IoT Based Pet Tracker

Amy Ideozu, Evan Lingo, Richard Taylor

MIDTERM REPORT

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IoT Based Pet Tracker

Amy Ideozu, Evan Lingo, and Richard Taylor

CONCEPT OF OPERATIONS

REVISION - 1
23 February 2022

CONCEPT OF OPERATIONS
FOR
IoT Based Pet Tracker

TEAM <17>

APPROVED BY:

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Project Leader Date

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Prof. Kalafatis Date

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T/A Date

Change Record

Rev.	Date	Originator	Approvals	Description
-	02/09/2022	IoT Based Pet Tracker		Draft Release
1	02/23/2022	IoT Based Pet Tracker		Revision 1

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1. Executive Summary

The purpose of this project is to address the problem of finding a pet whenever it is lost. The solution specified is to design and develop a GPS tracking system attached to the collar of a pet. On the collar there will be a GPS, camera, buzzer and LED. The GPS system and camera will communicate to a microprocessor which will then communicate to an android app. Through the app, the user will have the ability to set the dimensions of a safe area for the pet, request video streaming from the collar, and receive notifications when the pet is out of the specified safe zone. The buzzer and LED will be activated whenever the GPS detects that the pet has left the safe zone. Then the user will be notified via alert notifications from the app that their pet has escaped. By using the IoT Based Pet Tracker, the user should be able to locate and return their pet home safely.

2. Introduction

The Internet of Things (IoT) based pet tracker will perform a variety of features to enhance pet safety and monitoring. Many scenarios arise where pets compromise their safety by escaping or going into unsafe areas. By using the IoT based pet tracker, users can find the location of their pets whenever and wherever with the use of an Android app.

2.1. Background

Common measures for pet safety in place today include chipping—a practice where a chip containing the owner's information is inserted into a pet—and using pet collars that may have GPS capabilities. While these methods are effective, they are limited in their ability to efficiently locate pets. For example, chips only work by relying on the person who found the pet to take them to the pound and many GPS trackers do not report the exact location of the pet.

The IoT based pet tracker aims to improve the user's ability to find precious pets with the touch of an app. This can be used in tandem with chipping so users can find their pets while it's on the run or even after someone has brought it in to check the chip at a pound. It will also be helpful to be used along with a normal label and phone number on a dog collar. A bystander may notice your pet with the device lighting up and making sound and decide to call the number so you can get them back. This system will be able to replace other dog GPS trackers that have less features and overall usefulness than our tracker.

2.2. Overview

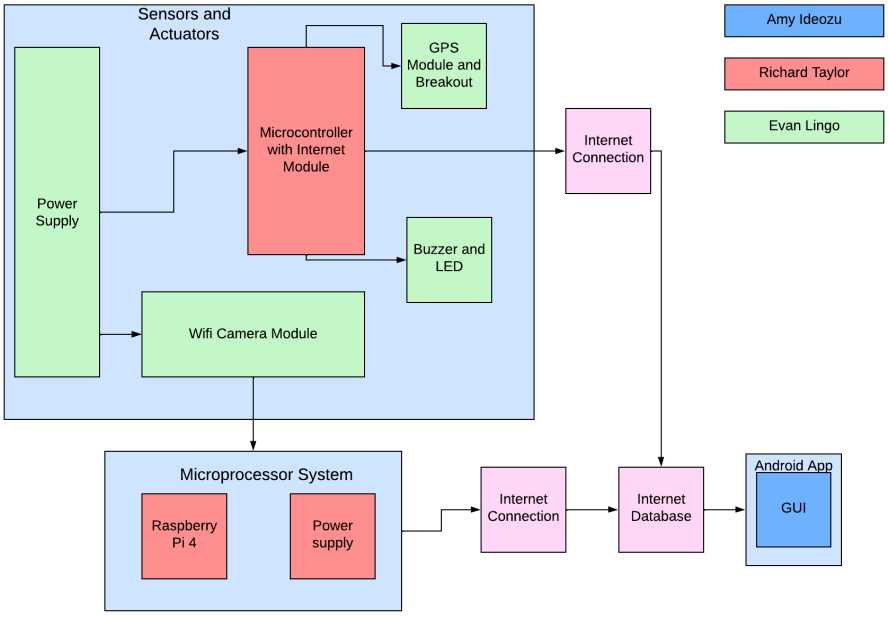

Figure 1: IoT Based Pet Tracker System Block Diagram

This system will be used to track the activities of a user's pet as it goes about its day to day life. There are three main subsystems involved in the IoT based pet tracker. The first subsystem is the system of sensors and actuators which will read input from the environment and send it to the microprocessor. By detecting GPS signals, the sensors will be able to send data as well as accept inputs from the microprocessor to actuate the camera, LEDs, and buzzer. The second subsystem will be the microprocessor system which will act as the middleman between the Android app and the first subsystem for the project. The microprocessor will contain all the code to accept and send input to the graphical user interface (GUI) via an online database as well as accepting and sending input to the sensors to ensure the whole project runs smoothly. The last subsystem is the Android app which will enable the user to monitor the activity of the tracker from their phone. It will have a variety of features including daily and weekly reports on pet activity, an option to check the video stream of the camera on the tracker, and an ability to set the bounds of the safety net for the pet.

