Automated Pet Food Dispenser

Written Technical Report

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Subject: Technology Project - TPJ655
Program: Computer Engineering Technology
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Date: April 7th, 2023

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Executive Summary

The automated pet food dispenser is a convenient device that enables pet owners to feed their pets automatically. The device utilizes a raspberry pi, bluetooth tag, flask web server, and database to automate the process of feeding a pet. The system is designed to allow the pet owner full control of how their pet is fed through the web server. The web server contains configuration options that allow the pet owner to set the feeding schedule, portion sizes, and even remotely feed their pet through the web interface.

The bluetooth tag on the pet's collar is used to determine whether the pet is nearby the dispenser to signal the food to dispense. This will allow the pet to adapt to the feeding schedule the owner sets. The flask web server along with its respective database will allow the user to configure their schedule to their likings with the raspberry pi operating the feeding mechanism. The device is easy to set up and can be controlled remotely through a web interface.

The automated pet food dispenser provides a convenient way for pet owners to ensure that their pets are fed regardless of any schedules they have to deal with in their lives. It eliminates the need for owners to manually feed their pets as they are only required to refill the dispenser once configured. With the full control provided to the owners, the device also serves to reduce any risks in overfeeding their pets, which could possibly lead to obesity and health problems. Overall, the automated pet food dispenser is a valuable product for pet owners who want to provide their pets with a maintained diet while gaining more time within their daily lives.

Introduction

Pets are animals that we choose to take in and care for. We facilitate an environment that will allow for our pets to live and maintain their own lives within ours. For them to maintain their own lives we have to work to ensure they stay mentally and physically healthy through providing them a means of eating, drinking, playing, and staying active overall. One part of this process that we have to handle ourselves is feeding our pets, but sometimes plans can get in the way of that. To mediate this issue and allow our pets to maintain themselves without the need for us to manually feed them we have assembled an Automated Pet Food Dispenser.

Our concept for the Automated Pet Food Dispenser is a tall dog bowl sized dispenser that would be able to detect whether your pet is nearby based on a special collar that will contain a chip that communicates with the dispenser to have it dispense food based on a time schedule. There will be restrictions that can be set in place by the user such as: how many times you want your pet to be fed, the minimum time between each feeding, and how much food should be dispensed. In case there is any use for it, a manual feeding option will be available for the user to simply dispense food through a website if they deem it necessary.

Functional Features

Device 1: Food bowl

- When the desired pet is near, and the set conditions are met, the food will be dispensed using a servo motor system.

Device 2: Collar Tag

- A bluetooth tag that attaches to the pet's collar for detection.

Device 3: Smartphone/Computer

- A port forwarded website that can be used to monitor if the pet has dispensed the food.
- Used for programming the amount of food dispensed, the intervals of the feedings, and how many times a day the pet will be fed.
- Manual dispensing option

Product Specifications

Device 1: Food bowl

- Product dimensions: 7.5”D x 6.5”W x 16”H
- Product weight: 4 Pounds (Full)
- Microcontroller: Raspberry Pi 3 B+
- Sensors: Bluetooth sniffer on raspberry pi

Device 2: Collar Bluetooth tag

- Tag dimensions: 1.4 x 1.1 x 0.2 inch
- Tag weight: 9.3 grams
- Sensor: Bluetooth tag

Device 3: Smartphone/Computer

- Any dimensions
- Able to connect to the internet

Hardware:

- Raspberry Pi 3B+
- SPT5525LV-360 25KG Digital Servo Motor
- Bluetooth Tag
- Smartphone/Computer

Software:

- Raspbian Full OS 64-bit Operating System
- Python Programming Language
    - Flask Library
    - Pandas Library
    - Subprocess Library
    - Time Library
    - Gpiozero Library

Network:

- WiFi Connection
- Port Forwarding
- Flask Server

Operating Instructions

Automated Pet Food Dispenser Step-by-Step Instructions

1. Plug the device into a wall outlet where you would like to configure the device, a keyboard, mouse, and monitor will be required.

