Chapter Two

Literature Review

2.1 Technical background

2.2 Related Work

2.1 Technical background:

2.1.1 Global Positioning System (GPS):

GPS is a system composed of a network of 24 satellites of the US. The satellites periodically emit radio signal to GPS receivers. The GPS receiver receives the signal from at least three satellites using triangular technique to compute two-dimensions, or four satellites to compute three dimensions (latitude, longitude and altitude).

2.1.2 Google Map:

Is a version of Google Earth it's free software to provide map by satellite image, the programming language of Google Map is KML (keyhole mark-up language). It used to show lines and pins objects.

2.1.3 Global System for Mobile Communication (GSM):

GSM is a standard developed by the European telecommunication standards institute (ETSI) to describe the protocols for second-generation (2G) digital cellular networks used by mobile phones, first deployed in Finland in July 1991. As of 2014 it has become the default global standard for mobile communications - with over (90%) market share, operating in over 219 countries and territories.

2.1.4 Subscriber Identity Module (SIM):

SIM is a detachable smart card considered one of the key features of GSM, SIM card containing the user's subscription information and phone book. This allows the user to retain information after switching handsets. Alternatively, the user can also change operators while retaining the handset simply by changing the SIM, Figure (2.1): the structure of GSM network:
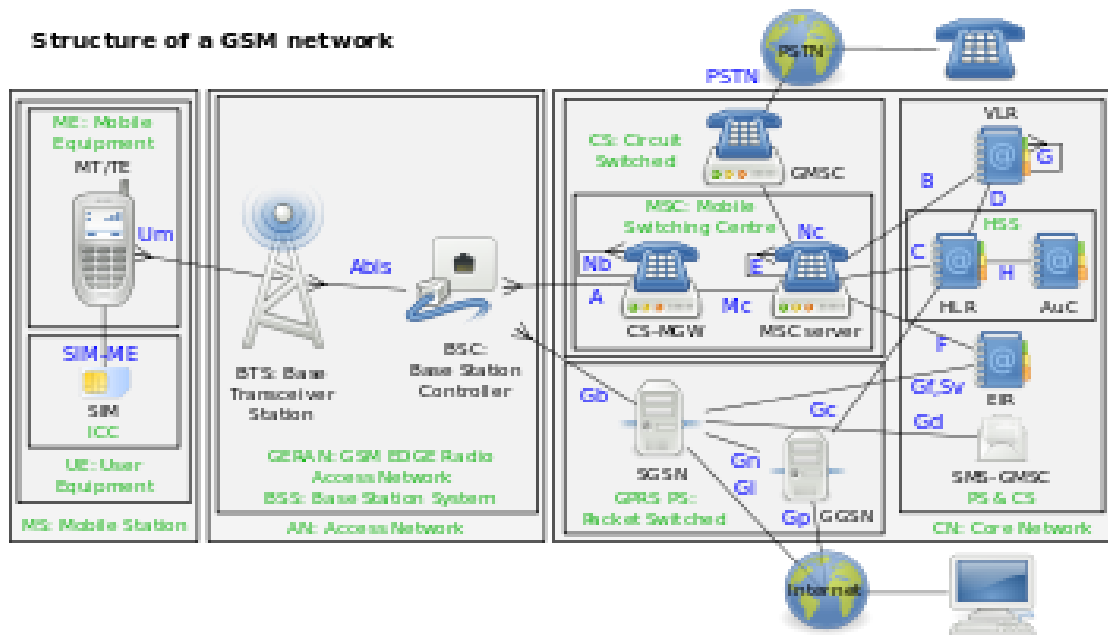
Figure (2.1): structure of GSM network.

2.1.5 General Packet Radio Service (GPRS):

GPRS was originally standardized by European telecommunication standard Institute (ETSI). Subsequently the 3GPP developed third-generation (3G) UMTS standards followed by fourth-generation (4G) LTE (long term evolution) advanced standards, which do not form part of the ETSI GSM standard.

