EEL 4914 - Senior Design 1

Divide & Conquer II

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Sliding Pet Door Opener

A remotely operated pet door system

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Group 10

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Project Narrative

Objective: Give pet owners a solution for letting their pets out when they are not home.

Project Description: Many people face the dilemma of having to be away from home for extended periods of time while leaving their pets at home alone. A prime example is going to work each day. With the usual work day starting at eight in the morning and ending at five at night, this leaves the pet stuck in the house for eight hours. The owner would then come home to their pet who has been restless and without any other way to relieve themselves besides going in the house.

Our project idea provides pet owners a solution to the problem of a pet "going" in the house and being restless. It is a remotely operated pet door that will allow the owner to open their standard sliding glass door to let their pet out even when they are not at home. When the pet gets close to the door an alert will be sent to the owner's phone which will then give them the option to unlock and open the door. The pet will be wearing a small device that can be attached to a collar, which allows the sensors on the doorway to recognize the pet is close. For security reasons, a camera will show the user their doorway to make sure that their pet is trying to get out and an intruder is not trying to get in. Once the pet has come back inside the door will be closed and locked by the owner. Our design also includes a speaker and microphone that can be used by the owner to either call the pet inside or call the pet to the door if the owner desires to let the pet out without the pets initiation of the system. With an easy to use mobile app, the user would also be able to set an at home mode that enables the door to open automatically without the approval from the owner.

The motivation for this project comes from us personally having pets while no one is home for long periods of time. We also wanted to take a different approach to solving this problem as there are products that are automatic pet door flaps. We did not want the user to have to make a hole in their wall to use our product. Opening the entire door instead of a pet door flap gives the user the possibility of getting any size pet they want in the future without worrying about the size of the pet door flap. This product will have minimal installation and a relatively small and mobile footprint.

Project Requirements

Hardware Requirements

In order to keep a more compact design we are designing two PCBs to be placed in parallel. We plan on having a single MCU control all input and output for the system. For power we have initially decided on drawing AC from the home electrical outlet and battery operation for peripherals such as the camera. Design communication will utilize wireless (WiFi) and wired connections. Research is needed for the AV components in order to tell if we can get an all in one component or if audio and visual need to be seperate. We plan on using a belt driven arm and motor setup to control the movement of the door.

1. PCB #1
    a. Houses communication peripheral connections
    b. Houses MCU
2. PCB #2
    a. Houses Power supply
    b. Power conversion
    c. Power storage
3. Microcontroller
    a. Communicate to the collar (RFID Tag)
    b. Control the door opening device. (Motor)
    c. Control the door locking device. (Hinge)
    d. Read information from camera and other IoT devices (Wired / WiFi)
    e. Wireless communication to mobile phone through application (WiFi)
4. Power Supply
    a. AC Source
    b. Powers the door opening device, sensors, peripherals, and microcontroller
5. Communication
    a. WiFi (IoT)
    b. Wired (RFID sensor)
6. Sensors
    a. RFID
    b. Camera
    c. Microphone/Speaker
    d. Ultrasonic motion sensor
7. Peripherals
    a. LEDs
    b. Display (Mode, Date, Time)
8. Motor
    a. Used to control the sliding arm.
9. Mechanical Sliding Arm
    a. Can attach to any standard sliding glass door
    b. Extends and retracts.
10. Mechanical Hinge
    a. Acts as door lock

b. Allows/restricts open and close operations
c. Prevents forceable entry

Software Requirements

We want to be able to communicate with the project via a mobile application using the internet. We need research to decide what mobile platforms we will be able to implement for. The application will incorporate all AV components and control the door lock and movement/position.

1. Mobile Application
    a. User interface to allow control of the door to the owner
    b. Can receive and control notification
    c. Allows the owner to interact with the door
    d. Gives owner live video feed to connected camera
    e. Gives owner ability to speak and listen
    f. Has security via individual account access
    g. Can change the mode of the door
2. WiFi Communication
    a. Able to connect to mobile devices
    b. Follow WiFi standard
3. MCU Communication
    a. Follow communication standard

