ECE 445

Senior Design Laboratory - **Project Proposal**

Automated Food & Water Dispensing System for Pets

Team #21

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Table of Contents

1. **Introduction**
    a. Problem
    b. Solution
    c. Visual Aid
2. **Design**
    a. Block Diagram
    b. Subsystem Overview/Requirements
    c. Tolerance Analysis
3. **Ethics and Safety**

Introduction

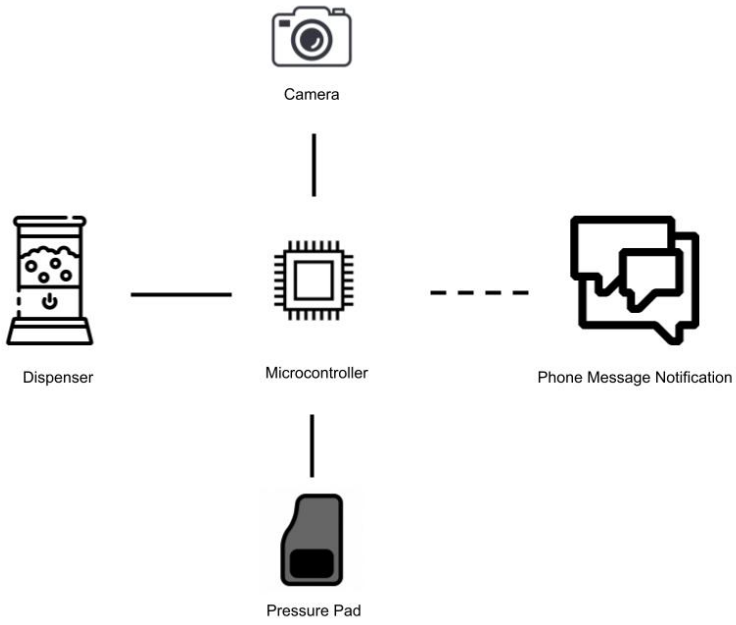
Problem

Tyler's friend Andrew is a recent college grad who is now working full time. Andrew has a pet cat that he has trouble feeding while he's away at work because he does not want to leave food and water out while he is away from home. Andrew would like a way to automatically feed his cat with the peace of mind of not overfeeding, while also knowing how much food and water his cat is consuming throughout the day. Lastly, Andrew would like to be provided updates on when the food/water bowl needs to be refilled and how much needs to be dispensed.

Solution

The solution to this problem is to design an automatic dispenser setup that delivers food and water to the user's pet. Our solution will involve a couple of subsystems in order to provide users' pets with the most comfort and care. Each dispenser is purposed for a single pet. The first and main subsystem will revolve around a pressure pad/sensor that will act as the main trigger for the dispensing system. The pressure pad can be customized to a certain weight range for the specific pet and while configure the amount of food and water needed based on those specifications and the breed of the pet itself. The next subsystem involves the dispensing mechanism for food and water.

Visual Aid



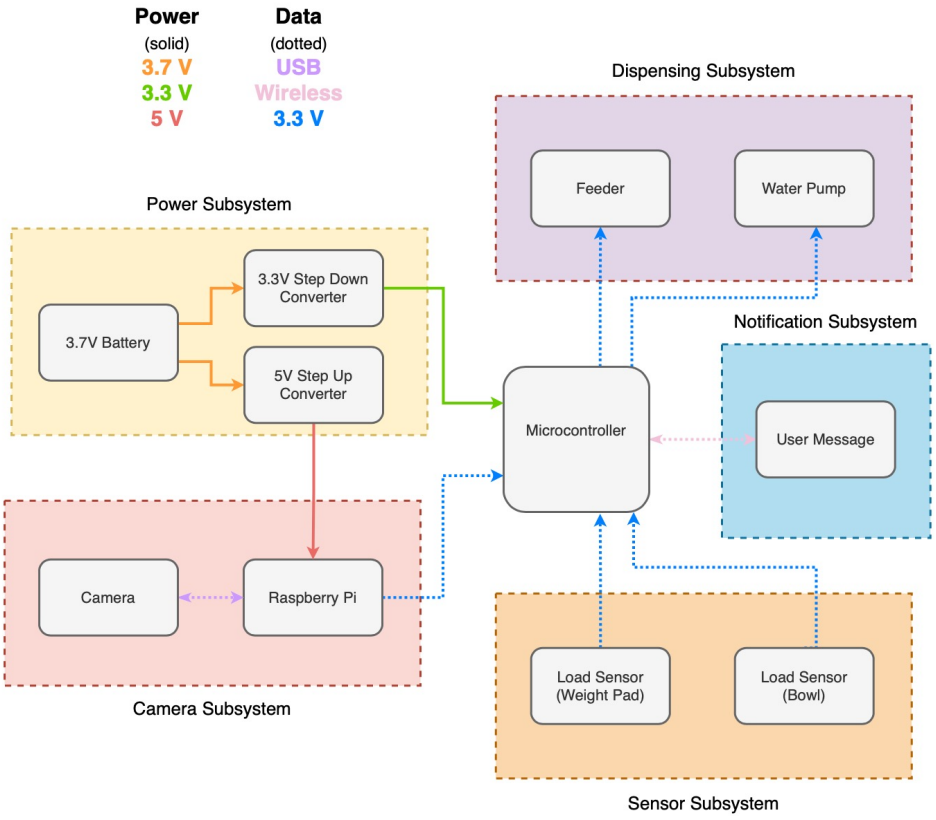
High-level requirements list

These three requirements outline what's most important towards building a successful and optimal food/water dispensing system:

- **Accuracy**: We want there to be easy communication between the user and when a pet interacts with the dispensing system. This will be judged by the accuracy of the dispensing system to provide food to the pet, as well as how accurate the measurements of the pet's weight are.
- **Timeliness:** The user's ability to react when a pet interacts with the dispensing system will depend on how quickly these updates can be sent. The pet's weight, the amount of food/water to be dispensed, as well as the updates corresponding to these actions need to be fast enough for any situation that may occur.
- **Adaptability:** The dispensing system must be able to account for a variety of scenarios in order to ensure the safety of the pet and to maintain the user's trust. This includes having the right contingency plan when the pet doesn't step onto the weighing scale long enough or when a refill is needed or even when the dispensing system malfunctions.