2.3. Referenced Documents and Standards

- Raspberry Pi Instruction video: https://www.linkedin.com/learning/raspberry-pi-essential-training/welcome?autoAdvance=true&autoSkip=false&autoplay=true&resume=true&u=74650722
- Instructables Raspberry Pi and Android App Communication: https://www.instructables.com/Raspberry-Pi-Android-App-communication/
- Using GPS/Location Services: https://developer.android.com/training/location

3. Operating Concept

3.1. Scope

This project would affect the market of dog and cat owners that are concerned about the safety and behaviors of their pets. The IoT based pet tracker will be able to interface with multiple users through an internet database which will communicate with the Android app. As long as the consumer has an android phone, a pet, and stable internet connection in their house, they will be able to set up the IoT based pet tracker.

3.2. Operational Description and Constraints

The project will be used for the recreational purpose of security of pets. By checking daily and weekly activities users can be sure that their pet is staying within the bounds of its designated safe zone most of if not all of the time. By ensuring the location of the pet through the GPS system as well as additional security methods such as the video camera, LEDs, and buzzer sounds, you will be reassured that their pet is out of harm's way. Checking up on your pet will only require checking the easy to use phone app.

The constraints of the system are as follows

- The GPS, LED, buzzer, video camera, and power supply will be attached to the collar of the pet on a PCB with a Wi-Fi module to connect it to the Raspberry Pi 4.
- The Raspberry Pi will remain stationary in the user's house.
- The Android app will run on your phone.
- Both the microprocessor and phone app will be connected to the internet database and thus will be able to communicate with each other.
- The cost for the design will be affordable for the average pet owner.
- Time for development will be limited to 13 weeks.
- The device will not be waterproof but instead will be water resistant.

3.3. System Description

- Android App: Will act as the user interface for the device, enabling the user to set the safe area, request video streaming for the collar, and receive notifications when the pet is out of the safe zone. This will be connected to an internet database that will be connected to the raspberry pi as well as the Wi-Fi camera module.
- Camera: Takes video input to send through internet connection to the database and then to the user's phone app.
- Buzzer: Will activate and remain active as long as the pet is outside of the safe zone.
- LED: Will activate and remain active as long as the pet is outside of the safe zone.
- Microprocessor: Raspberry Pi 4 will be used as the main functioning unit between the sensors and the android app. It will connect to the microcontroller via internet connection and connect to the GUI via an internet database.
- GPS module: Will record the location of the pet through GPS and provide feedback to the app via the microprocessor.

- Microprocessor: Will be connected to the GPS module, LED and buzzer on the PCB board. Then will be connected to the raspberry pi via internet connection.

3.4. Modes of Operations

The IoT based pet tracker will have two modes as well as an extra function that can be activated in either mode. The first mode will be INACTIVE in which the pet is inside the safe zone and thus the LED and buzzer will not be activated. In this mode , users will still be able to check the GPS location of their pet through the Android app. The second mode will be ACTIVE in which the pet is outside the safe zone and thus the LED and buzzer will be activated. In this mode, the user will receive notifications about their pet being outside the safe zone once every 30 minutes or so. In either mode the user will be able to use the Android app to check the video feed from the pet's collar.

3.5. Users

The IoT based pet tracker will be marketed to pet owners of dogs and cats of age 18 and above. It requires a basic understanding of replacing batteries for the system, setting up the Raspberry Pi, as well as basic knowledge about using the Android app. Many pet owners who are worried about where their pet may be at any given point in the day will benefit from using the pet tracker.

3.6. Support

Support for the IoT based pet tracker will come in a troubleshooting guide as well as a user manual. The user manual will encompass all the basic guidelines for using the system such as setting up the Raspberry Pi, replacing the batteries, and the basics for downloading and using the Android app.

4. Scenario(s)

4.1. Pet outside safe area

Once the pet is outside the safe area, the user will be notified via alerts on their phone. These alerts have to be manually turned off to ensure that the user is aware that their pet is outside of the defined safe area. At that point the user can choose to activate the video camera located on the collar. Additionally, the buzzer and LED on the collar will automatically be activated once the pet has left the safe area.

