GPS-GSM-BASED COMMUTER RIDE SERVICE APPLICATION SYSTEM

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ABSTRACT

The primary goal of the study is to design and develop a Global Positioning System and Global Systems for Mobile Communications' Based Commuter Ride Service Application System which can be used to monitor the availability of the tricycle drivers within the vicinity of Hermosa to aid commuters going to their specific destinations. In order to develop this project properly, the Rapid Android Application Development Model was used. This technique allows determining the requirements to be included in the design so that the desired characteristics of the system can be tested. The project was designed using Global Positioning System combined with Global Systems for Mobile Communications. As a result, data signals were sent and saved in a central database server through a Short Message Service transceiver application. The results of the study revealed that in terms of functionality, 100% of the SMS location were detected and saved. Also, with regards to the plotting of the driver's locations all were completely displayed within the Ride Service Application of the commuter with an access point. Database server management system inquiries in SMS with 100 % reply and feedback accuracy. With the development of the latest Android applications, the study recommends to provide more information about the driver's activity including the pick and drop off locations that will be automatically recorded on the system, include landmarks where the passenger is situated, pin the location within the Google maps and use a dual SIM module socket type for the GSM in case of having dissimilar network operation of transmissions.

Keywords*: Global Positioning System (GPS), Global Systems for Mobile Communications (GSM), Android Application*

INTRODUCTION

The android operating systems have been a major name in terms of various applications and equipment worldwide. Nowadays, android operating systems have been developed globally like Android Auto for cars, Android wear for wrist watches, and Android TV for Televisions each with graphical user interface. Applications of android are also used on notebooks, game consoles, digital cameras, and other electronics such as mobile phone [1].

In addition, Android applications have already been developed as a means for some type of business specifically for tracking purposes. The Android has played an important role in communicating with other devices and with other people by means of wireless technology. Wireless communications devices have been adapted to connect people in different locations.

One application of this technology is the Android Application for Vehicle Theft Prevention and Tracking System [2]. Because of a need for an enhanced property measures, new ways were developed to prevent car theft. A tracking system aims at finding location of a vehicle using different techniques like coordinated operations by electronic communications.

Background of the Project

People in the municipality of Hermosa today often experienced difficulty in commuting from their house to their working destinations, most especially when they have night-shift duties. Oftentimes, they find it hard to get a ride during heavy rains and harsh sunlight, thus making them wait for more time than usual.

A need for safer and faster access to transportation is seriously needed. A platform that can provide a ride for a

commuter in the company will help them ease their daily transportation uses. Equipped with GPS and GSM modules, the real-time location of the driver can be monitored by the passenger if the former is available.

The Industry Immersion Program

The study had undergone for an industry immersion program at the Integrated Meat and Poultry Processing Inc. (IMPPI), located at Brgy. Sumalo, Hermosa, Bataan. IMPPI is a chicken processing plant providing more than 500 jobs to the municipality of Hermosa as of year 2015. It outsources some of its supplies from other localities in Bataan.

The immersion program was a 480-hour exposure inside the company and its operations are focused mainly from chicken meat processing and packaging areas under the supervision of an industry adviser. Inconvenience of the workers were observed in their daily transportation due to the non-availability of a shuttle service in the company. Accessibility and convenience are two of the most important factors that should be satisfied. A more organized transport management system would be beneficial in increasing the productivity and security of the workers in the company.

Special Project Brief

The study was tried to conceptualize a solution to the problem that was identified inside the company. The commuters cannot easily track down a ride every time they leave the company premises, especially in cases where bad weather condition is intermittent. In most cases, the commuters have to walk from the company to a faraway street and will wait for a long hour until a vehicle arrives to transport them. This results to a more tiring and hustle time for every commuter especially for the women riders.

The proposed GPS-GSM-Based Commuter Ride Service Application System will make every commuter time more productive by having a more punctual and convenient means of transportation. The driver can be tracked down by the commuter's Android phone with the aid of the device that is attached to the vehicle.

Theoretical Background

This chapter reviews the conceptual literature and related studies conducted on GPS tracking systems and android applications, which provided valuable information on the development of the conceptual framework of this study and the design of the system and the prototype. All of the aforementioned portions shall be made to deliver all the processes relating in this project regarding any dissimilar technical terms involved, should there be any.

