EE183 DA
Team Buffalo
Preliminary Project Proposal

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February 7th 2019

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1.1 Problem Statement

Watching entertainment, whether sports or a movie, on a television commonly entails consuming snack food while watching. The biggest problem this presents is that these two activities often conflict with one another; in order to consume snack food, one must stand up and exit the room where the entertainment is to retrieve snacks from the kitchen. This action diverts their attention away from the entertainment and to the process of getting food. This can often lead to undesirable situations for the individual getting the snack food, particularly in the example of getting snacks during a sports game, where, without warning, an exciting moment can occur, and the individual retrieving snacks will miss the excitement and the positive emotions that come with said excitement.

One possible and common solution to this problem is to place the snacks in a bowl next the oneself while watching entertainment on a television. The problem with this approach is that unless the bowl is very large and therefore cumbersome and taking up an unnecessary amount of space, the bowl will eventually be emptied of snacks and the person watching entertainment will be faced with same problem as before.

1.2 Proposed Solution

The proposed solution is a snack launching system that determines where it is launching the snack by using facial detection to identify the location of humans in the room, determine the distance between the system and the human, determine the required trajectory and force, and then launch the snack to the human's mouth. The solution will consist of four parts, the first is a hardware and software system that uses facial detection to find and identify all human faces in the room. The second is a system that will use the output of the facial detection system to find the distance from the launcher to the human and determine the required trajectory. The third is the launcher actuator, which will use the data of the second system to orient the launcher for the required trajectory. The fourth is the launcher, which will take data from the second system, adjust the force it will apply to the snack, and then launch the object. Several approaches are being considered for each system. The required research for deciding which approach to take will be discussed as well.

The first part of the system is the facial detection system. This system must be able to accurately find the location of all human faces within the room. As there are systems like this already in existence, developing such a system will not be a part of this project. One area of consideration is whether this system will identify all faces in the room and launch snacks to all faces when the command to launch is given, or if it will use facial recognition to only shoot snacks to a specific person. The team will research more into the feasibility of using facial recognition over facial detection, specifically focusing on the feasibility of using facial recognition at distances up to 8 meters (the intended range of the launcher), given

the time limitations of the project, as well as the required sensors needed to achieve this; specifically if they can be implemented given the time and budget constraints of the project.

The second part of the system is the distance and trajectory finder. This will be a major component of the project. What the group aims to do that makes this project unique is develop a very accurate way for calculating trajectory, and mate this with a very accurate launching system. The reasoning behind this is that if the system will truly be able to launch a snack into someone's mouth, it must be very accurate to hit this target. This part of the system will require more research and testing either developing or improving an algorithm for calculating the trajectory. The goal of this algorithm will be to determine the necessary velocity that the snack must be moving at when it is launched, as well as the rotation angle and vertical angle (the rho and theta angles if the system is viewed in spherical coordinates). Depending on the facial detection system used, it may also be necessary for this system to have its own set of more accurate sensors for determining an exact distance to the target.

The third part of the robot system is the launcher actuator. The robot must be able to turn the launcher to face any direction in a 180 degree range. This assumes that the robot system will be placed next to a television, and all the people who want snacks while watching the television will be positioned within the 180 degree semicircle in front of the television. The angle of the launcher relative to ground will also be adjustable. Taking into account the standard ceiling height of 8 feet (2.44 meters), and the fact that snack consumers will be expected to be sitting within 25 feet (7.62 meters) of the television, the robot system must be able to fire a snack a lateral distance of 7.62 meters without the snack's trajectory exceeding 2.44 meters in height. Therefore, an adjustable range of 45 degrees to 90 degrees on the angle between the launcher and the ground will give the launcher the ability to launch a snack directly vertical if someone is standing over the launcher, and up to 9 meters laterally without the snack's trajectory colliding with a 2.44 meter ceiling. These calculations take into account the robot system being able to vary the launcher's force to launch the snack at speeds varying from 0 meters per second to up to 10 meters per second. A major goal of this system is to design it such that as much of the system as possible (excluding things like motors and motor drivers), can be 3D printed. With the widespread availability of 3D printers, creating a design that can be easily 3D printed and assembled, will make this project more accessible to others that have in interest in replicating it, either for the purpose of learning more about robotics, or personal enjoyment. The design of this system will be such that a motor rotates the entire launcher system, with a potentiometer or rotory encoder attached so that position at any time can be measured. The launch tube itself will connected to a linear actuator at the muzzle, which can raise and lower it, allowing for a change in angle. The opposite end will be pinned to allow the launcher tube to be moved completely by the actuator.

