University of Central Florida

Department of Electrical & Computer Engineering

Sit & Chow

Group 25

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Chapter 2 – Project Description

2.1 Motivation & background

Owning a pet comes with the responsibility of ensuring that pets are healthy, well fed, and properly trained. For many dog owners, balancing consistent feeding schedules and obedience training with the demands of daily life can be difficult. Busy work schedules, travel, and general responsibilities often interfere with maintaining reliable mealtimes or proper training. As a result, there is a growing need for smart pet care technologies that provide both convenience and effective behavior support.

One of the most fundamental commands in dog training is “sit” for basic discipline, safety, and other skills. However, consistency is essential to reinforcing this behavior, and not all owners are able to provide that reinforcement training every mealtime. Having human interaction whilst feeding their pets is extremely important in strengthening connections between pet and owner. Traditional automatic dog feeding systems offer convenience for feeding but do not allow the interaction between pet and owner, which can be a missed connection opportunity. Therefore, our system combines the ease of automatic dog feeding with the ability to communicate to your dog through the system.

Sit & Chow seeks to bridge this gap by combining automated feeding with training reinforcement. The system will have automated feeding at scheduled times that will only dispense after the dog is seen sitting. With this, the feeder provides both consistent food intake and daily behavioral training. Also, the system is connected to a mobile app in order to manage feeding schedules and portions, making it easier and more convenient for owners to balance their life’s schedule and have strong pet care support. In addition, the mobile app also allows the user to view the dog through the built-in camera at any point in the day. Thus, allowing a busy owner the ability to check in with their dog.

This project is motivated by the opportunity to go beyond simple automation and create a device that improves the daily routine of dogs and their owners, promoting healthier habits, and stronger training consistency.

2.2 Current Commercial Technologies and Existing Projects

2.2.1 YumShare Solo Automatic Feeder with Camera

The YumShare Solo Automatic Feeder with a Camera, developed by Petkit, integrates an AI-powered camera to monitor and manage automated feeding times [1] . The system offers scheduled feeding times, precise portion control, and real-time monitoring through a built-in camera, which is connected to a mobile application. The app provides a live video feed with owner-to-pet communication and voice recording whilst setting multiple feeding times with potentially customizable portions and servings.

The AI-powered camera has many advanced features for intelligent pet monitoring. It captures motion and then automatically classifies them into “feeding,” “eating,” and “pet visiting” with timestamps for each recorded event. The camera has a 940nm infrared LED fill light and high-sensitivity sensor, ensuring accurate detection even in low-light conditions.

The technology used in the Petkit YumShare is a reference point for the technologies that will be used for the Sit & Chow, such as scheduled feeding, portion control, and remote monitoring via a mobile app. While the YumShare leverages AI to categorize what pet activity is happening, Sit & Chow focuses specifically on behavior-based detection, using machine learning to determine if the dog is sitting before dispensing food.

2.2.2 Ultralytics YOLOv11

YOLO (You Only Look Once) by Ultralytics is a cutting-edge, real-time object detection framework that uses deep learning to identify objects in images or video streams. YOLOv11 offers fast and accurate detection, supports custom model training for specialized tasks, and provides a user friendly Python interface [2]. Therefore, making it easy to use with detailed documentation. It is pre-trained on thousands of various types of images, enabling robust general-purpose object detection.

A similar computer vision model approach will be developed for Sit & Chow but on a smaller scale. Rather than detect a broad range of objects, the system will specialize in identifying dog postures, specifically, when a dog is sitting. This model is still detecting in real-time while logging events through the camera system. By training a machine learning model on various images of different dog postures, Sit & Chow will be able to recognize the sitting posture to trigger the feeding system.

2.2.3 Academic Design Using YOLOv5

This project utilizes Ultralytics YOLOv5's deep learning to manage smart nutrition management [3]. It uses a weight sensor to control the portion size for each animal, a camera to identify each pet, and an ultrasonic sensor for proximity detection. For each feeding session the system will recognize the specific animal that approaches the feeding system and the weight of that specific animal. Using this information, it will then dispense the specific amount of food that correlates to the animal's weight, allowing for healthy and proper portion control.

