TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
THAPATHALI CAMPUS

FINAL YEAR PROJECT REPORT ON

INTELLIGENT TRANSPORTATION SYSTEM

BY:

Anita Maharjan	(72851)
Laxmi KC	(72868)
Rasmi Wagle	(72876)
Rasu Shrestha	(72877)

SUBMITTED TO:

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING
INSTITUTE OF ENGINEERING
THAPATHALI CAMPUS

KATHMANDU, NEPAL
Bhadra, 2071

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THIS PROJECT WAS SUBMITTED TO THE DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING, IOE, THAPATHALI CAMPUS IN PARTIAL FULLFILLMENT OF THE REQUIREMENT FOR THE BACHELOR’S DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMPUTER ENGINEERING
INSTITUTE OF ENGINEERING
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KATHMANDU, NEPAL
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DEPARTMENT ACCEPTANCE

The project titled "**Intelligent Transportation System**" submitted by **Anita Maharjan**, **Laxmi KC**, **Rasmi Wagle** and **Rasu Shrestha** in partial fulfillment of the requirement for Bachelor's Degree in Electronics and Communication Engineering has been accepted as a bona-fide record of work carried out by them for our department.

____

Er. Janardan Bhatta
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Department of Electronics and Computer Engineering
Institute of Engineering, Thapathali Campus
Kathmandu, Nepal

CERTIFICATE OF APPROVAL

The undersigned certify that they have read and recommended to the Department of Electronics and Computer Engineering, Institute of Engineering, Thapathali Campus, a final project work titled “**Intelligent Transportation System**” submitted by **Anita Maharjan**, **Laxmi KC**, **Rasmi Wagle** and **Rasu Shrestha** in partial fulfillment of the requirement for Bachelor’s Degree in Electronics and Communication Engineering.

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ABSTRACT

The project "**Intelligent Transportation System**" is an attempt to design a tracking system that uses **GPS** to determine the precise location of a vehicle and uses a **GPRS** connection implemented via a **GSM** modem to transmit location information to a remote user. This system incorporates a hardware device installed inside the vehicle termed in **In-Vehicle Unit** and a remote **Tracking Server**. This information is transmitted to Tracking Server using **GSM/GPRS** modem by using **HTTP** connection established with **Tracking Server** via **GPRS**. The **Tracking Server** receives the location information and stores in **Cloud Server** database. These information are available to authorized users of the system via website and also by using mobile application.

Keywords: **Intelligent Transportation System**, **GPS** (**G**lobal **P**ositioning **S**ystem), **GPRS** (**G**eneral **P**acket **R**adio **S**ervice), **GSM** (**G**lobal **S**ystem for **M**obile Communication), **In-Vehicle Unit**, **Tracking Server**, **HTTP** (**H**yper **T**ext **T**ransfer **P**rotocol), **Cloud Server**

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

1G	:	First Generation
2G	:	Second Generation
ADC	:	Analog Digital Converter
ADT	:	Android Development Tools
AJAX	:	Asynchronous JavaScript And XML
API	:	Application Programming Interface
ASCII	:	American Standard Code for Information Interchange
ASP	:	Active Server Pages
AT	:	Attention
CAN	:	Controller Area Network
COM	:	Communication
CPU	:	Central Processing Unit
CS	:	Control Segment
CSS	:	Cascading Style Sheets
DBMS	:	Data Base Management System
DCS	:	Digital Cellular Service
DUART	:	Dual Universal Asynchronous Receiver/Transmitter
EDGE	:	Enhanced Data rates for GSM Evolution
EEPROM	:	Electrically Erasable Programmable Read Only Memory

EGNOS	:	European Geostationary Navigation Overlay Service
EGSM	:	Extended Global System for Mobile Communication
EIA	:	Electronics Industries Association
FTP	:	File Transfer Protocol
GND	:	Ground
GPRS	:	General Packet Radio Services
GPS	:	Global Positioning System
GSM	:	Global System for Mobile Communication
GUI	:	Graphical User Interface
HTML	:	Hyper Text Markup Language
HTTP	:	Hyper Text Transfer protocol
ID	:	Identification
IDE	:	Integrated Development Environment
IP	:	Internet Protocol
IMSI	:	International Mobile Subscriber Identity
ITS	:	Intelligent Transportation System
JS	:	JavaScript
JSON	:	JavaScript Object Notation
LCD	:	Liquid Crystal Display
LED	:	Light Emitting Display
LVTTL	:	Low Voltage Transistor Transistor Logic

MHz	:	Mega Hertz
MVC	:	Model View Controller
NMEA	:	National Marine Electronics Association
OEM	:	Original Equipment Manufacturer
PC	:	Personal Computer
PCS	:	Personal Communication Service
PHP	:	Hypertext Preprocessor
PIN	:	Personal Identification Number
PSTN	:	Public Switched Telephone Network
RAM	:	Random Access Memory
RD	:	Receive Data
REST	:	Representational State Transfer
RF	:	Radio Frequency
RINEX	:	Receiver Independent Exchange Format
RISC	:	Reduced Instruction Set Computer
RMC	:	Recommended Minimum Sentence C
ROM	:	Read Only Memory
RS-232	:	Recommended Standard 232
RS-422	:	Recommended Standard 422
RS-485	:	Recommended Standard 485
RTCM	:	Radio Technical Commission for Maritime Services

SBAS	:	Satellite Based Augmentation System
SBS	:	Smart Bus System
SDK	:	Software Development Kit
SFTP	:	Secure File Transfer Protocol
SIM	:	Subscriber Identity/ Identification Module
SMS	:	Short Message Service
SQL	:	Structured Query Language
SRAM	:	Static Random Access Memory
SS	:	Space Segment
SVG	:	Scalable Vector Graphics
TD	:	Transmit Data
UART	:	Universal Asynchronous Receiver/Transmitter
UI	:	User Interface
URL	:	Uniform Resource Locator
US	:	User Segment
USART	:	Universal Synchronous/Asynchronous Receiver/Transmitter
USB	:	Universal Serial Bus
VB	:	Visual Basic
WAAS	:	Wide Area Augmentation System
XHTML	:	EXtensible HyperText Markup Language
XML	:	EXtensible Markup Language

1. INTRODUCTION

1.1. Background

The existing public transportation system in our country is troublesome for the general public. There is no systematic provision for traffic routes and hardly any vehicle arrives at a station on time. Under such circumstances people are compelled to waste a good part of their busy schedules waiting for their buses to arrive. The system, 'Intelligent Transportation System' seeks a solution to this prevailing problem of public transportation in Nepal and focuses to make public transportation systematic, dependable and easy to use. The design of this system uses Global Positioning System (GPS) and Global System for Mobile Communications (GSM) technologies. Each vehicle within the system is fitted with an In-Vehicle unit which consists of a GPS module and a GSM modem interfaced to microcontroller. The GPS module provides the location of the vehicle and this information is sent to a web server via GSM network using GPRS service. People can then access the location of the vehicle by logging into a website through their mobile phone with internet accessibility and also by using mobile application. The system is efficient, cost effective and useful in our nation's context. It provides a real time solution to the existing problem in public transportation system.

1.1.1. Background Research

Different countries have carried out different projects on intelligent transportation systems. Some of those projects have been taken as basis of research for our project. Those projects are listed below.

- GPS GSM Integration for Enhancing Public Transportation System: This system design is based on Global Positioning System (GPS) and Global System for Mobile Communications (GSM). The bus has an On-Board module which consists of a GPS module and a GSM modem interfaced with a microcontroller. GPS receiver identifies the location of the vehicle and the information of the vehicle’s location is sent to a web server via GSM network using SMS service. People can know the whereabouts of the vehicle by logging into a website through their mobile phone with internet accessibility [1].

- Winnipeg Transit System: According to Winnipeg Transit System bus riders in Winnipeg can access real-time bus schedule on the Winnipeg Transit website, on their smart-phones, and via SMS text messages. Winnipeg Transit’s Open Data Web Service provides a way for developers to retrieve live information about Winnipeg Transit’s services [2].

1.2. Problem Statement

Nepal is a developing country and many aspects in the field of transportation require improvement. Transportation is one of the most important infrastructures for the general public. The day to day activities of the general public depends upon quality of service provided by the public transportation system. Buses should arrive at each station at the scheduled time, but the schedule may be affected by certain unforeseeable occurrences such as traffic jams, road blocks, rallies etc. The bus schedule is also affected by the mood/nature of the drivers - they may choose to leave from the station either earlier or later than the scheduled time. Thus, people are compelled to waste a good part of their busy schedules waiting for their buses to arrive. So, it is necessary that public transport users know when buses will arrive so that they can manage their schedules to meet with the bus' schedule. There is also need of a control system that monitors the movement of vehicles at the station to ensure that buses do not queue up at the bus station resulting in a traffic jam. In order to solve these problems, there is need of a "Vehicle Tracking System" which helps in systemizing public transportation system making it more effective and efficient.

1.3. Objectives

The project objectives are listed as below:

- To develop an accurate vehicular tracking system to monitor and manage a public transportation system.
- To provide commuters with exact location and estimated schedule of buses through notification board at bus stops or more conveniently through a website and an android application.

1.4. Scope

Tracking systems have widespread scope in many different fields all over the world. Our project is constrained to the tracking of public vehicles for improving the public transportation experience for the general public, but the concept of tracking systems is very vast and finds application in many areas such as animal tracking - including both pets and wild animals to know their whereabouts continuously as well as to protect the endangered species against their poaching. Tracking systems can also be used as a security system for elderly people to track their movements by constant monitoring. Such systems may be even implemented in accident detection of vehicles so that immediate action can be taken. Also, private vehicles can be tracked in case of theft. Additionally, very important transportation systems like school/college buses, ambulances etc. can be kept under constant monitoring. Similarly, cargo trucks and truck carrying petrol and diesel for the purpose of export and import can also be tracked to know when and where the trucks stop and for how much time.

1.5. Project Summary

The project " Intelligent Transportation System" is an attempt to design a tracking unit that uses GPS to determine the precise location of a vehicle. This information is then conveyed to a remote server through a GSM modem using GPRS connection. The end user can view the location of the vehicle by accessing the remote server. The system, designed in this project, incorporates a hardware device installed in the vehicle (In-Vehicle Unit) and a remote Tracking Server. The information is transmitted to Tracking Server using GSM/GPRS modem on GSM network by using direct HTTP connection with Tracking Server through GPRS. Tracking Server receives the vehicle location information and stores it in a database. This information is available to authorized users of the system via a website or via an android application. In this system, GPRS technology is used to forward the coordinates and time information to the data server at a designated static IP address. In the website and the android application, the position of the vehicle is plotted on Google maps. This system gives the current vehicle location whenever needed with reliable accuracy. This project also gives functional, technical description and software implementation for the GPS and GSM/ GPRS based vehicle tracking system.