The fourth part of the robot system is the launcher itself. As mentioned above, the launcher must be able to launch snacks at speeds up to 10 meters per second. More research is required into this area of the robot system, particularly into what types of launchers would be suitable for the needs detailed here. The requirements for the launcher are that it have sufficient force to launch snacks with a mass of up to 8 oz (226 grams) at speeds of up to 10 meters per second. It must also have adjustable force, and be compact enough to be

mounted on the launcher actuator. Finally, this launcher must be cost effective enough to allow the project to stay within budget. The first possible option for the launcher are a pneumatic launcher, which uses pressurized air to accelerate a sled holding the snack. The second option is a spring launcher, which uses a motor or actuator to retract the sled holding the snack, before releasing it. The main consideration for deciding between the two of these is which will be easier and cheaper to implement, and which will allow for more accurate adjustment.

1.3 Novelties of the Project

This type of robotic snack launching system does not currently exist. It fills a need that many people have, and once designed and built, can readily fill that need, solving the problem mentioned in the problem statement. There is a similar project in existence, known as the "personal-beer-robot", which launches beers to humans. However, this project is aimed with a phone, and does not use facial detection. This team's system will simplify the user interaction, needing only a button to launch a snack, with no aiming required. The system will also be more accurate, as it will have to launch a snack not just in the general direction of a person, but into a person's mouth.

1.4 Interest and Value of the project

The project interests the team, as it solves a problem that each member of the team has had, and thus each member will be motivated to solve this problem by completing the project. It provides value both as a potential consumer product, as well as improving the quality of life of those that use it. The system combines the hardware and controls of a launching system and actuator, which interests two members of the team, with the necessity for facial detection and trajectory calculation, which interests the other two members.

1.5 Expectation of Project Success

The team believes that it can complete this project because one or multiple members of the team possesses the skills required for completion. The system characterization and control of the actuators and launcher was learned in this class through doing the Paperbot lab. The facial recognition portion of the robot relies on reading inputs from sensors and using them to characterize the robot's environment, much like with the Paperbot, except in this case the system would be identifying faces instead of distances to walls. The team will research and learn about the sensors and algorithms required for facial recognition over the course of this quarter, in preparation for implementing a facial distinguishing or recognition system on the snack launcher robot.

2 Voice to Morse Code Translator

2.1 Problem Statement

Morse code is an encoding scheme which can encode text into special signal and represent that signal using dots and dashes. However, untrained people cannot translate text into Morse code correctly and quickly. Most of the people need to search online to see the dots and dashes of each letter and then translate the text letter by letter. This takes times and can result in mistakes.

2.2 Proposed Solution

We are considering making a Voice to Morse code translator which can record what is said and translate it into Morse code. First, we need to make a voice to text system. This should be a machine learning system, where if we give it enough samples, can translate voice into text correctly. We plan to use Matlab to build this system because the voice signal is a bunch of data points which consist of frequency and amplitude. Matlab is good at characterizing data. As long as we have that system, we can say words directly into the microphone and the system will collect the voice signals and send it them Matlab. These voice signals will go through the algorithm we build and be translated into letters. The output should be the words the user says, which the computer display. Since the system will then get the text which it needs to translate, it will encode text into Morse code and represent the code with a buzzer.

2.3 Novelties of the Project

There are some Morse code encoders online, but most of them need the user to type what they want to say first. Our translator can record your voice and translate into Morse code directly. The user will just need to speak to the microphone and the computer will do the rest.

2.4 Interest and Value of the project

You can easily translate what you want to say into Morse code and send it your friends. Your friends may believe that this is a secret message and want to figure it out. After spending time decoding the message, he or she will find this is just a greeting message like “Good Morning”. It’s very interesting.

