves as an effective reagent for the water treatment processes, including purifying raw water from toxic heavy metals like Cadmium - Cd (II) [2], inactivating a wide range of pathogenic microorganisms, e.g.,, *E.coli* in wastewater [1]. Overall, Ferrate(VI) behaves as a competent disinfectant and a green oxidant which is sufficient for the wastewater treatment processes to benefit human wellness and the aquatic environment in the long term.

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Hardware and Software Co-design of Assistive Technology

Author: Modhumita Dey - Mentor: Professor Farrukh Zia

Computer Engineering Technology Department

ABSTRACT

In Computer Engineering Technology major, students learn how to combine computer hardware and software to make devices to solve real life problems. In this research project Math, Physics, Computer Hardware, Computer Software knowledge is used to develop a computer based device for Assistive Technology application. Assistive Technology (AT) refers to the use of technology to assist people with physical or learning disabilities.

INTRODUCTION

The Mini Enabled Controller is an open-source switch interface that enables adaptive switches and analog joysticks to be used with a compatible USB device such as a computer, tablet, or phone. The switches and/or joysticks can be used to input keyboard, mouse, or joystick/gamepad commands, depending on how the device is configured. The device accepts up to four adaptive switches and one dual axis analog joystick as inputs.

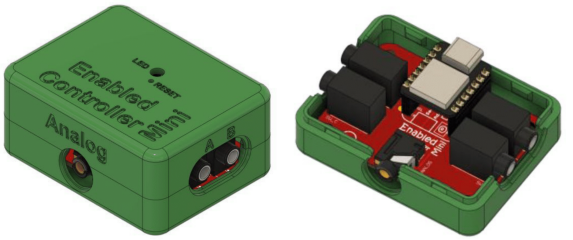
HARDWARE DESIGN

The hardware design of the controller is based on SAMD21 Arduino compatible micro-controller development board. This is a very low cost board (~$6) since it is based on open-source hardware design and can be programmed in open-source and free Arduino programming environment.

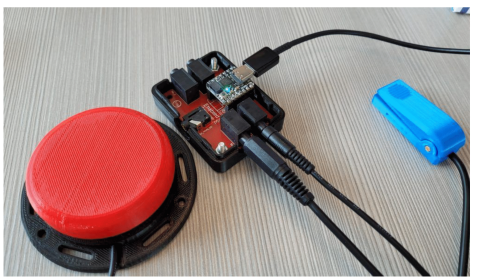
PARTS LIST

1. ADAFRUIT QT PY - SAMD21 DEV BOARD **x 1**
2. 7 POSITION HEADER **x 2**
3. CONN JACK STEREO 3.5MM R/A **x 4**
4. CONN JACK 4COND 3.5MM **x 1**
5. ANALOG 2-AXIS THUMB JOYSTICK WIT **(Optional) x 1**

3D CASE & PCB DESIGN



ELECTRICAL CONNECTIONS



ACKNOWLEDGEMENTS

- Emerging Scholars Program 2021 Fall
- Computer Engineering Technology Department

SOFTWARE PROGRAM

The code for Mini Enabled Controller is written in C++ language in Arduino Integrated Development Environment (IDE). It has two software versions. The USB version emulates a keyboard or a mouse. The Joystick version emulates a gamepad. Both versions use the same hardware. It is possible to change software versions using a computer and code update process in Arduino IDE.

CONCLUSION

The Mini Enabled Controller is smaller and more affordable than most commercial devices since it is based on low cost open-source hardware and free open-source software.

FUTURE WORK

Future work on this project will involve the design modifications to enhance the controller hardware and software to work with wireless Bluetooth or Wi-Fi based devices such as smartphones and tablets.

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Characterizing Tetrahymena thermophila Calpains Using Computational Tools

Olorundamilola Okemeta, Professor Ralph Alcendor

New York City College of Technology, Department of Biological Science, CUNY Research Scholars Program

Abstract

Tetrahymena thermophila is a model organism in biomedical research. *T. thermophila* belongs to a ciliated Protozoa, a major, ecologically successful monophyletic group of unicellular eukaryotes and freshwater organisms that inhibits streams, ponds, and can be found almost everywhere. These cells have been used in studies such as cell cycle, cell death, cell structure and function, and telomerase. Calpains are a family of ever-present expressed calcium-dependent, non-lysosomal cysteine proteases. While mostly calcium-dependent, calpains may also be activated through ERK-mediated phosphorylation. In humans, calpains are involved in apoptosis, cellular proliferation, and cell motility. The functional role of calpains was also associated with myogenesis. Calpains are found in almost all eukaryotes and some bacteria, but not in archaebacteria. Human beings have 15 different calpains classified as classical or non-classical. Classical calpains have a penta-EF (PEF) domain while the non-classical calpains do not. Although the genome of *T. thermophila* has been sequenced, little is known about the function of calpains in in this organism. This project is involved in characterizing TTHERM_00259450, one of the 27 calpains found in *T. thermophila*. Multiple sequence alignments were done using MUSCLE, MAFFT and T-Coffee while phylogenetic analysis was done using MEGA X.

Objective

The purpose of this research was to begin characterizing one of *T. thermophila* calpains, TTHERM_00259450, using bioinformatics tools.

Materials and Methods

- Identified the calpain of interest from *T. thermophila* using human calpain 1 as the search sequence.
- Searched for human calpain homologs using NCBI BLAST - overall Blast and using Homo sapiens as an organism of choice
- TTHERM_00259450 was selected from about 27 other calpains.
- BLASTp search was done using NCBI BLAST to identify which human calpain TTHERM_00259450 is closely equivalent to.
- Used MUSCLE, MAFT, and T-COFFEE for multiple sequence alignment.
- Used MAFFT and Phylogeny.fr to draw phylogeny trees.
- Downloaded and utilized MEGA for more detailed analysis

Description of Tools Used

NCBI BLAST: The Basic Local Alignment Search Tool (BLAST), finds regions of local similarity between sequences. The program compares nucleotide or protein sequences to sequence databases and calculates the statistical significance of matches.

MEGA: Molecular Evolutionary Genetics Analysis conducts statistical analysis of molecular evolution and for constructing phylogenetic trees.

MULTIPLE SEQUENCE ALIGNMENT TOOLS: MAFFT, T-Coffee, and MUSCLE were used for multiple sequence alignment. Phylogeny.fr, MAFFT and MEGA were used to draw phylogeny trees for evolutionary information.

PROTEIN STRUCTURE MODELING: SWISS-MODEL and PHYRE2 modeling database were used to foresee the predictable three-dimensional structure of calpain 7 and its homologous sequence, which results shows how superimposable the structures were.

Results

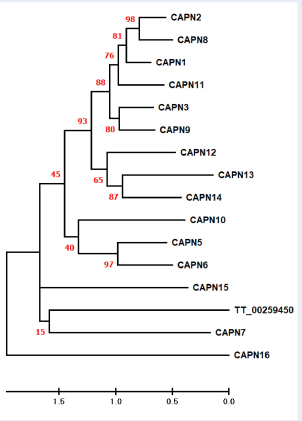

Figure 1. Phylogenetic tree. TT_00259450 protein sequence was compared to human calpains. TT_00259450 is more similar to CAPN7 but also shares some commonality with CAPN15. CAPN16 is very is the most diverse calpain. Maximum Likelihood method was used for this analysis.

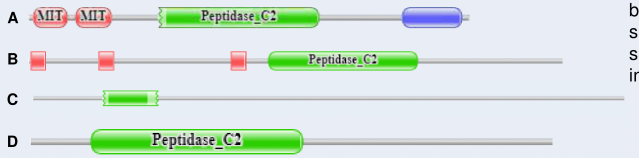

Figure 2. Conserved domains of selected calpains. Three human calpains, CALP7, CAPN15, CAPN16 AND TT_00259450 are displayed. CAPN16 is the most least similar of the four calpains. Pfam site was used to draw this domains.

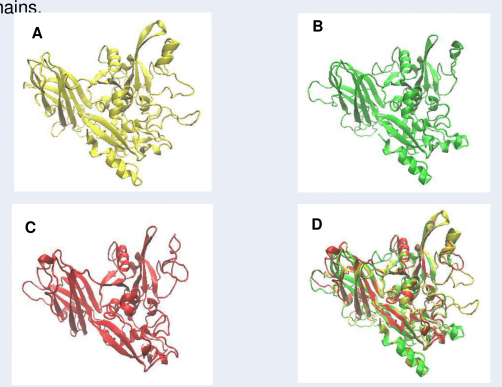

Figure 3. Predicted protein structures of selected calpains. Analysis supported TT_0025940 (A) being more similar to CAPN7 (C) compared to CAPN15 (B). SWISS-MODEL was used to predict protein structures while Comparison and overlay (D) were done using VMD.

Summary of Results

- ✓ TT_00259450 share a higher degree of similarity to human calpain 7 based on phylogenetic analysis using MEGA and other tools. Calpain 15 is the next human calpain that TT_00259450 shares a higher degree of similarity to.
- ✓ Protein structure prediction confirmed the conserved peptidase_C2 domain shared by calpains,
- ✓ SWISS-MODEL structure prediction and VMD comparison confirmed TT_00259450 being more similar to CALP7.

Conclusion

TT_00259450 is a member of T. thermophila family of calpains sharing a higher degree of similarity to human calpain 7. Structural prediction and analysis confirmed this similarity.

Future Studies

This research is a continuous project. More illustrations are to be carried out to further specify why human calpain-7 is specifically closely related to TTHERM_00259450, the similarities, the differences, the protein structure comparison, including its domain(s), biological importance, and relevance.

Acknowledgements

A special thanks to CUNY - New York City College of Technology and the Emerging Scholars Program (ESP) for the opportunity given to engage in this undergraduate research. This project would not have been completed without the proper directions from my amiable research mentor, Professor Ralph Alcendor. Thank you, Professor Alcendor.

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Identifying Protein-Protein & Specific Protein-DNA contacts using Programming Tools

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Abstract

Protein–protein interactions (PPIs) are important in a variety of biological processes. PPIs have a wide range of functions, including influencing enzyme kinetic characteristics, initiating metabolic events, activating or inhibiting proteins, changing protein specificity, regulating upstream and downstream levels, and transporting chemicals. PPI research can assist in revealing the underlying molecular mechanisms in cells(1). Protein–DNA interactions occur when a protein contacts a molecule of DNA, frequently to regulate the biological function of DNA, which is generally gene expression. In this research will show various examples of how to retrieve distances between atoms, and protein DNA contact using different libraries in Python and software tool Pymol.

Objective

The purpose of this project is to understand importance of python and how it can be applied into bioinformatics. This project will be covering libraries such as pandas and bio pandas for data frames and use NumPy to find the distances from each contact. Using Pymol as reference and to see structures .

Materials / Methods

```
#libraries
import pandas
import numpy
import numpy as np
!pip install biopandas
!pip install Biopython
from sklearn.neighbors import DistanceMetric
from biopandas.pdb import PandasPdb
from scipy.spatial import distance
from sklearn.metrics import pairwise_distances
```

Fig.1

- For this project used (Google Collaborate) to access Python.
- Python library is a reusable piece of code that you may use in your applications or projects. A 'library' in this context refers to a collection of fundamental components.
- Libraries used for this research is shown above in Fig. 1.
- Without these libraries the codes will not run and not calculate the distances.

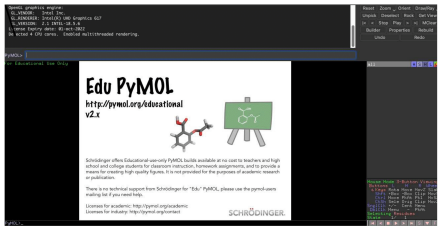

Fig.2

- Pymol was used to access PDB structures and distances.
- PyMOL is a cross-platform molecular graphic application that has been widely used for 3D macromolecule visualization. Plugins such as macromolecular analysis, homology modeling, protein–ligand docking, pharmacophore modeling, VS, and MD simulations have greatly increased PyMOL's capabilities.
- PDB is used throughout the experiment.

Results

```
ppdb = PandasPdb().fetch_pdb('1aay')
df=ppdb.df['ATOM']
df_xyz=df[['x_coord','y_coord',"z_coord"]]
df_xyz
```

Fig. 3a

```
[[ 0.          6.7025522  12.75660746 18.71756368 22.82592533 26.94490657
  29.18261142 30.99151627 32.48564037 33.1075181  33.14046816 28.79692449
  25.13096634 21.31363033 18.71475036 20.53185126 20.2384494  20.33153575
  20.88634513 19.73869421]
```

Fig. 3c

```
Pxyz = np.array([[15.423,21.293,39.836],
[15.565,15.224,42.677],
[13.051,11.368,47.491],
[11.236,9.583,53.825],
[5.282,8.838,56.055],
[-1.054,10.303,58.105],
[-7.125,12.17,55.96],
[-11.686,11.503,51.226],
[-13.651,8.158,45.959],
[-13.582,5.33,39.817],
[-1.843,-4.264,51.961],
[1.125,-2.741,46.706],
[1.513,0.381,40.711],
[0.47,6.191,38.221],
[-1.209,12.757,38.967],
[-4.745,18.009,41.842],
[-3.458,21.341,47.123],
[-0.658,23.452,52.088],
[3.859,22.979,57.147],
[10.13,22.283,58.826]])

print(pairwise_distances(Pxyz,Pxyz))
```

Fig. 3b

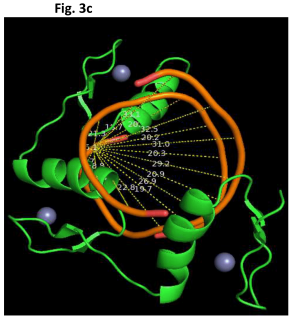

Fig. 3d

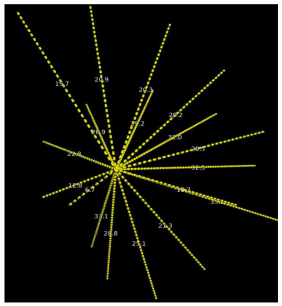

Fig. 3e

Figure 3a is fetching PDB 1aay which allows user to view data frame of XYZ coordinates of atoms. Fig.3b The distances given in the data frames, extracted the XYZ coordinates put them in a NumPy array and use pairwise distance to obtain the distances. The calculation is shown in Fig. 3c . To test the distance checked on Pymol using measurement wizard. The coordinates matches the output of the pairwise distance code Fig 3d-e.

```
#PDB 2AJF Structure of SARS coronavirus spike receptor-binding domain complexed with its receptor
#Light chain contact Ser19 Classification: hydrolase/viral protein
#Light chain Ser19 (angiotensin-converting enzyme 2 (ACE2) and Ser456 (Spike Protein) Classification: hydrolase/viral protein
#Organism(s): Homo sapiens, Severe acute respiratory syndrome-related coronavirus
Ser19_A = np.array([[-1.804,-32.498,53.932],
[-1.987,-31.633,52.728],
[-0.712,-31.602,51.879],
[0.3,-32.203,52.251],
[-2.373,-30.209,53.147],
[-3.349,-30.207,54.175]])

Ser456_E = np.array([[-6.93,-25.492,74.773],
[-6.239,-26.745,74.56 ],
[-4.839,-26.562,74.018],
[-4.616,-25.892,73.052],
[-7.041,-27.654,73.64],
[-7.09,-27.121,72.339]])

mat2 = pairwise_distances (Ser19_A, Ser456_E)
print(mat2)

distance_matrix  = pairwise_distances(Ser19_A,Ser456_E)
print(distance_matrix.shape)
smaller_matrix_test = distance_matrix[:6,:6]
print(smaller_matrix_test)
print(smaller_matrix_test<3)
```

Fig. 4a

```
[[22.57669579 21.86962775 21.16337988 20.3767387   20.95938379 19.89149502]
 [23.41211556 22.7729724  22.07050842 21.23454257 21.8789191  20.76030043]
 [24.49756845 23.84462076 23.0772788  22.22670567 23.00400109 21.89451632]
 [24.5876169  23.87969359 23.06560673 22.23959932 23.06670768 21.99924017]
 [22.59867726 22.03319816 21.33015413 20.44232284 21.17265449 20.0029672 ]
 [21.4320412  20.8778775  20.22987383 19.35666405 19.97585788 18.80024928]]
(6, 6)
[[22.57669579 21.86962775 21.16337988 20.3767387   20.95938379 19.89149502]
 [23.41211556 22.7729724  22.07050842 21.23454257 21.8789191  20.76030043]
 [24.49756845 23.84462076 23.0772788  22.22670567 23.00400109 21.89451632]
 [24.5876169  23.87969359 23.06560673 22.23959932 23.06670768 21.99924017]
 [22.59867726 22.03319816 21.33015413 20.44232284 21.17265449 20.0029672 ]
 [21.4320412  20.8778775  20.22987383 19.35666405 19.97585788 18.80024928]]
[[False False False False False False]
 [False False False False False False]
 [False False False False False False]
 [False False False False False False]
 [False False False False False False]
 [False False False False False False]]
```

Fig. 4b

Fig. 4a PDB file 2AJF Structure of SARS coronavirus spike receptor-binding domain complexed with its receptor. Pairwise distance of Light chain Ser19 (angiotensin-converting enzyme 2 (ACE2) and Ser456 can locate it on chain E (Spike Protein) of the sequence from pdb or Pymol. To acknowledge a distance contact must not be less then 3 Angstrom. In Fig 4a test smaller matrix less then 3. Output shows distance is above 3 Angstrom. (False for < 3) in Fig 4b.

```
#PDB 2AJF
GLU_502_E_CA = np.array([[-27.85,-8.865,76.5]])
SER_19_A_CA = np.array([[-1.987,-31.633,52.728]])
mat = pairwise_distances (GLU_502_E_CA,SER_19_A_CA)
mat

array([[41.86149277]])
```

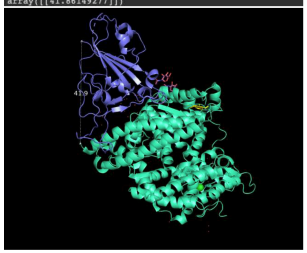

Fig 5.

Fig 5. shows the pairwise distances of light chain of spike protein and (ACE2).

Output: 41.86 Angstrom

Tested on Pymol:

Calculation 41.9 Angstrom

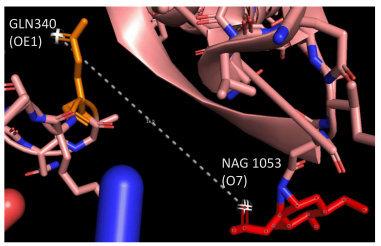

Fig 6.

From PDB file 2AJF database located the ligand interaction.

Used Pymol to locate the interaction by using sequence feature.

Used PK1 and PK2 feature to calculate distance on Pymol.

Discussion and Conclusion

- Important libraries used in this experiment in Fig 1. Pandas, a data manipulation and analysis software package created for the Python computer language. It provides data structures and functions for manipulating numerical tables and time series. NumPy is a library that adds support for huge, multi-dimensional arrays and matrices, as well as a vast number of high-level mathematical functions to work on these arrays. Package installer is called pip allows you to install packages from the package Index as well as other indexes (!pipinstall). Biopandas allows interaction with molecular structures in pandas data frames. To compute the distance matrix from a vector array X and, if available, Y. This method accepts a vector array or a distance matrix as input and returns a distance matrix as output. (sklearn.metrics import pairwise_distances). In Pairwise distances all pairs of sequences are evaluated, and the differences are converted into a distance using pairwise techniques. A reduction of data from a potentially large number of states to a single number. To estimate a tree, combining these distances must be less powerful than using the complete likelihood approach.
- In this experiment Pymol was used to fetch PDB files and use it as an reference to understand the calculations on of pairwise distances alongside with live visualization of protein interactions. This is a user-sponsored molecular visualization system built on an open-source base. (Fig. 2).
- The distance between the donor and acceptor atoms in hydrogen bonding is normally 2.7-3.3 Angstroms. Carbon-carbon lengths in hydrophobic interactions (van der Waals bonds) are typically 3.3-4.0 Angstroms. Which is why we are looking for distances that is not less then 3. (Fig 4a). Fig 4b output shows false which means none of the distances were less then 3 Angstrom.
- An antibody's heavy chain and light chain are two components. The heavy chain is an antibody's big polypeptide component, whereas the light chain is its little polypeptide subunit. In Fig. 5 calculated light chains. A binding affinity can be used to describe the interaction of ligands with their binding sites. In general, higher attractive forces between the ligand and its receptor result in high-affinity ligand binding, whereas lower attractive forces result in low-affinity ligand binding. Fig 6 calculation of the ligand interaction of 2AJF.

In conclusion, The goal of this project is to learn about the importance of Python and how it can be used in bioinformatics. How different libraries have an impact by using different PDB files and visually viewing the interaction using Pymol. Python is a computer programming language that is frequently used to create websites and applications, automate operations, and analyze data. Python is a general-purpose programming language, which means it can be used to develop a wide range of applications and is not specialized for any particular problem.
For this experiment used python for Data analysis and Visualization.

Acknowledgements

- I would like to thank Emerging Scholars Program committee for the Spring 2022 semester
- I would like to give a special thanks to my mentor Dr. David Giganti for his time and guidance throughout this semester.