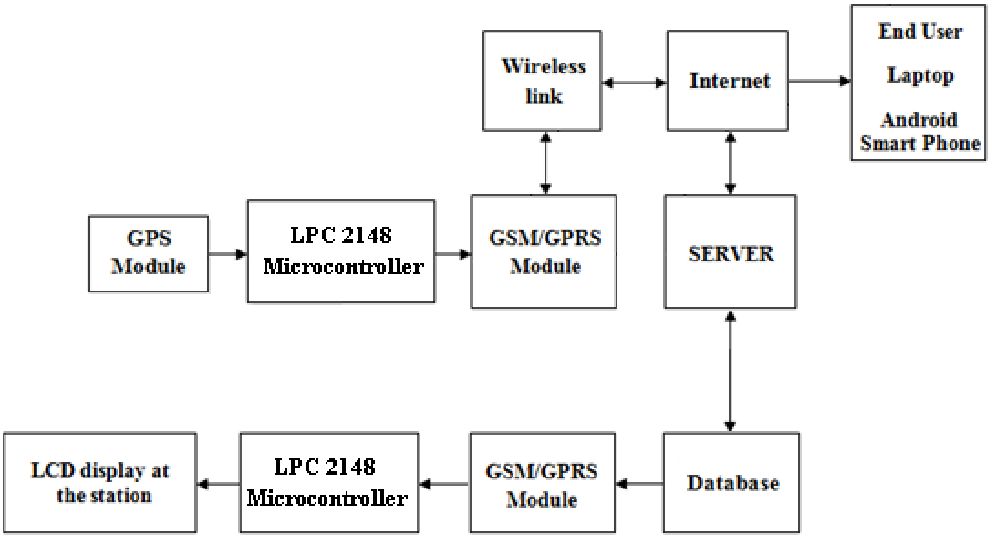


Figure 1.1: Block Diagram of the system

2. LITERATURE REVIEW

Vehicle Tracking Systems are developed and deployed in numerous environments. These systems are capable of transmitting vehicle’s location information and other custom parameters. In this project, we present the design and implementation of a system that incorporates a hardware device installed in the vehicle and a remote data center with tracking sever and a web application with Google Maps API to plot the trail of the vehicle. The vehicle’s location is determined using GPS, while the transmission mechanism can be satellite, terrestrial radio or cellular connection from the vehicle to a radio receiver, satellite or nearby cell tower. Once the positioning data is collected, it is transmitted through a wireless communication system. The most economical viable service used for this purpose is GSM/GPRS. In this project, we briefly describe the architecture and implementation of a Vehicle Tracking Systems using GPS for positioning information and GSM/GPRS for transmission of the information. The design and implementation of the system includes acquisition and transmission of vehicle’s location information and idling information to the data center/tracking server.

Vehicle tracking and security applications using GPS and GSM technology have been invented and implemented in different geographical locations serving different applications. The use of GPS enabled vehicles has made life easy as one can get to an unknown place with no help of others. Different projects concerning vehicle tracking are proposed and are implemented intending to make transportation and navigation easier, effective and systematic. So far sufficient research has not been carried out in this topic in Nepal. Our project is an attempt to make public transportation somewhat regulated and user friendly. A similar project was carried out by the students of the University of Victoria titled “Design a Smart Bus System” where the students have explored ideas of integrating the Victoria Regional Transit System with appropriate communication technologies and developing a corresponding smart-phone application. In the SBS, users can access real-time passenger information such as schedules, trip planners, bus capacity estimates, bike rack availability and bus stop locations, using their smart-phones or their computers at bus stops. This system is inclusive to all users including people with special needs. Here, the GPS is used to obtain the current location of the bus and the obtained location in latitude and the longitude is conveyed to the central server using GSM. The end user can obtain this information by logging into the server. Beside this, the data is also transmitted to the bus station where it is displayed in the LCD [3].

3. METHODOLOGY

3.1. System Block Diagram

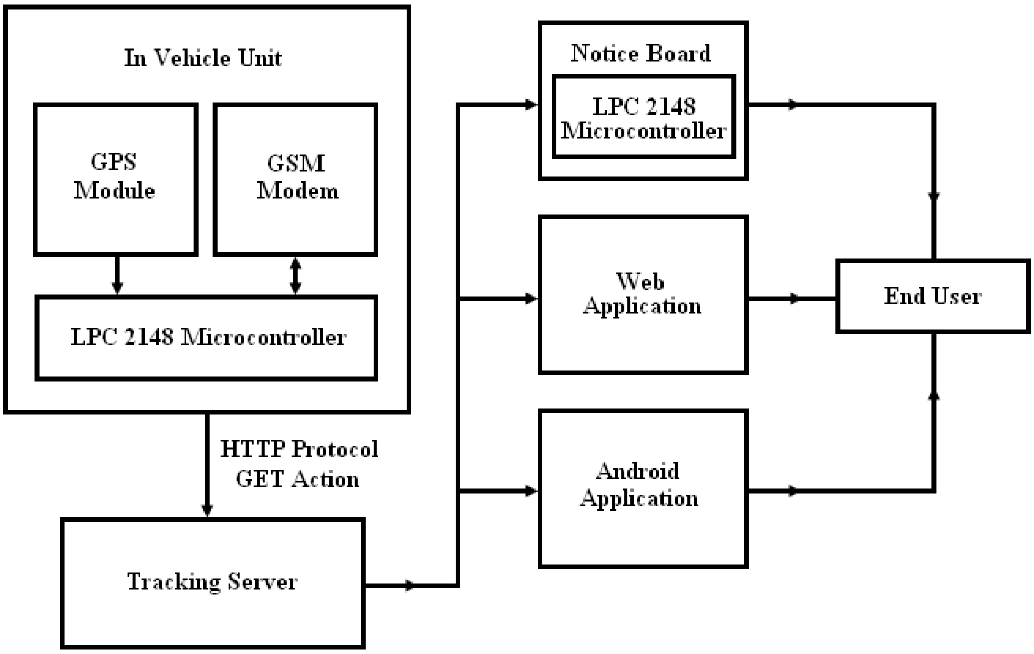


Figure 3.1: System Overview

The overall system is partitioned into three major design units:

- In-Vehicle Unit
- Tracking Server
- Notice Board

The In-vehicle unit and Notice Board at station consist of hardware as well as software whereas the Tracking Server is software only. The basic methodology used in our project can be described from the system overview presented in Figure 3.1.

The methodology of vehicle tracking includes the following steps:

- The GPS Receiver receives the GPRMC signal sent from the satellite. The signal contains different information like date, time, latitude and longitude at the time of transmission from the satellite.
- LPC2148 is serially interfaced with the GPS module. The signal received from the GPS Receiver is decoded and is passed to the GSM Modem.
- GSM Modem is also serially interfaced with the LPC2148 and operates based on the AT command it receives from the processor. The processor sends the GPS data to the Tracking Server using AT commands for HTTP protocol via GPRS connection.
- In the Tracking Server the data received through GPRS is collected in a database using ASP.NET.MVC.
- The data is then retrieved by web and mobile applications which plots the data in Google maps and presents it to the end user.
- The end user can know the position of vehicle by using web browser (intelligenttransportation.net76.net/final/index2.php) or through android application.
- For users at the bus stations, the vehicle information is displayed on an LCD Notice Board display. The data from the Tracking Server is retrieved using a GSM/GPRS connection and the data is forwarded to the LPC2148 microcontroller which displays it in the LCD Notice Board.

The three sections of this project are separately described below:

3.1.1. In-Vehicle Unit

The In-Vehicle unit contains three main components.

- GPS Receiver: It receives the GPS signal from the satellite. The signal contains different information like date, time, latitude and longitude at the time of transmission from the satellite.
- GSM Modem: The GSM modem operates based on the AT command it receives from the microcontroller. It is used to establish and maintain a

connection with the Tracking Server using HTTP protocol over a GPRS connection.

- LPC2148 microcontroller: It is serially interfaced with both the GPS module and the GSM modem. The LPC2148 microcontroller processes the location information received from the GPS receiver and sends it to the Tracking server using HTTP protocol via GPRS connection established using the GSM modem.
- LCD: The LCD is used for displaying the current position of the vehicle.

Flow Diagram

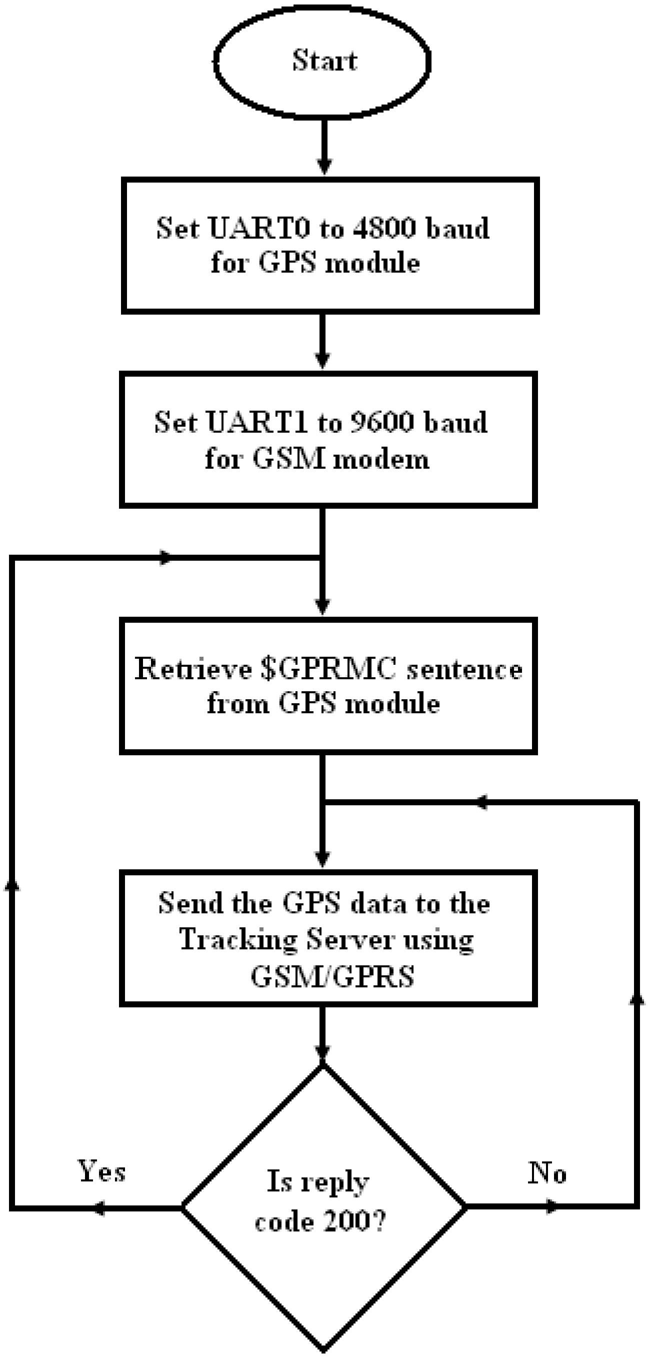

Start
Set UART0 to 4800 baud for GPS module
Set UART1 to 9600 baud for GSM modem
Retrieve $GPRMC sentence from GPS module
Send the GPS data to the Tracking Server using GSM/GPRS
Is reply code 200?
Yes
No