2.1.6 Android:

Automated Numeration of Data Realized by Optimization Image Detection is a mobile operating system (OS) currently developed by Google, based on the (Linux kernel) and designed primarily for touchscreen mobile devices such as smartphones and tablets.
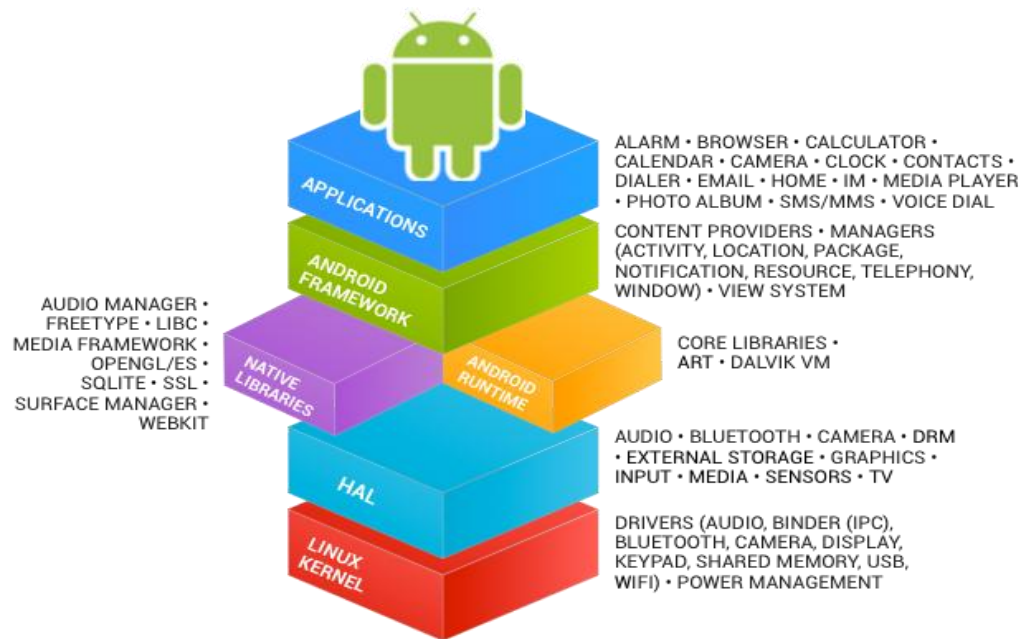
Figure 2.2: structure of Android platform.

2.1.7 Arduino:

Is an open-source computer hardware and software company, project and user community that designs and manufactures microcontroller-based kits for building digital devices and interactive objects that can sense and control the physical world.

The project is based on a family of microcontroller board designs manufactured primarily by Smart Projects in Italy, and also by several other vendors, using various 8-bit Atmel AVR microcontrollers or 32-bit Atmel ARM processors. These systems provide sets of digital and analog I/O pins that can be interfaced to various expansion boards ("shields") and other circuits. The boards feature serial communications interfaces, including USB on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino platform provides an integrated development environment (IDE) based on the Processing project, which includes support for C, C++ and Java programming languages.

The first Arduino was introduced in 2005, aiming to provide an inexpensive and easy way for novices and professionals to create devices that interact with their environment using sensors and actuators Common examples of such devices intended for beginner hobbyists include simple robots thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be manufactured by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduino had been commercially produced, and in 2013 that 700,000 official boards were in users' hands[1] .

2.1.7.1 Arduino Advantages:

It's simple and accessible user experience; Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community[1] .

There are many other microcontrollers and microcontroller platforms available for physical computing. Parallax Basic Stamp, Net

media's BX-24, Phidgets, MIT's Handy board, and many others offer similar functionality. All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems:

Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50

Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows.

Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the bread board version of the module in order to understand how it works and save money.

2.1.8 LinkIt-ONE :

LinkIt ONE is a co-design product by Seeed Studio and MediaTek. It brings together the parties' knowledge in open hardware and industry leading reference designs for Wearable's and IoT devices to create this powerful development board.

It supply hundreds of Groves and Shields, include sensors, actuators, displays and other modules.

