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ECE Honors Lab

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Automated Dorm Lock

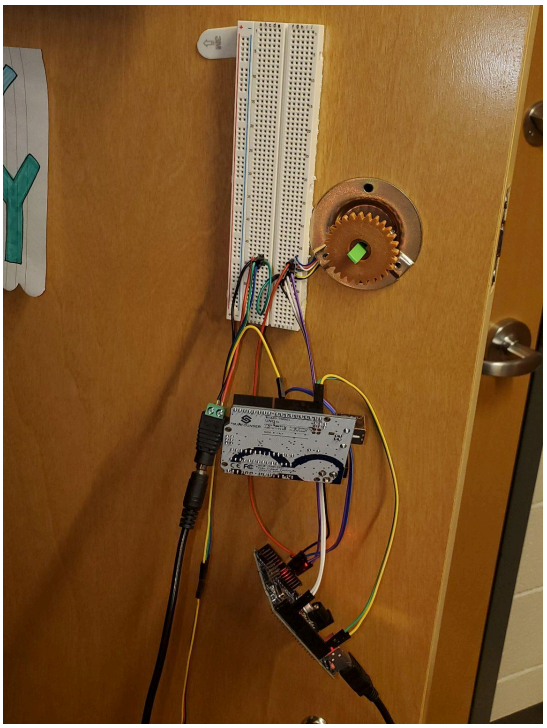
Introduction

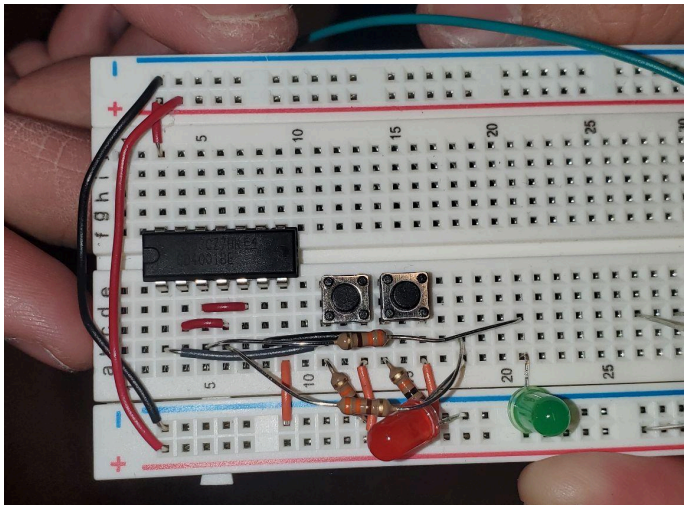
With this project, we initially sought to automate the locks on dorm rooms, so they can be locked and unlocked with just the i-card. Our goals for the project were relatively simple and included being able to use either the i-card or key to lock or unlock from the outside, only accept registered i-cards, and have an enable switch that would have to be activated for the circuit to activate. As a result of these features, the project would ideally have benefits for both the students and campus as students would only need to have an i-card instead of juggling around their dorm keys, whereas for the school, it would be easier for them to implement this lock since it functions with the pre-existing locks. Furthermore, this approach differs from previous attempts as it includes a 2-factor authentication that ensures a greater amount of security. However, due to some issues that we will discuss within the Problems and Challenges section, we had to replace the i-card with fingerprints; however, all the logic and functionality of the project is essentially the same.

