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EECS 1021

Major Project

INTRODUCTION:

- This is a project where it uses mechatronics and Graphical User Interface (GUI) to effectively and efficiently control a robot arm and a conveyor belt.
- All the icons, buttons, windows, menus, scroll bars, and so on are made using GUIs. GUI helps create easy, user-friendly, and visually appealing software designs to interact with electronic devices [1].

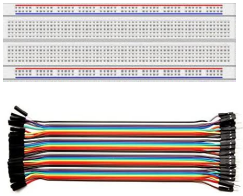
CONTEXT:

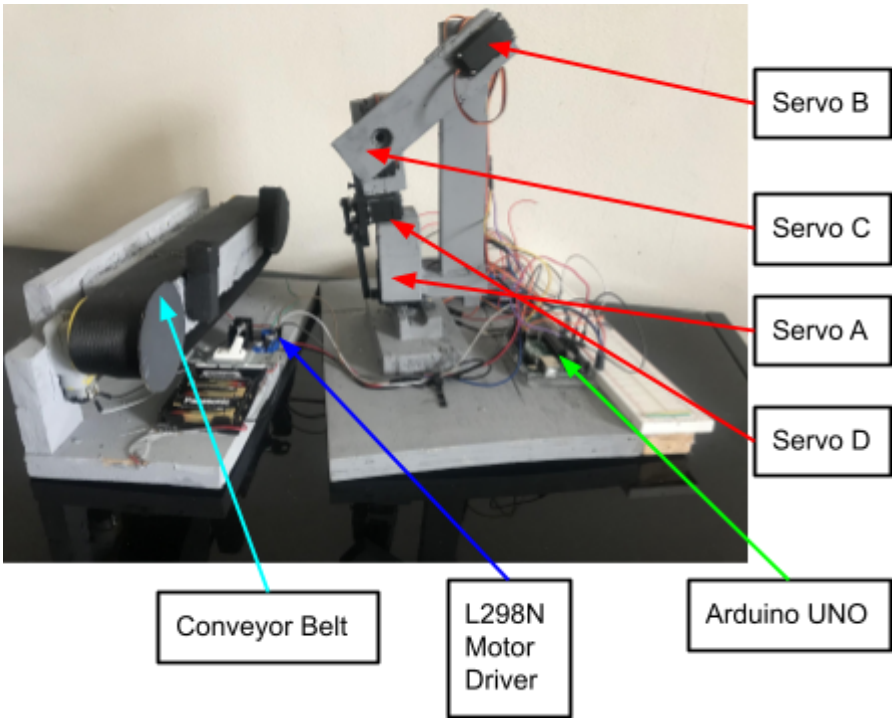
- Robot arms are used in most industries and are one of the most essential and widely used robots in this day and age. For example, robot arms are used in manufacturing industries to weld, pick up objects, place them in their designated locations, and etc. To create easy, user-friendly, and visually appealing software designs to control these robot arms, Graphical User Interface (GUI) can be used. GUI helps create safe designs to control these robots effectively compared to physical switches and buttons. GUIs help visually illustrate how, why, and where these robots can be used which gives more clear and precise information about how to run the robots which is extremely useful for creating safe work environments. In addition to the robot arm, this project includes a conveyor belt made from 2 DC motors, 2 motor gears and a seat belt.

