DoorSure:
The Garage Door Status Detector

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Chapter 2. Project Description

2.1 Motivations

Imagine this: you are rushing out of your home, running late for work. In the chaos of the morning— getting dressed, making breakfast, grabbing your keys— you pull out of the driveway without a second thought. But by the time you make the drive and arrive at your workplace, a nagging thought crosses your mind– did you remember to close the garage door? In today's fast-paced world, this scenario has more than likely been a reality for the average person. Preoccupied with more pressing tasks, it becomes easy for one to forget something as important as closing the garage door before leaving home.

Leaving your garage door open is not just an inconvenience, it poses a serious security risk. An open garage door provides easy access for burglars, putting your home, valuables, and personal safety at risk. According to the 2019 FBI UCR: Crime in the United States, approximately 6.9 million property crimes were reported. Of these property crimes, 1.1 million were burglaries, resulting in losses of an estimated $3 billion in stolen valuables and direct property damage. More recently, 2024 reports from Securiteam indicate that burglary remains a major concern, with approximately 2.5 million burglaries occurring in the United States, resulting in an estimated $3.4 billion in losses. However, advancements in smart security technology and neighborhood surveillance systems have contributed to an overall declining trend in burglary rates over the years. Enhanced security measures—such as smart home devices, motion-activated cameras, and automated alerts—are making it harder for intruders to go undetected, reducing the likelihood of break-ins.

Beyond theft, however, an open door exposes your garage to the elements - rain, wind, or even wandering animals that could cause property damage. If you're away for hours, or even the entire day, these risks only increase. In response to this problem, modern technology can be used to create smart home solutions that provide not only property security but also peace of mind. As engineers, we can create solutions by combining integration of sensors and real-time monitoring systems with software technology that will allow homeowners to remotely check the status of and receive alerts about their garage door, as well as giving said users the ability to interact with their garage door, ensuring their home remains secure even when they are miles away. This project will serve as our first real immersion into the world of engineering design, allowing us to take an idea from concept to complete prototype. Unlike structured classroom labs, where solutions are often known before experimentation begins, this project will require us to identify and design a device that will resolve a real-world issue, research and iterate on our designs to create a functional and reliable system, and integrate a software application that will directly interact with the hardware. We will gain hands-on experience with key engineering principles such as circuit design, sensor integration, and software development, all while addressing a real-world problem that affects millions of people. This project is not just about building a functioning product—it's about developing and applying the concepts and technical skills we have learned throughout our academic career here at University of

Central Florida. By combining hardware and software components, we will explore the intersection of electrical and computer engineering as a team, preparing us for more complex projects and team dynamics in our future careers. Ultimately, this project is an opportunity to gain valuable hands-on design experience while working with teammates of differing levels of skill sets to achieve a common goal: to transform everyday inconvenience into an innovative, user-friendly solution that enhances security and convenience for homeowners everywhere.

2.2 Existing Products

In our research, our team noticed existing garage door status detectors tended to be directly linked to their corresponding garage door brand. One of the brands found in our research, the Chamberlain MyQ Smart Garage Door Sensor, is cost-effective but is only compatible with Chamberlain and LiftMaster garage doors. Moreover, Chamberlain offers an indoor security camera with motion detection that connects to their corresponding application. However, these two devices are sold separately. Expanding from this idea, our device will combine both features of a garage door status detector and a security camera, while also offering open/close door features via a servo motor with a microcontroller and having a live streaming camera module that can be placed anywhere the client wants and connect seamlessly together with the web application. Chamberlain works with most garage door brands that use photoelectric sensors that do not shut off and it is not intended for use with openers in which the photoelectric sensors are located near the bottom of the garage door, all these requirements for the device to work properly which is a major inconvenience to customers. Our project aims to combine the garage door status detector with the camera while aiming for a lower cost compared to what Chamberlain offers for approximately 60 dollars combining both devices as our project aims to have a unit cost within \$40-\$60. Additionally, our project aims to offer full compatibility with any garage door no matter the year of manufacture, offering peace of mind to the consumer when purchasing our device. Another device that has similar properties to our proposed device is the Genie's Aladdin Connect. The Aladdin connect can enable the use of smartphones to open and close any garage door after 1993, but this is a costly item, being over \$50 to purchase a set of 2 garage control keys. Although this product offers control keys, it fails to offer an accompanying camera component. In contrast, our project will build upon theirs, offering the live feed of the camera viewable by the user on the web application.

Moreover, our web app will expand on the existing functions of the Chamberlain's device and the Genie's Aladdin connect such as receiving notifications if the door is being obstructed by sensors and on what object causing the obstruction (stretch goal) giving our product the better product overall, while recognizing that each product have their strengths and weaknesses as the Chamberlain's product offer the garage door status detector with a camera but with a trade off with the cost and compatibility with all garage doors, also the Genie's Aladdin connect offers control keys with the mobile application connectivity but with a weakness of high cost and no camera integration.

We recognize that every product has strengths and weaknesses including our product, but we offer compatibility with all garage doors, camera integration showing a live feed on our application, and object detection using the camera (stretch goal). Not only will these products give us an initial idea of how the project should look initially but also give us an opportunity to develop the next level product with better strengths and less weaknesses. Our project will have the opportunity to implement many optional features in the application that will be incredibly useful to users such as notifying the user what object is blocking the door, scheduling open close timing, ,notifying users of late garage opening and many more application features if time allows, that would allow our project to be an incredible startup idea that might replace the other two products we discussed.