2.1.8.1 LinkIt-ONE Features:

Includes GSM, GPRS, Wi-Fi, Bluetooth BR/EDR/BLE, GPS, Audio codec, and SD card connector on a single development board. Pin-out similar to Arduino boards, including Digital I/O, Analog I/O, PWM, I2C, SPI, UART and power supply, compatible with Arduino. LinkIt-ONE Provides various interfaces for connecting to most sensors, peripherals, Groves, and other widgets.

Using LinkIt ONE together with MediaTekLinkIt SDK (for Arduino) will be able to easily turns ideas into practical prototypes and make them a reality with the Seeed productization and agile manufacturing service.

2.1 Linkit-ONE Specification:

Chipset	MT2502A(Aster, ARM7 EJ-STM)
Clock Speed	260MHz
Dimensions	3.3x2.1 inches
Flash	16MB
RAM	4MB
DC Current Per I/O Pin	1mA
Analog Pins	3
Digital Output	3.3V
Analog Input	5V
UART	Software Serial (Serial) and Hardware Serial (Serial1, D0&D1).
SD Card	Up to 32G(Class 10)
Positioning	GPS(MT3332)
GSM	850/900/1800/1900 MHz
GPRS	Class 12
Wi-Fi	802/g/n
Bluetooth	BR/EDR/BLE(Dual Mode)

2.1.8.2 Linkit ONE Antennas:

There are three kinds of antennas in LinkIt ONE, they are used for:
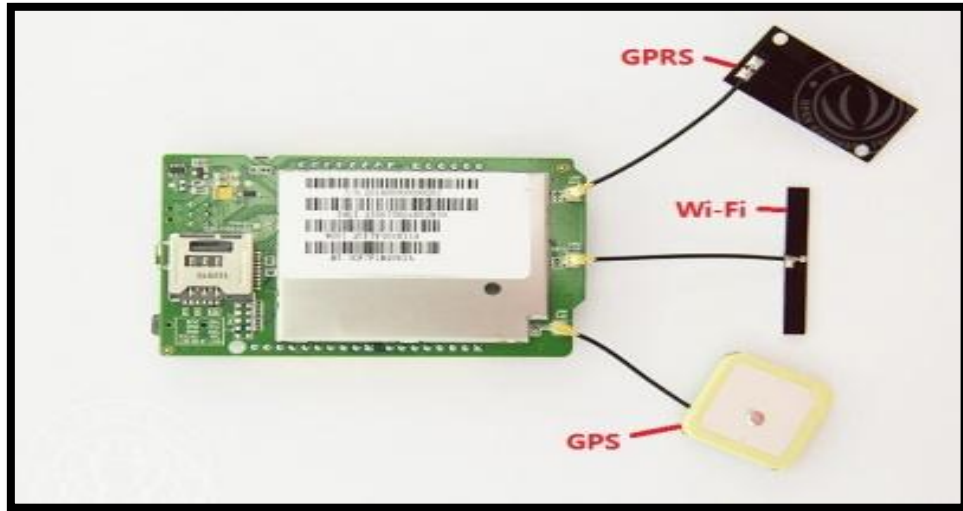
- GSM/GPRS
- Wi-Fi/BT
- GPS

Figure (2.3) Arduino LinkIt ONE antennas.