Sit & Chow will use a similar concept to portion feeding where the owner will be allowed to set the amount of food that will be fed to their dog. The camera will be powered by a machine learning model to identify when the owner's dog is sitting down to receive its food. Thus, combining the aspects of proper portion sizing and the training of good behavioral habits.

2.2.4 DIY Pet Feeder

The DIY Pet Feeder combines the concept of scheduled feeding for cats with the ability to entertain them as well [4]. This product uses a slotted wheel that dispenses roughly three grams of food per rotation of the wheel. During feeding time, this product uses an ultrasonic sensor in order to detect when the cat is relatively around the system, then it will dispense food through the slotted wheel.

However, the portion sizing in the DIY Pet Feeder offers minimal user control. Sit & Chow builds on this concept but adds several innovations. The owner will be able to customize the portion sizes through a mobile app, a machine learning powered camera to detect behavior, and logs feeding outcomes. This makes Sit & Chow not just a feeder, but a training and monitoring system specialized for dogs, integrating obedience training with automated feeding.

2.3 Goals and Objectives

2.3.1 Goals

Basic Goals

- Provide a reliable, automated feeding solution for dogs.
- Reinforce obedience training by requiring a dog to sit before eating.
- Ensure consistent portion control for healthy feeding habits.
- Allow owners to conveniently manage feeding times and portions through a mobile app.
- Allows owners to check in with their dog at any point of the day through the mobile app and camera.

Advance Goals

- Improve pet-owner communication with alerts and notifications.
- Track and analyze feeding compliance.
- Enhance reliability by monitoring food supply levels and system status.
- 2-way audio communication between owner and pet through mobile app and dog feeder.

Stretch Goals

- Enable selective feeding for multiple dogs.
- Enable simultaneous obedience training and automated feeding for cats

2.3.2 Objectives

Basic Objectives

- Develop a food dispensing system that operates on a timer.
- Incorporate a camera to detect dog's posture.
- Implement sound alerts to signal feeding time and when food dispenses.
- Design a mobile app for scheduling feeding times, adjusting portion sizes, and logging feeding history.

Advance Objectives

- Add app notifications for low food supply, failed training compliance, blockage, etc.
- Enable secure Wi-Fi connectivity for remote control and data synchronization.
- Allow scheduling multiple meals and portions in 1 day.
- Allow voice recording for alerting feeding time.
- Allow user to speak to dog through speaker.

Stretch Objectives

- Incorporate cloud storage for long-term feeding and training data.
- Enable camera to detect a cat's posture.

2.4 Specifications

2.4.1 System Specifications

Table 2.4.1: Specification of Sit & Chow

Food Storage Capacity	Maximum 5kg
Sound Output Level	65-70 dB
Dispensing Time	Under 30 seconds
Portion Dispensing Accuracy	±5 grams
Backup Battery Runtime	≥ 6 hours
Camera Streaming Resolution	720p – 1080p & depth stream
Camera Streaming FPS	10 – 30 fps
Depth Sensing Range	0.3 – 1 meter
Posture Detection Accuracy	≥ 90% accuracy
Feeding Schedule Accuracy	Within 1 minute
Wi-Fi Connectivity Range	≥ 10 meters indoors
Data Logging Retention	≥ 30 days
User interface	Mobile app, override button, camera display
App Scheduling Responsiveness	≤ 3 seconds delay
Mobile app features	Creating & editing feeding schedule, manual feed, feed history logs, live view camera, notifications, user authentication
Cost	~$150

