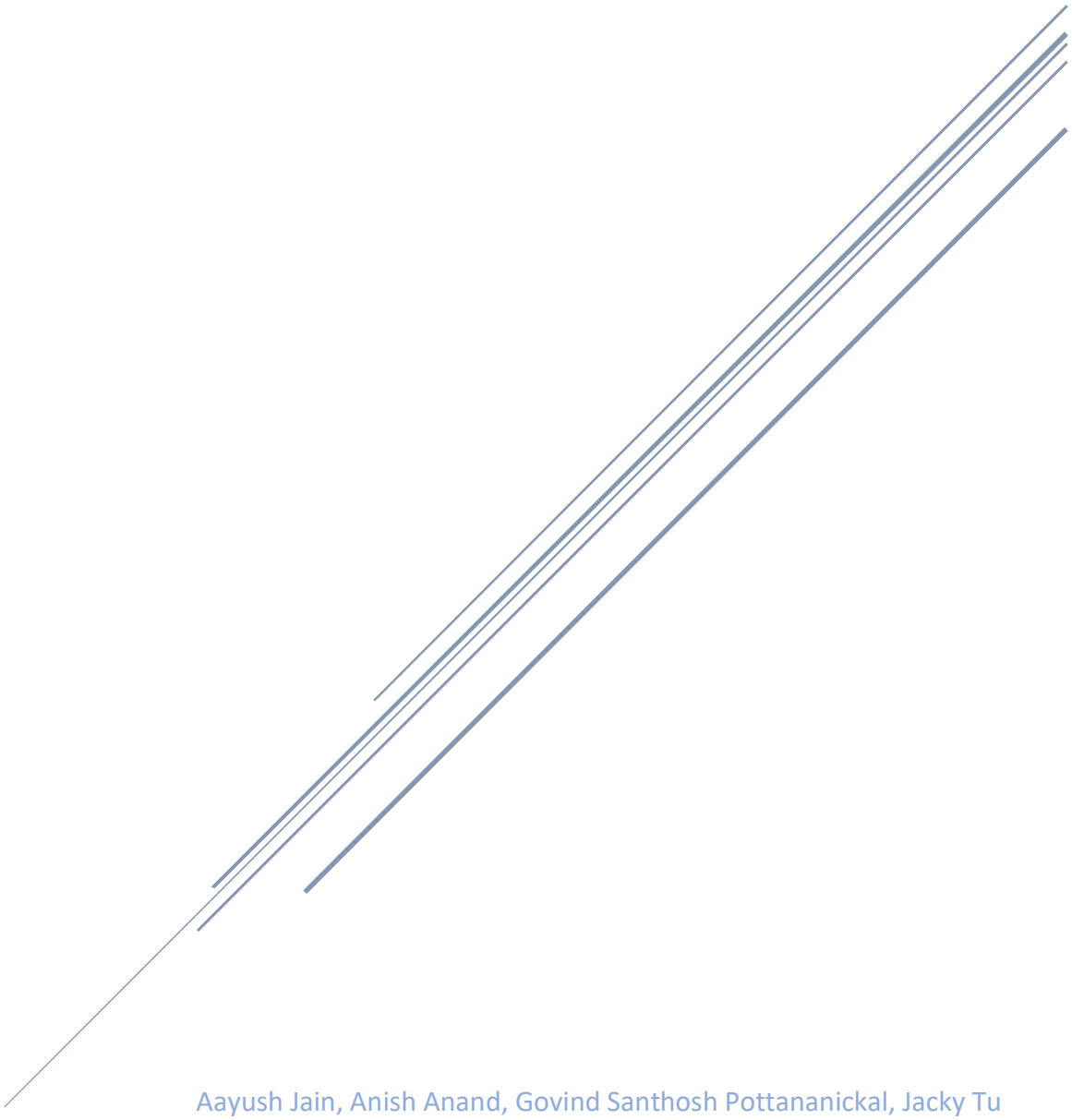
AUTOMATED GARAGE DOOR SYSTEM

ETDNAAL Group 1 Project



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Submitted To: Dr. Rakesh Kantaria

December 8th, 2023

Abstract

Metal-oxide-semiconductor field-effect transistors, or MOSFETs, are integrated as switches in the project, and their use as motion sensors will automate and improve the operation of conventional garage doors. The project aims to improve the user experience by reducing the process and adding efficiency into the operation of garage doors. Currently, users frequently rely on manual garage door buttons.