Figure 3.2: Flow Diagram of In Vehicle Unit

Working Principle

The GPS module, interfaced serially to the LPC2148 microcontroller, receives the location information from the satellite. The received data is sent to the microcontroller serially at a rate of 4800 baud. The received data can be selected among different formats like RMC, RINEX, RTCM SC-104, and NMEA 0813. In this project the RMC format is used and the $GPRMC data is read from the GPS module. This format contains different information like Universal Time Constant, Latitude, Longitude, Speed, etc. The GPRMC string is read by the microcontroller from the GPS module and is transferred to the Tracking Server via HTTP protocol over a GPRS connection made using the GSM modem. For connecting with the Tracking Server, the microcontroller is used to send several initialization AT commands to the GSM modem to establish a GPRS connection and to set up HTTP protocol parameters [4]. The GSM modem communicates with the LPC 2148 microcontroller through serial interface. The baud rate for serial communication between GSM modem and microcontroller can be altered. In this project, for simplicity the default rate of 9600 baud is used. The command sequence sent to the GSM modem for setting up the GPRS connection and HTTP protocol are listed below:

- AT+CPIN(to check if the SIM is ready)
- AT+CREG?(to check network registration)
- AT+SAPBR (for bearer checking)
- AT+HTTPINIT (for HTTP initialization).
- AT+HTTPPARA(to set HTTP parameter)
- AT+HTTPACTION(for GET and POST action of HTTP)

3.1.2. Tracking Server

Block Diagram

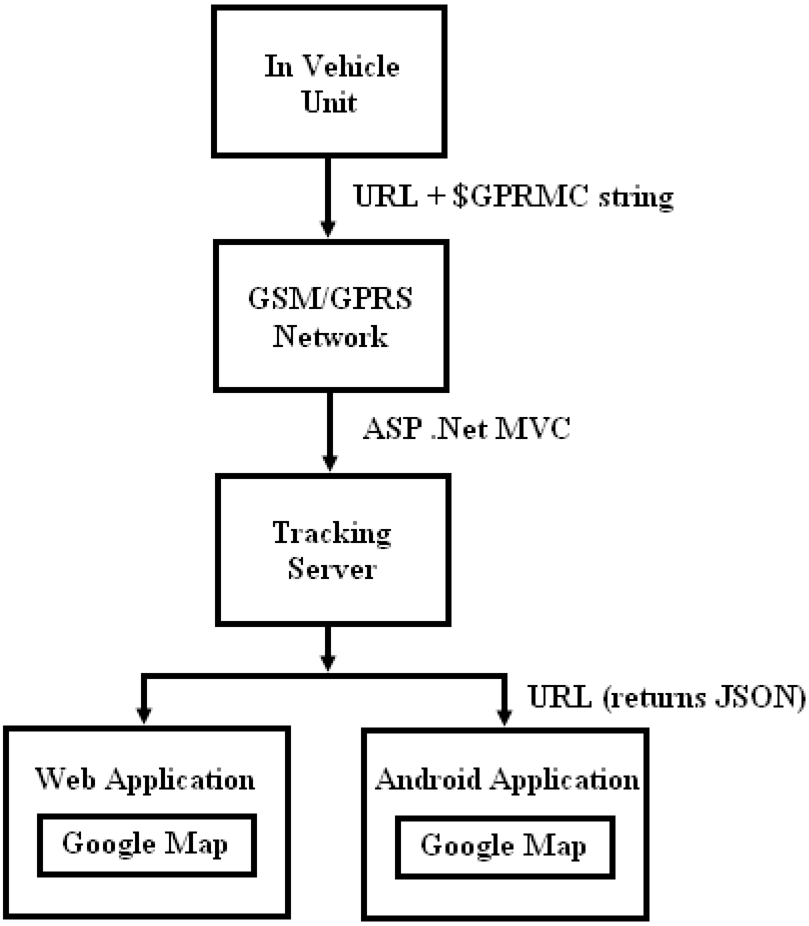


Figure 3.3: Block Diagram of User Interface Unit

Working Principle

For our user-interface application of this project, server side and client side applications have been developed.

Server Side

At the server side, a database, maintained using ASP.NET MVC programming, is used to store GPRMC values sent by the In-Vehicle Unit over the GPRS connection. To connect to server side, three URLs have been created:

- api/viewdata : to view data stored in database in listed form
- api/Store?{GPRMC value} : to send new GPRMC value to database
- api/GetData/{devid} : to retrieve latest location data stored in database

Client Side

In Client side, for flexible user interface, a web as well as an android mobile application has been developed.

Web Application

In the web application, the homepage allows user to select the vehicle to track. Once the selection is made the user is navigated to another page which displays full window Goggle map with an icon of the vehicle showing the present position of the selected vehicle as well as a pointer showing the user's current location. Each time there is a change in the position of the vehicle, the vehicle indicator icon will get refreshed to the new position without need to refresh whole page.

Android Mobile Application

In the android mobile application, the first screen consists of a Launch Map button. When the user clicks on the Launch Map button, the application connects to the Tracking Server database and extracts the most recent latitude and longitude data in JSON format. This data, after proper parsing, is then plotted in Google maps thus allowing the user to track the desired vehicle.

3.1.3. Notice Board

The Notice Board display at the bus stations consists of the following hardware components.

- GSM Modem: The GSM modem at the bus station is also used to establish and maintain a GPRS connection. It is used to get location data from the Tracking Server. The location data contains information about the vehicle like current vehicle ID, latitude and longitude.

- LPC2148 Microcontroller: The LPC2148 modem is interfaced with the GSM modem serially. The microcontroller first initializes the GSM modem by sending AT commands to set up the GPRS connection and also to initialize the HTTP parameters. It then issues the HTTP GET commands to request location data from the Tracking Server. Upon receiving the data from the tracking server the microcontroller sends it to the LCD for displaying.
- LCD: It is used for displaying information like current vehicle ID, latitude and longitude at the bus station.

Flow Diagram

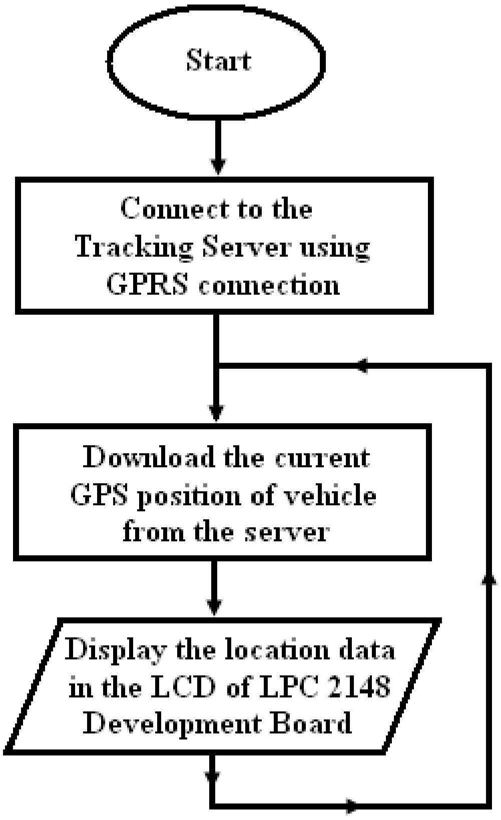

Start
Connect to the Tracking Server using GPRS connection
Download the current GPS position of vehicle from the server
Display the location data in the LCD of LPC 2148 Development Board

Figure 3.4: Flow Diagram of Notice Board System

Working Principle

The data from data base is obtained by the GSM/GPRS module by using the GET action of the HTTP protocol. This data is further forwarded to the LPC2148 microcontroller and finally displayed in LCD at the station.

4. COMPONENTS AND TECHNIQUES

4.1. Hardware Implementation

4.1.1. LPC2148 Development Board

The eCee LPC 2148 Development and Evaluation Board from RhydoLabz can be used to evaluate and demonstrate the capabilities of NXP LPC 2148 microcontrollers. The board (with a base board and header board) is designed for general purpose applications and includes a variety of hardware to exercise microcontroller peripherals. The LPC 2148 Board contains all hardware components that are required in a single-chip LPC 2148 system plus 2 COM ports for serial RS-232 output and interfaces like LCD, Buzzer, Keyboard, Temperature Sensor, Potentiometer, LEDs, EEPROM etc. [5] .

