The Ethical Implications of Bioengineering Advancements, Mainstream Media Coverage of those Developments, and the Future of Motherhood

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Abstract

How do the media interpret reproductive interventions that involve genetic testing? When a scientist performed the first known genetic editing on twins, Lulu and Nana, he ignored ethical considerations of CRISPR use. This project provides a content analysis based on a review of popular science and newspaper articles. Our interpretation of these articles suggest that there is a lack of critical understanding of this unethical procedure and a similar attitude towards future genetic developments. While the public is curious about the repercussions of genetic editing, not enough focus is applied to the ethics of conducting such a procedure.

Materials and Methods

- Vigorous online search on databases from scholars
- Read articles
- Decoded information provided by scholars
- Searched for reliable and accredited works
- Online research and search engines utilized
- Created timelines
- Brainstormed

Literature Cited

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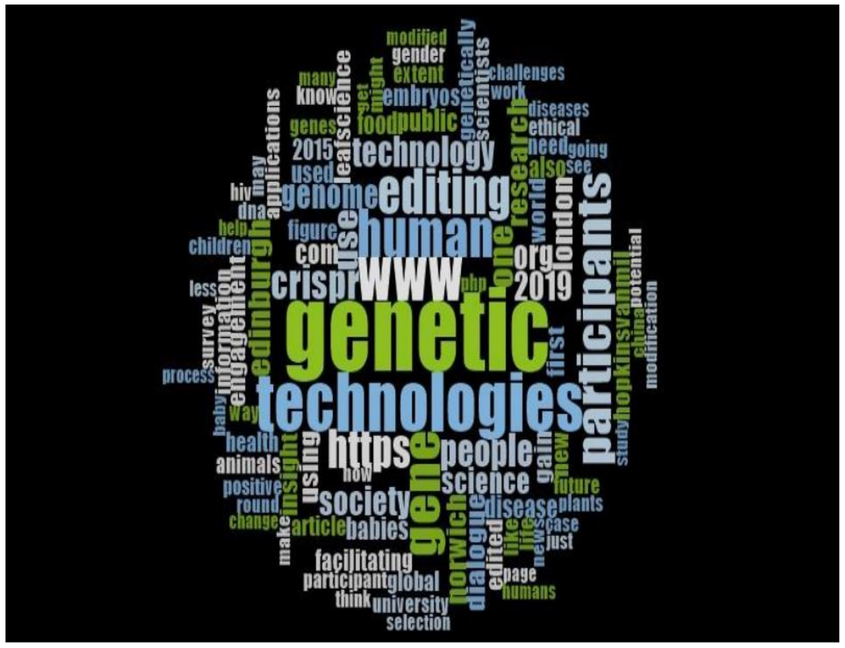
Results

As a result, our findings indicate it is unclear why there hasn't been a greater pool of people speaking on these unethical practices. Gene editing is not analogous to changing the taste, size and shape of a salmon fish. We are addressing the alteration of the biologicals of a human, specifically without a mother's consent. What will happen in the future? Why hasn't there been any mainstream media coverage on these unethical practices? Our research shows that we, as humanists, need to be more aware of what happens regarding our pregnancies. Is it fair that our rights as patients require that we search deeper to find critical information on such a sensitive topic? As a result, there is little to no information about the unethical practices of scientists and medical providers in regards to their ethical practices when in comes to our bodies. It is not publicly known what practices are taking place in laboratories experimenting with our human bodies, tissue, or DNA for research purposes, and it doesn't seem like it will come to light anytime soon.



Conclusion

In conclusion, it was evident that the public is uninformed about the unethicality's of professionals involved in the developments of gene editing. This is a very sensitive subject and not something that seems will be brought to light anytime soon. We as humans should be aware that acts of unethical behavior are happening without our consent when it comes to genetic engineering. Whether it be for the good of humanity or with the best of intentions, the public needs to take proper precautions. When one alters the future the result can be irreversible. Consequently, alteration of biology can lead to unimaginable results, for example concluding to human classification and separation.

Further Information

Could genetically modified embryos result in something more chaotic than what we can handle? This topic is relatively new and there is a limited amount of critical research available for review. We don't know what can arise of this nonconsensual practice. Counter arguments suggest this type information will inevitably violate HIPAA patient privacy regulations and health access in the case of DNA databases; or in the case of prenatal diagnosis during a pregnancy, it could lead to discriminatory actions if a genetic disease has been passed on from parent to fetus. Genetic counselors are now deployed as part of this process of understanding and decision-making upon discovery of inherited markers (Armstrong, 1998).

Acknowledgements ...

CUNY Research Scholar Program (CRSP) C-STEP

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Self-Driving Toy Car Using Deep Learning

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Mentor: Dr. Benito Mendoza

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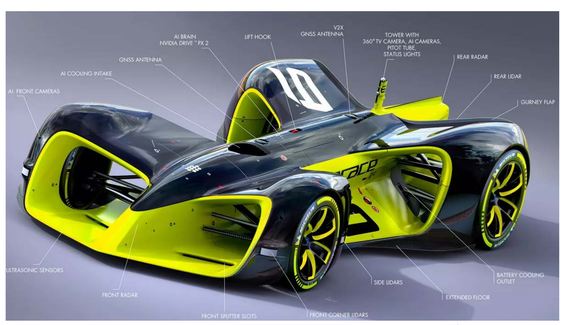
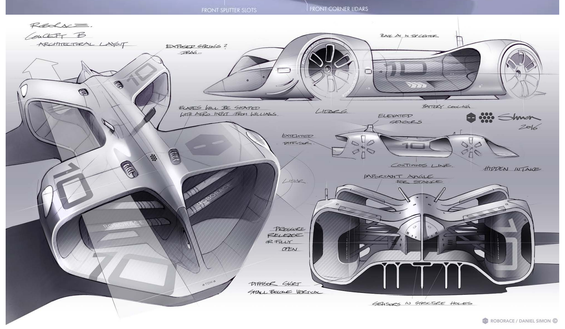
Abstract

Our research focuses on building a student affordable platform for scale model self-driving cars. The goal of this project is to explore current developments of Open Source hardware and software to build a low-cost platform consisting of the car chassis/framework, sensors, and software for the autopilot. Our research will allow other students with low budget to enter into the world of Deep Learning, self-driving cars, and autonomous cars racing competitions.

Introduction

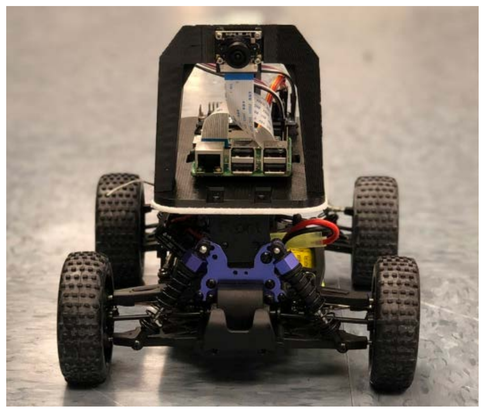
Self-driving car technology is one of the hottest areas of research and business. In the last few years, we have seen an enormous evolution in this area with autonomous cars from Uber, Tesla, Waymo. Artificial Intelligence, in particular Machine Learning and Deep Learning, has contributed to developing the latest generation of algorithms for the essential elements in the self-driving pipeline *Localization*, *Perception*, *Prediction*, *Planning*, and *Control*. Moreover, in recent years, an evolving sport of racing autonomous, electrically powered vehicles has emerged. These type of racing competitions such as **Roborace** are exciting and lucrative attractions that also worked as platforms for research and development for tech companies.

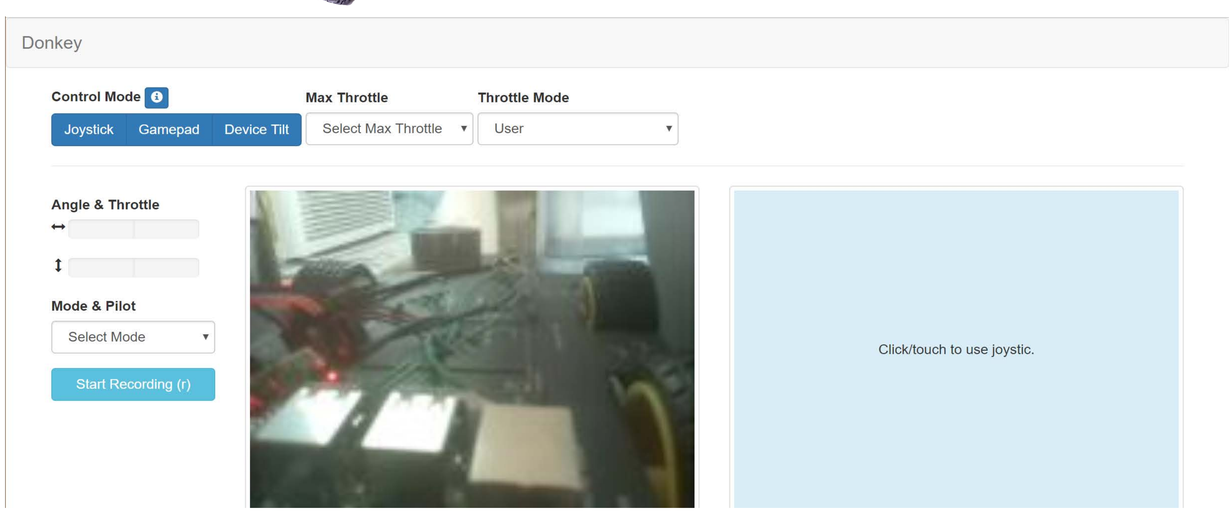




Background

Roborace's expensive high tech vehicles are out of reach for an average student. The alternatives are Amazon Deepracer & Donkeycar; a 1/18th and 1/10th scale model autonomous racing cars. These platforms provide developers with the opportunity to explore advanced AI techniques used on real self-driving cars. However, the cost of the hardware goes from $300 to $400. Our goal is to make cheaper and novice friendly version to make the process more streamlined for new users of donkeycar.





Materials & Method

To build the self driving car we used the following:

Hardware:

- Raspberry Pi 3B+ / NVIDIA Jetson Nano
- Raspberry Pi Camera V.2
- PCA 9685 Servo
- 3D printed hat & chassis
- 4 channel ESP
- NiMh 7.4V battery
- DC 5V battery

Software:

- Donkey Pi
- Donkey auto pilot.
- Tensorflow and Keras to train

Results

- Our model is capable of taking commands through local host.
- After the first run, the successful autopilot rate is 68%- 96%.
- While in autopilot mode, it can capture video at 30 frames per second @720p.

Conclusions

Our hardware and motor modifications already cut the cost to half of an actual donkey car. We are exploring JetBot as well, which is made by NVIDIA. Our goal is to make an understandable & simple version of self driving CityTech Race Car with a lower cost.

Future Work

- Voice control will be added
- Advanced hardware modification to achieve at least 40 mph speed.
- 3D printed body & upgraded chassis to maintain light weight.
- New simple software for training AutoPilot.
- CityTech Race Car and CityTech Race League

Acknowledgement

- Undergraduate Research Program
- CUNY Research Scholars Program (CRSP)

References

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- https://aws.amazon.com/deepracer/

Talk and Roll Bot - Mind-control

Authors: Cornelia Chen, Amanda Liang - Mentors: Professors Farrukh Zia and Ohbong Kwon

Computer Engineering Technology Department

ABSTRACT

Talk and Roll Bot is a mobile robot project which combines computer hardware, computer software, mechanical, electrical, data communication and networking subsystems to create a working prototype of a computer controlled robot system. In the current phase of the research project, background research is done to learn to use the Electroencephalogram (EEG) measurements of brain waves to control the robot. A modified Mindflex game controller is connected to Arduino and brain activity data is passed on to Processing code running on a PC in order to track and record brain wave patterns. The electrical activity of the brain will be used to control the DC motors in Talk and Roll Bot.