4.2. User request video camera

The user can request video whenever needed. It is not limited to only when the pet is outside of the safe area. However, the video will not always be streaming; the user must request the video stream via the app.

4.3. Redefining safe area

The user has the option to redefine the dimensions of the safe area for the pet. In the scenario where the user wants to take their pet to the park, they will be able to set the dimensions of the safe area to the park they are at. This ensures that the user is not limited to only one safe area.

4.4. GPS Malfunction

In the case that the GPS malfunctions or is not transmitting data to the user, the user can still request video feed from the collar. It is not an ideal situation, but there are still ways that the pet can be found. The buzzer and LED will not be activated as there will be no way to determine whether the pet is inside or outside of the safe zone.

4.5. Wear and Tear

In the event that the collar experiences any sort of wear and tear, including, but not limited to: exposure of the PCB boards, exposure of the battery, internal water damage, and/or physical damage inflicted on the collar, the user should remove the collar and dispose of it to protect their pet from any harm.

5. Analysis

5.1. Summary of Proposed Improvements

- Allow users to track and see the location of their pet at all times via phone app.
- Application will allow users to use geofencing to set “safe zones” for the pet.
- Provide visual and aural cues to alert user that pet is out of bounds and help user to locate their pet:
    - Video camera streams by user request.
    - LED and buzzer sounds when the pet leaves the area.

5.2. Disadvantages and Limitations

- No theft protection; the collar can be removed from the pet by anybody at any time
- App failure due to:
    - Slow/no network connection.
    - Blocking bugs in the program.
    - Disconnection from collar.

5.3. Alternatives

- Bluetooth, but this requires that the collar and the raspberry pi that is in the house is within approximately 30 feet. While Wi-Fi can connect up to approximately 1000 feet.
- Chipping pet, but requires the person who found the pet to go to a Veterinarian's office.
- Pet trackers that are already out in the market (but do not have video streaming capabilities):
    - Standard trackers: allows GPS signal only.
    - Hunting trackers: GPS tracking and buzzer to have.

5.4. Impact

Because the pet tracker collects video footage, there may be privacy concerns. There is also an environmental issue with the materials used due to having a lithium ion battery, while considered to be more eco-friendly than other batteries. Some of the positive impacts include being able to find your lost pet and knowing where your pet is at all times.

IoT Based Pet Tracker

Amy Ideozu, Evan Lingo, Richard Taylor

FUNCTIONAL SYSTEM REQUIREMENTS

REVISION – Draft
23 February 2022

FUNCTIONAL SYSTEM REQUIREMENTS
FOR
IoT Based Pet Tracker

APPROVED BY:

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Project Leader Date

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John Lusher, P.E. Date

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T/A Date

Change Record

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-	02/23/2022	IoT Based Pet Tracker		Draft Release

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1. Introduction

1.1. Purpose and Scope

The IoT Based Pet Tracker (IPT) aims to supplement pet security and monitoring by enabling pet owners to be more proactive. The system will use GPS, video streaming, visual and aural cues, and an Android app to help users track the wellbeing of their pets from wherever they might be, given that the user is connected to the internet.

The IPT consists of three main subsystems: the sensors and actuators, microprocessor and microcontroller, and graphical user interface (GUI) contained in the form of an Android application. The system of sensors and actuators will include a Wi-Fi enabled video camera, GPS transmitter, buzzer, and an LED. The microprocessor is a Raspberry Pi 4 that will act as a bridge between the sensors/actuators and Android app. Finally, the Android app will provide a simple and intuitive GUI for users to receive and request information from the tracker unit.