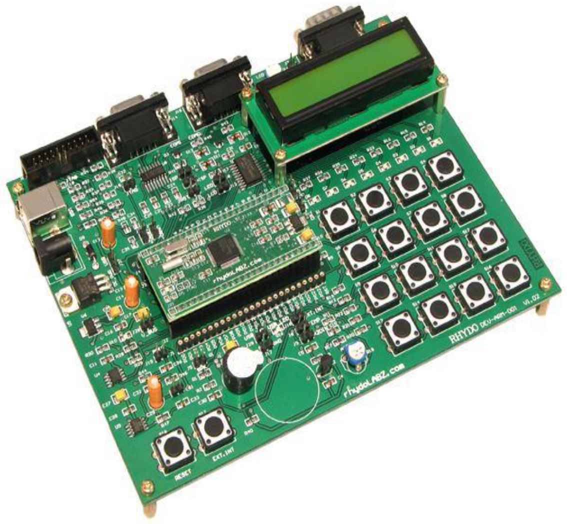


Figure 4.1: LPC2148 Development Board

Features [6]

- Includes LPC 2148 Header Board
- No Separate power adapter required (USB power source)
- Two RS-232 Interfaces (For direct connection to PC’s Serial port)
- On Board Two Line LCD Display (2x16) (with jumper select option)

- On Board USB Connector
- On Board 1 Amp Voltage Regulator
- On Board Connector for regulated 3V output
- On Board Connector for regulated 5V output
- Three On Board DB9 Connectors (Two for UART and One for CAN)
- On Board Reset button

In this project, the serial port interface (COM0) has been used for GPS interface and serial port interface (COM1) has been used for GSM interface. The 5 volt output obtained from pin number 0 and 1 of the microcontroller has been used as a power supply to the GPS receiver. The LCD display, available in the development board, has been utilized as the Notice Board display to display the latitude and longitude information.

4.1.2. GPS

The GT-320R module has been used as the GPS receiver in this project. The GT-320R is a compact all-in-one GPS module intended for a broad range of OEM products, where fast and easy system integration and minimal development risk is required. The module continuously tracks all satellites in view and provides accurate satellite positioning data. Its 12 parallel channels and 4100 search bins provide fast satellite signal acquisition and short startup time. Its low power consumption is suitable for a wide range application in handhelds, sensors, asset tracking, and vehicle navigation products. Both the LVTTL-level and RS232-level serial interface are provided on the interface connector. Supply voltage of 3.8V~8.0V is supported [7].

Features [7]

- 12 parallel channel GPS receiver
- 4100 simultaneous time-frequency search bins
- SBAS (WAAS, EGNOS) support
- -140dBm acquisition sensitivity

- -150dBm tracking sensitivity
- < 10 second hot start
- < 50 second cold start

Table 4.1: Pin Out Function Description of GT-320R GPS module

Pin	Signal Name	Description
1	Serial Data Out (LVTTL)	Asynchronous serial output at LVTTL level
2	Serial Data In (LVTTL)	Asynchronous serial input at LVTTL level
3	Serial Data Out (RS-232)	Asynchronous serial output at RS-232 level
4	Serial Data In (RS-232)	Asynchronous serial input at RS-232 level
5	Power	3.8V~8.0V DC input
6	Ground	Power and signal ground

4.1.2.1. NMEA 0183

It refers to GPS data stream in ASCII format. The NMEA 0183 data stream includes information on position, datum, water depth and other variables. The data is sent in the form of sentence each starting with a $ sign and terminating with a carriage return –line feed. The $ sign is followed by five characters address field which identifies the talker, the data type and the string format of the successive fields. The last field in any sentence is a check sum filed which follows a checksum delimiter “*”. The maximum total number of characters in any sentence is 82 [8].

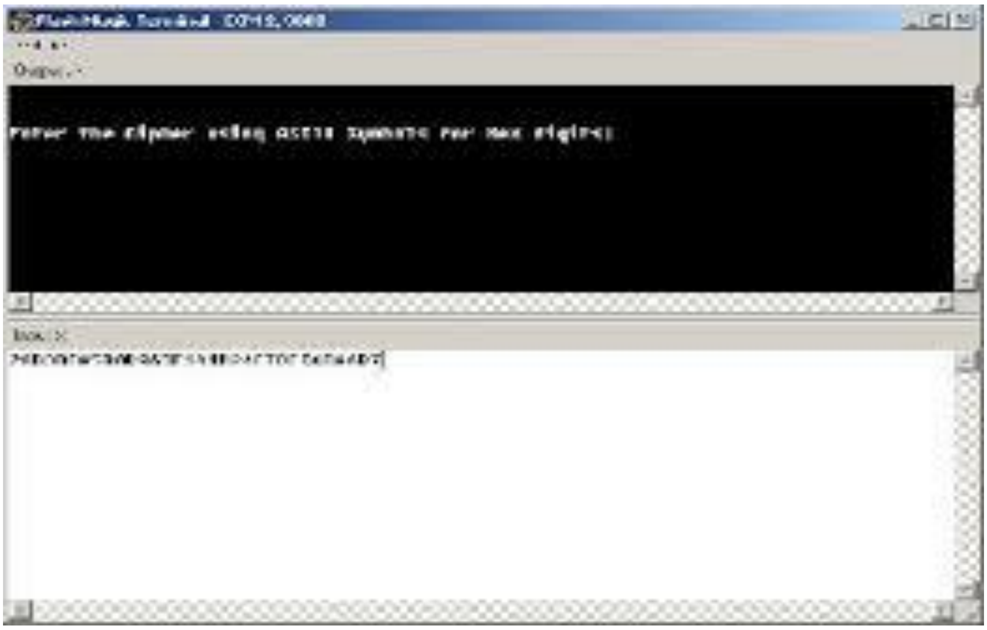
An example $GPRMC response is shown below and the break-down of the GPRMC sentence is presented in Table 4.2.

```
$GPRMC,123519,A,4807.038,N,01131.000,E,022.4,084.4,230394,003.1,W*6A
```

Table 4.2: RMC Data format

RMC	Recommended Minimum Sentence C
123519	Fix taken at 12:35:19
A	Status A=active or V=valid
4807.038,N	Latitude 48 07.038 N
01131.000,E	Longitude 11 31.000 E
022.4	Speed over ground in knots
084.4	Track angle in degrees true
230394	Date – 23rd March 1994
003.1,W	Magnetic Variation
*6A	Checksum data, always begins with *

4.1.2.2. Testing of GPS using Flash Magic Terminal



```
Enter the cipher using ASCII symbols for hex digits:
```

```
[illegible]
```

Figure 4.2: Data obtained from GPS module using Flash Magic Terminal

4.1.2.3. Interfacing GPS with LPC2148

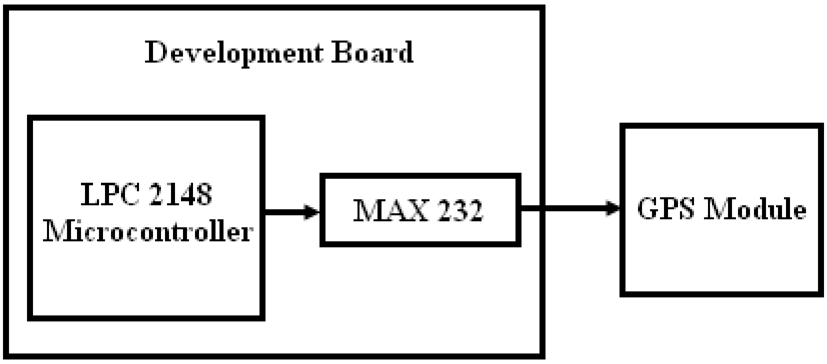


Figure 4.3: Interfacing of GPS module with LPC 2148

Figure 4.3 shows how the GPS module has been interfaced with the microcontroller. The GPS module continuously transmits serial data (RS-232 protocol) in the form of sentences according to NMEA standards. The latitude and longitude values of the location are contained in the GPRMC sentence (refer NMEA format). To communicate over UART, just three basic signals are needed which are namely, RD (receive), TD (transmit), GND (common ground).

4.1.3. GSM

The GSM modem used in this project is SIM 900A GSM modem. It works on frequencies EGSM 900MHz/DCS 1800MHZ and GSM 850MHz/PCS 1900MHz.The module is fitted with standard interface for a power supply, an antenna, a pc and a headset with its plug and play technology. It uses SIM Card and can be controlled by means of AT Commands.

Features [4]

- Quad-Band 850/ 900/ 1800/ 1900 MHz
- Dual-Band 900/ 1900 MHz
- GPRS multi-slot class 10/8 GPRS mobile station class B
- Compliant to GSM phase 2/2+Class 4 (2 W @850/ 900 MHz)
- Class 1 (1 W @ 1800/1900MHz)

- Control via AT commands (GSM 07.07 ,07.05 and SIMCOM enhanced AT Commands)
- Low power consumption: 1.5mA(sleep mode)
- Operation temperature: -40°C to +85 °C
- Status of Modem Indicated by LED
- Simple to Use & Low Cost
- Quad Band Modem supports all GSM operator SIM cards

Figure 4.4: SIM900 GSM modem

4.1.3.1. Interfacing GSM modem with LPC2148

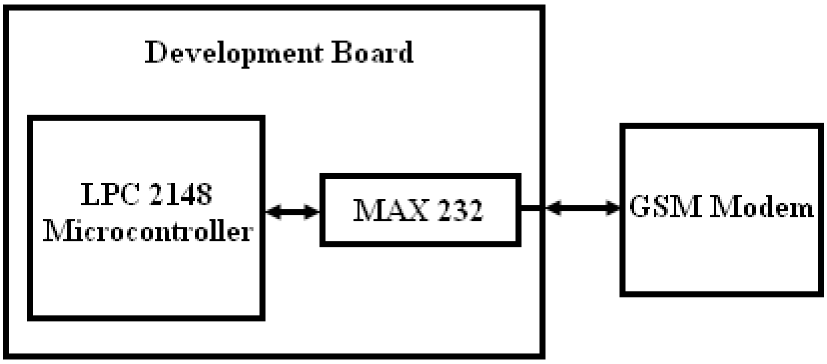


Figure 4.5: Interfacing of GSM modem with LPC 2148

Figure 4.5 shows how the GSM modem is interfaced with the microcontroller. The GSM modem communicates with the microcontroller through UART. To communicate over UART, just three basic signals are needed which are namely, RD (receive), TD (transmit), GND (common ground). In this scheme RTS and

CTS signals of serial port interface of GSM modem are connected with each other. The transmit signal of serial port of microcontroller is connected with transmit signal (TD) of the serial interface of GSM Modem while receive signal of microcontroller serial port is connected with receive signal (RD) of serial interface of GSM Modem. The GSM modem is used in the data acquisition section of the project for transmitting the received GPS data to the Tracking Server via GPRS connection. The modem is given the appropriate AT commands by the microcontroller to which it is interfaced through the serial port. Software flow control mechanism is employed for transferring the data between the microcontroller and a modem.