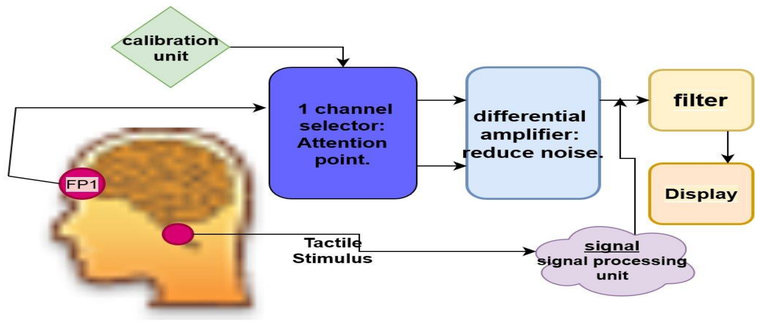
INTRODUCTION

The research project involves biomedical and computer systems knowledge to use the brain wave signals to control the motors. This project can help plant men and someone who can't physical moving. The mind-control project can put on their head to make them easy control or doing something that they want to do. Therefore, we are combined the biomechanical and computer knowledge together. It is not only make us convenient, also help physical disability use the EEG to control the machine, robot arm, chair and so on.

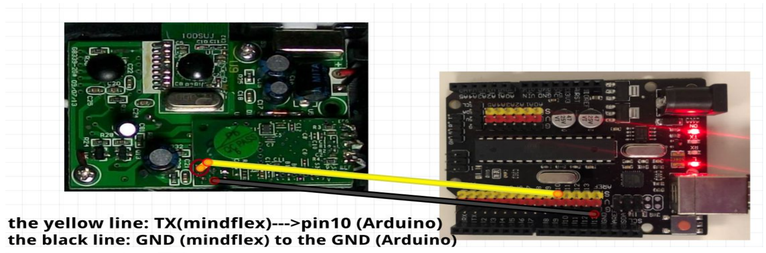
HARDWARE & SOFTWARE

First of all, we are soldering Arduino with mindflex to test and check the data. We get the eleven value at one line, the first value is measure attention, second to last value are Meditation, Delta, Theta, Low alpha, High alpha, Low beta, High beta, Low Gamma, High Gamma. After then, we check braingrapher of the mindflex machine in order to test good connect wire by the PC processing. At last, we connect bluetooth with mindflex. Here have two reasons we want to use Bluetooth connect with mindflex. One is look better, other is the Bluetooth serves as an excellent protocol for wirelessly transmitting relatively small amounts of data over a short range (<100m), also wireless help connect Arduino to modify the code.

BLOCK DIAGRAM



ELECTRICAL CIRCUIT



The picture on the left shows mindflex connection to bluetooth module

ACKNOWLEDGEMENTS

CUNY Research Scholars Program 2019 - 2020

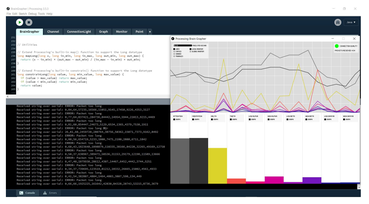
REFERENCES

https://www.medicine.mcgill.ca/physio/vlab/biomed_signals/eeg_n.htm (**detailed knowledge about EEG)**

https://github.com/kitschpatrol/BrainGrapher (**github code library**)

https://www.electrical4u.com/eeg-measurement/ (**EEG recording setup)**

PROGRAM CODE



CONCLUSION

We can clearly saw the graph of brain by PC processing. It helps us know and learn the trend of brain fluctuations. The library of code is find from the website, we modify time make the processing can contiurn record the data of brain.

FUTURE WORK

In this semester, we not connect the DC motor. Therefore, we will be continuous work it in the future, and make it control with DC motor of Talk and Roll Bot.

Degradation Rate Calculations of Polydimethylsiloxane (PDMS)

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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.

Introduction:

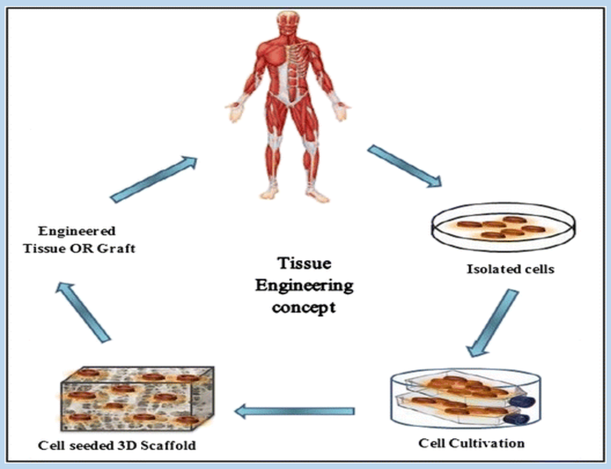

Figure 1. Tissue Regeneration

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:

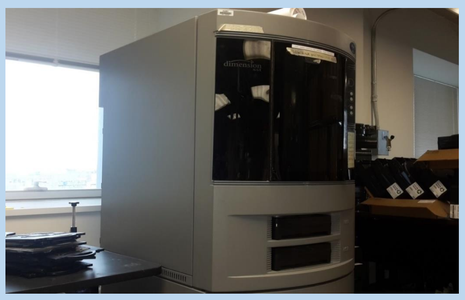

Figure 2. Tissue Regeneration

PDMS:

In this research, 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.

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.

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:

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- Suh, J.-K Francis, and Howard W.t Matthew. "Application of Polysaccharide Biomaterials in Cartilage Tissue Engineering: A Review."Biomaterials 21.24 (2000): 25Chitosan-based 89-598. Web. 13 Aug. 2014.

Analyzing exotic function in Calculus under the microscope

Showmik K. Chowdhury, Mentor: Satyanand Singh

CUNY Research Scholars Program

Abstract

In studying Calculus, we learn about **exotic functions** which can be seen everywhere, and we can differentiate them. By differentiating a function, we can visualize and understand the rule of its nature. People frequently wonder if such functions have real life applications. It turns out that movies such as "The Dark Knight" used exotic functions to create special sound effects. In our case, we closely studied the behavior of the Weierstrass function and sequences of functions that approximate to it from both a visual and theoretical perspective.

Define, $f(x) = \lim_{n\to\infty} f_n(x)$, where $f_n(x) = \sum_{k=0}^{\infty}(\frac{3}{4})^k g(4^k x)$

and g(x) = r (x-2Floor $(\frac{x}{2})$)

RStudio

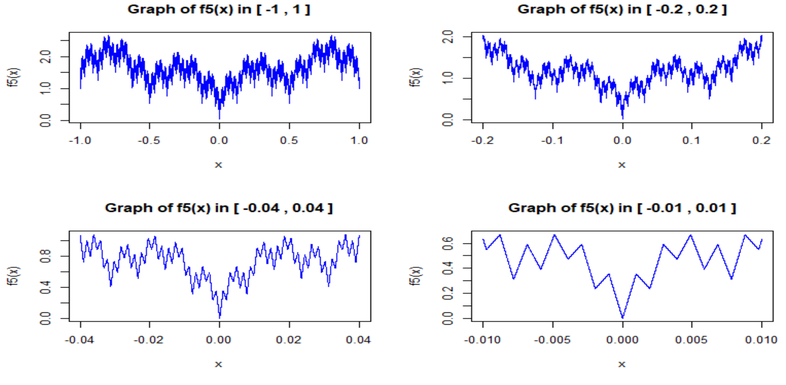
File Edit Code View Plots Session Build Debug Profile Tools Help

Go to file/function | Addins

graph f5.R

Source on Save

```
1  f5<-function(x){
2    k<-0:5
3    return(sum((3/4)^k*g(4^k*x)))}
4  f5<-Vectorize(f5)
5  zoom<-c(1,0.2,0.04,0.01)
6  par(mfrow=c(2,2))
7  for(n in 1:4){
8    x<-seq(-zoom[n],zoom[n],length.out=1e4)
9    plot(x,f5(x),type="l",lwd=0.5,col="blue",
10        main=paste("Graph of f5(x) in [",-zoom[n],",",zoom[n],"]"))
11 }
```



f(x) continuous on R

$f(x) = \sum_{k=0}^{\infty}(\frac{3}{4})^k g(4^k x)$

[Note: $g(x) \le 1$]

$f(x) = \sum_{k=0}^{\infty}(\frac{3}{4})^k g(4^k x)$ [This function is a geometric sequence.]

$$\sum_{k=0}^{\infty}\left(\frac{3}{4}\right)^k = \frac{1}{1-\frac{3}{4}}$$

Integers test:

$(4^n x - \frac{1}{2}, 4^n x)\ (4^n x + \frac{1}{2})$

$4^n x - \frac{1}{2}$ $\quad 4^n x \quad$ $4^n x + \frac{1}{2}$

(——————————|——————————)

Since, the length of the integer is <1.

According to this statement we can always produce:

$\delta_n = \pm \frac{1}{2(4)^n}$ [Where is no integer in $(4^n x, 4^n(x + \delta_n)]$

Claim

$\left|\frac{g(4^m(x+\delta_n) - g(4^m x)}{\delta_n}\right| = 4^m$

[For $0 \le m \le n$ *and* 0 *elsewhere.*] Profe

L.H.S, $\left|\frac{g(4^m(x+\delta_n) - g(4^m x)}{\delta_n}\right|$

$$= \left|\frac{g\left(4^m\left(x+\frac{1}{2.(4^n)}\right)\right) - g(4^m x)}{\frac{1}{2.(4^n)}}\right|$$

$$= \left|2.(4^n) g\left(4^m x \pm \frac{4^m}{2.(4^n)}\right) - g(4^m x)\right|$$

If, $0 \le m \le n$

Then, $\frac{4^m}{2.(4^n)} < \frac{1}{2}$

$\left(4^m x \pm \frac{4^m}{2.(4^n)}\right)$ [Not an Integer]

$= 2.(4^n)\ [4^m x \pm \frac{4^m}{2.(4^n)} - 4^m x]$

$= 2.(4^n)\frac{4^m}{2.(4^n)}$

$= 4^m$

[L.H.S = R.H.S]

We will also show that, $\left|\sum_{m=0}^{n}(\frac{3}{4})^m \frac{g(4^m(x+\delta_n) - g(4^m x)}{\delta_n}\right| = \sum_{m=0}^{n} 3^m$ to establish that f(x) is no where differentiable.

$$\left|\sum_{m=0}^{n}\frac{3^m}{4^m}\frac{g\left(4^m\left(x+\frac{1}{2.(4^n)}\right)\right) - g(4^m x)}{\frac{1}{2.(4^n)}}\right|$$

$$= \left|\sum_{m=0}^{n} 2.(4^n) g\left(3^m x \pm \frac{3^m}{2.(4^n)}\right) - g(4^m x)\right|$$

If, $0 \le m \le n$

Then, $\frac{3^m}{2.(4^n)} < \frac{1}{2}$

$\left(3^m x \pm \frac{3^m}{2.(4^n)}\right)$ [Not an Integer]

$= \sum_{m=0}^{n} 2.(4^n)\ [3^m x \pm \frac{3^m}{2.(4^n)} - 4^m x]$

$= \sum_{m=0}^{n} 2.(4^n)\frac{3^m}{2.(4^n)}$

$= \sum_{m=0}^{n} 3^m$

According to the previous step we conclude that:

$\lim_{h\to 0}\frac{f(x+h)-f(x)}{h} = \pm\infty.$

Conclusion

In the end, f(x) is continuous everywhere but differentiable nowhere. It is true that if, a function is differentiable at a point, then it must be continuous there as well. Furthermore, if a function exhibits a sharp turn then, the derivative does not exist at this point.