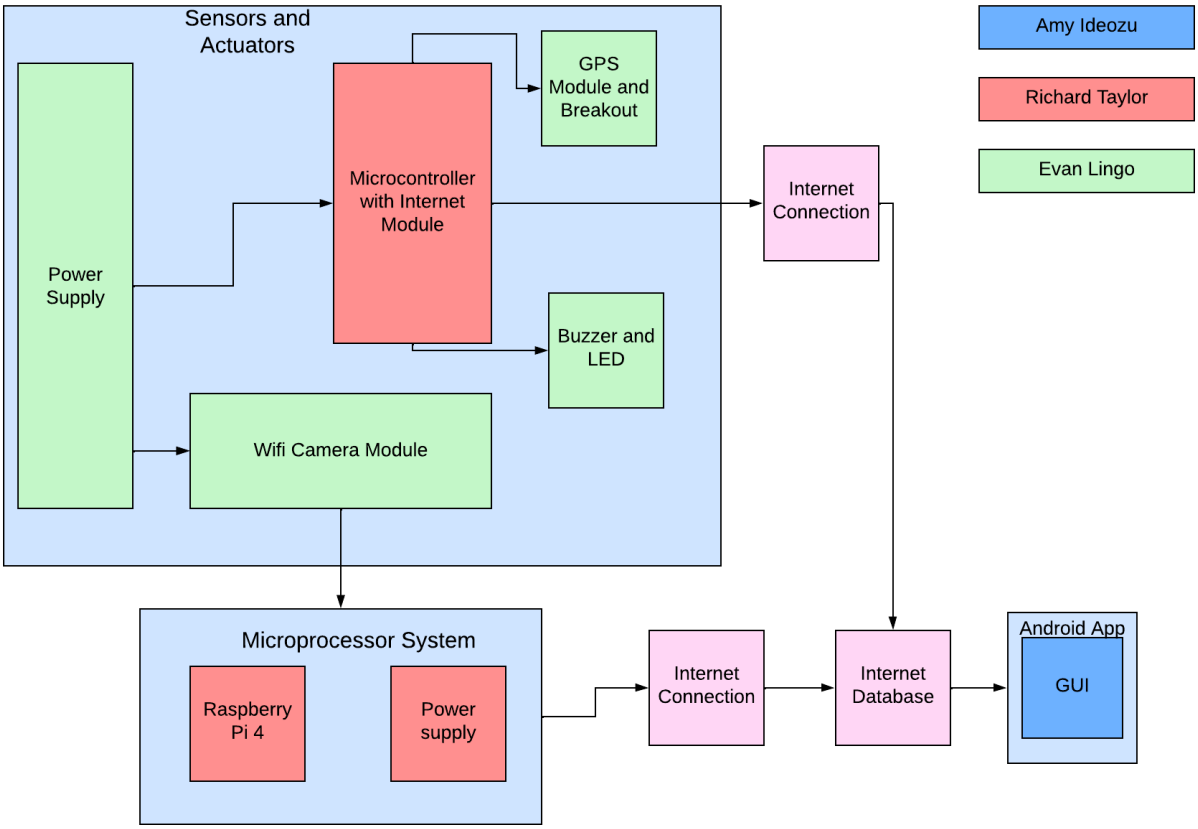

Figure 1: Block Diagram of the IPT

From the above figure, the sensors and actuators make up the tracker unit that will be placed on the pet. It will have an internet module to enable wireless communication with the Raspberry Pi 4. The Raspberry Pi 4 will be stationary inside the user's home, receiving and

sending data between the tracker and Android app. Finally, the Android app will allow the user to see the location of their pet(s) and define safe zones, request video footage from the tracker, and alert the user when their pet leaves a safe zone.

1.2. Responsibility and Change Authority

The team leader, Evan Lingo, will be responsible for making sure all the requirements set by the sponsor, Souryendu Das, are met. Any changes that are to be made to the product deliverables and/or specifications must be approved by the aforementioned team leader and sponsor.

Additionally, each team member is responsible for developing the following subsystems:

- Subsystem #1 (Sensors and Actuators): Evan Lingo
- Subsystem #2 (Microprocessor and Microcontroller): Richard Taylor
- Subsystem #3 (GUI): Amy Ideozu

2. Applicable and Reference Documents

2.1. Applicable Documents

The following documents, of the exact issue and revision shown, form a part of this specification to the extent specified herein:

Document Number	Revision/Release Date	Document Title
IEEE 802.11	2012	IEEE Standard for Information technology - Telecommunications and information exchange between systems Local and metropolitan area networks - Specific Requirements
IPC A-610E	Revision E – 4/1/2010	Acceptability of Electronic Assemblies
C2 - 2017	2017	National Electrical Safety Code(R)
ASME Y14.5	2018	Standard for establishing symbols, definitions, and rules for geometric dimensioning and tolerancing

2.2. Reference Documents

The following documents are reference documents utilized in the development of this specification. These documents do not form a part of this specification and are not controlled by their reference herein.

Document Number	Revision/Release Date	Document Title
Version 1.4	May 2017	SDI-12 A Serial-Digital Interface Standard For Microprocessor-Based Sensors
SLAS800	March 2013	TI MSP430 microcontroller data sheet
ESP8266	November 2014	Sparkfun Wi-Fi Module - ESP8266
Version 1.4	October 2013	Sparkfun GPS Receiver - EM - 506
ANSI C119.6-2011	5 May 2011	Electric Connectors--Non-Sealed,Multiport Connector Systems Rated 600 Volts Or Less for Aluminum and Copper Conductors
NFPA 70	6 Aug 2019	National Electrical Code

2.3. Order of Precedence

In the event of a conflict between the text of this specification and an applicable document cited herein, the text of this specification takes precedence without any exceptions.

All specifications, standards, exhibits, drawings or other documents that are invoked as “applicable” in this specification are incorporated as cited. All documents that are referred to within an applicable report are considered to be for guidance and information only, except ICDs that have their relevant documents considered to be incorporated as cited.