4.1.4. UART

Universal Asynchronous Receiver/Transmitter, abbreviated UART is a piece of computer hardware that translates data between parallel and serial forms. A UART is usually an individual (or part of an) integrated circuit used for serial communications over a computer or peripheral device serial port. UARTs are now commonly included in microcontrollers. A DUART combines two UARTs into a single chip. Many modern ICs now come with a UART that can also communicate synchronously; these devices are called USARTs. The UART takes bytes of data and transmit the individual bits in a sequential fashion. At the destination, a second UART re-assembles the bits into complete bytes. Each UART contains a shift register, which is the fundamental method of conversion between serial and parallel forms. Serial transmission of digital information (bits) through a single wire or other medium is less costly than parallel transmission through multiple wires. The UART usually does not directly generate or receive the external signals used between different items of equipment. Separate interface devices are used to convert the logic level signals of the UART to and from the external signaling levels. External signals may be of many different forms. Examples of standards for voltage signaling are RS-232, RS-422 and RS-485 from the EIA [9].

4.1.5. Liquid Crystal Display

LCD is an electronic visual display device. It uses light modulating properties of liquid crystals. It has been used to display current position (latitude, longitude, time and speed). The LCD screen is used in this project because of its ability to display numbers, characters, and graphics as well as because of its low price and easy availability in the market. LCD incorporates a refreshing controller. Based on the command, it can be operated in either four bit mode or in eight bit mode.

4.2. Software Implementation for Web

4.2.1. ASP.NET MVC

The ASP.NET MVC is an open source web application framework that implements the model–view–controller (MVC) pattern. Based on ASP.NET, ASP.NET MVC allows software developers to build a web application as a composition of three roles: Model, View and Controller. The MVC model defines web applications with 3 logic layers:

- Model (business layer)
- View (display layer)
- Controller (input control)

A model represents the state of a particular aspect of the application. A controller handles interactions and updates the model to reflect a change in state of the application, and then passes information to the view. A view accepts necessary information from the controller and renders a user interface to display that information [10].

Features [10]

- Compatible Language: C#, VB.net
- Operating System: Cross Platform
- Platform: Net Framework, Mono
- Type: Web Application framework
- License: Apache License 2.0

In the server side of this project, enriched classes of ASP.NET MVC were used for function such as parsing NMEA string of GPS, sent by the hardware device, into location, latitude, date, time and velocity and tracking changes in the Tracking Server.

4.2.2. ASP.NET Web 2.0

ASP.NET Web 2.0 API is a framework that makes it easy to build HTTP services that reach a broad range of clients, including browsers and mobile devices. ASP.NET Web API is an ideal platform for building REST full applications on the .NET Framework. A Web 2.0 site may allow users to interact and collaborate with each other in a social media dialogue as creators of user-generated content in a virtual community, in contrast to Web sites where people are limited to the passive viewing of content. Examples of Web 2.0 are blogs, wikis, folksonomies, video sharing sites, hosted services, Web applications, and mashups.

4.2.3. Microsoft Azure

Microsoft Azure is a cloud computing platform and infrastructure, created by Microsoft, for building, deploying and managing applications and services through a global network of Microsoft-managed data centers [11].

Features [11]

- Websites that allows developers to build sites using ASP.NET, PHP, Node.js, or Python and can be deployed using FTP, Git, Mercurial or Team Foundation Server.

- Virtual machines that let developers migrate applications and infrastructure without changing existing code, and can run both Windows Server and Linux virtual machines.
- Cloud services - Microsoft's Platform as a Service (PaaS) environment that is used to create scalable applications and services. Supports multi-tier scenarios and automated deployments.
- Data management - SQL Database, formerly known as SQL Azure Database, works to create, scale and extend applications into the cloud using Microsoft SQL Server technology. Integrates with Active Directory and Microsoft System Center and Hadoop.
- Media services - A PaaS offering that can be used for encoding, content protection, streaming, and/or analytics.

4.2.4. Visual Studio 2013

Visual Studio 2013 is a developer tool that allows developers to create applications for Windows 8.1, Windows Phone, the web or the cloud as well as standards-based, responsive websites, web APIs, or real-time online experiences using ASP.NET. It helps in publishing web application directly to Windows Azure from the IDE as well as to create web services consumed by connected devices.

4.2.5. Web Hosting Service Provider (000webhost.com)

000webhost.com ($0.00 webhost), is an industry leader in providing top class free web hosting services. Every account receives 1500MB space and a whopping 100G bandwidth free of cost. This was the main point of attraction about this web hosting service. As this project is not yet commercially launched, occasional server overload can be tolerated and so this free web hosting service was used. It also supports various software/services like My SQL, PHP MyAdmin, Website Builder, File Manager, Free Domain Name etc.

4.2.6. Domain Name (.net76.net)

The webhost also provides free domain name as “.net76.net”. The registered domain name, in 000webhost.com, web hosting service, for this project’s website is www.intelligenttranspotationsystem.net76.net.

4.2.7. HTML

Hyper Text Markup Language (HTML) is the main markup language for displaying web pages and other information that can be displayed in a web browser. HTML is written in the form of HTML elements consisting of tags enclosed in angle brackets (like <html>), within the web page content. HTML tags most commonly come in pairs like <h1> and </h1>, although some tags, known as empty elements, are unpaired, for example <img>. The first tag in a pair is the start tag, the second tag is the end tag (they are also called opening tags and closing tags). In between these tags web designers can add text, tags, comments and other types of text-based content [12].

4.2.8. JavaScript

JavaScript is a programming language used to make web pages interactive. It runs on visitor's computer and doesn't require constant downloads from website. It is programming code that can be inserted into HTML pages to be executed by web browser. Most of the APIs’ that we have used are scripted in JavaScript [12].

4.2.9. CSS

Cascading Style Sheets (CSS) is a style sheet language used for describing the look and formatting of a document written in a markup language. While most often used to style web pages and user interfaces written in HTML and XHTML, the language can be applied to any kind of XML document, including plain XML, SVG and XUL.

In this project, CSS have been used for formatting our client side webpage [13].

4.2.10. Adobe Dreamweaver CS6

Adobe Dreamweaver is a web development tool, developed by Adobe Systems, that provides Design view and a code editor with standard features such as syntax highlighting, code completion, and code collapsing as well as more sophisticated features such as real-time syntax checking and code introspection for generating code hints to assist the user in writing code. Dreamweaver features an integrated browser for previewing developed WebPages in the program's own preview pane in addition to allowing content to be open in locally installed web browsers. Dreamweaver can use third-party "Extensions" to extend core functionality of the application, which web developers can write (largely in HTML and JavaScript). Dreamweaver, like other HTML editors, edits files locally then uploads them to the remote web server using FTP, SFTP, or WebDAV. It supports different language like: Active Server Pages (ASP), C#, Cascading Style Sheets (CSS), HyperText Markup Language (HTML), Java, JavaScript, PHP: Hypertext Preprocessor (PHP), etc. This software was used for developing client side webpage using html, java script and CSS [14].

4.3. Software for Android Application development

4.3.1. Eclipse ADT

ADT (Android Development Tools) is a plug-in for Eclipse that provides a suite of tools that are integrated with the Eclipse IDE. It offers access to many features that help you develop Android applications quickly. ADT provides GUI access to many of the command line SDK tools as well as a UI design tool for rapid prototyping, designing, and building of application's user interface. Because ADT is a plug-in for Eclipse, the functionality of a well-established IDE, along with Android-specific features that are bundled with ADT is available.

The following describes important features of Eclipse and ADT [15]:

- **Integrated Android project creation, building, packaging, installation, and debugging**: ADT integrates many development workflow tasks into

Eclipse, making it easy for you to rapidly develop and test your Android applications.

- **SDK Tools integration**: Many of the SDK tools are integrated into Eclipse's menus, perspectives, or as a part of background processes ran by ADT.
- **Java programming language and XML editors**: The Java programming language editor contains common IDE features such as compile time syntax checking, auto-completion, and integrated documentation for the Android framework APIs. ADT also provides custom XML editors that let you edit Android-specific XML files in a form-based UI. A graphical layout editor lets you design user interfaces with a drag and drop interface.
- **Integrated documentation for android framework APIs**: You can access documentation by hovering over classes, methods, or variables.

4.3.2. XML

Extensible Markup Language (XML) is a markup language that defines a set of rules for encoding documents in a format that is both human-readable and machine-readable. It is defined in the XML 1.0 Specification produced by the W3C, and several other related specifications, all free standards. The design goals of XML emphasize simplicity, generality, and usability over the Internet It is a textual data format with strong support via Unicode for different human languages. Although the design of XML focuses on documents, it is widely used for the representation of arbitrary data structures, for example in services. Many application programming interfaces (APIs) have been developed to aid software developers with processing XML data, and several schema systems exist to aid in the definition of XML-based languages.

4.3.3. JSON

JavaScript Object Notation is an open standard format that uses human-readable text to transmit data objects consisting of attribute–value pairs. It is used primarily to transmit data between a server and web application, as an alternative to XML.

Although originally derived from the JavaScript scripting language, JSON is a language-independent data format, and code for parsing and generating JSON data is readily available in a large variety of languages. The JSON format was originally specified by Douglas Crock ford. It is currently described by two competing standards, RFC 7159 and ECMA-404. The ECMA standard is minimal, describing only the allowed grammar syntax, whereas the RFC also provides some semantic and security considerations. The official Internet media type for JSON is application/JSON. The file extension name for JSON is .json.

5. TIME SCHEDULE AND COST

5.1. Gantt chart

The time schedule followed through the course of this project is presented in the following Gantt chart.