Acknowledge

I would like to thank my mentor Dr. Satyanand Singh for his help and guidance. I would also like to thank CRSP for their support in this endeavor.

Reference

Nadia Benakli, Boyan Kostadinov, Ashwin Satyanarayana & Satyanand Singh (2017) Introducing computational thinking through hands-on projects using R with applications to calculus, probability and data analysis, International Journal of Mathematical Education in Science and Technology, 48:3, 393-427, DOI: 10.1080/0020739X.2016.1254296

Know your body: Health Data Analysis Across gender and ethnic populations

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Abstract

Why knowing your body is important? It's important for your health. Our diet, sleep pattern, pulse rate, lung capacity are key indicators of our risk for major illness. The human body consists of organized yet complicated organs and systems, making it work-day in and out. It can be affected by a person's life-style. Quality of an individual life depends largely on a person's mental and physical health. One's life-style plays a key role, however, one's genetic predisposition also is an important factor to be taken into consideration. Family history is a good index to identify disease traits early on. We hypothesize that life-style and genetic predisposition may be the key factors in triggering various chronic diseases. In this study we collected patient information from 20 females and 7 males. Our results show that there is a significant difference between male and female calorie intake and slept hours. Our results confirm that physiologically male and female body functions differently. Understanding sex differences as between calories intake, slept hours, lung capacity and pulse rate will allow a better diagnosis, treatment, and eventually prevention of diseases in men and women. Additional details will be discussed one the project is completed.

Introduction

Human body is very complex but well programmed. Healthy habits including a healthy diet, and proper sleep condition are essentials to maintain its efficient working throughout on life. This is because what we eat can impact our short-term and long-term health[1]. Make sleep a priority because without adequate sleep, we may be less productive, less mentally sharp, and health can be highly affected. Previous research support, that average sleep quality was better related to health, affect balance, satisfaction with life, and feelings of tension, depression, anger, fatigue, and confusion[2]. Men and women have different needs and those individual needs will vary depending on their life-style in which it can affect in their calorie intake, sleep, pulse and lung capacity. According to the American Society, a teenage male should aim for around 3,200 calories per day, while a man in his 30s should eat around 2,200 calories [3]. However, a moderately active woman requires about 1,800 to 2,200 calories each day for healthy weight maintenance [4]. In our research, we found that there is a difference between male and female sleep cycle. Our data shows that women sleep longer than men, and it confirms previous findings[5] . The normal average sleep cycle for a man is about 496.4 minutes, and women 507.6 minutes. Furthermore, our data shows a slightly difference in resting heart rate by gender. It was found that women have higher pulse rate than men. In this study, women ages 19-25 have the higher average at 77.95 BPM, while men ages 19-27 have an average among male at 71.80 BPM. However, according to its lung capacity, the volume of adult female lungs is typically 10–12% smaller than that of males who have the same height and age(19-27).

Materials and Methods

In this study patients used the following add to record their sleep cycle "Sleep cycle-iphone", "Sleep analysis", "sleeptimefree", sleep time to wake up time. These apps helped patients maintain equilibrium about the way to sleep. "MyfitnessPal", "LifeSum", "CouchTo5k", "My Plate", "fitbit" were the apps used to calculate the amount of calories intake. In order to calculate their pulse apps such as "Companion", "Livestrong", "Sommology" as well as Iphone watch were utilized. These apps helped the patients collected their sleep, calories, pulse rate and lung capacity for a period of 4 months.

Data collected (Results)

(A)

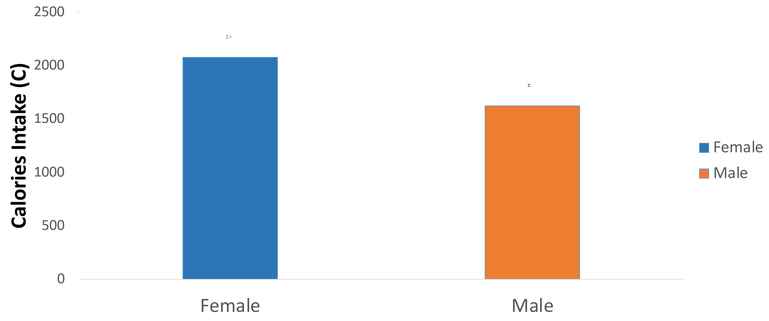

Figure 1: Female vs male calories intake (C). Patients between 19-27-year-old. Male n=7 and Female N=20. The values represent the difference between male and female, in the y-axis number of calories (C), and x-axis gender. Bars represent standard error of mean; a significant different *P<0.05. Male average 2078.34 whereas female average 1623.71.

(B)

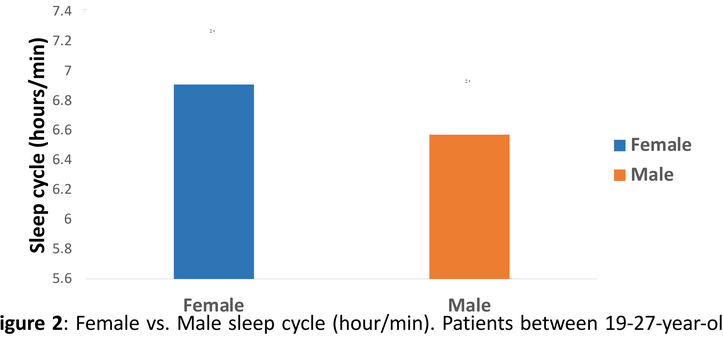

Figure 2: Female vs. Male sleep cycle (hour/min). Patients between 19-27-year-old. Male n=7 and Female N=20. The values represent the difference between male and female, in the y-axis the amount of sleep and x-axis gender. Bars represent standard error of mean; a significant different *P<0.05. Male average 6.57 whereas female average 6.91.

(C)

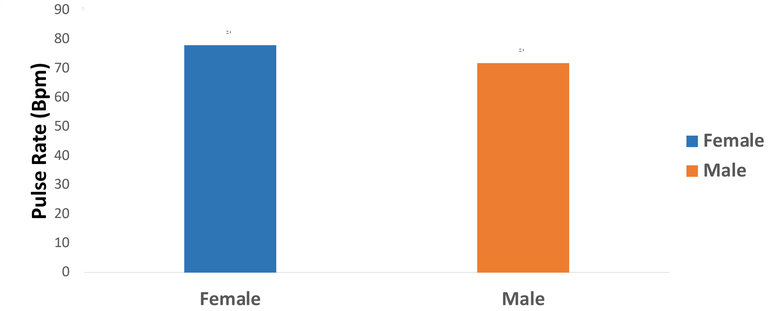

Figure 3: Female vs. male Pulse rate (BPM). Patients between 19-27-year-old. Male n=5, and Female n=20. The values represent the difference between male and female, y-axis pulse rate (BPM), and x-axis gender. Male average 71.8 whereas female average 77.95. No significant differences was observed

(D)

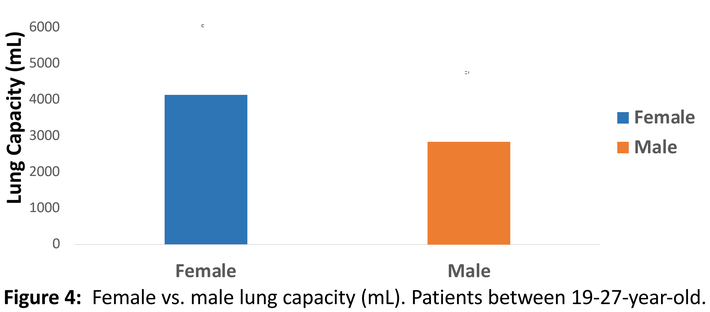

Figure 4: Female vs. male lung capacity (mL). Patients between 19-27-year-old. Male n=6, and Female n=15. The values represent the difference between male and female, y-axis lung capacity(mL) , and x-axis gender. Male average 4130.66 whereas female average 2834.375. No significant differences was observed

Discussions and conclusions

The goal was to investigate the difference between gender and its calories, sleep cycle, pulse rate, and lung capacity. Life-style and genetic predisposition may be the cause of various chronic conditions. Prevention is better than a cure because it is better and easier to stop a problem or illness from happening than it is to stop or correct it after it has started. Results show that male are more likely to become obese than female (**figure 1**). It can conclude that females have a more balanced healthy diet than male. On the other hand, male and female sleep cycle are significantly different (**figure 2**). However, lung Capacity and pulse rate are different as previously reported in the range of 19-20 years old. There is a difference between male and female pulse and lung capacity (**figure 3 and 4**). Understanding these differences between males and females may allow the discovery of preventive and treatment strategies for diseases associated with body weight, such as cancer, cardiovascular disease, Cholesterol, Hypertension, insomnia, etc. In conclusion, this study of 20 females and 7 males was conducted to analyze the differences between genders and our results confirm that physiologically male and female body functions differently.

Future work

- Work with different patients across variable groups
- Study variable across ethnic groups

Acknowledgments and References

I would like to thank Hamid Norouz, Abdou Bah Chritopher Navarrete, Reneta Lansiquot, and Jean Hillstrom for giving me this opportunity.

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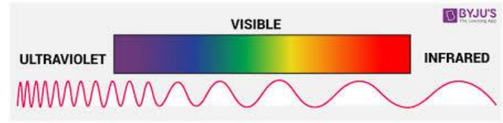
Physico-Chemical Modeling, Optical Microscopy and Near-Infrared Spectroscopic Characterization of Model Biomaterials.

Amina Shahbaz[1], Aldona Gjoni[1], Zoya Vinokur,[1] Chen Xu[2] and Subhendra Sarkar[1]

Departments of Radiologic Technology & Medical Imaging[1] and Computational Engineering Technology[2]

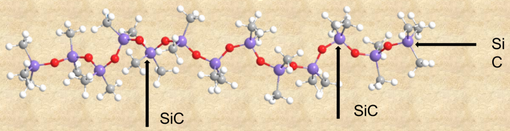


Abstract

Biopolymers are being developed with nanostructures which acts as a carriers for drug delivery to treat different diseases including cancers. In this project, the authors made one biopolymer PDMS with 0-0.9% of SiC filler a novel characterization was demonstrated.
Characterization included optical surface microscopy (5-100X) and 2D X-ray imaging at low kVp and low mAs to ensure proper loading and uniform distribution of SiC filler content in PDMS matrix distinguishable within 0.2 vol% of SiC. MR measurements also seemed to be very promising.

Background

Physics and Chemistry of tissue/biopolymer interaction is ill-understood. Biopolymers are being developed with embedded nanostructures in biomedicine while effective characterizations are lacking.



Methods

In the current project one biopolymer was designed and fabricated under a separate project: poly di-methoxy siloxane (PDMS) with 0-0.9 vol% of SiC nano whisker (fillers) that were non-destructively characterized and modeled by the authors. Optical spectroscopy is a technique for measuring light intensity in the ultraviolent, visible, near-infrared and infrared wavelength ranges. This system used in the experiments is AvaSpec-ULS2048, which can scan wavelength range from 200 to 1100 nm, and resolution can reach 0.05nm. To demonstrate the PDMS signals under the MR, we used the 3T Siemens Prisma from McClean Hospital Boston.

Results

Figure 1

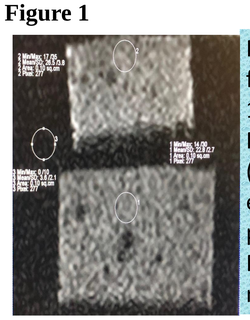


Fig 1 shows Signal/Background Noise for pure PDMS (Top) = (26.5-3.8)/2.1 = 10.8 while that for 0.2% SiC filler PDMS Signal/Noise (Bottom) drops to (22.8-2.7)/2.1 =9.6; a 12% decrease, even 0.2% SiC impurities restrict polymer chains from freely moving. MR signal depends on mobility of molecules.