Block Diagrams

Fig. 1.1 Initial Concept Picture

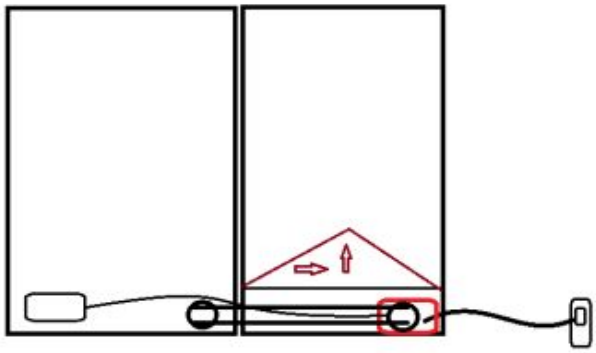

Figure 1.1 is a visual representation of what we envision our project to meet for its universal and portable design. Below in figure 1.2 we illustrate the overall project in terms of hardware, software, and input/output. A fully detailed block diagram with an expanded view is seen in figure 1.3 on the following page.

Fig 1.2 Overview Block Diagram

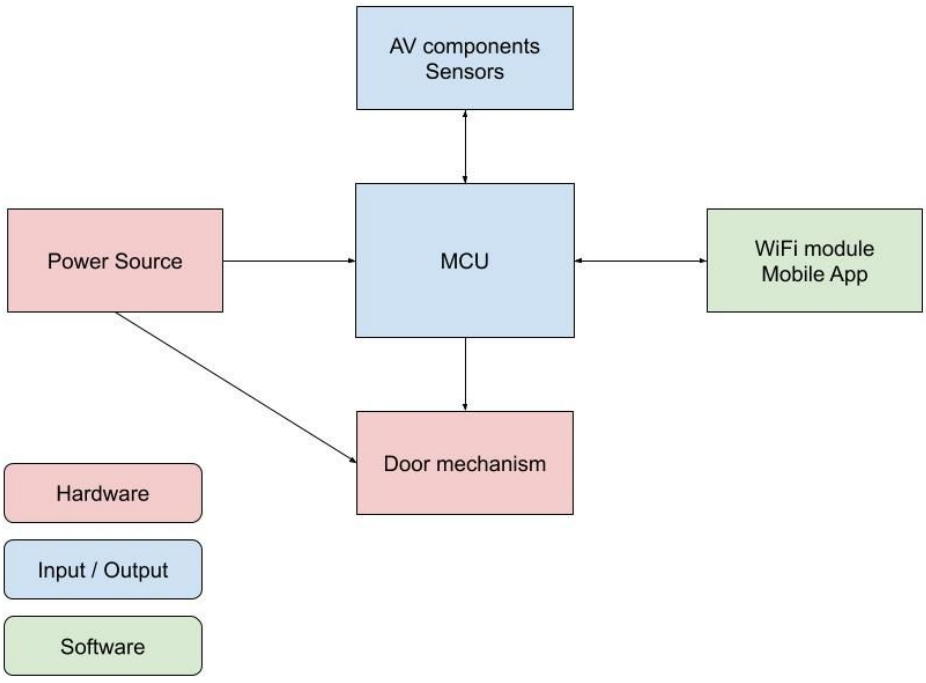

Fig 1.3 Detailed Block Diagram

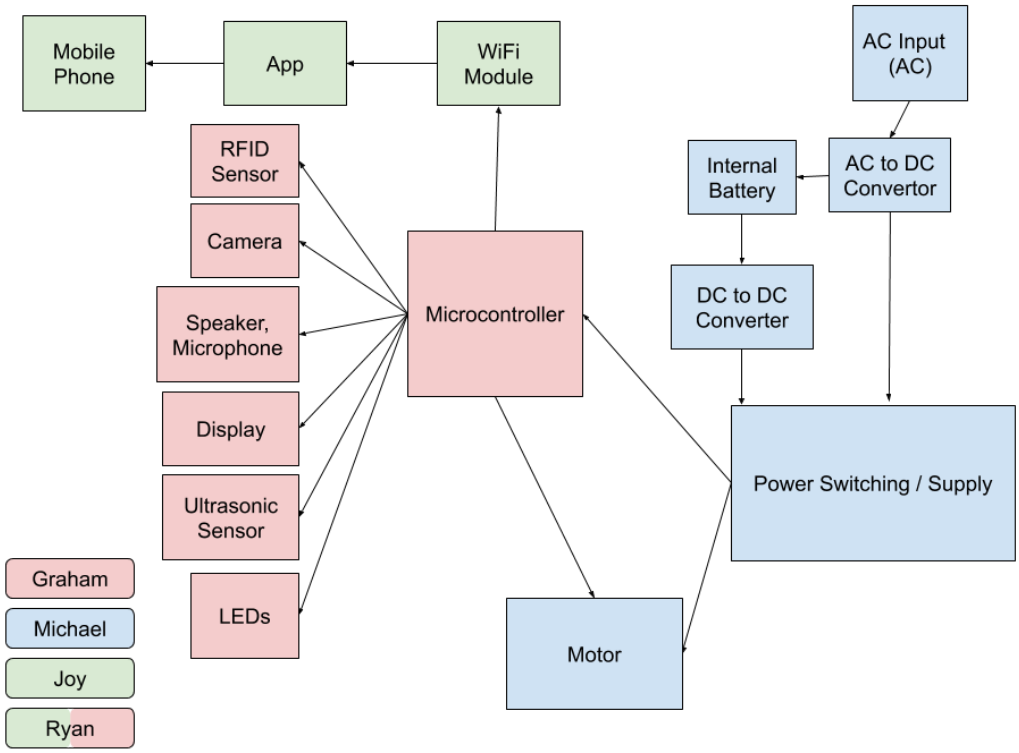

Table1.4 Block Diagram Status

Block / Part	Stage
PCB 1	Research
PCB 2	Research
Power Supply	Research
MCU	Research / To be acquired
Camera	To be acquired
Speaker / Microphone	To be acquired
RFID sensor / tags	Research / To be acquired
WiFi module	To be acquired
Ultrasonic motion sensor	Research / To be acquired
LCD display	Research
LEDs	Research
Motor	Research