2.3 Goals and Objectives

Basic Goals:

1. The user will have constant and accurate access to their garage door's status.
2. The user will be able to alter the status of the garage door regardless of their location.
3. The user will be notified if the garage door status is altered from its current state.
4. The user will be unable to request a status change if there is an object in the way of the garage door.

Advance Goals:

1. The user will be able to view live camera feed from the device on the web application.

Stretch Goals:

1. The device will be able to accurately identify objects that are causing any potential blockage to the garage sensors, therefore not allowing the garage door status to be changed.
2. The user will be notified of the object's presence, along with the object's identification.

Objectives:

To ensure constant and accurate access to the garage door's status, our device will utilize a microcontroller to process sensor input and manage communications. A reed switch will be used to detect whether the garage door is fully open or fully closed, while an ultrasonic or IR sensor will measure the garage door's position in real time. This will improve our device's accuracy rate concerning the real time status of the door. Furthermore, the microcontroller's wireless capabilities will transmit collected status data to a cloud database server, allowing the user access to the data through our secure web application. Throughout this process, LED indicators on our device will provide visual feedback on its operation, such as the power and wifi connectivity status. The device will be powered by a replaceable or rechargeable battery. When the battery voltage on any one of the three MCUs has been measured to be below a specific voltage level, the user will receive a notification stating the battery needs replacement or recharging.

In order to enable remote control functionality, our web application will send information to and from the user's device via a remote networking service while the Bluetooth module will allow high speed local control. Security features such as encrypted data transmission and user authentication will be implemented as needed to prevent unauthorized access to the data of the garage door.

The system will notify users whenever the garage door status changes, according to preferred notification configurations. The microcontroller will monitor input from the reed switch and ultrasonic/IR sensor, triggering real-time notifications whenever movement is detected. Notifications will be sent as push, SMS or email.

To ensure safety and property protection, the system will prevent the garage door from operating if an obstruction is detected. The ultrasonic sensor will continuously scan for objects in the path of the garage door. If an object is found to be in the path of the door, one of the microcontrollers will disable the Servo Motor from operating and send an alert to the user. LED indicators will visually indicate blockage. This detection system will be optimized for accuracy to minimize false positives and increase accuracy of the device during the testing phase.

The camera component will be used to capture and stream live footage. The camera will communicate with one of the microcontrollers, always allowing the user access to this footage through the web application. This will allow users to view a live video feed of their garage at any time through the web application.

As a stretch goal, the system will incorporate AI-based object recognition to identify specific obstructions preventing the garage door from closing. The camera module will capture images of the detected objects, and an AI model running on the microcontroller will classify them accordingly, such as persons, pets, bicycles, etc... The system will then notify users of the identified obstruction, displaying relevant details in the web application.

Although our device will connect directly to the user's home Wi-Fi network and utilize wireless communications, we may require further user authentication such as account creations to increase security of our device as needed. Although our device requires wireless connectivity to send any status alerts, it is important to add this level of security to not allow just anyone with access to the home Wi-Fi network control of the garage. This ensures that if an unauthorized user connects to the home Wi-Fi, they will not simply be able to enter the application and open the user's garage door. Depending on ongoing security concerns further into our project research, these choices can be further modified and built upon. User configurations such as customized door notifications and battery warning thresholds will be saved onto the microcontroller built-in non-volatile storage. These configurations can be altered by the user directly on our web application. As the project progresses, we will evaluate the need for additional external components, such as a microSD card, to expand storage capacity as necessary.

2.4 System Description

The hardware components for our device consist of the following bullet points. Please note that these components and possible alternatives based on potential setbacks are further explored in Section 2 of this report.

- Microcontrollers
- Wireless Modules
- Camera Module
- LED Indicators
- Enclosure
- Sensor
  - Reed Switch
  - Ultrasonic/ IR sensor
- Power Source
  - Replaceable/ Rechargeable battery

The software aspect of this project will consist of a web application, designed for direct user interactivity with the hardware. From the web application, users will be able to:

- Receive garage status notifications:
  - The garage door has been opened
  - The garage door has been closed
  - Garage door left open after x amount of time elapsed
- Directly interact with the garage:
  - Fully close the garage door
  - Fully open garage door
  - Custom garage door height
- Receive low battery notification of device
- View live camera feed (advanced goal)
- Receive notifications on what object is causing an obstruction (stretch goal)

2.5.1 System Specifications

The system specifications indicate what the smart garage door system must achieve to meet customer needs and project goals. They ensure the system can detect, process, and communicate the user's garage door status in various environmental and operational conditions.

Table 2.5.1: System Requirements

Parameter	Target Value	Description
Garage Door Status Detection	≥ 95% Accuracy	Ensures sensor precision for detecting door position.

Parameter	Target Value	Description
Notification Delay	≤ 2 seconds	Provides near-instant security alerts.
Obstacle Detection accuracy	≥ 90% Accuracy	Will not allow garage door to be closed if an object is obstructing the path
Door Opening time duration	≤ 15 seconds	Ensures the garage door opens within a reasonable timeframe for user convenience while maintaining smooth and safe operation.
Door Closure time duration	≤ 15 seconds	Ensures the garage door closes efficiently without unnecessary delays, enhancing security and usability.
Operating Voltage	3.3V - 5V	Ensures compatibility with embedded systems.
Overall Power Consumption	~2W - 6W	Total energy usage of the system
Unit Cost	$40-$60	Affordable, competitive cost
Battery Life	≥ 3 months	Extends operation without frequent replacements.
Installation Time	≤ 20 minutes	Ensures a user-friendly setup.
Operating Temp	-20°C to 60°C	Ensures reliable operation in various environments.
Humidity Tolerance	10% - 90% RH	Prevents failures due to humidity exposure.