2.4.2 Key Component Specifications

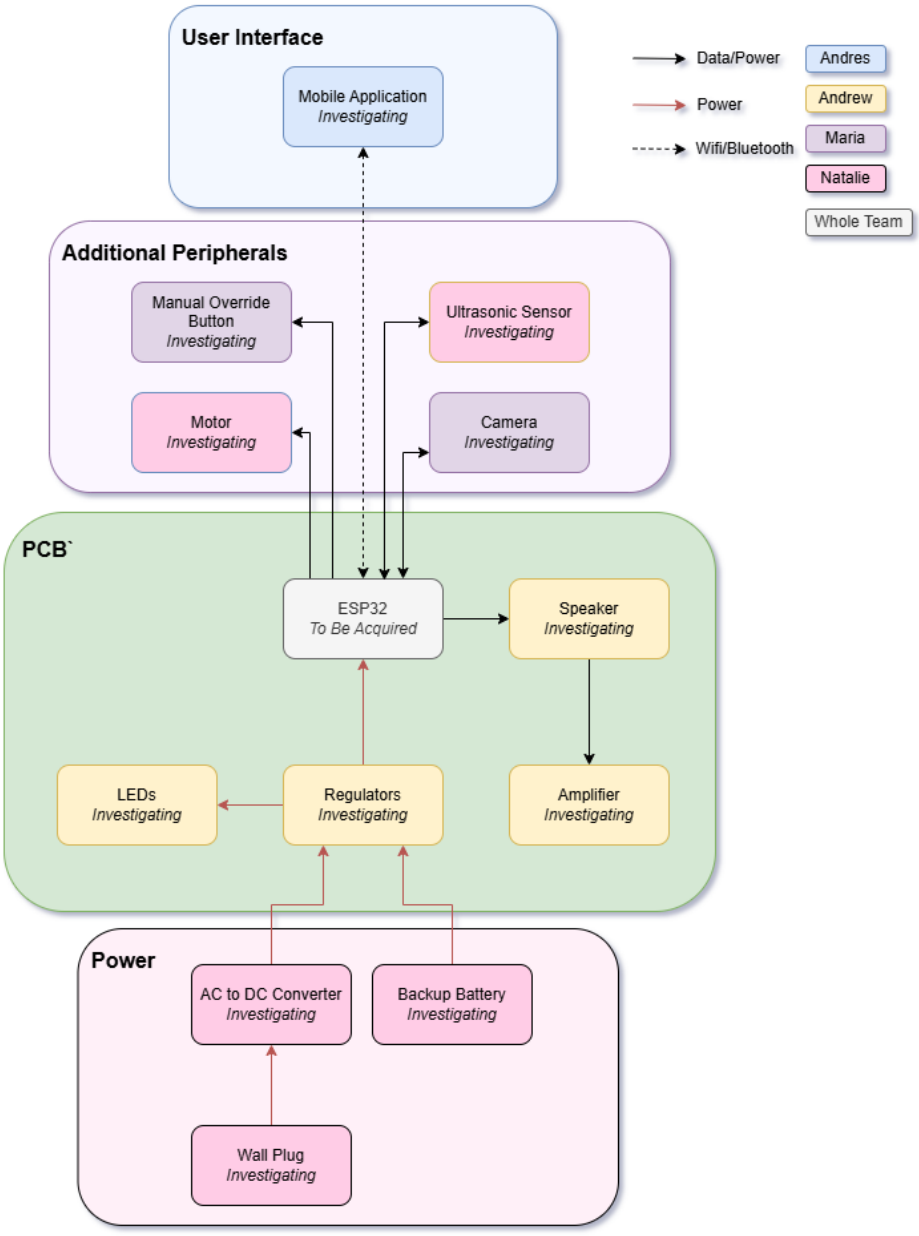
Table 2.4.2: Hardware Components

MCU (ESP32)	Wifi 2.4 GHz, BLE, 520 KB SRAM
Stepper Motor	~ 35 – 45Ncm Torque
Power Supply	12V, 2A + 5V buck, safe
Speaker	65 – 70 dB at 1m, 2 – 3 sec sound cue
Camera	720p – 1080p, 10 – 30 fps, 0.3 – 1 meter depth
LED Indicators	Red and Green, 2 – 3V
Food Storage Container	Maximum 5kg
Manual Override Button	≥150 gf operating force
Ultrasonic Sensor	≤ 0.5 meters
MicroSD Card	≤ 64 GB
Safety	Motor current limit
Backup Battery	Li-on battery pack 3.7-7.4V, 5000mAh

