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Prototype Progress Report
REFLECTION OF ONESELF
Nov 4th 2022
Website: https://github.com/alcho01/CART360
For images on Github you might need to download them

ABSTRACT

This progress report highlights the current state of my project while evaluating the assembly and programming process. The system reflects self-identity and surveillance abstractly. I wanted to represent panic and relaxation through means of mechanics rather than organic means, like how the human body behaves. To demonstrate these types of human behaviour, I programmed the system to shift between two states. The "Relaxed" state occurs throughout the program forever, while the "Panic" state only occurs when a living organism is outputting movement. Displayed in the system are mirrors that aim to frame the user's head. The purpose of this is to look at ourselves and self-reflect on who we are as a person. This type of gesture should not affect a change in states. However, if a sudden head turn occurs, the sensor will go off, triggering a state change.

FULL MATERIAL LIST

The system currently consists of four 2x2-inch mirrors, six reflective ornaments, five wooden planks, twenty-four screws, 8 L shaped screw anchors, a long strand of string, three pulleys, three hooks, hot glue, three servo motors, a PIR sensor, a PIEZO buzzer, jumper wires, a servo shield, the Arduino, and a breadboard.

STRUCTURE OF THE SYSTEM

I chose to design a structure resembling a shrine or monolith. A monolith is reflective, while a shrine is a place of worship and enlightenment. I merged the reflective material surface of a monolith with mirrors and combined it with a similar structure of a shrine. I want the user to really try and think about what this system is conveying because it might be too abstract to understand. If the user can identify the structure, they might acknowledge the theme.