Figure 2

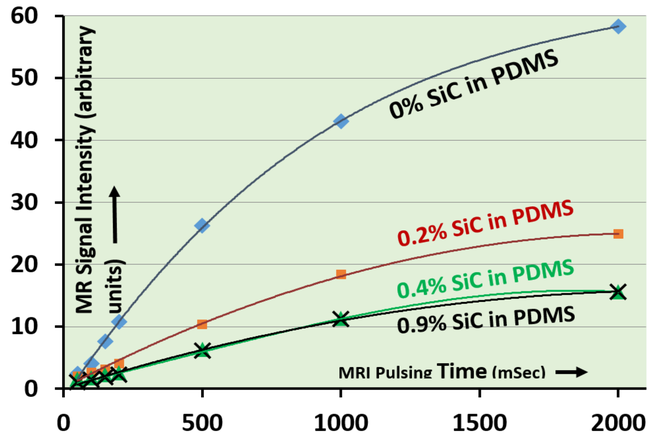


Fig 2 shows the increasing difficulty for PDMS to generate MR signal from the polymer when SiC is increased from 0-0.9%

Figure 3

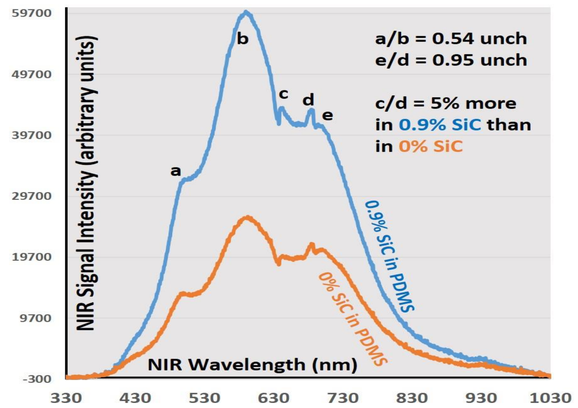


Fig 3 shows Near infra-red spectrum of 0 and 0.9% SiC fillers creating signature peaks between 600 and 750 nm wavelengths.

Figure 4

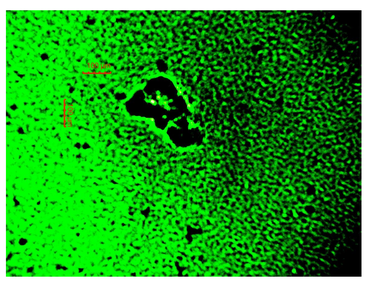
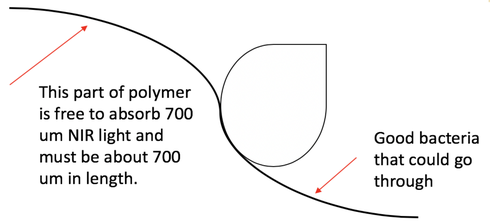


Fig 4 is a light microscopy image at 50x mag. showing a 300 um (0.3 mm) size defect in PDMS with 0.9% SiC.

Discussion

Both MRI and near infra-red spectroscopy (NIRS) seem to perform well to obtain basic filler-PDMS bonding behavior with increasing nano-filler load. Preliminary results suggest SiC anchored at the PDMS backbone even at 0.2 vol% causing the observed enhancement of mechanical properties with filler loading. However, the characteristic 700 nm absorption may indicate a restricted mode that reveals a possible anchored structure modeled below and may help design 700 nm size particles or friendly bacteria for controlled interaction for drug delivery, for example.



Conclusion

- This work shows preliminary morphology and chemical/electrical nature of SiC micro structures inside PDMS.
- We also demonstrate that as the percentage of SiC in PDMS increases, MR signal from polymer protons decreases due to their movement restriction perhaps with direct anchoring with SiC as modeled above.

Acknowledgment

This work is funded by CRSP undergraduate Research Scheme at City Tech. We would like to thank Prof. Samsur Rahman for SiC and Tetiana Soloviova and Viorica Gutu for help with X-rays and Kathleen Thangaraj from McLean Hospital, Boston for assistance in MRI.

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Biotechnology and reconstructing the self through genetic health markers and elevated health risks.

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ABSTRACT

New commercial technologies promise personalized genetic information upon request. As these technologies become more popular, it is meaningful to understand how consumers interpret their results. Applications like 23andme, AncestryDNA, and Promethease grant consumer access to their individual genome and interpret data for health markers. Using these applications, participants have gained genetic knowledge that shifts self-concepts of ethnic/racial ancestry, health risks, and the potential meaning of genetic identity. This study began as an autoethnographic account and then expanded to in-depth interviews with users of these kits. This study aims to understand how consumers use the applications and tools to interpret results, and how those results are understood as a determinant of wellness and health knowledge. Based on interview findings, consumers are concerned about privacy issues, discrimination, and data hacking.

INTRODUCTION

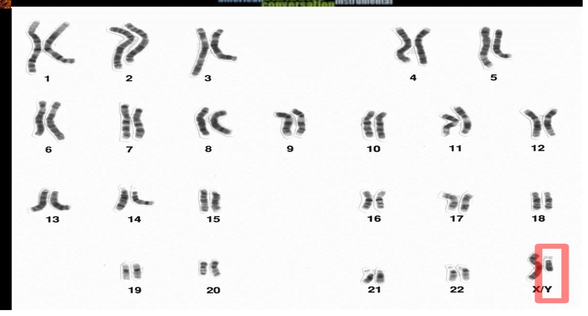
- Three years ago:
  - FDA prohibited 23andme from providing health information.
  - The software filtered some genotype results, but users had to download and then transfer DNA data to a source where they could gain information about health markers.
- Motivation to purchase a direct-to-consumer genetic kit:
  - Expectations about supposed hereditary and diseases.
  - Out of curiosity
- Will a predisposed health marker express itself for the following:
  - Alzheimer's Disease
  - Breast cancer
  - High blood pressure
  - Congestive heart disease
  - Colorectal cancer
  - Obesity gene

METHOD

Qualitative study

Analyzed thirteen transcripts based on in-depth interviews previously conducted by mentor.

Evaluated literature review.



THEMES

- Expose Truth
- Fears/ Ethic
- Identity/ Race
- Privacy Issues

"We learned that my dad's dad is not his dad."

" Doesn't trust government or private industry to store data. Concerned that government will misuse it and wipe out populations perceived as undesirable."

"I'm not particularly concerned about that, except in the way that it would be particularly like I said, regarding insurance companies, or folks that would want to use that information to deny new medical services, or my offspring medical services. And that would be the biggest concern that I have. I think people knowing a predisposition is a good thing. Plan for things as they get older. But on the other side, like I said, I don't, that as we get to know more and more about these genetic markers for things we're going to get to a point where we're going to be able to say that I'm not going to provide you insurance for cough medicine because you're predisposed to catching colds more than the average person. And I think that's when insurance begins to defeat itself, because it's no longer an actual thing."

"Everybody had an ethnic identity. That's how we would talk. As I got older, demographics were shifting, but I guess I wasn't thinking about demographics shifting, I just thought, we're all Latinos, and we're all in this together. It makes sense to group yourself under an umbrella term because it makes you more visibly larger. You're larger numbers, and you can claim things in a way that you can't claim when you're this little tiny group."

LIMITATIONS

- Small sample size
- Skewed for education and ethnicity
- Social desirability bias
- Researcher could be introducing informants to new ways of thinking about their genomic data

LITERATURE REVIEW

- "The human genome underlies the fundamental unity of all members of the human family. And yet each human genome is unique, differing by an average of about 0.1 per cent (1000 Genomes Project Consortium 2012)."
  - Forensic geneticists use this fact to target highly variable parts of the genome, and as a result the forensic geneticists can differentiate between individuals with a very high degree of certainty.
    - This was recently use to arrest the "East Area Rapist," "Original Night Stalker," "Diamond Knot Killer," and "Visalia Ransacker" in 2018
    - An DNA expert recover his DNA from a crime scene and trace it back to DeAngelo's great great grandparents. Then, was able to compare the sample from the crime to a trash sample and it was a match.
- Now there is technology to determines a person physical features base on their blood. Free will is a limiting factor, the computer can not determine if the person have a beard or mustache.

CONCLUSION

- As time goes on, these kits could be used in different ways.
  - Some may use it for health reasons; to see if they are predisposed to a specific disease and to change their lifestyle accordingly.
  - Some may use these kits to foster a sense of identity.
  - Some may use these kits to find out family mysteries.

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Fabrication and Imaging Characterization of Poly (Dimethyl Siloxane)/SiC Nano-fillers Samples as Model Biomaterials.

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Departments of [1]Radiologic Technology & Medical Imaging & [2]Mechanical Engineering Technology

Abstract

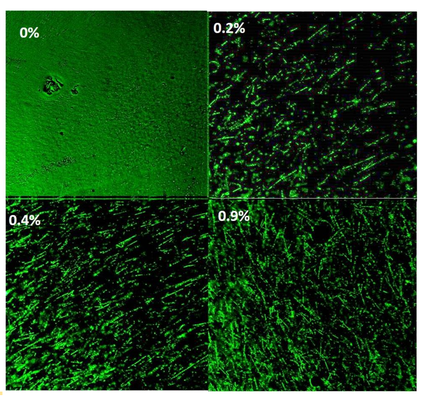
Biopolymers are being developed with embedded nanostructures for in vivo drug delivery to treat various diseases including cancers. In the current project we developed fabrication steps to prepare two biopolymers, poly di-methoxy siloxane (PDMS) with 0-0.9 vol% of SiC nano whisker (fillers) followed by non- destructive characterization. Optical reflection microscopy (5-100X) was performed to ensure loading and distribution of increasing SiC content. Optical microscopy showed progressively higher SiC distribution as filler loading was increased from 0-0.9 vol%. X-ray imaging at low kV (kilovoltage) and low mAs (milliamperage per second) were optimized to allow distinction between filled PDMS with SiC concentration that differed as low as by 0.2%. In addition, MRI characterizations are under investigation to obtain basic inter-molecular relaxation information with and without nano-fillers. Preliminary results suggest SiC attached at the PDMS backbone even at 0.2 vol% explaining observed enhanced mechanical properties with filer loading.

Introduction

Four samples of polymers with different concentration of SiC (silicone carbide) were prepared at Mechanical engineering department.
Sylgard 182 Silicone Elastomer Base with Agent in proportion 10:1 was used to develop neat clear sample of polymer. Further, SiC powder (filler) was added in different proportions to get 0.2, 0.4, and 0.9 vol % SiC mixed. Acquired solutions were placed in molds and heated for two hours. Four obtained samples were characterized using x-ray and MRI systems to detect defects and model filler-polymer interactions.

Results

Fig 1

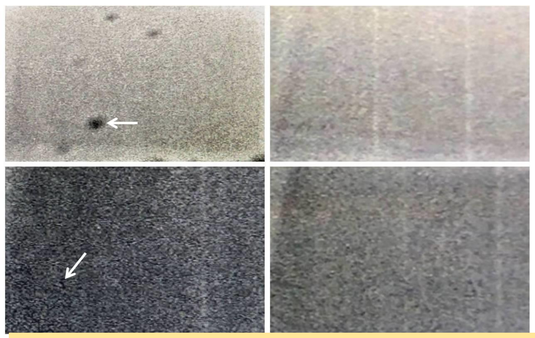


Light microscopy images (50x) for PDMS (top left) and PDMS + 0.2, 0.4, 0.9 vol% of SiC nanofillers .
Note: 0% SIC sample does not show any micro structures while 0.2-0.9 vol% of SiC are showing progressively more dense microstructures.

