CHAPTER ONE

INTRODUCTION

1.1 Overview

The "Vehicle Tracking System using GPS and GSM Technology" project is designed and develop to accommodate the needs of today's vehicle fleet company to keep track on their fleets. It is a very useful and versatile device, and in fact, it can be used by anybody with the need to keep track on their valuable goods and not just by the vehicle fleets company. The desired output from the system will be the data such as position, speed, and time obtained from the GPS receiver and will displayed on the computer screen..

The tracking system is a total security and fleet management solution. It is the technology used to determine the location of things or Vehicles using different methods like GPS and other navigation system operating via satellite and ground based stations. Modern tracking system use GPS technology to monitor and locate our vehicle anywhere on earth, but sometimes-different types of automatic location technology is also used. The tracking system provides effective real time location and the data can even be stored and downloaded to a computer which can be used for analysis in future. This system is an essential device for tracking any time the owner wants to monitor it and today it is extremely popular among Vehicles, used as theft prevention and recovery of the lost Vehicles. The data collected can be viewed on electronic maps via internet and software.

The wide coverage of cellular and satellite network leads to various useful applications that increase the convenience of our daily life. One of such applications is vehicles tracking or positioning system. The real time location of a person can be

tracked by using the GPS (Global Positioning System) and GSM (Global System for Mobile communication) technology.

A vehicle tracking system consists of an electronic device installed on a vehicle so that it could be track by its owner or a third party for its position. Most of today's vehicle tracking system uses Global Positioning System (GPS) to get an accurate reading of the vehicle position. Communication components such as cellular (GSM) and satellite transmitter will be combined to transmit the vehicle's position to remote user. Vehicle's information can be viewed by using a software on a computer.

A Tracking System consists of an electronic device installed on an unconscious's Vehicles. The desired output from the system will be the data such as position and time obtained from the GPS receiver and will display on the smart phone. Communication components such as Cellular GSM and Satellite transmitter will be combined to transmit the person's position and information that can be viewed by using software on smart phone.

1.2 The Problem Statement

To provide the stolen or lost vehicles locations, GPS is the most important tool used for the tracking system .GPS Tracking system have a proven to be effective in determining the precise location . GPS tracking uses a system of satellites orbiting the earth to find an approximate placement. The main problem is the lack of information regarding vehicle location could result in a decrease of the monitoring process performance.

1.3 Research Objectives

The objective of this project is to design and develop a Vehicle Tracking System using GPS and GSM Technology. In order to fully understand both GPS and GSM

technology, the research and study on how both technology works is essential to complete the whole project. The objectives of this project are:

- Tracking vehicles on the motion for surveillance purposes.
- Get the specific location for a stolen vehicle.
- Show the vehicle location on Google maps.

1.4 Conceptual Methodology

The first phase of this project, is a dynamic micro-controller connected to a GPS module and a GSM module. After gathering the geo-location data from the GPS module, the data is sent through the GSM module to a Smartphone. The second phase of this project involves the software implementation of the system, which consist of a responsive Smartphone application running on top the Smartphone. This application processes the sensed geo-location data in real time, and displays it in an interactive map. Furthermore, the solution is aimed to provide location feature such as live tracking and tracing and alert radiuses.

1.5 Project Outline

This project consists of an abstract and five chapters. The first chapter focuses on the introduction that consist of problem statements, research objectives and conceptual methodology. Chapter two will review all of the related study regarding on this project. In Chapter three, illustration will be on the methodology in conducting this project, which includes the methods and techniques used. In Chapter three will also contain the design consideration will be discussed. In Chapter four, the results and the discussion will be executed. Finally, conclusion and future work are presented in chapter five.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

A tracking device is an electronic tag that can be used to monitor the location of an object or Vehicles by using the radio signal or satellite signal. The design of the tracking devices is depending on several factors such as the nature of the object being tracked, the information needed by the tracker and the budget of the tracker. The indoor location tracking is available with various technologies such as ultrasonic, mechanical, infrared, and inertial or radio signal measurement. The GPS is the most effective outdoor tracking system with high accuracy.

The tracking devices can be categorized into two groups, which are globally and locally. For local tracking system, it does not require the global coverage such as GPS. It operates based on the local technology such as Wi-Fi, Bluetooth and RFID. While for global positioning system, satellites have to be used in order to obtain the required information.

Besides that, the tracking system can also be divided into passive or active device. The active tracking devices will send out a constant signal continuously while the passive tracking system only will send out a signal when the user require the data.

Generally a tracking system is used for the observing of a persons or objects on the movement and supplying a timely ordered sequence of respective location data to a model ; capable to serve for depicting the motion on a smart phone application.

2.2 Related Works

Various technologies can be used to detect the location of an object based on the requirement of the user. The differences between these technologies include the cost needed, accuracy, availability, type of coverage and coverage area. An overview will be given on some previous works, which are related to tracking.

2.2.1 Application of GSM and GPS technology

The wide coverage of cellular and satellite network leads to various useful applications such as vehicle tracking system, agriculture monitoring system and Vehicles tracking system.

- Vehicle tracking system

  An integrated GPS-GSM embedded system had been used to track the current location of the vehicle by using Google Earth.[7] The GPS receiver (MediaTek MT3329), microcontroller and GSM modem (SIM 900D) were mounted in the vehicle. Figure 2.1 shows the architecture of this system. The GPS receiver was used to receive the signal of the satellite.

  The microcontroller was used to read the certain engine parameters and transmit desired data to the server through the GSM modem. The second modem, which is connected to the PC, will receive the SMS that includes the GPS coordinate and engine parameter. Visual Basic program was used to convert the received SMS text to numerical form then saved in a Microsoft Office Excel file. In order to show the location of the automobile and the engine parameters on the map, the Microsoft Office Excel file was converted to KML (Keyhole Markup Language) format and Google Earth will interpret the KML file. This objective of this system is to manage a fleet, police automobiles distribution and car theft cautions.

Besides that, Kurnal Maurya . [8] also constructed a real time vehicle tracking system by using the same technology. A real time vehicle tracking system using GSM and GPS technology as an anti-theft tracking system had been built for monitoring a moving vehicle continuously and report to the owner regarding the vehicle status.