2.5 System Diagrams

2.5.1 Hardware Diagram

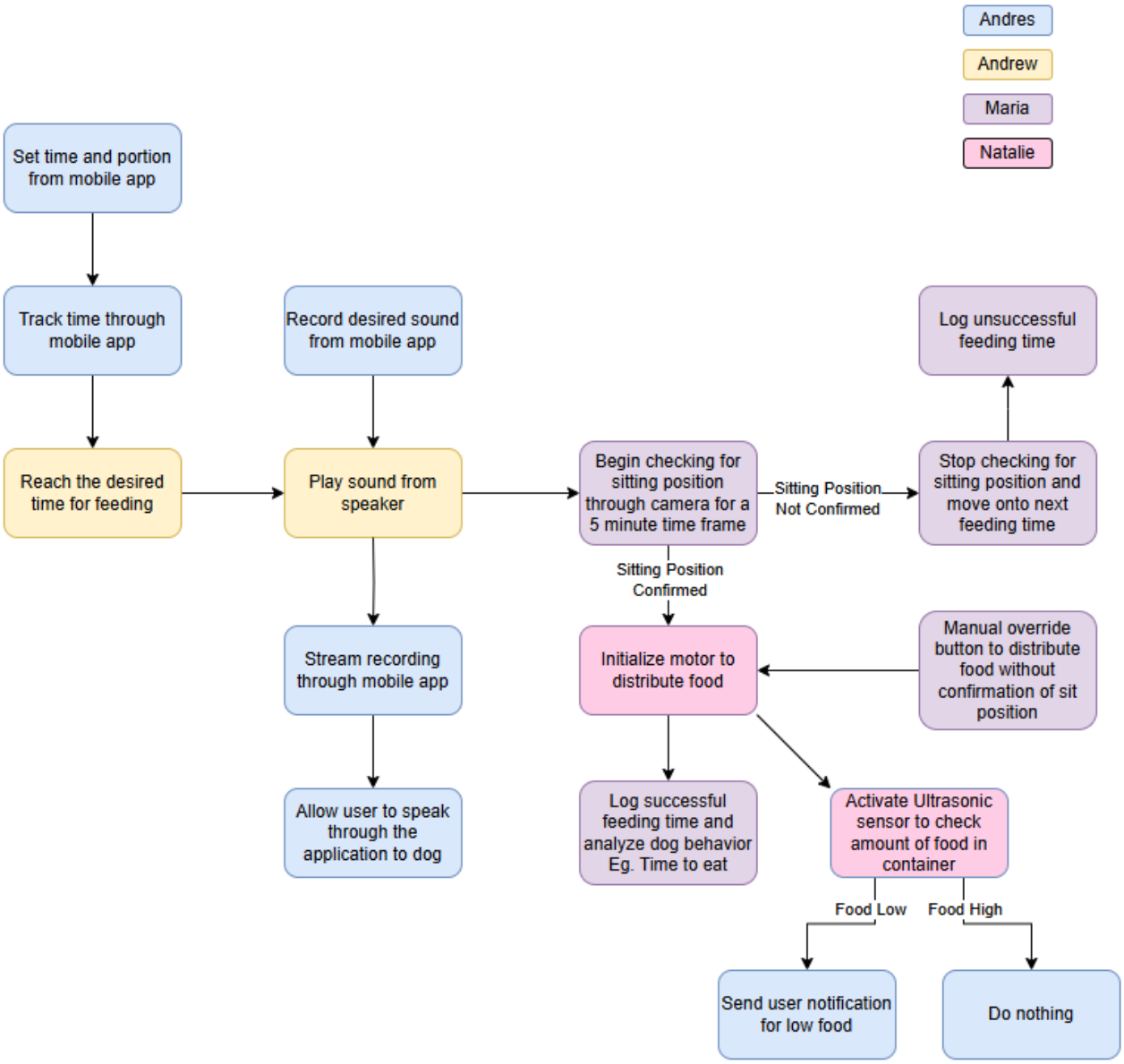
Figure 2.5.1: Hardware Diagram by Authors