Fig 2

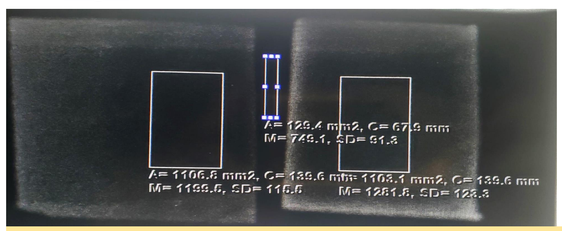
PDMS + 0.2 % SiC
(top) low x-ray techniques (40kV, 1 mAs), and (bottom) is medium power X-ray 45kV, 10 mAS, no grid, 10 magnification).
Low power x-ray image appears noisy (quantum mottle).

Fig 3



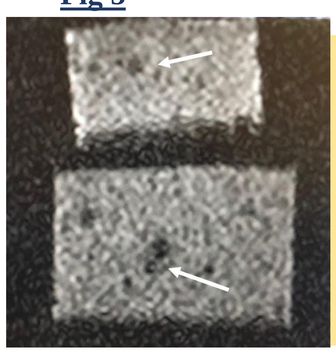
X-ray image: PDMS with 0%, 0.2%, 0.4%, and 0.9% from top left, clockwise

Fig 4



X-ray images of 0% SiC/polymer is shown on the right and 0.9% of SiC/polymer is shown on the left. Absorbed x-ray intensity and background noise are shown in the ROI's.

Fig 5



200 um resolution MR image (from Prisma 3T)
Of 0% SiC/PDMS (top); 0.9% SiC/PDMS (bottom).
Defects (white arrows) are approximately 1-2 mm in size (1000-2000 um)

Analysis of data

Figure 3 shows progressively less x-ray absorption as the SiC content increased from 0% to 0.9%. Small air bubble defect seen on 0% sample. On 0.9% we can see slightly darker area also marked with arrow.
Figure 4 MRI images show higher MR signal for 0% and lower signal for 0.9% sample. MRI theory behind MR signal is under investigation.
Figure 4 demonstrates difference between signal (S) to noise ratio of two samples: 0% and 0.9% SiC
S (0%) / Bkgd Noise = (1282-123):91=12.8
S (0.9%) / Bkgd Noise = (1199-116):91=11.9
Percent Difference in S/N = (12.8-11.9) / (12.8+11.9)/2 = 7%

Discussion

SiC filler range (0-0.9% tested here) should be varied to obtain desirable biopolymer mechanical strengths, biocompatibility and drug transport properties. The signal pattern seen on x-ray and MR is not well understood.

Future plan includes, electrospinning generation of poly lactic acid (PLA) biopolymers as well as X ray and MRI with iodine and gadolinium contrast will be performed to understand pores and defects that affect tissue compatibility and utility of such biomaterials.

Conclusion

- We observed SiC particulates in optical images (Fig 1) while those structures are beyond the resolution of X Ray (Figs 2-4) and MRI (Fig 5).
- X-ray imaging is important while somewhat insensitive tool for microstructure characterization of biopolymers.
- MRI is important while excessively sensitive ~~tool~~ for mapping defects in characterization of biopolymers.

Acknowledgement

This work is funded by CRSP undergraduate research scheme at City Tech. We would like to thank Prof. Chen Xu for valuable discussions, Amina Shahbaz and Aldona Gjoni for help with X-ray and Kathleen Thangaraj from McLean Hospital, Boston for assistance with MRI.

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2. Sarkar et al. NMR imaging of morphology, defects, and composition of tire composites and model elastomer blends. *Macromolecules.* 1992: 1420-26.

Correlation of Open Lab X and Students' Final Grades

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Mentor: Prof. Vinokur

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Introduction

The Department of Radiological Technology and Medical Imaging mission is to provide education that will enable our students to become competent entry level Radiologic Technologist by utilizing open-ended laboratory. Open-ended laboratory plays an important role in the radiology. In other universities that use open lab, they have demonstrated that using this resource pushes student to self-think and to formulate their own strategies while applying their understanding of concepts.[1] We will discuss how first, and second year students utilize open-ended laboratory and how does it impact their grades. Does it improve performance, communication skills and build confidence.?In addition, we are going to compare data from other years and see what trends impact the use of open laboratory.

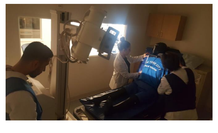
Program Structure

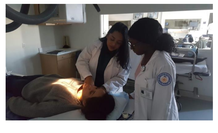
The program is separated into two, one-year phases with each year divided into trimesters. The first year is heavily weighted on the didactic side with classroom work three times a week and clinical twice a week. In this phase the student will be introduced to the science of Radiologic Technology and the different components to creating an acceptable x-ray. The second year consists of three days of clinical and two days of classroom work. In this phase, emphasis is placed on clinical competency and preparation for the American Registry of Radiologic Technology exam.

Goals

To produce Radiologic Technologists who hold entry-level clinical skills for employment, can demonstrate critical thinking skills, allowing them to meet the patients needs in the clinical setting, have excellent communication skills and to monitor overall program effectiveness to ensure we are meeting the needs of the students via the utilization of open-ended laboratory.

First year students practice on each other to learn proper position of body parts and placement of the central ray for the X-ray machines.





Second year students in the clinical sites and some at the open lab learning proper machine replacement for portable X-rays.

The learning experience may vary for the senior students in the open lab as they are heading towards becoming a licensed technologist. Second year students are getting a real-life experience from their clinical sites by being able to work with real patients, however, they are required to complete certain hours in the open lab to work on their weakness and building self confidence. They have more responsibilities as to give the best care to the patient and take the best images possible for the radiologist to diagnose the patient.

Abstract

Open ended laboratory or open lab as it is known to the Radiological Technology students is an invaluable tool that the Radiological Technology and Medical Imaging Department provides to help the students become better radiographers. One way to ensure students use this resource is to make it a weekly requirement for some classes, other classes have no requirements or may have a set total hour requirement per semester. We hope to study how utilizing this department resource impacts the student's final grades over a multi-year study. Does making it mandatory help the students succeed in improving their skills and knowledge base or does it harm students if they are unable to complete requirements. In surveying the Radiological students, we will investigate whether other factors impact how both the first and second students use this resource, such as personal commitments outside school, academic requirements that make it difficult to use this resource and whether or not the times designated as open lab are sufficient for all the students in the department.

Methodology

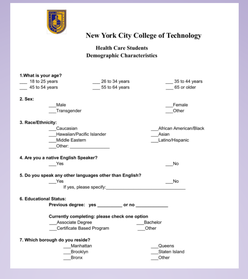
Our research builds upon data obtained from previous years of open laboratory and focuses on the students in the Radiological Technology Program. As part of a full year study to understand how attitudes, time and personal responsibilities, in addition to a participation requirement of open laboratory, we hope to understand how having or not having a mandatory open lab helps students perform better as radiographers. For the Fall of 2019, we have gathered statistical data detailing specific reasons of how students utilize the open laboratory hours that are set aside. Final grades for the fall will not be available for this poster session but will be presented in the Spring 2020 and a full year analysis will be available in the Summer of 2020.

Data will include snapshots of how the students are utilizing open lab over the fall semester. The same survey will be distributed several times in the Spring, and we will see if different semester academic and clinical requirements will impact how often and the end effect of open laboratory on the first-year students as they enter and complete the first phase of the clinical portion of their education

All data was exported into Microsoft Access for organization and analysis. We also used Microsoft Excel to create charts for more detailed data analysis.

Results

Utilizing surveys, we can gather snapshots of how the first year students are utilizing open lab and what external factors can impact their ability to use the lab during the hours that are available. This survey will be repeated before finals this semester and three more times for the first students in the Spring semester.



New York City College of Technology

Health Care Students

Demographic Characteristics

1.What is your age?
___ 18 to 25 years ___ 26 to 34 years ___ 35 to 44 years
___ 45 to 54 years ___ 55 to 64 years ___ 65 or older

2. Sex:
___Male ___Female
___Transgender ___Other

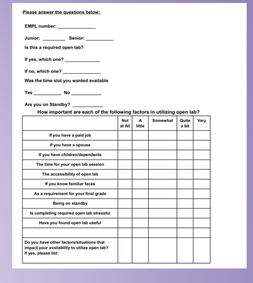
3. Race/Ethnicity:
___Caucasian ___African American/Black
___Hawaiian/Pacific Islander ___Asian
___Middle Eastern ___Latino/Hispanic
___Other: _____

4. Are you a native English Speaker?
___Yes ___No

5. Do you speak any other languages other than English?
___Yes ___No
If yes, please specify: _____

6. Educational Status:
Previous degree: yes _____ or no _____
Currently completing: please check one option
___Associate Degree ___Bachelor
___Certificate Based Program ___Other

7. Which borough do you reside?
___Manhattan ___Queens
___Brooklyn ___Staten Island
___Bronx ___Other



Please answer the questions below:

EMPL number: _____

Junior: _____ Senior: _____

Is this a required open lab?

If yes, which one? _____

If no, which one? _____

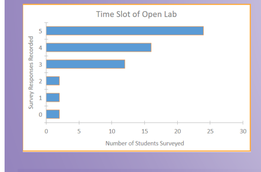
Was the time slot you wanted available

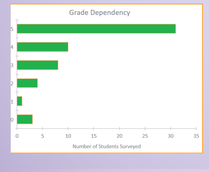
Yes _____ No _____

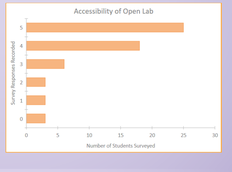
Are you on Standby? _____

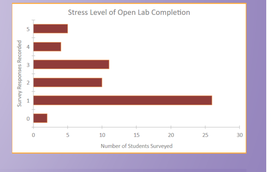
How important are each of the following factors in utilizing open lab?

	Not at All	A little	Somewhat	Quite a bit	Very
If you have a paid job					
If you have a spouse					
If you have children/dependents					
The time for your open lab session					
The accessibility of open lab					
If you know familiar faces					
As a requirement for your final grade					
Being on standby					
Is completing required open lab stressful					
Have you found open lab useful					
Do you have other factors/situations that impact your availability to utilize open lab? If yes, please list:					





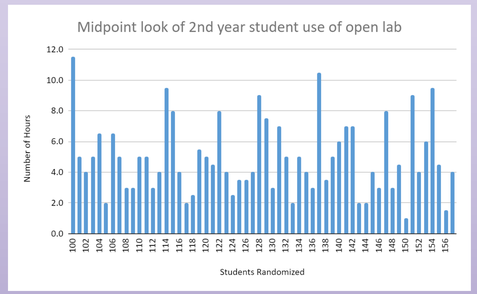




The importance gradient starts from zero which indicates no response to Very. Initial survey results demonstrate the students are "Very" satisfied with the availability and accessibility of open lab, low stress levels for completing open lab and high concern for the correlation of how open lab will affect their grades. As more surveys are completed, there may be shifting trends trends as first year students enter the clinical phase of their education.

Results continued

When analyzing 2nd year Radiological Technology students and their open lab requirement, only 9 out of 58 students have fully completed the total requirements at the mid-semester point. The remaining data will be gathered at the end of the semester, including any analytical correlation of increased open lab usage with final grades assessment.



Some of the objectives we will be looking at to see the correlation of grades with open lab

- ❑ Does increase number of open lab hours equal greater competency or greater communication skills in the clinic setting
- ❑ Does the increase number of open lab hours correlate to a higher grade
- ❑ Compare/correlation of the didactic and clinical grades.
- ❑ When tracking 1st years, does the weekly requirement lead to better technical performance during 1st clinical.
- ❑ Are the factors that impact first year utilization, have the same impact during the 2nd year, and for clinical
- ❑ When comparing grades of students, and open lab hours turn out a technically competent technologist or a compassionate, emphatic technologist.