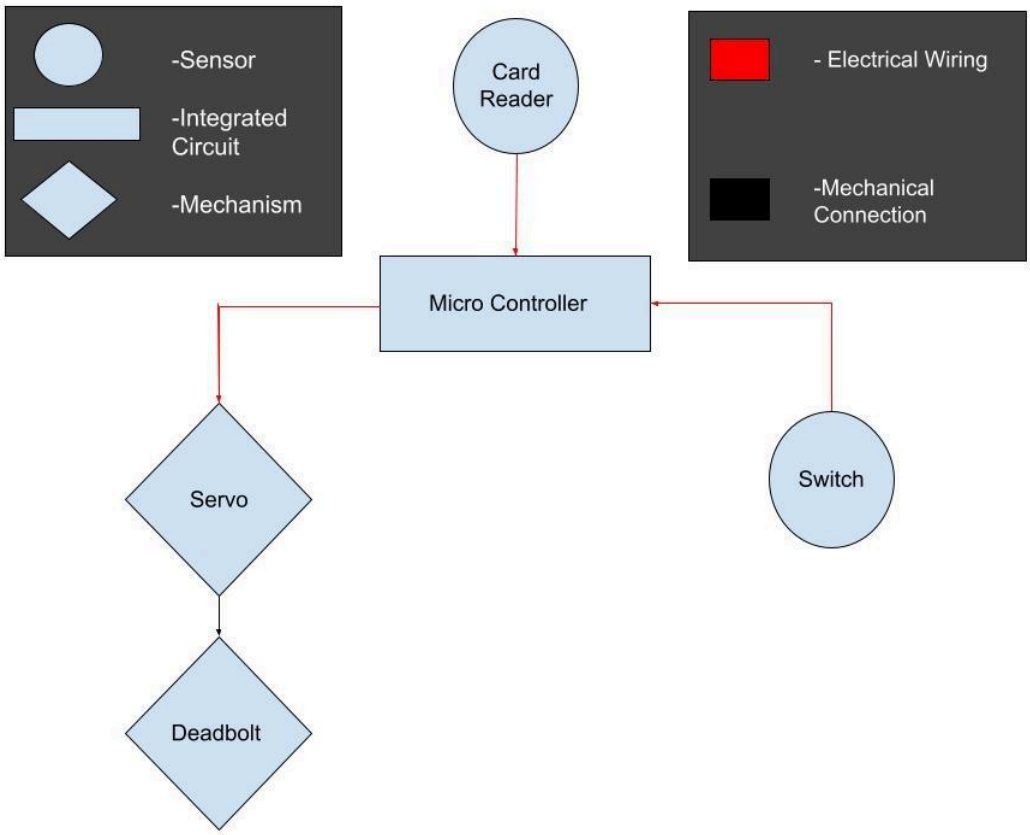
Design

The block diagram shown below illustrates the general design for the whole project. The circuit starts by finding the current enable switch position in which it then checks if this switch is on or off. If the switch is off then it simply returns to the initial stage of finding the current switch position; however, if the switch is enabled, it then moves on to start reading the user's fingerprint. If the fingerprint does not match that of a previously registered user, it simply returns

back to the find enable switch position; on the other hand, if the fingerprint does match, it checks if the door is locked or unlocked. When the door is locked, it moves the servo to the unlock position, but when it is unlocked, then the servos move to the lock position. The program then records this new servo position and then loops back to the find enable switch position. In this project, we only required a singular servo, fingerprint reader, and switch. The fingerprint reader would be attached to the front of the door with wires running to the back of it where the rest of the circuit would be securely held. This fingerprint reader would send signals from itself to the microcontroller which would then send the appropriate signal to the servo. The servo would be connected electrically to the microcontroller and physically to the existing deadbolt system through a series of gears. Since we were reusing the deadbolt system of the door, we did not need much else outside of a few 3-D printed gears for this system. Finally, the enable switch would rest on the back of the door and connect electrically to the microcontroller, which would send a signal to the microcontroller depending on which state is currently being held.







Results

The fingerprint sensor we used is the Ultra-Slim Round Fingerprint Sensor from Adafruit. Not only does this slim profile help with implementing it with the dorm door, it also contains its own FLASH memory so that extra implementation and logic is not needed to enroll new fingerprints and compare the read fingerprint with the ones stored in memory. The servo we used was the MG995 which needed its motor controller; however, we circumvented this problem by simply using a 2nd arduino to act as the microcontroller. So we have one arduino that's connected to the fingerprint sensor and the digital logic for the enable switch which connects to the 2nd arduino that acts as a microcontroller.

Problem and Challenges

One of the biggest challenges that we found was that when you try to use the RFID function of the i-card, it does not give an accurate reading. This is because the i-cards are encrypted and give random values each time it's read. We then tried switching to the swipe system that the buildings use, but due to supply issues, we were unable to get one. We then decided to use a fingerprint sensor since its implementation would be simpler.

