Smart GPS System

Group B

Group Members

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Project Introduction

We chose this project because we wanted to work on something that could be used in real-world applications, especially if it could potentially help someone else. As engineers-to-be, our goal is to solve problems and improve upon existing technology while challenging us to think outside the box. This project appeals to us because it encompasses several areas of Electrical and Computer Engineering that interest each of us and that we want to learn more about. It will include topics such as communications theory, microcontroller implementation, digital signal processing, and a fair amount of coding; all of which are areas that we have learned about in class but have not used in real applications, especially not together in one single project.

The Smart GPS System would be ideal for parents with small children, families of relatives that suffer from mental illnesses, such as Alzheimer's disease, and cannot be left unsupervised; day cares that need to keep track of the children under their care, or hospitals with mental illness patients.

Goals and Objectives

Our idea is to build a light weight and easy to use wireless GPS tracking system with low power consumption and improved accuracy through the use of DGPS. This system could be used as an added safety measure to prevent certain individuals from wandering off and possibly getting lost when left unsupervised. It will include a tracking device embedded on a clothing item, such as a wristband or a watch, that can be worn by the individual. This device will be used to send warning signals and track the person in case they leave the perimeter of a specific stationary area, also known as a geofence.

The way this will work is by having the device send a signal to a base station alerting it that it has left the area. In turn, this base station will send alerts to a mobile phone with several choices on how to proceed. One of these choices will be to start tracking the device, in which case the base station will signal the device for its location. The tracking device worn by the individual will start sending its GPS coordinates to the base station where they will be corrected using DGPS to improve its accuracy. This improved location will then be sent to the mobile phone for tracking purposes.

Specifications

Differential GPS (DGPS) Receiver

- A DGPS beacon receiver will be set up at the base station to receive pseudo range corrections from closest land station
- GPS location should be improved to within 2 meters using DGPS

Base Station

- A stationary computer/laptop will be used as the base station
- It will maintain two way communication with the tracking device, sending and receiving signals to perform actions.
  - Receive signal if device has gone outside the geofence
  - Send a signal to turn on GPS tracking
  - Receive GPS data from device
- It will maintain two way communication with mobile phone
  - Send alert if tracking device goes outside the geofence
  - Wait for response and act appropriately
  - Send GPS coordinates
- Request and receive DGPS data
- Perform calculations on GPS data integrating DGPS corrections

GPS Device

- Transmit location wirelessly to base station from a maximum distance of at least 1 kilometer
- Indoor tracking using sensor communication via Bluetooth/RFID
- Device will use a GPS chipset to receive GPS signals from satellites
- It will use a microcontroller to monitor power consumption and to act as intermediary between the GPS chip and the transmitter.

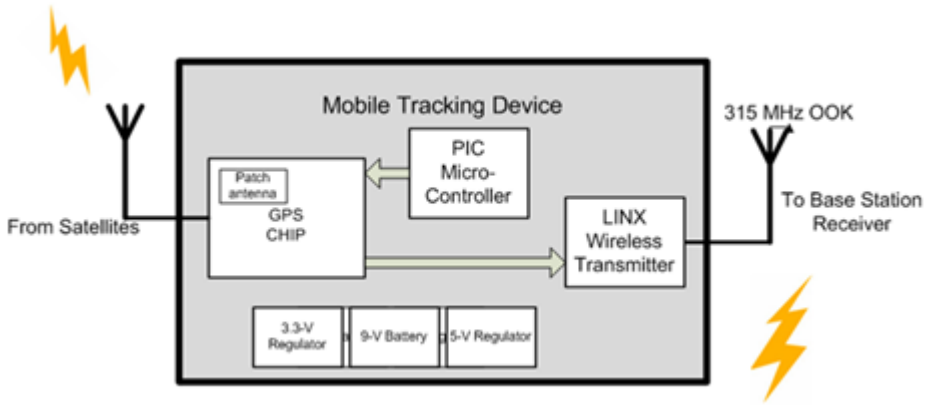
Geofence Implementation

- Set up a fixed perimeter around a point with a radius of ~15 meters
- Radio frequency technology used to monitor tracking device within this area
- The area will be mostly indoors