Conclusion

Open lab requires students to think about what they are doing and why, while working collaboratively with others.[2] In the end, students are self-directed, reflective, who can think critically, all the while building on the skills that are highly desirable in the field of medical imaging. Successful use of open lab requires that students know how to use and operate the equipment, as well as having all the needed imaging phantoms. The open labs are meant to expand upon the professor taught labs and to reinforce patient positioning and proper technique to create the optimal radiograph for diagnosis.

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PART I: COMPARATIVE ANALYSIS BETWEEN NATURAL AND CERAMIC TEETH

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Mentor Professor Daniel Alter

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ABSTRACT

The aim of this study is to attain a general understanding regarding the developments in the composition and indications of ceramics in dental applications. An in-depth analysis of the evolution this material has undergone during the last century in order to obtain esthetic and functional dental prosthesis that replace natural teeth when they are missing.

MATERIALS AND METHODS

- Selected articles from the PubMed database. Ten scientific articles were selected.
- Key words: natural teeth, dental materials, dental ceramics, ceramic restorations.
- Selection criteria: 2000 to 2019
- Experts consulted: Professor Daniel Alter CDT/MDT, Professor Avis Smith CDT, experienced Ceramists.

INTRODUCTION

Dental Ceramic materials have physical and optical properties that attempt to mimic the properties of natural teeth. The fabrication of ceramic restorations for every case is a complex process due to the particularities that natural teeth exhibit. Dental technicians must work ceramic materials with the purpose of obtaining natural colors aiming to achieve proper esthetics, as well as functionality and durability. Valuable data for ceramic systems is becoming increasingly available and results can be obtained with many commercial materials, providing guidance, regarding proper indications, in order to obtain successful results. However, dental technicians are responsible for processing restorations that meet the particular and desired characteristics for each case, because they are to make the best decision with regards to the use of different ceramic materials.

RESULTS

Natural Teeth

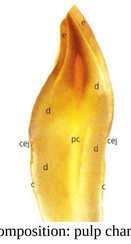

Figure 1. Tooth composition: pulp chamber (pc); enamel (e); dentin (d); cemento-enamel junction (cej); cementum (c)

Mature **enamel** is a **crystalline material**. Mature enamel is by weight **96% inorganic material, 1% organic material, and 3% water**. This crystalline formation consists mainly of **calcium hydroxyapatite/Ca10(PO4)6(OH)2**. CO3, Mg, K, Na, F are present in smaller amounts. The **ribbon-like crystals** of enamel are set at different angles throughout the crown area, each 30% larger than those in dentin. Enamel can endure crushing pressure of around **100,000 pounds per square inch**. Enamel appears **radiopaque (or lighter)**. Enamel alone is various shades of bluish white, which is seen on the incisal ridge of newly erupted incisors, but it turns various shades of yellow-white elsewhere because of the underlying dentin.

Mature **dentin** is a **crystalline material**. Mature dentin is by weight **70% inorganic material, 20% organic material, and 10% water.** This crystalline formation of mature dentin mainly consists of **calcium hydroxyapatite/Ca10(PO4)6(OH)2.** Small amounts of other minerals, such as carbonate and fluoride, are also present. The crystals in dentin are **plate like in shape.** Dentin also has **great tensile strength**, providing an elastic basis for the more brittle enamel. Because of the translucency of overlying enamel, the dentin of the tooth gives the white enamel crown its underlying **yellow hue**, which is a deeper tone in permanent teeth. Dentin appears more **radiolucent (or darker)**.

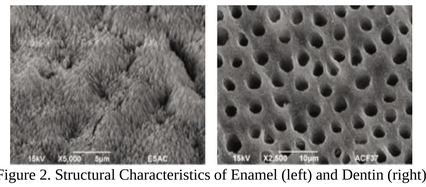

Figure 2. Structural Characteristics of Enamel (left) and Dentin (right)

Ceramic Teeth

Dental ceramics are characterized by their refractory nature, hardness, chemical inertness, biocompatibility and susceptibility to brittle fracture. They are usually referred as nonmetallic, inorganic structures primarily containing compounds of oxygen with one or more metallic or semi-metallic elements like aluminum, calcium, lithium, magnesium, phosphorus, potassium, silicon, sodium, zirconium & titanium.

Physical And Mechanical Properties. Ceramics and glasses are brittle, which means that they display a high compressive strength but low tensile strength and may be fractured under very low strain (0.1%, 0.2%) dental ceramics have disadvantages mostly due to their inability to withstand functional forces that are present in the oral cavity. The structure of porcelain depends upon its composition, surface integrity and presence of voids.

Table 1. Physical and Mechanical Properties of Dental Ceramics

Compressive strength	330 MPa
Diametral tensile strength	34 MPa
Transverse strength	62 - 90 MPa
Shear strength	110 MPa
MOE	69 GPa
Surface hardness	460 KHN
Specific gravity	2.2–2.3 gm/cm^3
Thermal conductivity	0.0030 Cal/Sec/cm^2
Thermal diffusivity	0.64 mm^2/sec
Coefficient of Thermal expansion	12 × 10-6/°C

Classification Of Dental Ceramics. Microstructure and Translucency are the two classifications to consider and focus on. However, dental ceramics classifications interrelate.

Table 1. Physical and Mechanical Properties of Dental Ceramics

CLASSIFICATION OF CERAMIC BASED MATERIALS	
Uses or indications	e.g. anterior, posterior crown, veneer, post and core, fixed prosthesis, ceramic stain, glaze
Composition	ceramics that are predominantly composed of glass, those made of particle-filled glass, and those consisting of polycrystalline
Principal crystal matrix phase	silica glass, leucite-based feldspathic porcelain, leucite-based glass ceramic, lithia disilicate-based glass-ceramic, leucite disilicate-based glass-ceramic, aluminous porcelain, alumina, glass-infused alumina, glass-infused-spinel, glass-infused alumina/zirconia
Processing method	casting, sintering, partial sintering and glass infiltration, slip casting and sintering, hot isostatic pressing, CAD-CAM milling and copy milling
Firing temperature	High-fusing (1,300°C), medium-fusing (1,101°C to 1,300°C), low-fusing (850°C to 1,100°C), and ultra-low-fusing (< 850°C)
Microstructure	**amorphous glass, crystalline, crystalline particles in matrix**
Translucency	**opaque, translucent, transparent**
Fracture resistance	Low, medium, hard
Abrasiveness	Comparison relative to enamel, against tooth enamel

Classification by Microstructure. At the microstructural ceramics are defined by the nature of their composition of glass-to-crystalline ratio. Ceramics can be broadly classified as non-crystalline (Amorphous Solids or glasses) and Crystalline ceramics. They can be broken down into four basic compositional categories, with a few subgroups:

1. Composition category 1 – glass-based systems (mainly silica)
2. Composition category 2 – glass-based systems (mainly silica) with fillers
3. Composition category 3 – crystalline- based systems with glass fillers
4. Composition category 4 – polycrystalline solids (alumina and zirconia)

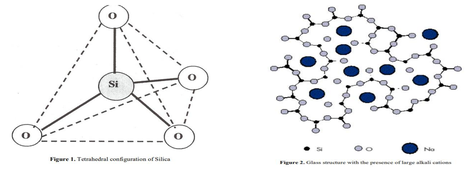

Figure 3. Dental Ceramics Based on Their Microstructure: (1) predominantly glass; (2) particle-filled glass; and (3) fully polycrystalline.

Classification by Translucency. A natural tooth derives most of its color as a result of the light reflectance from dentin that is altered by absorption and scattering by the enamel. Several factors affect the translucency of dental ceramics. Thickness of the material has the greatest effect, but translucency can also be affected by the number of firings, the shade of the substrate, and the type of light source or illuminant. Porcelain translucency is usually measured with the translucency parameter. or the contrast ratio (CR). The chemical nature, size, and number of crystals in a ceramic matrix will determine the amount of light that is absorbed, reflected, and transmitted compared with the wavelength of the source light.

Figure 4. Relation Between Translucency and Opacity

All teeth that are naturally covered by the enamel present opalescence. In ceramic systems, opalescence has been responsible to solve aesthetic problems making possible to produce unnoticeable restorations. The correct reproduction of opalescence involves careful observation of adjacent teeth and the selection and application of opalescent in appropriate locations.

Figure 5. Central Incisors Opalescence. Under Reflected Light (left). Under Transmitted Light (right)

Fluorescence is a luminescence phenomenon. Tooth fluorescence is usually associated with a blue-white chromatic appearance caused by the incidence of the UV wavelength. Under natural light, fluorescence makes teeth more luminous and shinier, giving them an internal luminescence. The incidence of UV wavelengths in a tooth restored with nonfluorescent material causes metameric failure and is responsible for highlighting the restorative material. Fluorescence must be present in restorative materials to obtain natural-looking results.

Figure 6. Central Incisors Fluorescence. Under Daylight (left). Under Black Light (Right)

DISCUSSION

The natural tooth section on the right is 0.55mm thick. From this cross section, it is easy to see the optical complexities of tooth structure. The feldspathic ceramic cross section on the left is 1.5mm thick. This cross section shows the different layers of material that are necessary to mimic natural teeth. The sample in the center is a replica of the left sample. It is made from monolithic zirconia. The zirconia cross section shows the optical challenges the dental technician faces when using this material to match teeth. Light scattering within homogenous monolithic materials makes the replication of teeth very difficult. Monolithic materials have gained in popularity, but present many esthetic challenges.

Figure 7. Natural Tooth Cross Section (Right). Fieldspathic Cross Section (Center). Zirconia Cross Section (right)

A shade value is taken when integrating tooth-colored restorative materials or artificial teeth or crowns within an individual dentition. The goal is to match the color of the patient's surrounding natural teeth as closely as possible. The optical properties of new generation porcelains mimic more closely the interaction of the natural dentition with light. The "illusion of reality" is developed by carefully blending opalescence, fluorescence, and translucency given by the composition of the dental ceramics to be used when fabricating ceramic prosthesis.

CONCLUSION

Dental ceramics is a material group that would continue to play a vital role in dentistry due to their natural esthetics and biocompatibility. However, there will always remain a compromise between esthetics and biomechanical strength. In order to achieve adequate mechanical and optical properties in the final porcelain restoration, the amount of glassy phase and crystalline phase has to be optimized. Good translucency requires a higher content of the glassy phase and good strength requires a higher content of the crystalline phase. For this reason, the two material phases need to be balanced. Success of the ceramic restoration depends on the collaborative work between dental clinicians and technicians and their ability to select the appropriate material to match intraoral conditions and esthetic demands.

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Non-Destructive Testing on Concrete

Shaylin Venitelli, Raadiya James, Professor Navid Allahverdi

Civil Engineering and Construction Management Technology

Abstract

The use of concrete in the world's infrastructure dates back centuries. Builders in Ancient Rome used limestone and volcanic rock to create structures more durable than many of those erected today. In order to assess the strength of existing structures the construction industry utilizes Non-Destructive Testing. Non-destructive testing applies to a diverse array of techniques used in science and technological fields in order to evaluate the properties of a material, component or system without causing damage. Non-destructive testing is applicable to many fields and circumstances in which properties are unknown or have changed due to time. It allows analysts to determine how strong structures are without destroying their integrity and preserving their form.

