Miniature Tracking FOB

PROJECT PLAN

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Revision History

Version	Date	Reason	Signature
1.0	2/20/2016	Rough Draft	David Carlson
1.1	4/4/2016	Updated Rough Draft	Brandon Trent
1.2	4/21/2016	Preparation for Submission	Brandon Trent

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1 Introduction

1.1 Project statement

This project is about developing a tracking device that can be inconspicuously attached to a traffic sign, and can communicate information about its location with a server over a long range network. It is also the development of a mobile app/web application that can communicate with the server to pinpoint where each tracking device is located. This inexpensive system composed of the small tracking device and application will prevent assets from being lost or stolen saving the customer time and money.

1.2 Purpose

The main purpose of the project is to locate lost or stolen road construction signs. This project could increase safety in construction zones because there would be appropriate signage to make drivers aware of workers. This tracker will also reduce replacement costs of road signs for our customer. When they can locate missing road signs, they can save about $300 per missing sign in replacement costs.

1.3 Goals

- Customer satisfaction
- Having a small enough device that can remain hidden
- A device that can withstand harsh weather
- A device that is battery powered and can last for around 6 months
- Implement a server that can store location information and be able to receive and send that information to the mobile/web application
- Implement a mobile/web application that will integrate with the Google API to show a map where the trackers are located based on the information received from the server.

2 Deliverables

- The Device
    - Microcontroller
    - GPS chip
    - Cellular chip
    - Battery
- The Database
- The Web/Mobile Application

3 Design

3.1 Previous work/literature

Some similar products include different pet tracker devices such as Whistle GPS Pet Tracker [4] and Pod Tracker [3]. Similarly there are some vehicle tracking devices as well [1]. The closest thing that we could find to our product is the Dewalt MobileLock [3].

All of these products have something in common, their cost is too high whether it is monetary or power cost. The customer needs the device to last 6-9 months since the asset will be in use that long and the price must be low enough that we are not effectively doubling the cost of each asset since we are looking to save money in the long run and not spend more of it.

3.2 Proposed System Block diagram

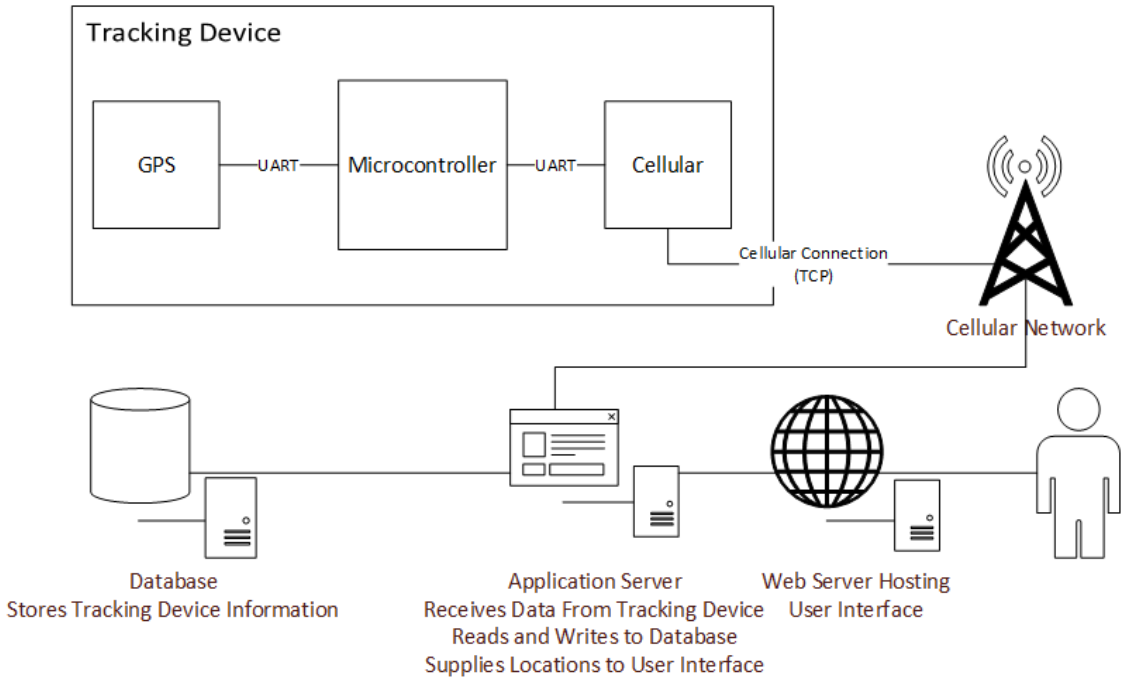

Figure 1 - System Level Block Diagram

As shown in the diagram above our tracking device will be using UART to interface with all of its different components. The tracking device will then interface with the application server via the cell network. The application server will be running any background code that will convert the data received from the tracking device and then store it on the server. The application server will also be running any php code that we would use to have the web server pull data from the database server. The web server will be where the web/mobile application will be hosted.