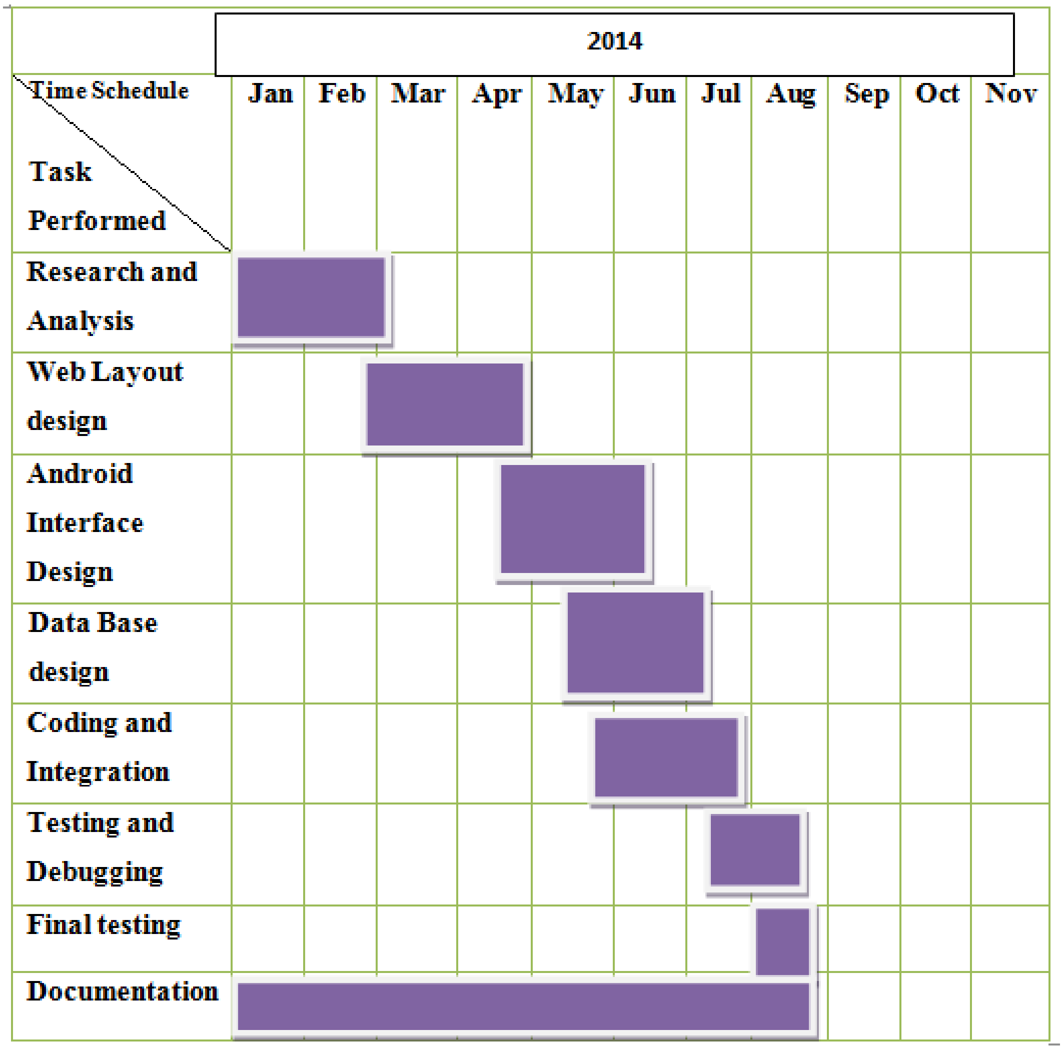


Figure 5.1: Gantt Chart

Legend 🟪 **: Working days**

5.2. Cost Description

Table 5.1: Cost Description Table of the Project

Items	Quantity	Amount (Rs)
eCee LPC 2148 Development Board	1	12,000
GPS module	1	3,500
GSM modem	1	5,500
DB9 connectors	4	60
Serial to USB converter	1	600
Battery	1	100
Grand Total		21,760

6. RESULT

The principle objective of the project “Intelligent Transportation System” was to develop an efficient and accurate vehicle tracking system for use in public transportation. In addition to this, the project objective also included a means to inform the general public about location of vehicles through a notice board system at every bus station and via web and android applications.

To build the vehicle tracking system, an embedded system was built consisting of a GPS module and a GSM modem interfaced with an LPC2148 development board. This system is designed to be mounted on to every public vehicle currently in operation within the public transportation system. The interface between all the modules used in this tracking system meets the desired operation requirements and the overall system has been tested successfully. The LPC2148 microcontroller reads the GPRMC location data from the GPS module. The microcontroller also communicates with the GSM modem via AT commands and initializes and sets up GPRS connection and HTTP transmission protocol. The microcontroller communicates the location data to the central data server thorough the GPRS connection.

The central database server holds the database that stores the location information of all the vehicles in the public transportation system. The central database of the system is built on Microsoft Azure cloud storage. The database server receives the full length GPS data in raw GPRMC format and parses the raw GPRMC string to extract location, date and time information. This stored data is available for download and is used to display location information to the end user.

The end user can access the location data of a vehicle by three means – namely notice board display at bus station, web application and android application.

The notice board display unit is used to display the location data of vehicles to the commuters at the bus stations. The notice board display unit consists of an LPC2148 development board, a GSM modem. The LPC2148 microcontroller communicates with the central database server through a GPRS connection established using the GSM modem. The microcontroller then prints out the location information on the LCD display present on the development board.

The web application is hosted on a free web hosting domain. The project website is intelligenttransportation.net76.net/final/index2.php. The end user can view a Google map plot of the current position of the vehicle by visiting this web page.

The android application also allows the end user to view the location information as a plot on Google map. The application connects to the database sever and extracts the most recent latitude and longitude data. This data, after proper parsing, is plotted in Google maps thus allowing the user to track the desired vehicle.

The objectives set for the project were thus met by the designed system. The final prototype of the system is functional and with some optimization can be developed into a commercially viable product.

7. APPLICATION

This project "Intelligent Transportation System" finds applications in a number of ways:

- **Accurate Vehicle Tracking**: This system involves accurate vehicle tracking. It is used to locate the location of desired vehicles or any objects which location we need to trace.
- **Transportation Management**: Since passengers can get pre-informed of the location of the buses they need to know, it saves considerable amount of time. The queues and crowds in public vehicles and public stations will be minimized.
- **Security Purpose**: The system can be implemented to keep any objects secure against theft. So that it can be used in private vehicle tracking.
- **Implementation with Sajha Yatayat**: The system design can be applied to Sajha Yatayat within the Kathmandu valley. This will help make Sajha Yatayat more popular among the general public and it will be more efficient.

8. PROBLEMS FACED

A number of problems were faced during the project.

- The GPS module returned garbage data in initial days as no data was obtained owing to cold start which was solved later on.
- Connecting to the Server through GPRS required several attempts due to the different errors in the network.
- AT first the online database for the tracking server was created inside 000.webhost.com which is also the web hosting service of the project website, but due to constant error while accessing the database, the database’s location had to be changed to Microsoft Azure Cloud Storage.

9. LIMITATIONS AND FUTURE ENHANCEMENT

The objectives set during the start of the project have almost been met. However, there are some limitations to this project. They are:

- Android application has to be refreshed each time as it receives new data from the server.
- If the GPS module is not used for long time, then cold start occurs during power up. So if the system has to be used after a long time, the cold start time of the GPS module has to be waited out before a correct reading can be made from the module.
- If the LPC2148 board is power cycled/reset but the GSM module is not power cycled/ reset then the LPC2148 board again tries to initialize the GSM module and re-register to the GPRS network but since GSM modem is already registered, the system gets halted.

To solve this problem, the GSM module has to be reset each time the board is reset.

Similarly, there are number of ways in which this project can be enhanced. Some of the planned enhancements to the project are listed below:

- Our system is designed such that the location of the vehicle is displayed on the notice board in the stations which can be further enhanced by implementing audio speakers which will facilitate the visually impaired and uneducated people.
- The system overall would be more effective if the distance and time remaining for the next vehicle to arrive could be calculated and displayed at stations.
- Android application could be improvised further by implementing AJAX for automatic loading of new data from the server.

10. CONCLUSION

A sufficiently accurate vehicle tracking system was successfully designed and implemented by the end of this project. The In-Vehicle Unit designed for the project, effectively communicates location information to the central Tracking Server and the data from the server is promptly made available to the end user via Notice Board display, web application and android application.

This project was very helpful in developing skills demanded by technical design and prototyping work. It helped in building efficient coding skills, debugging and testing skills as well as helped in learning many important aspects of critical problem analysis and troubleshooting. Designing and maintaining the server side database also helped in learning efficient techniques of database management as well as networking.

Apart from technical skills, the project was also helpful in learning the importance of team work. This project was carried out under constraints of time and budget, and helped in learning how to use effective time management and efficient budget allocation techniques to carry out productive work under such constraints. Thus, this project has proven to be a great learning experience and has served as good preparation for working in other such highly technical projects.

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APPENDIX

A.1 Web Application

Web application layout was designed using HTML & CSS.

Major command includes following:

tags	**description**
<div>	Refers to a division or a section in an HTML document. It is used to group block-elements to format them with CSS.
<a href=””></a>	Defines a hyperlink, used to link from one page to another. In the case of our project, we have used sajha.html as link's destination.

Functionality was added to application using Javascript.

Google API’s:

Google Hosted Libraries that serves jQuery to your users directly from Google’s network of datacenters (1.5.1 & 1.8.11 are stable versions).

Insert your generated API key in the required **key** parameter (key=*YOUR_API_KEY)*.

The **sensor** parameter is required and it indicates whether this application uses a sensor (such as a GPS locator) to determine the user's location. Set this value to either true or false.

(i)"http://ajax.googleapis.com/ajax/libs/jquery/1.5.1/jquery.min.js"

(ii)"http://ajax.googleapis.com/ajax/libs/jqueryui/1.8.11/jquery-ui.min.js"

(iii)https://maps.googleapis.com/maps/api/js?key=AIzaSyC6oXZijZTNoggBZxPcdaW6HjY1V7SzQHI&sensor=false

Define Properties for Map

To initialize a Map, we first create a Map properties object to define some properties for the map:

```
var mapProp = {
  center:new google.maps.LatLng(51.508742,-0.120850),
  zoom:7,
  mapTypeId: google.maps.MapTypeId.ROADMAP
};
```

Center

The center property specifies where to center the map. Create a LatLng object to center the map on a specific point. Pass the coordinates in the order: latitude, longitude.

Zoom

The zoom property specifies the initial zoom level for the map. zoom: 0 shows a map of the Earth fully zoomed out. Higher zoom levels zoom in at a higher resolution.

MapTypeId

The mapTypeId property specifies the initial map type to display.

The following map types are supported:

- ROADMAP (normal, default 2D map)
- SATELLITE (photographic map)
- HYBRID (photographic map + roads and city names)
- TERRAIN (map with mountains, rivers, etc.)

Where to Show the Google Map

A named <div> element is often used to hold/show the Google Map:

```
<div id="googleMap" style="width:500px;height:380px;"></div>
```

Create a Map Object

```
var map=new google.maps.Map(document.getElementById("googleMap")
,mapProp);
```

The code above creates a new map inside the <div> element (googleMap) using the parameters that are passed (mapProp).

Add Marker

The Marker constructor creates a marker. (Note that the position property must be set for the marker to display).