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Introduction

Our concept, 'Automated Garage Doors,' stands out as a trailblazing endeavor that combines technology with daily ease in the age of smart living. With the precision of a Sonic Sensor and the power of Python programming, this project has the potential to completely transform the traditional garage door experience.

The Sonic Sensor, a scientific marvel that can accurately identify the presence of a vehicle within predetermined boundaries, is the central component of our concept. The garage door opens smoothly as a car approach thanks to the orchestration of autonomous motions started by this sensor. A sophisticated automated closing adds a layer of protection and improves operating efficiency, demonstrating the elegance of automation.

Recognizing the value of user control, our solution incorporates manual alternatives with ease. By providing consumers with the option to manually operate the garage door through two buttons, automation and individualized control are harmoniously balanced. This deliberate dualism makes sure that our system adjusts to its users' changing needs and preferences.

Safety is our priority as we strive for innovation. Our dedication to user welfare is further demonstrated by the addition of an emergency stop button. By immediately stopping the motor in an emergency, this function serves as a fail-safe and creates a safe environment for individuals engaging with the automated garage door system.

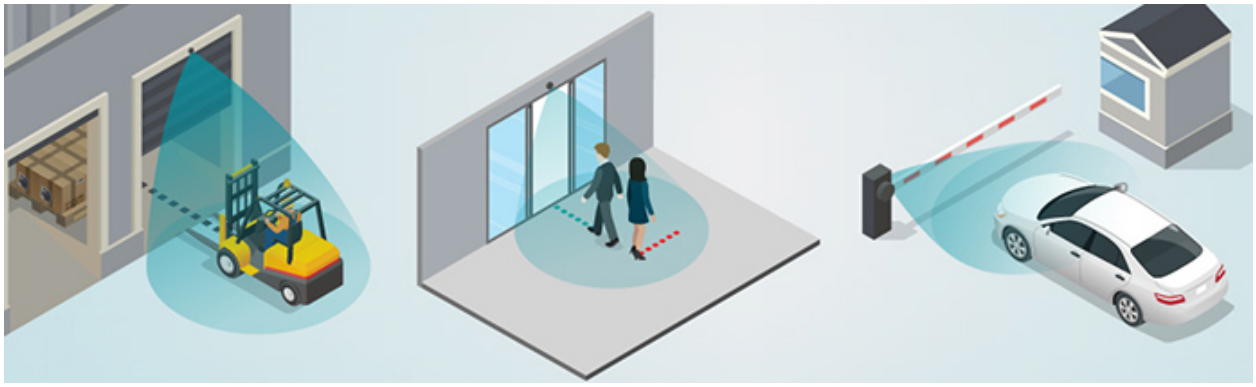


Figure 1Garage door sensor visual

As we set out to explore the complexities of "Automated Garage Doors," this report will reveal the painstaking design considerations, implementation challenges overcome, and final realization of an advanced, user-centric solution that redefines the fundamentals of garage door functionality in the context of modern smart living.

Description

Technical Operation Overview

The automated garage door system functions with precision, employing optical isolators to control door movement. Comparable to the functionality of an H-Bridge, the system utilizes Pulse Width Modulation (PWM) to determine the rotational factors for the motor. When one Voltage input (Vinput) is set to 1 and the other to 0, the door either opens or closes, facilitating a seamless and controlled motion. Notably, in the event of an emergency, the kill switch acts as a fail-safe mechanism. If both Vinputs are the same, the motor stops working, reminiscent of a kill switch scenario, enhancing safety and preventing unintended movements. The integration of an ultrasonic sensor further enhances safety by automatically detecting the presence of interference, contributing to the overall reliability of the system.