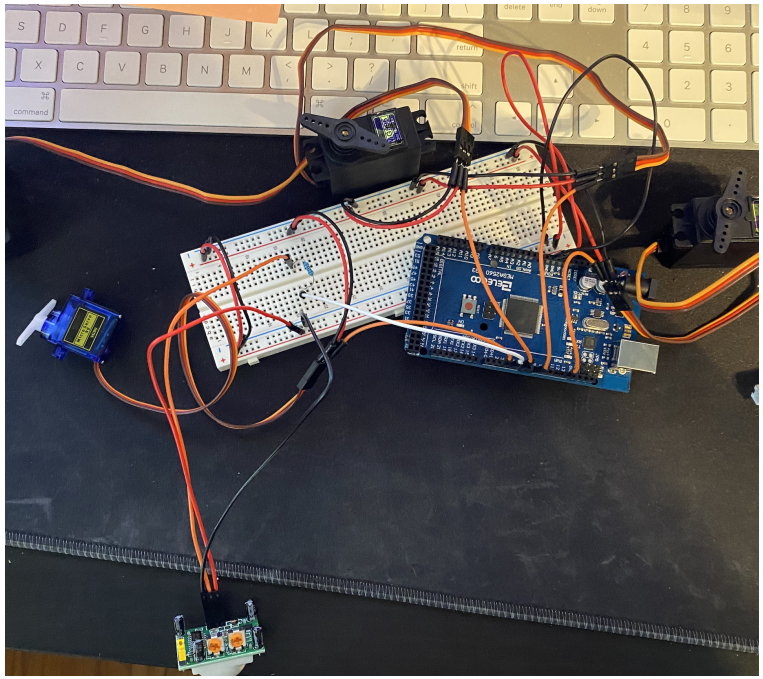
MIRRORS AND REFLECTIVE ORNAMENTS

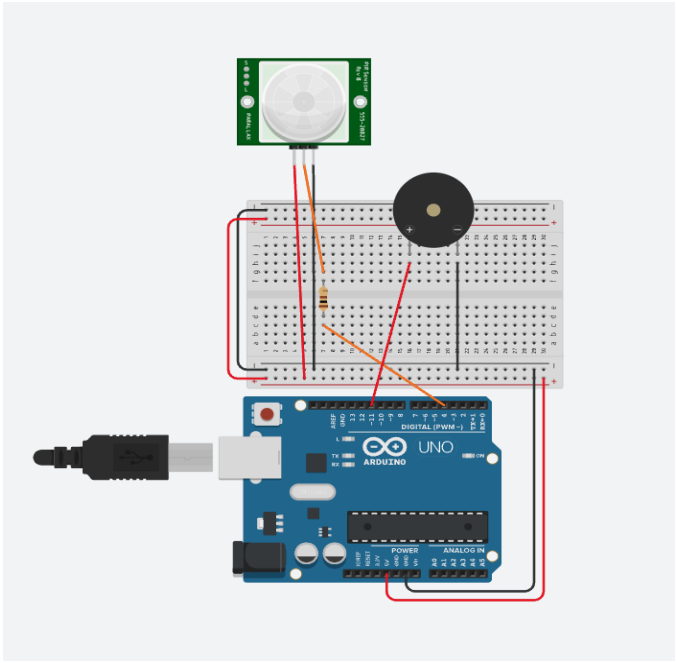
I chose two reflective objects for strategic and visual reasons. The strategic reasoning was to avoid collision between each object while also factoring in how much weight the string could withstand. The visual reasons were to include a variety of entities and different viewpoints reflecting off of their surfaces. The flat mirrors reflect a normal reflection, while the ornaments reflect a distorted view.

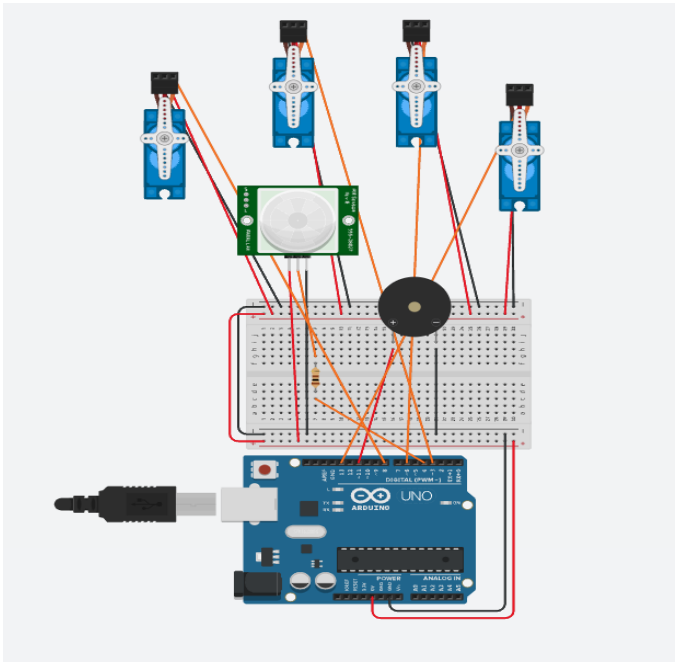
STARTED WORK ON THE PROTOTYPE - OCT 15th 2022

I started my prototype by making circuits digitally on Tinkercad to gather a visual representation of what I wanted to achieve. I made two separate circuits, one where the PIR sensor communicates with the Piezo and another where once the buzzer notifies the user, the Servo motors rotate.

Then I assembled the fully built circuit which includes, the breadboard, the arduino, 3 servo motors, the PIR sensor, the Piezo buzzer, jumper wires, and a 100 ohm resistor.







STARTED WORKING ON THE PROGRAMMING - OCT 18th 2022

After building up the circuit, I then started to write the code. The code is pretty straightforward, and I have made subtle changes to enhance the program in hopes of reducing malfunctions. These changes are viewable on Github.

I built the code based on two for-loops which act as two states. The first state, which I call the "Relaxed" state, is continuous throughout the time the program is running. While the "Panic" state activates when the system detects human movement.

To switch between these states, I created a variable called "delayer," containing an integer of initially 15 milliseconds. The detection of movement decreases the "delayer" variable to 5 milliseconds concluding to a faster-paced motion for the Servos.

Before the servos switch state from "Relaxed" to "Panic," A buzzer sounds off, notifying and interacting with the user that the system reads the input and is now sending out an output. I built a simple function containing three tones the buzzer can make. It releases an alarming sound representative of panic.