Future Plans

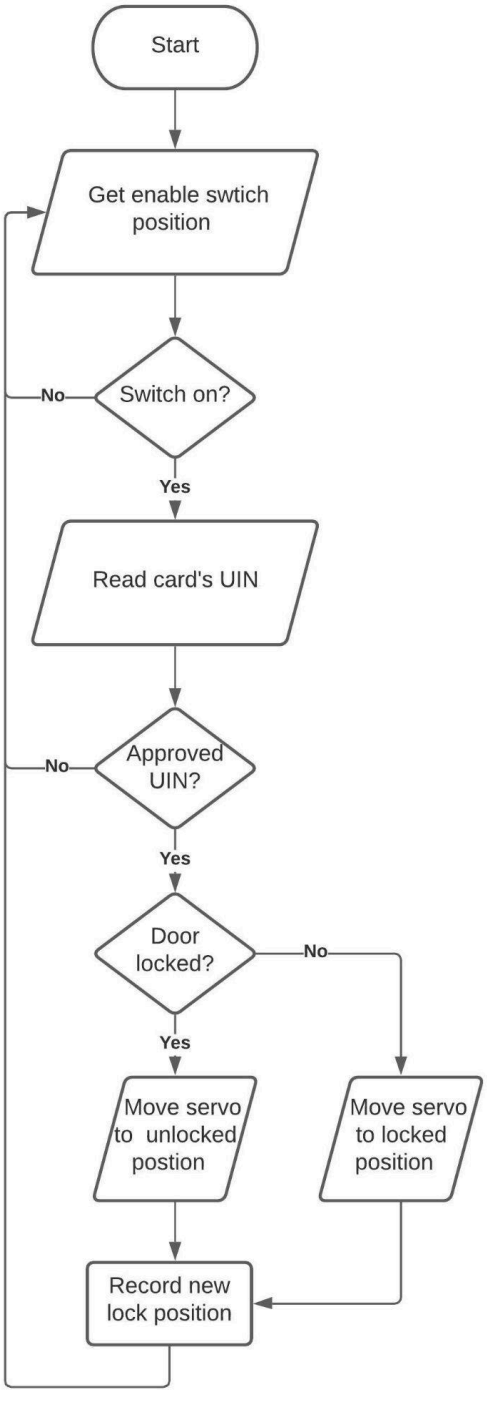
We want to turn our digital logic circuit into a printed PCB and create a 3-D printed bracket to hold the servo in place. These two changes would make the overall design much cleaner and smaller which should make it easier to use.

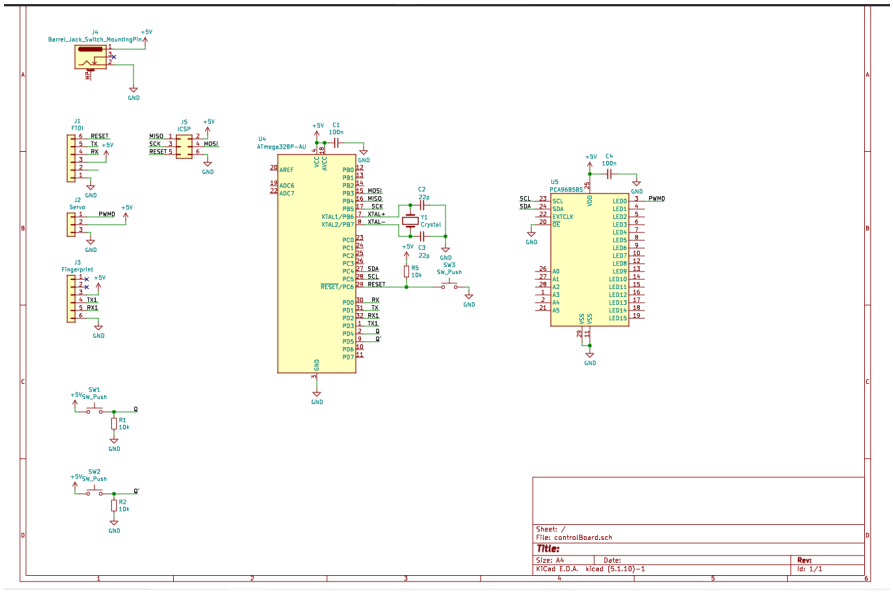
References

[1]"Seos Card", *Hidglobal.com*, 2021. [Online]. Available: https://www.hidglobal.com/sites/default/files/resource_files/pacs-seos-card-ds-en_0.pdf. [Accessed: 11- Dec- 2021].