The diagram above illustrates the Sit and Chow's hardware architecture, with the ESP32 at the center connecting sensors, motor, camera, speaker, and mobile app. It highlights data, power, and wireless flows, as well as the regulated power chain from wall plug to components, ensuring reliable operation and user interaction.

2.5.2 Software Diagram

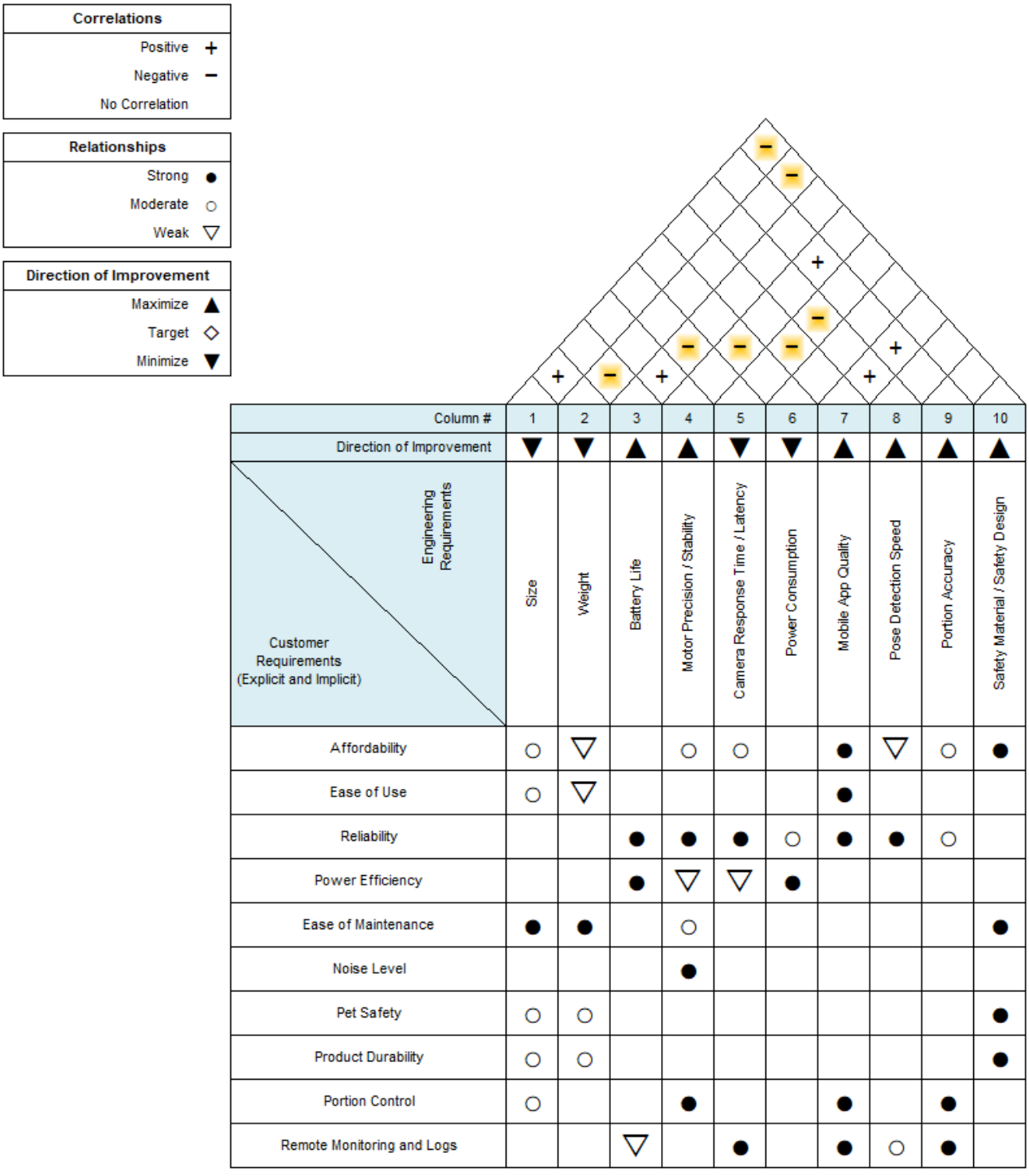
Figure 2.5.2: Software Diagram by Authors



