Initial Project and Group Identification Document

Senior Design I
Group C
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1 Project Overview

1.1 Project Descriptive Title

Luggage Link: a luggage tracking system which utilizes global positioning satellite (GPS) technology to provide real-time locating and tracking of luggage.

1.2 Group Members

- David Farrell
- Evan Husk
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1.3 Sponsors or Significant Contributors

At the time of the writing of this document, no sponsors or significant contributors have been identified. A project briefing is currently being developed to present to potential sponsors.

2 Project Narrative Description

2.1 Statement of Motivation

According to statistics, 1 out of every 150 airline passengers has their luggage misdirected or left behind. Not being able to fully rely on companies to process and handle luggage has become a significant problem, as well as a major inconvenience, for travelers. The motivation for this project is to help solve the problem of lost luggage and set those who use the system at ease by providing a simple, reliable way for travelers to locate and track their luggage at anytime, anywhere in the world.

2.2 Goals and Objectives

2.2.1 Top Level Goals and Objectives

The Luggage Tracker Unit (LTU) should be able to support the tracking of multiple pieces of luggage reliably, at any time and location. At certain time intervals, status updates and notifications will be sent via text message and/or email. These notifications will contain the information necessary to properly identify the location and current status of the item. This information will include the current coordinates of the item, its velocity, and any other relevant information, so the user can easily identify the location of their luggage.

With the help of the cellular network and WiFi provided in most airports, a secure, reliable connection can be maintained so that the correct coordinates will be received in a timely manner. That is, the user will not be receiving invalid coordinates and information based on the item's previous locations. Also, the coordinates will provide a sufficient degree of accuracy so the article's position can be identified even when inside of the airport.

An extremely important feature that is absolutely necessary to provide a reliable system is a robust power supply that can support the basic functionality of the LTU for an extensive period of time. The LTU must be able to maintain its functionality for a number of days to allow any lost or misplaced luggage to be located and retrieved.

2.2.2 Hardware Goals and Objectives

From a hardware perspective, a highly portable, affordable, and reliable LTU must be designed which provides an accurate position, current velocity, and can send Short Message Service (SMS) text messages, as well as emails, to the specified user(s). In order to properly design an efficient and accurate unit, many hardware sub-goals must be met.

Since the small size of the unit is a vital concern, an important hardware design sub-goal is to ensure that all components be placed in the housing in a compact, orderly manner to minimize the overall dimensions of the unit. Another sub-goal is finding and integrating a reliable, yet, somewhat inexpensive GPS module which can be easily integrated into the relatively small, portable encasement. In order to successfully send SMS text messages and emails, a Global System for Mobile Communications (GSM) module and a WiFi module must be incorporated in the hardware design. Again, these units should be small and affordable so they can easily integrate into the compact design.

Another important hardware sub-goal is to find and incorporate a power source that can support the multiple modules in the system. It is imperative that the battery is reliable and able to work for extended periods of time in between charges. With the accomplishment of each hardware sub-goal, the main hardware objective will inevitably fall into place.

2.2.3 Software Goals and Objectives

In order to develop a system which supports the functionality discussed in the previous sections, software components must be integrated. The most important piece of software will be the on-chip software, or firmware. The on-chip software must allow all of the components and modules on the chip to exchange information in an efficient manner. It will also direct the functionality of each of the components (sending SMS text messages, emails, etc.). A logging mechanism will also be set in place so times and coordinates can be stored if a text or email notification cannot be sent at that moment. In order for the user to control the basic settings and sending of information, an Apple Operating System (iOS) App, Desktop Software, and a Java Applet will be developed. It should be noted that a security feature will be implemented in each of these software packages to ensure the position(s) of the user's item(s) remain confidential.

The iOS App will allow for a portable and user friendly way of interacting with the LTU. Within the app, the user will be able to view and select various preferences. These preferences will allow the user to change the rate at which he/she receives notifications concerning their luggage, information on the WiFi networks currently available based on their item's position, etc.

The personal computer (PC) software will allow the user to plug in the LTU using a Universal Serial Bus (USB) cable. Once connected the user can view the logs made by any unsuccessful transmissions of notifications as well as edit and update user settings. The PC software will allow the user to update the firmware. The Java Applet will work much in the same way as the other software systems will. However, the Java Applet will be accessible from anywhere, through any system since it will be available on the Internet.

2.3 Project Function

The Luggage Link system will allow users to implant a small, lightweight LTU and easily track their luggage through multiple user-friendly software interfaces. The LTU will utilize GPS technology to provide real-time locating and tracking of the user's item(s). The design of the actual LTU will be a highly portable, lightweight device that can be easily placed within any item the user would like to track. It will utilize GSM and WiFi to send notifications at regular time intervals to keep the user updated on the location of their luggage.