Emergency Features and Resumption Mechanism

A key aspect of the system's safety features lies in the implementation of an emergency kill switch. When activated, this switch serves as a quick and effective means to halt the door's movement in critical situations. The kill switch acts as an immediate response to emergency scenarios, prioritizing user safety. Following the activation of the kill switch, a resume switch is incorporated to seamlessly restore the door's functionality. The resume switch serves as a vital component, allowing users to resume normal operations once the emergency has been addressed. This combination of emergency features, including the kill switch and resume switch, ensures that the automated garage door system is not only efficient in its everyday operation but also well-equipped to respond to unexpected situations, providing a comprehensive and secure user experience.

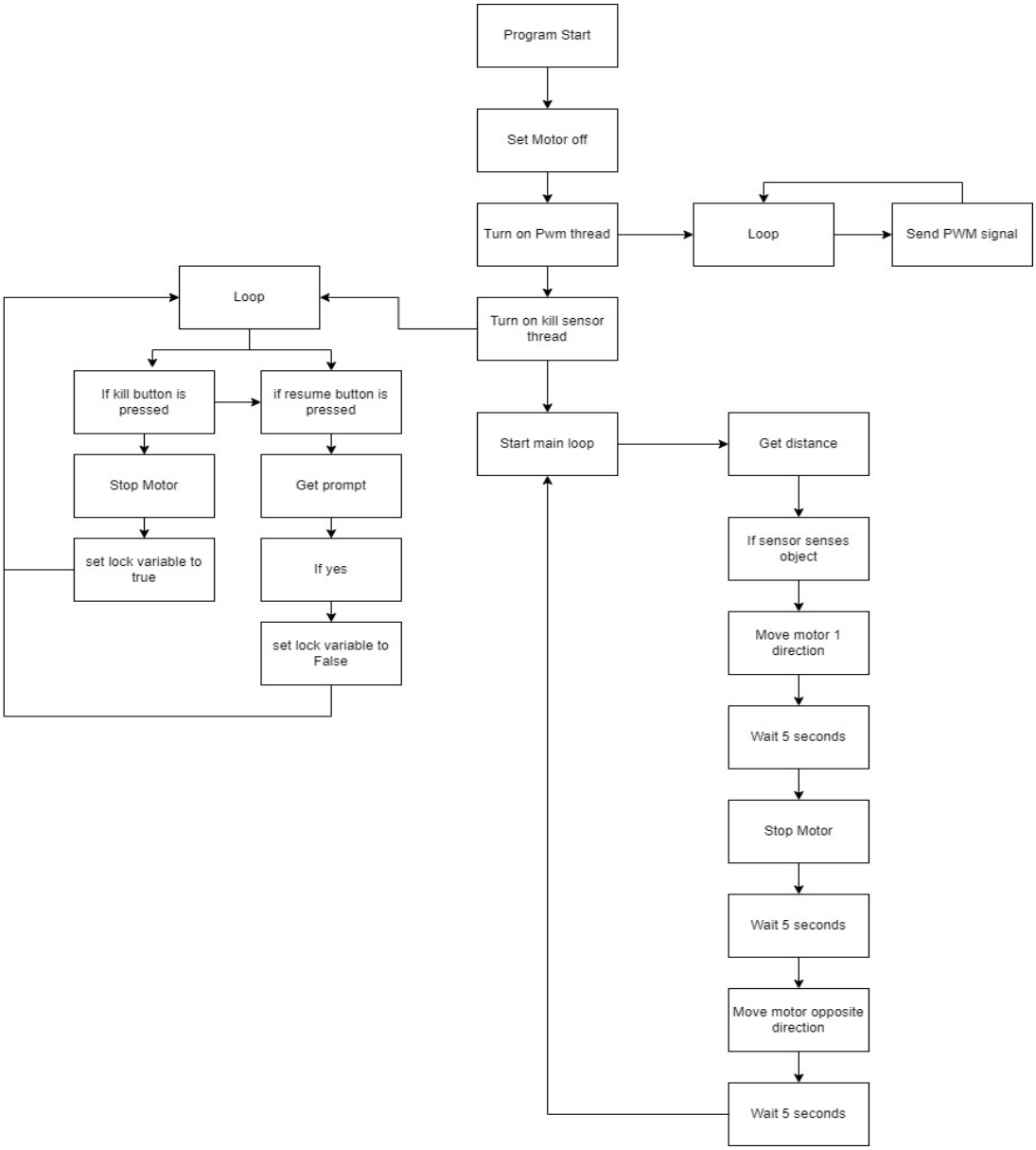


Figure 2Flowchart for python code

Problem Statement

Our project addresses a common challenge faced by homeowners: the inconvenience and potential safety issues associated with traditional garage door systems. The existing manual garage doors often require users to physically open and close them, posing challenges in inclement weather or when in a rush. Additionally, the lack of automated safety features can lead