2.1.8.3 Linkit ONE Switches :

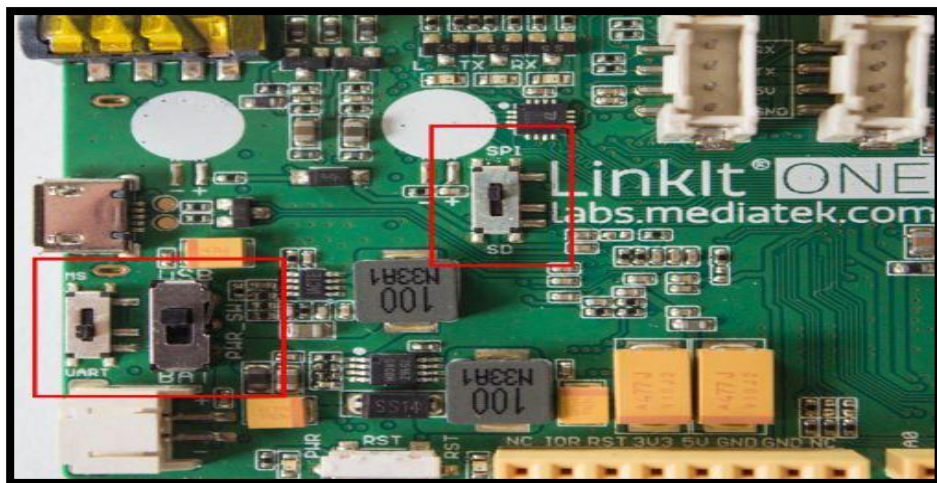These switches are use LinkIt-ONE configuration as Shown in figure 2.4.

Figure (2.4) Linkit One Switches.

Program mode of the switches is:

MS: The program will not run in this mode, when you connect LinkIt ONE to your PC, you will find a 10M size u-disk, you can put some file to it, and read it out via the code.

UART: When you want to program the board, you should set this switch to UART.

Power switches:

BAT: Power with Li Battery. When you want to charge the battery, you should set to BAT and connect LinkIt ONE to PC as well.

USB: Power with USB, when there's no battery insert and you want to program the board, you should set to USB.

Three SD/SPI switches:

SPI: When you want to use the extern SPI pins (D10 - D13), set to SPI

SD: If you had inserted a TF card and want to read it via code, you should set to SD. When you set to SD, D10-D13 will not available any more.

2.2 Related works:

Tracking system is very important in our life; so many different solutions have proposed show as related work bellow:

The low-cost vehicle tracking and monitoring system is presented to track and monitor vehicle status that are used by certain party for particular purposes, and to provide location and time information anywhere on earth. The proposed system consists of in-vehicle GPS

receiver, GSM modems and microcontroller GPS module shield is used to track and locate the position of the vehicle, and the GSM for sending warning message to the owner of the vehicle and embedded controller. Google Maps used to show the current location of the vehicle and usually locate device position with the help of network. the client just send one message to the vehicle and the vehicle's mobile will send you the current location of vehicle in the form of web link and user has to click on a link and that link goes to Google map and will show the current location of vehicle[2].

Although using SMS technology which it's convenient way of transferring and receiving data, and it is inexpensive technology, but the web service is not available at the whole time, so an android phone application can be useful for receiving data without internet.

The system presents a GPS and GSM based vehicle tracking system that provides the owner with full security and track of the asset. GSM/GPS technology used for security purposes, whereas the theft prevention system provided by Android application. The aim proposed is to implement miniature model by using a single chip microcontroller in the vehicle. The system embedded in the vehicle, consist of a GSM modem, GPS receiver, control relay, current sensor and Microcontroller

The system allows users to track the position, speed, water level, engine level and different parameters. The owner   just has to send an SMS and the tracking system installed inside the vehicle will respond within a minute. User can stop the two wheeler when the vehicle under theft by android application. In this system GPS, GSM is interfaced with atmega162 v microcontroller and 16x4 LCD display is used to show some message to the user. The web to track the vehicle on internet, and an android application for smart phone to track the vehicles on Google

Maps without need of internet. That system shows and introduced the traditional existing tracking systems in terms of cost, services, reliability and control[3].

Although of theft prevention and control introduced by this system and SMS technology, but the owner need a long time to get his vehicle.

Vehicle tracking system based on Google map and smartphone application:

The proposed system is used Google earth and smartphone application to track the vehicle at any time and to solve various problems that faced in this urban life transportation. The system proposed a vehicle tracking system using GPS/GSM/GPRS technology and a Smartphone application to provide better service and cost effective solution for users. GPS is mounting on the vehicle which gives current location and it is transport by GSM along with various parameters in the form of SMS to the receiver. Microcontroller is used to read certain engine parameters from automobile data port, processes the GPS information and to transmit this data to the server using GSM modem by SMS. Smartphone application to track and monitor a vehicle location obtained from the system in-vehicle tracking device controlled by a microcontroller. In this proposed system a vehicle location and all information are automatically placed on Google map after processing using Smartphone application. Thus, users will be able to continuously monitor a moving vehicle on demand [4-7].