Logic Flowchart

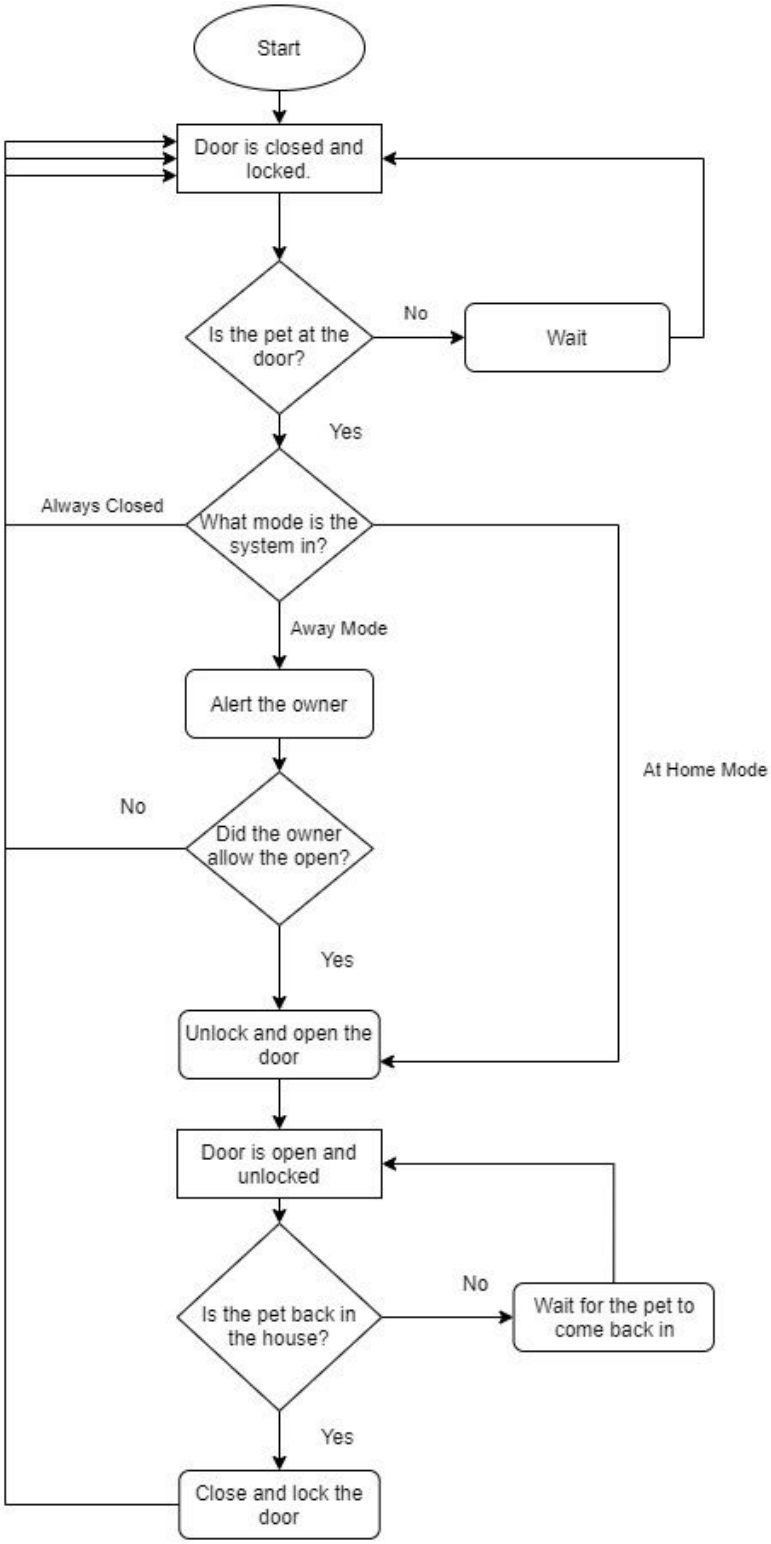

Fig 1.5 Flowchart

The flowchart above (Fig 1.5) shows the operation of our project concept. The sliding door is closed and locked initially and the pet owner is alerted when their pet is at the door if they are in the Away Mode. They then have the option to allow the door to open from the mobile app, which will tell the device to open the door to let the pet out. If the system is in the At Home Mode, the door will just be opened automatically without the permission needed from the owner. The system waits until the pet is back in the house to close and lock the door again. The Always Closed Mode does not allow the pet to be let out and does not alert the owner. This process is then repeated throughout the day as the owner can change the setting in the mobile app.

Budget and Finances

Table 1.6 is an initial summary of what parts we expect to need for our project and their estimated costs.

Table 1.6 Projected Bill of Materials

Item (number)	Cost
PCB	$20 -$30
Mircocontroller (1)	$30
RFID Reader (2)	$5 - $15 each
Camera(1)	$50
Microphone(1)	$20
Speaker	$60
Door Frame	$150
Mechanical Hinge	$30
Power Source	$30
Ultrasonic Sensor	$5
LCD screen display	$20
LEDs (5)	$5
Total	$480

Project Milestones

Tables 1.7 and 1.8 are our detailed plans per semester to keep on schedule in order to complete this project.

Table 1.7 SD1 Milestones

Reference #	Milestone	Dates	Status	Responsibility
Senior Design 1				