Add the marker to the map by using the setMap() method:

```
var marker=new google.maps.Marker({
  position:myCenter,
  icon:'pinkball.png'  //marker with image icon
  });
marker.setMap(map);
```

Loading the Map

Execute the initialize() function that constructs the Map object on window load, to ensure that the map is placed on the page after the page is fully loaded:

```
google.maps.event.addDomListener(window, 'load', initialize);
```

The getCurrentPosition() Method - Return Data

Use the getCurrentPosition() method to get the user's position.

```
<script>
var x = document.getElementById("demo");
function getLocation() {
    if (navigator.geolocation) {
        navigator.geolocation.getCurrentPosition(showPosition);
    } else {
        x.innerHTML = "Geolocation is not supported by this browser.";
    }
}
function showPosition(position) {
    x.innerHTML = "Latitude: " + position.coords.latitude +
    "<br>Longitude: " + position.coords.longitude;
}
</script>
```

Example explaination:

- Check if Geolocation is supported
- If supported, run the getCurrentPosition() method. If not, display a message to the user
- If the getCurrentPosition() method is successful, it returns a coordinates object to the function specified in the parameter (showPosition)
- The showPosition() function gets the displays the Latitude and Longitude

Ajax function:

AJAX is the art of exchanging data with a server, and updating parts of a web page - without reloading the whole page.

Example:

```
   Jquery.ajax({
  Type:Get/Post, // the type of request: GET or POST
  url:"http:url", // the location of the file on the server
  async:true/false, //  true (asynchronous) or false (synchronous)

success:function(data){//do something if url loading sucess}

}
Error: function(err){//else do something
```

A.2 Android Application

Programming for Android Application Development can be classified into the following files

- **Java implementation file** - This is the file that implements the behavior of the widget. If you can instantiate the object from layout XML, you will also have to code a constructor that retrieves all the attribute values from the layout XML file.
- **XML definition file** - An XML file in res/values/ that defines the XML element used to instantiate your widget, and the attributes that it supports. Other applications will use this element and attributes in their in another in their layout XML

  Java implementation file is composed of different classes

- **MainActivity Class**

  The Activity class is an important part of an application's overall lifecycle, and the way activities are launched and put together is a fundamental part of the platform's application model

- **Activity Lifecycle**

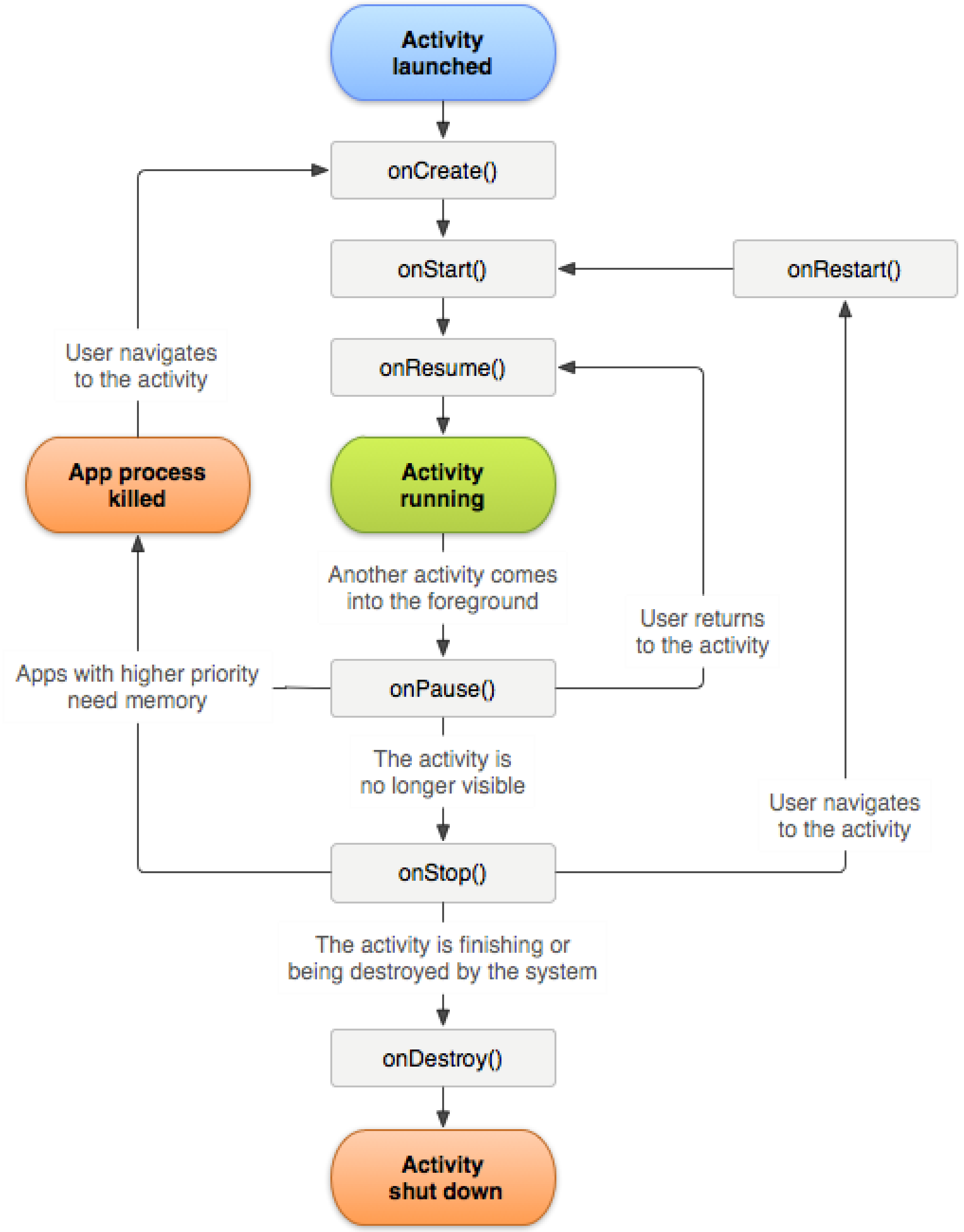
  Activities in the system are managed as an *activity stack*. When a new activity is started, it is placed on the top of the stack and becomes the running activity -- the previous activity always remains below it in the stack, and will not come to the foreground again until the new activity exits.

  An activity has essentially four states:

- ▪ If an activity in the foreground of the screen (at the top of the stack), it is active or running.
- ▪ If an activity has lost focus but is still visible (that is, a new non-full-sized or transparent activity has focus on top of your activity), it is *paused*. A

paused activity is completely alive (it maintains all state and member information and remains attached to the window manager), but can be killed by the system in extreme low memory situations.

- If an activity is completely obscured by another activity, it is *stopped*. It still retains all state and member information, however, it is no longer visible to the user so its window is hidden and it will often be killed by the system when memory is needed elsewhere.
- If an activity is paused or stopped, the system can drop the activity from memory by either asking it to finish, or simply killing its process. When it is displayed again to the user, it must be completely restarted and restored to its previous state.
- The following diagram shows the important state paths of an Activity. The square rectangles represent callback methods you can implement to perform operations when the Activity moves between states. The colored ovals are major states the Activity can be in.


Activity launched
onCreate()
onStart()
onRestart()
User navigates to the activity
onResume()
App process killed
Activity running
Another activity comes into the foreground
User returns to the activity
Apps with higher priority need memory
onPause()
The activity is no longer visible
User navigates to the activity
onStop()
The activity is finishing or being destroyed by the system
onDestroy()
Activity shut down

There are three key loops you may be interested in monitoring within your activity:

- The **entire lifetime** of an activity happens between the first call toonCreate(Bundle) through to a single final call toonDestroy(). An activity will do all setup of "global" state in onCreate(), and release all remaining resources in onDestroy(). For example, if it has a thread running in the background to download data from the network, it may create that thread in onCreate() and then stop the thread in onDestroy().

- The **visible lifetime** of an activity happens between a call toonStart() until a corresponding call to onStop(). During this time the user can see the activity on-screen, though it may not be in the foreground and interacting with the user. Between these two methods you can maintain resources that are needed to show the activity to the user. For example, you can register a Broadcast Receiver in onStart() to monitor for changes that impact your UI, and unregister it in onStop() when the user no longer sees what you are displaying. The onStart() and onStop() methods can be called multiple times, as the activity becomes visible and hidden to the user.
- The **foreground lifetime** of an activity happens between a call to onResume()until a corresponding call to onPause(). During this time the activity is in front of all other activities and interacting with the user. An activity can frequently go between the resumed and paused states -- for example when the device goes to sleep, when an activity result is delivered, when a new intent is delivered -- so the code in these methods should be fairly lightweight.

The entire lifecycle of an activity is defined by the following Activity methods. All of these are hooks that you can override to do appropriate work when the activity changes state. All activities will implement onCreate(Bundle)to do their initial setup; many will also implement onPause()to commit changes to data and otherwise prepare to stop interacting with the user. You should always call up to your super class when implementing these methods.

```
public class Activity extends ApplicationContext {

protected void onCreate(Bundle savedInstanceState);

protected void onStart();

protected void onRestart();

protected void onResume();

protected void onPause();
protected void onStop()

protected void onDestroy();

 }
```

Map

A Map is a data structure consisting of a set of keys and values in which each key is mapped to a single value. The class of the objects used as keys is declared when the Map is declared, as is the class of the corresponding values. A Map provides helper methods to iterate through all of the keys contained in it, as well as various methods to access and update the key/value pairs.

HashMap is an implementation of Map. All optional operations are supported. All elements are permitted as keys or values, including null.

Intent

Intent provides a facility for performing late runtime binding between the code in different applications. Its most significant use is in the launching of activities, where it can be thought of as the glue between activities. It is basically a passive data structure holding an abstract description of an action to be performed.

AsyncTask

AsyncTask enables proper and easy use of the UI thread. This class allows performing background operations and publishing results on the UI thread without having to manipulate threads and/or handlers.

AsyncTask is designed to be a helper class around Thread and Handler and does not constitute a generic threading framework. AsyncTasks should ideally be used for short operations (a few seconds at the most.) If you need to keep threads running for long periods of time, it is highly recommended you use the various APIs provided by the java.util.concurrentpacakge such as Executor, ThreadPoolExecutor and FutureTask.

An asynchronous task is defined by a computation that runs on a background thread and whose result is published on the UI thread. An asynchronous task is defined by 3 generic types, called Params, Progress and Result, and 4 steps, called onPreExecute, doInBackground, onProgressUpdate and onPostExecute.