Review of Conceptual Literature

Global Systems for Mobile Communications (GSM)

GSM MODEM is a class of wireless device that is designed for communication between a computer and a GSM network. It has a standard communication interfaces like RS-232 serial port to interface it easily with a microprocessor and microcontroller. The circuit board for power source is built in a hardware by means of an adapter that needs a module card just like mobile phones to activate communications with a link network [3].

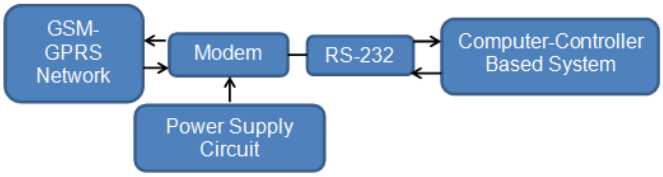

Figure 1. Block Diagram of GSM Module

GSM MODEM Operations

The first function of a GSM is to receive, transmit and delete messages in a Subscriber's Identity Module [4]. Short messages Service can be viewed, modified and added as a data entry to the GSM. Using this Modem can also search phonebook entries of the SIM. The maximum data allocation for its operation is assigned for making and receiving a voice call.

The hardware requests commands to interact with the operations which are linked through serial codes. These commands are commonly received by the processor to interrelate with the GSM network [5].

GSM Module Interface

A GSM Module is a hardware that is associated to a board with diverse types of output occupied from RS232 to line directly with a computer. The platform will also have pins to assign a microphone and speaker, to yield out +5V or other pin assignments and pin addresses [6].

Global Positioning System (GPS)

The Global Positioning System (GPS) is a type of navigation system completed up of a link of 24 satellites positioned into orbit by the U.S. Department of Defense. A device which was originally projected for military applications and later made available for civilian use. This hardware works normally in

varying weather conditions from different parts of the globe anytime [7].

GPS Operation

The receiver routine a constellation of satellites and ground stations to calculate time triangulation position from different parts of the world. The location of the satellites is made in a way that the sky over the location will always cover at most twelve satellites. The main solution of the twelve visible satellites is to convey information back to earth over a communication link frequency. With this operations and calculations, a device can provide its position and time [8].

The GPS Receiver

A downlink data signal contains a few different pieces of information that allows the GPS receiver to accurately calculate its position and time. An extremely accurate atomic clock is an important piece of equipment on each GPS satellite. From this information found on the time in the clock, the GPS receiver now determines the distance to each four-orbiting satellite in view which is known as the lock or fix calculated position and time of an object [9].

Ground Base Stations

Along with receivers, there are earth-built stations that can connect with the satellite network and some GPS. This system is the control segment and surges the accuracy of the GPS receiver. Differential GPS needs a specific type of receiver and gets centimeter accuracy. DGPS units are also exclusive and incline to be higher because they need an additional antenna [10].

GPS Accuracy

GPS Accuracy rest on on a signal to noise ratio, position, obstructions and weather such as terrains and buildings. These aspects can make errors in perceived coordinates. Signal noise usually generates an error from about one to ten meters. A GPS receiver must be able to fetch a lock on four satellites to be able to crack for a position [11].

Assisted GPS (AGPS)

This method uses wireless links to communicate between the satellite and the receiver when the GPS signal is not enough to be received. There are two ways AGPS can solve the error, the first is by giving the receiver sufficient data and by using a higher adding power and decent satellite signal of the earth base to read the cracked information the receiver is made of give enhanced reading [12].

AGPS is commonly operated by GPS receivers on cellular towers [13]. When transmitting with these receivers, the GPS can obtain a lock on the satellite faster as well as receive more accurate information. This method is used for GPS in mobile phones and why they're sometimes better than the GPS receivers. ADPS is now commonly built in all mobile devices. It's most useful in areas of obstruction where building where taking place of signal transmission.

DGPS uses earth fixed stations to control the position, but it finds the change between both the satellite and the ground location analysis [14]. It is significant to note that accuracy declines the further the setting from the ground post. DGPS is accomplished by a ground station propagating a signal which orders the error between the actual pseudo range and the measured pseudo range. This value is intended by the product of both speed of light and the time it takes the signal to foldaway from the satellite to the receiver.