[2]A. Industries, "Ultra-Slim Round Fingerprint Sensor and 6-pin Cable", *Adafruit.com*, 2021. [Online]. Available: https://www.adafruit.com/product/4750. [Accessed: 11- Dec- 2021].

Appendix


Start
Get enable swtich position
Switch on?
No
Yes
Read card's UIN
Approved UIN?
No
Yes
Door locked?
No
Yes
Move servo to unlocked postion
Move servo to locked position
Record new lock position


Barrel_Jack_Switch_MountingPin
FTDI
Servo
Fingerprint
ICSP
ATmega328P-AU
PCA9685BS
Crystal
SW_Push
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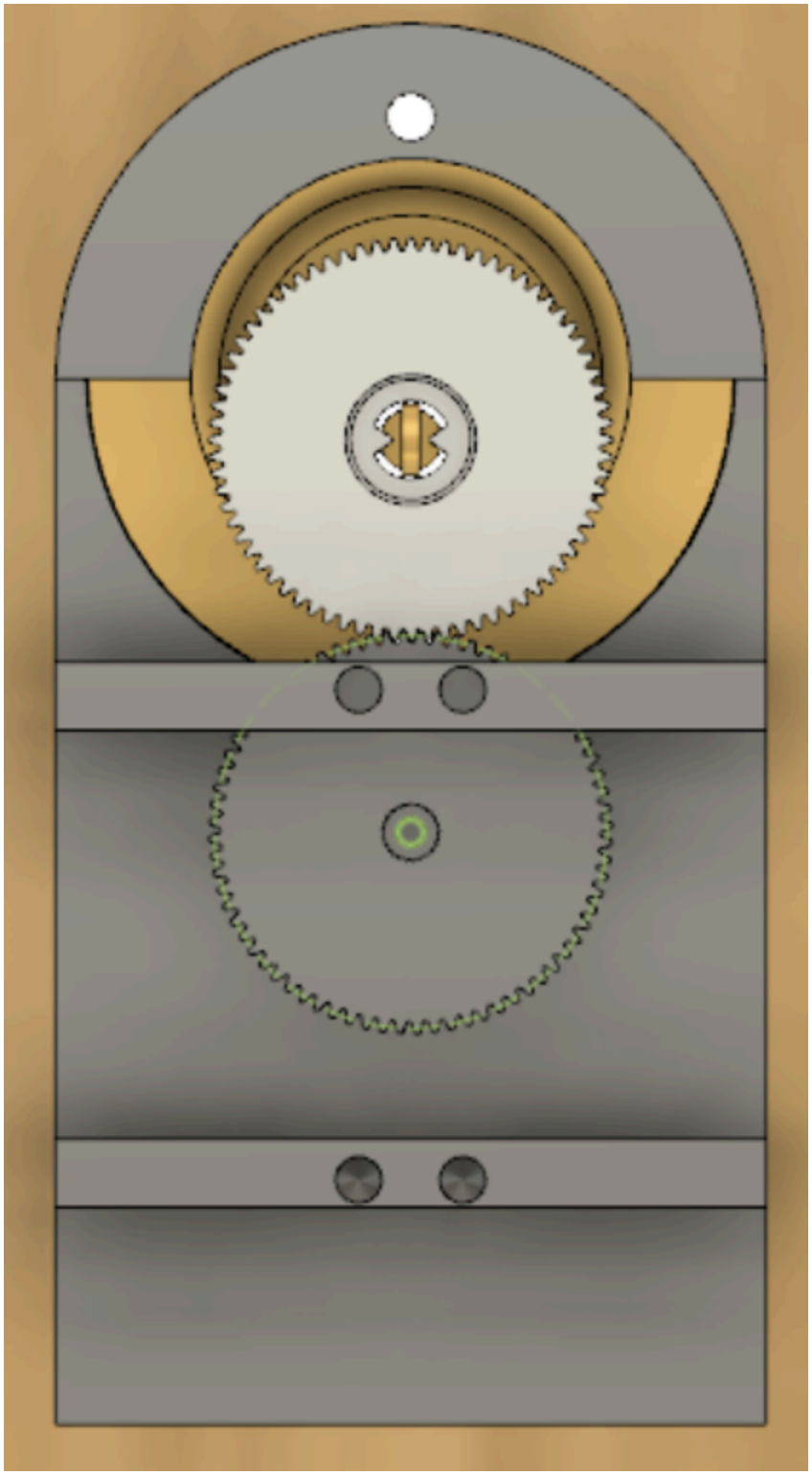