The 4 steps

When an asynchronous task is executed, the task goes through 4 steps:

- onPreExecute(), invoked on the UI thread before the task is executed. This step is normally used to setup the task, for instance by showing a progress bar in the user interface.
- doInBackground(Params...), invoked on the background thread immediately after onPreExecute() finishes executing. This step is used to perform background computation that can take a long time. The parameters of the asynchronous task are passed to this step. The result of the computation must be returned by this step and will be passed back to the last step. This step can also use publishProgress(Progress...) to publish one or more units of progress. These values are published on the UI thread, in the onProgressUpdate(Progress...)step.
- onProgressUpdate(Progress...), invoked on the UI thread after a call to publishProgress(Progress...). The timing of the execution is undefined. This method is used to display any form of progress in the user interface while the background computation is still executing. For instance, it can be used to animate a progress bar or show logs in a text field.
- onPostExecute(Result), invoked on the UI thread after the background computation finishes. The result of the background computation is passed to this step as a parameter.

JSONArray

JSONArray has the same type coercion behavior and optional/mandatory accessors as JSONObject. See that class' documentation for details.

InputStream

Most clients will use input streams that read data from the file system (FileInputStream), the network (getInputStream()/getInputStream()), or from an in-memory byte array (ByteArrayInputStream).

Use InputStreamReader to adapt a byte stream like this one into a character stream.

Most clients should wrap their input stream with BufferedInputStream. Callers that do only bulk reads may omit buffering.

Some implementations support marking a position in the input stream and resetting back to this position later. Implementations that don't return false from markSupported() and throw an IOException when reset() is called.

HTTPClientClass Overview

Interface for an HTTP client. HTTP clients encapsulate a smorgasbord of objects required to execute HTTP requests while handling cookies, authentication, connection management, and other features. Thread safety of HTTP clients depends on the implementation and configuration of the specific client.

Buffered Reader Class Overview

Wraps an existing Reader and *buffers* the input. Expensive interaction with the underlying reader is minimized, since most (smaller) requests can be satisfied by accessing the buffer alone. The drawback is that some extra space is required to hold the buffer and that copying takes place when filling that buffer, but this is usually outweighed by the performance benefits.

A typical application pattern for the class looks like this:

```
BufferedReaderbuf = new BufferedReader(new FileReader("file.java"));
```

Connectivity Manager

The primary responsibilities of this class are to:

1. Monitor network connections (Wi-Fi, GPRS, UMTS, etc.)
2. Send broadcast intents when network connectivity changes
3. Attempt to "fail over" to another network when connectivity to a network is lost
4. Provide an API that allows applications to query the coarse-grained or fine-grained state of the available networks

Network Info

Use getActiveNetworkInfo() to get an instance that represents the current network connection.

JSONObject

This class can coerce values to another type when requested.

- When the requested type is a boolean, strings will be coerced using a case-insensitive comparison to "true" and "false".
- When the requested type is a double, other Number types will be coerced using doubleValue. Strings that can be coerced using valueOf(String) will be.
- When the requested type is an int, other Number types will be coerced using intValue. Strings that can be coerced using valueOf(String) will be, and then cast to int.
- When the requested type is a long, other Number types will be coerced using longValue. Strings that can be coerced using valueOf(String) will be, and then cast to long. This two-step conversion is lossy for very large values. For example, the string "9223372036854775806" yields the long 9223372036854775807.
- When the requested type is a String, other non-null values will be coerced using valueOf(Object). Although null cannot be coerced, the sentinel value NULL is coerced to the string "null".

For User Interface Designing we used XML format.

Widgets like ImageView, TextView, Button and EditText were used in Linear Layout.

ImageView

Displays a button with an image (instead of text) that can be pressed or clicked by the user and displays an arbitrary image, such as an icon. The ImageView class can load images from various sources (such as resources or content providers), takes care of computing its measurement from the image so that it can be used in any layout manager, and provides various display options such as scaling and tinting.

TextView

Displays text to the user and optionally allows them to edit it. A TextView is a complete text editor, however the basic class is configured to not allow editing.

Button

A button with two states, checked and unchecked. Represents a push-button widget. Push-buttons can be pressed, or clicked, by the user to perform an action. Interface definition for a callback to be invoked when a button is clicked.

EditText

An editable text view that shows completion suggestions automatically while the user is typing. EditText is a thin veneer over TextView that configures itself to be editable.

A.3 AT Commands

GSM module used in this project is SIM 900A GSM modem.It can be controlled by means of AT Commands.

The command sequence is:

- AT+CPIN(to check if the SIM is ready)
- AT+CREG?(to check network registration)
- AT+SAPBR (for bearer checking)
- AT+HTTPINIT (for HTTP initialization).
- AT+HTTPPARA(to set HTTP parameter)
- AT+HTTPACTION(for GET and POST action of HTTP)

AT+CPIN Enter PIN

AT+CPIN Enter PIN	
Test Command **AT+CPIN=?**	Response **OK**
Read Command **AT+CPIN?**	Response TA returns an alphanumeric string indicating whether some password is required or not. **+CPIN:<code>** **OK** **Parameter** **<code>** **READY** MT is not

	pending any password. **SIMPIN** MT is waiting SIM PIN to be given. **SIMPUK** MT is waiting SIM PIN to be given.

AT+CREG Network Registration

AT+CREG Network Registration	
Test Command **AT+CREG=?**	Response **+CREG : (list of supported <n>s)** **OK** **Parameter** <n> 0 Disable network registration unsolicitated result code 1 Enable network registration unsolicitated result code +CREG:<stat> 2 Enable network registration unsolicitated result code with location information +CREG:<stat>[,<lac

	>,<cid>]
Read Command **AT+CREG?**	**Response** TA returns the ststus of result code presesntstion and an integer <stat> which shows whether the network has currently indicated the registration of the ME. Location information elements <lac>and <ci> are returned only when <n>=2 and ME is registered in the network. **+CREG:<n>,<stat>[**

	,<lac>,<ci>] **OK** If error is related ME functionality: **+CME ERROR:<err>**

AT+SAPBR Bearer Setting for Application Based on IP

AT+SAPBR Bearer Setting for Application Based on IP	
Test Command **AT+SAPBR=?**	Response **+SAPBR: (0-5),(1-3),"ConParmTag","ConParamValue**" **OK** Parameters **<ConParam Tag>** bearer parameter **"CONTYPE"** Type of internet connection Value refer to <ConP"aram Value_ConType> **"APN"** Access point name string:maximum 50 characters

Write Command **AT+SAPBR+<CMD_TYPE>,<CID>,[<ConParam Tag>,<ConParamValue>]**	**Response** **OK** If<cmd_type>=2 **+SAPBR:<cid>,<status>,<IP_Addr>** **OK** If <cmd_type=4 **+SAPBR:** **<ConParam Tag>,<ConParam Value>** **OK**
	Parameter **<cmd_type>** 0 close bearer 1 open bearer 2 query bearer 3 set bearer parameters 4 get bearer parameters **<cid>** bearer profile

	identifier **<status>** 0 bearer is connecting 1 bearer is connected 2 bearer is closing 3 Bearer is closed **<ConparamValue>**bearer parameter value **<ConParamValue_ConType>** **“CSD”** Circuit-switched data call **“GPRS”** GPRS connection **<ConParamValue_Rate>** 0 2400 1 4800 2 9600 3 14400 **<IP_Addr> the IP address of bearer**

AT+HTTPINIT Initialize HTTP Service

AT+HTTPINIT Initialize HTTP Service	
Test Command **AT+HTTPINIT=?**	Response **OK**
Execution Command **AT+HTTPINIT**	Response **OK** If error is related to ME functionality **+CME ERROR:<err>**

AT+HTTPPARA Set HTTP Parameter Value

AT+HTTPPARA Set HTTP Parameter Value	
Test Command **AT+HTTPARA=?**	Response **+HTTPPARA:"HTTPParamTag","HTTPParmValue**" OK
	Parameters <HTTPParam Tag> HTTP Parameter **"CID"** (Mandatory Parameter)bearer profile identifier **"URL**" (Mandatory

	Parameter) HTTP client URL . **<HTTPParam Value>** HTTP Parameter value Type and supported content depend on related <HTTPParam Tag>
Read Command **AT+HTTPPARA?**	Resonse **+HTTPPARA:** **<HTTPParamTag>, <HTTPParam Value>** **OK**
	Parameters <HTTPParam Tag> HTTP Parameter **“CID”** (Mandatory Parameter)bearer profile identifier **“URL”** (Mandatory Parameter) HTTP client URL . **<HTTPParam Value>** HTTP

	Parameter value Type and supported content depend on related <HTTPParam Tag>
Write Command **AT+HTTPARA=<HTTPParamTag>,<HTTPParaValue>**	**Response** **OK**
	Parameters **<HTTPParam Tag>** HTTP Parameter “CID” (Mandatory Parameter)bearer profile identifier “URL” (Mandatory Parameter) HTTP client URL . **<HTTPParam Value>** HTTP Parameter value Type and supported content depend on related <HTTPParam Tag>

AT+HTTPACTION HTTP Method action

AT+HTTPACTION	**HTTP Method action**
Test Command **AT+HTTPACTION=?**	Response **+HTTPACTION: (0-2)** **OK**
Write Command **AT+HTTPACTION=<Method>**	Response **OK** If error is related to ME functionality: **+CME ERROR:<err>** Unsolicited result code: **+HTTPACTION:<Method>,<StatusCode>,<Datalen>**
	Parameter <Method> HTTP method specification: 0 GET 1 POST 2 HEAD **<StatusCode>** HTTP status code responded by remote server it identifier refer to HTTP1.1(RFC2626)

	100 Continue 101 Switching Protocols 200 OK 201 Created 202 Accepted 203 Not Authoritative Information 203 Not Content 204 Reset Content 205 Partial Content 300 Multiple Choices 301 Moved Permanently 302 Found 303 See Other 304 Not Modified 305 Use Proxy 307 Temporary Redirect 400 Bad Request 401 Unauthorized 406 Not

	Acceptable 408 Request Time Out 409 Conflict 500 Internal Server Error 501 Not Implemented 502 Bad Gateway 503 Service Unavailable 504 Gateeway Time-out 505 HTTP Version not Supported 600 Not HTTP PDU 601 Network Error 602 No Memory 603 DNS Error 604 Stack Busy **<DataLen>** The length of data got