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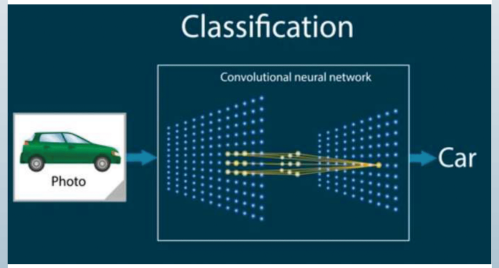
4. *RCSB PDB - 2AJF: Structure of SARS coronavirus spike receptor-binding domain complexed with its receptor*. (n.d.). PDB. https://www.rcsb.org/structure/2AJF
5. . *RCSB PDB - 1AAY: ZIF268 ZINC FINGER-DNA COMPLEX*. (n.d.). PDB. https://www.rcsb.org/structure/1aay
6. https://research.google.com/colaboratory/faq.html

Convoluted Neural Network – Image Classification

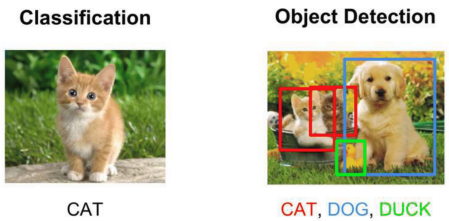
Sisiame B. Sakasamo
Mentor: Marcos Pinto

Abstract

Convoluted Neural Networks (CNNs) are algorithms used in computer vision where the objective is to make computers view the world as human beings view it.



Among the challenges to accomplish this is image recognition/classification, or the ability of computers to identify entities in images. These entities can include, but are not limited to people and objects. The purpose of this research project is to identify practical uses to implement image classification in everyday life, as well as further explore methods to classify images efficiently and effectively.

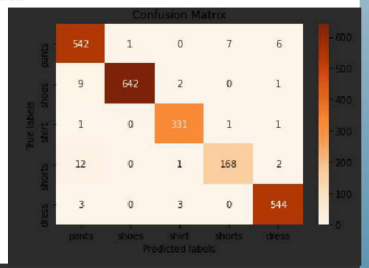


Materials

For this project, a dataset of images with various apparel was utilized, as well as a personal computer with Python programming capabilities.

Methodology

The project utilized the Visual Geometry Group (VGG) model implemented through Python programming to classify a dataset of images. A dataset of apparel images, provided by Kaggle, was analyzed to test the effectiveness and practicality of the VGG model.



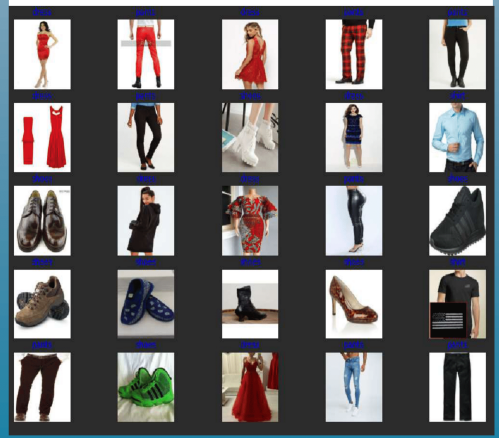

```
def train_model():
    """
    Train a given model and return the trained version.
    """
    model = create_model() # Create a model
    model.summary()
    tensorboard = create_tensorboard_callback() # Create
    model.fit(x=train_data,
              epochs=NUM_EPOCHS,
              validation_data=val_data,
              validation_freq=1,
              callbacks=[tensorboard,early_stopping]) # Fi
    return model
```

Results

In the end, the software was able to recognize various apparel to approximately 97% accuracy, with around 11,385 images used to train the model.

```
408s 1s/step - loss: 0.0462 - accuracy: 0.9848 - val_loss: 0.0742 - val_accuracy: 0.9776
395s 1s/step - loss: 0.0379 - accuracy: 0.9893 - val_loss: 0.0739 - val_accuracy: 0.9758
420s 1s/step - loss: 0.0310 - accuracy: 0.9911 - val_loss: 0.0739 - val_accuracy: 0.9785
417s 1s/step - loss: 0.0280 - accuracy: 0.9915 - val_loss: 0.0746 - val_accuracy: 0.9807
387s 1s/step - loss: 0.0223 - accuracy: 0.9943 - val_loss: 0.0866 - val_accuracy: 0.9728
399s 1s/step - loss: 0.0206 - accuracy: 0.9941 - val_loss: 0.0757 - val_accuracy: 0.9785
401s 1s/step - loss: 0.0169 - accuracy: 0.9960 - val_loss: 0.0812 - val_accuracy: 0.9780
```

The apparel analyzed included dresses, pants, shirts, and shorts, with colors including black, blue, brown, green, red, and white.



Conclusion

The VGG model is highly accurate and effective in identifying and classifying apparel by type and color. The model is effective, as the software is able to train an apparel image recognition model in under 30 minutes on a mid-high end, 4 year old personal laptop.

Recommendations

Although highly accurate and effective in identifying and classifying apparel by type and color, further research on program runtime, as well as comparison to other image classification machine learning models is necessary to determine how efficient the VGG model is.

Acknowledgements

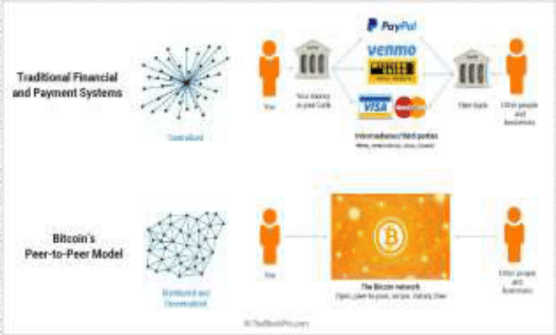
I would like to thank my faculty mentor for providing this research project to work on, as well as the Emerging Scholars Program for giving the opportunity to start this research project.

Accuracy of Predicting Bitcoin Currency Price Using Machine Learning Models

Svetlana Idrovo Shindler
Mentor: Patrick Slattery – Computer Information Systems

Abstract:

The price of Bitcoin changes constantly and can seem unpredictable. Through this poster I demonstrate high performance machine learning based classification and regression models, that exist in finance world for predicting Bitcoin price movements. For this purpose, I found out that time series forecasting technique will be the best fit. These technique involve taking models fit on historical data, using time component, and using them to predict future observations.



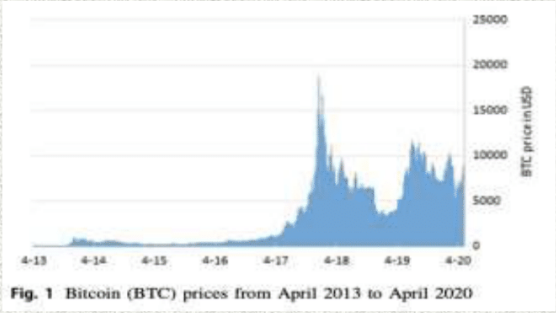


Fig. 1 Bitcoin (BTC) prices from April 2013 to April 2020

What type of model works best for Bitcoin predictions?

Pure models which uses historical data on variable to be predicted, that can be drawn as a line over time.

Explanatory models which use a function to predict an outcome which is not typically following a line over time

Conclusion:

We would prefer Time Series Explanatory Models over pure models because of 2 reasons:

1. Bitcoin are likely to change unexpectedly, and they considered as nonstationary (unpredictable). The results obtained by using non-stationary time series may be more useful to indicate a relationship between two variables where one does not exist.

2. Large number of features and the proposed ML methodology handles autocorrelation, seasonality and trend affects, while the training process of pure time series models require manual tuning to address these affects.

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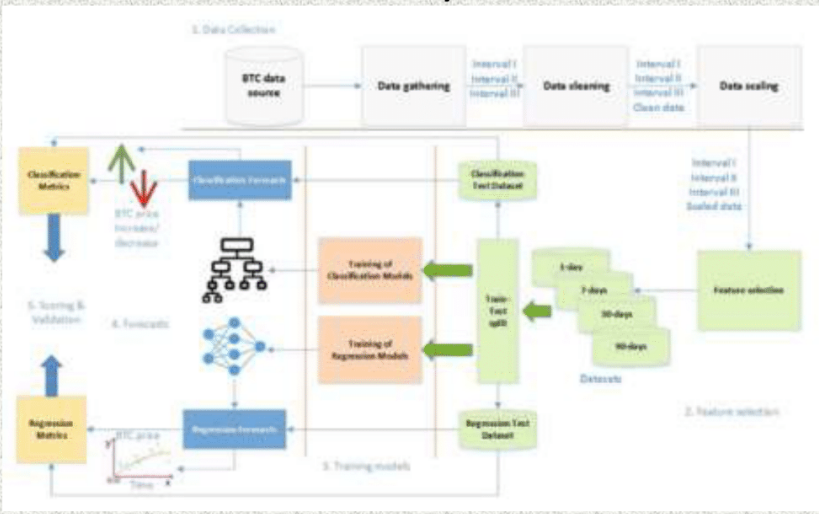
3.https://www.sciencedirect.com/science/article/abs/pii/S136481521730542X#:~:text=Time%20series%20analysis%20with%20explanatory%20variables%20encompasses%20methods%20to%20model,series%20models%20with%20explanatory%20variables.
4.https://link.springer.com/content/pdf/10.1007/s00521-020-05129-6.pdf
5. https://jfin-swufe.springeropen.com/track/pdf/10.1186/s40854-020-0174-9.pdf

Future steps we will take to predict Bitcoin currency Price:



1) In the pre-processing stage, data is gathered, cleaned, scaled/normalized and construction of a dataset.
2) Feature selection is identified relevant features (the most important step in ML).
3) Training of ML models and forecasts considering underline features from training data (based on statistical factors such as variance and SD that changes over time) and allow to predict the outcome in previously unseen cases.
4) ML for time series forecast used for classification and regression.
5) Usage of models: ANN, SANN, SVM, LSTM to predict prices of Bitcoin considering the changes.

Novice Peer-leader Learning During Initial Training

Taspia Jannat, New York City College of Technology, CUNY – Spring 2022
Mentor: Dr. Nadia S Kennedy

Abstract

The project focuses on the learning of novice peer-leaders, who are currently taking MEDU 2901. Three surveys will be administered throughout the semester. A pair of these surveys will be distributed, one in the beginning of the semester and another in late April, in order to trace whether novice peer-leaders' views of the role of the peer-leader have changed as a result of their training. An additional survey will be given in late April to examine the perceptions of the novice peer-leaders on skills acquired during the peer-leader training.

Introduction

PLTL (Peer-Led Team Learning) is a collaborative model in where small groups of students meet weekly for sixty-minute workshop sessions led by one or more Peer Leaders. Together, the group works through challenging math or statics problem sets that are designed to engage students in problem solving strategies, primarily in groups. PLTL has proven to be an effective model for many institutions. Citytech utilizes this model in some Mathematics and Statics courses. Currently some 28 classes—one MAT 1190 and 27 sections of MAT 1275 have incorporated PL workshops. Another 7 Calculus and 3 Statics courses have independent PL workshops.

Literature Review

Peer leaders serve as a liaison between faculty and the students they work with and are often high-performing students themselves, providing effective support to other students in problem solving [1]. Required peer-leader knowledge and skills concern content skills such as mathematics problem-solving [2]. However, there are other knowledge and skills that go beyond content knowledge and concern instructional methods, beliefs, attitudes, and views of the role of the peer-leader [3], [4], [5]. This study examines how these views may change as a result of peer-leader training.

Method

The study tried to answer the following research questions: 1) What do novice peer-leader learn during their one semester training? 2) What is novice peer-leaders' conception of the role of the peer-leader? Does this conception change during the course of their training?

The students from the MEDU 2901: Peer-leader Training in Mathematics, were surveyed in the beginning and the end of the Spring 2022 semester to determine the answers to these questions. The surveys use close- and open-ended response questions.

Results

What do novice peer-leader learn during their one semester training

Peer-leaders report the following:

Novice Peer-leader Survey Responses

	Questions	End of semester: Agree and strongly agree	End of semester: Strongly agree
Q1	My knowledge of mathematics/engineering is reinforced.	50%	0%
Q2	I have confidence in public speaking.	50%	50%
Q3	My communication skills have improved.	100%	50%
Q4	I am able to use different techniques to promote group learning.	100%	50%
Q5	I enjoy sharing my mathematics/ engineering knowledge.	100%	50%
Q6	I am considering teaching as a possible career option.	100%	50%
Q7	My understanding of mathematical/engineering concepts is increased.	100%	50%
Q8	I am able to explain mathematics/engineering concepts clearly.	100%	50%
Q9	I am considering applying to graduate school.	100%	50%
Q10	My confidence in mathematics/engineering has increased.	100%	50%
Q11	My leadership skills have increased.	100%	50%
Q12	I would join this program as a freshman in college.	100%	50%

Peer-leaders also reported that they gained experience of teaching other students, and learned ways to help students who are struggling.

What is novice peer-leaders' conception of the role of the peer-leader? Does this conception change during the course of their training?

The role of peer leading is to:

Not give the students answers, but to guide them with hints and clues.
Help students to be goal orientated
Help students with problems step by step.
Tell students new ways of solving problems.
Give students the formulas (if they don't know them)
If students have any questions I am there for them to answer it.
Whatever you know you could tell them, but stay away from giving answers you are not sure.
Help students understand the topic better
Help them not be afraid of math.
Peer leaders are there to pick up in those common mistakes that may not be so common for other people and try to correct them.
I try not to give them the answers but sometimes it gets so

Peer-leaders' misconceptions about the role of the peer-leader

Lack of clarity about the role of the peer-leader.

Conflicting Conceptions:
Guiding students vs Telling students

What *guiding/supporting students* mean:

leaving students "alone" ["I do not give them the answers, I give them hints. I tell them to go back to their notes, and look at their notes,"] *spoon-feeding* students by giving them formulae and telling them what steps to follow ["Giving them the formulas (if they don't know them)"; "If students have any questions I am there for them to answer it."] *facilitating a discussion and scaffolding the problem-solving through questions rather than providing answers.*

Conclusions

- Novice peer-leaders report perceptions of gained confidence, improved communication skills, listening, and group facilitation skills
- However, some misconceptions about the role of the peer-leader, the types of problems that students should be engaged in, and about who has the responsibility for student learning seem to persist
- The conclusions indicate the need of further work focused on clarifying the role of the peer-leader, the concepts of "helping students in problem solving," and student responsibilities in their own learning, as well as the need to engage the peer-leaders in rehearsing routines that are essential in the peer-leading.

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Acknowledgments

I would also like to thank the Emerging Scholars Programs for the opportunity to conduct this research.

Mechanical Characterization of Nano-material Doped Polydimethylsiloxane (PDMS)

YeHun Jeong
Prof. Dr. Ozlem Yasar
Department of Mechanical Engineering Technology, New York City College of Technology, CUNY

Abstract

In this project, dog-bone shaped PDMS testers are fabricated at the Research Laboratory SET in the Department of Mechanical Engineering Technology. Tensile tests are performed to investigate the mechanical properties of the PDMS. Similar procedure are also repeated for the nanomaterial doped PDMS to investigate the effects of nanomaterials on the mechanical properties of PDMS. Our preliminary results indicates that engineered scaffolds' mechanical properties can be improved with nanomaterials.

Introduction

Tissue engineering is a relatively new multidisciplinary field involving cell regeneration and shaping in order to grow new organs. Generated organs require scaffolds to build upon for cell growth and to guide tissue development. The scaffolds created must be biocompatible, biodegradable, and provide enough stiffness and strength relative to the organ that it is replacing/repairing. Fabricated organs will require Angiogenesis (The growth of blood vessels from the host to the organ) or Inosculation (Prebuilt blood vessels in the organ that then connect to the h

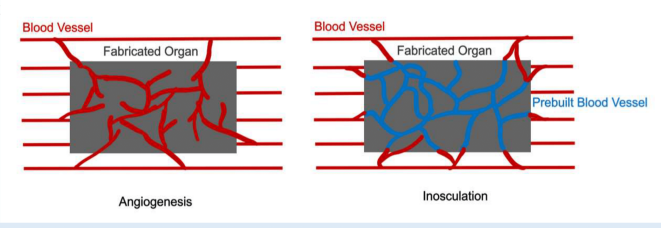

Figure 1. Angiogenesis and Inosculation.

There are many different fabrication techniques for scaffolds that usually revolve around creating porous structures such as Porogen leaching and Phase separated scaffolds, or a form of additive manufacturing with 3D printing.

Results

Due to the current pandemic, the SET Research Laboratory has been closed, suspending research activities there. When lab access will be given again is unknown.

Literature Review

The basic background of tissue engineering, its components and methods are listed in 'Tissue Engineering. Second edition'. Scaffolds and their fabrication techniques such as micro molding and photolithography are briefly covered. 'Direct-Cell Photolithography and Optical Soft Lithography Using PDMS Cell Imprints' goes more in depth for the fabrication method used for this research.

Acknowledgments

The authors acknowledge the research support from Dean's Office, Research Scholars' funds and SET-CUNY

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Method

For this research two methods of fabrication will be used. Micro molding and photolithography. Photolithography can be separated into 2 parts, Direct-Cell Photolithography and Optical Soft Lithography.

- Micro molding is used to mass produce previously created structures. The molds can be created with micrometer precision and can be used to create similar structures out of different materials from the original cast. The molds allow a wide array of flexibility in design while retaining the original shape.
- Direct-Cell Photolithography is arranging cells on glass wafers to use as a photomask. The photomask is placed over a substrate that solidifies with UV light exposure. UV light is shown over the photomask and solidifies the substrate into a specific structure based on the photomask.
- Optical Soft Lithography is the same method as Direct-Cell Photolithography but replaces the cells with a PDMS mold of the photomask. PDMS is transparent to most UV light and would create a similar structure on the substrate as Direct-Cell Photolithography.

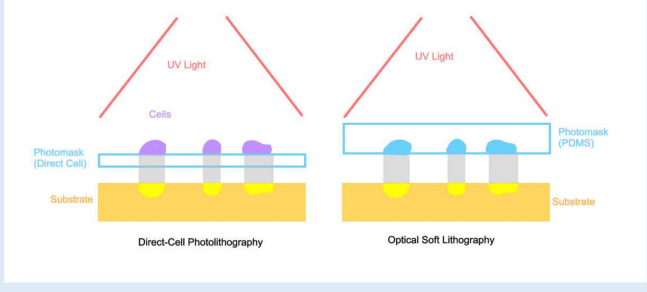


Figure 2. Direct-Cell Photolithography and Optical Soft Lithography.

For this research micro molding is used to create a mold in order to replicate create inlet and outlet channels for a 3D PDMS structure. This is done by casting the PDMS mold with Sylgard 184 A and B in a 10:1 weight ratio favoring Sylgard 184 A. First a 3D printed structure that replicates inlet and outlet similar to inosculation is made out of easily dissolvable material. This structure is then secured in a container with screws connecting together through pre-drilled holes at the outer edges.

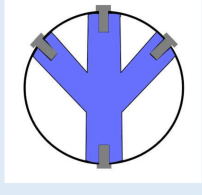


Figure 3. The 3D Printed Structure Secured in the Container.

The PMDS mixture is then poured into the container until it is almost full with the 3D structure being fully covered. The now filled container is placed into a desiccator in order to remove any air bubbles before being placed into an oven for an hour at 40 degrees Celsius. Once the PDMS structure is fully cured, the screws are removed and the PDMS structure can be extracted from the container. The 3D printed insides are then dissolved creating inlet and outlet channels that replicate the exact shape of the dissolved structure in the mold itself.

The Start of a New Revolution: Addressing Government Failure in Ending Homelessness in NYC

New York City College of Technology, City University of New York

Author: Ruth Lovely Joseph
Mentor: Dr. Laura Westengard, Department of English

Abstract

Homelessness is a serious issue in New York City. This project involved research to establish the causes of the homelessness problem in NYC, investigate current solutions currently being implemented by the city, and finally to develop a detailed proposal about a community-based approach to homelessness.

The guiding research questions include: What are the major causes and effects of homelessness in New York City? What are the challenges and shortcomings of existing New York City programs addressing homelessness? What elements should a successful community-based organization include in order to address these shortcomings? What are the underlying biases and moralistic assumptions that keep the general public from supporting homeless initiatives?

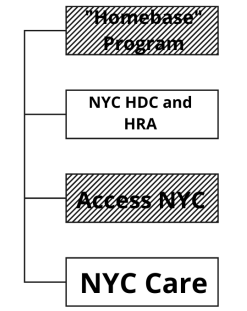
Personal Objective

"As part of the initial research to establish the problem, I watched 'How Do Homeless Women Cope With Their Periods?' by Bustle and 'What Beauty Is Like For Homeless Women On The Streets' by Refinery 29. Both of these videos are about how female homelessness is being treated in the world. I believe that both men and women need protection, but women who are homeless are more vulnerable. Further, in my experience when I walk through the streets or the train station, I see that most homeless people need a place that is warm and safe and a place where they don't feel alone. Based on these two things, I realize that even though the government claims that they are helping homeless people, they aren't doing so sufficiently because then the problem wouldn't continue to exist. People are losing jobs and homes, and the government should have a plan to help people so they don't become homeless. Everyone needs a place to stay, and I was encouraged to do this project because we are all human beings that deserve love, care, and a warm place. No one deserves to be homeless."
--Lovely Joseph

Methodology

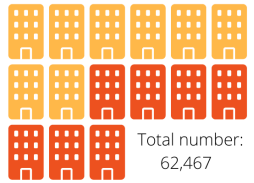
- Literature Review
  - Best keyword and search practices, academic library resources, assessing sources for appropriateness and impact, and developing logical conclusions and next steps by synthesizing research gathered were used to develop an overview of the existing literature on homelessness. This facilitated reflection on current homelessness programs in NYC and their shortcomings.
- Qualitative Data Gathering and Analysis
  - Reviewing and reflecting on documentary coverage of homelessness and its impact on those of different genders, races, and abilities created a foundational understanding of the issue and best options for developing an effective proposal.
- Field Research
  - Field research, including place-based observation and community outreach, was used to develop guiding questions and hypotheses and to establish the problem and develop potential solutions.
- Expert Interviews
  - Interviews with those working in community and health services provided an overview of the strengths and weaknesses of existing programs.