3.3 Assessment of Proposed methods

One method we discussed was using satellite ping to directly send data to our database about our devices location, however this had the potential of being much more expensive as we would have to pay for each transmission of data from the satellite as well as it would bring about extra battery drain than our accepted method. We also looked at communicating over the cell network, but using cell tower triangulation to determine a device's location instead of GPS. However, like the previously mentioned satellite method, this would be much more expensive in battery cost and would make it more difficult to achieve our goal of a battery potentially lasting 6 months. We have decided to follow a method that will draw latitude and longitude data via satellite and the device will then send this information to our database over the cell network. This utilizes less power than the cell tower triangulation and will cost less than the satellite directly transmitting data to our database method. A block diagram of this implementation can be seen in figure 1. In the figure you can see we plan to use a microcontroller to handle timing, and startup both the

gps module and cellular module. This will allow us to go into a low power state between transmissions of data allowing us to conserve power by not being constantly on allowing us to achieve multiple months of battery life. When the tracker is awake it will send the raw data from the gps to the application server along with its battery information and an identification number. This method allow us to minimize computation onboard and utilize the power of our server before storing the data in a database. This database is then accessed through the application server which will translate or filter data as the user requests from the web application.

3.4 Validation

Once we have our prototype built, we will be able to test that it can receive location information and communicate it across the cell network to our database. Based on similar projects found through research we concluded our desired method will work and be efficient in both cost and power consumption.

4 Project Requirements/Specifications

4.1 The Device

4.1.1 Functional Requirements

- Battery should last more than one week, preferably nine months.
- We want to keep the device relatively small to remain inconspicuous.
- Device timer will wake it up and update the devices location at least twice a week.

4.1.2 Non-Functional Requirements

- The device must be able to send data to the server reliably.
- The device must not drain the battery below safe thresholds.

4.2 The Application/Server

4.2.1 Functional Requirements

- Web application marks location of each device on a Google map.
- Device receives confirmation that proper GPS data was received and stored in the database so the device can go back to sleep to conserve power.
- If database does not receive proper GPS data, device stays awake to try again.
- While the user is not logged in, the application shall display a login prompt.
- When the user provides valid login credentials, the application shall enable access to main displays.
- When the user clicks logout, the application shall return to the login prompt.

4.2.2 Non-Functional Requirements

- The application must finish logging in a user within ten seconds.
- The application must finish logging out a user within ten seconds.
- The application must be appealing to look at and inviting.
- The application must have smooth transitions between screens.
- The application must be able to be navigated through in a logical manner.
- The application must allow only one user to be logged in per device.

- The application must allow login with a valid encrypted username and password.
- The application must not discriminate between race or ethnicity.
- The application must be maintained every three months and updated when security patches and new content are released.
- The application must abide by the laws and regulations of applicable jurisdictions.

5 Challenges

The main challenge for this project is conserving power while the product is sending information as well as when it is idle. In order for the battery life to be upwards of six months, the product must enter a low power mode when not in use as well as only power parts needed for operation. Another problem we will have is communicating to the server over the cellular network. No one in our team has done this before, so it will take a sizable amount of research for this to work correctly. Throughout this project, there will also be a large amount of testing that will be required including power consumption, message send/receive times, and coordinate accuracy, among others.

6 Timeline

Task Name	Start	Finish
Planning & Research	Tue 1/19/16	Sat 4/23/16
Research Elements of Project	Tue 1/19/16	Fri 2/26/16
Project Plan Rough Draft	Fri 2/12/16	Sat 2/20/16
Design Document Rough Draft	Thu 2/18/16	Fri 3/11/16
Order Dev Parts	Fri 2/26/16	Sat 3/5/16
Project Plan 2	Fri 3/25/16	Mon 4/4/16
Final Project Plan & Design Document	Fri 4/1/16	Sat 4/23/16
Development	Fri 2/26/16	Fri 11/4/16
Database	Fri 2/26/16	Fri 3/11/16
Microcontroller Software	Fri 2/26/16	Fri 11/4/16
GPS Interface	Fri 2/26/16	Fri 4/1/16
Cellular Interface	Fri 2/26/16	Fri 4/15/16
Low Power Mode	Fri 2/26/16	Fri 9/30/16
Web Application	Fri 3/11/16	Fri 11/4/16