to accidents or damage to vehicles and property. Recognizing these issues, our project aims to introduce a cutting-edge solution that not only enhances convenience but prioritizes user safety through innovative automation.

Project Goals

The primary goal of our project is to revolutionize the garage door experience by seamlessly integrating technology for an efficient, user-friendly, and secure solution. We aim to design a system that eliminates the need for manual effort, providing homeowners with the luxury of automated garage door operations. Simultaneously, our project aspires to set a new standard for safety in garage door systems. By incorporating advanced features such as the Sonic Sensor and emergency stop button, our goal is to create a smart living experience where users can confidently rely on a garage door that not only responds to their needs but also ensures a secure environment for both individuals and vehicles.

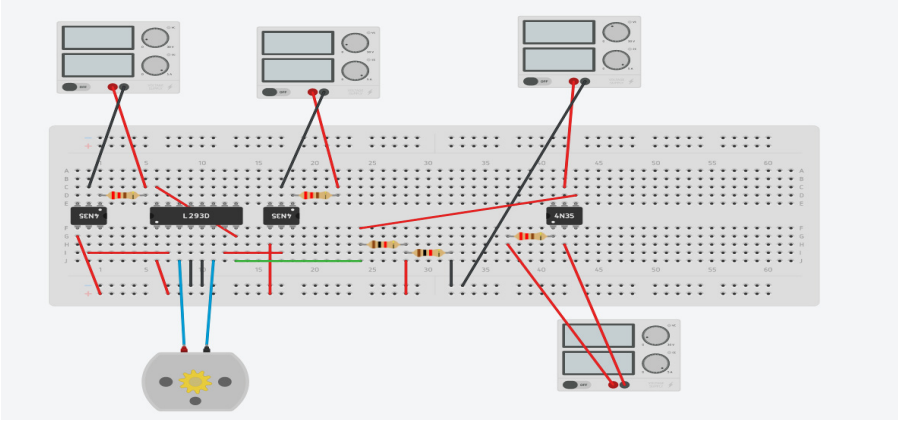


Figure 3Circuit Diagram

Project Objectives

To achieve our ambitious goals, we have outlined specific project objectives. Firstly, we will implement the Sonic Sensor technology to accurately detect the presence of a vehicle within the predefined boundaries, ensuring a precise and responsive automated door operation. Secondly, the integration of Python programming will enhance the overall intelligence and adaptability of our system, offering users a seamless and intuitive experience. Thirdly, we will prioritize user control by incorporating manual operation options, providing a harmonious balance between automation and individual preferences. Lastly, the implementation of the emergency stop button will serve as a fail-safe mechanism, underscoring our commitment to user safety in emergency situations. Through these well-defined objectives, our project aims to set a new standard for smart, safe, and convenient garage door systems.

Results and Discussion

The outcomes of our project represent a significant achievement, marking a successful endeavor in integrating innovative technology with practical living. From a technical standpoint, the project encountered challenges during the circuit creation phase, including issues with loose connections and short circuits. Additionally, the PCB printing process faced some hurdles, highlighting the importance of meticulous attention to detail in manufacturing. An interesting technical aspect emerged during testing, revealing a potential vulnerability in the sensor's ability to differentiate between human and non-human interferences. This provided valuable insights for future development, pushing us to explore advanced technologies such as license plate recognition or AI integration to enhance the system's accuracy and security.

From a Project Management perspective, the team exhibited commendable resilience and adaptability. While facing circuit-related challenges, the team rallied to address issues promptly, showcasing effective problem-solving skills. Despite hurdles, each team member contributed diligently, demonstrating a commitment to project goals. Communication played a pivotal role, and the implementation of Space, Face, and Place principles contributed to a harmonious working environment. Open-mindedness prevailed, fostering a culture of collaboration and creativity.