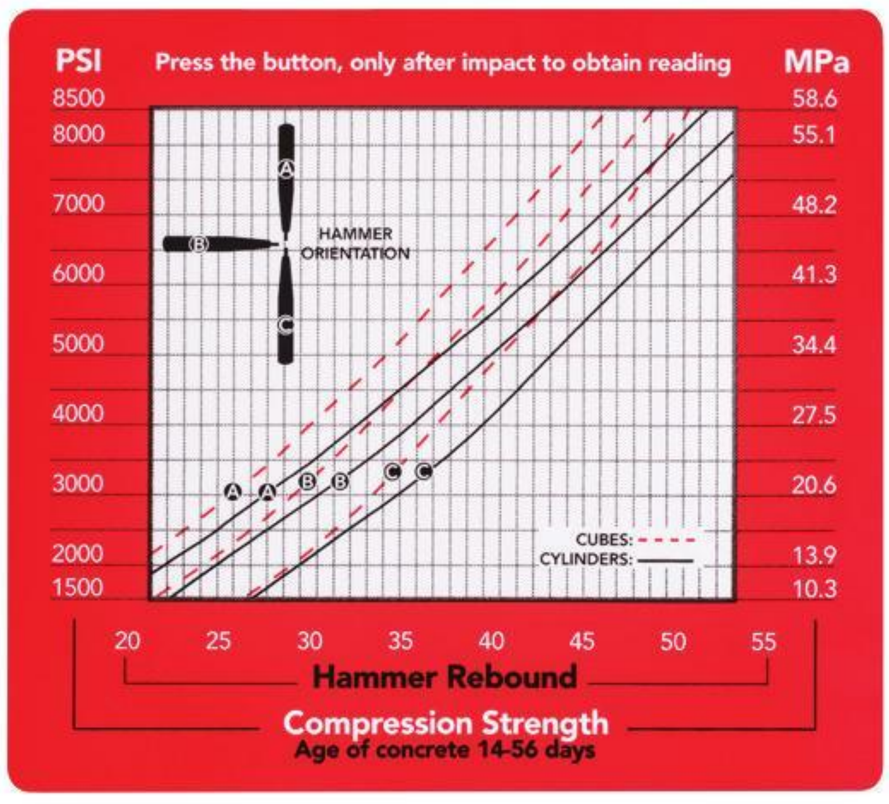
With the use of devices such as the Schmidt Hammer, the elastic properties, or strength of concrete, are determined through the rebound resistance that the tested material exerts on the device. The accuracy of non-destructive testing results will be assessed through comparison with results obtained from destructive techniques. With comparative data describing the benefits of non-destructive, the industry can focus on efficiency and productivity.

Research Findings

1. Determine the most efficient means of NDT
   - The Schmidt Hammer provides an inexpensive means of analysis in determining the strength of concrete.
   - Most NDT techniques are expensive and determine a variety of different properties.
2. Evaluate how the Schmidt Hammer works:
   - It determines the strength and homogeneity of an existing concrete specimen.
   - It provides a value to allow the user to analyze the compressive strength.

Schmidt Hammer for Sclerometric Method

The above images represent the process of taking a reading from a Humboldt Schmidt Hammer.



Depending on the position in which the test was taken, in this case Class A, the hammer rebound helps to determine the compressive strength in either PSI or MPa.

Future Analysis

In the semesters to come we will explore:

- The Schmidt Hammer under proper conditions to determine the strength of materials.
- Comparative data between non-destructive techniques and destructive techniques.
- Different types of NDT methods to determine different properties of the concrete specimen being examined.
- Analyzing and comparing data found.

Conclusion

The construction industry is a large contributor to how an economy functions and grows. With the constant need for concrete analysis the amount of waste that compiles daily is unfortunate. With the use of NDT approaches in the field the amount of waste can be limited in the construction industry. Once these procedures are adapted and implemented it can be an efficient means of determining the strength of structures both new and existing.

In the upcoming semester we hope to find valuable comparative data that will help to prove the reliability of NDT such as the Schmidt Hammer, as well as other means of NDT testing

Refernces

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Augmented Reality Gaming: Harnessing Real-World Environment With Game Interactions

Steven Li; Prof. Mendoza

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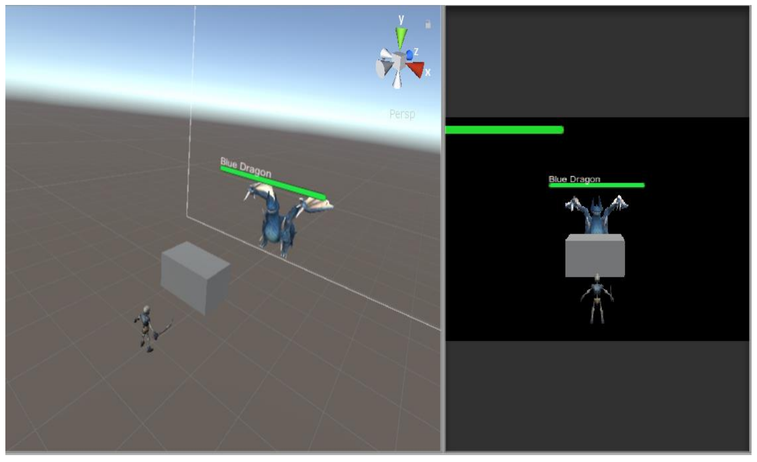
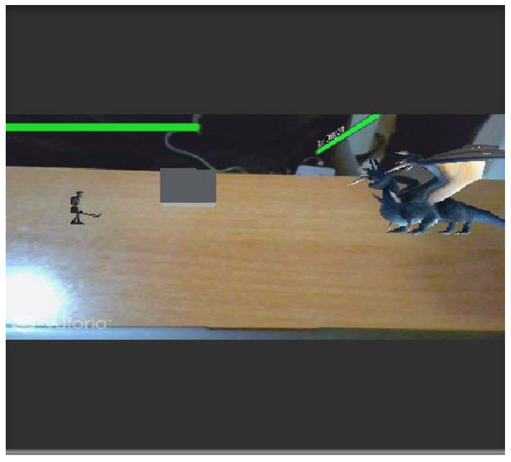
Introduction

Augmented Reality or AR is a technology that allows people to use computers that bring visual objects which does not actually exist into the real world surroundings. AR technologies enhance the version of the physical environment with computer-generated sensory input such as sound, video, or graphics overlaid on top of the real-world view. AR can also be used to improve the user experience while interacting with the world. Today, some examples of AR games consist of Pokémon Go and Zombies Run!. These games display virtual characters in the real-world using smartphones, capturing the surrounding environment, and embedding the virtual characters as if they were real ones. In these games, players are also able to interact and play against each other. AR has other uses beyond gaming, for example, it can be used to display an interactive MTA map just by scanning a small barcode. In this project, we focus on making virtual characters interact with the real-world environment and explore more possibilities on how AR can be used to communicate between the people and virtual objects. Many AR applications bring virtual objects to the real-world environment but are unable to make them interact with real objects around them because both objects are in two different worlds. Our goal is to make AR interact with real-world objects like they actually coexist in a cyber-physical world.

Process

- An AR camera was added in order to catch the characters and display it to the real world.
- Like any other games, two characters will attack each other while also being affected by the objects that surround them in the actual world.
- Objects like a box will be placed in the game world between them, making them unable to pass. If there was also a box like structure between them in the real world, then it will make it seem as if the characters are really interacting with them.





Results

- Through the camera on the computer, the characters was able to be seen in the real world.
- Both characters was able to move and interact with each other.
- The box in the image will serve as an object like a notebook. If a real notebook exist in the real world, then when the box and notebook overlap together, it will look like as if the characters are touching the notebook.

Next Step

In the next step of the project, I will try to display the AR image through goggles instead of other electronic devices such as a smart phone or computers. The reason behind to this next step is because goggles are much easier to wear and bring around to scan AR than a phone. There are limits to how much a phone can capture while when using AR goggles, it is able to capture much more view and objects all at once.

Additionally, I will also find a new way in how people can scan barcodes or other actions using buttons existing on AR goggles. If people are able to use their hands to give out instructions to the AR goggles, then it would definitely be a lot easier for people to use.

Conclusion

AR have always been used in a way where people are able to see the virtual image created but are unable to react with the real environment. Therefore, I think by creating a shape like object in the virtual world and make it coexist with a same shape object, then it is able to make the characters and object move at the same pace.

If AR are able to communicate with the real world, then in a way, it would make it more realistic and more fun.

References

- AR goggle image from the following website: https://arpost.co/2018/08/27/the-big-year-for-ar-your-ar-glasses-intro-guide-for-2018/

Acknowledgements

Thanks to Prof. Mendoza for introducing me to CRSP and supporting me in this project.

Image Classification – MNIST

New York City College of Technology, CUNY
Department of Computer System Technology

Students: Saminur Miah *Mentor*: Prof. Marcos Pintos

Abstract

One of the problem that arises when dealing with extremely large amounts of data, big data, is image classification and among the type of image data we have to deal with is handwritten text that must be 'read' by an automate system, for example a computer. And there comes machine learning again which is a method that relies on the fact that one can build systems that can learn from data, identify patterns and make decisions with minimal human intervention. The project uses a popular dataset called MNIST (Modified National Institute of Standards and Technology) that contains handwritten digits that is commonly used for training various image process systems.

Introduction

MNIST is a dataset of images of hand-written digits from 0 to 9.Since its release in 1999, this classic dataset of handwritten images has served as the basis for benchmarking classification algorithms. As new machine learning techniques emerge, MNIST remains a reliable resource for researchers and learners alike. In this competition, we aim to correctly identify digits from a dataset of tens of thousands of handwritten images. Kaggle has curated a set of tutorial-style kernels which cover everything from regression to neural networks. They hope to encourage us to experiment with different algorithms to learn first-hand what works well and how techniques compare.

Test Methods

For this competition, we will be using Keras (with TensorFlow as our backend) as the main package to create a simple neural network to predict, as accurately as we can, digits from handwritten images. In particular, we will be calling the Functional Model API of Keras, and creating a 4-layered and 5-layered neural network

```
In [1]:
import pandas as pd
import numpy as np

np.random.seed(1212)

import keras
from keras.models import Model
from keras.layers import *
from keras import optimizers
```

Figure 1

Test Data & Results

```
In [2]:
df_train = pd.read_csv('../input/train.csv')
df_test = pd.read_csv('../input/test.csv')
```

```
In [3]:
df_train.head() # 784 features, 1 label
```

ut[3]:

	label	pixel0	pixel1	pixel2	pixel3	pixel4	pixel5	pix
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	1	0	0	0	0	0	0	0
3	4	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0

5 rows × 785 columns

Figure 2(a)

1	ImageId	Label
2	1	2
3	2	0
4	3	9
5	4	9
6	5	3
7	6	7
8	7	0
9	8	3
10	9	0

This is the output

Conclusion:

Following our simulations on the cross validation dataset, it appears that a 4-layered neural network, using 'Adam' as the optimizer along with a learning rate of 0.01, performs best. We proceed to introduce dropout in the model, and use the model to predict for the test set. The test predictions generated by our model predicts with an accuracy score of 97.600%, which places us at the top 55 percentile of the competition.

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Acknowledgements

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Implication of local weather on heat transfer rates by infiltration

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Mentor: Prof. Daeho Kang

ABSTRACT

The first law of thermodynamics, also known as "Law of Conservation of Energy", states that energy can neither be created nor destroyed; energy can only be transferred or changed from one form to another. The natural transfer of heat flows from a warmer environment to a colder environment. Infiltration through a building entrance door has major impacts on the indoor thermal environment, indoor air quality and energy performance. In our research, we measured differential pressure and air velocity across entrance doors. We also monitored the indoor and outdoor environments in the Environmental Building by collecting data using specialized instruments and sensors. After analyzing the measured data, we were able to calculate the heat transfer of the infiltration through the entrance doors. Finally, we were able to compare the heat transfer rates calculated from local weather and standard weather.