2.5.2 Component Specifications

The component specifications define the specific hardware modules and capabilities, explaining the role of each component in the overall system. These specifications ensure the smart garage system is compatible, reliable, and meets the technical demands of the project.

Table 2.5.2: Component Specifications

Component	Parameter	Value

Microcontroller	Clock rate	80 MHZ - 240 MHZ
Camera Module	Resolution	At least 720P
Power Source	Battery life	Last 3 month
Wi-Fi Bands	Bandwidth	2.4GHz, 5GHz
Wi-Fi Range	Coverage	≥ 30 meters indoors
Bluetooth Range	Coverage	≥ 10 meters indoors

2.5.3 House of Quality

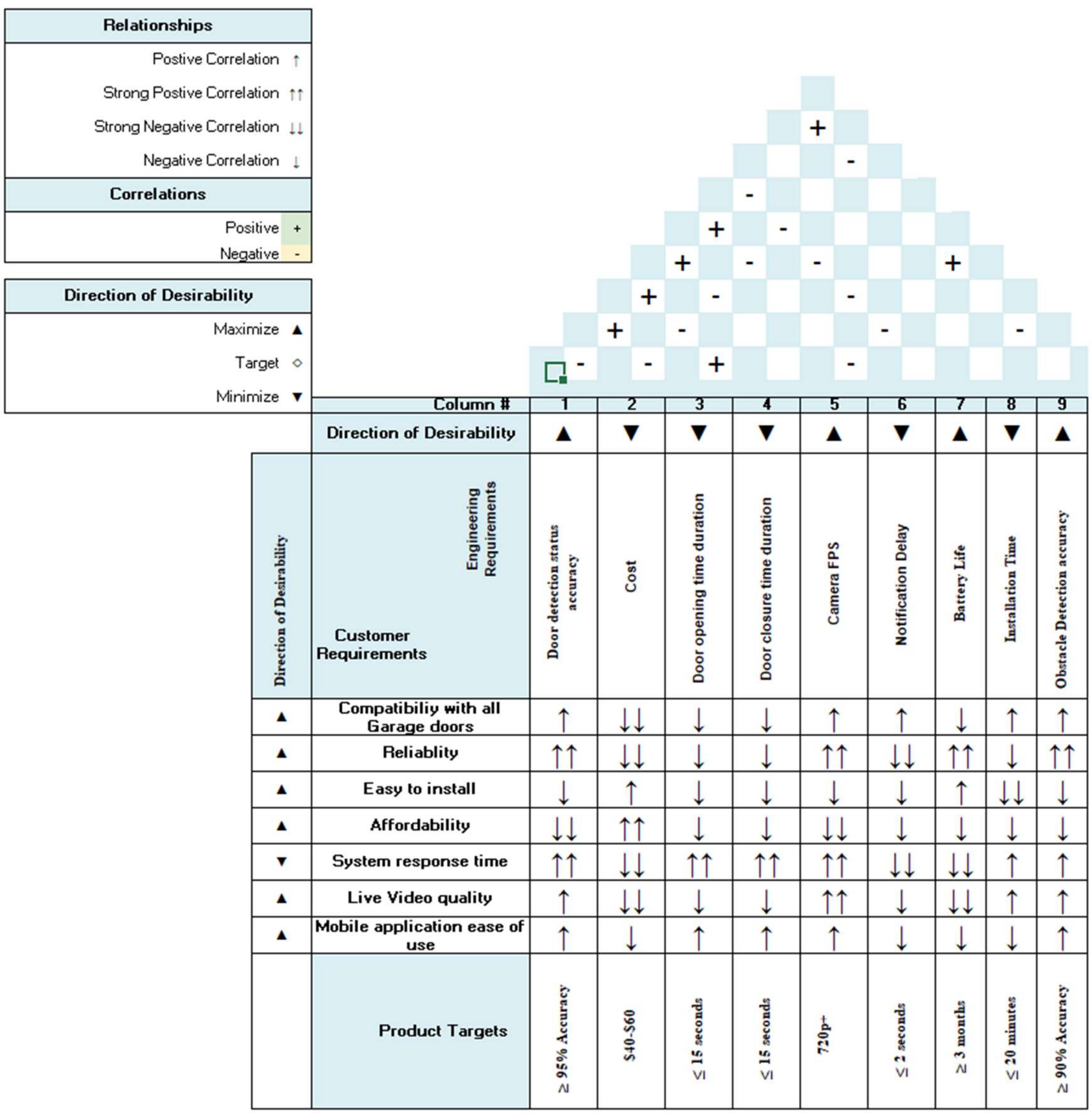

Figure 2.6.3: House of Quality

2.6.1 Hardware Block Diagram

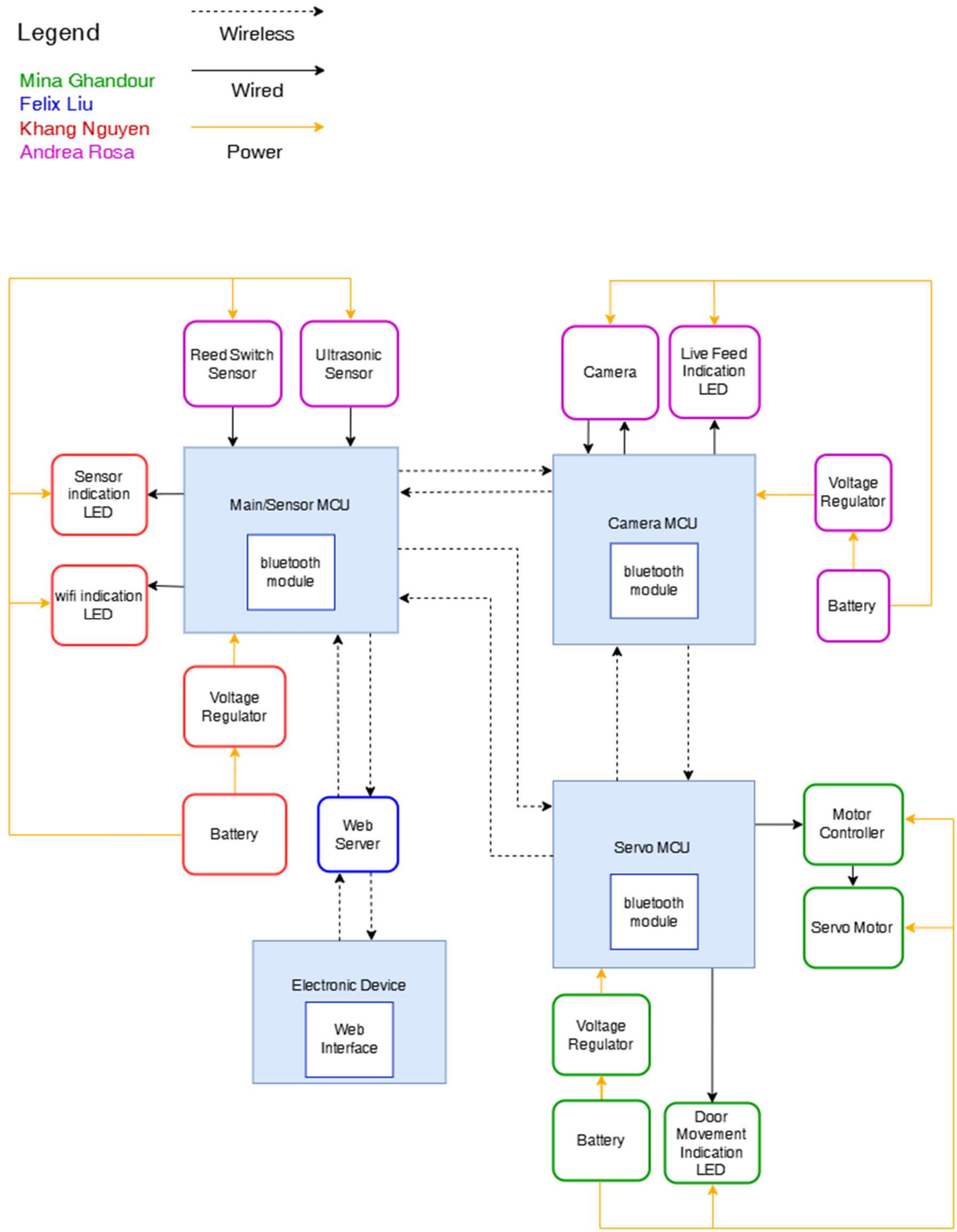

Figure 2.6.1: Hardware Block Diagram

2.6.2 System Flowchart Diagram

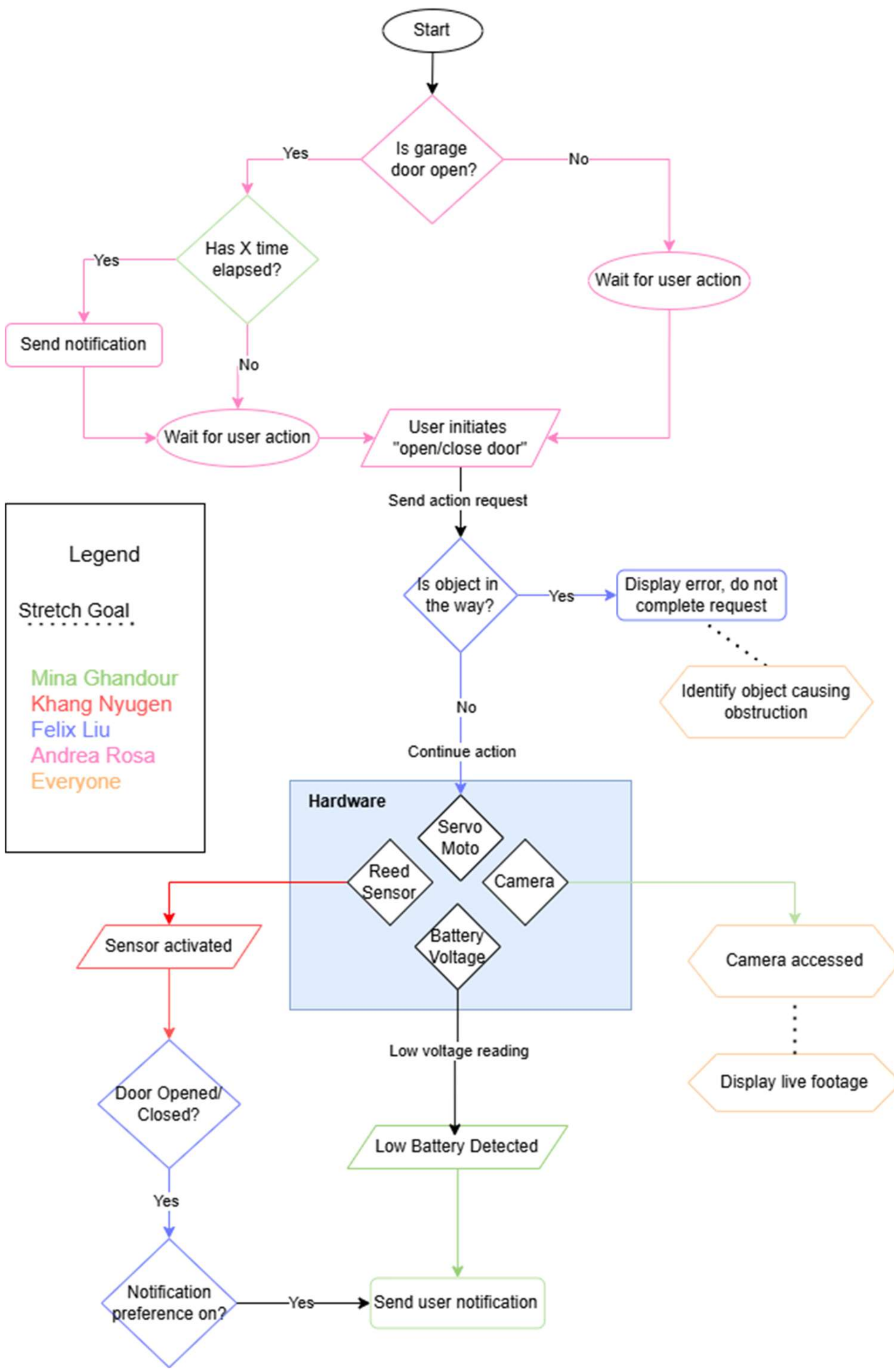

Figure 2.6.2: System Flowchart Diagram

Chapter 3. Research and Investigation

Extensive research is one of the most important aspects of project design. As discussed in Senior Design I ABET lectures, it is important for a project to be relevantly researched to avoid failure. In this section of the report, our team will be delving into different technological aspects of our project proposal, including both hardware and software comparisons. These comparisons are absolutely essential to our designing process as it not only allows the team to make the most informed decisions on hardware parts that will minimize overall costs, but also maximize

3.1 Technology Comparison (10-15 pages)