Key Findings



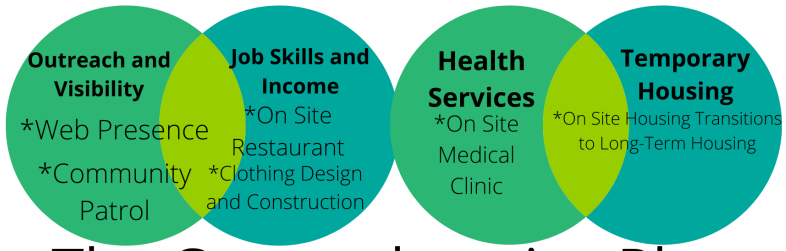
Existing Programs in NYC

Major Causes of Homelessness



"In April 2015, New York City sheltered 59,285 homeless people (including both single individuals and members of families), and an estimate based on a street survey done in February of that year indicates that there were an additional 3,182 persons living in public spaces" (Main 2).

"In my job they take of anyone who doesn't have a house and people who don't have others to take care of them. We take care of the homeless, give them food, clothe, and clean them. They also help find houses for the homeless people."
--Yolette Joseph, Riverdale Nursing Home



The Comprehensive Plan

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Conclusion

The research completed during this project has provided a clearer overview of the homelessness problem in New York City as well as the potential solution that might best address the problem while keeping in mind the strengths and shortcomings of existing programs.

The conclusions will lead to a formal proposal and implementation of a community-based solution with multiple elements, including a self-sustaining structure with outreach, a restaurant, health services, clothing, temporary housing, and job skills training. Even if someone has done bad things, it doesn't mean they deserve homelessness. People do bad things to others because bad things have happened to them—it is a cycle. This project is designed to break this cycle.

The project has also supported the following learning outcomes for the student participant, who is in her first-semester at New York City College of Technology: Basic inquiry, research, and communication techniques facilitated an increased ability to value knowledge and learning, communicate in diverse settings and groups, understand and employ both quantitative and qualitative analysis to describe and solve problems, gather, interpret, evaluate, and apply information discerningly from a variety of sources, transform information into knowledge, and knowledge into judgment and action, assume responsibility for social justice, and show ability to contribute actively by applying knowledge to the identification and analysis of societal and professional problems to enact solutions.

New York City College of Technology
Emerging Scholars Program Presentation
Spring 2022

America Through Immigrant Eyes

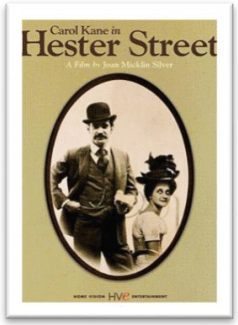
Samuel Cheung & Professor Peter Catapano, Department of Social Science

Project Description:

The cinematic depiction of the immigrant experience has been a staple of the medium since the silent era. Using such films in the classroom, students may be introduced into the discipline of immigration history. This presentation will provide representative examples of U.S. immigrant history teaching modules that incorporate film sources. Each example will be representative of the diversity of the immigrant experience during the 19th and 20th centuries.

Europe:

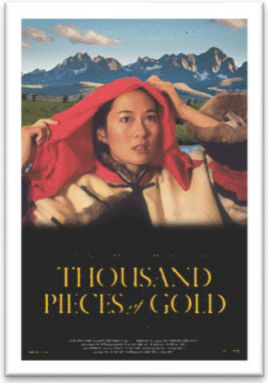
Many of the immigrants who entered through Ellis Island settled in New York. A "Little Italy" centered on Mulberry Street and an Eastern European Jewish ghetto on the Lower East Side became vibrant examples of the "new immigrant" neighborhoods established during the era. These neighborhoods proved those new to America an entry point into an alien culture.



Hester Street, Directed by Joan Silver, May 1, 1975

Asia

The Immigration Center at Angel Island in San Francisco Bay was constructed in 1905 and began to operate in 1910. Because of the Chinese Exclusion Act (1882) which effectively halted new immigration from China, Angel Island, unlike Ellis Island, functioned primarily as a detention center for those suspected of illegal entry from Asia. The Chinese Exclusion Act was rescinded after World War II. Changes in immigration laws in 1965 further reduced legal barriers to immigration from Asia. After 1970, immigration grew from Asia fastest of all continents. Not only China, but immigrants from the Philippines, Korea, Vietnam and India began to enter the U.S. in increasing numbers.



Thousand Pieces Of Gold, Nancy Kelly, April 26, 1991

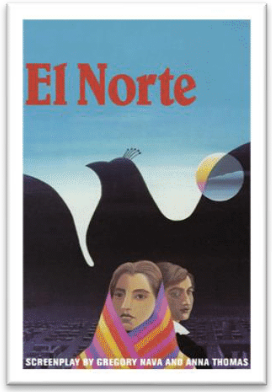
Black Diaspora from Africa and the Caribbean

The long history of African migration to the America begins with the forced migration of the African slave trade beginning in the 17th century. Voluntary immigration to the United States from descendants of the black diaspora from the Caribbean began in large numbers in the early twentieth century. However, the number of black immigrants from the Caribbean as well as from the nations of Africa has increased dramatically after the ending of national quotas in 1965. The top nations of origin for black immigrants in 2019 were Jamaica, Haiti, Nigeria and Ethiopia.

The Sun Is Also A Star, Russo - Young, May 16, 2019

Latin America

The Second Quota Act of 1924 dramatically reduced immigration from Europe by placing quotas based on the national origin of immigrants. However, the restrictions did not include Western Hemisphere. As a result, immigration from Canada and Mexico grew as a replacement pool of labor in American farms and factories.



El Norte, Directed by Gregory Nava, Jan 27, 1984

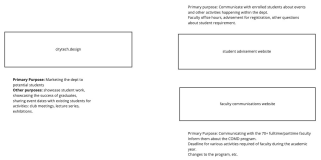
After World War II, illegal immigration from Mexico increased and greater measures to police the border ensued. After the 1965 immigration act, legal preferences for family reunifications increased the numbers of Mexican immigrant. Changes in U.S. law coupled with global political and economic factors led to an increasing number of Hispanic immigrants from the Caribbean, Central America and South America after 1970.

For more information on each film and a select list of recommended films you can contact Professor Catapano. pcatapano@citytech.cuny.edu.

Learning to Innovate Websites and Apps Through Knowledge and Understanding of How the Internet Works.
(Originally titled: Developing an App with Social Media Performance Capabilities)

Student Researchers-Ali Abbas, Bilal Badar
Faculty Member-Daniel Wong

1 Our Goal



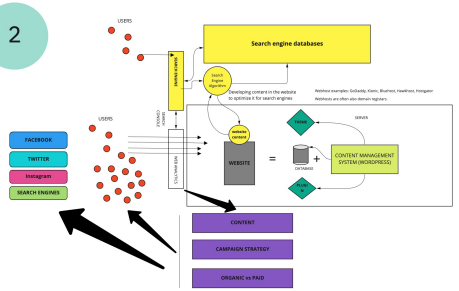
My group is focused primarily on the citytech.design website for the student life section of the site. our main goal is to advertise or market the City Tech comd design department to potential new students and to encourage them to enroll in this department of City Tech, Although other purposes for the site is to showcase students work, showcase the success of graduates, show event dates with existing City Tech students for activities:club meeting, lecture series and exhibitions.

For the student advisement website the primary purpose is to communicate with enrolled students about future events and activities happening within the Department. also for Faculty office hours, advisement for registration and other questions about student requirements.

The faculty communications website will be primarily used for Communicating with the 70+ full time/part time faculty and to inform them about the COMD program. deadlines for various activities required of faculty during the academic year and changes to programs will only be showed or discussed on this section of this site.

How to attract search engines and users while managing your website

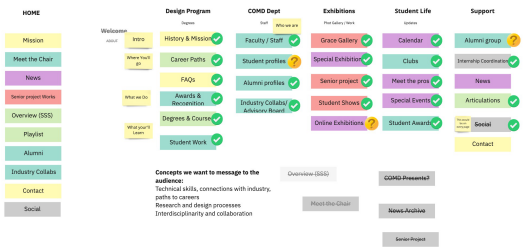
2



Wordpress is an open-source content management system (CMS)

In diagram 2 we want search engine to index student's content that we put onto citytech.design, and we want out content to be optimized for search engines and help attract new users because our main objective with our site is to encourage new students and search engines to find our site. while also looking at what the comd design department at city tech have done and encourage new users to study at city tech in the comd design department by uploading students work. However in order to attract new users and managed your site,you must have a nice theme, database and plugins for your website and also making sure your website is presentable and user friendly, while also having a unique UI and Interface. indexing our content is necessary because it will make attracting search engines like google more accessible to new users like having advertisements promoting the content of our comd design students on the citytech.design website.

3 Overall view of what we have achieved



In diagram 3 this will be our drop down menus our main focus is to create a navigation experience that users can easily find the content they are looking for without making it too convoluted and frustrating for our users. However we made sure to include as many programs and options as possible like design program,COMD Dept, Exhibitions, Student Life and support. All of this makes it easy for students to find what they need without going through a messy site since we plan to keep everything organized, although future adjustments may be required. lastly this will be an inclusive site for all future and current students who have interests in the COMD dept.

This Research is ongoing...

The Energy Challenge: Moving From Fossil Fuels To Biofuels, Hydrogen, and Green Energy Sources

Aneeza Hussain & Afrina Nishat

Mentor: Professor Alberto Martinez

New York City College of Technology, Department of Chemistry

CUNY Research Scholars Program

ABSTRACT

The aim of this literature research is to evaluate and identify alternative sources of energy instead of fossil fuels. Fossil fuels like natural gas, oil, and coal are known as nonrenewable resources because they are finite resources that cannot be readily replenished at the same pace as their consumption. The alternatives that will be searched for in this literature review are specifically, biofuels, hydrogen, and green energy sources which are all known as renewable. The review will then focus on hydrogen as true potential replacement of fossil fuels. In some countries, alternative renewable sources include geothermal energy, nuclear energy, solar energy, wind energy, and hydroelectric technologies. Hydroelectricity is the only renewable energy that is reliable. Generally, renewable energy sources generate most of their energy at certain times of the day, and their electricity generation does not match the peak demand hours. The intermittency of sunshine and wind cannot provide an on-demand power source 24 hours a week. Solar energy and wind are unpredictable. Unlike fossil fuel, green/renewable energy does not appear to be a one size fits all solution. The use of multiple sources is generally required to meet energy needs. Identifying those sources and evaluating their viability is the adjusted purpose of this research project.

MATERIALS AND METHODS

-Extensive Literature Research Conducted on Energy sources
-Google Scholars was used to search related articles
-Critical Understanding of Inorganic Chemistry and biochemistry
-Keywords: alternatives, energy, renewable, hydrogen, electrolysis
-Selected 7 articles out of 32 that were read for this research
-Research Experts Consulted: Professor Alberto Martinez

INTRODUCTION

Fossil fuels used today as main source of energy have a limited lifespan and a high environmental cost. Concerns on climate change and global warming are progressively raising in developed societies, which are trying to reduce their dependence on fossil fuels to generate energy. Renewable energy sources are being explored as a true alternative. These sources (biomass, hydropower, geothermal, wind, solar, etc) are naturally replenishing but flow-limited.

As wind, solar, and lithium-ion each have their own shortcomings and are not enough to meet the demands of the future, science has proven that hydrogen is the best and the cleanest option for renewable energy. Hydrogen has the potential to play a vital role in meeting the energy storage needs required to slash CO_2 emissions. It is the most plentiful element in the universe and its capability as an effective energy carrier has been well-understood for decades. Because hydrogen does not exist freely in nature and is only produced from other sources of energy, it is known as an energy carrier. It is a clean-burning fuel, and when combined with oxygen in a fuel cell, hydrogen produces heat and electricity with only water vapor as a by-product. [1]

Hydrogen can be made directly from fossil fuels or biomass, or it can be produced by passing electricity through water, breaking the water into its constituent components of hydrogen and oxygen. Some envision a future "hydrogen economy," where hydrogen is produced from a variety of energy sources, stored for later use, piped to where it is needed, and then converted cleanly into heat and electricity. [2]

Most hydrogen production today is by steam reforming natural gas. But natural gas is already a good fuel and one that is rapidly becoming scarcer and more expensive. It is also a fossil fuel, so the carbon dioxide released in the reformation process adds to the greenhouse effect. Hydrogen has very high energy for its weight, but very low energy for its volume, so new technology is needed to store and transport it. And fuel cell technology is still in early development, needing improvements in efficiency and durability. [3]

RESULTS

A simple element like hydrogen has unique properties such as, it's highly combustible and very cold as a liquid, but it also has its challenges like it's the smallest molecule to contain. Processing and storing hydrogen requires expertise. Hydrogen can be produced in different ways, typically from fossil fuels, nuclear and renewable sources. Water electrolysis is a commonly used method. During this process an electric current is used to split hydrogen from oxygen. If the electricity comes from renewable sources, the hydrogen fuel is considered to be renewable or "green" because it is produced without CO_2 emissions. Electrolysis is energy-intensive and has only recently been considered feasible as the cost of renewable power has declined and electrolysis technology has improved. Nuclear power can also provide the energy for electrolysis to split water without CO_2 emissions. U.S. utilities Exelon, FirstEnergy, Xcel Energy, and Arizona Public Service have all committed to commencing small-scale hydrogen production at nuclear plants. [4]

Hydrogen is almost always found as part of another compound, such as water (H_2O) or methane (CH_4), and it must be separated into pure hydrogen (H_2) for use in fuel cell electric vehicles. Hydrogen fuel combines with oxygen from the air through a fuel cell, creating electricity and water through an electrochemical process. Electrolysis is an electric current that splits water into hydrogen and oxygen. If the electricity is produced by renewable sources, such as solar or wind, the resulting hydrogen will be considered renewable as well and has numerous emissions benefits. [5]

Hydrogen energy storage and transportation issues are present and inspiring issues. Storage and transportation operations are important as production processes. Those processes play a very essential role in the hydrogen energy economy. The common strategy for the storage of hydrogen are compressed gas, cryogenic liquid hydrogen, and solid hydrogen. Also, the density of the hydrogen stored as a liquid is greater than the density of its stored as compressed gas, and it stores more energy per unit volume. In the liquid hydrogen storage method, hydrogen is stored for a short time due to its low boiling point. On the other hand, In the solid state storage method, a large amount of hydrogen can be stored in a small volume. It is more efficient than the other two methods because it needs less volume. There are two ways of storage for the solid storage method. One is nanostructured materials that can store more hydrogen with nanotechnology. The solid storage method also uses complex hydrides, such as lithium borohydride ($LiBH_4$), sodium borohydride ($NaBH_4$), magnesium borohydride ($Mg(BH_4)_2$), and calcium borohydride ($Ca(BH_4)_2$). [6]

In a polymer electrolyte membrane (PEM) electrolyzer, the electrolyte is a solid specialty plastic material. Water reacts at the anode to form oxygen and positively charged hydrogen ions (protons). The electrons flow through an external circuit and the hydrogen ions selectively move across the PEM to the cathode. At the cathode, hydrogen ions combine with electrons from the external circuit to form hydrogen gas. (as shown in figure 1) [7]

Anode Reaction: $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$
Cathode Reaction: $4H^+ + 4e^- \rightarrow 2H_2$

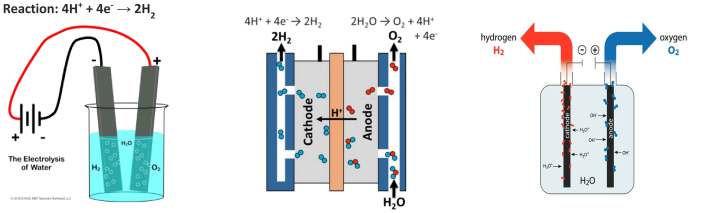


Figure 1. Left: Schematic representation of a simple water electrolysis. Center and right: Schematic representation of a fuel cell

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DISCUSSION

Hydrogen can be produced and used without toxic pollution or CO_2 emissions. It burns clean when mixed with oxygen from the atmosphere and can be used as a source of heat or to power an internal combustion engine. Hydrogen can also be fed into a fuel-cell device that converts hydrogen's chemical energy into electricity. In either case, the only emission produced is water vapor. When hydrogen fuel cells are used to power an electric motor, the system is more than twice as efficient as conventional internal combustion engines.

Hydrogen rarely exists in isolation but is amassed in enormous quantities in water, hydrocarbons, and biomass. Efficient extraction of hydrogen from these compounds is critical for wide-scale deployment. Currently, about 95% of hydrogen is produced by splitting it from natural gas through a process called "steam-reforming." Hydrogen produced in this manufactured to as "gray" and is generally not considered an effective climate solution because it gives off CO_2 as a byproduct. However, it is possible to capture and sequester the CO_2 to produce "blue" hydrogen at an additional cost of about 30%. The oil and gas sector, in particular Shell, BP, and Repsol, are interested in the blue hydrogen approach because it could help preserve the value of their natural gas assets. Commonly used methods of storage as compressed gas and liquid hydrogen. Compressed gas transport by steel, aluminum, and carbon fiber reinforced plastic composite materials.

Hydrogen production via electrolysis may offer opportunities for synergy with dynamic and intermittent power generation, which is characteristic of some renewable energy technologies. For example, though the cost of wind power has continued to drop, the inherent variability of wind is an impediment to the effective use of wind power. Hydrogen fuel and electric power generation could be integrated at a wind farm, allowing flexibility to shift production to best match resource availability with system operational needs and market factors.

CONCLUSION

Electrolysis is a leading hydrogen production pathway to achieve Hydrogen Energy. Hydrogen produced via electrolysis can result in zero greenhouse gas emissions, depending on the source of the electricity used. The source of the required electricity including its cost and efficiency, as well as emissions resulting from electricity generation must be considered when evaluating the benefits and economic viability of hydrogen production via electrolysis. In many regions of the country, today's power grid is not ideal for providing the electricity required for electrolysis because of the greenhouse gases released and the amount of fuel required due to the low efficiency of the electricity generation process. Hydrogen production via electrolysis is being pursued for renewable (wind, solar, hydro, geothermal) and nuclear energy options. These hydrogen production pathways result in virtually zero greenhouse gas and criteria pollutant emissions; however, the production cost needs to be decreased significantly to be competitive with more mature carbon-based pathways such as natural gas reforming. [5] [6] Although the compressed gas method and liquid state storage method are widely used in hydrogen storage, the method to be used for the future is the solid state storage method. The solid-state storage method also consists of complex hydrides, chemical hydrides, magnesium-based alloys, and intermetallic compounds. Complex hydrides have high hydrogen storage capacity.

Today's grid electricity is not the ideal source of electricity for electrolysis because most of the electricity is generated using technologies that result in greenhouse gas emissions and are energy-intensive. Electricity generation using renewable or nuclear energy technologies, either separate from the grid or as a growing portion of the grid mix, is a possible option to overcome these limitations for hydrogen production via electrolysis. The U.S. Department of Energy and others continue efforts to bring down the cost of renewable-based electricity production and develop more efficient fossil-fuel-based electricity production with carbon capture, utilization, and storage. Wind-based electricity production, for example, is growing rapidly in the United States and globally. [7]

Studying Connectance and Robustness of Criminal Networks

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Abstract

Criminal networks and particularly drug trafficking networks (DTN) are different from social networks. In this work we analyzed various networks based on the communication strength among the actors (drug traffickers or players). A DTN can be represented by directed graphs (digraphs) through direct or indirect connections - a directed arc points from the exchange initiator (money, phone call, email, money laundering) to the receiver. Comprehensive analyses of DTNs are important to understand the dynamics of various such networks. We calculated several graph characteristics such as densities, clustering coefficients, and various other centrality measures for few simulated networks. This work can assist us in evaluating which actors or players are more connected to each other. Identifying the key players, strategists, lieutenants, and brokers helps law enforcement personnel strategizing methodical plans for efficient disruption.

Introduction

Criminal networks often are self-preserving and robust in its ability to adapt from an ever-changing presence from law-enforcement. It is necessary to study criminal networks, in this case, drug cartel networks (DTN), in order to hinder the operation and function of these networks in a large scale. The drug cartel often works against the ideals of concealment in order to maintain a sense of order. The presence of several brokers brings flexibility, integration, and creativity to an ensemble to the DTN by maintaining clarity on the occasion that one broker is targeted by law enforcement. In our research we analyze the roles of nodes/actors in a network to mirror criminal networks.

Conclusion

In the results for the figures, we see that nodes with the most connections often have the highest degree of centrality. From our research, we know that a high degree of centrality carries the risk of high visibility in a criminal network. In the DTN, the role of the broker, by definition, creates the most visibility, yet these actors are necessary for the function of the DTN. We can conclude that, despite lacking secrecy, the drug cartel remains robust in its ability to function, often due to the placement of several actors with brokerage roles to secure the connectivity of the criminal network.

Method

The centrality measures and other variables were calculated with the following equations by hand.

Degree Centrality, $D_i = \frac{d_i}{N-1} = \frac{\sum a_{ij}}{N-1}$

Closeness Centrality, $C_i = \frac{1}{L_i} = \frac{N-1}{\sum_j d_{ij}}$

Betweenness Centrality, $B_i = \frac{\sum_{j<R} \frac{n_{jk}(i)}{n_{jk}}}{(N-1)(N-2)}$

Clustering Coefficient, $C_i = \frac{2E_i}{K_i(K_i-1)}$

Density, $2 * \frac{|E|}{(|V|*(|V|-1))}$

These calculations were then verified by code in Python. The calculations in Python were done with the usage of the NetworkX library, as it comes with built in functions to calculate all types of centrality measures from a graph. The graphs themselves were made in python as we were able to present the data in an array format and use both NetworkX to turn the array into a network and MatPlotLib to then display the network.