2. Once booted, connect the Raspberry Pi to your local network

3. Open a terminal and enter the command “ifconfig” and look for wlan0, write down the "inet" address in wlan0 somewhere you can keep track of it

4. Now plug in the device where you would like it to dispense the food

5. Log into a PC on your local network and download VNC Viewer

6. In the search bar of VNC enter the “inet” address recorded earlier and press enter to start connecting

7. Now connected to the Raspberry Pi, open a terminal and enter the command “./startServer.sh”

8. Now you may close VNC Viewer
    a. **WARNING: Do not close the terminal, only close VNC Viewer, if the terminal is closed you will have to repeat steps 6 - 7**

9. Download the app from your internet provider to manage the internet

10. Find the option to port forward, add a port forward, select the Raspberry Pi, leave the “Manual Setup” option selected, type “5000” for the port number, and leave “TCP/UDP” selected

11. Go to a search engine of your choice and go to https://www.whatismyip.com/ and note the IPV4 address

12. Go to the IP address noted early and add “:5000” to the end on either a smartphone or computer

13. Navigate to the “Feeder Setup” page

14. Choose the settings you want for your pet and submit

15. The homepage will now display the feedings that are taking place in a table

16. Fill the Automated Pet Food Dispenser with the pet food and place the bluetooth tag on the collar of your pet

17. Let the Automated Pet Food Dispenser do its work!
    a. If you ever feel the need to test functionality simply click the manual feed button on the main webpage.

Automated Pet Food Dispenser Written Instructions

Feeder

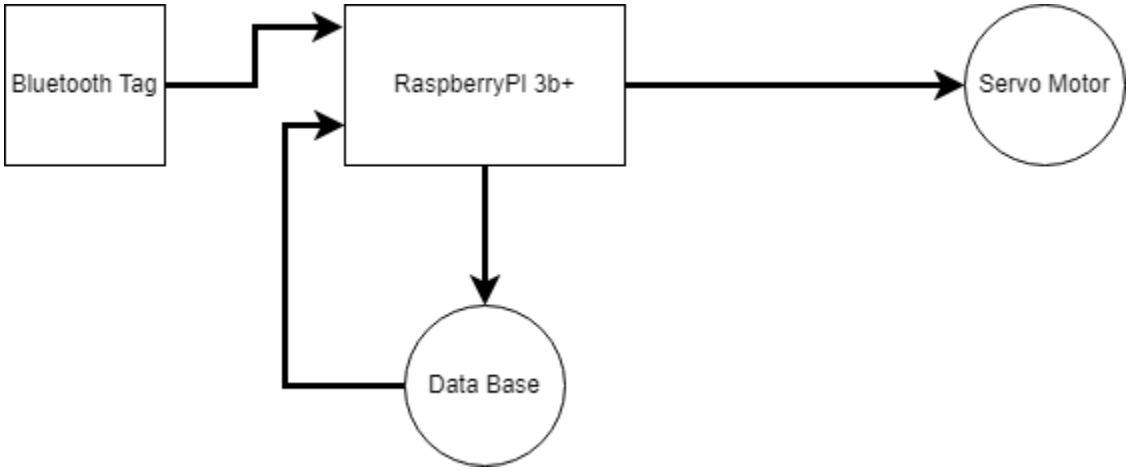
The automated pet feeder will require a wall plug, keyboard, mouse and display to become fully operational. The next step is to connect the device to your home network and open a terminal to note the “inet” address. Now download VNC Viewer and connect to the Pi via the “inet address”. Once in the Pi, open a terminal and run the command “./startServer.sh”. Now the website needs to be configured for access outside the home network. Find the IPV4 address of your internet so that it can port forward the website. Using your internet provider’s router management app, setup port forwarding for the Raspberry Pi on port 5000. The device website will now be accessible through the IPV4 address found earlier. Once on the website, the last things to configure are “feed interval”, “max feed quota”, and “feed amount”; Once these are configured fill up the top holding unit with the food of your choice and the device is fully configured and ready to go. On the main homepage you will be able to view the feedings that are taking place. To ensure proper operation of the device try out the “manual feed” button on the website, it should dispense the set amount of food even without the bluetooth tag present.