There will also be three software interfaces that will allow the user to interact with each LTU. An iOS App will allow the user to track their item(s) from any location via their iOS supporting device. A Java Applet will allow the user to track their item(s) in much the same way as the iOS App except the user can access the Java Applet through any device that is connected to the internet. While the desktop software will also provide notifications and information concerning the item(s) being tracked, it will be used more extensively for maintaining the LTU.

3 Specifications and Requirements

3.1 Hardware

3.1.1 GPS Communication

The LTU shall contain a GPS module to provide real-time position tracking. The GPS shall provide position information accurate to within +/- 15 meters. The GPS shall provide velocity information accurate to within +/- 0.2 meters per second.

3.1.2 Cellular Communication

The LTU shall contain a GSM module. Based on settings determined by the user, the GSM module shall transmit SMS text message and email alerts with GPS coordinates and other pertinent information.

3.1.3 WiFi Communication

The LTU shall contain a WiFi module as a last-resort communication source. If the GSM module is not obtaining reception, the WiFi module will turn on and search for any available wireless networks. If a valid wireless network is found, all necessary data will be transmitted via the WiFi module until a GSM connection is re-established.

3.1.4 Indicators

The LTU shall contain two externally viewable Light Emitting Diodes (LEDs), one to indicate power and one to indicate GPS signal reception. The power indicator LED shall be turned on when the LTU is powered on and remain on until the LTU is powered off. The signal indicator LED shall turn on and flash at 2-second intervals when the LTU has established a GPS connection. The signal indicator LED shall remain in this state until the connection is broken or until the LTU is powered off.

3.1.5 Power

The LTU shall contain a rechargeable battery capable of powering the system for a minimum of 48 hours without recharging. A power adapter for the LTU shall be implemented in order to recharge the battery.

3.1.6 User Controls

The LTU shall include an external 2-position switch which turns the device on and off. The switch should be resistant to movement from incidental contact, but easy for the user to switch on and off intentionally.

3.1.7 Enclosure

A two-piece enclosure shall be utilized to house the LTU. The enclosure shall contain apertures for the Mini-USB port, power switch, and LED indicators. The maximum dimensions of the enclosure shall be 4” × 4” × 1”. The enclosure must have a durable, robust design, yet be easy to open for access to internal components.

3.1.8 I/O Port

The LTU shall have a Mini-USB port which provides a serial data interface between an LTU and personal computer. This port will allow the LTU to be updated with any new user settings or firmware updates, and will allow the battery to be recharged.

3.1.9 I/O Cable

A USB to Mini-USB cable shall be included with each LTU. This cable shall be used to both sync and charge the LTU. The USB end will connect to a computer with the PC software installed on it, and the Mini-USB end will connect to the LTU.

3.2 Software

3.2.1 Smart Phone Application

A smart phone application for iOS platforms shall be developed. The application shall have the following features:

- Login screen for secure use
- Map feature that displays the current location of all LTUs registered to the user
- Alert center with customizable settings for text message and email alerts

3.2.2 PC software

A software program shall be developed for use on a PC. This software package will be the core of this project’s software suite. The PC software shall provide a “synchronize” feature which updates the LTU with the user’s desired settings for that unit.

3.2.3 Java Applet

A java applet shall be created at which a user can log in and view the current location of any or all of their LTUs. This feature is primarily for users who do not own an Apple iPhone or iPod and do not have access to a computer with the PC software. A Java applet will be developed and used as the core of the website.

3.2.4 Firmware

3.2.4.1 Data Logger

A data logger shall be implemented on the printed circuit board (PCB) to store events and other usage data. Because a wireless connection, whether it be GSM or WiFi, cannot be guaranteed, it is necessary to store the events occurring within the LTU for later retrieval and analysis. Potential events are loss of GSM signal, loss of GPS link, beginning of sleep mode, beginning of active mode, attempt to send SMS message, attempt to send email message, attempt to connect via WiFi. The information stored in the data logger shall be accessible for download via the Mini-USB port.