Results

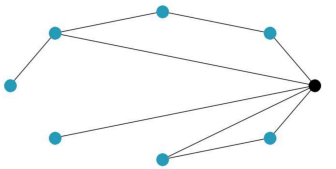

Figure 1 - Single node Analysis

Node	Degree Centrality	Closeness Centrality	Betweenness Centrality	Clustering Coefficient	Density
Black	4/7	8/9	13/21	1/10	18/56

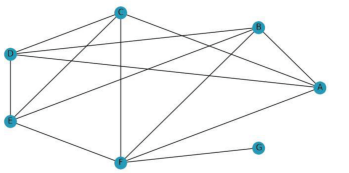

Figure 2 - Criminal Network Analysis

Node	Degree Centrality	Closeness Centrality	Betweenness Centrality	Clustering Coefficient	Density
A	4/6	6/8	0.75/15	4/6	26/42
B	4/6	6/8	0.75/15	4/6	
C	4/6	6/8	0.75/15	4/6	
D	4/6	6/9	0.5/15	4/6	
E	4/6	6/8	0.75/15	4/6	
F	5/6	6/7	5.5/15	4/10	
G	1/6	6/12	0/15	0	

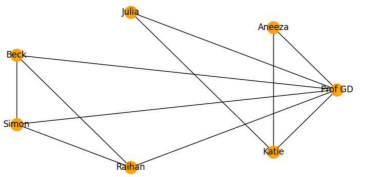

Figure 3 - Social Network Analysis

Node	Degree Centrality	Closeness Centrality	Betweenness Centrality	Clustering Coefficient	Density
Prof GD	6/6	6/6	9.5/15	5/15	22/42
Katie	3/6	6/9	0.5/15	2/3	
Aneeza	2/6	6/10	0/15	1/1	
Julia	2/6	6/10	0/15	1/1	
Raihan	3/6	6/9	0/15	3/3	
Simon	3/6	6/9	0/15	3/3	
Beck	3/6	6/9	0/15	3/3	

Discussion

The DTN often has many brokers implemented into the network so that it can maintain connectivity while risking the visibility of the actors. Although targeting these highly visible actors has little impact on the evolving drug cartel networks, identifying and targeting higher-importance actors/nodes in these networks is still effective in allowing law enforcement to seize resources from the DTN, i.e., Project Ciel. However, the DTN can still be affected by many other factors other than the removal or hindrance of a singular node. We agreed that in order to combat the growth and function of DTN law enforcement, there must be further attempts to study the behavior of the networks while accounting for outside factors or exterior nodes.

Future Work

From the information we've gathered, we can establish an understanding of how a criminal network might interact in a closed environment. With this in mind, how can we improve on the work done? We can begin by improving methods to better identify missing actors and links in a network. This information would allow us to better identify key figures in a group and understand how a criminal network needs to operate to remain robust.

Acknowledgment

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Radiologic Technologist: More Than A Button Pusher

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Department of Radiologic Technology & Medical Imaging

Abstract

The profession of a radiologic technologist requires much more than simply capturing radiographs of bones. Radiologic technologists utilize their skills and knowledge to provide quality diagnostic x-rays while minimizing the dose of harmful radiation to the patient as low as reasonably achievable. The purpose of this research is to determine the public's knowledge of what a radiologic technologist is, what they really do, and to raise awareness of the career field for those who are uninformed.

An online survey was conducted to measure the public's existing knowledge of radiologic technologists. Some questions included were; the level of education of a radiologic technologist, job title (technologist vs. technician), and basic educational course work. The results revealed that roughly 90% of individuals have had experience with x-rays although only 16% knew the correct title for a professional who takes x-rays. The data also revealed that 11% agreed that technologists are just button pushers, 11% of individuals agreed that the job of a radiologic technologist is easy and 35% remained neutral.

X-rays are the eyes of medicine, yet the field is often overlooked and overshadowed by the other widely recognized healthcare professions. Especially after the COVID-19 pandemic, it poses the question, "Who are considered frontline healthcare workers?". This profession plays a vital part of medicine and requires more effort than a push of a button. It takes strength, critical thinking and problem-solving skills, a combination of physics, pathology, and anatomy to get an optimal image and save the patient from unnecessary radiation exposure. This research can help gain new perspectives or shine new light onto a field that is so often kept in the dark. It is hard work and deserves as much recognition and credit as other healthcare professions.

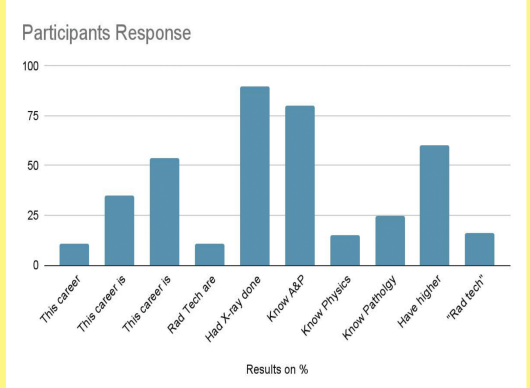
Method

Online survey was conducted to find out people's knowledge about Radiologic technologists, what they think about this profession, how much knowledge it takes to become one and how much effort it requires to get a good radiograph.

We used "Survey Monkey" to conduct this research and posted on our social media platform to reach an audience.

A total of 100 participants took the survey.

Image 1.1



What you should know

More than pushing a button, radiologic technologist must:

- **Operate high tech advance imagining equipment.**
- **Know and perform CPR during medical emergencies**
- **Provide care for in-patients and immunosuppressed patients**
- **Practice Aseptic and Non-Aseptic techniques**
- **Prepare and administer contrast materials to patients**
- **Produce quality radiographs for diagnosis and treatment of diseases.**
- **Have an in-depth understanding of radiation protection, radiation physics, anatomy and physiology, and pathology.**
- **Obtain a minimum of an associate's degree from an accredited JRCERT institution.**

Image 1.2 is an example of radiologic technologist performing onsite images during surgery using state of the art machines called C-ARM

Image 1.3 Radiologic Technologist working through the pandemic

Results

Image 1.1 show our online survey results

- **90% of the public that participated had an x-ray done**
- **80% said Rad Techs should know A&P**
- **15% said Rad Techs should know physics**
- **25% said Rad Techs should know pathology**
- **60% said Rad Techs have a higher degree than Bachelor's**

Not included on the graph but also part of the survey results:

- **11% said Rad Techs are button pushers.**

When asked if this career is "easy", 11% agreed, 35% remained neutral, and 54% of participants disagreed

Fun fact only 16% said "Rad Tech" stands for radiologic technologist, which is the correct title

Image 1.2

Image 1.3

Conclusion

Radiologic Technologist before "pushing buttons" requires a whole chain of knowledge; from image evaluation, sectional anatomy, patient care and even pathophysiology. Radiologic technologist are medical professionals and should be treated with more respect and given more credit for the job that they do. A career in radiologic technology is in high demand and has great growth opportunity. One can explore other career paths such as Computed Tomography, Magnetic Resonance Imaging and Mammography. Upon completion of this research the results showed that majority of the public are truly unaware of who radiologic technologists are, what are their responsibilities entailed and the depth of knowledge needed.

Citation

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Refugees in the World

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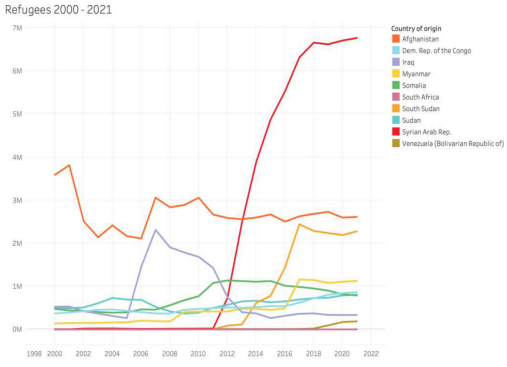
Abstract

There are millions of refugees all around the world today. Around 84 million refugees have been forcibly displaced worldwide as a result of persecution, conflict, war, violence or human rights violations. We are now witnessing the highest levels of displacement on record all around the world. In this project, we will investigate the origin of displacements, the reasons of displacements, and the hosting countries of refugees by analyzing data which is obtained from the United Nations of High Commissioner for Refugees (UNHCR).

Introduction

Refugees are people who have been forced to leave their country for various reasons like escaping from war, political conflict, violence, natural disaster, poverty, or persecution for reasons of race, religion, or association with a particular group. According to the United Nations, around 84 million people were forcibly displaced by 2021. Nearly 26.4 million refugees, around half of whom are under the age of 18. Also, 50.9 million refugees are internally displaced. Out of which 4.4 million refugees are asylum-seekers.

Displacement Trend Around the World

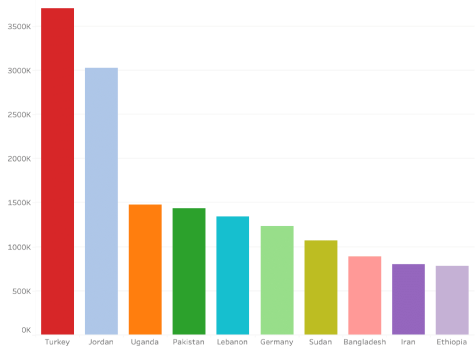


The trend lines indicate that the number of refugees increase when there's a war or political conflicts in a country.

Methodology

We obtained a dataset from UNHCR which contains the origin and the hosting countries of refugees from 2000 to 2021. The data is sourced primarily from governments and from UNHCR operations. We examined the data by creating trend lines and bar graphs of refugees from source countries that have the most displacements. Then, we looked at the hosting countries of refugees.

The Hosting Countries of Refugees



Most of the refugees, like 80% of them escape to one of the world's developing countries, usually to the closest neighboring country which has limited resources to offer aid. For instance, Uganda and Sudan are two of the leading refugee host countries in the world, but also, they're the least developed countries according to the Human Development Index (HDI). Even though wealthier, developed countries have a greater capacity to aid, accept, and incorporate refugees, the data indicates that they don't host much refugees.

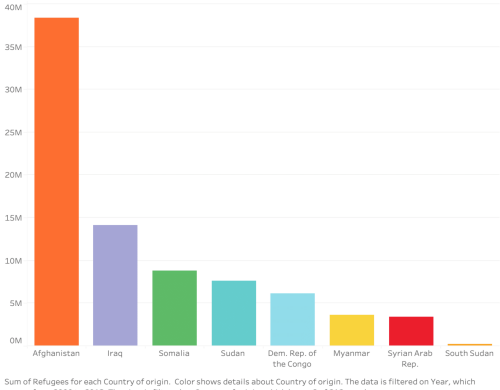
Top 10 Countries Hosting the Highest Number of International Refugees (mid-2021 data)	
Country	Number of Refugees 2021
Turkey	3,696,831
Jordan	3,027,729
Uganda	1,475,311
Pakistan	1,438,523
Lebanon	1,338,197
Germany	1,235,160
Sudan	1,068,339
Bangladesh	889,775
Iran	800,025
Ethiopia	782,896

Data Source: https://worldpopulationreview.com/country-rankings/refugees-by-country

Which countries do most refugees come from?

Because refugees flee their country for specific reasons like war, violence, and poverty, certain countries prone to these conditions generate more refugees than countries more stable. Most of the refugees originated from Syria, Afghanistan, South Sudan, Myanmar, and Venezuela.

2000-2013

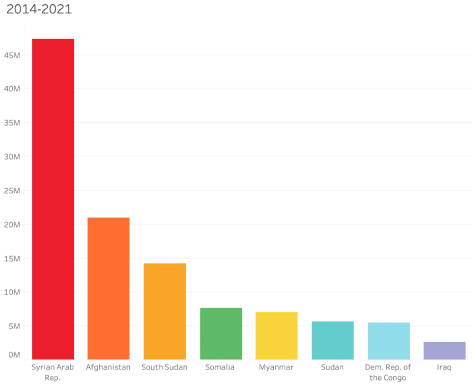


Nearly 40 million Afghans have been driven out of their country because of war, conflict, and poverty between 2000 – 2013.

Top 10 Origin Countries of Refugees (mid. 2021 data)	
Country	Number of Refugees 2021
Syria	6,761,560
Venezuela	3,944,279
Palestine	3,372,780
Afghanistan	2,610,067
South Sudan	2,277,919
Myanmar	1,127,588
Democratic Rep. of Congo	864,510
Sudan	805,874
Somalia	790,022
Central African Republic	713,262

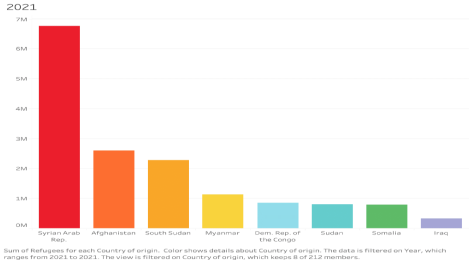
Data Source: https://worldpopulationreview.com/country-rankings/refugees-by-country

2014-2021



Due to the Syrian civil war, the most refugees have been generated from Syria.

2021



Notes:

The Education of refugee children has always been at risk. Close to half of all refugee children, 48 percent of them remain out of school. The data that was collected from 32 different countries shows that the pre-primary enrollment rate for refugee children is 34 percent. The percentage of refugees enrolled for higher education in college or university is much lower with the number being only 5 percent, up from 3 percent in 2020.

Conclusion/Future Work

The trend lines of data indicate that the number of refugees from countries that have war, violence, conflict, and famine is increasing. The leading countries in generating refugees are Syria and Afghanistan because of the war in those countries. The leading countries in hosting refugees are Turkey, Jordan, and followed by Uganda. The data indicates that most of the refugees are being hosted by the least developed countries.

In the future, we would like to investigate the refugees who have fled from Venezuela, Palestine, and Ukraine and we will study the hosting countries of those refugees.

Acknowledgments

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It's funded by The Robin Hood Foundation grant focusing on incoming first semester/freshman students.

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“An Analysis of Non-Comparison Based Sorting Algorithms”

By: Jacob Gomez , Edgar Aponte, Prof. Brad Isaacson

Abstract

Sorting algorithms put elements of a list into an order (e.g., numerical, alphabetical). Sorting is an important problem because a nontrivial percentage of all computing resources are devoted to sorting all kinds of lists. For our project, we implemented two non-comparison based sorting algorithms from pseudocode and compared them to various comparison based sorting algorithms. The two algorithms have their advantages and disadvantages as well as their unique features. We found that Radix Sort (which is a modified version of Counting Sort) was the most efficient of them all.

Introduction

Many sorting algorithms have been invented for sorting. They are either comparison based or non-comparison based. Their relative advantages and disadvantages have been studied extensively.

A comparison based sorting algorithm runs the elements through a single abstract comparison operation (usually a "less than or equal to" operator) that determines which of two elements should occur first in the final sorted list. Such examples include Bubble Sort, Insertion Sort, Mergesort, Heapsort, Timsort, and Intro Sort.

Non-comparison based sorting algorithms, on the other hand, are sorting algorithms which are not comparison based. Examples include Counting Sort and Radix Sort.

In this poster, we chose to discuss the non-comparison based sorting algorithms Counting Sort and Radix Sort. These are straightforward algorithms in which all Computer Science and Applied Mathematics majors should be able to learn. Counting Sort is a linear sorting algorithm that sorts in *O(n+k)* time when elements are in the range from 1 to *k*. Radix Sort uses Counting Sort as a subroutine to sort.

For our project, we created an application which included these two sorting algorithms. We analyzed the running times of these sorting algorithms with various sets of unsorted data. Through this process, we gained a better understanding of these two sorting algorithms and their worst-case time complexities. In conclusion, Radix Sort was the fastest and most efficient sorting algorithm we tested.

Process

The application we used to compile the algorithms was JDoodle. This is an online site where you can run and write out different languages of code like Java, C++, Python and many more. The only limitation on this site is the amount of memory you’re given, so printing large arrays causes run-time errors. Nonetheless, we were able to calculate the running time for the sorting algorithms we implemented. Although we tested various inputs, we preferred to use randomly generated lists of 10,000 integers from 0 to 9, 10,000 integers from 0-999,999, and 50,000 integers from 0 to 999,999. The pseudocodes for the 2 non-comparison based sorting algorithms we implemented, Counting Sort and Radix Sort, can be found on the right side of this poster.

Discussion

Based on the results, we found that Radix Sort was the fastest and most efficient sorting algorithm. We found that Counting Sort was one of the slowest and least efficient for lists containing a large range of values but when dealing with integers 0 to 9, Counting Sort was 2x faster than radix sort. Since Radix Sort was the fastest algorithm we tested in all of our experiments, our findings are consistent with Radix Sort being used as the non-comparison based sorting algorithm industry standard.

Counting Sort

```
function CountingSort(input, k)

    count ← array of k + 1 zeros
    output ← array of same length as input

    for i = 0 to length(input) - 1 do
        j = key(input[i])
        count[j] += 1

    for i = 1 to k do
        count[i] += count[i - 1]

    for i = length(input) - 1 downto 0 do
        j = key(input[i])
        count[j] -= 1
        output[count[j]] = input[i]

    return output
```

- Counting Sort is a non-comparison based algorithm that collects objects according to keys (like hashing). The way it operates is by determining the position for each key value in the output sequence by counting the number of objects with distinct key values. When using counting sort, the input of the soon-to-be sorted array is a simple sequence of integers itself. It's efficient if the range of input data is not significantly greater than the number of objects to be sorted. It's very fast when dealing with arrays containing a small range of values and has a worst-case running time that is linear to the input size.

Radix Sort Using Counting Sort

```
Radix-Sort(A, d)
//It works same as counting sort for d number of passes.
//Each key in A[1..n] is a d-digit integer.
//(Digits are numbered 1 to d from right to left.)
    for j = 1 to d do
        //A[]-- Initial Array to Sort
        int count[10] = {0};
        //Store the count of "keys" in count[]
        //key- it is number at digit place j
        for i = 0 to n do
         count[key of(A[i]) in pass j]++
        for k = 1 to 10 do
         count[k] = count[k] + count[k-1]
        //Build the resulting array by checking
        //new position of A[i] from count[k]
        for i = n-1 downto 0 do
         result[ count[key of(A[i])] ] = A[j]
         count[key of(A[i])]--
        //Now main array A[] contains sorted numbers
        //according to current digit place
        for i=0 to n do
          A[i] = result[i]
    end for(j)
end func
```

- The idea of Radix Sort is to do a digit-by-digit sort starting from least significant digit to most significant digit. Radix Sort uses Counting Sort as a subroutine to sort (although not apparent from the pseudocode provided). This algorithm takes advantage of the fact that any number in the decimal system can be represented by digits from 0 to 9. So in this algorithm, we perform a Counting Sort with 10 keys in every pass for a total of *ceil(log_{10}(max_element))* number of passes. For example, if we were sorting a list whose elements are in the range of 0 through 999,999, Radix Sort would be executing a Counting Sort with 10 keys five times: once for the ones digit, tens digit, hundreds digit, thousands digit, and ten-thousands digit. This algorithm employs the linked list data structure which is a linear collection of data elements not given by their physical placement in memory. The issue with linked lists is that it requires a lot of memory allocation and deallocation which slows the algorithm down. This algorithm is slower than comparison based algorithms for smaller sized lists due to the aforementioned overhead, but superior for larger sized lists. The worst-case running time of Radix Sort is linear to the input size of the list.

Results

We tested 4 sorting algorithms:

(i) Comparison based:

(1) Timsort, (2) Intro Sort,

(ii) Non-Comparison based:

(3) Counting Sort, (4) Radix Sort using Counting Sort.

Below are the running times of the 4 sorting algorithms using randomly generated unsorted lists of (1) 10,000 integers whose values are between 0 and 9, (2) 10,000 integers whose values are between 0 and 999,999, and (3) 50,000 integers whose values are between 0 and 999,999. Each box corresponds to the same input.

10,000 Elements (Integers 0-9)

```
Time Shown 0.04924464225769043 seconds (Tim sort)
Time Shown 0.03343319892883301 seconds (Intro sort)
Time Shown 0.006261348724365234 seconds (Radix sort)
Time Shown 0.0034852027893066406 seconds (Counting sort)
```

```
Time Shown 0.04634857177734375 seconds (Tim sort)
Time Shown 0.033632755279541016 seconds (Intro sort)
Time Shown 0.006282806396484375 seconds (Radix sort)
Time Shown 0.0035185813903808594 seconds (Counting sort)
```

10,000 Elements (Integers 0-999,999)

```
Time Shown 0.19681119918823242 seconds (Counting sort)
Time Shown 0.051963090896606445 seconds (Tim sort)
Time Shown 0.042730093002319336 seconds (Intro sort)
Time Shown 0.03761935234069824 seconds (Radix sort)
```

```
Time Shown 0.20296931266784668 seconds (Counting sort)
Time Shown 0.05223226547241211 seconds (Tim sort)
Time Shown 0.0399172306060791 seconds (Intro sort)
Time Shown 0.03919267654418945 seconds (Radix sort)
```

50,000 Elements (Integers 0 – 999,999)

```
Time Shown 0.34042906761169434 seconds (Tim sort)
Time Shown 0.26348209381103516 seconds (Counting sort)
Time Shown 0.24551963806152344 seconds (Intro sort)
Time Shown 0.22077488899230957 seconds (Radix sort)
```

```
Time Shown 0.40522193908691406 seconds (Tim sort)
Time Shown 0.2821061611175537 seconds (Counting sort)
Time Shown 0.2418227195739746 seconds (Intro sort)
Time Shown 0.23436379432678223 seconds (Radix sort)
```

Code Cyber: A Curated Collection of Cyber Security Sources

Kazi Tasin, Mohammed Zaman, Ethan Pruzhansky, Jason Lin, Tanvir Rahman
Mentor: Professor Patrick Slattery

Introduction

For our research, we established a website to teach the public on five different aspects of cybersecurity, based on the NIST standard for identifying, protecting, detecting, responding to, and recovering from cyber attacks. By educating the public on these five critical issues, they will have a better understanding of how the industry protects their devices from cyber threats and viruses.