This software block diagram illustrates the Smart Dog Feeder's feeding logic and app integration. It shows how scheduled times trigger sound playback, camera-based sitting verification, and food dispensing via motor control. It also includes manual overrides, food-level detection, logging of feeding outcomes, mobile app communication, and user notifications for low food supply.

2.6 House of Quality

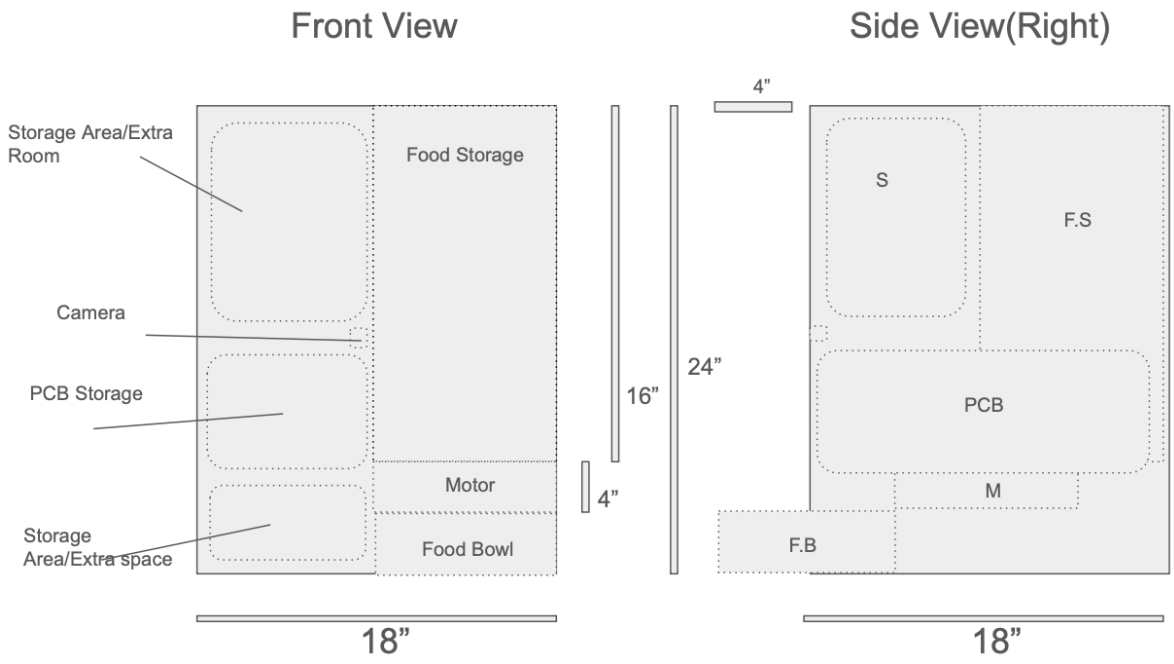
Figure 2.6.1: House of Quality by Authors



House of Quality for Sit & Chow, illustrating the relationship between customer needs and technical specifications, and highlighting key design priorities for Sit & Chow

2.7 Prototype Illustration

Figure 2.7.1: Illustration



A conceptual diagram of the Sit & Chow smart feeder, showing the integration of key components including the camera module, PCB, motor, and storage area.