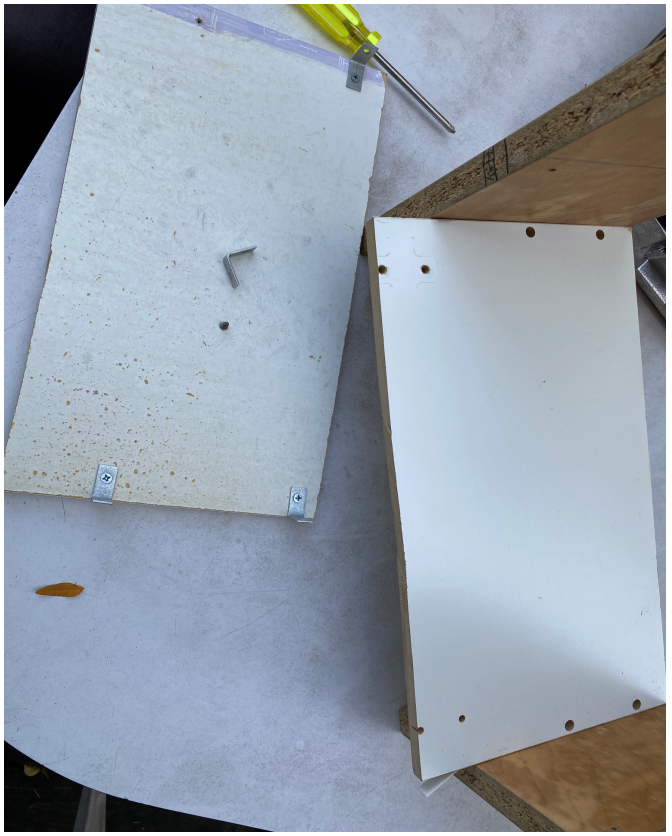
I programmed the servos to rotate only until 90 degrees because I plan on laying the servos flat. Lying them flat creates a seesaw-type motion enabling the mirrors to go up and down.

The two forms of interaction occurring within this system are the user movement and the system communicating from the PIR to the Piezo to the Servo.

STARTED WORKING ON THE ASSEMBLY - OCT 29th 2022

The last part of the project is to assemble the structure. I began by taking measurements of how much space the circuit would occupy. Once that was resolved, I cut two pieces of wood, one for the top and one for the bottom half. The circuit will lay on the lower layer, and by the final artifact, the front and back will be covered to complete the construction of the box.

Setting Up the Structure

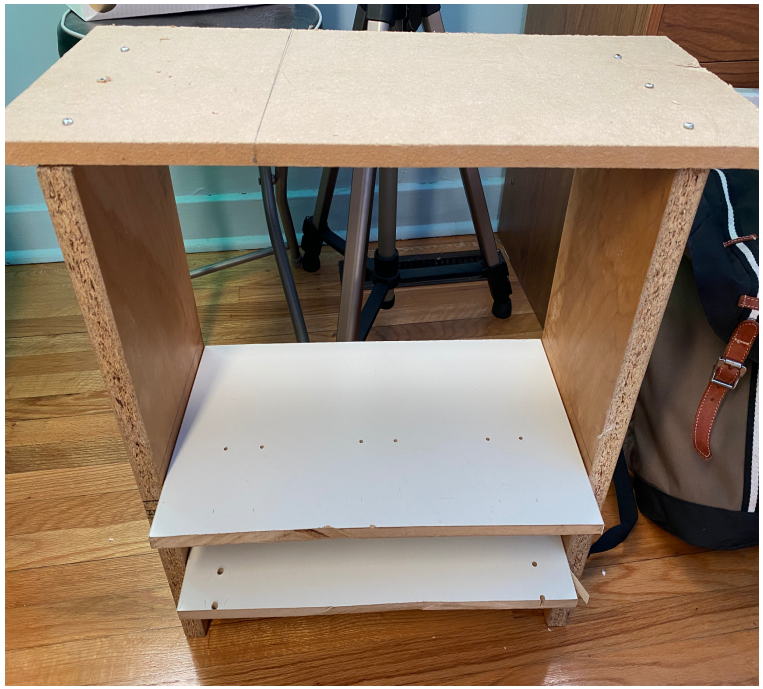


I then screwed those planks to two large pieces of wood vertically stacked to establish a sturdy foundation. Afterward, I drilled six evenly distributed holes in the top layer of wood to allow a string to pass through from the servo through the hole around the pulley back through the hole and attach to the other end of the servo. I drilled six holes because I am using three servo motors that each have two ends.

