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Departamento de Electrónica, Sistemas e Informática

Especialidad en Sistemas Embebidos

Kid Tracker Prototype

TRABAJO RECEPCIONAL que para obtener el **GRADO** de
ESPECIALISTA EN SISTEMAS EMBEBIDOS

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Abstract

This document describes the implementation of the prototype of kid tracker that was made as part of a specialization program at ITESO. This device is meant to be a platform for more features to build upon. The goal of this tracker device is to send periodic updates of the whereabouts of the person using the device. To accomplish this goal the device uses multiple technologies included but limited to GPS, GLONASS, SMS, GPRS and GSM.

1 Introduction

An Embedded System is a group of components that are programmed to execute a specific function. We find embedded devices in a wide range of industries. For example, automotive, industrial and healthcare. Figure 1 shows an example.

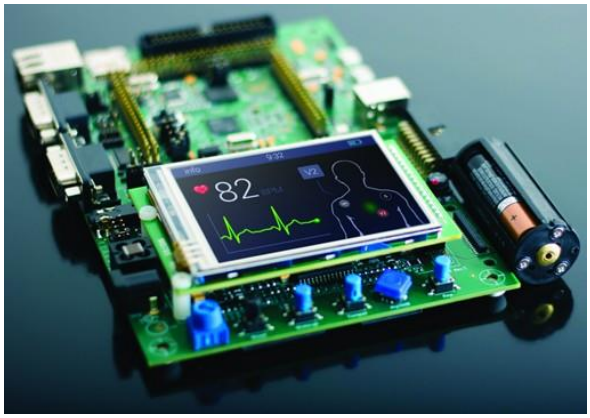

Figure 1: An Embedded System.

The Global Positioning System (GPS) is a system created by the US government to provide location information to devices listening to the GPS frequencies. In the beginning it was mainly used by the US military but them they opened it up so it could be used commercially worldwide which enabled limitless possibilities of the type of applications that we could create that used location information as its core function. we can see an example of how GPS works in Figure 2.

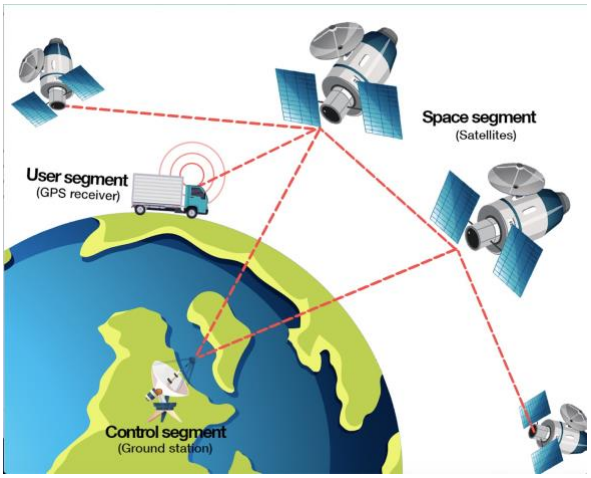

Figure 2: Global Positioning System.

2 Arquitecture

The tracker that was implemented tracks the children's location in real time. Periodic location updates are sent to a server which saves the information into a database for further processing. The parent has an application which can show the current location of the child. The application connect to the server via a http request to query for the information. The server in turn processes the request and sends back the most up to date information received from the tracker.

Figure 3 shows how the mobile application that was developed for this project communicates with

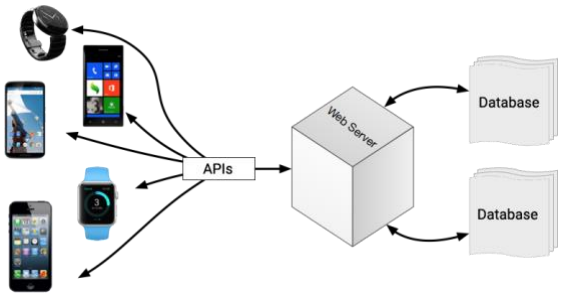

Figure 3: APP and server communication.

the server. The server is currently running on the cloud which is the best option for having a reliable system. The server provides an API(Application programming interface) for the mobile application to consume. This API provides multiple endpoints for consuming the location information and also for receiving the location information. A health endpoint is also implemented which lets us see the current state of the server. The health endpoint is very important because we can setup alerts in case the server is not working correctly it can let us know and not compromise the behavior of the system.