DGPS was industrialized by the FAA to support aircraft GPS, WAAS routines a system of specifically built earth stations. WAAS holds a specific set of accuracy standards that ground station sizes must see. Laterally and vertically, WAAS must be accurate to within 7.6 meters 95% of the time. These ground stations send their measurements to leading stations which send the improvements to WAAS satellites every 5 seconds or earlier [15].

METHODOLOGY

The research methodology used in this study was based on the references from consultations, books, journals, internet resources, and projects previously completed. It also covers the instruments, devices and experiment procedure used in performing the testing and evaluation

General Method Used

The researcher conceptualized the project by using the Rapid Android Application Development RAAD model as a guide in the development of the proposed system. The following are the processes that were followed;

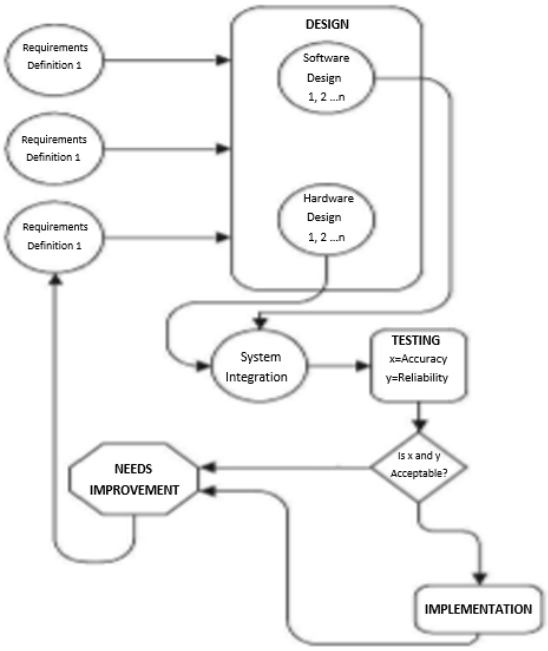

Figure 2. Rapid Android Application Development

Requirement Definition

In the initial development of the study, a simplification of the over-all process between a commuter and a driver was considered. To get the relevant information, the Hermosa TODA drivers association was asked about the existing transportation system within the Barangay unit regarding the process of commuting and the fare charges. The gathered data for the proposed system were recorded to expand the process flow of the system.

System Design

This part comprises the composition of the structures to build the hardware and the software. It will serve as a complete guide for the visual analysis and interaction of the system design across the devices and platforms. It was built for the sake of the employees in the Integrated Meat and Poultry Processing Inc. The user interface provided a list of available drivers that can be selected by the commuter.

In order to properly develop this project, the Rapid Android Application development was used. This technique allows determining the requirements to be included in the design so that the desired characteristics of the system can be tested. It also provided the factors to identify the necessary improvements in the design and functionality of the system as recommended by the end user.

Hardware Design

The representation of a block for each module to the entire set up linked to represent the connections between all the components used. The schematic diagrams shows the interdependencies and interconnectedness of the electronic components used.

A series of testing were done on the GPS receiver to stabilize the performance of the system. Two hardware modules were used to the platform for their compatibility testing and performance. The components were carefully evaluated by noting its inaccuracy and power, trace what is needed and to be removed. Then the evaluations were measured using Computer Aided Design and other software analysis tools like DIP TRACE, EAGLE and PROTEUS. In this period, the components, process orders and inputs data were settled with the system.

Software Design

The software used in the system is the open-source Arduino software. The source code for the Java environment is released under the C/C++ microcontroller libraries. The board is equipped with sets of digital and analog input and output pins that is interfaced to the expansion board or the module. The boards feature serial communications interfaces which include the Universal Serial Bus used for loading the program.

Testing of the software subroutines such as the link and the internet processes over the World Wide Web had experienced in depth testing and assessment measures which are led to attest the condition of the system. Debugging is the most significant stage on testing the source codes which can check the functionality of the program used and assure that it is cooperating properly when integrated into all the platforms.

System Integration and Testing

The project was designed using Global Positioning System combined with Global Systems for Mobile Communications. As a result, data signals are sent and saved in a central database server through a Short Message Service transceiver application.