Adding Second Layer & Drilling Holes in Middle Layer

I then added the top piece making the structure even more secure. I nailed it down, then replaced the nails with screws. Once the top was screwed in, I added three hooks to allow the pulleys to hang.

Top Piece Added and Structure Base Complete



Following that, I thread some string through one end of the servo, through the middle of the wooden plank, then going around a pulley, ending back through the other side of the servo motor. I repeated this process two more times.

Adding String and Pulleys

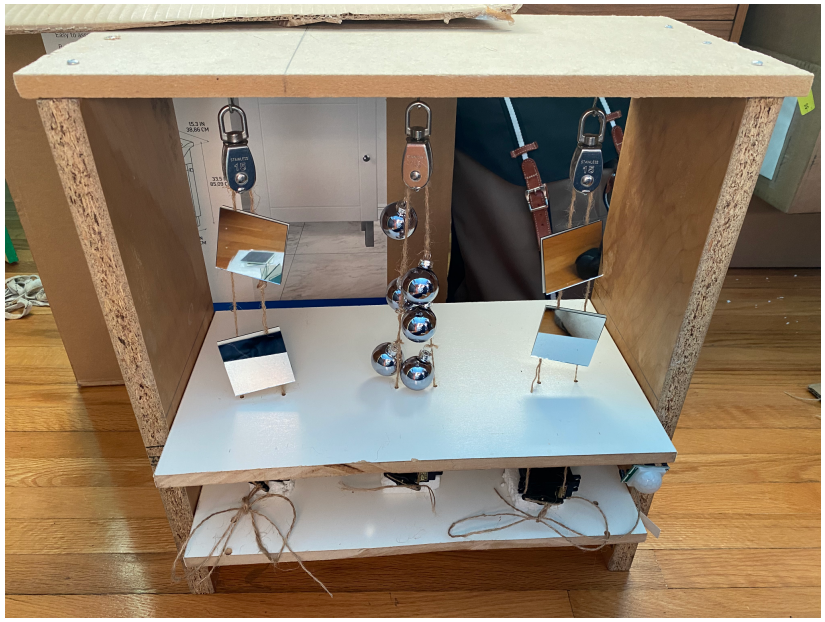
After setting the circuit into place, I used styrofoam to raise the servo motors off the ground. I also made platforms and constraints for the breadboard and the Arduino from styrofoam. I did this to avoid the circuit from moving caused by the servos rotating.

I finally added small Christmas balls attached by a strand of string to the pulley system. The mirrors were placed by taking a piece of cardboard and a mirror and sandwiching the pulley string with hot glue attached to the cardboard.

Mirror Assembly Process

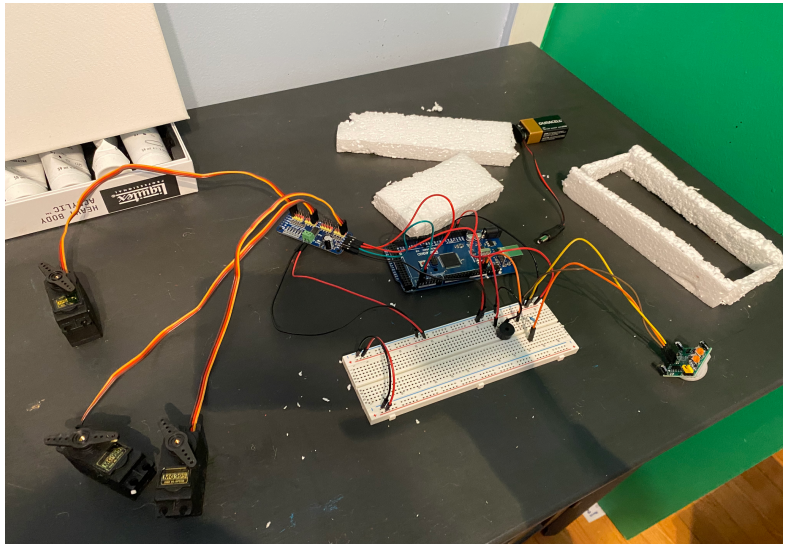
Now that the prototype is complete, the next elements to include are making the system more aesthetically pleasing and, if possible, quick fixes to the program for a more accurate reading of human movement.