3. Requirements

3.1. System Definition

The IPT is a reliable system that will allow users to be able to track their pets. Users will be alerted whenever their pet has exited the defined safe area, which will activate the LED and buzzer on the pet's collar. It will also allow the user to see where their pet is via a Wi-Fi camera module that can be activated at any time. The IPT three subsystems are as follows: Sensors and Actuators, Microprocessor and Microcontroller, and GUI.

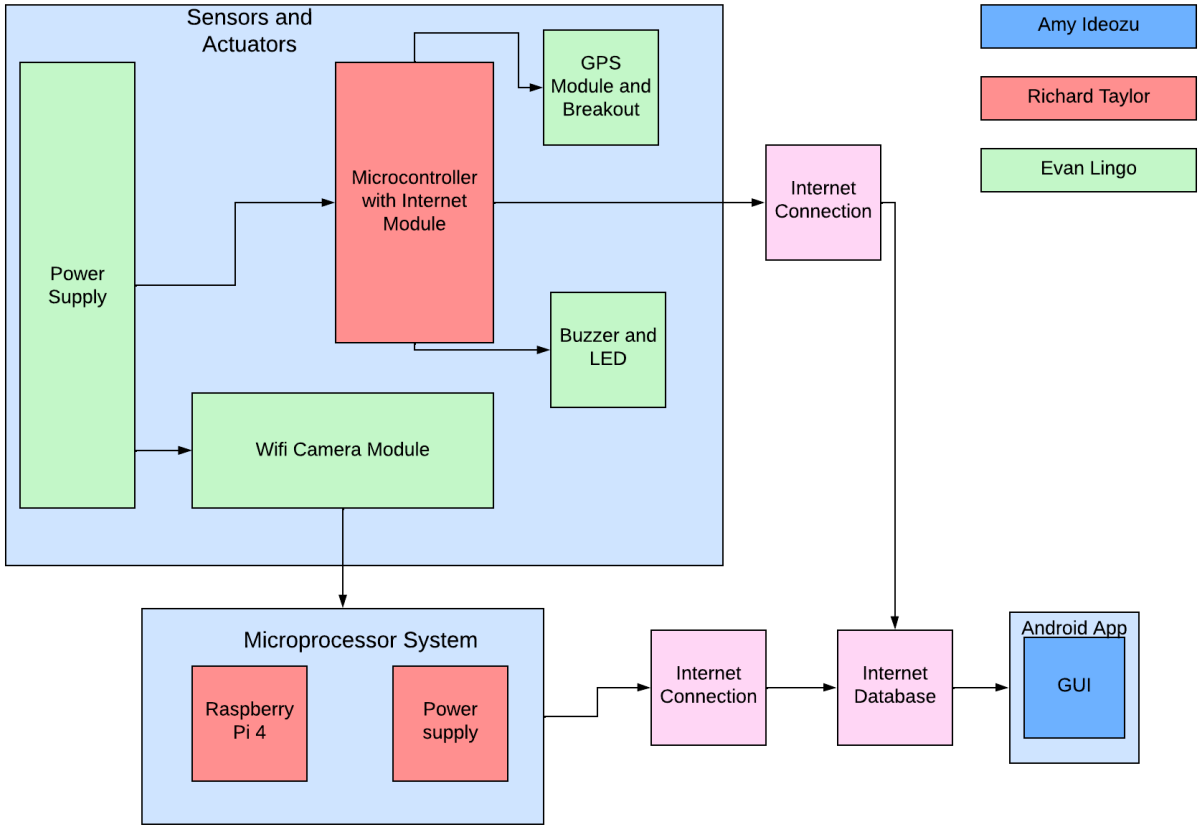

Figure 2: Block Diagram of System

3.2. Characteristics

3.2.1. Functional / Performance Requirements

3.2.1.1. Battery Operating life

The IPT should have a battery life of at least 8 hours.

Rationale: Having a long battery life (for lithium batteries) will be more convenient for the pet owner to charge at leisure.

3.2.1.2. Time to Alert

The IPT should be able to alert the owner via LED + buzzer and phone notification within a minute of the pet exiting the safe area.

Rationale: The IPT should be able to alert the owner quickly so that the pet cannot get too far outside the safe area before it is lost. Having a quick alert will lessen the chance that the pet gets injured or lost before the owner is able to find it.

3.2.1.3. Geofence Size

The IPT will have a minimum geofence size of 100 sq. ft and a maximum size of 3600 sq. ft.

Rationale: The IPT should have a fairly large minimum size as the GPS may not be specific enough to designate a safe zone between a small size. The size should be a maximum of 3600 sq. ft because that would be the limit of the average Wi-Fi signal.