1	Project Ideas	5/11 - 5/15	Completed	Individual
2	Divide and Conquer	5/18 - 5/29	Completed	Group
3	Group meeting with Professor	6/2	Completed	Group
4	Research requirements and preliminary components	6/3 - 6/28	Pending	Group
5	Part Research (Camera, RFID,Sensor, LCD Display Microphone and Speaker)	6/3 - 6/28	Pending	Ryan, Joy
6	Microcontroller Research	6/3 - 6/28	Pending	Graham
7	User application (Mobile)	6/3 - 6/28	Pending	Ryan
8	WiFi Communication Research	6/3 - 6/28	Pending	Joy
8	Finalize peripherals	6/3 - 6/28	Pending	Ryan, Joy
9	Research Power Supply	6/3 - 6/28	Pending	Michael
10	Submit 60 page draft	6/3 - 7/3	Pending	Group
11	Begin writing draft paper for SD1 100 Page Report	6/3 - 6/17	Pending	Group
12	100 Page Report	6/3 - 6/17	Pending	Group
13	PCB Layout	July	Pending	Michael
14	Part Order	July	Pending	Group

Table 1.8 SD2 Milestones

Reference #	Milestone	Dates	Status	Responsibility
Senior Design 2				
1	Troubleshooting/Testing	TBA		Group
2	Finalize prototype	TBA		Group
3	Peer presentation	TBA		Group
4	Final report	TBA		Group
5	Final Presentation	TBA		Group

House of Quality

Shown below in figure 1.9 the House of Quality for our project categorizes the user requirements financially, by usability, and by security. Cost, durability, and maintenance are considered up front financially. Where as ease of use, install, smartphone app, and user interface all fall under the usability of the product. Lastly, security, smartphone app, and user interface all pertain to the security requirement.