Final Built System Without Tidy Up



Video of the system working. Accessible on Github Page.

Final Built Circuit



TOUCH UPS BEFORE PRESENTING PROTOTYPE - NOV 1st 2022

I implemented the servo shield a few days before the prototype. I had a bit of difficulty getting it to start. After two hours, it eventually started working. I also had to implement a library in my program. I used the Adafruit PWM Servo library easing the implementation of servo motors. Instead of reading the angle of the servo, the library reads the position. Therefore, I had to test different numbers until I finally got what I wanted.

I added a calibration timer in the setup that delays the system for 30 seconds. This allows the PIR sensor to calibrate and read the room in the given time.

WHAT HAVE I LEARNT THROUGH THE PROCESS?

The ideation process can be the longest because formulating a concept can be difficult. However, for this project, I had an idea already brewing in my head. This part of the process makes it easier later on because there is a concrete idea to use as a reference.

The iteration process consists of testing out sensors separately to see if they function before combining them. I went through some issues with a sound sensor I was initially going to add. I attempted to write code to aid this manner, but it complicated things even more. I continued researching information on the sensor, and it turned out it does not work the way I envisioned. Therefore, the sound sensor was ultimately unnecessary. The iteration process is necessary because it would have been too late during the prototype process to come to this realization.

Finally, the prototype involves assembling everything to see if it functions correctly and as planned. Two key aspects I had to rely on were organization and time management.

This process taught me that an initial idea will undergo changes over time. In addition, the need to adapt and improvise when the system is not working by finding other creative solutions. Finally, to not go into something without knowing what your idea is. At the beginning of this project, it seemed overwhelming because I was frantically building circuits without a purpose. However, when I came up with my idea, the stress started easing away, and meaningful work was being accomplished.

TECHNICAL EVALUATION OF SENSORS AND THEIR AFFORDANCES

The focus of my project relies on human movement. The PIR sensor is perfect for this type of interaction because it detects only this type of movement and disregards movement coming from inanimate objects because they do not radiate infrared light. It is hard to tell how far the sensor can detect a human because my room is limited in space, but I managed to walk to the end of my room which was about 15 feet, and it still detected when I jumped. I adjusted the sensitivity of the sensor to make it trigger more accurately, and I also adjusted the delay of the sensor to make it stay at the digital value a little longer, which I tested in the serial monitor. The purpose of my project has to do with surveillance and interacting with the self. Therefore, the affordance a PIR sensor brings to my project is the capability of reading when the system is being watched.

The PIR sensor consists of a pyroelectric sensor and the fresnel lens.

The pyroelectric sensor is attached underneath the Fresnel lens, enabling infrared radiation to be sensed. It includes two outputs, a positive and a negative output. When a person walks past the sensor, it causes a positive change. The opposite goes for when the person is limiting their movement, causing a negative change. A visual representation would be looking at a graph and identifying that the high peaks suggest a living being caused movement, while the low points mean there was less movement.

The Fresnel lens increases the distance and field of view that the PIR sensor can capture movement. The patterns carved into the fresnel lens aid to refract light. Therefore, making it possible for an increased distance while still being fairly accurate.

The PIR sensor has three pins, VCC, Output, and Ground. VCC connects to the power of the breadboard. The output pin connects to the breadboard and crosses a 10k ohm resistor ending in the selected pin. Finally, ground connects to the ground of the breadboard.

The core interaction comes from the PIR sensor, but the other half of my project comes from the servo motors. The servos control the animated visuals. While I initially wanted the servo motors to rotate on their axis in the proposal, I realized this motion might be too generic. Instead, having the motors go up and down provides an asymmetrical look, which reveals more depth to the theme.

HAS THE PROJECT'S INITIAL INTENTION CHANGED?

The meaning and intention of my project have not changed. I did, however, make some adjustments. Firstly, I had to reconsider the size of my project, which affected how many mirrors I could use. Then, one of my motors stopped working, forcing me to cut down to three servos. I removed the sound sensor because it did not detect the sound I was looking for. In my opinion, these omissions do not deteriorate my project. Instead, it allows me to hone in on specifics of the system since there are fewer and perfect those.