Chapter 10 – Administrative Content

10.1 Budget

For our senior design project, developing a smart dog feeder requires a carefully planned budget to ensure both functionality and affordability. Our project budget is capped at $500. As electrical and computer engineering students, we must allocate funds for essential components such as microcontrollers, sensors, actuators, power supply units, and communication modules, which form the core of the system. Additional costs include materials for the feeder structure, such as food storage containers and dispensing mechanisms, as well as PCBs, wiring, and protective enclosures to ensure safety and durability. Software development tools and cloud integration services may also require minor licensing or subscription fees. To stay within a reasonable student budget, we will prioritize cost-effective parts while maintaining quality and reliability, aiming to balance innovation with financial responsibility. This budget not only outlines the material and component costs but also emphasizes the importance of resource management as part of the engineering design process.

10.2 Bill of Materials

Component	Part name	Quantity	Unit price	Total price
Electrical Engineer (EE)				
Servo/ Stepper motor	Nema 17 Stepper Motor	1	$7.93	$7.93
LEDs	SML-512PWT86A	1	$0.52	$0.52
Power supply (12V adapter)	DC 12V 3A Power Adapter	1	$9.99	$9.99
Power Jack	PJ-082BH	1	$1.78	$1.78
Camera	OV2640	1	$9.95	$9.95
5V Voltage Regulator	TPS563200DDCR	1	$1.02	$1.02
3.3V Voltage Regulator	TPS564257DRLR	1	$0.52	$0.52
Speaker	Adafruit 3 W 4 Ω Mini Speaker	1	$1.95	$1.95
Amplifier	Adafruit MAX98357A I²S Class-D Amp	1	$5.95	$5.95
Button	TS02-66-70-BK-160-LCR-D	1	$0.10	$0.10
Ultrasonic Sensor	RCWL-1601	1	$3.95	$3.95
Computer Engineer (CpE)				
Microcontroller	ESP32-S3-WROOM-1N16R8	1	$6.56	$6.56
EE & CpE Collaboration				
Mechanical Assets (Casing, feeding mechanism, etc.)			~$75	~$75
Breadboards	4PCS Breadboards Kit	1	$6.59	$6.59
Wires	ELEGOO 120pcs Multicolored Dupont Wire	1	$6.98	$6.98
Tapes	Electrical Tape	1	$2.26	$2.26
Total Cost				
Electrical Engineer	$43.66			
Computer Engineer	$6.56			
EE & CpE Collaboration	$90.83			
Grand Total	$141.05			

10.3 Milestones

10.3.1 Senior Design 1 Milestones

Milestone Number	Milestone Description	Start Date	Anticipated End Date	Dependencies & Requirements
1	Group Finalization	08/19/25	08/26/25	Organizing/Deciding our Final Group Members
2	Project Idea Finalization	08/20/25	08/28/25	Research EE, CPE. Decide project idea to do

3	Design specifications	08/20/25	09/04/25	Finish D&C, obtain Dr. Saleem Sahawneh meeting.
4	Divide and conquer Document	08/27/25	09/05/25	Project overview and Organization (First 10 Pages)
5	Midterm Milestone Report	08/27/25	10/30/25	First 60 pages of our report.
6	Midterm Report Revision	10/30/25	11/07/25	Revision/Correction of Report
7	Project Report (120 Pages)	08/27/25	11/12/25	Full 120 Pages of the Report
8	Final Project Report	08/27/25	11/25/25	Fully revised Final report (Full 120 Pages)
9	Mini Demo Video	09/22/25	11/25/25	Demonstration of Fully Working Product
10	Project Design	11/25/25	12/06/25	Individual system design, Breadboard Prototyping, PCB ordering