3.2.1.4. Video Stream Quality

The IPT will have video stream quality of 480p.

Rationale: The IPT should have fairly decent video quality so the user will be able to see what is going on.

3.2.2. Physical Characteristics

3.2.2.1. Mass

The mass of the IPT shall be less than or equal to 213 grams.

Rationale: The IPT should be fairly light so it doesn't discomfort the pet while it is being worn

3.2.2.2. Size

The volume of the IPT shall be less than or equal to 1.5 inches in height, 2 inches in width, and 3 inches in length.

Rationale: The size of the IPT should be fairly small so it doesn't discomfort the pet while it is being worn

3.2.2.3. Mounting

The IPT sensor and actuator subsystem will be mounted on the pet's collar to enable precise monitoring of the pet. The Raspberry Pi 4 component of the IPT will be mounted in a different stationary location in the user's house. The Android app will be downloaded onto the user's device.

Rationale: The system should be mounted onto the pets collar so that it will monitor the pet properly. The Raspberry Pi 4 will be mounted in the user's house to enable precise video

streaming quality. The android app will be downloaded to the user's device for easy accessibility.

3.2.3. Electrical Characteristics

3.2.3.1. Inputs

As long as the inputs for the IPT are functioning within the limits of the ICD, it will not malfunction or have a reduced life expectancy.

Rationale: Having the IPT not malfunction as long as it is within the limits of the ICD will be beneficial to the user.

3.2.3.1.1 Power Consumption

The maximum peak power of the system shall not exceed 2.12 watts.

Rationale: The peak power consumption should be low so that it can run efficiently for long periods of time.

3.2.3.1.2 Input Voltage Level

The input voltage level for the IPT shall be +1.8 to +3.6 VDC.

Rationale: The Input voltage should be set to an appropriate level so that it does not mess up the system.

3.2.3.1.3 External Commands

The IPT will have an external command for requesting video via the Android phone app.

Rationale: The IPT will need video streaming to check on the location of their pet.

3.2.3.2. Outputs

3.2.3.2.1 Data Output

The IPT will output data through the Raspberry Pi 4 component and the MCU to the user's Android phone app via the internet database.

Rationale: The IPT must pass data through the internet system since it is an IoT based device.

3.2.3.2.2 Diagnostic Output

The IPT shall include a diagnostic interface for control and data logging.

Rationale: Provides the ability to control things for debugging manually and a way to view/download the node map with associated potential targets.

3.2.3.2.3 Raw Video Output

The IPT will include video streaming to the user's Android phone app via the Raspberry Pi 4 component.

Rationale: Too much data to store internally.

3.2.3.3. Connectors

The IPT shall use external connectors in accordance with American National Standard for Electrical Connectors ANSI C119.6-2011.

Rationale: Conform to connector standard.

3.2.3.4. Wiring

The IPT shall follow the National Electric Code guidelines or the NFPA 70 regarding electrical wiring.

Rationale: Conform to wiring standard.

3.2.4. Environmental Requirements

The IPT shall be designed to withstand and operate in the environments and laboratory tests specified in the following section.

Rationale: The IPT will be fully functional when under normal environmental conditions.

3.2.4.1. Thermal

The IPT will have a heat sink in the Raspberry Pi 4 component. Otherwise, it will not require thermal sinks.

3.2.4.2. External Contamination

The IPT will be in a sealed container that has a charging port which will have a cover to prevent damage.

3.2.4.3. Rain

The IPT should not be exposed to water for large periods of time.

3.2.4.4. Humidity

The IPT will be resistant to normal levels of humidity.

3.2.5. Failure Propagation

The IPT System shall not allow propagation of faults beyond the IPT System interface.

3.2.5.1. Failure Detection, Isolation, and Recovery (FDIR)

3.2.5.1.1 Failure Detected

In any case that the IPT experiences failure to the hardware system that is beyond simple adjustments, then the user can send back the device to be repaired or replaced.

4. Support Requirements

The IPT will require an internet connection to enable communication between the different subsystems. Users must possess an Android device that has internet connectivity (Wi-Fi or mobile data) and provide power for the second subsystem, the Raspberry Pi 4. Additionally, the user must also be able to provide power to the tracker when it needs to be recharged. The IPT will come with one (1) tracker unit which consists of: one (1) battery, one (1) camera, one (1) LED, one (1) buzzer, one (1) GPS module, and one (1) Wi-Fi module. A power cable will also be included for recharging purposes. The microprocessor and microcontroller subsystem will consist of one (1) Raspberry Pi 4 unit, one (1) power cord, and one (1) MSP430. A collar will also be provided for tracker mounting purposes.