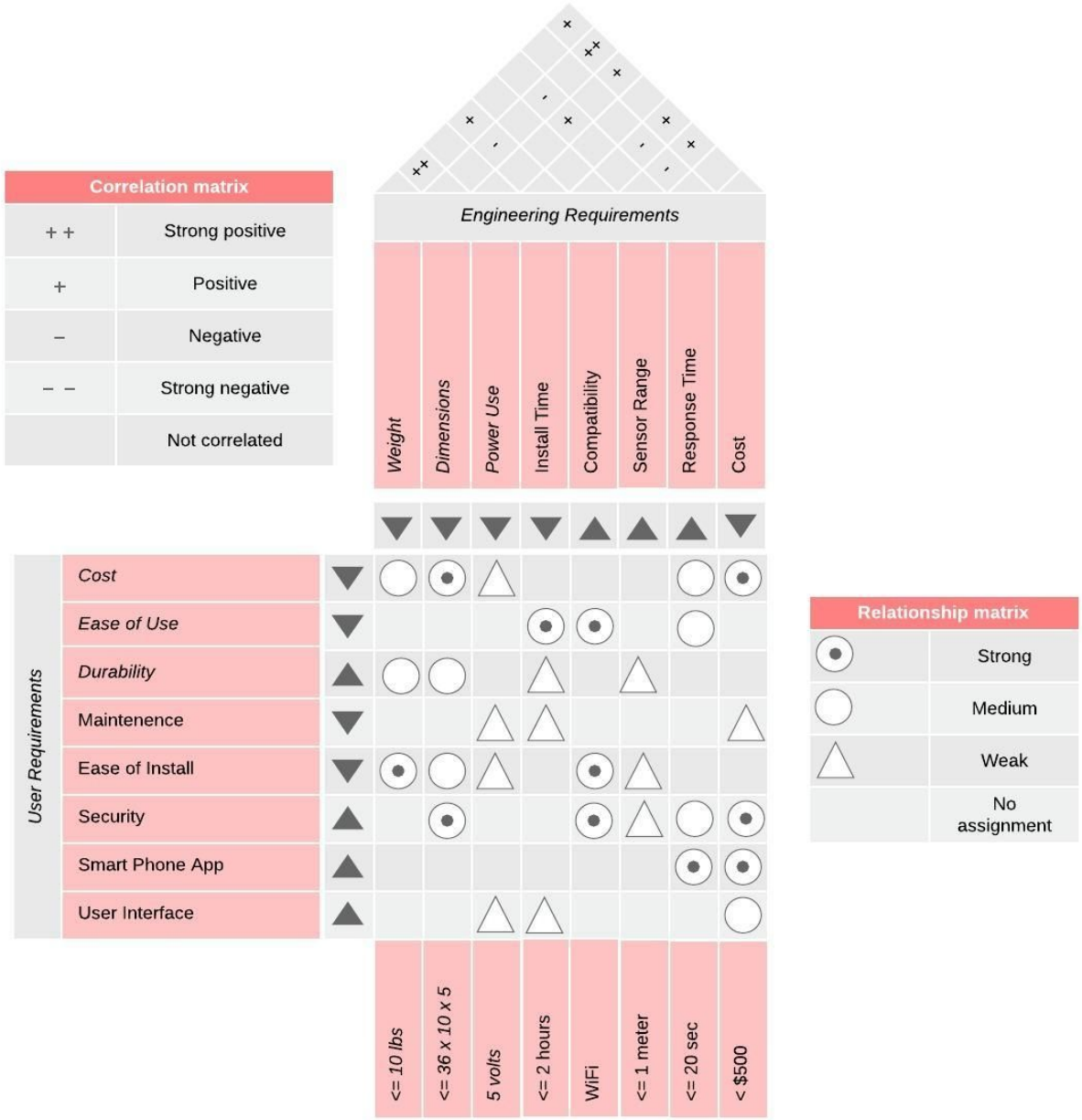

Fig 1.9 House of Quality