Tracking system using GPS technology:

The proposed "Hybrid GPS-GSM" [7] system helps the police automobile distribution and theft caution; it's used SMS to track the vehicle, and used "kalman" filter to correct the current position. Whereas

in other proposed systems The Google Maps API is used to display the vehicle on the map in the Smartphone application, moreover the system will locate target by the use of a Web application which that it require web server to run[7].This tracking system monitors all hazard and threats, used for security, remote monitoring transportation and other field, and alert message to mobile phone for remote information. Also this approach presents low cost solution for automobile position and useful in the case of car theft situation. Although of using smartphone or Google map on internet to track the vehicle, but the internet is not available at the whole time to track the vehicle. Thus, off line android application can be useful for tracking and antitheft situations.

The propose system will give the exact location of vehicle with distance between user and vehicle.

The organizations are investing money in monitoring and tracking vehicles aiming at improving services and ensuring the safety in cargos transports. Transmitting Side contains GPS, GSM and GPRS functionality which is preloaded in a smart phone . The system contains single android mobile that is equipped with GPS and GSM modems along with processor that is installed in vehicle. The system allows those companies to monitor the travelled routes through a web client that using Google Maps API and shows colors on the map to indicate if the devices on route.

According to survey GLONASS and GALILEO provides more accuracy than GPS but their receiver costs very high. GPS is the best technology considering its availability and cost, because every Android phone has inbuilt GPS receiver. Therefore there is no need of purchasing a separate GPS receiver for each client[8].

I. A. H. Eltoum and M. Bouhorma [9] have proposed object aimed at developing a velocity based system for location tracking that will be more convenient for users and more reliable. This system put the consideration of the network service and increasing the accuracy in Smartphone's. It is base of developing application in Android and it has been designed to facilitate the reuse of components and allow the components to be replaced by users , and used Linux kernel performs as an abstraction layer between the hardware and Android software. This approach studies the real-time location tracking and control system that can track the target position at all time and places as required by the user, and optimized localization system depending on the integration of GPS and GPRS/3G techniques[9].

This approach uses Android application for more reliability, and used the velocity equation to increase the accuracy of tracking; the problem of using GPS is that it's not efficient in the area which is full of tall buildings, as a result of those Wi-Fi signals proposed to replace GPS.

Z. Liu, A. Zhang and S. Li [10] have proposed a vehicle tracking and theft prevention system using GPS/GSM and SMS technology. They used RFID module as controller to switch ON and OFF. When the car is stolen, the vibration sensors and pyro electric infrared sensors mounted inside the vehicle are triggered "pyro electric to make sure it's caused by human factors", then GSM module will send the location information obtained by GPS module to the owner's mobile phone. SMS Control Protocol to locking the car, unlocking the car and cutting of gasoline according to the content of the short message[10].

This approach operated by RFID module, GPS stores the latitude and longitude information collected in E2PROM chip. GPS module working independently is that the accuracy of the data received each

time is guaranteed. GSM reports the information to master control module, which is able to forcibly lock and unlock the car.

Although this system can be very useful when the vehicle is stolen, using SMS to stop the vehicle, but it's inefficient to control the vehicle, thus an android application with web server can be effective solution to stop the vehicle.

T. Selvamurugan [11] presents a solution system to solve the problem of vehicle theft and accident due to over speed, alcohol drunken by driver. This proposed system has been designed for tracking and monitoring of the vehicle using ARM processor and provide effective and real time vehicle location using GPS and GSM. The system used geographic positions and time information from the global Positioning Satellites. The prototype has been extensively tested in real-life situations and experimental results are very encouraging for drivers and proprietors. Design and Implementation of vehicle tracking and monitoring using GPS and ARM processors to avoid vehicle collision and reduce traffic jams on the road at the same time speed of the vehicle also has been monitored[11].