● Appendix A: Acronyms and Abbreviations

GPS	Global Positioning System
GUI	Graphical User Interface
ICD	Interface Control Document
IoT	Internet of Things
LED	Light-emitting Diode
mA	Milliamp
mW	Milliwatt
PCB	Printed Circuit Board
TBD	To Be Determined
IPT	IoT Based Pet Tracker
MCU	Microcontroller Unit
MPU	Microprocessor Unit

● Appendix B: Definition of Terms

● Appendix C: Interface Control Documents

IoT Based Pet Tracker

Amy Ideozu, Evan Lingo, Richard Taylor

INTERFACE CONTROL DOCUMENT

REVISION – Draft
23 February 2022

INTERFACE CONTROL DOCUMENT
FOR
IoT Based Pet Tracker

APPROVED BY:

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Project Leader Date

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John Lusher II, P.E. Date

_____
T/A Date

Change Record

Rev.	Date	Originator	Approvals	Description
-	02/23/2022	IoT Baser Pet Tracker		Draft Release

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1. Overview

This document is provided to detail how the three subsystems, the sensors/actuators, microprocessor, and Android app, will interface to achieve the specifications outlined in the Function System Requirements document. The following sections will specify the requirements for each subsystem on three different aspects (where applicable): physical, electrical, and communications.

2. References and Definitions

2.1. References

ANSI C119.6-2011
Electric Connectors--Non-Sealed, Multiport Connector Systems Rated 600 Volts Or Less for Aluminum and Copper Conductors
5 May 2011

NFPA 70
National Electrical Code
6 Aug 2019

IEEE 802.11
IEEE Standard for Information technology - Telecommunications and information exchange between systems Local and metropolitan area networks - Specific Requirements
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IPC A-610E
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C2- 2017
National Electrical Safety Code ®
2017

ASME Y14.5
Standard for establishing symbols, definitions, and rules for geometric dimensioning and tolerancing
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SDI-12 A Serial-Digital Interface Standard for Microprocessor-Based Sensors
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SLAS800
TI MSP430 microcontroller data sheet
March 2013

ESP8266
Sparkfun Wi-Fi Module - ESP8266
November 2014

Version 1.4
Sparkfun GPS Receiver - EM - 506

2.2. Definitions

mA	Milliamp
mW	Milliwatt
GPS	Global Positioning System
GUI	Graphical User Interface
ICD	Interface Control Document
IoT	Internet of Things
LED	Light-emitting Diode
PCB	Printed Circuit Board
TBD	To Be Determined
IPT	IoT Based Pet Tracker
MCU	Microcontroller Unit
MPU	Microprocessor Unit

3. Physical Interface

3.1. Weight

The weight of the IPT will be about 213 grams.

3.2. Dimensions

3.2.1. Dimension of MCU and MPU

The microcontroller will approximately be 14 mm by 14 mm. The Raspberry Pi 4 including its case will be 8.9 cm by 6.35 cm by 2.03 cm.

3.2.2. Dimension of PCB

TBD

3.3. Mounting Locations

The PCB and MCU system of sensors and actuators will be mounted on the collar of the pet. The MPU will be mounted somewhere stationary in the user's home.

4. Thermal Interface

There will be heat sinks on the MCU and PCB to prevent overheating as it will run the tracking program to provide the location of the pet at all times. This will prevent it from overheating while running the video streaming program. The Raspberry Pi 4 comes installed with a heat sink.

5. Electrical Interface

5.1. Primary Input Power

5.1.1. Wi-Fi Camera

The Wi-Fi camera will be connected directly to the power supply of 3.7V and will receive 3.3V through a buck converter circuit.

5.1.2. MCU

The MCU will be connected directly to the power supply of 3.7V and will receive 3.6V through a buck converter circuit. The MCU will also have four other components drawing power from it. The Wi-Fi module, GPS module, buzzer and LED.

5.2. Voltage and Current Levels

Maximum Values

Component	Voltage (V)	Current (mA)	Power (mW)
Raspberry Pi 4 B	5	2	10
GPS Module EM 506	6.5	38	247
Microcontroller MSP430FR60371IPZ	4.1	2	8.2
Wi-Fi Module ESP 8266	3.6	12	43.2
Wi-Fi Camera module ESP 32CAM+	5	310	1550
Arceli Buzzer	5	30	150
5mm LED	3.6	30	108

Table 1: Maximum Voltage, Current and Power Levels

The values of Table 1 are per second to allow for accurate gauging of power consumption at max power usage.