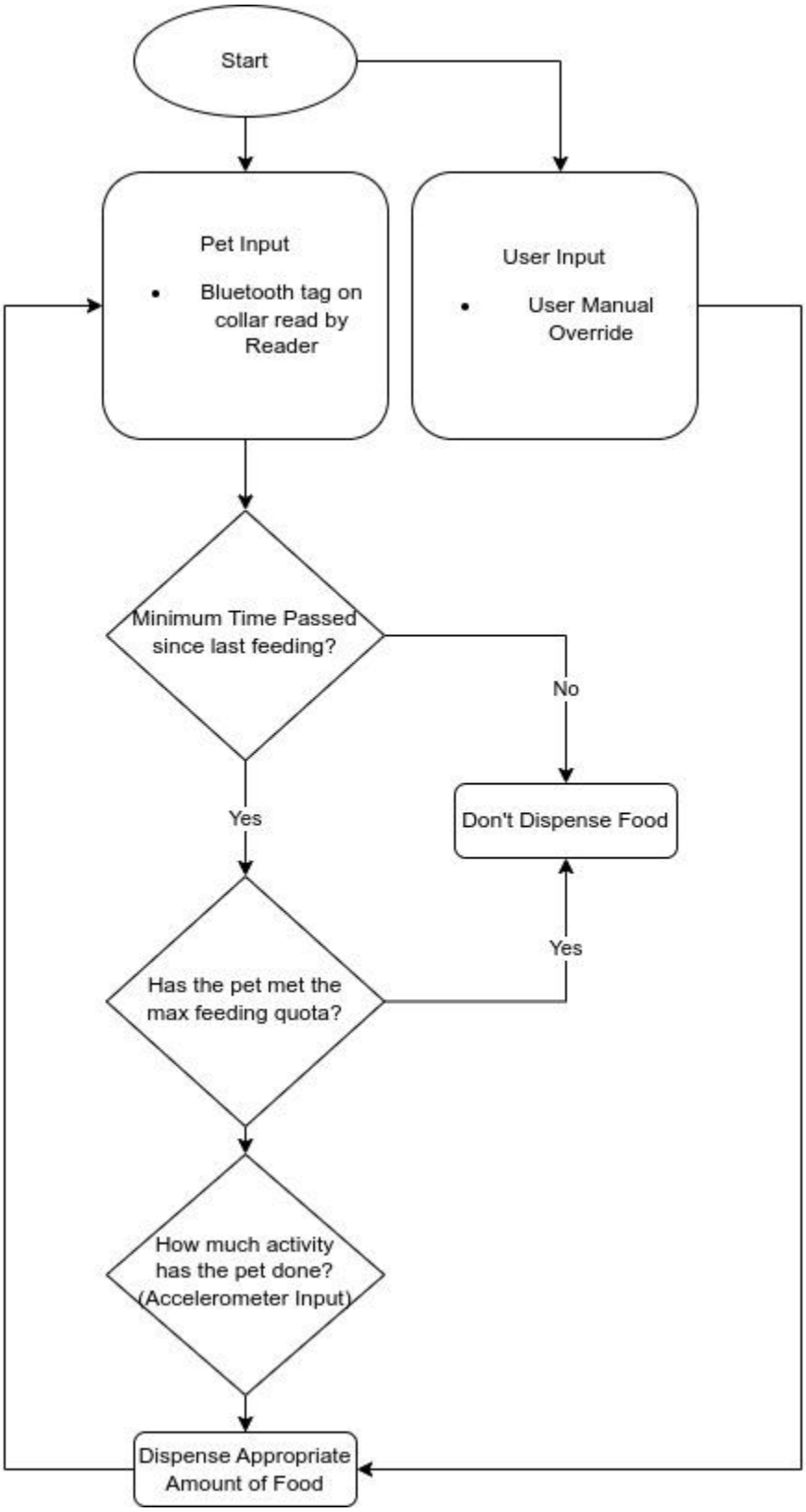
Bluetooth Tag

The tag included will require a battery to be operational. To turn the tag on hold the center button until the device sounds an audible beep, if you would like to turn the tag off repeat the same process. The tag can then be attached to the pet.