Although this approach present successful implement to determine speed using accelerometer, which that gives high accuracy in speed, and used ARM processor, but it requires some cost.

V. H. KomalBhujbal and Bhakti Kulkarni [12] have proposed "Tracking Location & Speed of Vehicles: Using GPS on Android Platform". They present a system that provides tracking services using "Orion Easy track" device which is a GPS/GSM/GPRS module, and they used Google maps to show the last updated position of all the user`s vehicles as an image that represents the current location of a selected

vehicle. This system combines the installation of an electronic device in a vehicle, with software at least at one operational base to enable the owner or a third party to track down the vehicles position, speed, stops, movements, and collecting data from the field and deliver it to the base of operation. In this approach an SMS notifications are sent to the user's cell phone in case of Over-Speeding, Enter/Exit a Geo-fence area "virtual perimeter for a real-world geographic area", Car Stops/Moves and Car Alarm going on. The proposed GPS system is divided into three main parts: the Server, the Client applications, and the GPS tracking device. The very important feature is to provide to the admin is finding the location and speed of the vehicle[12]. This approach is divided into three main parts: Server, Client applications, and Orion device, working integrated together, that's enabling managing of location, speed and specific boundary.

J. R. Mahalingam T. and Shunmuganathan K.L [13] dealt with concept of tracking system based on cloud computing infrastructure. Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand. This system is implemented in android for giving mobility and user friendly. The information is transmitted to Tracking server using GSM/GPRS modem on GSM network by using SMS or using direct TCP/IP connection with Tracking server through GPRS[13].

This approach has disadvantage of using personalized web server, because of the storage capacity is limited, maintaining is too tough, backing up data or transferring to another new server is difficult and human interface is needed every time Installing a new server and maintaining costs high.

A. P. SumitRai [14] has proposed an approach for tracking using Google map application. The system implemented using GPS and GSM unit to collecting the data from the field and deliverers it to the server from where it will be fetched by android application. The vehicle's location can be viewed on Google maps in android application using internet. GPS will give the longitude and latitude values and that values has been transmitted to the server (open GPS server) using GSM module, and the longitude and latitude value will be uploaded on the server, then the user will able to get the real time location of the vehicle and show it on Google map using android application and internet[14]. This approach is very useful because of using android and "open gps" server to store and process data, the problem of using that it's not efficient in offline systems.

S. S. T. Mahadevaiah K G, Abhishek V, Rakshith P R and Ashish N Koushik [15] have proposed vehicle tracking system used GPS and GSM. They used SMS technology to control the vehicle, which can be turned off by only with a simple SMS using microcontroller to stop engine motor. This system consists of a android based remote vehicle disengaging system will provide effective, real time vehicle location, mapping and reporting this information value and add by improving the level of service provided. The proposed system used geographic position and time information from the Global Positioning Satellites, GSM and SMS technology for wireless data transmission. Vehicle information can be viewed on electronic maps via the Internet or specialized software. Vehicle tracking systems are also popular in consumer vehicles as a theft prevention and retrieval device and used in deferent applications when vehicle is stolen, field service management and it used for food delivery and car rentals companies[15].

Although of using GPS and an android app to provide security system more than other system , and gives a good control of vehicle, but this approach can be control of one vehicle not fleet of vehicles .thus, Server is useful to control of fleet of vehicles.

R. K. S Om Prakash [16] has proposed system to track the movement of vehicle's location at any time. The system presents low cost solution with very less Hardware components which are cheaper and accessible by everyone. This system implemented unit using GPS module to get geographical coordinates from satellites and GSM /GPRS module to transmit the GPS data to the web server. It also used TCP server to store the GPS data containing the location information of vehicles, and used Google Maps API or smartphone for displaying the vehicle's location on a map[16].

Although this system is very useful when the vehicle is in fleet services, and requires low cost hardware components, but data cannot be sending correctly, if there is some problem with Internet connection, moreover it required high speed internet connection.