Figure 4: APP and server comunication.

The mobile application has security integrated into it. when the parent first uses the application a login screen will appear the parent has to input their credentials to be able to login into the application and see the information for their kid. Once the parents successfully authenticate themselves they can proceed to the main screen. The main screen shows a map where they can see the location of their children in real-time.

The main screen also has two buttons which are AUTO and QUERY. The Auto button serves the purpose of automatically moving the map to the center of where the children is. This is useful in case the parent moves the map to another point and is not able to go back to where the children's location was the AUTO function centers the map automatically. The QUERY button serves to manually query the location data from the server. This is useful in case the parent wants to see the exact coordinates of the children. Figure 4 shows an example of the mobile application

The embedded system consists of the freedom board KL25Z. The KL25Z was chosen for multiple reasons. The KL25Z features a high performance ARM Cortex M0 Core that runs at 48MHz which is fast enough for our needs. It features multiple UART modules which are needed for communicating with the GSM module. it features 128KB of flash memory which can store our code without a problem. it also features 16KB of RAM. Along all the hardware reasons for choosing this board is that the company that makes the board provides extensive support. For example, it provides source code for multiple projects on samples on how to use the peripherals.

Figure 5: K25LZ.

The tracker device also incorporates a SIM-808 shield which is used to get the GPS information and also send the request to the server so it can store the information. The K25LZ uses UART and AT commands to communicate with the shield. The K25LZ first sends a command to turn on the GPS unit. The GPS unit can be turned on and off with a simple command this is to save energy when the device is not in use.

3 Results

As for the results I observed the location updates were accurate within a certain radius. Most of the location updates are within 15 meters of the real location, Figure 6 shows an example. I also observed problems in getting a location fix in building that had a lot of concrete and metal, but that is to be expected as GPS has a lot of flaws when working inside of a building. An alternative to GPS exists but its costs are higher and not available worldwide. This device is intended to grow over time and for that we need GPS as a positioning mechanism. The are other positing mechanisms that we can use for example GLONASS from and Galileo from the UK but for the scope of this project I decided to keep it simple and just implement one system of positioning.

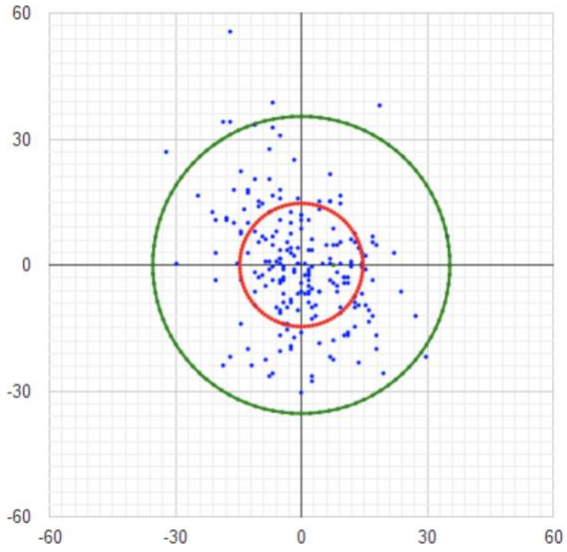

Figure 6: GPS Margin of error.

4 Conclusions

Overall the device implemented could extend to multiple uses not just as a children tracker. Tracking is really useful when applied correctly to multiple fields and industries. I would like to see this project expand and be used in animals also.

Acknowledgments

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