A GPS-GSM Predicated Vehicle Tracking System, Monitored in A Mobile App based on Google Maps

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***Abstract*— "Internet of things"– is a subject of great interest for many in today's world. IoT is the future that scholars and researchers anticipated and worked for. IoT tries to bring everything under one umbrella with cross disciplinary collaboration. The unification of everything in the world, making use of a common infrastructure that can not only provide the users with the control but also helps them understand the state of it, is the zenith of IoT. Vehicle tracking is one such application of IoT. This system comprises of a GPS antenna, a GSM modem, Atmega microcontroller and a mobile application that locates the vehicle on a map and also helps the user navigate to it. This system is developed keeping in mind, the trouble of finding one's vehicle when lost.**

Keywords*— *Internet of Things; GPS; GSM; Arduino; Vehicle Tracking

I. INTRODUCTION

The Internet of Things (IoT) is a framework in which all things have a representation and a presence in the Internet[1]. It is the interconnection over the Internet of computing devices embedded in everyday objects, enabling them to send and receive data. IOT broadly refers to the extension of network connectivity and computing capability to objects, devices, sensors, and items not ordinarily considered to be computers. As the father of IoT, Kevin Ashton once said, "Information is a great way to reduce waste and increase efficiency, and that's really what Internet of Things provides". These "smart objects" require minimal human arbitration to generate, exchange, and consume data; they often feature connectivity to remote data collection, analysis, and management capabilities. The fields of application for IoT technologies are as numerous as they are diverse, as IoT solutions are increasingly extending to virtually all areas of everyday. One such application where IoT has made an impact is the vehicle tracking system. This paper explains the importance, working and the application of a vehicle tracking system[2].

A vehicle tracking system is the solution to the number of questions user has in his mind. Say, the user forgets the parking position of his vehicle in a mall or say the vehicle is lost. This paper talks about the simplest solutions IoT has to offer to the aforementioned questions. The GPS module which consists of the GPS Antenna generates the coordinates on the request of the user. The data (coordinates) is then passed on to the user with the help of GSM modem. Finally, the vehicle is located on the map (pointed by a marker) using the coordinates (longitude and latitude) sent to the users' mobile from the GSM modem via an SMS.

Number of papers has been published on the development of vehicle tracking system using GPS and GSM Modem [4-9],[11-12],[14-15],[17] and [19].

II. PROCEDURE

The vehicle tracking system consists of a GPS antenna that generates the coordinates, a GSM modem for receiving requests from the user and sending the coordinates (viz. latitude and longitude) of the vehicle generated by the GPS antenna via SMS, an Atmega microcontroller as an interface and a mobile application based on google maps to point out the location of the vehicle. The following sections explain in detail each segment of the system.

A. Interface

The Arduino is open-source, which means hardware is reasonably priced and development software is free. The Duemilanove board features an Atmel ATmega328 microcontroller operating at 5 V with 2 Kb of RAM, 32 Kb of flash memory for storing programs and 1 Kb of EEPROM for storing parameters. The clock speed is 16 MHz, which translates to about executing about 300,000 lines of C source code

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per second[20]. The board has 14 digital I/O pins and 6 analog input pins. There is a USB connector for talking to the host computer and a DC power jack for connecting an external 6-20 V power source, for example a 9 V battery, when running a program while not connected to the host computer. Headers are provided for interfacing to the I/O pins using 22 g solid wire or header connectors[21].

Fig.1 Arduino Uno board with Atmega microcontroller.

B. *Generating Coordinates*

To obtain excellent GPS reception performance, a good antenna will always be required. The antenna is the most critical item for successful GPS reception in a weak signal environment[10]. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and therefore accurate fix measurements are obtained[22].

User can consider following factors as:

- Choose a linear antenna with a reasonably uniform hemispherical game pattern of >-4dBi.
- Use of an antenna with lower gain then this will give less than desirable results[13].
- Proper surface plain sizing is a critical consideration for small gps antennas.

To obtain the coordinates, use the AT commands specified in the table I.

TABLE I: AT commands used for GPS[23]

Command	Description
AT+CGPSPWR	GPS POWER CONTROL
AT+CGPSRST	GPS RESET MODE
AT+CGPSINF	GET CURRENT GPS LOCATION INFO
AT+CGPSOUT	GPS NMEA DATA OUTPUT CONTROL
AT+CGPSSTATUS	GPS FIX STATUS

C. *Sending/Receiving SMS*

AT commands necessary for sending and receiving SMS are:

- AT+CMGF=1
  Set SMS system into text mode, as opposed to PDU mode[24].
  Response on success: OK
- AT+CSCA=[<sca>,<tosca>]
  Service Center Address, value field in string format, BCD numbers (or GSM 7 bit default alphabet characters) are converted to characters of the currently selected TE character set (refer to command AT+CSCS), type of address given by . SC address Type-of-Address octet in integer format, when first character of is + (IRA 43) default is 145, otherwise default is 129 [24].
  Response on success: OK
- AT+CNMI=<mode>[,<mt>[,<bm>[,<ds>[,<bfr>]]]]
  0 – Buffer unsolicited result codes in the TA. If TA result code buffer is full, indications can be buffered in some other place or the oldest indications may be discarded and replaced with the new received indications[3].
  1 – Discard indication and reject new received message unsolicited result codes when TA-TE link is reserved (e.g. in on-line data mode). Otherwise forward them directly to the TE[16].
  2 – Buffer unsolicited result codes in the TA when TA-TE link is reserved (e.g. in on-line data mode) and flush them to the TE after reservation. Otherwise forward them directly to the TE [24].
  Response on success: OK
- AT+CMGL=<stat>