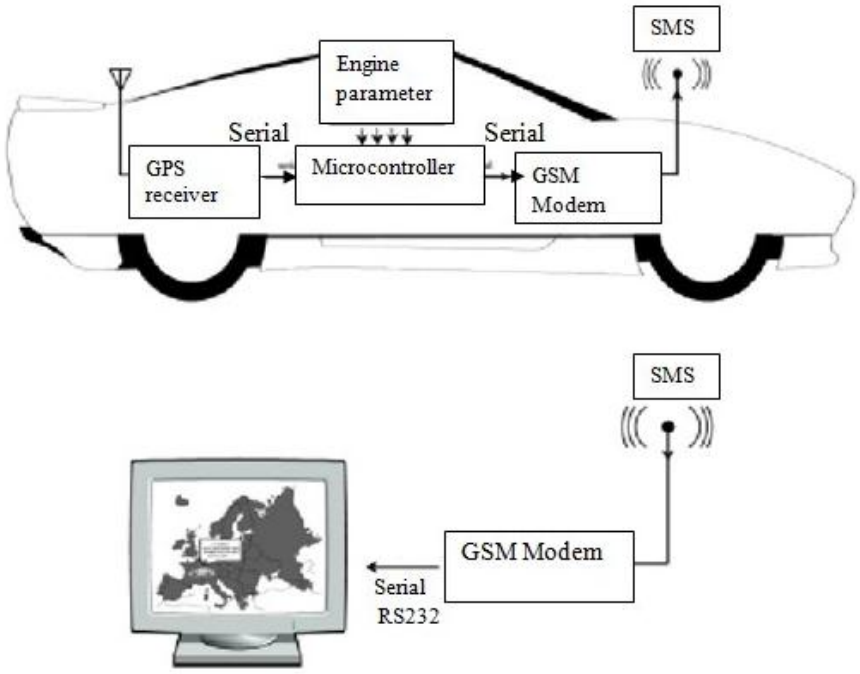

Figure 2.1: The System architecture of vehicle tracking system

- **Agricultural Monitoring System**

Besides Vehicles and object tracking, GPS and GSM technology also can be used for agriculture monitoring. Two of UTM undergraduate students, Gan Teck Yik [9] and Arsany Bin Arsad [10], had done this research.

They used the BSmart A300 b'AT Unit (concurrent GPS and GSM real time positioning technology) to monitor their plant, and receive warning messages during critical situations.

- **Vehicles Tracking System**

GPS and cellular network based system are commonly used to provide navigation services for outdoor environment. A UTM student, Aliff Fawzuan Othman had done a research based on the Hajj Pilgrim Tracking system GPS and GSM technology [11].

The tabung Haji staff will use the Android smart phone to request the position of Hajj pilgrims while the Hajj pilgrims carried the GPS tracker or Smart phone. This system was using both GPS and GSM network technology for Vehicles tracking purpose.

- **Wi-Fi (Wireless-Fidelity)**

Wi-Fi is a wireless network technology that can provide the wireless internet and network connection through radio wave. Amalina Abdul Halim from Mara University of Technology had done a research based on Wi-Fi positioning system [12].

It determined the user's location based on the Wi-Fi signal strength. By using the Wi- Fi, it is possible to determine the exact location of a person with accuracy up to 1 meter.

The research used the real time location system from Ekahau to build their application, where Ekahau real time location system is a wireless radio frequency solution that is based on the Wi-Fi access point. Vehicles tracking system by using Wi-Fi technology is more economical because most of the communication devices are equipped with the wireless network. With a Wi-Fi receiver, the communication device can be used to determine a location.

However, Wi-Fi only can determine the user location at areas that have wireless reception, so it is not suitable to use in the rural area and this technology needs an extensive mapping and high power consumption.

- **RFID (Radio Frequency Identification)**

The tag-based system also can be used for tracking purposes. Tags based system includes RFID, barcode and Bluetooth. RFID, which stands for Radio Frequency Identification is an electronic device that belongs to a group of technology named Automatic Identification and Data Capture (AIDC). This technology can automatically identify the object and directly send the collected data to a computer.

Nezar Amer Alnizari [13] had done a research on real time Vehicles tracking by using this technology. For RFID technology, it can transfer the data from a tag, which is attached to an object through the radio frequency. RFID consists of three important components, which are RFID tags, RFID reader and RFID PC reader. The RFID tag is used to send the RF signal to RFID reader, RFID reader is acting as a transceiver, receive the RF signal from the RFID and send the signal to the RFID PC reader. The received signals can be displayed on the PC through the RFID PC reader.

Vehicles tracking system by using tag-based technology is low cost compared to the other technology, but it only can be used locally and works only approximately tags.

- **A Global Positioning System (GPS)**

The Assisted Global Positioning System is another technology, which can be used for positioning purposes. Albert Kai-Sun Wong and his partners [14] from Hong Kong University had designed an experimental AGPS-based elderly tracking system.

It was a system, which includes a wearable AGPS terminal, GPS Reference Station, location server, web client and web engine. In this

research, the wearable AGPS terminal retrieved the assistance data by using the SUPL (Secure User Plane Location) protocol.

For this system, AGPS terminal comprises of three main components, which are the 3G baseband chip (provides the terminal's HSPA (High Speed Packet Access) connectivity with the network, RF chips and GPS RF Chips (perform GPS positioning computation).

A device, which was embedded with GPS receiver and ARM7 processor, was used to receive the navigation message from the satellite and sent the signal to the AGPS controller and AGPS data store. AGPS is a technology, which has faster time-to-first-fix and ability to provide an accurate indication of one's location in outdoor and even the urban canyon environment.

However, A-GPS cannot contact directly to the satellite. It needs to use other resources such as mobile network in order to contact to satellite. Thus, the user needs to pay for the mobile subscription fee.

Table 2.1 represent the comparison between vehicles tracking technologies.

Table 2.1: Comparison between Vehicles tracking technologies

SUBJECT	ACCURACY	DISADVANTAGES	ADVANTAGES
Satellite-based positioning system (GPS)	>1 m – 15m Accuracy depends on the service or technology used	Too weak to receive signal indoor, slower time-to-first-fix	High accuracy , no operation cost
A-GPS [15]	3 – 50m	Being charged for using the mobile network	Faster time-to-first-fix, can work in both indoor and outdoor environments
Cell – based mobile communication network (GSM)	25m-30km the accuracy based on the size of communication cell and mobile	Provide limited accuracy with regard to the position of the mobile device.	Can work in both indoor and outdoor environments
Wireless technology (RFID, WIFI)	<1m – 50m Accuracy	Commonly use at indoor environment	Lower cost

2.3 Global Positioning System

Navigation System with Timing and Ranging Global Positioning System, NAVSTAR is the full description of GPS. GPS [1] is a space based navigation system which being developed, operated and maintained by the Defense Department of US. Although the US government is controlling it, it is freely accessible by anyone with a GPS receiver.