Stand-By Values

Component	Voltage (V)	Current (mA)	Power mW
Raspberry Pi 4 B	3.3	2	6.6
GPS Module EM 506	5	34	170
Microcontroller MSP430FR60371IPZ	3.6	2	7.2
Wi-Fi Module ESP 8266	3.6	12	43.2
Wi-Fi Camera module ESP 32CAM+	3.3	20	66
Arceli Buzzer	3.3	30	99
5mm LED	3.6	20	72

Table 2: Stand-By Voltage, Current and Power Levels

The values of Table 2 are per second to allow for accurate gauging of power consumption at average power usage.

5.3. Signal Interfaces

5.3.1. Signal interface for GPS

The GPS will be mounted on the PCB and controlled through the use of the MCU

5.3.2. Signal interface for Camera

The camera will also be mounted on the PCB but it will be controlled remotely via the MPU.

5.3.3. Signal interface for Buzzer

The buzzer will be mounted on the PCB and controlled through the use of the MCU

5.3.4. Signal interface for LED

The LED will be mounted on the PCB and controlled through the use of the MCU

5.4. Video Interfaces

The video camera will be installed on the tracker device. The other video interface will be the Android app where the user will be able to watch live video from the device through the internet.

5.5. User Control Interface

The control interface will be on the Android app. The user will be able to set a geofence for their pet within the guidelines, receive data for their pet's daily and weekly activities, as well as watch live video of the pet whenever they wish.

6. Communications / Device Interface Protocols

6.1. Wireless Communications (Wi-Fi)

6.1.1. Wi-Fi

The internet module within the tracker uses the IEEE 802.11 b/g/n standard while the video camera uses the IEEE 802.11b/g/n/e/i standard. The Raspberry Pi 4 has a built-in Wi-Fi module that uses IEEE 802.11ac standard. These connections will allow the devices to connect to the database, enabling communication to and from the different subsystems.

6.1.2. GPS

The GPS module with breakout will be connected to the Wi-Fi module to allow communication with the Android app.

6.2. Databases

There will be two MySQL databases where user information and device controls/protocols are stored respectively.

IoT Based Pet Tracker

Amy Ideozu, Evan Lingo, and Richard Taylor

SCHEDULE AND VALIDATION PLAN

REVISION – Draft
23 February 2022

Schedule:

Task	Owner	Deadline	Current Status (Completed, In Progress, Behind Schedule)
Concept of Operations first draft finished	All	2/9/22	Completed
Functional System Requirements first draft finished	All	2/23/22	Completed
FSR, ICD, Milestone, Validation Plan draft complete	All	2/23/22	Completed
Parts Ordered	All	2/25/22	In Progress
Multisim schematic started	Evan Lingo	2/25/22	In Progress
Explore Android Studio APIs	Amy Ideozu	2/27/22	In Progress
learning how to program on CC Studio	Richard Taylor	2/27/22	In Progress
Midterm Presentation	All	3/2/22	In Progress
GPS Program started	Richard Taylor	3/4/22	Not Started
Functionality of geofencing	Amy Ideozu	3/4/22	In Progress
Begin breadboard of multisim schematic with physical parts	Evan Lingo	3/4/22	Not Started

Learning how to code Raspberry Pi 4	Richard Taylor	3/12/22	Not Started
GPS finished and video program started	Richard Taylor	3/18/22	Not Started
Functionality of video streaming	Amy Ideozu	3/18/22	Not Started
Learning and understanding Altium / begin on PCB design	Evan Lingo	3/18/22	Not Started
Finalize PCB design and order PCB	Evan Lingo	3/25/22	Not Started
Status Update Presentation	All	3/30/22	Not Started
Video program finished	Richard Taylor	4/1/22	Not Started
User database, device pairing	Amy Ideozu	4/1/22	Not Started
Learning how to solder and use the soldering station	Evan Lingo	4/1/22	Not Started
Begin soldering PCB	Evan Lingo	4/8/22	Not Started
all MCU and MPU programs are functional and ready for testing	Richard Taylor	4/15/22	Not started
UI elements/design, Validation	Amy Ideozu	4/15/22	Not Started

PCB testing and validation	Evan Lingo	4/15/22	Not Started
Final Presentation	All	4/20/22	Not Started
Final Demo	All	4/29/22	Not Started
Final report	All	4/30/22	Not Started

Validation Plan:

Subsystem	March 4th	March 18th	April 1st	April 15th	April 29th
Sensor and Actuator	Multisim schematic of system complete	Physical breadboard design complete and begin PCB design	PCB soldering and testing of components	Final testing and subsystem validated	Final Demo
Microprocessor and Microcontroller	Have GPS program started	GPS should be finished and video program should be started	Video program should be finished and internet database should be setup to properly transfer data	Final testing and subsystem validated	Final Demo
GUI	Have functionality for geofencing complete	Polish geofencing, have video streaming functionality complete	Polish video streaming, work on login info, device pairing	Integrate all functions into one app, polish UI elements	Final Demo