Objectives

- This website's purpose is to educate the public about cybersecurity. If someone has a question about cybersecurity and would like it answered, they should visit our website.

Statistics Of Cybersecurity

According to our analysis, over 95% of all data breaches are the result of human error. This means that humans are particularly vulnerable to themselves. While you may believe that your computer's built-in security measures are sufficient, there are situations when they are ineffective and will fail to prevent a data breach.

Around 94% of all malware attacks come from emails, as some people don't realize they are clicking on shady links or falling into scams from emails. On average, cyber attacks happen every 39 seconds and it takes on average around 279 days to contain a data breach. This leaves about 9 months where attackers can steal data, and trade or sell your personal information on deep web markets.

Source: IBM Data Breach report of 2021[4]

Process Of The Website

We used various programming languages to develop our website, such as using Vs-code, Atoms, HTML, CSS, & Javascript. We also created a domain for our website. We spent hours focusing on the website graphics, and our website is made of high-resolution prints which help people navigate the website easily. We made various navigation bars for users, this way it will be easier for them to navigate, we also linked one HTML file to another HTML file, so that they can easily read and close the page. We faced various problems making the website, the first one was to make the mobile version of the website responsive, and we are still in process of making it compatible for every mobile device. We also faced difficulties controlling the navigation bar, and by using various methods we were able to resolve the issue.

Why use our site?

Our website is unique due to the fact that we are creating something that has never been done before. Yes, there are websites that teach you how to code and what it is. But there are not really any websites that teach you what the core of cybersecurity is. That is what our website is for.

What resources did we used in order to educate the public?

ISACA - We chose this because it helps people learn more about the IT industry and has multiple certificate courses to choose from.
NCPS- We chose this because the National Cybersecurity Protection System (NCPS) is an integrated system-of-systems that delivers a range of capabilities, such as intrusion detection, analytics, information sharing, and intrusion prevention. These capabilities provide a technological foundation that enables the Cybersecurity and Infrastructure Security Agency (CISA) to secure and defend the Federal Civilian Executive Branch (FCEB) agencies' information technology infrastructure against advanced cyber threats.
NCSA- We chose this because of its efforts to protect the federal ". gov" domain of civilian government networks and to collaborate with the private sector - the ".com" domain - to increase the security of critical networks.
IBM Security- chose IBM Security because it brings together powerful, industry-leading security software, analytics capabilities and deep.
CISCO- We chose this because it also provides free couches on cyber security and contains information on computer networking products.
NIST- We chose this because it helps people with businesses of all sizes better understand, manage, and reduce their cybersecurity risk and protect their networks and data.

Cybercrime is estimated to cost the entire world around 10.5 trillion dollars per year by 2025.[5]

Conclusions

Tips to help keep yourself safe:

- Don't click on shady links that you receive from SMS messages.
- Avoid giving personal information even on sites that seem safe, sometimes those links that you find on emails use different characters to trick you into thinking those are real actual sites
- Watch over your children or grandparents who are the most vulnerable to scams and various other cyber crime.

Additional Facts:

- Scams via the internet have increased due to the pandemic.
- Larger data breaches often result in the fact that it is less likely there will be a data breaches for companies in the future for the next two years.
- Human error accounts for around 23% of data breaches.
- Yahoo holds a record for the largest data breach with around Three billion compromised accounts.

REFERENCES

[1] Code Cyber Website: https://fancy-scone-434a23.netlify.app/
[2] NIST: https://www.nist.gov/
[3] Varonis: https://www.varonis.com/blog/data-breach-statistics
[4] IBM: https://www.ibm.com/security/data-breach
[5] Cybersecurity Ventures: https://cybersecurityventures.com/hackerpocalypse-cybercrime-report-2016/

ARCscholars - NYCHA

The Wagner Youth Center Renovation

Jason Voss (FX Collaborative LLC.) & Nina Lesser (Peter Gisolfi Associates)

Jeanpaul Montano, Scarlett Morales, Analyesia Calo, Hermione Thompson, Liverio Thompson, Jercanti Strachan

ABSTRACT

Who are we?

We are a diverse group of scholars ranging in age, gender, and background from all over New York City. We share a common interest in solving our urban challenges through studying and proposing improvements to the built environment. From professors at CUNY CITY TECH to NYCHA Design & Implementation specialists and NYCHA residents, we encompass a group of scholars united by this common purpose.

What are we here to accomplish?

This team of ARCscholars is working collaboratively, sharing lived experiences, creatively thinking & planning and applying our research discoveries to the proposed design interventions. We seek to address and combat critical issues to foster a measurable improvement in community health, understanding, and relationships. Through enhancing the community at large via housing equity and durability and beauty, we hope that the proposed design improvements will have a direct, indirect, and long-lasting positive effects on the NYCHA communities.

How are we doing it?

We have developed an architectural and urban proposal that will enhance the overall quality and design of our case study development: the NYCHA Wagner Houses in Manhattan. Our research included a comprehensive site investigation, multiple informative discussions with the Resident Leaders at the development, and an understanding of planning issues. We met weekly to analyze, discuss, and investigate architectural and urban concepts, and develop specific planning interventions. We also me in person twice to workshop ideas and establish close personal connections. Personal anecdotes from our NYCHA resident students helped inform the design strategy.

What have we found?

Our research informed us that our proposal should address the overall campus in addition to providing specific design interventions. The students were divided into three groups, based on their interests, and focused on three main categories of development: an overall site strategy, a reimagining of the senior center and a redesign of the youth center.

Youth Center

Throughout the process of improving the youth center we began discussing what were the key elements that we wanted to incorporate and how to make it more welcoming to the community. We wanted to enhance the use of the youth center by creating a tutoring center/ preschool as well as a café with a second level that would serve to the basketball court later. The tutoring center would benefit those who live in the area. The café would also work as a food distribution center. We hope that both the café and tutoring center would be economically affordable for those who need the resources.

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Cafe: https://www.timeout.com/newyork/restaurants/best-coffee-shops-in-new-york

EXISTING CONDITIONS

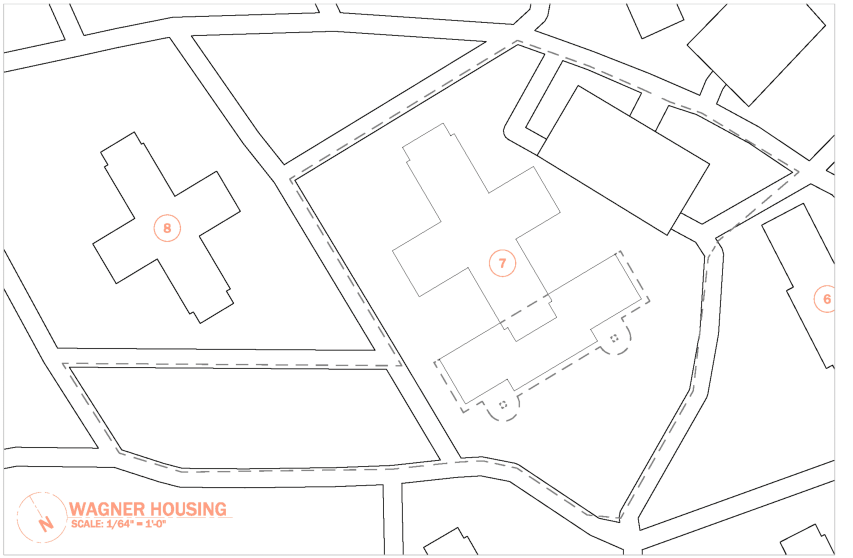
During our site visit we realized the disconnect between the youth center and the basketball court. It was strange to see only one bleacher on the side of the basketball court. As for the youth center from what we noticed was fenced and boarded up and could not see the interior but fortunately we noticed how it has the potential to be renovated and repurposed.

PRECEDENTS

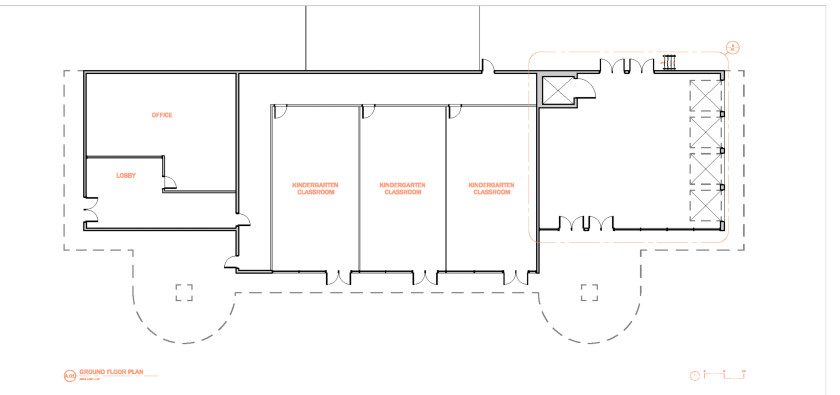
YOUTH CENTER PROPOSAL

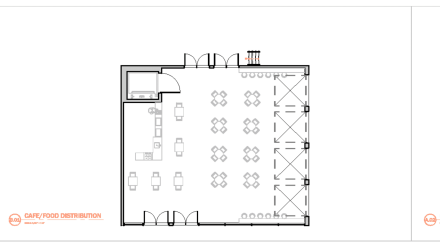
Our proposal for the renovation of the existing Wagner Youth Center will advocate for a new and elegant design, introducing larger windows, which will allow for better natural lighting and ventilation. Our goal was to reconnect the younger and older generation, giving the opportunity for the community to connect without sectioning the area integrating the basketball and the newly constructed open space.

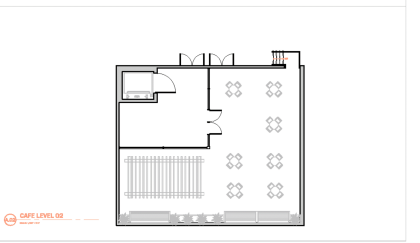
SITE PLAN



GROUND FLOOR PLAN







Augmented Reality Collaboration with Membit.Co

Authors
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Communication Design
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Abstract

Augmented Reality is an emerging medium for visual art and technology that superimposes a computer-generated image over a user's view of the real world. This emerging form of communication enhances the physical world through various technological elements such as audio and visual. AR has evolved from a science fiction concept to a tangible method of design and communication. Through our research, we explored how shared experiences or memories were accessed using this new media and how it was different and distinct. We utilized the AR application Membit™, "a geolocative augmented reality (AR) storytelling platform for iOS," developed and co-founded by Professor Jay Van Buren. AR is the future of the digital experience; combining aspects of the physical and digital world opens the door for accessibility and larger scales of effective communication.

Introduction

Membit collaborated with the Shops at Hudson Yards to launch a virtual Easter Egg Hunt. The user utilizes clues in the channel to locate hidden eggs throughout the mall in order to get a percentage off their purchase at Dylan's Candy Bar. The research group was tasked with testing the user experience and interface design of the app. The egg hunt spanned multiple floors, indoor and outdoor environments, and superimposed 3D objects onto the surroundings.

Additionally, the research group created assets and tested Richard Humann's "Ascension" project collaboration with Membit. Using twelve imaginary constellations suspended in the sky over the High Line, Richard Humann's AR installation merges an alternate universe within our own. Inspired by Greek mythology, Richard created modern-day folklore using 20th-century figureheads and key events such as World War 2 and Elvis Presley. The research group created an effective channel button and an informational screen to communicate and grab users' attention.

Methods and Materials

To conduct our research as well as create the assests needed for the Richard Humann "Ascension" collaboration we used the following components:

- iPhone or iPad with camera
- App store to download the Membit application
- Adobe Illustrator
- Adobe Photoshop

Discovery

Our results were possible with a well-laid plan that guided us along the sidewalk of the High Line by Hudson Yards. This allowed each of us to test and work on two constellations that show up in the sky when viewed through the Membit application. The images on the right show examples of how the constellations are displayed. With the Membit application, we could get the distance we wanted by making the constellations appear further away by adding some depth and adjusting the constellation to the ideal size for viewing. Working collaboratively, we were able to achieve great results.

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Pain Communication or Absence Thereof in Diseased White Matter Tracts in Neurodegenerative Brain

Neuroinflammation in the white matter can be utilized as an early marker for the prediction of cognitive decline AD during aging. White matter is enriched with microglia cells (immune cells of the nervous system). The gene of interest is CD36 which has shown mutations on microglial cells. This mutation will then produce a hyperactivation causing effects of pro-inflammatory conditions such as Alzheimer's Disease. Microglia induced neuroinflammation is predominant in the white matter of aging- and brains. Alzheimer's Disease has an accumulation of beta-amyloid plaques and neurofibrillary tangles composed of tau amyloid fibrils associated with synapse loss and neurodegeneration leading to memory loss and other neurodegenerative anomalies. There exist cellular diffusion abnormality in cerebral white matter where key areas suffer from atrophy and poor white matter connectivity. In this analysis we provide evidence in how the neuroinflammation in white matter has a linkage to AD. Other key points mentioned in this analysis is the use of functional magnetic resonance imaging. Fmri can provide a deeper understanding of the brain's connectivity in the white matter. We conclude the use of FMRI can bring longevity in patient overall pain level, specifically in the case of mild AD patients. The pain level will most probably be increased as the disease progresses.

Keywords: Pain communication, white matter tracts, neurodegenerative brain, atrophy, MRI, FMRI

INTRODUCTION

* In elderly patient's chronic pain aggravates AD pathogenesis through dysfunction of LC-NE signaling and subsequent microglial activation-induced neuroinflammation.
* Microglia Inflammatory activation starts in the white matter region in middle-aged subjects' postmortem and PET analysis. [1]
* Neuroimaging studies have shown that Alzheimer's Disease patients with increased neural activity with noxious stimulation, even when pain areas are diminished.
* During noxious pressure stimulation in the sensory, affective, and cognitive areas such as the dorsolateral prefrontal cortex (dlPFC), there was a spike in the blood oxygenation level dependent (BOLD) signals in patients.
* There is evidence of increased functional connectivity between the dlPFC and anterior midcingulate, periaqueductal grey (PAG), thalamus, and hypothalamus regions of the brain.
* The dlPFC plays an important role in general cognitive function and pain management. [2]
* Neuroimaging studies have implicated micro- and macrostructural abnormalities in white matter in the risk and progression of AD,
* In addition to the neuronal loss characteristic of the disease, white matter degeneration and demyelination may be important pathophysiological features. [3]

METHOD

First, we were able to utilize research-based projects from meta-analysis acquisitions. Second, we perused through a few articles by using the keywords provided in the abstract, while combining biology and neuroimaging studies.

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2. Raj, D., Et al. (2017, June 30). *Increased White Matter Inflammation In Aging-and Alzheimer's Disease Brain*. Frontiers In Molecular Neuroscience.
3. Cao, S., Et al. (2019, November 6). *The Link Between Chronic Pain and Alzheimer's Disease*. Journal of Neuroinflammation. Retrieved May 1, 2022.

RESULTS

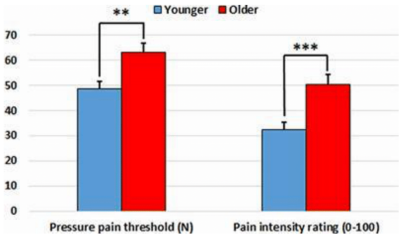
* An increase gene expression belonged to antigen presentation, interferon signaling and cytokine signaling.
* Gene expression in aged microglia showed inflammation.
* IBA1 and CD45 were stained in microglia were found in white and gray matter.
* Lysosomes that had the CD68 protein, were noted in white matter microglia in the corpus callosum, cerebellar white matter, and cortical white matter. [1]

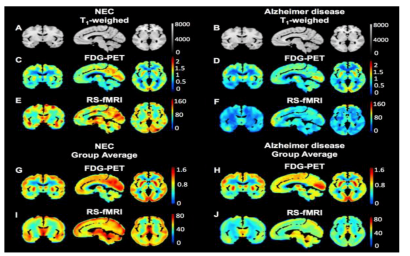
Neuroinflammation in the Human Brain Starts during Middle Age in White Matter Regions:

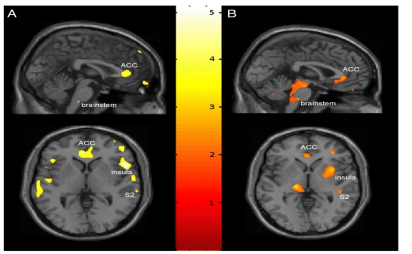
* There is increasing emotional reactivity and pain processing noted in neuroimaging studies.
* Maladaptation of pain networks were presented even in the early stages of disease compared to healthy subjects in Functional Magnetic Resonance Imaging (F-MRI).
* In the somatosensory cortex, cerebellum, and caudal pons is where the increased pain-related BOLD activation was located.
* There are lower pain modulation regions in the dlPFC, dorsal ACC, and subgenual ACC in patients with Parkinson's Disease than healthy subjects.
* Connections between dorsal ACC and dlPFC during pain anticipation were reduced.
* Increased pain-related activation with sensory-discriminative and cognitive-affective regions in Positron Emission Tomography (PET) scans were regulated. [2]

Brain region	Young average	Young SD	Middle-aged average	Middle-aged SD	*P*-value
Amygdala	1.42	0.35	1.79	0.37	0.090
Basal ganglia	1.26	0.21	1.65	0.73	0.236
Cerebellum	0.92	0.19	1.47	1.06	0.242
Cingulum	1.21	0.32	1.52	0.59	0.278
Frontal cortex	1.55	0.65	1.82	1.13	0.591
Hippocampus	1.14	0.29	1.47	0.39	0.094
Insula	1.04	0.13	1.19	0.29	0.228
Occipital cortex	1.68	0.81	1.36	0.28	0.381
Parietal cortex	1.72	0.88	1.28	0.22	0.262
Temporal cortex	1.05	0.28	1.21	0.21	0.279
Thalamus	1.04	0.27	1.16	0.42	0.566
Mesencephalon	1.51	0.51	2.05	1.23	0.307
Pons	1.31	0.37	1.89	0.59	0.051
Corpus callosum_total	2.69	0.92	3.64	0.63	0.045
Corpus callosum_trunk	2.31	0.72	3.14	0.51	0.038
Corpus callosum_splenium	3.52	1.16	4.34	1.23	0.223
Corpus callosum_genu	2.79	1.03	4.42	1.99	0.078
White matter	1.73	0.90	1.79	0.40	0.829

Figure 2: Table showing the binding potential of [11C]-PK11195 in young and middle-aged brains.







DISCUSSION

* White matter hypersensitivity affects the areas of the brain differently.
* The area of interested in patients with Alzheimer's are in the spinothalamic tract
* It is responsible for the transmission of pain, temperature, and crude touch to the somatosensory region of the thalamus which can lead to an increase in pain to the brain.
* One reason for brain changes is the occurrence of Alzheimer's disease.
* As the brain ages, the functions will decrease simultaneously.
* The main areas featured in Alzheimer's disease are frontal and parietal lobes which are responsible for voluntary movement and messages to the control center of the brain.
* Recent studies have shown patterns of age related predominant subcortical atrophy.
* The white matter of the brain has been a key to detecting correlations between white matter atrophy and cognitive decline. [3]
* The ROI areas are the frontal cortex, occipital cortex, parietal cortex, temporal cortex, cerebellum, hippocampus, thalamus, basal ganglia, mesencephalon, pons, and corpus callosum.
* There is a translocator protein (TSPO) used in PET scans called the radioactive ligand [11C]-PK11195 and it is in the glial cell outer mitochondrial membrane.
* White matter pathology was observed in the study collection which pointed white matter atrophy in EOAD patients in the genu, body, and the splenium of the corpus callosum, fornix, and main anterior-posterior pathways.
* Diffusion Tensor Imaging MRI illustrated minute changes in the white matter tracts in Alzheimer's Disease patients.
* White matter abnormalities can be an early indication that is initiated before gray matter atrophy in EOAD. [2]

ACKNOWLEDGEMENTS

Expressed gratitude to the Emerging Scholars Program who has been immensely helpful to guide us through the steps of the research and poster presentation.

Researcher Reflexivity on the First Year Transition to College During Pandemic Times

Undergraduate Researchers: Katelyn Lopez, Kamara Smith, Asset Mballo
Faculty Mentors:
Mery Diaz, Associate Professor in the Human Services Department
Karen Goodlad, Interim Chair and Associate Professor in the Hospitality Department

Abstract

This semester, we participated in the "Our Stories" qualitative research project that involves learning more about students' first year, and first-semester experiences at City Tech during pandemic times. As we organized and read students' posts, we journaled and practiced reflexivity, a qualitative research process that helps us examine how we are interpreting the data that we are engaging with. T Reflexivity is a process in qualitative research involving frequent examination of one's position in the project. These positions include one's assumptions, feelings, and so forth. An essential question for qualitative researchers, according to Leavy (2011), is "Has the researcher engaged in an ongoing process of reflexivity?" (Leavy, 2011. P. 140). The following is an exploration of our use of the reflexive journaling process for the "Our Stories" project and our initial interpretations of the first-year student narratives about their experiences during pandemic times.

Time Management and Motivation

"X Student also spoke of the hardship of remote learning because of the lack of social interaction and motivation because of the lack of discipline."

"The problems of scheduling, and organization of time management is extremely important. I would agree that a planner is a great way to organize not only schoolwork like homework but also life events"

Asking for Help

"Added that it was also a struggle because she had to solve her problems on her own. This is something I experienced in my first semester as well. Not even because I couldn't ask for help but I felt this is adulthood and that is what comes with it. But it definitely can be overwhelming.