One of the most important aspects of our project is the web application associated with our device. Besides initial physical setup with the sensors, camera, and main body device placements within the user's garage, the majority of user interaction with said device will be completed through our application. As such, it is crucial to research and decide on proper software technology. When beginning our research, it was important to understand how our software will interact with the hardware and vice versa. Our physical device will connect to the user's home WiFi network. This means that, whenever our user is not home, they will need a way to alter the state of the garage. There are many ways for this connectivity to occur such as using a cloud server or port forwarding.

To ensure communication between the device and the user while the latter is away from the home Wifi network, we can rely on either port forwarding, cloud servers, or even using a built-in mini-server from the microcontroller.. Port forwarding, however, is not the most user-friendly choice. Assuming the user does not already know how to port forward, the user will have to do their own research which increases installation time. Furthermore, if the user port forwards their router without ensuring a firewall is running beforehand, their security is at risk of being compromised. In addition, many people may not know how to port forward which will increase set-up time. One of our marketable aspects is to have an easy install, so this would not be a great choice. As designers, it's important to take into account our desired consumer base and make decisions based on usability.

A cloud server provides many benefits to not just the user but also the developer. In addition to being a more user-friendly experience upon setup, cloud servers allow for easier scalability, security, and low costs. If the team was interested in bringing this project into further fruition, cloud servers would definitely be the better choice . Purchasing a cloud server from a provider is relatively low but, seeing as port forwarding is free, in this case would be a disadvantage. Cloud servers have significantly higher security protocols in place which provides more protection for our users and takes away the need for the user to be aware of

Table X: Remote Networking Comparison

	Advantages	Disadvantages
Port Forwarding	- Fast communication times - No cost	- Not user-friendly - Increased security risk
Cloud Server	- Scalability - Decreased security risk - High storage capacity - User friendly	- Higher cost than port forwarding - Decreased communication times
Built-in Microcontroller Module** fix wording	- No additional cost - Lowest communication times - User friendly	- Limited storage

*Our team has initially chosen a web-based application to minimize costs associated with platform-specific APIs, such as those required by the Apple Developer Program and Google Play Console (expand on)

3.2 Part Selection (30-40 pages)

These are the sensors we find that fit this project, we are comparing the available options based on their pros and cons.