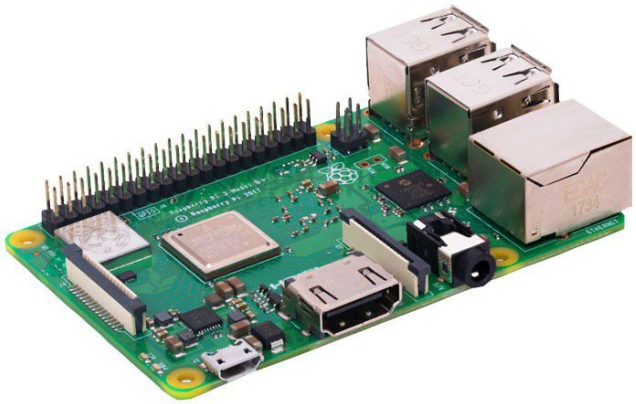
Product Design, Implementation, and Operation of the System

System block-diagram and software UML diagram




Start
Pet Input
Bluetooth tag on collar read by Reader
User Input
User Manual Override
Minimum Time Passed since last feeding?
No
Yes
Don't Dispense Food
Has the pet met the max feeding quota?
Yes
How much activity has the pet done? (Accelerometer Input)
Dispense Appropriate Amount of Food

Component Images and Components Description

	Device	Description
1	Raspberry Pi 3B+ 	Single board computer used as the brains of the project. ● Broadcom BCM2837B0, Cortex-A53 (ARMv8) 64-bit SoC @ 1.4GHz ● 1GB LPDDR2 SDRAM ● 2.4GHz and 5GHz IEEE 802.11.b/g/n/ac wireless LAN, Bluetooth 4.2, BLE ● Gigabit Ethernet over USB 2.0 (maximum throughput 300 Mbps) ● Extended 40-pin GPIO header ● Full-size HDMI ● 4 USB 2.0 ports ● CSI camera port for connecting a Raspberry Pi camera ● DSI display port for connecting a Raspberry Pi touchscreen display ● 4-pole stereo output and composite video port ● Micro SD port for loading your operating system and storing data ● 5V/2.5A DC power input ● Power-over-Ethernet (PoE) support (requires separate PoE HAT)
2	SPT5525LV-360 25KG Digital Servo Motor	The servo motor used for dispensing food. ● Material: metal ● Product: SPT5525LV-360 25KG Digital Servo ● Dead Band: 4Î¼s

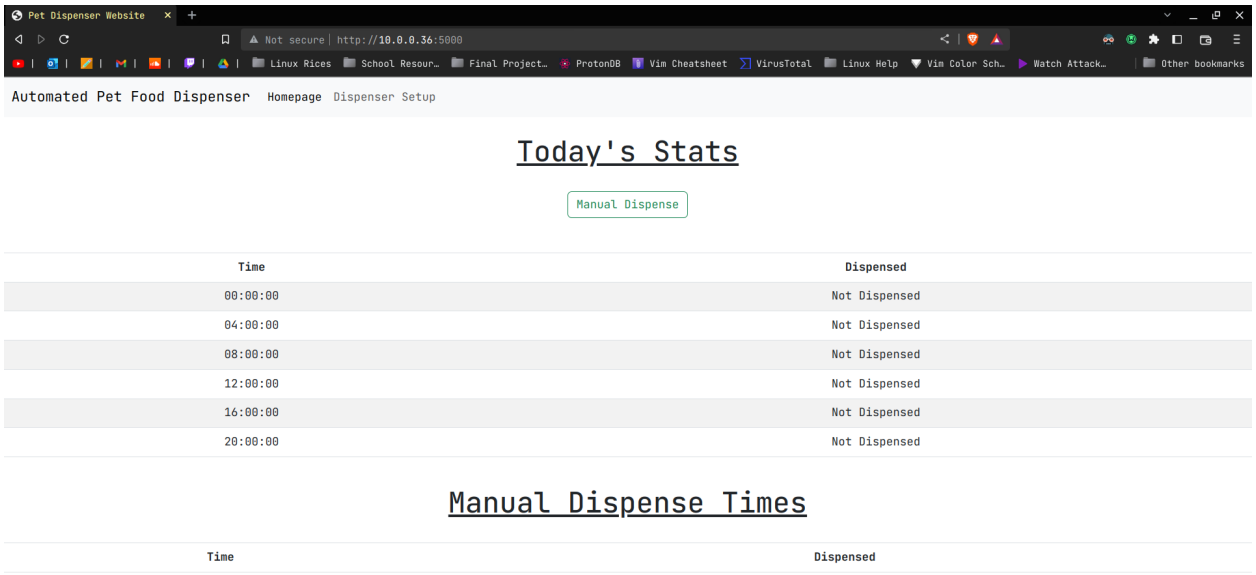
		• Neutral Position: 1500Î¼s/330hz
		• Motor: Core motor
		• 500-2500Î¼s Angle: 360 Continuous Rotation
		• Voltage Range: 4.8V-6.0V
		  • *Operating Speed(4.8V): 44rpm*
		  • *Operating Speed(6.0V): 55rpm*
		  • *Stall Torque(4.8V): 24 kg.cm*
		  • *Stall Torque(6.0V): 26 kg.cm*
		  • *Dimensions: 40.5*20*40.5mm/1.6*0.8*1.6in*
		  • *Weight: Approx.68g/2.4oz*
		  • *Connector Wire Length: JR 260mm/10.2in*