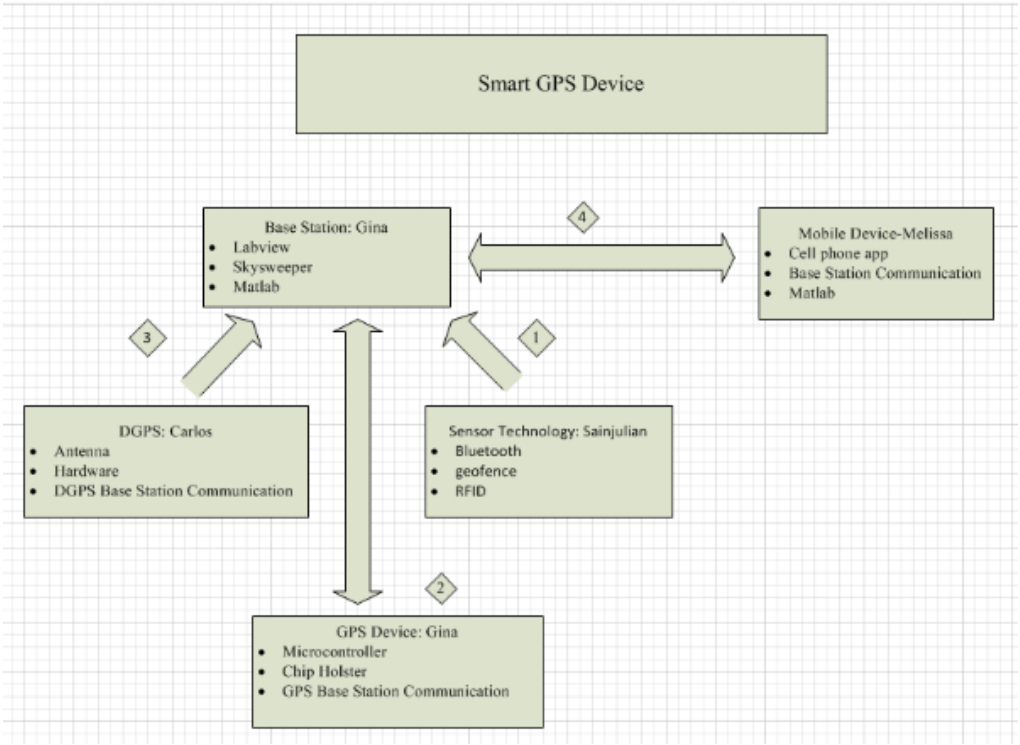
Computer to Cell Phone Communication

- Client-Server Application - computer will be the server, mobile phone will be the client
- GUI Interface on the client's side
- Push capability - when a message comes through to the phone, it will wake up the application. Thus, the application does not need to be running
- Ability to send alerts to mobile device and for device to respond to the alerts
- Use of TCP/IP for communication for increased mobility - mobile phone does not need to be in the same area as the computer

Block Diagrams



Block 1: Mobile Tracking Device



Block Diagram 2: Conceptual Overview

Project Milestones

- January - March: Research
- April - August: Design
- September: Buy materials
- October: Build prototype
- November: Test
- December: Present

Project Budget and Financing

- Personally financed by group.

Materials

Tentative Budget

Components	Amount	Unit Cost	Total Cost
RFID	3	$40	$120
Chip Holster	1	$10	$10
DSPG Chip	1	$60	$60
Circuit components	25	N/A	$5
Estimated Grand Total			$195

Software

In order to create a tracking device that contains all the features and capabilities envisioned, a number of software interfaces must be employed. Matlab will be used to analyze the numerical data obtained from the GPS and DGPS. Furthermore it will be the platform in which the GPS information will be converted and combined to determine the location of the tracking device. Matlab will also be used to transmit information both to and from the mobile device and base station.

Labview will be used to sample the signal generated by the GPS and DGPS and to convert the information into a sound wave which will be analyzed by Skysweeper.

Skysweeper is a signal analyzer and decoding program that will be able to manipulate the data produced by Labview.

Hardware

The device used to track the person in question will consist of a chip on which a microcontroller and a sensor (used to determine if the person leaves the perimeter of the geofenced area) will be embedded onto a wrist band. This device will also include a GPS chipset, power device (battery), and the wireless transmitter to transmit data to the base station.