Looking ahead, our project has a robust foundation for future developments. The experiences gained during this phase, both technically and in project management, will guide the integration of cutting-edge features like voice-activated commands (e.g., "Hey Siri, open my door") and more sophisticated interference detection mechanisms. This critical analysis serves as a roadmap for continual improvement, ensuring that our automated garage door system evolves to meet emerging challenges and remains at the forefront of technology. The success of this project not only lies in its technical achievements but also in the effective collaboration, problem-solving, and forward-thinking approach demonstrated by the project team.

Extensions

The present project establishes a solid basis for an automated garage door system, but when more time and money are allocated to it, a wealth of fascinating opportunities become apparent.

1. Superior Environmental Flexibility:

Weather Integration: Improving the system's ability to react to weather conditions intelligently, for example, by shutting down automatically in the event of rain or unfavorable circumstances, would greatly improve its usability and practicality.

Animal and Pedestrian Detection: Adding cutting-edge sensors to identify nearby animals and people would improve safety by averting unintentional closures when impediments are identified.

2. Remote Management and Communication:

Functionality of a Remote Starter: With more resources, adding the ability to operate the garage door from a distance via secure remote signals would provide a level of convenience for anyone leaving or returning home in bad weather.

AI Integration: speech-activated commands might be made possible by investigating compatibility with virtual assistants like Siri. This would enable users to effortlessly operate the garage door with basic speech requests like "Hey Siri, open my garage."

3. Strengthened Safety Protocols:

Adding real-time monitoring and making sure the garage door doesn't close when the automobile is halfway through its route are two ways to improve the activity sensor concept. This would offer one more degree of security and avert any mishaps.

4. Artificial Intelligence Integration:

Artificial Intelligence (AI)-based Learning: By exploring the incorporation of machine learning algorithms, the system may be able to learn from and adjust to user behavior over time, forecasting trends and streamlining the automation process for specific users.

Smart Alerts: By putting in place AI-driven warning systems that inform users of any strange activity or illegal entry attempts, garage door systems may be made more secure overall.

These additions are not only necessary, but also consistent with how smart home technology is developing. They could transform the system into a clever, flexible, and safe garage door automation system, moving it beyond a convenience-focused setup.

Conclusion

In a nutshell, our project has been a fantastic journey of turning ideas into reality. We successfully created an automated garage door system that opens smoothly as a car approaches, thanks to smart technology. We faced some challenges like tricky circuits and sensor confusion, but our superhero team handled them like pros. From a Project Management perspective, we aced it – good communication, teamwork, and everyone playing their part. Looking ahead, we've got exciting plans to make our system even cooler with voice commands and super-smart features. This project has been a win, and we're ready for more wins in the future!

To wrap it all up, we built something awesome, learned a ton, and had a blast doing it. The automated garage door system is now a reality, making life a bit more convenient and safer. It's been a journey of teamwork, challenges, and success. Our project isn't just about opening doors; it's about opening possibilities for the future. Cheers to a job well done!

References

https://www.mightymule.com/blog/how-does-a-smart-garage-door-opener-work/

https://artisandoorworks.com/blog/7-surprising-benefits-of-automated-garage-doors/

https://www.cgdoors.com.au/obstacle-detection-system/

https://e2e.ti.com/blogs_/b/industrial_strength/posts/bring-intelligence-efficiency-and-convenience-to-automated-entrance-systems-with-ti-mmwave-sensors