INTRODUCTION

The Architectural Design for a building has an effect on the day to day operations and functionality. This is especially true when it comes down to deciding what materials to choose for the building envelope, determining where to place the entrance doors & what types of entrance doors to use. These factors have a direct impact to the indoor thermal environment, indoor air quality & the building energy performance. For this project we conducted research on infiltration through the entrance doors in the Environmental Building. On a cold winter day, we measured local weather conditions, along with other environmental parameters in the Environmental building. With the measured data we were able to accurately calculate the airflow rates & quantify energy losses through the entrance doors. This poster presents the methods we developed & the significance of the weather sources in the calculation of heat transfer rates by natural air flow through building entrance.

RESULTS

Table 2 Heat loss calculated by two weather data sources in Environmental Building

Variable	Measured Weather		Standard Weather	
	Door 1	Door 2	Door 1	Door 2
Velocity (fpm)	109	139	350	351
Flow Rate (CFM)	2179	2756	6999	7017
Temp Difference (F)	9.8	9.6	11.3	11.6
Heat Loss (MBTU)	24	29	86	86

DISCUSSION

This is part of a long-term project to investigate the impact of infiltration through building entrance doors. This poster focuses on the influence of weather resources on the prediction of the infiltration through entrance doors. We have developed a method to accurately quantify infiltration rates and successfully estimate the heat losses due to the infiltration as shown in Table 2.

Table 2 shows that using the local measured weather is critical in the accurate prediction of heat losses through building entrance door. Standard weather data is widely used to predict physical phenomena taking place in buildings and their surroundings. The heat transfer rates of infiltration are solely dependent on the weather data since the energy equation is the function of an air flow rate and a temperature difference. The results indicate that if the standard weather data is continuously used to quantify heat loss through buildings entrance door will lead to the system being oversizing and the heat loss being overestimated. As infiltration may improve indoor air quality, this aspect should also be studied.

METHODS

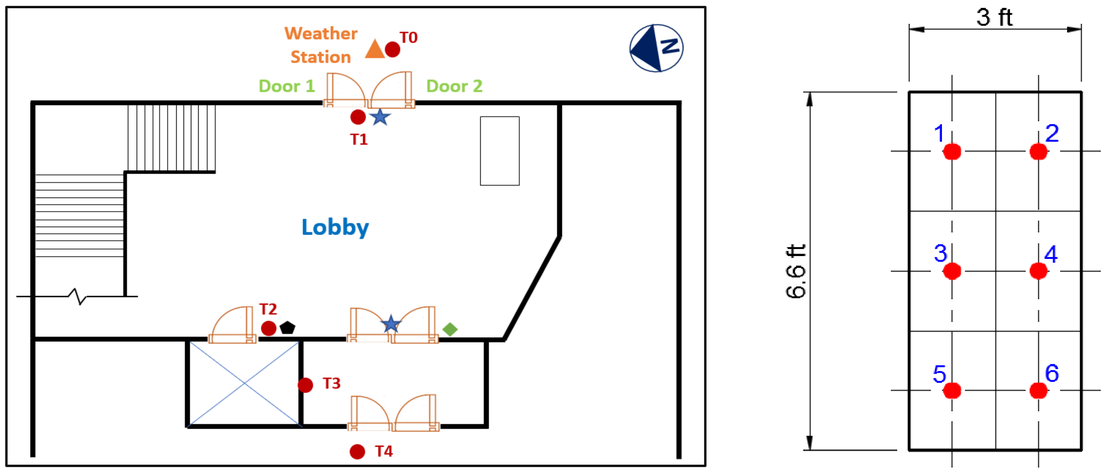

Figure 1 The measuring points on a building plan and the section of entrance doors

This differential pressure across the entrance doors in *in. wg.* can be expressed as

$$P_{diff} = P_h - P_l$$

where P_h is high-pressure side in *in. wg.* and P_l is low-pressure side in *in. wg.* The air flow rate in *CFM* across the entrance doors is expressed as

$$Q = AV$$

where *A* is the area of doors and *V* is the velocity of incoming air in *fps*. The energy equation is used to calculate the heat transfer rate of the natural airflow as

$$\dot{q} = 1.1Q\Delta t$$

where Δt is temperature difference in *°F* between outdoor air and indoor air.

Table 1 Measuring parameters and specification of the measuring instruments

Parameters	Instrument	Measuring Interval	Range	Accuracy	Resolution
OA Temp/RH	HOBO MX2301	1 min	-40-70°C	±0.2°C	0.04°C
Indoor Temp	HOBO U10	1 min	-20-70°C	±0.53°C	0.14°C
Door Opening	HOBO UX90-6M	1 sec	12m / 102°	-	-
Velocity	TSI Velometer	-	0-20 m/s	±5%	0.01 m/s
Wind Speed	HOBO U30	1 min	0-76m/s	±4%	0.5m/s
Wind Direction	HOBO U30	1 min	0-355°	±5°	1.4°

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MQTT Protocol for Application of In Internet of Things (IOT)

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Abstract

The Internet of Things (IoT) refers to a vast number of “things” that are connected to the internet so they can share data with other things. ThingsBoard is an open-source IoT platform that enables rapid development, management and scaling of IoT projects. With ThingsBoard, we can collect and visualize data from devices and assets.

Introduction

In our research topic we get familiar with internet of things in ThingsBords, it is a free open source grant by the government, it is used by most of technology companies in the USA.

MQTT can analyze incoming telemetry and trigger alarms in our system. MQTT is a publish-subscribe-based messaging protocol used in the internet of Things. It works on top of the TCP/IP protocol, and is designed for connections with remote locations where a "small code footprint" is required or the network bandwidth is limited. The goal is to provide a protocol, which is bandwidth-efficient and uses little battery power. So, it’s the perfect solution for Internet of Things applications. In our research project, we adopt the MQTT protocol with an open source platform, Thingboard, to collect real time data and display them in real time with user design dashboard. MQTT Integration allows to connect to external MQTT brokers, subscribe to data streams from those brokers and convert any type of payload from your devices to ThingsBoard message format. Its typical use is whenever your devices are already connected to external MQTT broker or any other IoT platform or connectivity provider with MQTT based back-end.

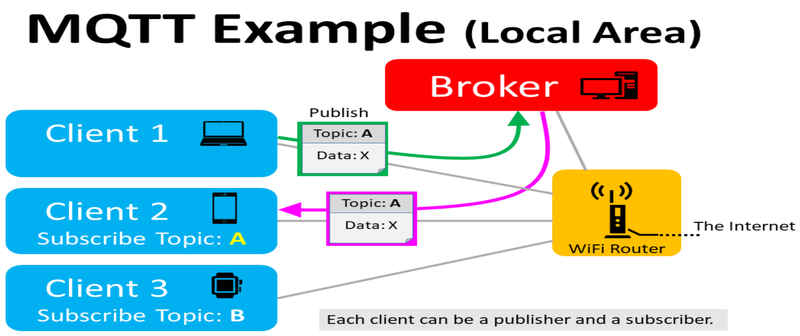

Fig. 1 MQTT bing.com

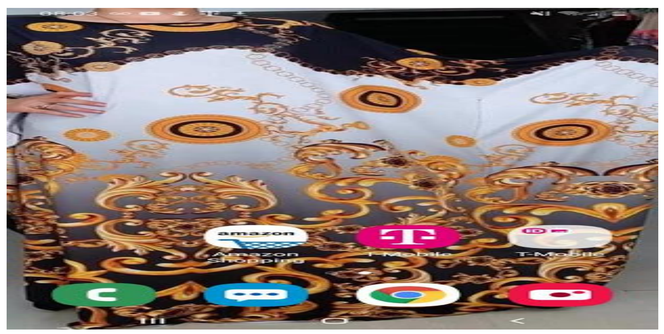

Figure 2
MQTT cloud

```
clc
close all
s=tf('s');
R=0.4e3;
R1=10;
%find inductance and capacitance from
impedances and frequencies
L=(5e3)/(2*pi*5e3);
C=1/((5e3)*2*pi*pi*5e3);
XL=s*L;
Xc=1/(s*C);
%transfer function
G=(R1+XL+Xc)/(R+R1+XL+Xc);
disp('Required transfer function')
minreal(G)
bode(G)
grid on
%this is notch filter or band reject
filter
%with fo=5kHz
```

Required transfer function

ans =

$$\frac{s^2 + 62.83\,s + 3.101e09}{s^2 + 2576\,s + 3.101e09}$$

Continuous-time transfer function.

Fig. 3 code of high band system

Network Access Methods Use by MQTT

. When multiples device need to share a communication or connect line, access methods are required to identify which devices can transmit data at appropriate time, this technique is called polling and selecting. MQTT use the broadband networks apply the frequency division, separating the communications line into many different frequency channels. The most common types of access methods use by MQTT are contention methods : Ethernet. Since the wireless technology can also be used to interconnect two wired networks, as result MQTT have also been used widely adopted by home users, technology companies, who prefer to plug in Ethernet for live video, home safe camera connect to the cellular or devices.

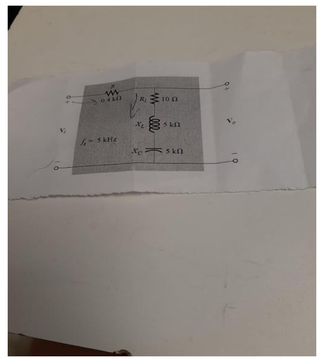

Fig. 3 System circuit

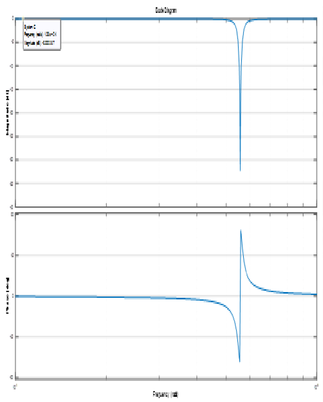

Fig. 4 Code MQTT System Plot .

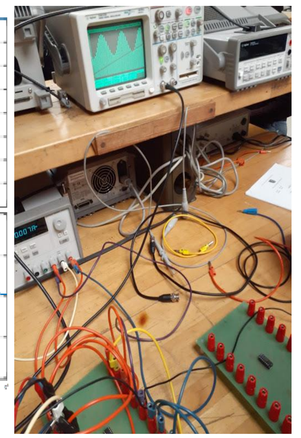

Fig.5 hardware Systeme use by MQTT

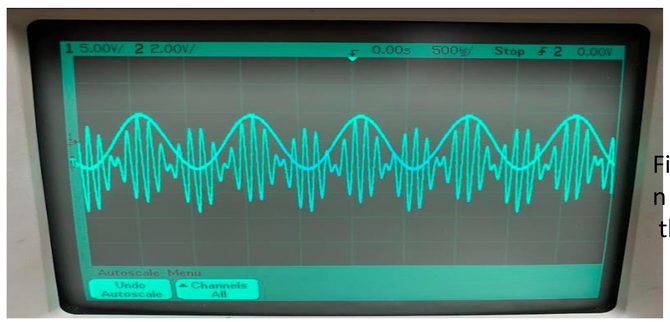

Fig. 4 MQQ Ssignal represented n
the modulated signal.

References

- ThingsBoard Website https://thingsboard.io/docs/samples/arduino/temperature/

Knowledge

- Thank you to Professor Xinzhou Wei to his explanations on MQTT,

Conclusion

MQTT is an open OASIS and ISO standard lightweight publish-subscribe network protocol that connect information between devices. MQTT use two different signals to create a modulated signal. MQTT also use frequency and other modulate the amplitude between the connection of Things. In this research we learned about how MQTT use intelligent in ThingsBoard, although it suppresses the carrier leaving only the sidebands. In amplitude modulation we also use a carrier signal superimposed on the intelligence signal, the benefit of this design is that to demodulate the signal we can use a single rectifier diode circuit in the application of things.. That is also the reason why MQTT is more widely used than because the process is very easy and can be achieving without having any noise.