Table 3.1.1: Door Position Detection Sensors

Sensor Type	Description	Pros	Cons
Reed Switch	Use a magnet to detect open/closed states	-Low cost -Low power draw -Reliable	-Need precise alignment -Only detect open/close
Hall Effect Sensor	Detects magnetic field changes	-No wear and tear -More precise	- High power draw -Requires calibration
Limit Switch	Mechanical switch that detects physical contact	-Simple and reliable -Low cost	-Wear over time

Table 3.1.2: Obstacle Detection Sensors

Sensor Type	Description	Pros	Cons
Ultrasonic Sensor	Measuring distance using sound waves	-Good accuracy -Works in many lighting conditions	-Affected by environmental noise -Power consuming
Infrared Sensor	Detects based on infrared reflection	-Low cost -Simple to implement	-Poor performance in bright light -Short range
Lidar Sensor	Laser to measure the distance	-High accuracy -Works in all lighting conditions	-Cost –Higher power consumption
Camera with AI	Processes images to detect objects	-Versatile -More visual information	-Processing power -Privacy concerns

3.3 Batteries

Table 3.3.1: Battery Type

Choosing the appropriate battery for the garage door status detector ensures long-term operation and reliable performance. For our garage door detector system, we needed to consider the type of battery that would be implemented for the devices. Before choosing which battery to use, we will need to look at the types of battery technologies that we will implement for our devices. Primary batteries cannot be recharged, hence they are labeled as single use batteries. Secondary batteries on the other hand can be rechargeable. (OpenSTAX) For our device, we concluded that using primary batteries would fit better in the long run, as we want the devices to keep running as much as possible; having one of the systems be offline due to the amount of time that a device needs to be recharged would be inefficient. Using primary batteries would also relieve users that are not experienced with handiwork installation as all they need to do is replace the batteries if they get low without doing any reassembly with the detector devices.

Table 3.3.1: Battery Comparison

Battery Type	Description	Pros	Cons
Alkaline (AA/AAA)	Common disposable batteries	-Low cost -Availability	-Lower capacity -Less lifespan
Lithium	Primary Batteries	-Long lifespan	-higher cost

Carbon-Zinc	Primary Batteries	-good for low drain systems	-Low shelf life -Less capacity
Lithium-ion	High energy density	-Longer lifespan -Lightweight -rechargeable	-Higher cost

Although any primary battery would technically work with the system, we decided to process through which type of primary battery would be most effective and long lasting to install in the devices. Alkaline batteries are generally used everywhere in household products and are easy to find and cheap to acquire in large quantities. Lithium batteries have a higher capacity compared to alkaline batteries and can be recharged but are slightly expensive to buy compared to alkaline. Zinc Carbon batteries are best used for devices that do not consume energy at the high level due to their short shelf life. Based on these comparisons if the user does not want to constantly change their batteries on a frequent basis lithium batteries are the best choice, despite the slightly higher price point if left constantly running they will not experience the same properties as a leaking alkaline battery.

3.3.2 Battery Size

Along with the primary battery type of choice, the size of the battery also needs to be considered. Because we plan on making the devices small and compact, we cannot use batteries that are larger than a AA battery, in this case D batteries would not be sufficient. This leads us to these types of batteries as shown on this table.

Table 3.3.2: Battery Size Comparison (Renogy, 2024)

Battery Name	Shape	Available Battery Types	Dimensions	Voltage	Capacity
AA	Cylindrical	Alkaline, Lithium	L 50 mm x D 14.2 mm	1.5V	1800–3000 mAh
AAA	Cylindrical	Alkaline, Lithium	L 44.5 mm x D 10.5 mm	1.5V	850–1200 mAh
9V	Square	Alkaline, Lithium	H 48.5 mm x L 26.5 mm x W 17.5mm	9V	500–600 mAh
123	Cylindrical	Lithium	L 34.5 mm x D 17 mm	3V	1500 mAH

CR2	Cylindrical	Lithium	L 27.5 mm x D 16 mm	3V	800 mAh
N	Cylindrical	Alkaline	L 30.2 mm x D 12 mm	1.5V	800–1000 mAh
CR2025	Cell	Lithium	H 2.5mm, D 20mm	3V	170 mAH
CR2032	Cell	Lithium	H 3.2mm, D 20mm	3V	235 mAH

3.3.2.1 AA Batteries

AA batteries are one of the most common sizes of batteries the general consumer uses and while they would be a good use for the devices, they would be insufficient to use in the long run. As AA batteries only hold a voltage of 1.5 V, this would require two AA batteries connected in series to properly function, which would contradict the design language in the small form factor. Since we are also using lithium batteries in our project buying a pack of 4 would be expensive to purchase. For these reasons the AA batteries are not a good choice to use.

3.3.2.2 AAA Batteries

AAA batteries are similar to AA batteries but only with a slightly smaller length and depth. Despite the slightly smaller size they still have the same issues as mentioned in AA batteries; only 1.5V of voltage and requiring at least 2 AAA batteries for each of the devices making the overall enclosure of the design slightly bulky. The AAA batteries would also not be good to use for the project.

3.3.2.3 9V Batteries

9V batteries are the only kind of battery with a square shape, and 1 battery can be used per device. While 9 volts is enough to supply the ESP32, the large value of the voltage can cause problems even if a step down regulator is used. (need to find sources other than bs and chatgpt) In addition, because we are using lithium batteries a lithium 9V battery would be expensive, on average around 5-7 dollars per 9V battery is not ideal for the project.

3.3.2.4 123 Batteries

Compared to AA batteries, 123 batteries have a small and compact size that carry 3V of voltage. They have been applied to many electronic systems (like smart door locks) and because they are mainly lithium batteries their battery life is long. The disadvantage of using 123 batteries is the cost of each battery due to the advanced technology in lithium batteries.