Appendix A: PCB designs

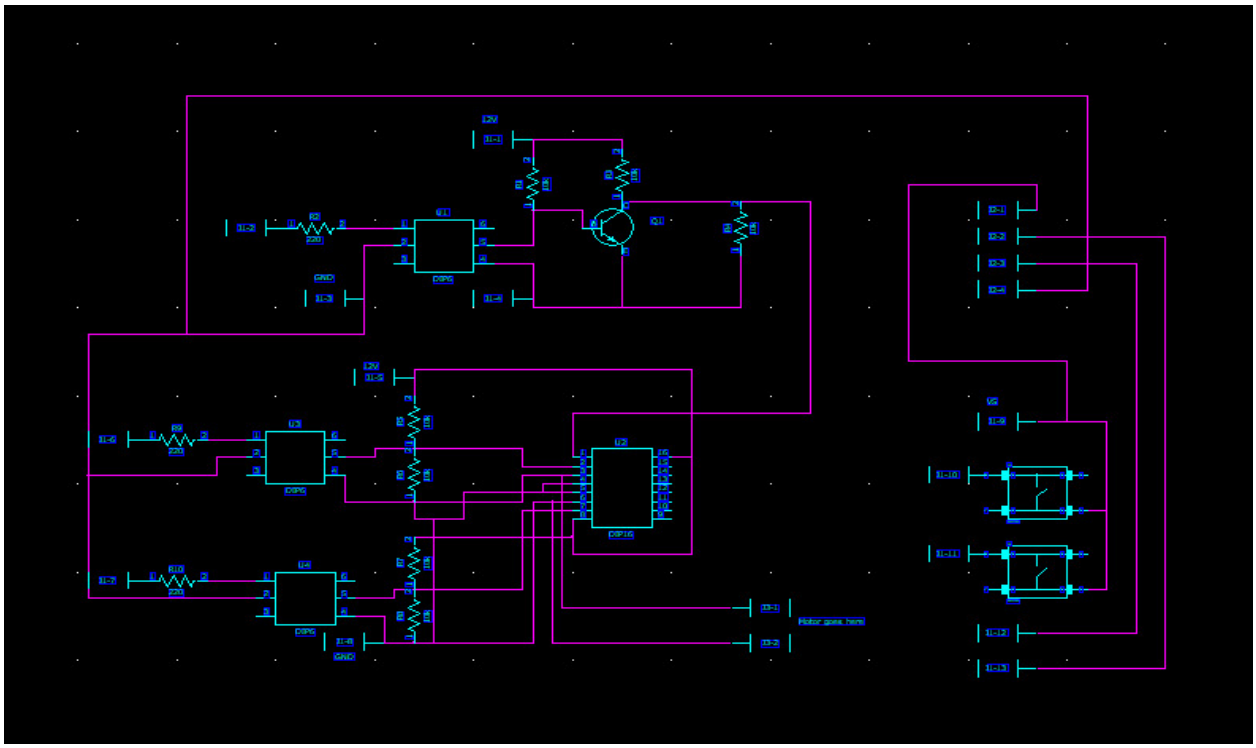


Figure 4PCB Design

Appendix B: Bill of Materials (BOM)

Quantity	Part Name	Part Number	Unit Price	Extended Price
1	L293D	497-2936-5-ND	12.67	12.67
3	4N25	160-1300-5-ND	3.45	10.35
1	2N3904BU	2N3904FS-ND	1.65	1.65
3	CF14JT220R	CF14JT220RCT-ND	0.83	2.49
7	CF14JT10K0	CF14JT10K0CT-ND	1.16	8.12

Appendix C: Program codes

```
def main():
    # start motor off as off
    global killSwitchted
    killSwitched = False
    d.setFIOState(6, 0)
    d.setDIOState(7, 0)
    turnOnPwm = threading.Thread(target=pwmsignal, daemon=True)
    sensor = threading.Thread(target=killsensor, daemon=True)
    turnOnPwm.start()
    turnOnPwm.join()
    sensor.start()
    sensor.join()
    while True:
        distance = getDistance()
        print(distance)
        time.sleep(0.01)
        if distance < 5 and not killSwitched:
            # move motor for 5 seconds
            if not killSwitched:
                d.setFIOState(6, 1)
                time.sleep(5)
            # stop motor for 5 seconds
            if not killSwitched:
                d.setFIOState(6, 0)
                time.sleep(5)
            # move motor otherway for 5 seconds
            if not killSwitched:
                d.setFIOState(5, 1)
                time.sleep(5)
            # stop motor
            if not killSwitched:
                d.setFIOState(5, 0)
```