Reflecting on First-Year Transition Experiences During the Pandemic

As undergraduate researchers, helped to organize and began to engage with student narratives posted on the Open Lab "Our Stories" page during the Fall of 2021. As we began to organize students' stories, we also engaged in the process of reflexivity thinking about how we were interpreting their stories. We read many of the 35. Similar to the students who participated in the "Our Stories" reflective writing project, we then responded to a reflective journal prompt at the beginning of the semester and toward the end of the semester project. : As I am working on organizing the student posts, and beginning to code and interpret what they mean, this is how I am thinking about their first-year experience during the pandemic and this is how my experience compares with theirs."

Why Reflexivity in Qualitative Research Matters

Reflexivity is a process in qualitative research involving frequent examination of one's position in the project. These positions include one's assumptions, feelings, and so forth. An essential question for qualitative researchers, according to Leavy (2011), is "Has the researcher engaged in an ongoing process of reflexivity?" (Leavy, 2011. P. 140). This process stems from Black and indigenous feminist standpoint theory and feminist social constructivism, which noted the significance of critically examining who is conducting research, toward what end, and how these ends reflect the "truth" (Absolon, 2011; Collins, 2000 hooks, 1990; Tuck & Yang, 2014; Wigginton & Lafrance, 2019 Tuck & Yang, 2014). Moreover, these critical researchers, highlight that the "self" is essential in interpreting research, objectivity, and neutrality are neither feasible nor desirable. Dogson writes,
"The researcher is the research instrument'. Therefore, we as readers of qualitative research need to understand who is doing the research in ways that go beyond their name and professional affiliations to include the researcher's positionality in relation to what is being studied" (Dogson, 2019, p.1).

Technology

" Personally, for me I haven't been a freshman in years but my experience was completely different, all of my classes were in person and there was barely any online work given beside the every now and then essays that had to be submitted through Blackboard. For these students in the year of 2021 many of the classes were online and these individuals struggled with remembering the various online websites that the professors used"
All across the board all students spoke on the intensive assignments and projects. That is my personal only hardship of college just because it is time consuming and very much becomes overwhelming some weeks and could really discourage you... I had a problem with blackboard collaborate through no fault of my own. Somebody just assumed I had used it before

Our Reflections

The following are examples of our reflections on the student stories that we were reading:
Connecting
"Since the classes were online there was less engagement between professors and students and of the interaction of student with students. This made it hard to be able to make new friends and focused on a more studious relationship with the classes. For me being back in classes now I can definitely relate on how these online courses can hinder having relationships with others. Everyone is more focused on the class work that has to be submitted and negate even trying to get to know someone'

"These students also encountered building a friendship to be difficult. Due to the classes being online there wasn't much interaction between classmates unless it was by joining a club or being invited to a class text group chat. Toward the end of the semester, the students felt more confident in their schooling and were looking forward to their following semester."

"I felt the same way about remote learning in the sense of the lack of human interaction like making friends because I'm a very social person and I was robbed of my last 2 years of highschool due to schools closing and was looking forward to meeting new people. but my experience with doing work and going to class while remote made me prefer it."

Discussion and Conclusion

The process of reflexivity helps us understand more about how our personal experiences overlapped with the experiences of the students whose stories we were reading. A lot of the time we were able to think through possible suggestions and tips we would give students to overcome the challenges they were sharing because we had been through the same challenges. Other times we noticed that we had not had the same experiences at all, or that we had these experiences later in our time at City Tech, so we were prepared in different ways. As we go forward on this project we will continue to engage in reflexivity, unpacking more about our interpretations of the data and how this will influence the stories we tell with the data.

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Art and Mathematics meet at the Edge of Chaos

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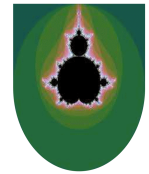
Department of Applied Mathematics



ABSTRACT

We will investigate iterative mappings in the complex plane, study orbits and create fractals. Fractals are objects which are self similar and infinitely replicating. Some of this work trace its origins to the 1800's but became useful and important in modern studies as computers became more advanced. Some special sets that will be examined are Julia and Mandelbrot. We will use computer simulations, theoretical considerations and complex analysis to better understand and extend work on the special sets. We will also discuss practical applications of our work. Our research will culminate with a study of the underlying chaos that is present in these systems and touch upon chaotic dynamical systems.

INTRODUCTION

Fractals are recursive, self-similar patterns generated by iterative processes in dynamic systems. Beginning with a set of non-integer numbers {M,N}, fractal models continue to duplicate their original composition under infinite magnification of their dimensions D, where:

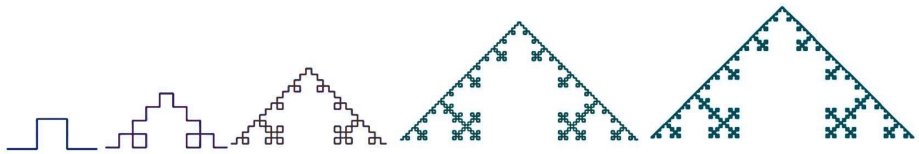
$$D = \frac{\log(M)}{\log(N)}$$

Fractal sets, such as those developed by Gaston Julia in 1918, and Benoit Mandelbrot in 1977, gained traction in the early twentieth century as a potential tool for surveying real world structures that exhibit the chaotic twin properties of "complexity and unpredictability", such as meteorological systems and stock market trends. (Field, ix)

OIL SPILL TRAJECTORY

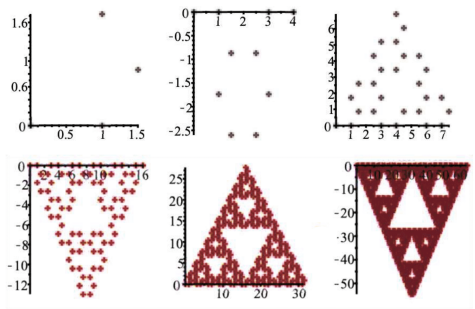
Benoit Mandelbrot first noted the topographical similarities of fractal sets and the natural environment in 1983 with a term coined 'fractal geography.' Oceanographic researchers have since developed technologies which marry these patterns to complex surface systems such as coastlines and ocean currents. Fractal mapping has found utility in modeling oil spill trajectories via computer simulation of the Julia Set of $z_i = z_{i-1}^2 + zc$ generated by Maple Software in the fractal spiral image to the left, which may assist in the prediction of spill trajectory by discriminating between textural features of "oil spills, look-alikes and surrounding sea surface waters." (Marghany et al, 240)

$$f(z) = z^2 + 0.360284 + 0.100376i$$



THE KOCH SNOWFLAKE

The Koch curve was first described in 1904 by mathematician Helge von Koch, who outlined the methodology for replicating a self-similar structure on a limitless scale. The resulting outline above delineates the namesake, although the Koch snowflake also exhibits a singular peculiarity in that it is "a curve of infinite length surrounding a finite area. . . that has a tangent line nowhere." (Edgar, 36)

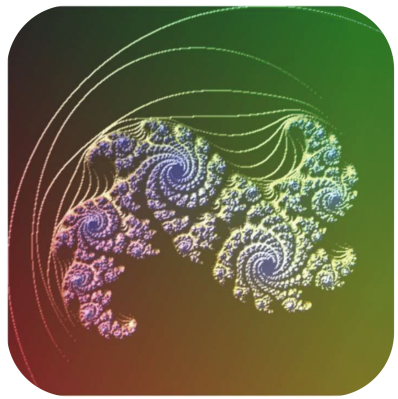


SIERPINSKI'S TRIANGLE

In 1915, Wadaw Sierpinski defined properties of equilateral triangles which, through the iterative process of interior perforations with scaled down triangles of equal dimensions, would produce a 'sieve-like' structure. Magnified on all scales, will continue to duplicate the same tessellating. (Devaney, 130)

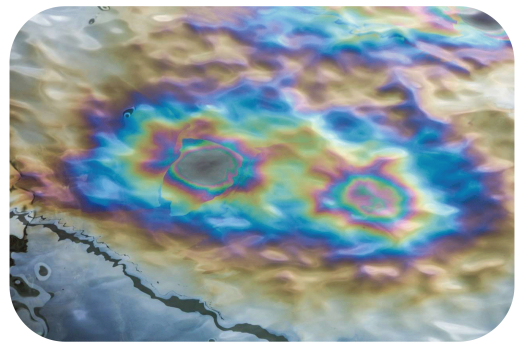
SIERPINSKI'S GASKET IN NATURE

The Cone Shell is exquisite evidence of Sierpinski's gasket in nature. "The onset of chaotic behavior follows the same general pattern, that of gradual change followed by a sudden transition." (Pritchard 25)



FRACTAL SPIRALS

Generated by Maple software.



USS ARIZONA LEAKAGE

The USS Arizona sank in the bombing of Pearl Harbor in 1941. According to the History.com it has leaked roughly 9 quarts of oil a day since and it is estimated this will continue with the 500,000 gallons remaining for 500 more years.

CHAOS THEORY AND THE STOCK MARKET

If you have ever heard the saying "If a butterfly flaps it wings in the Amazonian jungle, a storm ravages through Europe", this springs from Chaos Theory. The concept is that a small event can have great unexpected consequences. Mandelbrot applied fractal and Chaos Theory to understanding one of the most complicated systems, the Stock Market. Options are a tool that allow a trader the option to buy or sell a commodity at a certain time and price. Pricing these options is complicated and there are several methods, the most well known is Black-Scholes-Merton. This method relies on the volatility of the stock market being constant and that prices fluctuate along the bell curve. Mandelbrot suggests that the markets are turbulent and there are far too many butterfly's flapping their wings for accurate predictions. Methods to incorporate chaos and fine tune predictions and pricing have been made and are continually improved.

CONCLUSION

Fractals are remarkably visually appealing evidence of Chaos Theory. By studying fractals, we can gain knowledge of unpredictability and solve real world problems such as combatting damage from oil spills, interpretating the volatility of the stock markets to figuring out the way branches grow on a tree. Fractals are more than a hypnotic screensaver and by embracing chaos we can find ways of understanding our world and enriching our lives.

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Criminal Network Analysis

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Criminal Investigation and Network Analysis a DHS Center of Excellence

Abstract

In this project we analyzed connected criminal networks (CN). We used the spectral clustering method (SCM) to partition CN into clusters such that actors within a cluster are more connected to each other than between two different clusters. Moreover, we experimented on improving this partitioning using a combination of SCM and linkage-based density techniques (LbDT). While the CN was successfully partitioned based on SCM, the LbDT method with SCM did not improve the partitioning. Therefore, we tested this medley of two methods on two networks of different densities, and this resulted in improved partitions on the network with higher density. Prompted by this result, we experimented studying the effects of network densities on partitioning CN using the combined method of SCM and LbDT on various networks of different densities. This work can assist law enforcement personnel in evaluating which actors or criminals are more connected to each other, and thus help them to strategize an efficient plan for disruption.

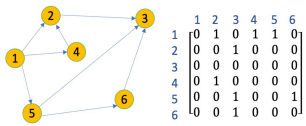
Method

1. Problem

How do we analyze a criminal network? Can we identify clusters within a network to better explore CN communication strategies and identify significant actors? Does the LbDT process further optimize SCM?

2. Adjacency Matrix of Directed Network

This model of a criminal network graph reads from the column to the nodes. The directed graph shows the flow of communication. Each node is a player, and each edge is communication.



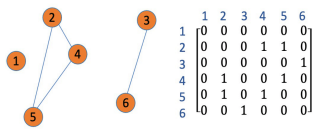
Directed Graph

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{bmatrix} 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Directed Matrix

3. Adjacency Matrix of Undirected Network

The undirected graph shows two directed edges between any two nodes that, in the directed graph, possess at least one directed edge. This shows the strength of communication.



Undirected Competition Graph

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

Undirected Competition Matrix

4. Compute Laplacian

A Laplacian matrix is a degree matrix subtracted by an adjacency matrix. It is defined by being symmetric and positive semi-definite. Each row and column sum to zero.

$$\begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{bmatrix} 0 & 2 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 2 & 0 & 0 \\ 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \end{array} - \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \end{bmatrix} \end{array} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \\ 6 \end{array}\begin{array}{c} \begin{array}{cccccc} 1 & 2 & 3 & 4 & 5 & 6 \end{array} \\ \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 0 & -1 & -1 & 0 \\ 0 & 0 & 1 & 0 & 0 & -1 \\ 0 & -1 & 0 & 2 & 1 & 0 \\ 0 & -1 & 0 & 0 & 2 & 0 \\ 0 & 0 & -1 & 0 & 0 & 1 \end{bmatrix} \end{array}$$

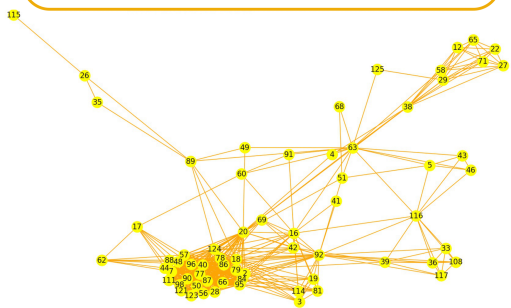
Adjacency Matrix — Degree Matrix = Laplacian Matrix

5. Find Fiedler Order

The second smallest Laplacian Eigenvalue, the Fiedler vector, tells us the Algebraic Connectivity and measures the connectivity of the graph.

6. Data Collection

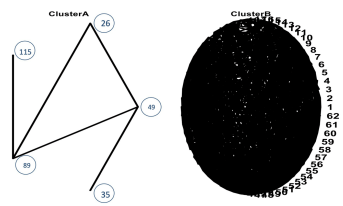
Data was collected from a known drug trafficking network based in New South Wales, Australia (Ciel Network). Information was based off a previous published network. (Bright et. al. 2015)



Ciel Criminal Network

7. Partition Based on Spectral Clustering

The Eigenvector is partitioned into two clusters, non-negative and less than zero.



8. Calculate Objective Function Value

The M_cut formula further optimizes the clusters by minimizing the similarities between clusters and maximizing the similarities with the clusters.

cut(A,B) = W(A,B) where W(A,B)=

$$\sum_{i\in A, j\in B} W_{i,j}\,, \qquad \mathrm{W(A)} = \mathrm{W(A,A)}$$

$$M_cut = \frac{cut(A,B)}{\mathrm{W(A)}} + \frac{cut(A,B)}{\mathrm{W(B)}}$$

The M-cut value for the clusters before linkage-based refinements is 0.6053.

9. Apply Linkage-Based Density

Linkage-based refinement measures each node individually by subtracting the similarities within one cluster to the other. Linkage-based density quantifies the fit of the individual node to the cluster.

l(u,A), l(u,B) =
similarity between individual node u and the cluster

$$\Delta\, l(\mathrm{u}) = l(\mathrm{u,A}) - l(\mathrm{u,B})$$

10. Calculate Objective Function Value

Nodes that have been identified through linkage-based density as a possible better fit are moved to the other cluster one by one and the M_cut is recalculated.

11. Has the Objective Function Value Improved?

The closer the M_cut is to zero, the more the nodes are a better for to each cluster. The table below shows the linkage difference, the new M_cut and whether the node should be kept in the new cluster or returned to its original.

Nodes	Linkage Difference	Original Cluster	New Mcut	Keep or Return?
9	0.0664	B	3.624	Return
11	0.1629	B	3.296	Return
37	0.1806	B	1.881	Return
66	0.07	B	3.286	Return

Conclusions

- Spectral clustering methods successfully partitioned the Ciel network in two different partitions based on their communication strength (see box 7).
- Linkage-based density techniques did not improve the partitions.
- We tested the method with more dense networks and the combination objective function value calculation and LbDT improved the partition of the spectral clustering method.
- With this knowledge an efficient disruption strategy can be applied by law enforcement by identifying key figures, their roles and how information moves.

Future Work

- Pairing of spectral clustering methods and and linkage-based density techniques can be tested on networks of various densities.
- This same method can be used to analyze sex trafficking, identity theft, the January 6th insurrection or any other type of clandestine organization.

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COVID-19 VACCINE MANDATE

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INTRODUCTION

The new SARS-CoV-2 coronavirus strain (also called COVID-19) has spread quickly throughout the world since the first case came across in December 2019 in Wuhan, China (Zhu et al., 2020). Moreover, COVID-19 pandemic has wreaked havoc on the planet and killed millions of people. Since the pandemic began, the COVID-19 cases among health care workers and radiology students have surged (Poyiadji et al., 2022). Vaccination need has largely increased with the pandemic. Moreover, vaccination is largely regarded as one of humanity's greatest medical accomplishments. Furthermore, vaccines have made diseases that were formerly ubiquitous in civilization relatively rare. Although science has proven time and time again that vaccines are here to help our safety and us, some people are still skeptic about them and refuse to be vaccinated. The objective of this study is to take input from health care workers and radiology students regarding COVID-19 vaccine safety and importance.

ABSTRACT

Since, COVID-19 has come, vaccine mandate has become the need of the time. But since the vaccines have come out, there is a public impetus to condemn these vaccines, based on the false assumption that the Covid-19 vaccines are not safe. One primary reason the COVID-19 vaccines are being viewed with skepticism is that they came out in short span and the fact that they have not been subjected to animal trials or been thoroughly tested in populations large enough to detect most side effects. The present study is designed to estimate the pro-vaccine attitudes among health care and radiology students regarding vaccine safety. This study is not only an important resource for patients and public education but holds significance for disproving any myths surrounding the vaccine.

Key Words: COVID-19, Vaccine, Questionnaire, Survey, Mandate

METHODOLOGY

A web-based cross-sectional study was conducted through utilizing online questionnaire. Moreover, Google forms were used to design the online questionnaire. The questionnaire's link was created and shared with the health care workers and radiology students via social media platforms. Electronic consent was obtained from the participants with an introductory section of the survey that included the purpose of the survey, volunteer participation, and declaration of confidentiality.The questionnaire included questions that asked about vaccine need, importance and associated misconceptions. The statistical package for the social sciences (SPSS) version 21.0 (IBM SPSS Statistics, New York, NY, USA) was used for the statistical analysis.

CONCLUSION

This study highlights the importance of vaccination to acquire greater protection against COVID-19 viruses so that surging incidence rate can be lowered down.

DISCUSSION

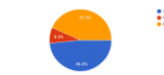
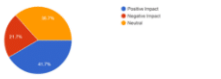
Results of this study show that almost the health care workers were fully vaccinated and majority were non-hesitant about being vaccinated. Also, majority stretched upon to take preventive measures before coming to the school. Also, the health workers and radiology students stretched upon the greater need to make the vaccine mandatory. This study has signified the importance of COVID-19 vaccine. The information provided through this survey is helpful for policy making and for framework design for population-specific management to reduce the COVID-19 vaccine-related misconceptions and promote the acceptance of the vaccine among the general public.

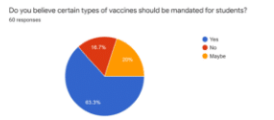
ACKNOWLEDGEMENTS

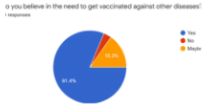
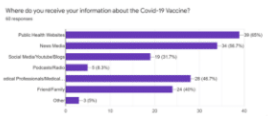
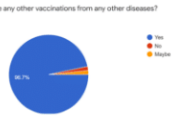
We want to thank our Mentor, Professor Zoya Vinokur for the completion of this project. Also, we want to thank our parents who have made our educational journey possible. We especially want to thank our colleagues for their worthy advice to make this project successful and up to the mark.

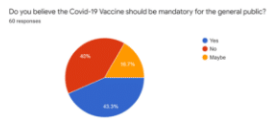
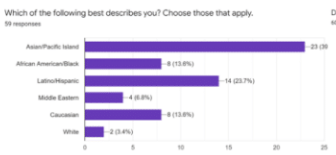
RESULTS

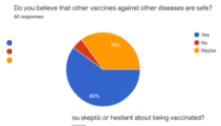
Radiology Students Survey

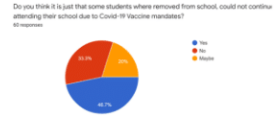



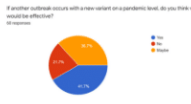
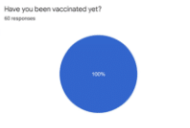


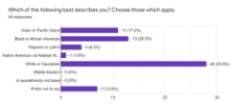
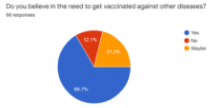
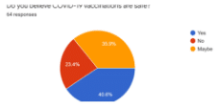



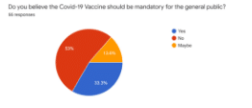
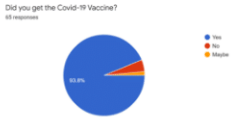
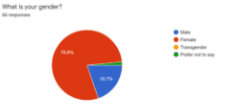
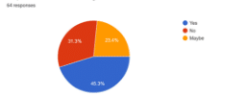
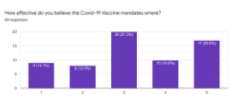


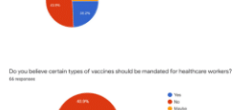


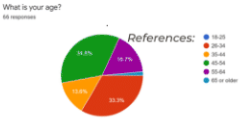
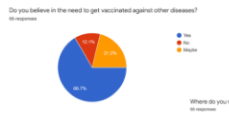
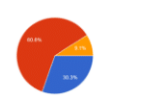
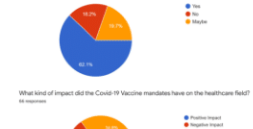
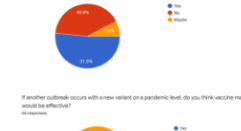
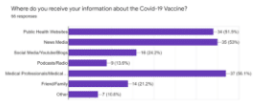



Health Care Workers Survey



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How has Covid-19 Impacted Dental Hygienists, other Dental Professionals and Students

Students: Nathaly Rojas and Dosyleny Arias

Advisor: Professor Susan Davide, RDH, MS, MSEd

Department of Dental Hygiene

Introduction

This research is a continuum to investigate how dentistry has been affected by Covid-19: employment, workplace disease transmission, use of personal protective equipment (PPE), and student learning.[3] Hesitancy among US dental hygienists to return to work has persisted, yet the dental care system has shown positive signs of recovery and continues some improvements in workplace safety and increased vaccination rates.[1-2,4] Most US dental hygienists always wear masks and eye protection during patient care and the use of N95 or equivalent respirators and additional infection control methods declined during 2021.[2] An online survey was offered to NYCCT students, faculty/staff, local dental community, and on social media platforms. The purpose was to determine if Covid-19 has negatively impacted dentistry and dental education.