3.3.2.5 CR2 Batteries

CR2 batteries have a similar size to 123 batteries while having the same voltage of 3V. As one battery can suffice (with a voltage regulator), the only disadvantage like the 123 batteries are the high price point for a pack of 2.

3.3.2.6 N Batteries

N Batteries are sized like 123 and CR2 batteries, however they are only alkaline and like AA and AAA batteries they only have a voltage of 1.5V. These batteries would not be suitable for the project by this result.

3.3.2.7 CR2025 Batteries

CR2025 Batteries are small coin sized lithium batteries that have a voltage of 3V, meaning that one cell battery can be sufficient to use (with a regulator). Having a small height and diameter CR2025 batteries match the form factor idea of the garage detecting device. The only disadvantage is the limited capacity of 170 mAH, which could lead to a limited battery life compared to using 123 batteries.

3.3.2.7 CR2032 Batteries

CR2032 batteries also have a similar design to the CR2025 batteries, though they are slightly thicker. The difference of thickness is very negligible as the 3.2mm height does not affect any physical change to the housing for the battery. The extra thickness allows an increased capacity to 235 mAH, though compared to the capacity of 123 batteries the power life of the device might not last longer than what we desire.

Chapter 10. Administrative Content

10.1 Budget

After researching the project and discussing the allocated budget for each team member, we agreed that every team member can spend up to $200 which will be divided among the components in the bill of materials. This list is subject to changes based on time and money constraints. Since our team is composed of 4 team members, our total budget is $800. The huge gap in the total amount spent on components illustrated in the bill of material and allocated funds by each team member, allows us to have faster delivery for the components and PCBs. Additionally, BOM gives us more liberty when it comes to brainstorming and executing more creative and innovative solutions to problems we may find along the way for this project. We recognize we may accidentally damage components along the way during testing and prototyping so these extra funds will give us the opportunity to replace those components as well as add any additional components as needed.

10.2 Bill of materials

Components	Details	Vendor	Quantity	Unit price	Total price
Microcontroller	ESP 32s 2.4 GHZ dual mode WIFI +Bluetooth dual-core microcontroller integrated with antenna RF AMP filter	Amazon	2	\$8.99	\$17.98
Camera module	ESP 32-cam MB 5v Wi-Fi Bluetooth CH340 OV2640/ 8225N camera	Amazon	1	\$13.99	\$13.99
Ultrasonic sensor	HC-SR04P, ultrasonic module distance measuring sensor	Amazon	1	\$1.91	\$1.91
Reed switch	4 pcs door sensor magnetic switch	Amazon	1	\$7.99	\$7.99
Replaceable batteries	Duracell coppertop AA	Amazon	4	\$1.18	\$4.72
Servo motor	SG90 180-degree servo motor	Amazon	2	\$3.50	\$6.99
Colored LEDs		Amazon		\$4.99	\$4.99
Total:					\$58.57

Table 10.2: Bill of Materials

10.3 Work Distribution

After multiple meetings with the team and assessment of everyone's personal and technical skills, we have created the following work distributions table. As we are all current students juggling differing work and class schedules, it is important to note that we are open to helping one another out with tasks as needed. If someone is struggling with a certain aspect or needs assistance, as we are a team working towards one goal, we will help one another in any way we can. Regardless of that fact, members are still expected to make continuous progress in their assigned tasks in order to ensure we meet the deadlines specified in our milestones. Senior Design is a rigorous course and as such we must keep one another in check to ensure proper completion of our project. Furthermore, our team will have two meetings per week to ensure the workload is sufficient for each member and to have continuous progress checks. This is done to ensure the project is moving ahead with each passing week and to adjust tasks as necessary based on actual progress and outcomes.

Table 10.3: Work Distribution

Primary Team Member	Responsibilities
Mina Ghandour; EE	Hardware design, power system integration, battery selection, circuit design, and sensor integration.
Khang Nyugen; EE	Hardware design, PCB layout, microcontroller selection and programming, and connectivity modules (Wi-Fi/Bluetooth).
Felix Liu; CPE	Software development, embedded programming, database management, and backend web application development.
Andrea Rosa; CPE	Web application frontend design, user interface, cloud server integration, and security implementation.

10.4 Milestones

Below are the team's hard deadlines for Senior Design I and Senior Design II. These milestones were generated based on the course outline. In order to ensure our team will meet the deadlines listed and successfully complete the course with a finished prototype, it is absolutely crucial that our team not only meets the expectations associated with the deadlines but continues to strive above and beyond what is expected for the project. Additionally, note that no deadlines were written in or meeting dates specified with our review committee, but our team will ensure that our reviewers continue to stay up to date with our project and progress as the course continues. Also note that the milestones for Senior Design II are broad as our team begins work for Senior Design II. Based on our progress on hardware and software, we will create the necessary milestones for the Summer term as needed to ensure success.