1. Text Mode:
   a. "REC UNREAD" received unread message (i.e. new message)
   b. "REC READ" received read message
   c. "STO UNSENT" stored unsent message
   d. "STO SENT" stored sent message
   e. "ALL" all messages
2. PDU Mode:

   0 – received unread message (i.e. new message)
   1 – received read message
   2 – stored unsent message
   3 – stored sent message
   4 – all messages

- AT+CMGS=<da>[,<toda>]<CR>
  <da>

Destination-Address, Address-Value field in string format; BCD numbers (or GSM 7 bit default alphabet characters) are converted to characters of the currently selected TE character set, type of address given by <toda> [18].

<toda>
TP-Destination-Address, Type-of-Address octet in integer format. (when first character of is + (IRA 43) default is 145, otherwise default is 129). The range of value is from 128 to 255 [24].
Example:
AT+CMGS=”1234567890”<CR>
>ABCD<ctrl-z>
+CMGS: 46
OK

D. User Interface

A mobile app is developed using android-studio and google maps API to locate the traced vehicle on the map and also help the user navigate to it.

III. RESULTS

A mobile app is developed for user convenience. Following are the images of the user interface developed and the location of the vehicle marked on the map.

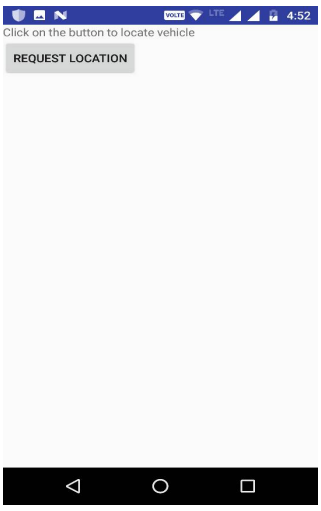

Fig. 2 Request screen of user interface(mobile app)

The user is allowed to press the “Request Location” button and the app sends a request to the GSM modem to initiate the process of generating coordinates and send them via an SMS.

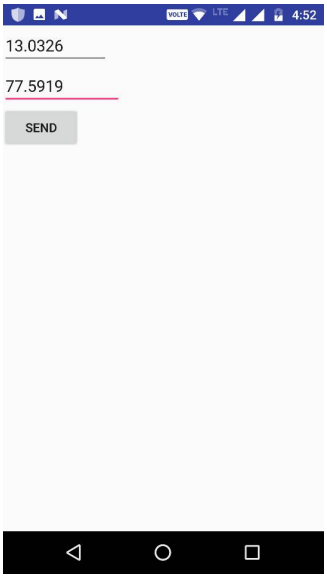

Fig. 3 Received coordinates via SMS

Now, the user has to enter the latitude and the longitude mentioned in the received message in the app to locate the vehicle (Fig. 4).

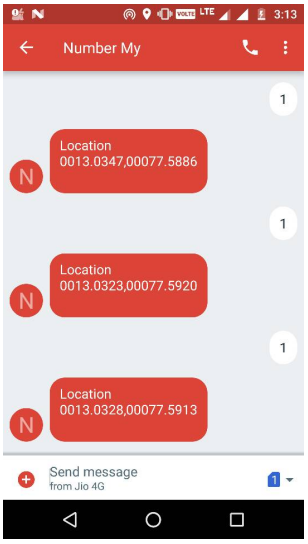

Fig. 4 Entering the longitude and latitude

The vehicle will be pointed by a marker on the map based on the received coordinates from the GPS antenna (Fig. 5).

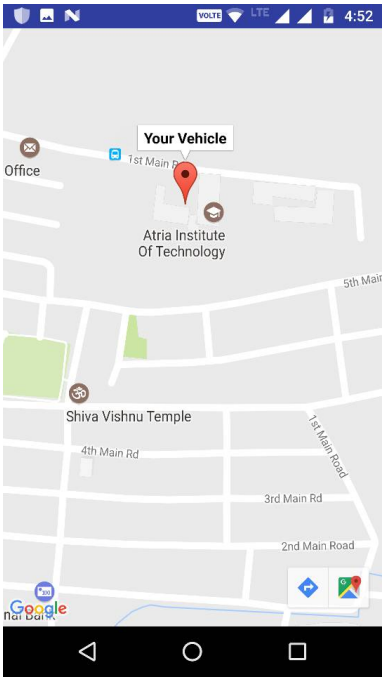

Fig. 5 Marker pointing to the users' vehicle on a map

IV. CONCLUSIONS

Internet of Things (IoT) is a trending topic in this technologically advancing world. IoT has evolved remarkably over a very short period of time. The existing systems can be internetworked with the various hardware platforms available in the market. The functionality of the platform varies but the essence more or less will remain the same. The vehicle tracking system as seen in this paper has its traditional roots but with the touch of IoT. This is quite evident as various elements in the system generate data, communicate with one another and produce the outcome.

In conclusion, Internet of Things announced its arrival by doing extremely well in a variety of streams across the globe. This is just the beginning and one can predict more in the coming years. One may say that it will be much more than "things"[25].

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