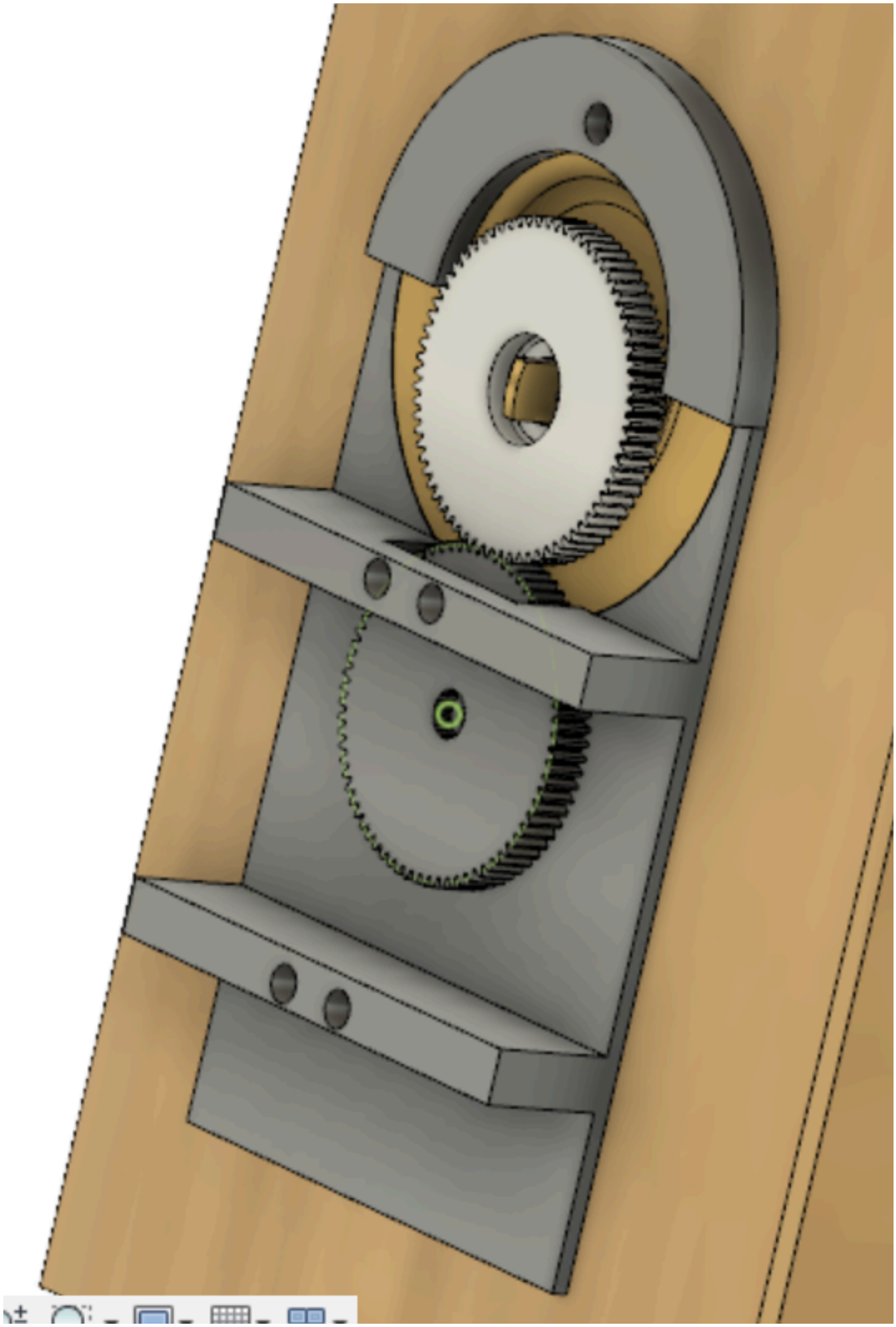

Code: https://github.com/bidpl/doorLock/tree/main/communicationTest