Figure 5Python Snippet A

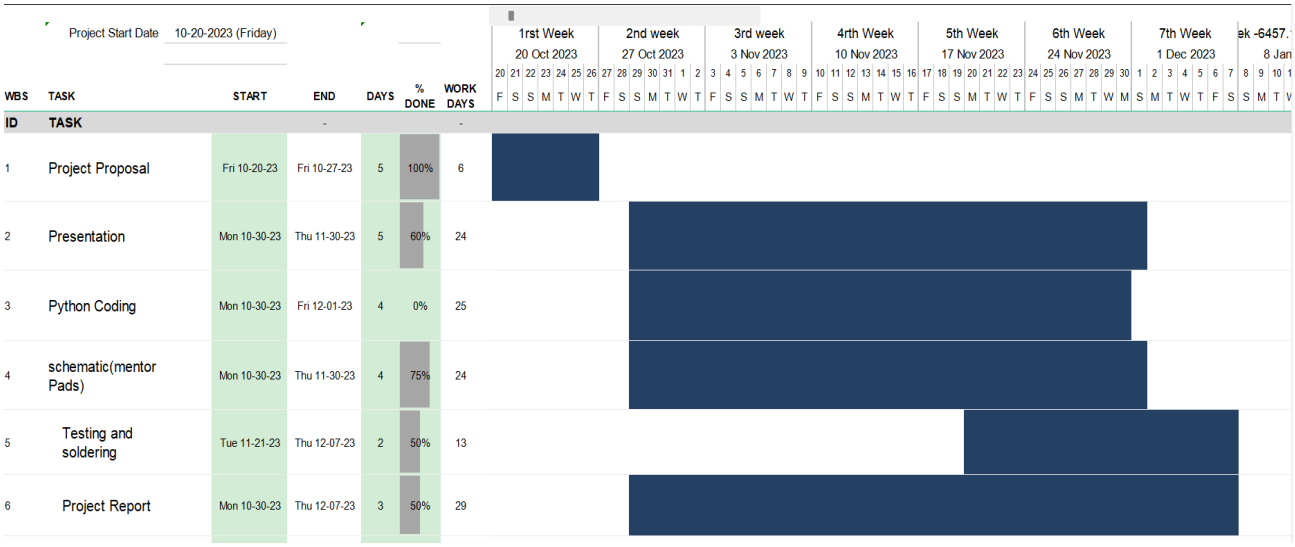
```python
def pwmsignal():
    while True:
        # pwm signal always
        d.getFeedback(u3.Timer0(Value=13109, UpdateReset=True))


def killsensor():
    global killSwitched
    while True:
        if d.getAIN(0) > 3.3:
            d.setFIOState(6, 0)
            d.setFIOState(5, 0)
            killSwitched = True
        if d.getAIN(1) > 3.3:
            yesno = input()
            if yesno == 'yes':
                killSwitched = False
            else:
                killSwitched = True


def getDistance():
    data = []
    distance = 0
    d.setFIOState(7, 0)
    time.sleep(0.00001)
    d.setFIOState(7, 1)
    time.sleep(0.00001)
    d.setFIOState(7, 0)
    # take reading
    # take # of readings and store in array
    for i in range(MAX_REQUESTS):
        data.append(d.getAIN(0))
    # process array
    # high means burst is still transmitted and waiting to recieve
    # low means burst is recieved back
    # distance is measured by how many high values are in the data array
    for i in data:
        if i > 0.5 and i < 6:
            distance += 1
    return distance
```

Figure 6Python Snippet b

Appendix D: Gantt Chart



Project Start Date: 10-20-2023 (Friday)

WBS	TASK	START	END	DAYS	% DONE	WORK DAYS
ID	TASK		-			-
1	Project Proposal	Fri 10-20-23	Fri 10-27-23	5	100%	6
2	Presentation	Mon 10-30-23	Thu 11-30-23	5	60%	24
3	Python Coding	Mon 10-30-23	Fri 12-01-23	4	0%	25
4	schematic(mentor Pads)	Mon 10-30-23	Thu 11-30-23	4	75%	24
5	Testing and soldering	Tue 11-21-23	Thu 12-07-23	2	50%	13
6	Project Report	Mon 10-30-23	Thu 12-07-23	3	50%	29

Figure 7Gantt Chart