The GPS is comprised of three important segments as shown in Figure 2.2. The segments of GPS are:

- Space segment. The space segment consists of satellites that orbit the earth on six different orbital planes. Each of these planes has four satellites, which will transmit the one-way signals to the receiver equipment on earth.
- Control segment. The control segment is the earth equipment that carrying out the task of monitoring and controlling the space segment, satellite tracking, telemetry and maintain the satellite orbit configuration.
- User segment. The user segment is the satellite receiver equipment is which are used to receive the signal from the satellites and determine the current location of the user based on the received signals.

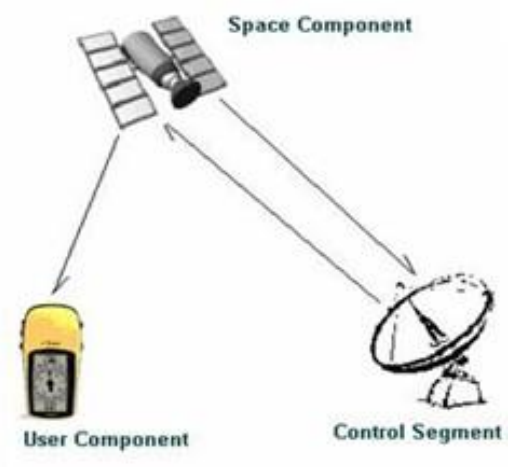

Figure 2.2: Segments of GPS

The GPS is suitable to be used in the Vehicles tracking embedded system because the GPS can work in any weather condition, anywhere in the world, 24 hours a day with no subscription fees or setup charges [2]. Besides that, the GPS also can provide three-dimensional positioning. Thus, it can be used to detect the location of the user with high accuracy.

2.3.1 History of Global Positioning System (GPS)

The GPS System was created and realized by the American Department of Defense (DOD) and was originally based on and run with 24 satellites (21 satellites being required and 3 satellites as replacement). Nowadays, about 30 active satellites orbit the earth in a distance of 20200 km. GPS satellites transmit signals which enable the exact location of a GPS receiver, if it is positioned on the surface of the earth, in the earth atmosphere or in a low orbit. GPS is being used in aviation, nautical navigation and for the orientation ashore. Further it is used in land surveying and other applications where the determination of the exact position is required. Any person in possession of a GPS receiver can use the GPS signal without a fee.

2.3.2 GPS Position Determination

The satellite of GPS will transmit the one way signals to the GPS receiver equipment on the earth. Every satellite will transmit the data that indicates its location and the time they sent out the signal. The timing information plays an important role in determine the users location on the earth, thus, GPS satellites are equipped with atomic clock on board to provide an accurate time reference [3]. The distance between the particular satellite and the GPS receiver can be determined by calculating the travel time of a signal from the satellite to the receiver, where:

Travel time = signal reception time - signal transmission

Time Distance = travel time x speed of light

Figure 2.3: The distance between satellite and one's position on earth

Trilateration (triangulation) is used to calculate the current position of the GPS receiver based the information on GPS signal's travel time from three nearby satellites and their exact locations in the orbit. However, in order to determine one's location in 3D space, 4 satellites are needed instead of three [3]. Figure 2.3 shows the intersection point that indicates the location of GPS receiver.

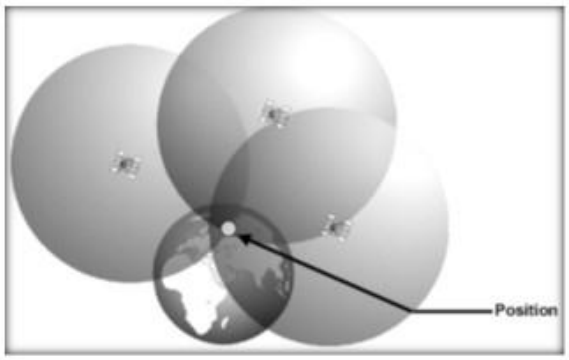

Figure 2.4: The intersection Point indicates the location of the GPS receiver

2.4 Global System for Mobile Communications Technology

Global System for Mobile communications (GSM) is a cellular network, which means that mobile phones connect to it by searching for cells in the immediate vicinity. GSM networks operate in four different frequency ranges. Most GSM networks operate in the 900 MHz or 1800 MHz bands. Some countries in the Americas (including Canada and the United States) use the 850 MHz and 1900 MHz bands because the 900 and 1800 MHz frequency bands were already allocated.

2.4.1 GSM Modem

GSM modem is similar to mobile phone. It is a specialized wireless modem, which needs a SIM card and works with a GSM wireless network. GSM modem utilizes the radio wave for sending and receiving the messages. Utilization of SMS technology has become popular because it is an inexpensive, convenient and accessible ways of transferring and receiving data with high reliability. Besides that, GSM modem can be used for automating business process, sending SMS from a computer and vehicle tracking with integrated GPS.

There are three different types of GSM modem, which are:

(i) A GSM modem with SIM card can be an external modem device, which is connected to a computer through USB port, serial port, Bluetooth or infrared.

(ii) A GSM modem can be a PC card or PCMCIA card, which is installed in a notebook computer.

(iii) A GSM modem can also be a standard GSM mobile phone

A GSM modem is controlled by using the AT commands. If the user would like to do the operation such as reading, writing, deleting and sending messages, an extended set of AT commands which are defined in the GSM standard is needed.

2.4.2 GSM Network

GSM network [5] is a public land mobile network (PLMN). Mobile station which is made up of a SIM (Subscriber Identity Module) card is the user terminal in GSM network while the mobile terminal refers to the user device such as mobile phones. A system that uses a cellular network based around broadcast stations or satellite technology that is connected to signal from orbit are part of the GSM network. The main purpose of the GSM network is to facilitate easier access to cellular and satellite platforms across international lines.

A GSM network comprises of three major systems, which are:

- Switching system (SS): The main functions of this system are performing call processing and subscriber related task. The functional units under the switching system are home location register (HLR), mobile services switching center (MSC), visitor location register (VLR), authentication center (AUC) and equipment identity register (EIR).
- Base station system (BSS): Base station system is responsible for radio related functions, which consists of the base station controller (BSCs) and base

transceiver station (BTSs). The base station controller is used to manage the resource distribution while the base transceiver station is radio equipment which responsible for handling the radio interfaces to the mobile station.

- Operation and support system (OSS): The OSS will be connected to the equipment in the switching system and base station system. Operation and support system is used to provide a network overview, customer support for operation and maintenance activity which required for a GSM network.

2.5 AT command

AT which stands for ATtension is a set of instructions that are used to control modems such as GSM/GPRS modem and GPS modem. AT command can be divided into two types, which are the basic commands and extended commands. The basic commands are commands which do not have "+" after "AT", such as ATA, ATD, ATO and ATH. For extended commands, there is a "+" after "AT" such as "AT+CMGD" and "AT+GMCF".