Design

Block Diagram



Subsystem Overview/Requirements

Dispensing Subsystem:

DC Servo Motor:

The motor will be connected to the microcontroller and will control the sliding doors for the food and water containers. Its power will be supplied by the power subsystem and will require 5V.

1) The motor should be able to push or rotate the door at a precise amount proportional to the opening of the container to control rate of dispensing.
2) The motor must be powerful enough to move the door with 5lbs of food weighting the door down.
3) The motor must be able to be controlled by the microcontroller.

Food/Water Containers:

The containers will be used to store dry food and water for dispensing and will have the sliding door attached to its opening.

1) The containers need to be able to store 5lbs of food or water.
2) The containers must have a spout that is able to be closed by the door.

Water Pump:

The waterpump will get 5V of power from the power subsystem and dispense water out of the water container into the bowl. The water pump will be in the spout of the container.

1) The water pump must be able to be turned on or off by the microcontroller.

Camera Subsystem:

Raspberry Pi 4 Model B:

The Raspberry Pi connects to the camera and captures photos when the load sensor of the weight pad is activated. The Pi should be able to power the camera and control it to take pictures of the pet when it is on the pad to eat or drink. The Pi then sends the photos to the user through the notification subsystem.

1) The Raspberry Pi must be able to power and connect to the camera.
2) The Raspberry Pi must capture photos through the camera in response to the pad load sensors.

Camera:

The camera will be powered by the Raspberry Pi and positioned to have the pressure pad and pet in frame when capturing photos.

1) The camera should be able to take colored photos with a minimum of 720p resolution.

Power Subsystem:

3.7V Lithium Battery:

The 3.7 V Lithium Battery will supply power to our components. No components are directly connected to the battery, instead converters adjust the voltage to 3.3V or 5V in order to supply the correct voltage to our components.

1) The 3.7V Battery should be able to supply at least 3.7V +/ 0.1V.

5V Step Up Converter:

A 5V step up converter will take the 3.7 Lithium battery as input, and supply the Raspberry Pi with 5V of power

1) The 5V step up converter should be able to supply at least 5V +/ 0.1V.

3.3V Step Down Converter:

A 3.3V step down converter will take the 3.7 Lithium battery as input, and supply the Microcontroller with 3.3V of power

1) The 3.3V step down converter should be able to supply at least 3.3V +/ 0.1V.

Sensor Subsystem:

Load Sensor (Weight Pad):

The Load Sensors in the weight pad will be used to determine whether the owner's pet is on the weight pad. The data from the sensor will be sent to the microcontroller to determine whether the sensor reading should trigger the dispensing subsystem to dispense food and water to the bowls.

1) This load sensor should be able to accurately determine the weight of the pet +/- 0.1kg up to 50 kg.

Load Sensor (Bowl):

The Load Sensors in the bowl will be used to determine the amount of the food or water has been consumed by the pet. The data from the sensor will be sent to the microcontroller to calculate how much food or water was consumed based on data from the dispensing system versus the amount of food or water in the bowl.

1) This load sensor should be able to accurately determine the weight of food or water in the bowl +/- 0.1kg up to 50 kg.

Notification Subsystem:

Notify API:

The Notify API which is platformed through Twilio, will be used to send the user notifications through SMS about how much food and water has been dispensed to the pet and if a refill is required. Additionally it will send a picture of the pet interacting with the dispensing system. The user can then contact the appropriate individual to go in and refill the food. If after a certain time, the microcontroller finds that the dispensing system hasn't been refilled it will alert the user again.

1) The API should be able to send notifications instantly after the dispensing actions have been completed.
2) The API should interact with the microcontroller such that it extracts the correct statistics about how much food and water has been dispensed and then sends this to the user.

<u>Tolerance Analysis</u>

The hardest system to implement as part of this proposal will be the sensor subsystem which will then relay information to the dispensing subsystem about providing food and water to the pet. It's critical that the dispensing system only provides food and water to the pet when absolutely necessary or we could encounter unnecessary refills. Additionally, the load sensor for

the weight pad should only be activated once the pet interacts with it for a certain amount of time. If the pet just accidentally touches it and the dispensing system is activated, we are not using the subsystem for its intended purpose. Lastly, when the sensor subsystem is activated, the food should be dispensed when we know that the pet needs to be fed, rather than everytime the pet interacts with the weight pad.

Ethics and Safety

The IEEE Code of Ethics states the need to uphold safety, health, and welfare of the public. The goal of our project is to automatically dispense sustenance for the pet and give the user a better understanding of the well-being of their pet when they are away. While the project should greatly help users with taking care of their pet, it is not a complete substitute for the care of the pet. The owner is responsible for the overall understanding and care of the well-being and health of their pet. To uphold the Code Ethics, we will explicitly warn users of this.

IEEE Code of Ethics states in Section 1.5 that members must be committed to seek and accept honest criticism of their work and correct their errors. To uphold this code, we will communicate with TAs and the professor during the whole process of creating our project. We will carefully listen to criticism and be thoughtful and quick to fix errors that arise during development.

As team members, we will strive to uphold Section II and III of the IEEE Code of Ethics by making sure members of the group and the TA is being treated fairly and with respect and that there is no harassment or discrimination.