

# Final Embedded Report

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## Proposal

This project we are proposing is a protective solution that solves the problem of children around the ages of 6 to 10 contracting accidental drug poisoning by pills from the bathroom medicine cabinet while their parents are not present. Our solution to this problem is using facial recognition technology to lock children out of the cabinet while providing easy access for adults. Our main hardware will be a motion sensor to detect when a potential user is close to the cabinet, a camera for the user to look into as well as a servo motor and force sensor to simulate the locking of the cabinet door. We will be using the Raspberry pi 3B+ for the use of the camera as well as the facial recognition and openCV libraries for facial detection and recognition.

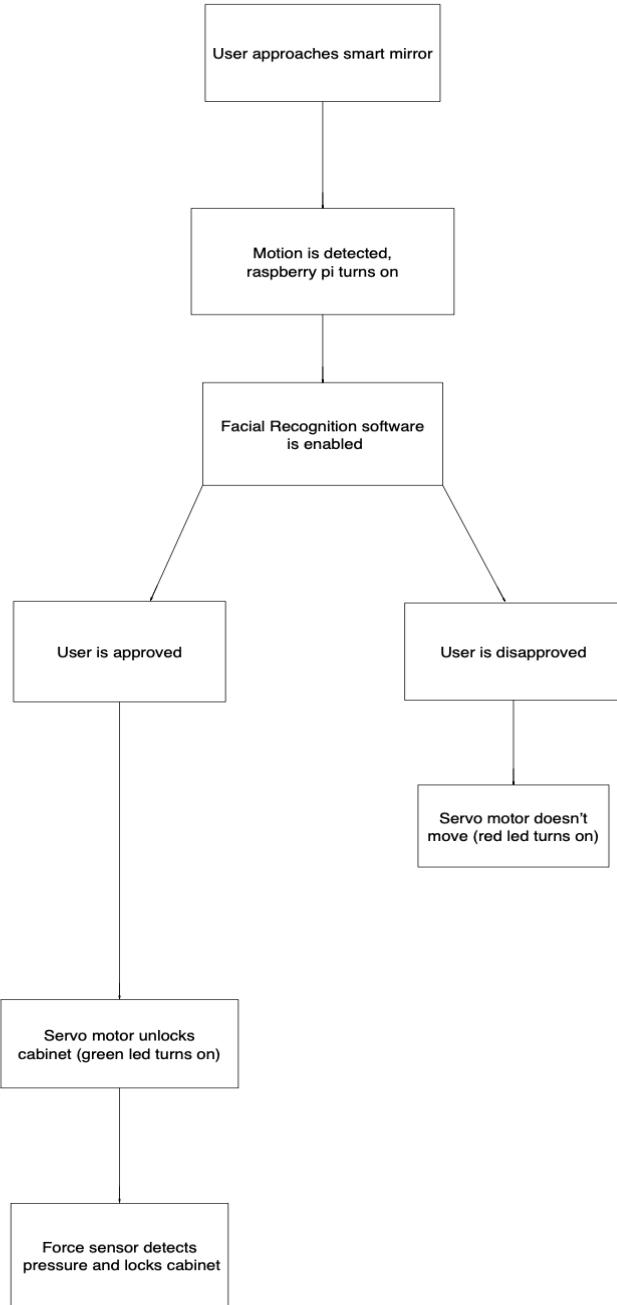
## Hardware

- Raspberry pi 3B+
- Raspberry pi Camera
- Servo Motor
- Force Sensor
- Motion Sensor
- Capacitors as necessary
- Bread Board
- 3 Leds (Green, Red, Blue)