Since this project needs the operation of sending, reading and writing the SMS messages, an external AT commands which are defined in the GSM modem will be used.

Table 2.2: shows some of the AT commands for GPS modem and GSM modem.

AT COMMAND FOR GSM	**FUNCTIONS**
AT + CMGD	DELETE SMS MESSAGE
AT + CMGF	SELECT SMS MESSAGE FORMAT
AT + CMGR	READ SMS MESSAGE
AT + CMGS	SEND SMS MESSAGE
AT + CMGW	WRITE SMS MESSAGE TO MEMORY
AT + CNMI	NEW MESSAGE INDICATION
AT + CSCB	SELECT CELL BROADCAST SMS MESSAGE
AT COMMAND FOR GPS	**FUNCTIONS**
AT + CGPSIPR	GPS RESET MODE (COLD / WARM / HOT)
AT+ CGPSPWR	GPS POWER CONTROL
AT + CGPSRST	SET TE-TA FIX LOCAL RATE

2.6 Programming Language and Environment

C# and Arduino are the programming languages that are used as the interface languages in this project. The programming environments that are used to write C# program is Microsoft Visual Studio 2010 while the Arduino programming was developed using the Arduino Interface Development Environment [16].

2.6.1 C# Programming Language

C#, pronounced as c sharp, is a multi-paradigm programming language that was created by Microsoft in 1999 and 2000. It is encompasses strong typing, imperative, declarative, functional, generic, object-oriented and component-oriented programming disciplines. It can be used to give instructions to a computer. The instructions can be written in a text editor such as notepad or Microsoft Visual Studio [16].

2.6.2 Arduino programming Language

Arduino programming language is a simplified version of C or C++ programming language. This programming language does not need to include the header file at the beginning of the coding. Besides that, there are only two functions are needed in order to make a cyclic executive program. Those functions are setup () and loop (). Setup () is the function that is used to initialize the settings and only runs once at the beginning of the program. While the loop () is the function that is called continuously.

2.7 Microcontroller

Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Arduino can either be powered through the USB connection from the computer or from a 9V battery, Figure 2.5 describe all Arduino pins. Arduino can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently [19].

The hardware consists of an open source hardware board that is designed around the Atmel AVR Microcontroller. The intention of Arduino was to make the application of interactive components or environments more accessible. Arduino is programmed via an Integrated Development Environment (IDE) and run on any platform that supports Java like LABVIEW. An Arduino program is written in either C or C++ and is programmed using its own IDE.

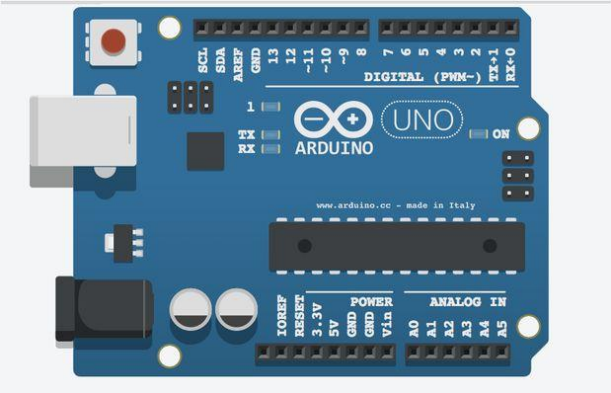

Figure 2.5: Arduino UNO

2.7.1 Microcontroller components

A microcontroller basically contains one or more following components:

- Central processing unit

  Central Processing Unit is the brain of a microcontroller. CPU is responsible for fetching the instruction, decodes it, and then finally executed. CPU connects every part of a microcontroller into a single system. The primary function of CPU is fetching and decoding

instructions. Instruction fetched from program memory must be decoded by the CPU.

- Memory

  Memory in a microcontroller is same as microprocessor. It is used to store data and program. A microcontroller usually has a certain amount of RAM and ROM (EEPROM, EPROM, etc.) or flash memories for storing program source codes.

- Parallel input/output ports

  Parallel input/output ports are mainly used to drive/interface various devices such as LCD'S, LED'S, printers, memories, etc. to a microcontroller.

- Special functioning block

  Some microcontrollers used only for some special applications (e.g. space systems and robotics) these controllers containing additional ports to perform such special operations. This considered as special functioning block

2.7.2 Microcontroller application

Microcontrollers are widely used in modern electronic equipment. Some basic applications of microcontroller are given below:

- Used in biomedical instruments.
- Widely used in communication systems.
- Used as peripheral controller in Personal Computer (PC).
- Used in robotics.
- Used in automobile fields.

Microcontroller applications found in many lives filed, for example in Cell phone, watch, recorder, calculators, mouse, keyboard, modem, fax card, sound card, battery charger, door lock, alarm clock, thermostat, air conditioner, TV Remotes, in Industrial equipment like Temperature and pressure controllers, counters and timers.

CHAPTER THREE

System Components

3.1 Introduction

To develop a position data acquisition system for tracking purpose. The signal received from satellite is sent to hardware devices for further processing and finally the signal is sent to the PC for displaying on the Google Map.

This project is divided into two parts, which are the tracking part and a displaying part. The tracking part is responsible for obtaining the user location while the control and displaying part is for displaying the detected location on the Google Map through a C# Windows Form application.

The hardware devices that are used in this project are the GPS / GSM Module and Arduino UNO Microcontroller. All of these hardware devices being programmed by using AT commands, C# and Arduino programming. The software that used to write the coding is Microsoft Visual Studio and Arduino IDE. Besides that, a user interface was created by using a C# window form.

3.2 System Development

Figure 3.1 shows the design flow of Vehicles tracing system. The design process was started by writing the source code for the tracking module and displaying module. After that, the coding for tracking part was downloaded into the microcontroller. Both of the coding for tracking and displaying parts is then tested to make sure they meet the specification. When both of the coding meet the specification, the whole system is being tested to ensure it works properly.

When connecting all these elements together the final module view and the result.

The right side of the design flow represents the displaying module over view and whether it is working or not.

The right side of the design flow represents the Tracking module over view and whether it is working or not. Figure 3.1 represent the main block diagram.