Methods

1. CUNY Human Subject Research Exempt Status granted by the University Integrated Institutional Review Board (IRB); file # 2022-0170-NYCCT.

2. Using SurveyMonkey® platform, an introduction and voluntary consent to participate was included in a 10-question survey sent via City Tech email to future dental hygiene (DH) students, current DH students, alumni, faculty, restorative dentistry students and faculty, and via social media platforms using Instagram and TikTok, to local practicing dental hygienists. Two reminder emails were sent to increase participation and a QR code was provided for social media platforms for survey access.

3. Data results were analyzed using SurveyMonkey® platform reviewed and stored on this secure digital platform.

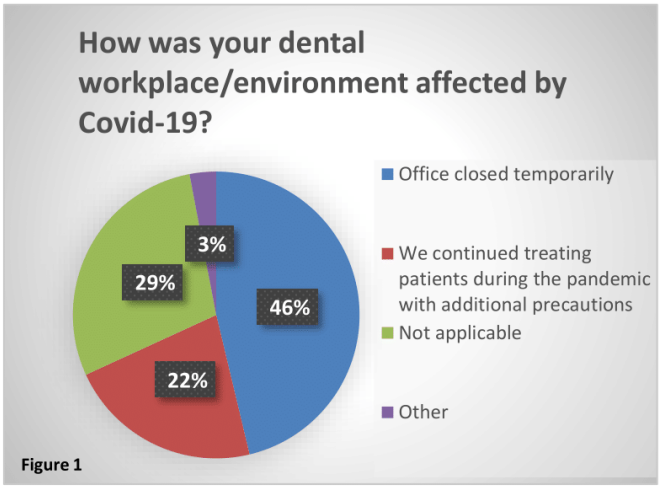

Figure 1

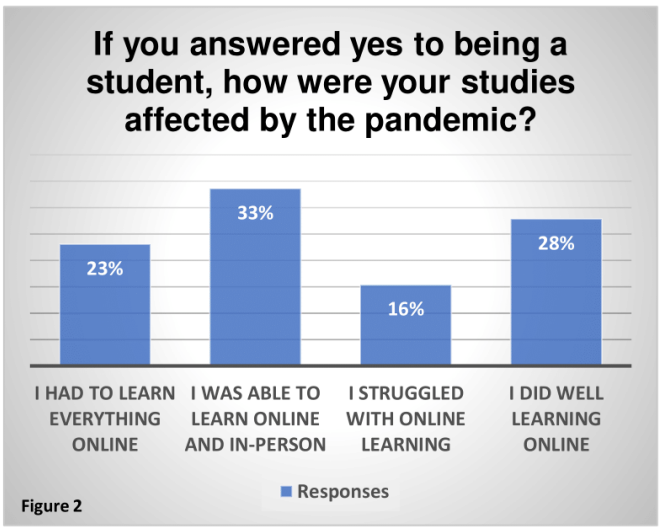

Figure 2

Results

- Of the 201 respondents (N=201), 53% are dental hygienists, 32% students*, 9% assistants, 3% dental lab technicians, and 3% dentists. Students* includes dental, DH, dental lab/restorative dentistry
- 46% of dental establishments were temporarily closed.
- 47% of patients have returned to receive treatment care.
- 74% of the dental practitioners did not contract Covid-19 while working during the pandemic.
- 60% of dental practitioners were wearing their PPE all the time even before Covid-19.
- 33% of students were able to learn online and in-person.
- 37% were unemployed 1-3 months during the height of pandemic.

Conclusion

The findings support how dentistry was affected; approximately three-quarters never contracted virus while working. Most students were affected with online learning and may have experienced difficulties with this learning modality. Over half were wearing PPE properly before the pandemic and a third indicated they did not wear properly yet are now. Covid-19 has changed dentistry, dental education and patient care with increased infection control techniques to prevent disease transmission.

Acknowledgements

We would like to express our thanks to Professor Davide, for her support and guidance throughout this research project.

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Compare how students performed and attendance before, during and after pandemic waves

Prof. Zoya Vinokur, Dept of Radiology Technology

Student Researchers: Peber DeJesus, Rohini Mattan, and Ralph Lauren Ocampo

Abstract

Covid-19 is a global pandemic that affected many people that includes students from all different parts of the world. In this case, the research would focus on the Radiologic Technology and Medical Imaging program students at New York City College of Technology, who must do hands-on learning in order to accomplish the experience required for the degree.

One of the hardest obstacles that radiologic students must go through are the ones that are unable to be online. One example of those required classes would be the Clinical Rotation. It is mandatory for the radiologic student to go to a required hospital site and complete the necessary hours and competency to get passing grades. The Radiologic Technology and Medical Imaging Radiology is a degree where students must deal with patients and have in-person contact in order to take the best diagnostic medical images. The covid-19 virus was spread to the whole United States and was announced a pandemic beginning in March of 2020.

It got to the top peak level of exposure in hospitals within that time. In order to gather the data that would be used in this research, surveys would be sent out to both Juniors and Seniors in the program. which would represent the answers to how the pandemic affected students. Comparisons are going to be made on how students did and attended through the pandemic and after the pandemic between juniors and seniors. Analysis of how Radiology tech students attended school before, throughout, and after the pandemic (when vaccines were out), are going to be further critiqued and explained.

Once the Surveys have been answered the research would create a data and graph that would be analyzed in order to compare the Attendance and Performance in the Year 2020 to the Year 2022 to see if there were any changes that affected the student during those pandemic years. This is continuous research as the Covid-19 Pandemic is still active as of this day.

Introduction

Many people around the world were affected in a variety of ways due to the COVID-19 pandemic. The pandemic forced many people to have to make changes or new adjustments in their lives that they wouldn't think would ever happen. Many workers had to switch from being in person to working online, which is an adjustment for people who didn't have a workstation at home or may not have a proper environment necessary to focus on what they need to get done. This also goes for students, many students had to switch to virtual learning, and some are still virtual. This was an adjustment for many especially people who are visual learners. On the other hand, many students still had to function through the pandemic in person. This goes for the students in the Radiologic Technology program at New York City College of Technology. Surveys were done to analyze the different experiences each student in the program had before, during, and after the pandemic. After being in person and virtual during the pandemic every student had a different learning experience and preference.

Methodology

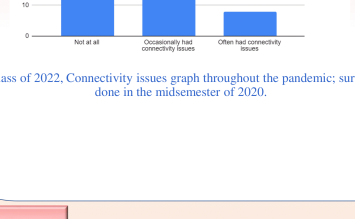
In order to compare differentiate the performance of the Junior Student and Senior Student in Radiology. The used of surveys is the most ideal scenario for this research study due to the facts that surveys have a high reliability, as it produce a similar results under the consistent conditions that we apply for both, Juniors and Seniors. Google Survey is the form that have been chosen to be used in this research. Since Google Surveys are known for their flexibility of creating a data that would be used for this research.

For us to acquired the results we need for both, Seniors and Juniors, we asked the professor of the Radiologic and Imaging department to send the surveys during class time. Having a professors sending the surveys during class time allows us to gain the response and data we need in more efficient way since many would answer it. Due to the facts, it may be part of the curriculum or can be graded by the professor. Which give the for both Juniors and Seniors surveys validity and reliability as the whole class answered it .

The moment the data have been collected for both Junior and Senior. Google Survey have a built-in tool to create a Graph, or a chart based on the response we received. In this research we would use the pie chart as it is more accurate to use the percentage since we can see the amount of student answers in percentage which would allows us to divide and review it. Once the pie graph is done, we would then compare the results to both Juniors and Seniors to see which of the two made a difference in terms of different environment.

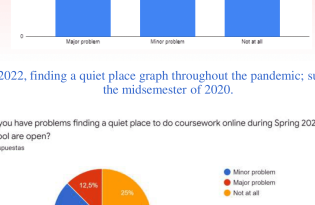
Results Senior Year

Seniors are students that have already gone through the three stages of pandemics; before, through and after. Class of 2022 when they started as juniors, they had to go to clinical even though in hospitals there was already a high rate of covid. Also, despite all their concerns about the pandemic, they made it through, they also continue forward by studying through the challenging exams that professors give in order to prepare them for the board exam. After the pandemic it was all getting better, but what was their comparison between the pandemic times when there were juniors compared to now when the pandemic is already over.

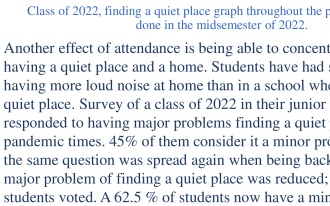


Class of 2022, Connectivity issues graph throughout the pandemic; survey done in the midsemester of 2020.

In their junior's year of the class of 2022, students had some attendance effect when there was attending online. One of them was internet connectivity. In a survey that was spread in Fall 2020 to juniors, in the mid-semester. 59% of students had occasionally had connectivity issues. 13% of students had often a connectivity issue. In total that makes 72% of students that had connectivity issues of some type leaving almost 28% of the class that didn't have all issues. The most important thing in doing online class is not having issues with connectivity at all so it doesn't interfere with your assignment submission, quizzes, or even exams.



Class of 2022, finding a quiet place graph throughout the pandemic; survey done in the midsemester of 2020.

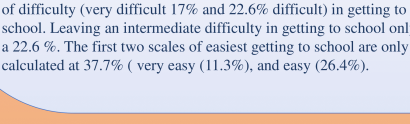


Class of 2022, finding a quiet place graph throughout the pandemic; survey done in the midsemester of 2022.

Another effect of attendance is being able to concentrate in classes by having a quiet place and a home. Students have had struggles with having more loud noise at home than in a school where you can find a quiet place. Survey of a class of 2022 in their junior year, 32% of them responded to having major problems finding a quiet place at home in pandemic times. 45% of them consider it a minor problem. Nowadays, the same question was spread again when being back on campus, a major problem of finding a quiet place was reduced; only 12.5% of students voted. A 62.5 % of students now have a minor problem finding a quiet place. This percentage increased now when they are back on campus.

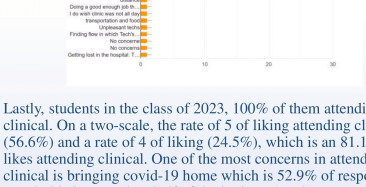
Results Junior Year

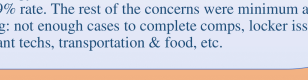
Surveys were successfully submitted and responded to, by the juniors from class 2023. The juniors from class 2023 are 69.8% females and 30.2 % male which makes a total of participants of 53 people. After a whole pandemic, students this year had an opportunity of coming back to school with vaccination mandates. The class of 2023 responded with a total of 69.8 % being satisfied including both votes of satisfied(45.3 %) and very satisfied (24.5 %) this year coming back to an in-person class, leaving only a total of 30.2% of the class being somewhat satisfied (28.3%) and not satisfied (1.9%). One of the factors of being satisfied with coming back to school is what type of learner students are. Therefore, 64.2 % of respondents were visual learners leaving 35.8 % being Auditory learners with 13.2% and Physical learners with 22.6% of respondents.



One of the main effects of attendance can be transportation and vaccination mandates. One of the first effects of school can be transportation. A 100% of the class of 2023 takes Public transportation to get to school. Only 39.6 was in the last two scales of difficulty (very difficult 17% and 22.6% difficult) in getting to school. Leaving an intermediate difficulty in getting to school only a 22.6 %. The first two scales of easiest getting to school are only calculated at 37.7% (very easy (11.3%), and easy (26.4%).

Another effect of attendance is the lack of concentration, compare to pandemic times, students could not concentrate as much. Now that people are back to school is better, in school you can even find a quiet place to study, etc. A 41.5 % of the class of 2023 replied with a yes in concentrating more than in pandemic times. A 75.5 % find a quiet place in school. A 54 .7 % person find that place to study which is located in the hallway chairs available for students. Even though great things can be obtained by being on campus, unfortunately, a 43.4% voted that they want to go back to online classes





Lastly, students in the class of 2023, 100% of them attending clinical. On a two-scale, the rate of 5 of liking attending clinical (56.6%) and a rate of 4 of liking (24.5%), which is an 81.1 % that likes attending clinical. One of the most concerns in attending clinical is bringing covid-19 home which is 52.9% of respondents voted; this is more than half of the juniors. Another concern is the lack of energy to come to didactic classes which were voted second with a 49% rate. The rest of the concerns were minimum as the following: not enough cases to complete comps, locker issues, Unpleasant techs, transportation & food, etc.

Conclusion

Concluding all the surveys and comparing through previous years, Radiology students were having more struggles and times were harder through pandemic. Radiology students were committed professionally because they had to proceed in clinical despite difficulties but even in the middle of a pandemic, they made it through. In the surveys that were spread now in 2022, the rate of in-campus concentration, and studying was higher. Also, majority of students that were back on campus stands more satisfactory. All of this, as a result, reflects the improvement in attendance that radiology students made after the pandemic.

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Title: Biometal Distribution and Diffusion: Contrast Resolution by Low Energy Mammography versus High Spatial Resolution by Computed Tomography

ESP Scholars: *Guito Charles (1,2); Robert O'Brien (1) and Areeba Masroor (1)*

Mentors: *Subhendra Sarkar(1); Zoya Vinokur(1) and Teri-Ann Hawley(1,2)*

(1)Department of Radiologic Technology and Medical Imaging) (2) Maimonides Medical Center

Abstract

- Low energy X-rays from a mammographic system were used to capture small differences in inherent tissue contrast in two-dimensional images of cut samples of select fruit and vegetable models avoiding excessive volume averaging. High spatial resolution CT images were also acquired of whole fruits to avoid volume averaging to help detect low tissue contrast. A limitation of CT imaging is the high kVp unavoidable in CT that lowers tissue contrast while the advantages are that of non-invasive 3D visualization. Using these two approaches that are very different in physical principles it is not known if either one could display possible displacement of diffusion of endogenous minerals in fresh fruits during thermal stress from the heat shocks and during interaction with exogenous radiological contrast media. This project will compare benefits of high spatial resolution in CT with the high contrast details present in Mammography.

Methods

- **Hardware:** A GE Light Speed CT unit,64 slice capability, gantry: 70cm. **Protocols:** With Ascend reconstruction software small body C-spine protocols for axial slice thicknesses 1.25-2.5mm were selected at either 120kVp/12mAS or 80kVp/48 mAs and small focal spot.

- **Samples:** Identical fresh sweet potatoes (one with and another without microwave heat shock for 21 sec were used prior to and post following contrast media administration)

- **Contrast media:** 3 MRI contrasts, Gadavist (most dense), Dotarem, and Eovist (least dense) and 2 CT contrasts, Omnipaque 350 (350 mg/mL Iodine loading) and Omnipaque 240 (240 mgI/mL and hence less Iodine loading) were used that have the following viscosities at 37C :

Contrast Agent	Temp (C)	Viscosity (centipoise, cp)
Gadavist (Whole Body MR Contrast)	37	4.96
Dotarem (Whole Body MR Contrast)	37	2.40
Eovist (Liver MR Contrast)	37	1.19
Omnipaque 240 (CT contrast)	37	3.4
Omnipaque 350 (CT contrast)	37	10.4

Results-I

For comparison, heat and mechanical stress effects on x-ray absorption are shown at low kVp applications (20 kVp/10-20 mAs for another fruit group: Red Delicious apples, shown below with mechanical cuts, from our Laboratory.

(For details see Orellano et al. in this symposium)

Also note the mineral compositions of sample apple and sweet potatoes listed below. Our interest is the metal ion content and their diffusion with heat stress.

https://www.lenntech.com/fruit-vegetable-mineral-content.htm

Minerals in 100g raw Apple:

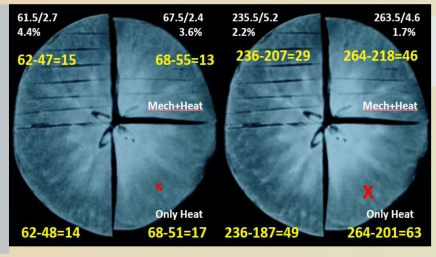
Fe 0.12 mG Na 1 mG K 107 mG Mg 5 mG Ca 6 mG P 11 mG (Mn Trace) pH 2.9-3.3

Minerals in 100g raw Sweet Potato:

Fe 0.61 mG Na 55 mG K 337 mG Mg 25 mG Ca 30 mG P 41 mG Mn 0.25 Cu 0.15 pH 5.3-5.6

Heat Shock Results-Soft X-Ray Mammography

Figure 1.
One hr post mechanical stress using sharp cuts on cold apple piece (Left half) and on heat shock apple piece (Right half,) for each slice shown, for 20kV/10mAs (Left) & 20kV/40mAs (Right panel).The excess radiation absorbed (shown by X, particularly for 40 mAs) is perhaps due to clumping of minerals diffused inward after heat shock, more when no mechanical separation present to block diffusion of metal ions after heat shock.



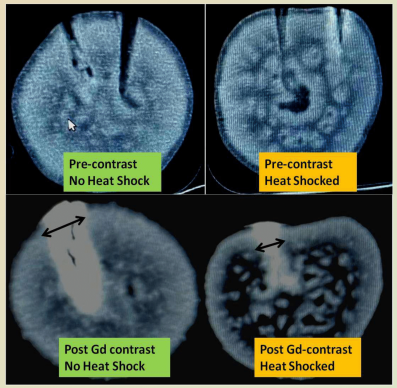
Heat Shock Results-High Resolution Computed Tomography

Figure 2.

Pre-post 3-drop of Gadavist infused fruit matrix and the role of heat shock to assess diffusivity of high viscous contrast media (Gadavist in this case).

Result II - Figure 2.

Both Pre and Post were obtained using 120 KVP and 12mAs, small FOV and 2.5 mm slice thickness. In the top right heat shocked sw potato shows segregation of dense matrix creating heterogenous x-ray absorption distinctly with less diffusion. In the image below for post gadavist/post heat shock, Gadavist does not spread as much as the image on the left: this indirectly suggests a gelatin matrix.



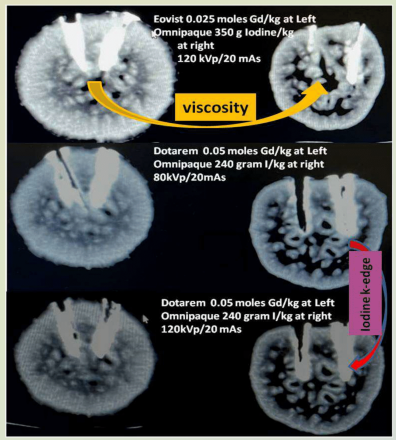
Result III - Figure 3.

These images shown different contrast materials included MRI and CT. For each sweet potatoe listed on the image has 3 different MR contrasts on the left side (Gadavist, Dotarem and Eovist) and 2 different CT contrasts at the right wells (350 and 240 mgI/mL).

Figure 3.

At 80 kV the k-edge effects can be shown better.
Iodine has a k-edge of 33 that is closer to mean energy of 80 kVp beam than Gd (K-edge 50 keV)
Hence more absorption for Iodine.

Low viscosity of Eovist (1/4 of Gadavist) allows it to spread out quickly (Brown Arrow) after heat shock tha Gadavist (see viscosity table).



Discussion

(1) This is perhaps the first demonstration of the x-ray relation between ultra-low energy and higher energy using clinical systems in the diagnostic energy range. Soft x-rays from low energy Mammography unit and high resolution, high energy CT both seem to be able to map out metal ion distribution in terms of higher x-ray absorption density. Mammography has the benefit of low energy k-edge for lighter metals while higher energy CT has the advantage of thin slice, non-invasive mapping and 3D reconstruction if needed.

(2) Low energy that is more sensitive to light metals, was able to show iron and also perhaps potassium distribution in apple model in spite of these being less than 0.1% in composition (by another research group in our lab, Orellana et al) and observe redistribution or precipitation of biometals from biochemical pathways with heat shock (Figure 1).
Our experiment by CT here with sweet potato that has approx. 10 times more metal ions (but still less than 1% of bulk weight) is the main focus of this poster (Figs. 2, 3).

(3) Fig 3 shows Eovist, with ¼ viscosity diffuses out faster than Gadavist and the k-edge of Iodine(33 keV) allows more absorption by photoelectric effect than Gd(50 keV) for 80 kVp beam.

(4) Using high viscous contrasts we can detect heat induced structural change mapped by diffusivity differences.

(5) The thin slice/3D capability, particularly on intact samples by CT, allows a unique capability that is absent in Mammography. However, Mammography has the higher sensitivity to light minerals like Ca, K, Mg, Fe, Cu and Mn which are common in fruits and in human tissue. Light minerals have K-edges in single digits (3-8 keV) while an 80 kVp CT beam has mean energy approx. 27 keV, further from 3-8 keV.

This may be used to monitor over time, say, microwave ablation on patients using medium energy CT with high spatial and temporal resolutions.

Acknowledgment

We would like to acknowledge valuable help from Jodi-Ann Douglas, Sr. CLT and other CRSP researchers: Sonia/Maria Orellana, Aravis McBroom, Aaliyah Solomon and Joanna Sisco. This work was supported by ESP stiepend from Undergraduate Research , City Tech.