## Software

- Python3
- Facial\_Recognition Library
- OpenCV Library

# Flowchart



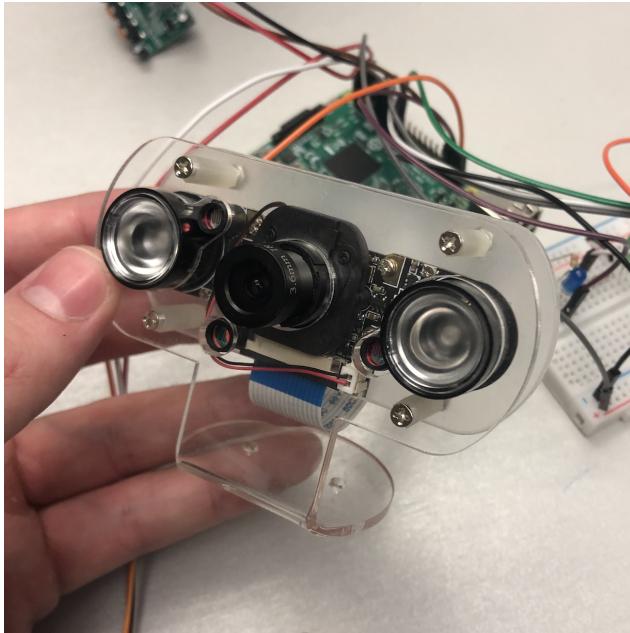
## Process

### Step 1.) User Approaches Mirror



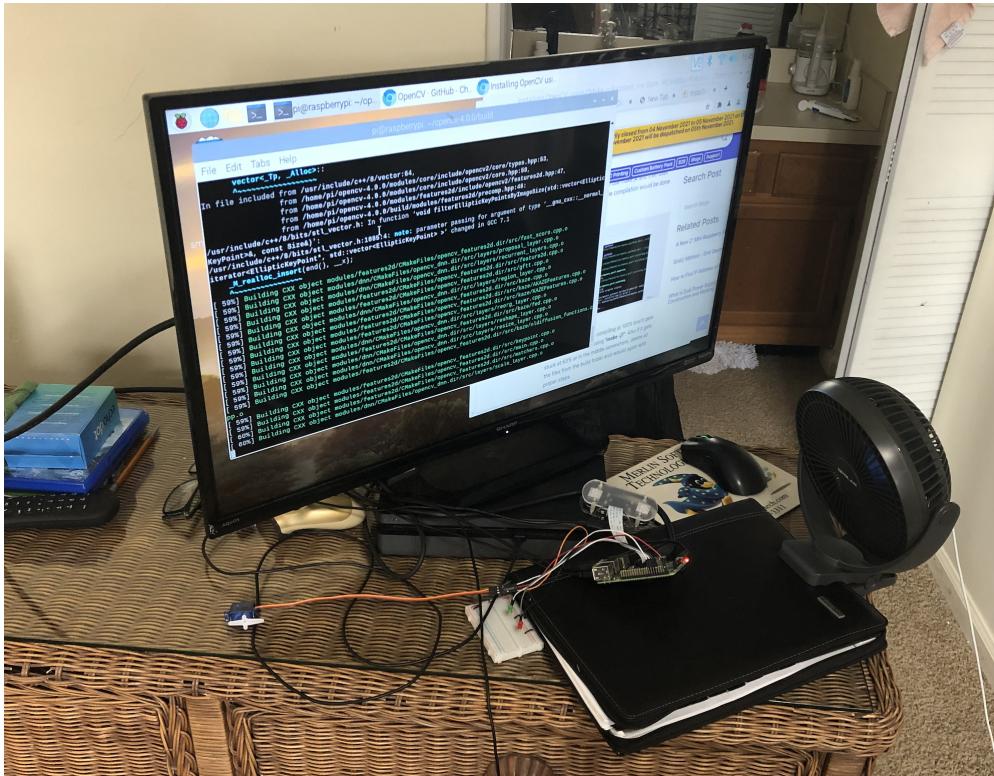
The user approaches the mirror and becomes detected by the motion sensor. We used a PIR motion sensor which is an electronic sensor that measures infrared light radiating from objects that are in its field of range. Our software uses the data from this hardware to detect if a user is near the cabinet. This is essential because we are able to detect when a user is not present which enables us to not run the bulk of the software 100 percent of the time which leads to lower power usage. The motion sensor was implemented closer to the end of the project and was relatively difficult to implement. Originally we faced the problem of the sensor not detecting objects because there are two different controls that affect sensitivity and distance. We later manipulated the controls to result in the correct distance. Lastly we used a blue LED to show when motion is detected which will emit a solid light while in the bulk of the software.

