CSTEP Summer Program for Undergraduate Research (CSPUR) 2021 Abstracts

Michael Calixto

PID Controller for Motion Control of a Mobile Robot

Faculty Mentor: Professor Xiaohai Li

Department: Computer Engineering Technology

PID stands for three terms: Proportional, Integral, Derivative, and has been broadly used in numerous applications to control a dynamical system to achieve the desired state. In this project, we aim to apply and develop a PID controller for the motion control of a mobile autonomous robot. This algorithm helps the robot drive in the desired trajectory (for example, a straight path) with certain parameters. A robot car with two alike motors will move forward but with the derivation of speeds due to the wheel, ground, and friction conditions. The PID controller will automatically correct the derivation and make the robot move along the desired trajectory. With self-driving cars becoming more popular, the algorithm will help assist the car in its journey.

The main hardware includes a smart car platform with two encoder gear motors, a motor driver, and an Arduino Nano 33 IoT microcontroller. The encoder's purpose is to find the position of each motor. The motor driver functions allow control of the speed and rotation of the motors. Ultimately, this microcontroller will apply the downloaded operations. The software using Arduino IDE language programmed a control system. The system consists of the algorithm, readings from the encoders, and motor control to drive this robot car. The algorithm holds the parameters for the system and the sum of the three terms. The encoders will have to return and display readings from the motor's shaft position. Lastly, the motor control function will drive the motors at variable speeds.

With the use of the plotter, the user can see the motor position and target position. While the motors rotate at similar speeds, the parameters of the system have to be adjusted to reduce errors from the straight path. A useful function to add is to display the speed of the motor shaft. This will allow you to see any speed difference while the motors rotate without any other tools. To improve the algorithm on its own will need additional sensors such as an IMU (Inertial Measurement Unit) that can be used to drive on unsmooth surfaces and/or environmental factors such as wind. Additional operations such as obstacle avoidance and target location may be added to advance this smart robot car.

Souleymane Diakite

Cloud Based-Object Detection in Computer Vision

Faculty Mentor: Professor Xiaohai Li

Department: Computer Engineering Technology

The recognition of a real-time object in interest has become a central problem for many industries, such as navigation, security, etc.... In this research, we focused on cloud-based-object detection in computer vision to train a model to recognize cars in real-time. We used Stanford's cars databases, which consists of over 16,000 cars divided evenly among 2 sets, set,train_set, and test_set. We stored these datasets in Amazon Web Service (aws) 's Simple StorageService (Amazon s3) and used Amazon SagerMaker to apply eXtreme Gradient Boosting(XGBoost). The research is inconclusive right now since I didn't finish, but hopefully, I can get enough fund to continue working on it.

Rosario Garcia-Cortez

Augmented Reality &Virtual Reality

Faculty Mentor: Professor Marcos Pinto

Department: Computer Systems Technology

The project focus on creating a simple Augmented Reality (AR) program that allows the addition of a virtual object to an actual instance of the real world, for example the insertion of a virtual object to the video captured by a computer's camera. The inclusion of the virtual object to the computer's cameral real scene is possible with the aid of a marker, a QR-type graphical mark, that triggers the computer to add the virtual object to what the camera captures from the real world. Research was done on AR as well as Virtual Reality (VR) and how both cause virtual changes in the real world. The benefits of AR and VR are increasingly being explored by business, industry, and education as a means for improving product manufacturing, sales, and research.

Aneeza Hussain

The Possible Library Project: Participatory Assignment Design

Faculty Mentor: Professor Nora Almeida

Department: Applied Chemistry & Library

This project involves a student as a research partner, ethnographic subject, and pedagogical co-designer in the redevelopment of a high-stakes assignment from the course LIB1201: Research and Documentation for the Information Age. This final assignment requires LIB1201 students to conceptualize and document a "possible library" that responds to a social need in a specific community. This assignment was designed specifically for virtual learning during the COVID-19 pandemic but many students struggled with both conceptual components and technical execution. In response, the original creator (course instructor) of the assignment invited a former student to collaboratively revise the "possible library" assignment based on their first-hand experience in the course and subsequent analysis of the assignment as a

pedagogical artifact. As part of this process, we conducted research on assignment co-creation, student-centered pedagogy, and alternative information spaces. We also designed and conducted an ethnographic interview and incorporated the student's reflection and analysis facilitated by ethnographic inquiry into a revised assignment. This project positions the student as a research partner and co-designer of both the "possible library" assignment and the meta-cognitive revision process. The final deliverable includes critical, reflective documentation on the experience of participatory assignment design drawing from literature and first-hand student experience.