Server Code	Fri 3/11/16	Sat 9/17/16
Integrate Sensors	Fri 3/18/16	Sat 4/30/16
Testing	Fri 4/1/16	Fri 11/25/16
Gps Module	Fri 4/1/16	Sat 4/16/16
Cellular Communication	Fri 4/15/16	Sat 5/7/16
Evaluate Power Draw	Fri 9/30/16	Sat 10/8/16
Hardware with battery	Sat 10/8/16	Fri 10/21/16
Web Interface	Fri 11/4/16	Sat 11/12/16

Table 1 - Project Timeline

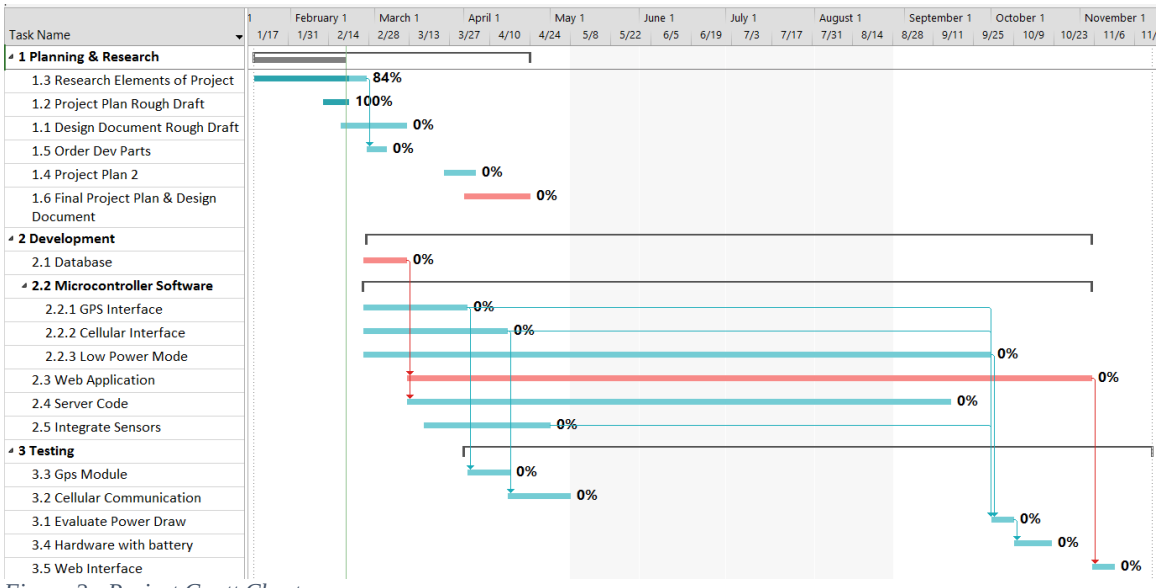

Figure 2 - Project Gantt Chart

6.1 First Semester

For the first semester, we plan to finish research, order parts, and develop a potential prototype of our tracker that can receive GPS coordinates and communicate then over the cell network to a database. We also plan on having the web app working to a point where we can confirm proper data was received. We will be concluding this semester by creating a final version of a design document for our tracking FOB.

Tyler Dahle and Tristan Walters - database and web application

Brandon Trent - Cellular communication

David Dalo - Power usage and overall component integration and microcontroller

Alex Sundholm - Database setup and maintenance, and microcontroller

David Carlson - GPS module integration

6.2 Second Semester

The second semester will largely focus on testing and finalizing our web application. We will ensure the web application displays location of the device on a Google map and contains the interface we desire toward the beginning of the semester. We will then focus largely on testing our device and make database and web application tweaks as needed.

7 Conclusions

In conclusion, our project plan discusses how our team plans to meet our goal of developing a miniature tracking fob. The goals we desire to meet are creating a device small enough to be somewhat inconspicuous when attached to a road sign while having it receive GPS location data that it will send over the cell network to a database where it will be used to mark its location on a map for the user to find any signs that may go missing from a job site. Our method, we believe, will be not only the most cost effective method, but also consume the least power to allow the battery to last as long as possible to keep our customer from having to recharge them too frequently.

8 References

[1] Brickhouse Security (2016). Home Page [Online]. Available: http://www.brickhousesecurity.com/category/gps+tracking/vehicle+tracking+devices.do

[2] Dewalt Mobilelock (2013). Home Page [Online]. Available: http://www.dewaltmobilelock.com/home

[3] Pod Trackers ANZ Pty Ltd. (2016). Home Page [Online]. Available: https://www.podtrackers.com/

[4] Whistle Labs, Inc. (2011-2016). Home Page [Online]. Available: http://www.pettracker.com/