3	Tracker,Anti-Lost Tracker	The bluetooth tag that attaches to the pet. • Item Type: Bluetooth Anti-lost Tracker • Color(Optional): white, black, red, blue, green • Battery: 1*CR2032 (Not Included) • Bluetooth Version: Bluetooth 4.0 Low Energy • Support systems: for IOS7.0 or above; for Android 4.4 or above; Models need to support bluetooth 4.0 standard • Working Distance: Within 25 meters (no obstacle) • Scope: Cellphones, Wallets, Cars, Children, Pets And Other Ancillary Objects • Size: 5.5*3.3cm/2.2*1.3in

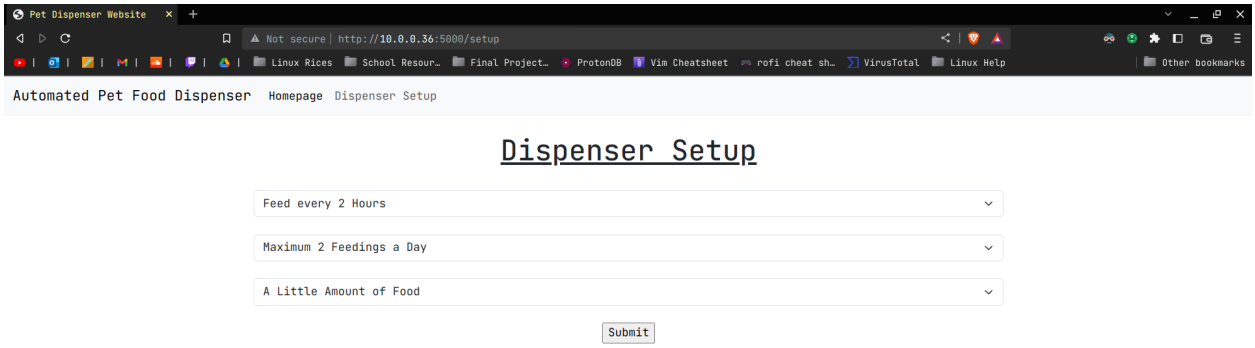
	 Key Tracker GPS Locator	● Weight: Approx.9g/0.3oz