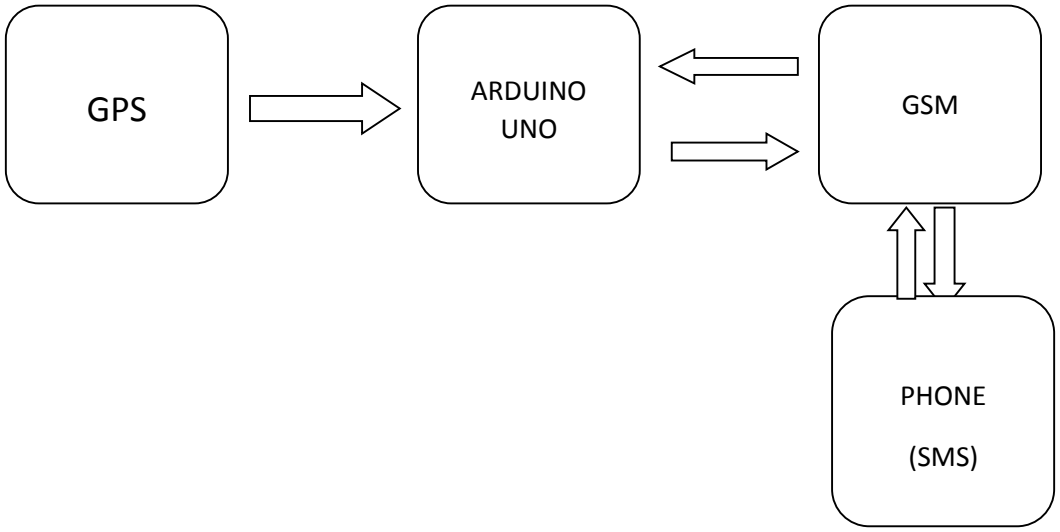

Figure 3.1: main block diagram

This block diagram presents the GPS module tracking system and works as following:

- The GPS Module starts working and gives data to the Arduino UNO.
- Then the Arduino sends data to the phone via the GSM Module after receiving a message from source.

3.3 Description of Tracking Unit:

This part describe the tracking unit that used to keep track on an object, also defined the project components.

3.3.1 Global positioning system

Global positioning system (GPS) modules are popularly used for navigation, positioning, time and other purposes. GPS antenna receives the location values from the satellites [11]. GPS gives information about International Journal of Computer Science, Engineering and Applications.

- Message transmission time
- Position at that time

Figure 3.2 Global positioning system Module

3.3.2 Global system for mobile communications

Global System for Mobile communications (GSM) modem is used for transmitting and receiving the data [4]. SIM 900 is a tri- band GSM/GPRS engine. It works on various frequencies i.e. EGSM 900MHz, DCS 1800MHz and PCS 1900MHz.

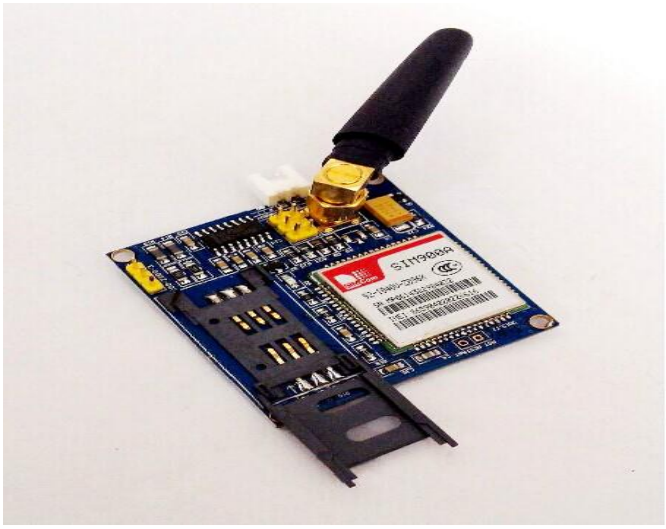

Figure 3.3 Global System for Mobile communications Module

3.3.3 Microcontroller-Arduino

Arduino is a small microcontroller board with a USB plug to connect to your computer and a number of connection sockets that can be wired up to external electronics, such as motors, relays, light sensors, laser diodes, loudspeakers, microphones, etc. Arduino can either be powered through the USB connection from the computer or from a 9V battery, Figure 3.4 describe all Arduino pins. Arduino can be controlled from the computer or programmed by the computer and then disconnected and allowed to work independently.

The hardware consists of an open source hardware board that is designed around the Atmel AVR Microcontroller. The intention of Arduino was to make the application of interactive components or environments more accessible. Arduino is programmed via an Integrated Development Environment (IDE) and run on any platform that supports Java like LABVIEW [17]. An Arduino program is written in either C or C++ and is programmed using its own IDE.

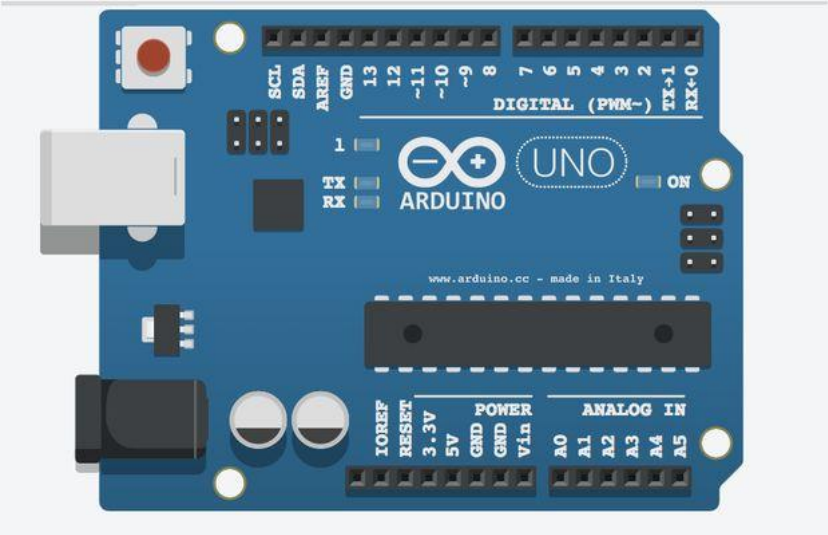

Figure 3.4 Arduino Microcontroller

3.3.4 Male / Female Cables

These cables are used for making wiring and jumpering between the different headers on PCB's. In this project they will be used for a serial connection between the GPS shield and Arduino.

Figure 3.5: Cables

3.3.5 Radio-Frequency Identification

RFID stands for Radio-Frequency Identification. The acronym refers to small electronic devices that consist of a small chip and an antenna. The chip typically is capable of carrying 2,000 bytes of data or less.

The RFID device serves the same purpose as a bar code or a magnetic strip on the back of a credit card or ATM card; it provides a unique identifier for that object. In addition, just as a bar code or magnetic strip must be scanned to get the information, the RFID device must be scanned to retrieve the identifying information.