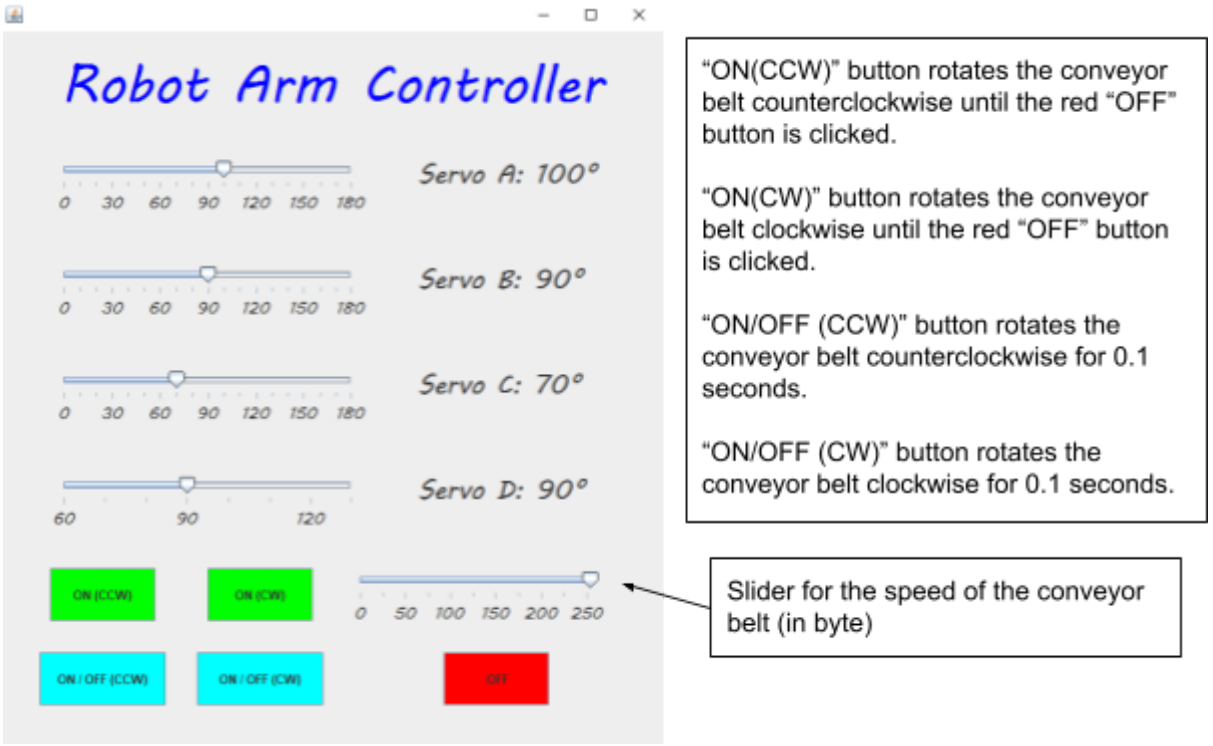
TECHNICAL REQUIREMENTS / SPECIFICATIONS:

- This project uses a conveyor belt and a robot arm controlled by Java Graphical User Interface (GUI) to pick up and put objects from the conveyor to the designated locations. This conveyor belt is used to transport objects to the robot arm so that it picks these objects and puts them into their designated spots. The conveyor belt makes it easy for the robot by supplying these objects to it.
- The robot arm is made from 4 MG995 Servo Motor, a gripper, and wood for its body. The conveyor belt is made from 2 DC motors, 2 motor gears, 2 wheels, and a seat belt. The conveyor belt is controlled by an L298N motor driver. This motor driver allows us to control the direction of rotation and speed of the conveyor belt. In addition, the motor driver allows us to power up anything up to 25V without burning the Arduino Uno.

COMPONENTS LIST:

Quantity	Material	Picture	Quantity	Material	Picture
4	• MG995 Servo Motor		1	• Actobotic Horizontal Standard Gripper Kit A	
1	• L298N		1	• Arduino Uno	
2 2 2	• Tire Wheels • DC Motors • Gears		2 10+	• Bread Board • Wires	
10+	• 9V and AA Batteries		10+	• Wood	-
1	Switch		1	• Seat belt	-

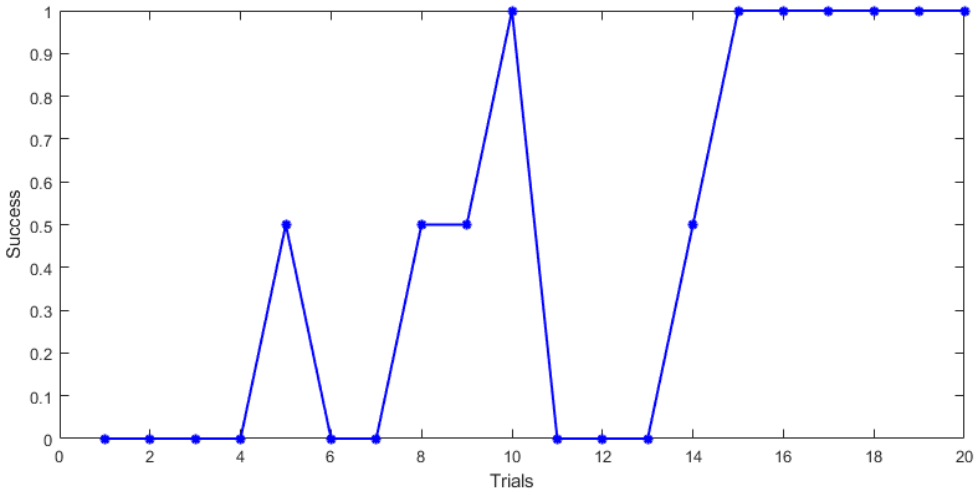




PROCEDURE:

- This project took multiple procedures to make. First, woods were cut into needed lengths suitable to the design. Then these woods were drilled and cut to allow the servo motors to be attached properly. Before connecting the woods and servos, the servo positions needed to be calibrated to degrees required from the design. Finally, to finish off the robot arm, a Actobotics Horizontal Standard Gripper Kit A was added.
- To make the conveyor belt, 2 DC motors, 2 motor gears, 2 wheels, and a seat belt were required. The seat belt was then cut and sewed after connecting both ends.
- For the Java code, Maven libraries such as JMusic, and Firmata were used. For the robot arm controller made by Java GUI, 5 JSliders, 5 JLabels, 5 JButtons were made. Each servo motor is controlled by a slider designated to them (named like "Servo A", "Servo B", "Servo C", "Servo D"). The first slider (slider0) is used to control the speed of the conveyor belt. The 5 buttons are also used to control the conveyor belt. Two of the buttons (green) are "ON" buttons (one to rotate clockwise(CW) and the other counterclockwise(CCW)). The other two buttons (cyan) are also "ON" buttons but they only rotate the conveyor belt clockwise (CW) and counterclockwise (CCW) for 0.1 second. This helps us move objects on the conveyor belt to fine margins.

TEST:



- This is a Success vs Trials graph showing whether each trial was successful or unsuccessful. When the trial is unsuccessful, the success on the graph is given 0 and when the trial is successful the success on the graph is given 1.
- For the first 4 tests, the robot arm didn't work as planned as the MG995 Servo Motors were spinning uncontrollably. After a couple of minutes of research, I found out that the Servo Motors require additional power supply on top of what the Arduino Uno was offering. After adding external 9V and AA batteries, the robot arm showed improved performance but it didn't show the desired outcome hence why it's given 0.5 for the 5th trial. After the 5th trial, it crashed and one of the Servo Motors got burned because of excess power supplied by the batteries. After changing that Servo Motor, the robot arm showed improvement again but still not the desired outcome. After a roller coaster of performance, on the 10th trial, the robot arm worked perfectly. However, it stopped working immediately and for the next 3 trails. Finally, on the 14th trail, the robot arm showed a perfect performance and kept that performance for the last 6 trials.

LEARNING OUTCOMES:

- The code (program) for this project was tested and debugged multiple times (shown in the graph above) before finalizing the design.
- A suitable program using Java Graphical User Interface (GUI) and firmata4j was built to create a simple yet useful and applicable design that is commonly used in the 21st century.
- In order to perform its designed tasks, Servo Motors, DC motors, L298N motor driver, Java Graphical User Interface (GUI), and commonly used materials were used to make this project.

CONTINGENCY:

- At the early stages of brainstorming for this project, I planned to use a TCS3200 color sensor so that the robot arm can only pick up objects with a chosen color. The color sensor distinguishes between colors by their frequencies. However, my limited knowledge about JAVA and firmata4j prevented me from using this color sensor. One big lesson I learned from this project is how to use time effectively. I started planning about the project before the start of the term. As a result, I was able to execute my plan even though I had to adjust my initial plan. In my 2nd, 3rd, and 4th year of Computer Engineering Degree, I would like to expand on this project. To expand and improve this project, I am planning to use 3D printers to print the robot bodies and other advanced materials.

ADDITIONAL MATERIAL:

- As mentioned above, robot arms have become one of the most commonly used robots in industries in the 21st century. These kinds of robots are cost and time effective, reliable, and fast. In addition, these robots can work 24/7 without needing air conditioners or food as long as they get power which a human being isn't capable of. Furthermore, we can use robot arms to perform tasks that are dangerous for human beings to do. This helps reduce accidents, human labor, and unnecessary cost in the long run.

CONCLUSION:

- This project is a mini representation of many robot arms used in industries such as automotive, assembly, food preparation, agriculture, and etc. The robot arm in this project uses a conveyor belt to deliver an object to it so that it can pick it up and drop it to the chosen location. To effectively and simply perform this task, Java Graphical User Interface (GUI) was made. The built GUI has sliders, buttons, and labels. These combined help us to simply, efficiently, and precisely control the robot arm and conveyor belt to small margins.

Citation

1. "Graphical User Interface." *Wikipedia*, Wikimedia Foundation, 31 Mar. 2022, https://en.wikipedia.org/wiki/Graphical_user_interface.