Captures of the Major GUIs that you created in your project

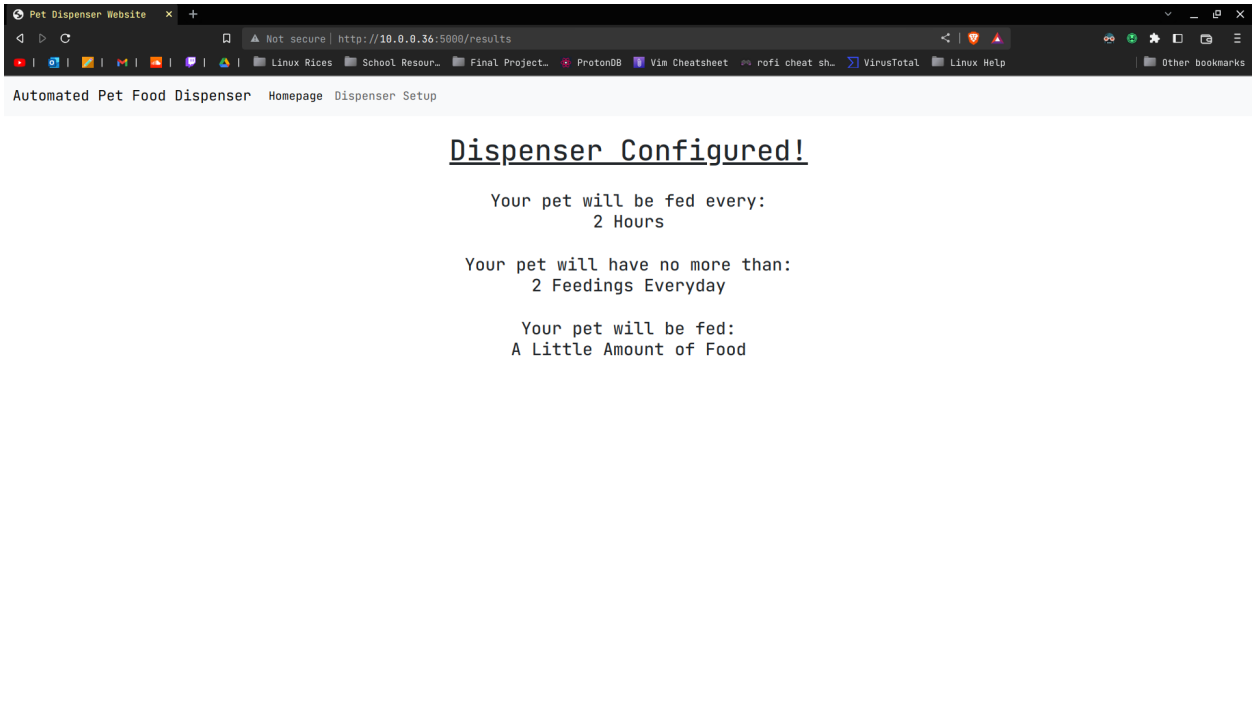
Main Page of Website



Dispenser Setup Page of Website



Configuration Results Page of Website



Theory of Operation of the Entire System

- Web Server/Web Design
    - Flexibility on any device

The starting ground of our system was the website in which the user is meant to interact with. The method in which we would create this website would largely affect the way we'd configure the overall system. The web server does utilize a flask server that uses jinja2 (python in html), css, and html. The flask server was configured to hold all the webpages required that we had created ourselves through html. Jinja2 was used to create a base template for the html code that the other webpages would simply access to allow global changes to the header and web page menus throughout the work process. CSS was implemented through the use of bootstrap which is a widely adopted front-end framework for web design. This allowed for quick configuration and changes for menus, buttons, and overall navigation of the site.

- Database Creation/Manipulation

The core of this system for software is the database table creation/manipulation to allow for both user and automated dispensing. The website allows users to configure the Automated Pet Food Dispenser to feed at certain intervals, have a maximum quota per day, and have an amount of food selected. The flask server would then run a terminal command (using the subprocess python library) and copy an excel template that was created for a certain interval. That excel spreadsheet is then converted into a database through the pandas python library and has the user form values updated into the database. That updated database is then written back into the excel spreadsheet for use later. Excel spreadsheets serve as the web servers databases that are accessed through multiple python files. This process is utilized whenever updates have to be made to the tables or configurations are changed by the user. The entire process of the running bluetooth scans is automated based on the times present within the excel spreadsheets.

- Bluetooth Detection

The bluetooth detection function in this system is used to control whether the PWM signal is sent through to the motor at certain times of the day. This portion of the system was built on the linux OS's ability to run terminal commands through bash scripting.
Within a bash script we configured the os to empty a text file, run a bluetooth scan for 5 seconds and take the output of that command into the emptied text file, and finally run a python file to check whether the MAC address of our tag is present in the file. Based on if the tag is detected a signal is then sent through to the motor and the database table is updated.
The OS checks hourly to see whether it should scan based on the excel spreadsheet times. If an hour is present then it will run the bluetooth scan bash script which will handle the process as mentioned above. This time checking the configurations we've made to the OS's crontab files (command automation).