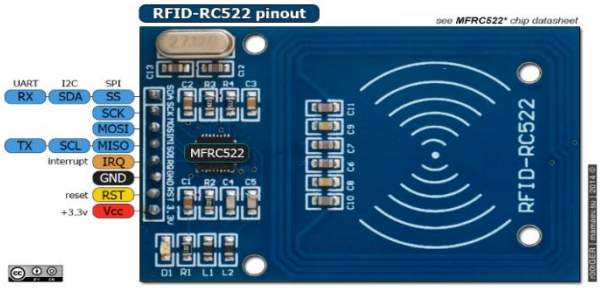

Figure 3.6: Radio-Frequency Identification

3.3.6 Passive infrared sensor

PIR sensors allow you to sense motion, usually used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low power, easy to use and do not wear out. For that reason, they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors.

PIRs are made of a pyroelectric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one-half sees more or less IR radiation than the other, the output will swing high or low.

Figure 3.7: PIR

3.4 System Software

The software programming is done in Arduino Integrated Development Environment (IDE). The IDE (integrated development environment) is a special programming running on your computer that allows you to write sketches for the Arduino board in a simple language. The magic happens when you press the button that upload the sketch to the board the code that you have written is translated into the C language and is passed into the AVR microcontroller.

Data (co-ordinates) received by GPS from the satellites is defined in the software. Decoding the NMEA (National Marine Electronics Association) protocol is the main purpose of developing this software. The mobile number of the user should be included in the software programming in order to receive the location values from the SIM card, which we are using in GSM modem. The NMEA protocol consists of set of messages.

These messages are ASCII character set. GPS receives data and present it in the form of ASCII comma – delimited message strings. '$' sign is used at the starting of each message. The software protocol consists of the GGA (global positioning system fixed International Journal of Computer Science, Engineering and Applications and GLL (geographic position latitude/longitude). However, in this system we are using CGA only.

3.5 Monitoring Unit

The monitoring unit consists of a GSM mobile and a Smartphone Application. The GSM mobile will acquire the position of the vehicle (longitude and longitude) and then by typing those co-ordinates in web application owner of the person can get the exact location of the vehicle movement. The web application part is covered later in this report.

3.6 MAPPING

The Map form contains only a single Web browser. This form accepts the latitude and longitude as argument and uses that data to display the position on the Google Maps. A query string is formed using round the latitude and longitude is passed to the web browser to navigate to the location which indicated by the latitude and longitude. The Google URL is “http://maps.google.com/maps?q=”. If the coordinate of the user is “N1.55845,E103.65095”, the coordinate of user will append it and become “http://maps.google.com/maps?q=N1.55845,E103.65095” .

CHAPTER FOUR

SYSTEM DESIGN

4.1 Introduction

The design of this project is consisted from two main parts, which are hardware design and software design.

4.2 Hardware design

4.2.1 System Architecture

In the design phase, we describe the technology enables to be used in the system and we investigate and develop our algorithms by taking into account the interaction between the different modules of the system. This section presents the architectural design of our "Vehicles Tracking System". The following architecture provides an overall view of the project, which contains Arduino UNO, GPS tracker that will collect and send the GPS data, and the end users that can see in real time the location of their Vehicles in a map from either a web interface or an Android-based smartphone.

4.2.2 System Electrical Part

System electrical part can be described by using block and wire diagram, which declare the hardware consideration. Tracking module which consists of GPS/GSM module is responsible for tracking the current location of the user, extracting the $GPGGA sentences and send out the signal through GSM network.

The operation of the GPS and GSM can be viewed by connecting the GPS/ GSM modem to a PC through the serial port. The commands sent to GPS/GSM module for setting the GPS mode. The power and reset vector of GPS was set to High in order to turn ON the GPS power and reset the GPS in autonomous mode.

Autonomous operation mode causes the GPS to receive the signal from satellite by using radio signal only, without using other network resources.

PIR works as an alarm security for the vehicle if anyone is trying to steal or attack the vehicle the PIR sends an order to the Arduino to send message-using GSM to the Owner. In order to use the vehicle the RFID Card allow stopping the alarm.

4.3 Software design

4.3.1 Displaying Module

Displaying part is used to display the user location on Google Maps and store this information in a text file.

4.3.2 Valid coordinates

When the GPS/GSM modem receives “AT” command, which is sent by the PC, it gives the response “OK” to indicate that it was ready to communicate with PC. After that, PC will configure the modem to use the text mode by sending the command of “AT+CMGF=1”. In order to read the messages in SIM card, AT+CMGL= “ALL” was sent to GPRS/GSM modem.

4.3.3 Source Code

When we started working on our project the main objective was to track Vehicles using a direct link to the google using Internet of things (IOT) system, unfortunately because of SUDAN has a lack in internet access, therefore the Google Map and the website where not working due to leak coverage of internet, slow internet and even sometimes the lack of coverage of cell phone Data. Refer to appendix A.

Therefore, we start using another component, which is GSM Module so that we track the Vehicles using SMS messages, which sends a link of Google Map to the Phone.

4.4 Analysis of Results

After completing the modules, the entire system is tested to ensure that the people tracking system is working well and meets the requirement. This chapter will discuss about the results that are obtained from the testing the functionality of the system.

4.4.1Results

The operation of the GPS and GSM can be viewed by connecting the GPS/ GSM modem to a PC through the serial port. The commands sent to GPS/GSM module for setting the GPS mode. The power and reset vector of GPS was set to High in order to turn ON the GPS power and reset the GPS in autonomous mode. Autonomous operation mode causes the GPS to receive the signal from satellite by using radio signal only, without using other network resources.

After turning ON the GPS, the GPS receiver will start receiving the signal from satellite. Since GPS needs time to warm up and become stable, the GPS was commanded to track the user location for 10 rounds per cycle, in order to obtain correct and stable coordinate. If the GPS is not ready, the $GPxxx sentences that we received just having the information of current time and check sum data. If the GPS is ready, the complete $GPxxx sentences with full information is received. The coordinate information that is received from GPS receiver was in various forms of $GPxxx signal, such as $GPGGA, $GPRMC, $GPGSA, $GPGSV, and $GPGLL.

All of these $GPxxx sentences contain the latitude and longitude information, but in different format. . Microcontroller extracting the $GPGGA sentences from various form of $GPxxx sentences because the latitude and longitude information for $GPGGA sentence are in degree and minute, which are easier to extract and interpret. The Blue box in figure 4.1 shows parts of the $GPGGA sentence that is

extracted from the signal received by the GPS receiver while the green box shows the $GPGGA sentences that is saved in the array.