**Step 2.) Motion is detected and facial recognition software is enabled**



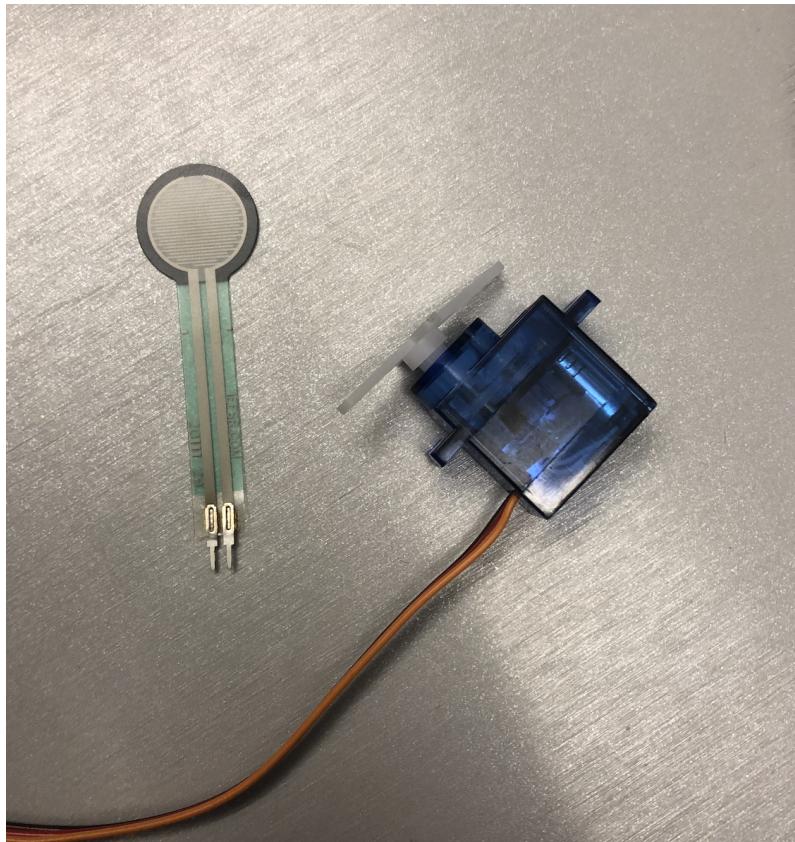
After the user approaches the cabinet and motion is detected the bulk of the software is enabled. When detecting faces in the database we use openCV for facial detection and the facial\_recognition library for recognizing the correct face in the database. When interacting with the hardware from the software perspective we used the GPIO library to

take in inputs and display our outputs. We used python3 because of its simplicity with the openCV and facial\_recognotin library. This was quite difficult to implement into the raspberry pi because there are multiple 3rd party dependencies that are needed to enable the library as well as interact with the camera.