- Motor Control

The servo motor's functionality in this system is to control the dispensing mechanism of the food. The motor has three wires that are connected to one of the Raspberry Pi's 5 volt pins, ground pins, and GPIO pins. We utilized pins 4, 6, 32 respectively. The GPIO12 pin serves to send a PWM signal through to the motor for it to spin, while the 5 volt and ground pin simply serve to power the motor. This signal is detected based on whether the user clicks the manual dispense button on the webpage which sends a signal through the GPIO12 pin or has a feeding time with the bluetooth tag present. If one of the conditions for feeding is not met the PWM signal is not sent through.

- Website Access

In order for the user to access the website outside of their local network port forwarding the raspberry pi's address was done. Allowing the public ip address of the raspberry pi to both put out and take in data on a selected port allows for users to connect to the website globally. This allows for monitoring how much their pet has been fed along with maintaining the ability to manually dispense food.

Maintenance Requirements

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1. Refilling the Dispenser: In order to ensure that food is dispensed, refill the pet food at your discretion.
2. Bluetooth Tag Battery: Maintaining the system functionality will involve replacing the battery of the bluetooth tag every three months.
3. Software Updates: Maintaining the security of the raspberry pi requires the pi to be updated occasionally. All that is required is that you download the update from the pet feeder website.
4. Servo Motor Maintenance: Maintaining the dispensing functionality requires that the motor remains clear of any debris and needs to be checked occasionally.
5. Moving the device: If power is lost from relocating, power outage, etc… the configuration will have to be redone to bring the device back online.