After that, the GSM mode is turned ON. The AT and extended AT commands were sent by the microcontroller to configure the GSM modem and request GSM to send the string in the array to another GSM modem which is connected to the PC. This procedure is repeated continuously**.**

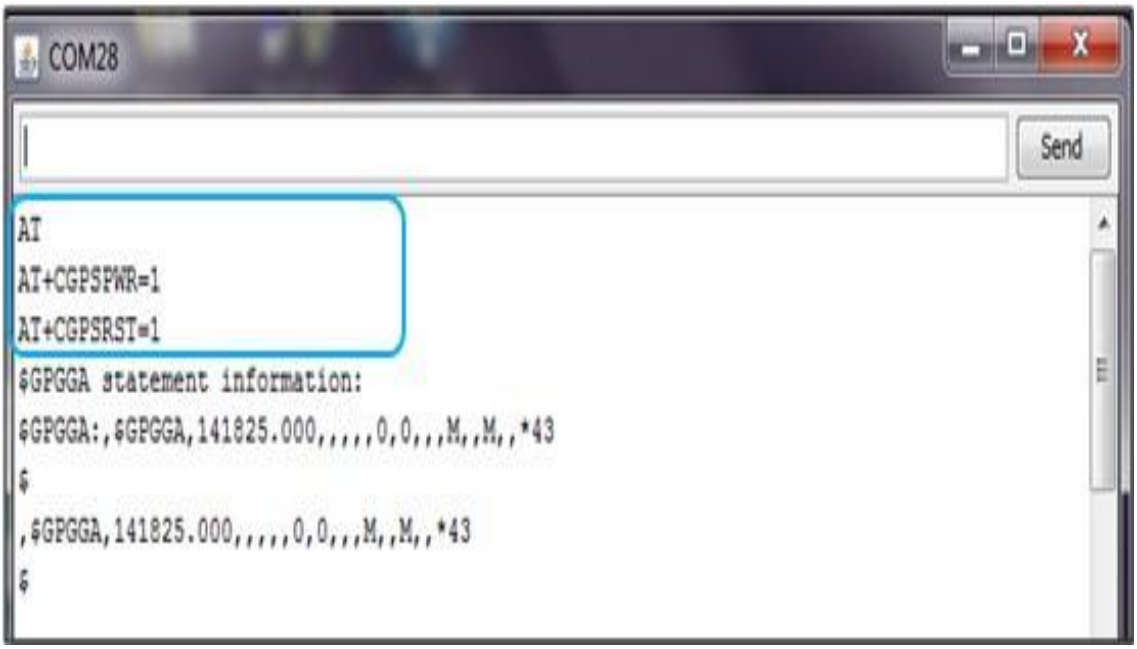

Figure 4.1: Turn ON GPS

4.4.2 Tracking device

When the GSM receive message from the phone, it replies to the phone with a message such as in figure 4.2

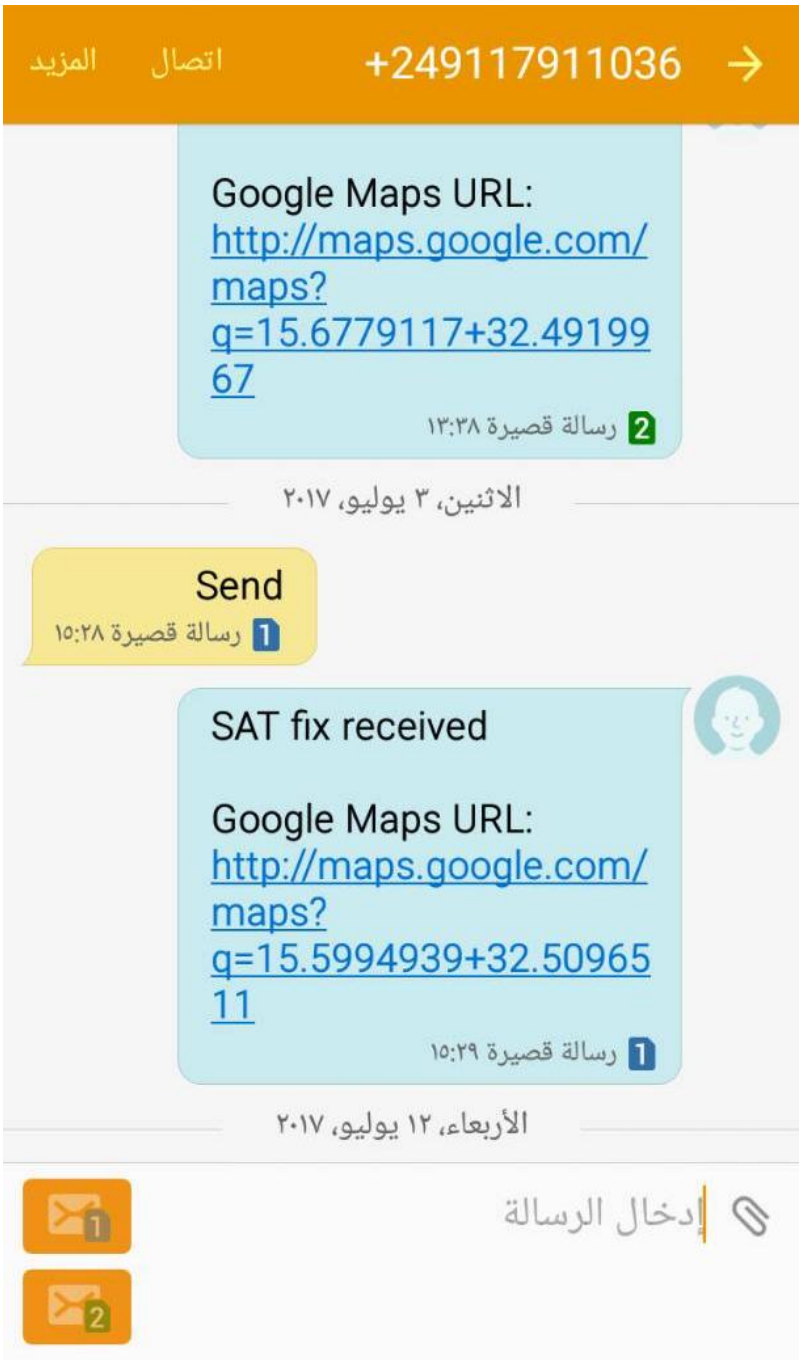

Figure 4.2: SMS Message

❖ Point A:

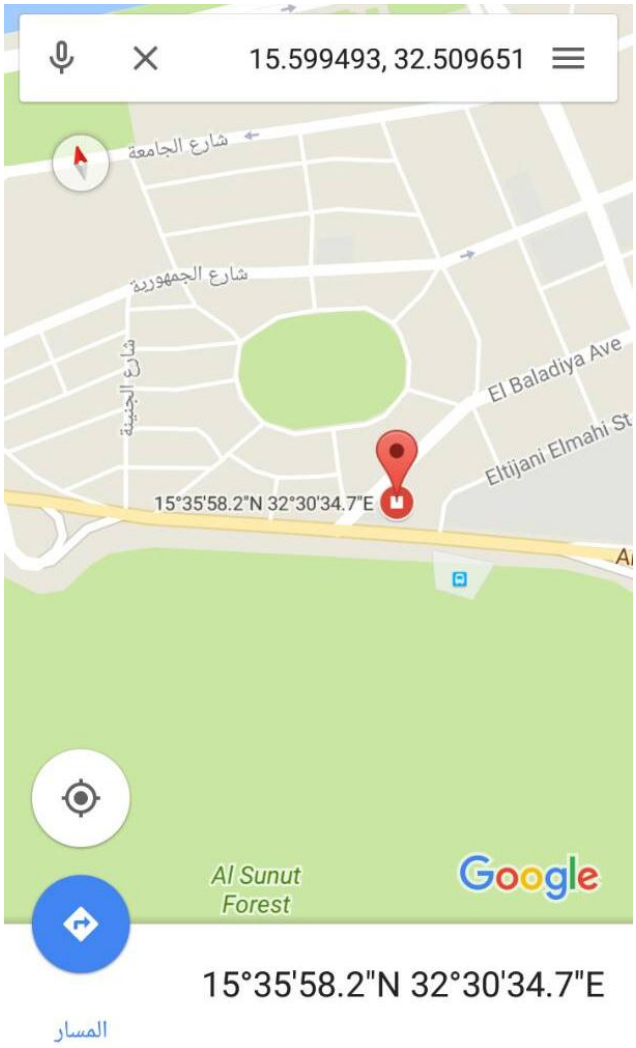

Figure4.3: Google Map tracking – Point A

❖ Point B:

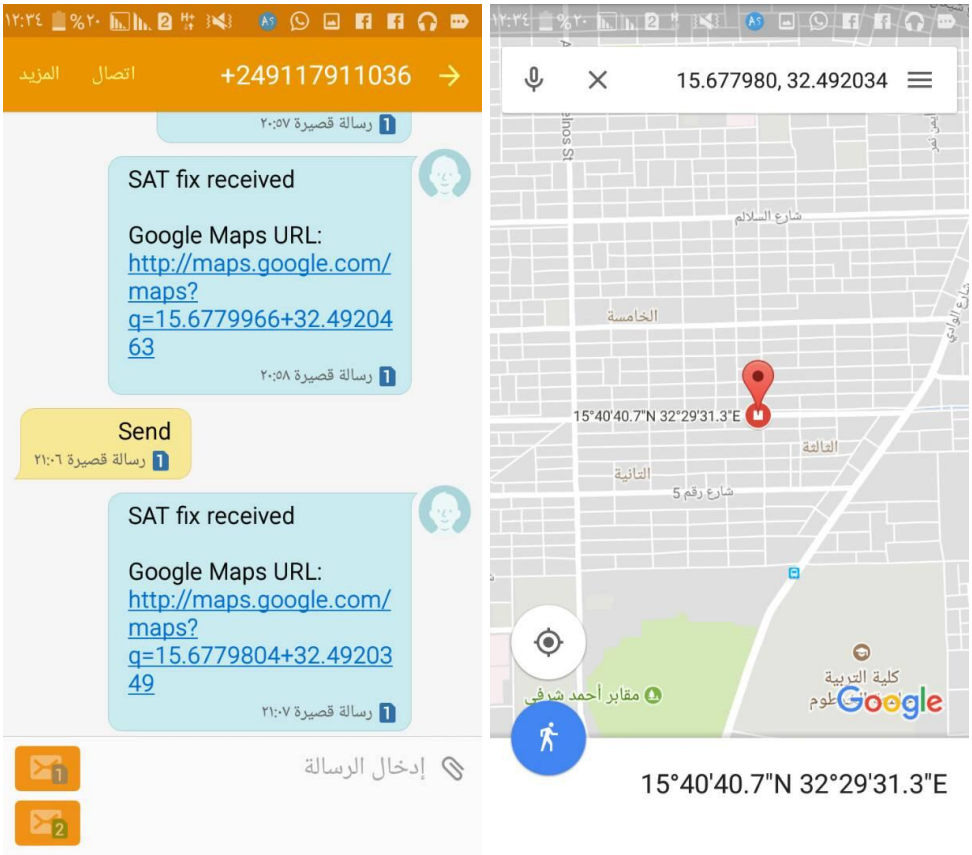

Figure 4.4: Google Map tracking – Point B

Table 4.1: results from GPS

	LONGITUTE	LATITUTE
POINT A	15.5994939	32.5096511
POINT B	15.6779804	32.4920349

The table above shows two different points where taken in two different locations, we used GSM in order to get the specific location of the vehicle needed to track by getting a google map link through a text message to the phone.

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

This work explores the foundation of GPS, GSM, Arduino and C# programming and uses all of these concepts to prototype a real time people tracking system. The design and development of this system has been successfully completed. The hardware and software integration meets the requirements and works as expected. Besides that, all the objectives of this project were achieved. The design for real time tracking of people in 2D map had been prototyped, GSM modem has been implemented for receiving the information from GPS receiver and sending the message to control center. Besides that, the user interface for displaying the current location of the user on map was created.

The people tracking system was being divided into tracking module and displaying module. Tracking module is used to track the user location while the displaying module is used to plot the user location on Google Maps. For this project, the user location is updated every time needed. In other words, the people tracking system took less than expected from tracking user location to mapping the location on Google Maps.

5.2 Recommendation

For this section, some useful recommendations will be proposed for future works.

- Plot the path of the user, the last position of the user is plotted on the Google Maps. Although after displaying the user location in the textbox of latitude and longitude, the coordinate of the user is saved in a text file, the data is not retrieved for displaying the path of user on the map. Thus, in order to make

the monitoring clearly and easily, for future work, the path of the user should be plotted on the map by retrieving the coordinates that are saved in the text file.

- Plot the Location of Several Users on the Same Map

  The displaying part of this project can only plot the location of one user. This causes inconvenience for people or organizations that need to monitor more than one user at the same time. Thus, the mapping part of this project can be improved by plotting the coordinates of several users on the same map and using different labels for different users.

  The design should be improved and try the usage of Ethernet and GPRS so that it give us a better result and faster achievement of locations.

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