10.3.2 Senior Design 2 Milestones

Milestone Number	Milestone Description	Start Date	Anticipated End Date	Dependencies & Requirements
1	PCB Testing	01/16/26	01/31/26	Continue work on PCB and research
2	System Testing	02/01/26	03/01/26	Check for potential mistakes
3	Project Demo	03/02/26	03/16/26	Putting devices together
4	Document	01/16/26	04/04/26	Finalize document
5	Practice Final Presentation	04/05/26	04/12/26	Practice and ready for presentation
6	Final Presentation	TBD	TBD	TBD

10.3.3 Schedule

Week	Task	Responsibility
08/28/25	-Finish D&C document -Prepare D&C meeting	Natalie Nguyen Maria Tran Andres Arzola Andrew Balmes
09/09/25	-Research EE, hardware -Select and acquire equipment: Servo, Sensors, etc	Natalie Nguyen Andrew Balmes
	-Research CpE, software	Maria Tran

	-Select and acquire equipments	Andres Arzola
09/22/25	-Draft hardware block diagram -Review with advisor	Natalie Nguyen Andrew Balmes
	-Draft software architecture - Review with advisor	Maria Tran Andres Arzola
09/29/25	-Select and order motors, sensors, power supply -Approve component list, procurement	Natalie Nguyen Andrew Balmes
	-Select microcontroller/embedded platform -Build the mobile app -Approve component list, procurement	Maria Tran Andres Arzola
10/06/25	-Build motor control circuit, set up sensors, test power distribution -Integrate hardware + firmware for initial protype -Basic prototype that dispenses food on command	Natalie Nguyen Andrew Balmes
	-Write basic firmware -Integrate hardware + firmware for initial protype -Basic prototype that dispenses food on command	Maria Tran Andres Arzola
10/13/25	-Testing and debugging PCB, motor module, power module, ultrasonic sensor - Improve hardware reliability (safety, noise filtering, enclosure wiring). - Implement wireless communication (WiFi/Bluetooth).	Natalie Nguyen
	-Testing and debugging mobile app - Improve hardware reliability (safety, noise filtering, enclosure wiring). - Implement wireless communication (WiFi/Bluetooth).	Andres Arzola
	-Testing and debugging button, camera - Develop mobile/web app for scheduling and monitoring. - Implement wireless communication (WiFi/Bluetooth).	Maria Tran
	-Testing and debugging LEDs, speaker - Develop mobile/web app for scheduling and monitoring. - Implement wireless communication (WiFi/Bluetooth).	Andrew Balmes
10/20/25	-Midterm report – 60 pages -Test app scheduling and features -Demo -Conduct system integration testing	Natalie Nguyen Maria Tran Andres Arzola Andrew Balmes

10/31/25	-Revision -Prepare for presentation -Collect test data	Natalie Nguyen Maria Tran Andres Arzola Andrew Balmes
11/13/25	-Final Report -Mini Demo Video	Natalie Nguyen Maria Tran Andres Arzola Andrew Balmes

Appendices

Appendix A - Citation

[1] "PETKIT," YumShare Solo Automatic Feeder with Camera, 2023. [Online]. Available: https://petkit.com/products/yumshare-solo-with-camera.

[2] G. Jocher và J. Qiu, "Ultralytics," Ultralytics YOLO11, 2024. [Online]. Available: https://docs.ultralytics.com/models/yolo11/.

[3] O. E. Castillo-Arceo, R. U. Renteria-Flores và P. C. Santana-Mancilla, "Design and Development of a Smart Pet Feeder with IoT and Deep Learning," trong *The 11th International Electronic Conference on Sensors and Applications*, 2024.

[4] M. Radwan, I. Martinez, B. Y. J. Cyrille, F. Harte và M. David, "Autodesk Instructables," 26 12 2023. [T]. Available: https://www.instructables.com/DIY-Pet-Feeder-and-Entertainer-Robot/.

Appendix B – Copyright Permission