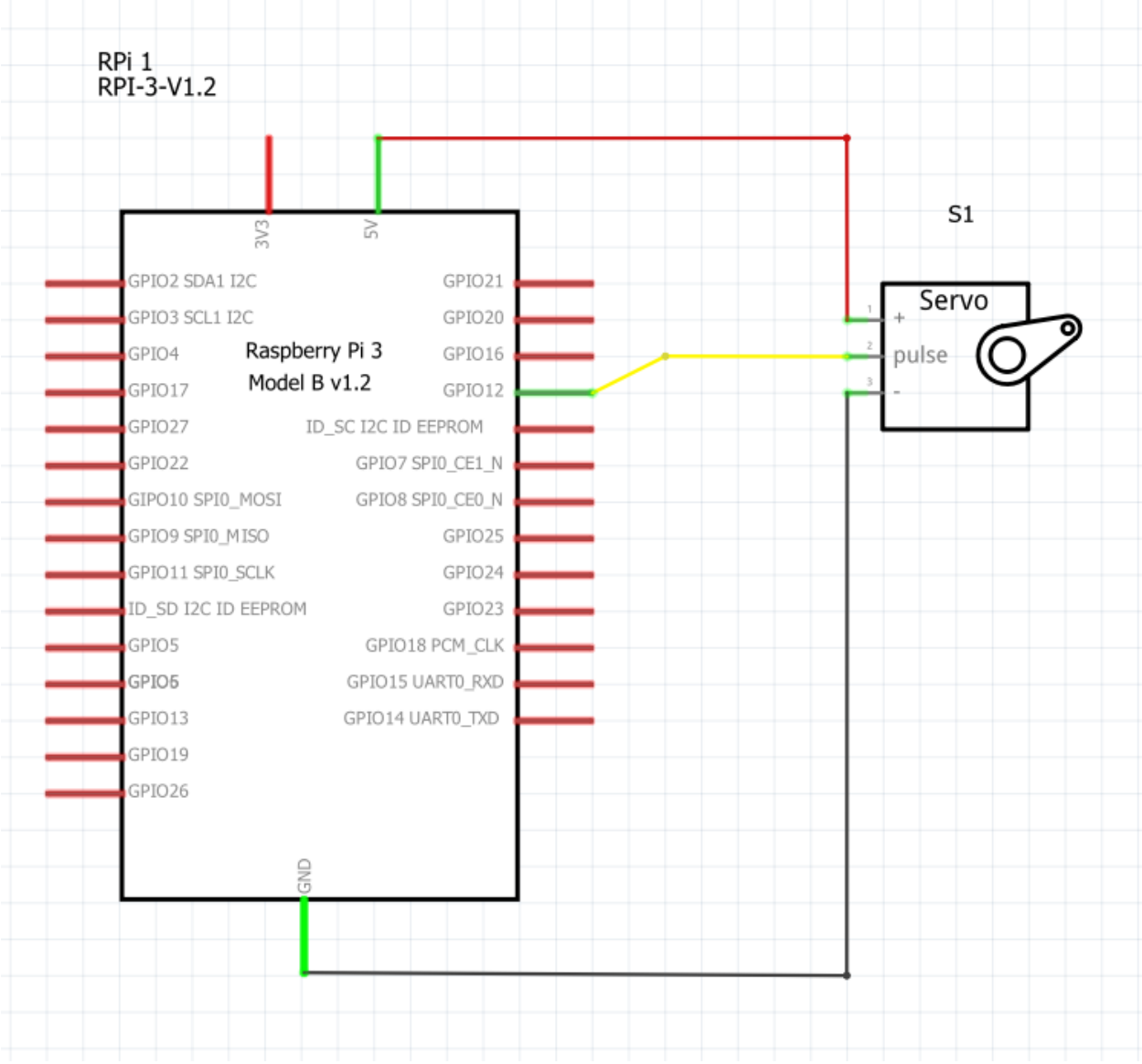
Conclusion and Further Developments

The Automated Pet Food Dispenser allows for the user to have their pets feed themselves whenever they are hungry if all the conditions set by the owner are met. This is all under the goal of preventing under/overfeeding of the pet. With the product's ability to detect when the pet is near using Bluetooth technology it is more efficient and convenient for the owners to manage their pets mealtime and make sure the right pet is getting the right food, leading to a happy and healthy life for both pets and owners.

Future developments involving our product would include a custom made enclosure, an accelerometer that would be attached to the pet with a tag (in order to have the feed amount be based on pet activity), a non port forwarded website for easier access using a domain name, and finally have the feeder be able to accommodate multiple animals.

Appendix

Electrical Schematics



Parts List/Bill of Materials (BOM)

Part#	Model	Reference Designation	Component Description	Supplier	Cost/Unit	Qnty	SubTotal
1	Raspberry Pi 3 B+	RPI1	Main Microcontroller running the device	Amazon.ca	$151.71	1	$151.71
2	SPT5525LV-360 25KG Digital Servo	S1	Used to spin the flap that dispenses food	Amazon.ca	$27.13	1	$27.13
3	Zevro KCH-06119/GAT102 Indispensable Dry Food Dispenser		The main holding device for the pet food and other components	Amazon.ca	$29.08	1	$29.08
4	Tracker,Anti-Lost Tracker Key Tracker GPS Locator		Keeps track of the pet if nearby the feeder Allows the pet to be discoverable by the dispenser	Amazon.ca	$10.64	1	$10.64
5	T-PCE Pipe		Mount for the servo motor	Canadian Tire	$7.49	1	$7.49
6	DWV 90-Degree Elbow Pipe		Used for directing the food to the bowl	Canadian Tire	$2.49	1	$2.49
7	Hose Clamp		Mounts the Pipe to the base	Canadian Tire	$3.49	2	$6.98
8	Various Wires		For connecting the motor to the Pi	Sayal Electronics	$6.50	3	$19.50

Total (w/o tax): $255.02

List of all Usernames and Passwords used in your project

Local User Login:

- Username: petfeeder
- Password: Rockey

Quotations/Citations/References, and Links to Major Component Manufacturers Specifications

SPT5525LV-360 25KG Digital Servo: http://www.spt-servo.com/Product/5621733416.html

Raspberry Pi 3 B+:
https://static.raspberrypi.org/files/product-briefs/Raspberry-Pi-Model-Bplus-Product-Brief.pdf
Tracker:
https://www.amazon.ca/Finder-Tracker-Locator-Wallets-Tracking/dp/B081DL1WQY/ref=sr_1_16?crid=141C4RQ67WY5C&keywords=Tracker&qid=1680912231&sprefix=tracker%2Caps%2C96&sr=8-16

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