3.2.4.2 Power Control

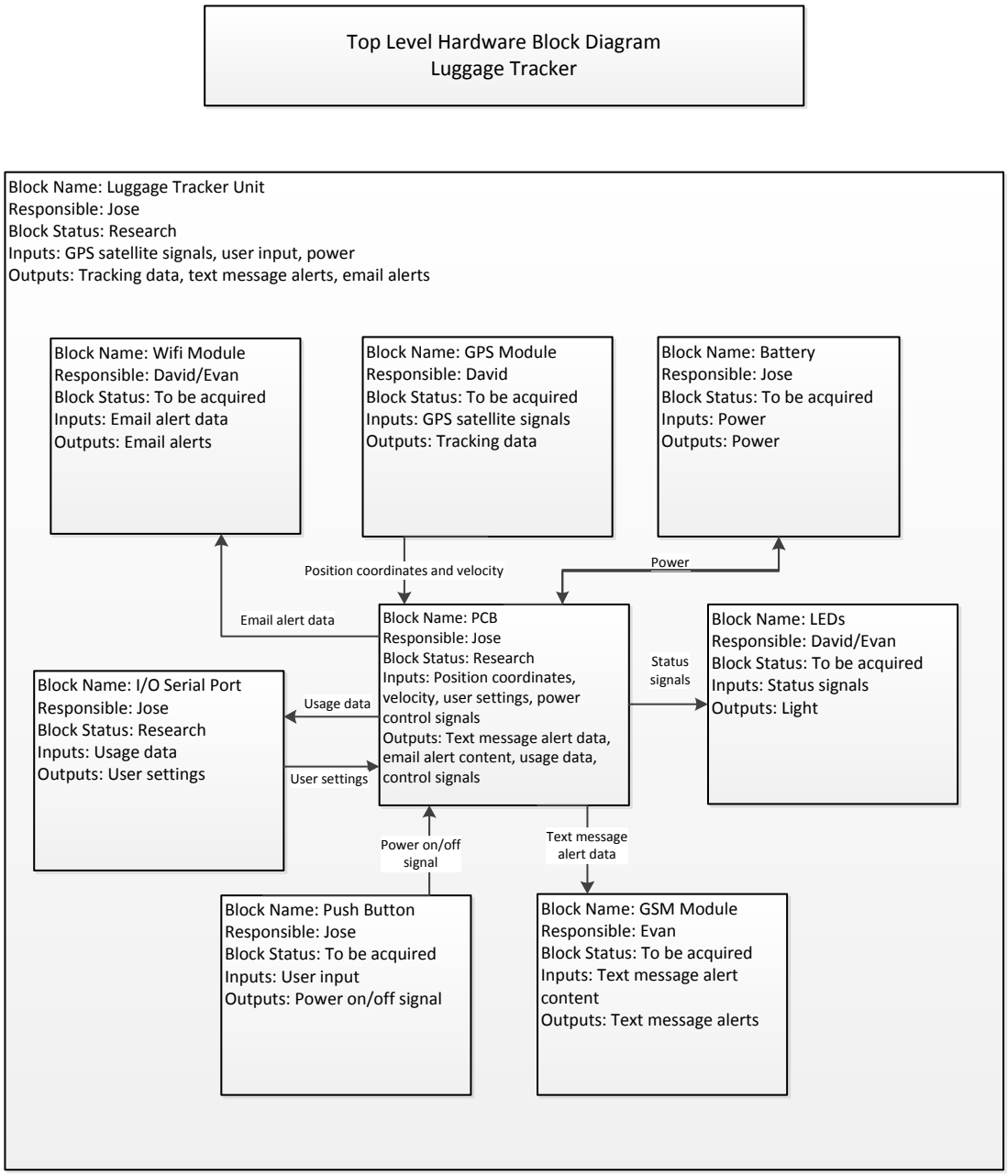
A power control program shall be developed to regulate the power being supplied by the battery, as well as the power being received through the Mini-USB port to recharge the battery. Algorithms will be developed to minimize power consumption.

3.2.4.3 Alert Control

Alert control software shall be developed to determine what alerts are sent to the user and when they are sent. This software will monitor the incoming GPS data and compare the LTU's location with its intended destination. If conditions are met that qualify an alert to be sent, the appropriate data will be gathered and sent the GSM or WiFi module for transmittal.