Table 10.4.1: Milestones for Senior Design I

	Task	Start	End	Status
1	Team Formation	Week 1		Completed
2	Project Ideas	Week 2		Completed
3	Divide & Conquer	1/17/2025	1/23/2025	Completed
4	ABET Lectures	1/21/2025	2/13/2025	In Progress
5	Divide & Conquer Meeting	1/28/2025		Completed
6	Create and Update the Group Website	1/28/2025	2/7/205	In Progress
7	ABET Quizzes (A to G)	2/8/2025	3/7/2025	Incomplete
8	Spring Break	3/17/2025	3/22/2025	N/A
9	Midterm Report	2/7/2025	3/25/2025	Incomplete
10	Midterm Report Meeting	3/26/2025	3/28/2025	Incomplete
11	Update Group Website With Midterm Report	3/28/2025	4/4/2025	Incomplete
12	Final Report & Mini Demo Video	4/4/2025	4/22/2025	Incomplete

Table 10.4.2: Milestones for Senior Design II

	Task	Start	End	Status
1	Build Prototype	May 2025		Incomplete
2	Software Build	June 2025		Incomplete
3	Testing Phase	July 2025		Incomplete
4	Final Presentation	Final Week		Incomplete
5	Final Report	Final Week		Incomplete

APPENDIX A - References

[1] FBI — Property Crime

[2] US Burglary Statistics 2024

[3] CHAMBERLAIN Smart Garage Control Product
https://www.amazon.com/Smart-Garage-Opener-Chamberlain-myQ-G0401/dp/B08GD3D9YJ?pd_rd_w=wROxZ&content-id=amzn1.sym.55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_p=55c0153f-1fb7-42ff-8241-d1c0f3732289&pf_rd_r=ESZSGMK7RD2924642GRS&pd_rd_wg=mezPF&pd_rd_r=66378763-1e5b-4f0e-94c1-6a46d390b9ba&ref_=sspa_dk_detail_img_1&sp_csd=d2lkZ2V0TmFtZT1zcF9kZXRhaWxfdGhlbWF0aWM&th=1

[4] CHAMBERLAIN myQ Smart Indoor Security Camera
https://www.amazon.com/dp/B0D2LW9M4P/ref=sspa_dk_hqp_detail_aax_0?sp_csd=d2lkZ2V0TmFtZT1zcF9ocXBfc2hhcmVk&th=1

[5] Genie Aladdin Connect
https://www.amazon.com/Genie-Company-ALKT1-R-Smartphone-Anywhere/dp/B016QB7K5O?maas=maas_adg_6D4C85CB50484BEBD447209BF1C8A89E_afap_abs&ref_=aa_maas

[6] Pros and Cons of Cloud Storage | Secure Storage

APPENDIX B - Parts

[1] Servo Motor Part
https://www.amazon.com/DIYables-Degree-Arduino-ESP8266-Raspberry/dp/B0BPFXTZ73/ref=asc_df_B0BPFXTZ73?mcid=6caed98ed8e23609961ab0c9ef94c526&hvocijid=12273598725803836168-B0BPFXTZ73-&hvexpln=73&tag=hyprod-20&linkCode=df0&hvadid=721245378154&hvpos=&hvnetw=g&hvrand=12273598725803836168&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011767&hvtargid=pla-2281435176658&th=1

[2] AA Duracell replaceable batteries
https://www.amazon.com/dp/B00000JHQ6/ref=twister_B0CX2ZM9CF?_encoding=UTF8&th=1

[3]DoorSensor https://www.amazon.com/DIYables-Magnetic-Arduino-ESP8266-Raspberry/dp/B0B3D7BM4K/ref=asc_df_B0B3D7BM4K?mcid=3da3e052d4453e6d825a02bcd1e45e49&hvocijid=187620812624435686-B0B3D7BM4K-&hvexpln=73&tag=hyprod-20&linkCode=df0&hvadid=721245378154&hvpos=&hvnetw=g&hvrand=187620812624435686&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011767&hvtargid=pla-2281435177818&psc=1

[4]UltrasonicSensor https://www.amazon.com/HC-SR04-HC-SR04P-Ultrasonic-Distance-Measuring/dp/B07KNTQ4C2/ref=asc_df_B07KNTQ4C2?mcid=9601b6d8b1df3f319306a5d594025b6e&hvocijid=14937213940166474350-B07KNTQ4C2-&hvexpln=73&tag=hyprod-20&linkCode=df0&hvadid=721245378154&hvpos=&hvnetw=g&hvrand=14937213940166474350&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9057291&hvtargid=pla-2281435178138&psc=1

[5] ESP-32S Development Board (MCU)
https://www.amazon.com/ESP-WROOM-32-Development-Dual-Mode-Microcontroller-Integrated/dp/B07WCG1PLV/ref=asc_df_B07WCG1PLV?mcid=7cc24e50dc423e8e9f1039421f865b8a&hvocijid=3062641011911185649-B07WCG1PLV-&hvexpln=73&tag=hyprod-20&linkCode=df0&hvadid=721245378154&hvpos=&hvnetw=g&hvrand=3062641011911185649&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9011767&hvtargid=pla-2281435177418&th=1

[6] ESP32-CAM-MB 5V WiFi Bluetooth
https://www.amazon.com/ESP32-CAM-ESP32-CAM-MB-Bluetooth-Development-CH340G/dp/B0CBQ7DDM8/ref=asc_df_B0CBQ7DDM8?mcid=e0c8b396601e33dd9db

e848de410cfea&hvocijid=758869657899358644-B0CBQ7DDM8-&hvexpln=73&tag=hyprod-20&linkCode=df0&hvadid=721245378154&hvpos=&hvnetw=g&hvrand=758869657899358644&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9057291&hvtargid=pla-2281435177818&psc=1

[7] Colored LEDs
Amazon.com: (100 Pcs) MCIGICM 5mm LED Light Diodes, LED Circuit Assorted Kit for Science Project Experiment (Multi-Colored - 5 Color) : Industrial & Scientific

Logo image generated using Canva's AI tools.

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