2.5 Expectation of Project Success

In our group, everyone has their own expect fields so everyone can be in charge of a different task on this project. After deciding which project to pick, we will make a schedule which contains when each part should be done. Finally, we have a clear idea of what should the final project will be and where to start. This means we know what our final goal is as well as how to achieve it. Finally, our final goal is that the user needs to say letter by letter because we don't have time to build a database which allows our voice to text system to recognize all words; however we believe 26 letters is achievable.

3 Resistor Sorting Robot

3.1 Problem Statement

Being an electrical engineer, there must be a period of time for you to work with resistors, either for experiments or personal projects. There is nothing more frustrating than finding out the flaw on your circuit you have been troubleshooting for hours was caused by a wrong value of resistor. Even for experienced engineers, it can still take them hours to sort them by reading the color code.The time will be much better spent on their actual projects.

3.2 Proposed Solution

The solution our team came up with is a robot that will sort a pile of resistors and put them into a resistor organizer automatically. The robot will first determine the resistance of the resistor. Then it will transport the resistor to the organizer that is placed in a specific area with indicator for the robot. After that, the robot will put the resistor into the according organizer cell by scanning the color code on the cell.

There are two potential methods for determining the resistance. The first one is implementing an imaging processing system on the robot to distinguish the color code on the resistor through Matlab. Matlab already have image processing toolbox build in to the program. There are also tutorials in the Matlab's forum guiding beginners to get a hand on image processing. There are multiple processes that need to be made on the image before it can recognize the code on it. For example, filtering unnecessary information on the image such as the background or the body of the resistor, since those are not the desired information. Another process that needs to be figured out will be reading the color code order since color code needs to be read in order. Another method is measuring the resistance of the resistor as the robot picking it up. An ohmmeter can be implemented using an Arduino board. As the robot picks up the resistor, it will close the circuit with another resistor with known value. The voltage across the circuit will be feed into one of analog input pins. The resistance of the resistor can be calculated through the voltage divider equation. The resistance can be distinguished by the method above.

The next step after recognizing the resistance of the resistor is transporting the resistor to the organizer. This problem can be solved by implementing the lab's material. From lab experiment, the state estimator that can estimate the position of the robot after various commands was implemented. Then with the combination of control, the robot will be able to move along a desired path to get to the organizer.

After the robot reaches the organizer, the robot will move around the box and scan for the color code that matches with the current resistor and put the resistor into the according cell. For the method of using Arduino as an ohmmeter, each cell will locate on specific points in the coordinate system. We just need to program the robot to drops the resistor on that point. The whole process will then repeat until the pile of resistors is gone.

3.3 Novelties of the Project

There are some resistor sorting machines out in the world but most of them are stationary. Our robot is more mobile compare to the sorting machine. It can transport the resistors to the desired destination as long as a path is inputted. Therefore, it can be used to clean up the workspace of the user.

3.4 Interest and Value of the project

This robot is valuable since it keeps all the resistors organized which engineers are not experts on. When there is a large quantity of resistors that need to be organized, our robot can finish the job instead of wasting the user's time. This project is interesting to us since none of the members in the team has experience with image processing, which will be a challenge to us.

3.5 Expectation of Project Success

Our team can complete this project since every member in the team has been faced with the same problem and frustration of dealing with unorganized resistors. Therefore, everyone is motivated to put in the work to complete the project. Also, the problem of the robot needing to move to a destination has already been encountered during the paperbot lab. The challenge will be improving the algorithm to fit the purpose of our robot. Furthermore, we will setup clear checkpoints that need to be achieved each week for our ten week class. With different expertise across the team, we will be able to finish the project on time.

4 References

For demonstration and references of the novelties of each proposal, please visit the links attached to the topics.

4.1 Facial Recognition Snack Delivery Robot

- Video: Mini Fridge Beer Cannon Walkthrough

4.2 Voice - Morse Code Translator Robot

- Video: Arduino Morse Code Translator
- Matlab: Speech Recognition

4.3 Resistor Sorting Robot

- Website: 3D Print Resistor Sorting Machine
- Video: Resistor Sorting Machine