4 Block Diagrams

4.1 Hardware Block Diagram

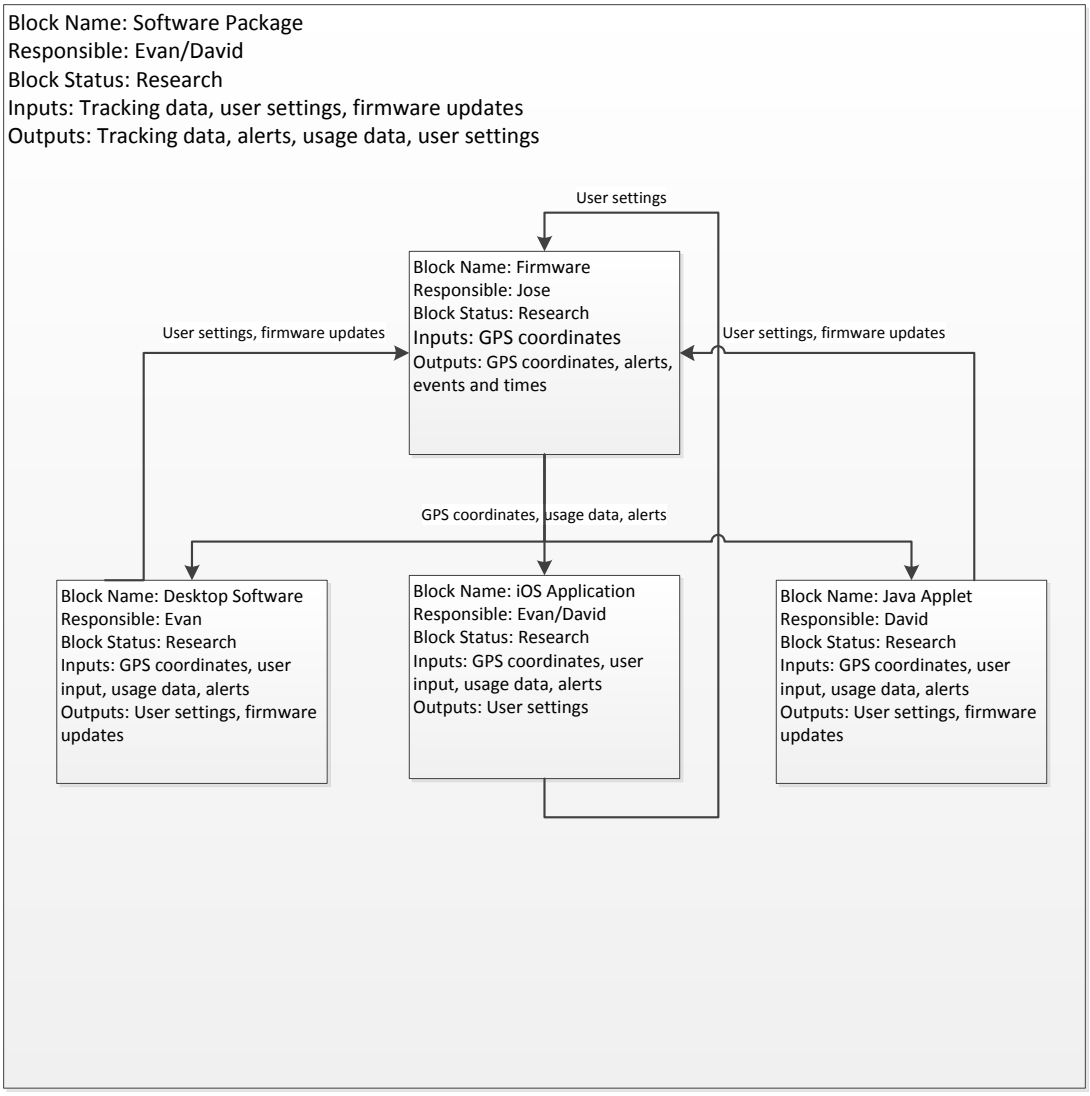


Legend

GPS – Global Positioning System
GSM – Global System for Mobile Communications
LED – Light Emitting Diode
PCB – Printed Circuit Board

4.2 Software Block Diagram

Top Level Software Block Diagram
Luggage Tracker



Legend

GPS – Global Positioning System
iOS – (Apple) Operating System

5 Budget and Financing

As mentioned previously, at the time of the writing of this document, no sponsors or significant contributors have been identified. A project briefing is currently being developed to present to potential sponsors. If no sponsors or donors are found, the cost of the project will be divided evenly amongst the team members.

The estimated budget for this project is shown in the table below:

Part	Cost	Quantity	Total Cost
GPS Receiver	75.00	2	150.00
GSM module	75.00	2	150.00
Wifi module	60.00	2	120.00
USB cable	5.00	2	10.00
Battery	30.00	2	60.00
PCB	40.00	2	80.00
iOS Developer Membership	100.00	2	200.00
Miscellaneous/Unexpected expenses	50.00	N/A	50.00
Total			**$820.00**

6 Project Milestones

The following are key milestones that should be met in order to keep the project moving ahead at a desirable pace.

Date	Milestone
02/24/12	GPS module selected
02/24/12	GSM module selected
02/24/12	WiFi module selected
03/02/12	Battery pack selected
03/02/12	PCB design begun
03/05/12	Desktop software development begun
03/05/12	iOS app development begun
03/09/12	Java applet development begun
03/17/12	PCB ordered
04/20/12	PCB testing begun
05/18/12	LTU prototype #1 assembled and testing begun
07/20/12	LTU prototype #2 assembled and testing begun

7 Acronyms

GPS	Global Positioning System
GSM	Global System for Mobile Communications
iOS	(Apple) Operating System
LED	Light Emitting Diode
LTU	Luggage Tracker Unit
PC	Personal Computer
PCB	Printed Circuit Board
SMS	Short Message Service
USB	Universal Serial Bus