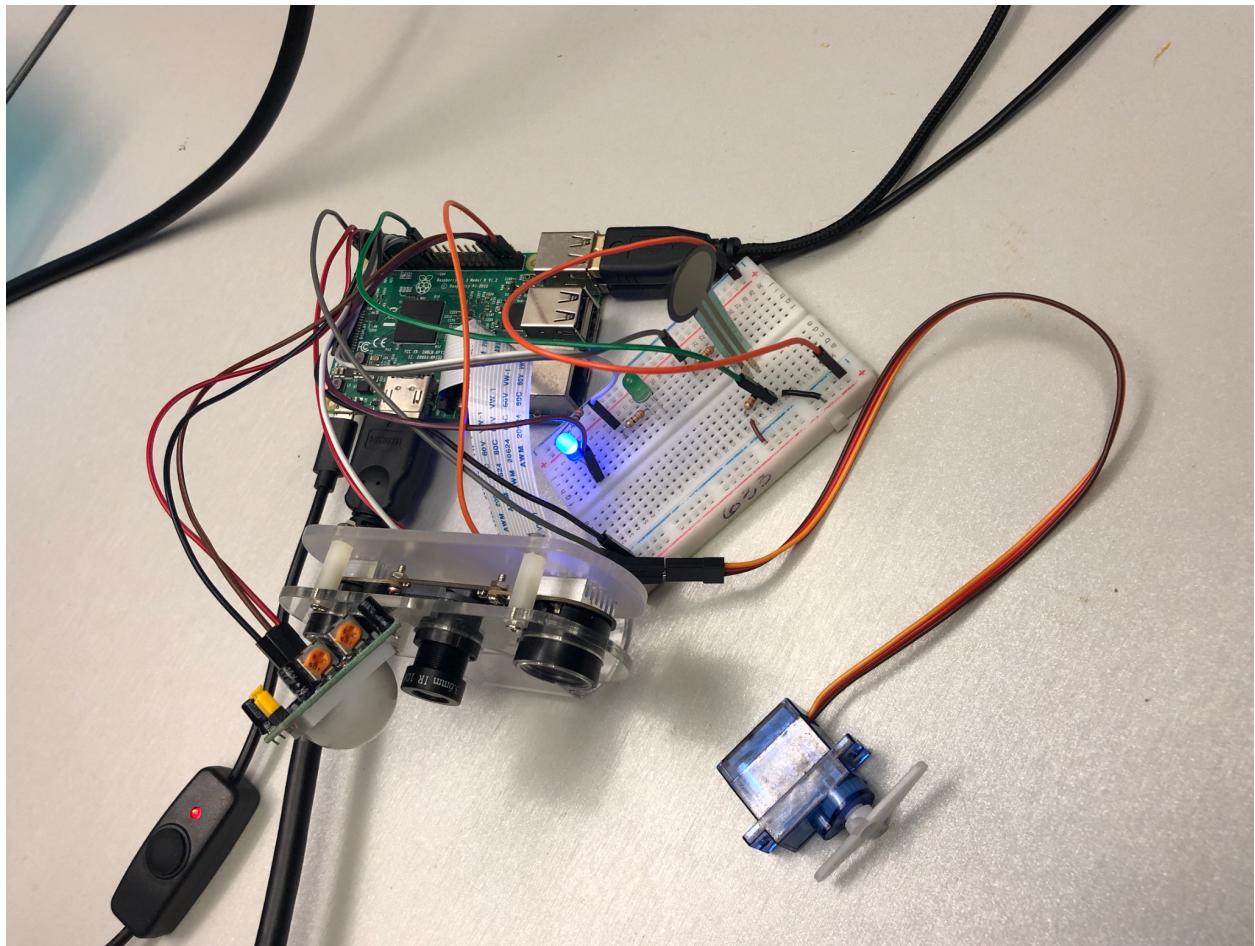
In the picture above there is a fan on the raspberry pi because downloading the dependencies needed for the raspberry pi was so tasking the processor became hot enough that a warning displayed on the screen and an external fan was needed to cool down the microprocessor. Once that was implemented the documentation for both libraries made it quite easy to follow in order to program the facial recognition software needed for our project. After a face is detected in the database a Green LED will emit a solid green light to show that access has been granted. When a user is not in the database a red LED will emit a blinking light to show that the user is not allowed in the cabinet.

**Step 3.) Servo motor and force sensor simulates the locking and unlocking of the cabinet**



Once a user is granted access into the database the servo motor will turn to simulate the unlocking of the database while if the user is denied the servo motor will stay static. Once the servo motor is unlocked and the user has acquired what they needed from the cabinet the force sensor is used to simulate when the door is closed. After touching the force sensor the servo motor moves back to its original position to simulate the locking of the cabinet. When implementing the servo motor the only problem we encountered was figuring out how to move the servo motor back after the force sensor had been touched. When implementing the force sensor we faced the problem that the sensor outputted analog values while the raspberry pi only takes in digital values. Facing this problem was interesting because we thought about using an analog to digital converter although we came up with a simpler solution using a voltage divider which always brings the output to 0 while when touching the force sensor brings the output to 1.

## Final Picture



## Conclusion

In conclusion this project has enabled us to learn about the raspberry pi as well as embedded system concepts. Neither of us have used python much and this project gave us that window of opportunity to do that. We also learned that big topics such as facial recognition are not as hard to implement after spending time and learning the topics through forums and documentation. Lastly learning about the different parts that we used such as the motion sensor force sensor and the basic circuitry to design the voltage divider was quite interesting as well and we are glad that we were able to demonstrate a useful protective solution to children entering their parents' pill cabinet.