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Degradation Rate Calculations of Polydimethylsiloxane (PDMS)

Ibrahim Chouman, *Sandya Persaud*

Professor. Dr. Ozlem Yasar

Department of Mechanical Engineering Technology, New York City College of Technology, CUNY

Abstract:

Tissue Engineering has been studied to develop tissues as an alternative approach to the organ regeneration. Successful artificial tissue growth in regenerative medicine depends on the precise scaffold fabrication as well as the cell-cell and cell-scaffold interaction.

PDMS is a biodegradable and biocompatible material that is commonly used in the Tissue Engineering field. In this research, the degradation rate of PDMS is investigated by dissolving the PDMS within the water and ethyl alcohol. Outcomes are compared to decide the degradation speed of engineered scaffolds. Our preliminary results indicate that PDMS can be dissolved within ethyl alcohol faster.

In tissue engineering, the hydrogel polymer PEGDA, polyethylene glycol diacrylate, is a biodegradable and biocompatible material regularly utilized.

Introduction:

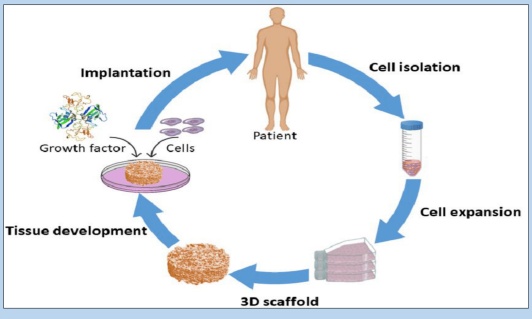

Figure 1. Tissue Regeneration

Tissue Engineering is the study of the growth of new connective tissues, or organs, from cells and a collagenous scaffold to produce a fully functional organ for implantation back into the donor host.

Tissue Engineering aims to regenerate damaged tissues by combining cells from the body with highly porous scaffold biomaterials, which act as templates for tissue regeneration, to guide the growth of new tissue. Scaffolds should have the mechanical strength needed for the creation of a microporous structures that will retain its properties after implantation.

Methods:

Figure 2. Tissue Regeneration

In this research for PDMS, a thin layer of PDMS solution was prepared by mixing curing agent and base in 10:1 ratio.
Then they were baked in the oven in different temperatures.
Fully solidified PDMS samples will be studied to investigate the toxicity rates. Then, INSTRON Machine will be use to do the compressive tests for PDMS mechanical characterizations.

The photolithography technique is used to fabricate the scaffold, PEGDA. PEGDA is mixed with a photo-initiator solvent to create a substrate in a wafer that will be coated, so that the wafer is prepared to accept the photoresist by producing a clean surface. Then, the wafer is exposed by a UV light that is traveling through a mask to the resist. Through developing and etching the initial liquid structure of the PEGDA photo-initiator solution should finally be solidified and take the form of molding shape.

Results:

In this research, our preliminary experimental results showed that PDMS can easily be prepared in different thicknesses by mixing the base and the curing agent in 10:1 ratio.

Also, PEGDA can be controlled to be strong enough to be implanted in human bodies and help many.

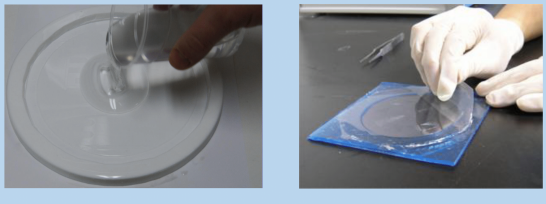

Figure 3. PDMS preperation

Conclusion:

Tissue Engineering has achieved remarkable success. However precise fabrication of tissue scaffolds always has been a challenge. Our research showed that 100% PEGDA scaffolds has the lowest yield strength whereas 20% PEGDA has the highest yield strength.

Literature Review:

Today in the research world many successful research institutes are working in this promising field Tissue Engineering. MIT, North Carolina University, Texas A&M, Drexel and many more universities are using different biocompatible materials for scaffold fabrication.

Acknowledgment:

The authors acknowledge the research support from Dean's Office, Research Scholars' funds and SET-CUNY

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ARCscholars - NYCHA

Shun Ebihara, Habiba Abdelgawad, Erickson Diaz, Marissa Zoya
Vaidehi Mody(NYCHA), Julien Sneck (NYC Department of Planning)

Abstract

Who are we?

We are a diverse group of scholars ranging in age, gender, and background from all over New York City. We share a common interest in solving our urban challenges through studying and proposing improvements to the built environment. From professors at CUNY CITY TECH to NYCHA Design & Implementation specialists and NYCHA residents, we encompass a group of scholars united by this common purpose.

What are we here to accomplish?

This team of ARCscholars is working collaboratively, sharing lived experiences, creatively thinking & planning and applying our research discoveries to the proposed design interventions. We seek to address and combat critical issues to foster a measurable improvement in community health, understanding, and relationships. Through enhancing the community at large via housing equity and durability and beauty, we hope that the proposed design improvements will have a direct, indirect, and long-lasting positive effects on the NYCHA communities.

How are we doing it?

We have developed an architectural and urban proposal that will enhance the overall quality and design of our case study development: the NYCHA Wagner Houses in Manhattan. Our research included a comprehensive site investigation, multiple informative discussions with the Resident Leaders at the development, and an understanding of planning issues. We met weekly to analyze, discuss, and investigate architectural and urban concepts, and develop specific planning interventions. We also me in person twice to workshop ideas and establish close personal connections. Personal anecdotes from our NYCHA resident students helped inform the design strategy.

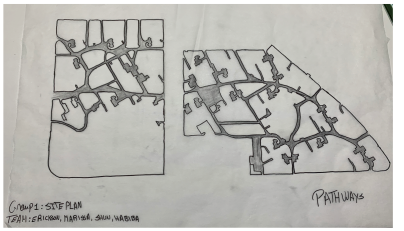
What have we found?

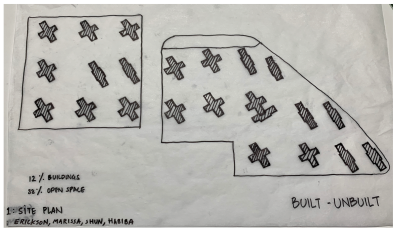
Our research informed us that our proposal should address the overall campus in addition to providing specific design interventions. The students were divided into three groups, based on their interests, and focused on three main categories of development: an *overall site strategy*, a reimagining of the *senior center* and a redesign of the *youth center*.

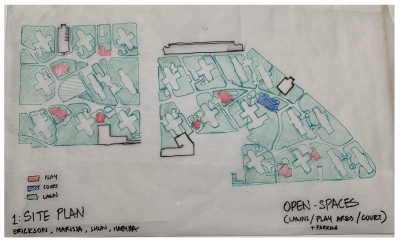
Site plan:

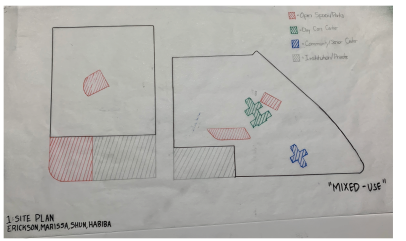
The site strategy team studied five basic elements of a city identified by Kevin Lynch. These five qualities; paths, edges, districts, nodes, and landmarks are used to define how people experience a city or a neighborhood. Through these qualities, the urban areas become characterized and an opportunity for growth become visible. Through site visits and observations, we deciphered what was missing and could be added enhance the development. We believe that these additions will help shape the community and be a greater connection to the city.

Site Studies







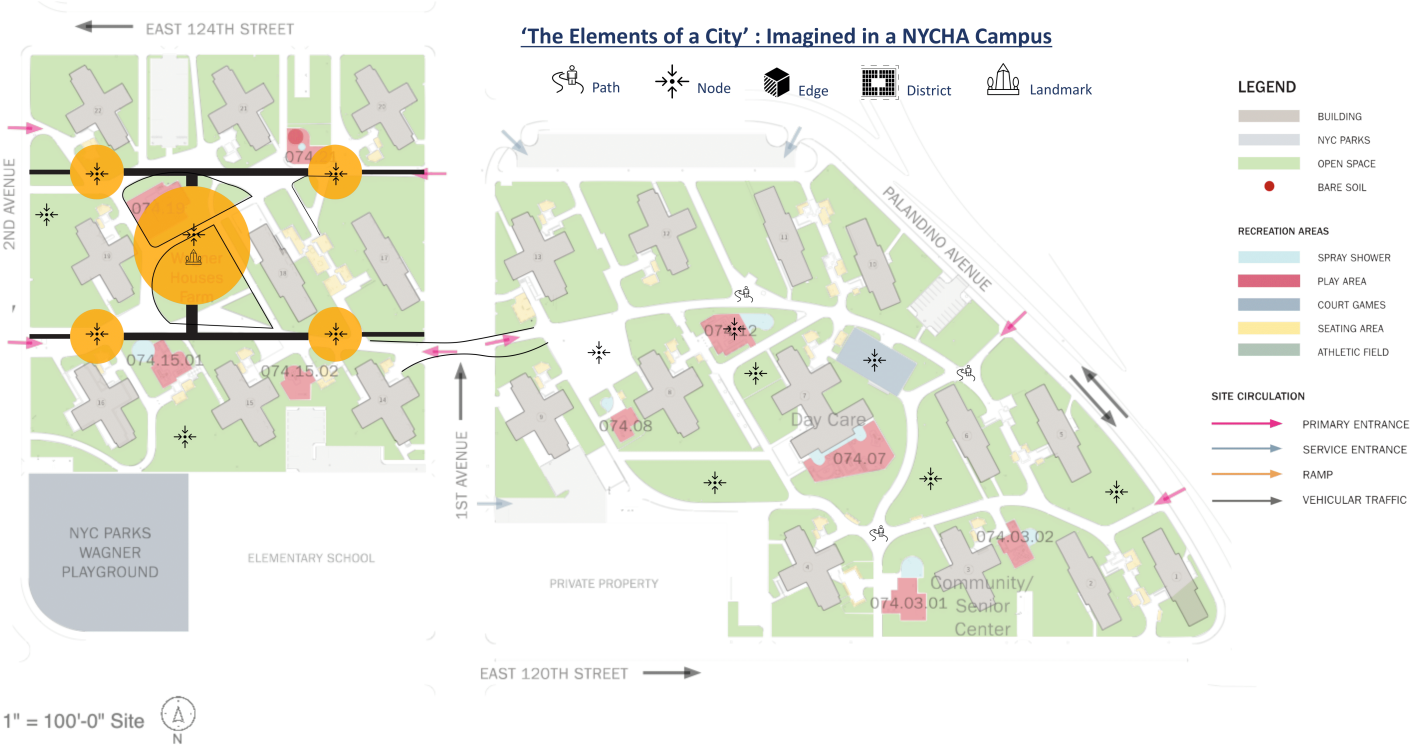


Program Improvement

BBQ Areas

Welcoming Seating Areas

Water Park



'The Elements of a City' : Imagined in a NYCHA Campus

Path Node Edge District Landmark

LEGEND

BUILDING
NYC PARKS
OPEN SPACE
BARE SOIL

RECREATION AREAS

SPRAY SHOWER
PLAY AREA
COURT GAMES
SEATING AREA
ATHLETIC FIELD

SITE CIRCULATION

PRIMARY ENTRANCE
SERVICE ENTRANCE
RAMP
VEHICULAR TRAFFIC

Child Detection System For Preventing Hot-car Death

Fahmeda Khanom & Touheda Khanom

Mentor's Name - Dr. Xiaohai Li

Department of Computer Engineering Technology, EMERGINHG SCHOLARS PROGRAM

City Tech Robotics Research Lab

www.citytechrobotics.org

According to the Safety Organization Kids and Cars, an average of 38 children die each year in hot cars due to being left in a car alone. To save children's lives, in this project we will develop a child detection prototype system that can determine the presence of a child left alone inside a hot car and immediately send alert notifications to child caregivers. Our system will also be able to help save children's lives in cold weather. Our research by far focused on providing precise information about inside the car by fusing multiple channels of sensor measurements with high precision. We have tested and integrated three different types of sensors to accurately detect the presence of a child without an adult in a car. Moreover, we have tested sending text alerts to child caregivers about the situation inside the car by using a PaaS (IFTTT) . We will also report the car's GPS location and aim to stream a live video to children's caregivers in the next stage of the project.

INTRODUCTION

In the United States, 52 children died in 2018, and 43 children died in 2017 because of heatstroke in vehicles [1]. The parent's lack of knowledge about temperature rise inside the car and their careless behavior causes the death of the child due to heatstroke. Children hot car death is still a growing problem that has yet to be addressed and requires effective solution (Table 1). A child's body temperature tends to increase faster than adults in a closed vehicle. A child is more sensitive than an adult when the temperature increases, which can damage the internal organs such as the brain and kidneys. Our child detection system uses multiple sensors to detect the motion of a child and a weight sensor that reads the child's loads and then reads the temperature to send to the parents. This prototype alerts and send notifications to the parents about their children and will prevent several deaths of children that occurred due to heatstroke during summer season. Our research is still working on GPS locations for parents to find their child location without any delay.

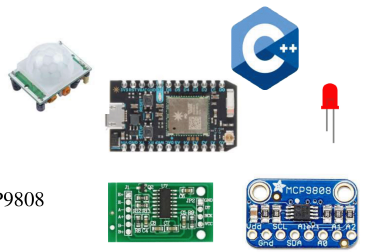
Child Hot Car Deaths Each Year

Year	Number of Babies
2021	23
2020	26
2019	53
2018	54
2017	45

Table 1 [3]

COMPONENTS & DEVICES OPTIONS

- Particle Photon Board
- PIR sensor -HC-SR31
- LED
- Weight sensor -HX711
- Temperature sensor – MCP9808
- IFTTT



DISCUSSION

In our research, we have used Particle Photon (Figure 1) to test our sensors. First, we tested individual sensors to figure out the most precise sensors to build our child detection system to prevent hot car death. We used a PIR sensor with LED attached and when the motion is detected the LED turns on. When no motion is detected, the LED turns off. Then we attached four load cells, each load cell is 50 kg, to determine the weight of the child and adult. When no adult is detected, the temperature sensor which is MCP9808 will start measuring the temperature. Moreover, our project can send alert notifications to parents and caregivers using IFTTT when temperature sensor detect higher temperature inside the car (Figure 2). Some studies used the sensors to detect the temperature and send text messages to alert only the driver's phone (Visconti, 2020). However, the driver might not respond to the alert if the phone battery is dead, or the phone is in silent mode. In cases when no response is found from the parents/caregiver our child detection prototype we are working on will reach 911.

RESULTS

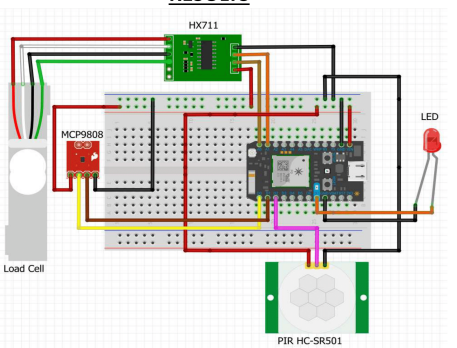


Figure 1: Particle Photon Board

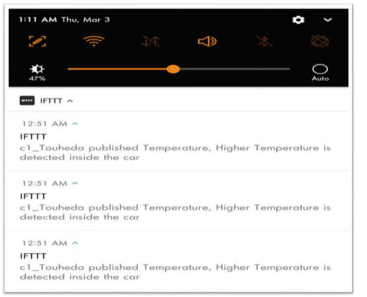


Figure 2: IFTTT Mobile Alert Notification

TESTING CODE

```
void loop()
{
  float Temperature = mcp.getTemperature();
  if (Temperature > 30) Particle.publish("Temperature", "Higher",  PRIVATE);
  if (Temperature < 30) Particle.publish("Temperature", "Lower", PRIVATE);
  Serial.print("Temp:"); Serial.println(mcp.getTemperature(), 4);
   //Particle.publish("Temperature in Celsius   : ", String(cTemp));
   //Particle.publish("Temp:",  String(Temperature));
   delay(1000);
}
```

CONCLUSION & FUTURE WORK

In the research project, we have designed our child detection prototype system that will be low-cost and easy to use for most of the users with the support of sensors. We have used multiple sensors which were individually tested. In our project we have implemented an alert system to inform the parents about their children in hot-car that can reduce the death of the children using IFTTT. In future, our goal is to use a GPS module to send the parents/caregiver the location of the child if they forget where they parked the car.

ACKNOWLEDGMENT

EMERGING SCHOLARS PROGRAM

Special thanks to Dr. Xiaohai R. Li

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NYCHA & ARCscholars

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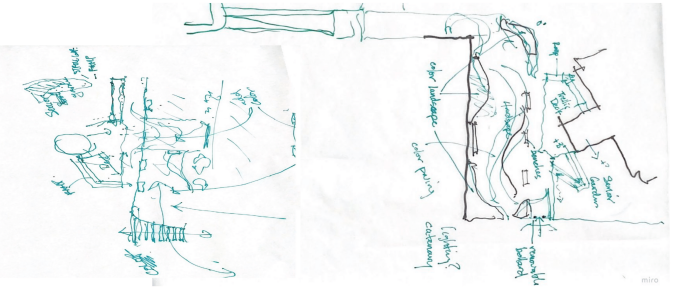


Abstract

Who are we?
We are a diverse group of scholars ranging in age, gender, and background from all over New York City. We share a common interest in solving our urban challenges through studying and proposing improvements to the built environment. From professors at CUNY CITY TECH to NYCHA Design & Implementation specialists and NYCHA residents, we encompass a group of scholars united by this common purpose.

What are we here to accomplish?
This team of ARCscholars is working collaboratively, sharing lived experiences, creatively thinking & planning and applying our research discoveries to the proposed design interventions. We seek to address and combat critical issues to foster a measurable improvement in community health, understanding, and relationships. Through enhancing the community at large via housing equity and durability and beauty, we hope that the proposed design improvements will have a direct, indirect, and long-lasting positive effects on the NYCHA communities.

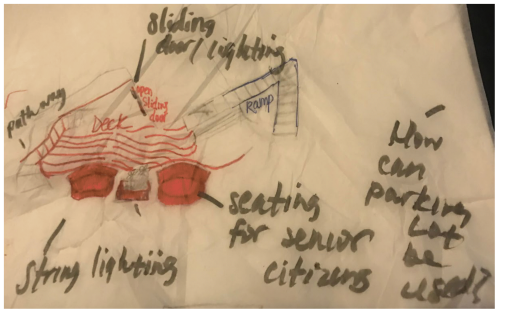
How are we doing it?
We have developed an architectural and urban proposal that will enhance the overall quality and design of our case study development: the NYCHA Wagner Houses in Manhattan. Our research included a comprehensive site investigation, multiple informative discussions with the Resident Leaders at the development, and an understanding of planning issues. We met weekly to analyze, discuss, and investigate architectural and urban concepts, and develop specific planning interventions. We also me in person twice to workshop ideas and establish close personal connections. Personal anecdotes from our NYCHA resident students helped inform the design strategy.

What have we found?
Our research informed us that our proposal should address the overall campus in addition to providing specific design interventions. The students were divided into three groups, based on their interests, and focused on three main categories of development: an overall site strategy, a reimagining of the senior center and a redesign of the youth center.

Senior Center:
We learned that there is a large senior population at Wagner Houses and chose to focus on the design and improvement of the Senior Center. The existing Senior Center has no seating areas or equipment to enjoy. The space in front of the building is a large concrete plaza that is used as a parking lot. As a group we chose to develop both the interior entry space in the building and the surrounding landscape and plaza. The current entryway will be converted into a multipurpose room enclosed by glass. There will be a deck added to the sides and accessible ramps placed within a new colorful landscape. In addition, the entry plaza will be developed to include seating, landscape, and catenary lights. The new interior spaces, new deck and ramps, additional lights, color, and access to the gardens will unify the space and provide a safe, appealing set of spaces for the senior population.

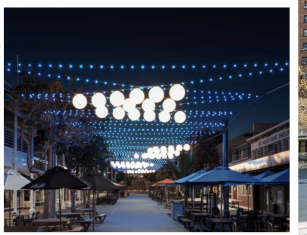
Deck Area

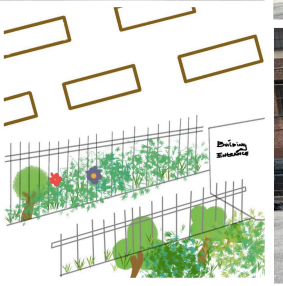
The deck will be elevated and connecting to ramps that will give easy access to the ground getting rid of the fences and placing the deck will allow seniors to have a place to relax inside and outside.

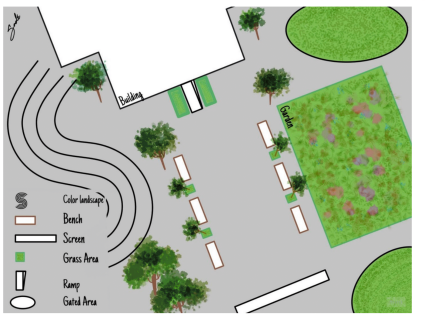
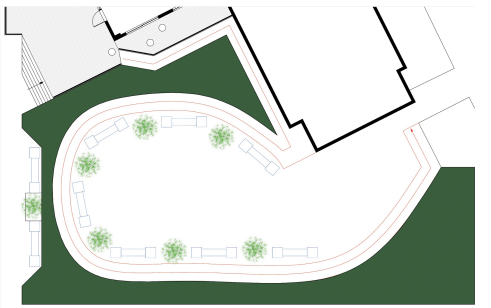


Plaza Design

At the front of the senior center the open space is proposed to be a grand space with seating that will allow movie on to the tall concrete wall that exists the space will be mixed with hardscape and softscape.





Garden Space

Next to the center there is an open piece of green land that is separated from the city streets through perimeter fences. On this land a garden can be placed within the center of a long-curved ramp.