Fadimatou Mossi & Kadidjatou Mossi

Deep Learning Frameworks for Biometric Sensors

Faculty Mentor: Professor Yu Wang

Department: Computer Engineering Technology

The purpose of this research conduction is to study and review the machine learning frame and algorithms for biometric data sets used in health care fields. Our role as CSTEP research assistants was to disseminate data and papers published by the Institute of Electrical and Electronics Engineers (IEEE), Association of Computer Machines (ACM), and other professional organizations and sources, and provide a comprehensive presentation of ways deep learning frameworks are used in biometrics and new technologies to preserve the future of healthcare. In order to accomplish these tasks, we read published articles and journal papers about machine learning and its uses in health care, along with reading and learning about Python programming languages. The lab platforms used for machine learning algorithm study include Pycharm and Jupyter Notebook in Anaconda. Although we are still in the process of analyzing data, we gained skills in professional writing capabilities, referencing, public skills and the understanding of compiling open-source data. Our future research includes collecting datasets about diabetes prediction using machine learning.

Jasmin Mou & Erik E. Peregrina

Bi-Polar Stepper Motor Control Via Infrared Remote

Faculty Mentor: Professor Andy Zhang

Department: Mechanical Engineering Technology

Mechanical engineering is a major that is involved with designing products that have moving parts. Motors are used in many cases to provide the motion needed for the products. Any mechanical engineering students who will be working on product design much have knowledge on motion control and how to choose motors and their controllers that accomplish the desired motion.

Motor selection and control thus has become a staple wherever motors are used. In cars and trains, or even in machines, motor control becomes the vital part in the product design. There are different ways to control various types of motors, and each has its own advantages and disadvantages. This project deals with motor control for stepper motors.

Stepper Motors are highly precise motors that are used in manufacturing machines, 3D Printers, robotics, or other precision machinery. Being able to control these motors with precision is vital to obtain the results desired. There are many ways to control these motors through computer input, analog input, and other various inputs.

The research project involves the selection of stepper motors and stepper motor controllers or drivers based on the load and current rating, and how to control the stepper motor remotely using IR technology.

Gilbert Page

A Framework to Designing an Online Survey Tool

Faculty Mentor: Professor Elizabeth Milonas

Department: Computer Systems Technology

Properly articulated research problems, objectives, and questions form the foundation for successful research. Further, if data collection is wrong, there is the risk that the entire research becomes useless. If data is erroneous, the research objectives may fail to be answered. Consequently, the findings get mismatched with the research objectives leading to the drawing of wrong conclusions and recommendations. Therefore, the research can become invalidated. There are some data collection challenges and mistakes to avoid to collect data that closely matches the research objectives. The use of complicated forms, inadequate identification of the respondent, language barriers, and insufficient responses can hinder the collection of relevant data. The results of the studies in the literature review indicate a lack of a design framework that integrates the pre-data collection tasks with the survey tool and its distribution. The findings within the literature reviews also led to a framework that can inspire the design of an online survey tool. This research is focused on the development of methodology for an online tool which can be used to help avoid these data collection errors. By reviewing literature, available information on challenges to data collection, and how the use of a well-designed online tool should help the collection of more accurate research data.

Mark Stewart

Comparing SQL to NO-SQL

Faculty Mentor: Professor Jean Boulet

Department: Computer Systems Technology

This research project presents the difference between a relational database management system (Oracle) and a non-relational (NoSQL) document-oriented database management system (MongoDB). The following features were compared for both the relational and non-relational database systems: importing data, creating tables, inserting values, and querying. The task was to understand the purpose of using the NoSQL in this day of age. We used a Costco like database with purchases, ID's, dates, total items. The following is a comparison of this task.