In testing the functionality of the system, numerous units of testing were done to test for the reliability and accuracy of the system. This process also includes system compatibilities for hardware modules embedded with software drivers. Upon the installation and activation of devices, the network functionality was configured along with the database server and the Android devices. Integrating the hardware and the software of the system is the most important key factor to identify the errors in the project.

Project Technical Feasibility

The GPS-GSM-Based Commuter Ride Service Application System focuses on monitoring the driver's availability within the area that has an access point. It uses GPS+GSM modules to scan the locations of the drivers that automatically update the data for every two minutes. Each vehicle has an installed module box that contains a GPS unit to track them one by one. The GPS box is a hardware module that converts the signal fetched by the GSM reader via SMS going to the database server.

The android application was developed using MIT Android App Inventor. The Ride service application is compatible with Android Version Marshmallow while the SMS Transceiver is compatible with any of the Android versions. It uses MySQL for its database server to store and handle the signal fetched by the GPS receivers. Access point is provided by a generic wireless router that uses the IEEE wireless standard 802.11n and has a radius range of 300 feet. This access point is also the medium to be used by the applications to transmit and receive locations of the vehicle to be forwarded to the commuter. The access point connects the android phone to the computer server.

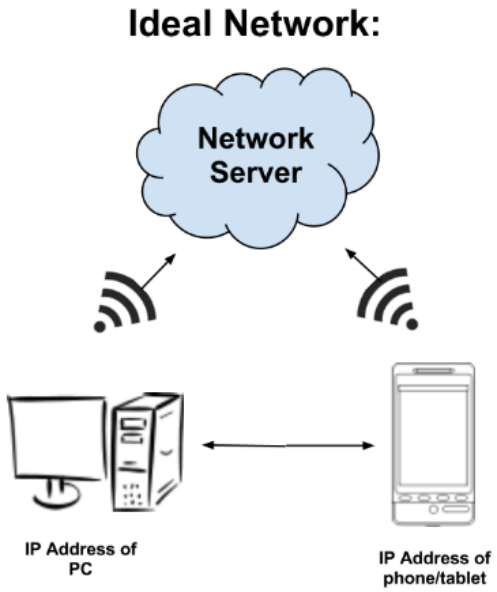

Figure 3. Wireless Connections of Devices

Figure 3 shows the connection of the devices access such as personal computers and mobile phones to the network server. The access point serves as the communications medium for the GPS data signals such as the latitude and longitude to be transmitted from the Web Server application going to the Android mobile phones. The transmission medium functions also as a bridge to connect the commuter to the driver for the confirmation of a ride. Each device contains its own unique Internet Protocol (IP) address to be connected with the network.

RESULTS AND DISCUSSION

Android is one of the preferred platforms for developing mobile applications [16]. It will help make a crucial decision regarding the architecture, design and also provide inputs on whether what framework to be used.

Testing

The application was installed into the Android version 6.0 Marshmallow and met the software and hardware requirement in a complete network set-up configuration using the GPS receivers and GSM transmitter attached into the vehicle. Hardware and network connectivity speeds also vary based on the user's location and the kind of connectivity from the internet.

In testing the GPS functionality and hardware key, a power button was used to provide an immediate activation of the hardware component while the antenna position was determined to be installed on the roof top of the vehicle.

Accuracy Test

Since most of the mobile applications rely on network connections, measuring the performance of mobile network is very important for the system functionality of the project. The response time measurements were measured in the tests that were administered on two same devices with each of them having ten samples while the accuracy is compared with an existing android phone with built-in GPS system. Moreover, the reliability was performed by having different network providers in communicating with the network and devices.

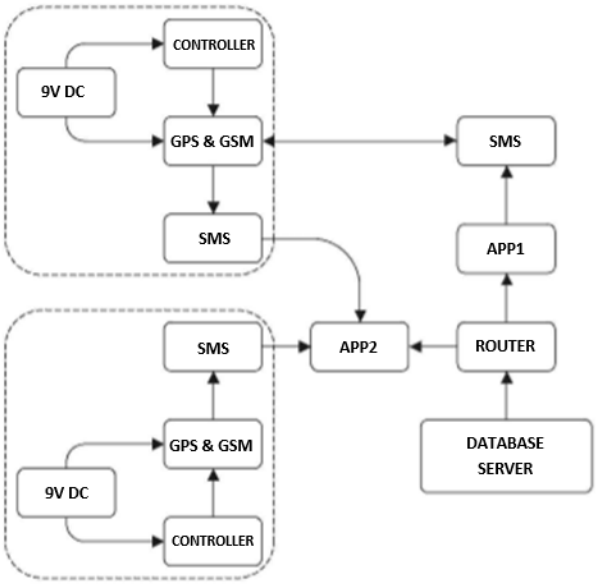

Figure 4. Project's Block Diagram

The GPS-GSM-Based Commuter Ride Service Application System is shown in Figure 4 which is composed of the following components namely; 9V DC battery, microcontrollers, GPS and GSM modules, Android Phone, SMS capable phone, pocket Wi-Fi for router, Database Server, SMS Transceiver and the Ride Service Application.

The GSM and GPS module wireless communication comprises the main framework of the design. The module box is attached within the vehicle that sends the coordinates via SMS. The Ride service application with a GPS and Wi-Fi active will be used by the commuter to locate a ride. The commuter's request will pass through the database server so as to scan the availability of the driver, and then a GSM module embedded within the microcontroller unit will be connected to the driver's GSM through the use of a SMS Transceiver application. The data will be saved and forwarded directly to the database via internet connection to be accessed by the system administrator for daily monitoring of travel and ride activities. Data that has been sent from the server will be received by the commuter through the use of the Ride Service application to view the driver's availability. After the request, a confirmation will be done by the driver through the use of SMS. All of the time and location logs within the last two minutes and within the nearby location scan will be recorded to the database. The database will be the one responsible for data handling for all the distance computations of the nearest drivers and will provide the driver's information about commuter such as his/her location and phone number.

Project Evaluation

Accuracy was tested based on the actual GPS coordinates plotted on the system versus the GPS plotted on a standard android phone device which is an AGPS based on WAAS. It is accurate if the GPS coordinates plotted is the same coordinates that was received in the android phone device. Table 1 shows the result of the Accuracy Test done on the system.

Table 1. Accuracy Test

No. of Trials	Box #	GPS device-Input	Phone-Actual Output	Remarks
1	GPS-1	14.83214,120.48886	14.83213,120.48884	Accurate
2	GPS-1	14.81516,120.48615	14.81513,120.48612	Accurate
3	GPS-1	14.82008,120.48452	14.82004,120.48451	Accurate
4	GPS-1	14.81738,120.48569	14.81733,120.48564	Accurate
5	GPS-1	14.78881,120.49136	14.78883,120.49133	Accurate
6	GPS-2	14.80421,120.48835	14.80424,120.48831	Accurate
7	GPS-2	14.80818,120.48756	14.80813,120.48753	Accurate
8	GPS-2	14.81262,120.48669	14.81264,120.48663	Accurate
9	GPS-2	14.82011,120.48455	14.82013,120.48454	Accurate
10	GPS-2	14.81399,120.48643	14.81398,120.48641	Accurate

The results showed that 10 out of 10 GPS coordinates received have accurate readings since the received data on the system is the same data the android phone displayed which is the existing device. The results showed that 100% of the data receptions for GPS coordinates were accurately detected.

CONCLUSION

The system was constructed using the GPS hardware module receiver naming Elecrow SIM808 and the gizDuino ATMega328 microcontroller that provides the direct connection for the network interface of the application.

The android app was developed using MIT App Inventor and the suitable database software is MYSQL. Viewing of drivers is available thru the app and SMS request to the GSM module. The system can determine the driver's current location. The APP can only be used if the user is within the access point. During the testing, 100% of current location was able to be viewed thru the application connected to the access point. Database server management system inquiries in SMS with 100 % reply and feedback accuracy.

The functionality of the system was tested and evaluated in terms of its response time for the two same devices which has an average response time of 0.60 and 0.80 seconds for ten trials which proved that the data transmission speed rate was accurate and reliable in comparison to the existing device. Its reliability is also determined with an average response time of 0.80 seconds for the transmission and reception of two same networks and 5.9 second maximum for dissimilar networks which proved that there is a faster data transmission speed rate for two similar networks of operation.

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