An Efficient Approach for Ambulance Tracking System using GPS and GSM

Abstract. An ambulance tracking system (ATS) is the need of the hour due to the recent pandemic situation going on around us. It is necessary that patients carrying vehicles such as ambulances must be equipped with the ATS technology. The ATS technology helps the hospital administration to carry out the necessary steps before the patient arrives at the hospital premises. In this technology, Global systems for Mobile communication (GSM) and Global Positioning System (GPS) are used for the efficient working of this device. In this system, a low-cost microcontroller-based electronic device Arduino is used to control the GPS and GSM modules. In this system, modem and display device such as liquid crystal display (LCD) is used at the user end which is also called as Base Station. Information regarding the location of the ambulance is provided by the GPS module. GSM module is used for communicating with the base station. The hospital administration can get the information of the arrival of the ambulance well in time and can increase the chance of survival of the patient as the time required for setting up basic components is done well in advance. This system can also be used for various other vehicles used in emergency situations.

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1. Introduction
The advancement in recent technological aspects has led to establishment of various industries in our country. Recently, some mobile and electronics companies have created their setup in India for manufacturing and assembling their products for overcoming the demand of Indian masses. In our country, transportation is always a problem or we face massive traffic jams due to overcrowded roads and also due to lack of suitable technologies to overcome these problems with efficacy [1-2]. The transportation of raw material needed by the various industries is maintained by the local transport vendors. It is often seen that several mishaps have occurred in the past few decades such as theft, burglary, etc. These mishaps not only causes monetary losses as well as also lead to manufacturing delays which causes surge in market of that particular product. Logistics managers need some technology to keep a watch on the movement of the needed raw material while on their way. The technique is hereby developed to identify the current location of the vehicle. The technology used is satellite communication technology. Ambulance Tracking System (ATS) uses this technology and is now used in day-to-day life by the hospital administration. Common people who own their vehicle, as well as by several cab operators, etc. can also use these technologies. GPS is used in almost all vehicles which we see around us and specifically in ambulances, police jeeps, and rental cars. In India,
almost government vehicles such as local buses, bank vans, and petroleum carrying vehicle are using GPS technology. The existing technologies provide the tracking information of vehicle such as its exact location and status. GPS-GSM based system integrates or utilizes GSM and GPS technique to overcome certain issues.

Millions of people uses both the technologies in every aspect of their life and hence it is useful hat people are aware about these technologies. The developed system will be useful for the managers who work in the field of land construction material transportation, business purpose transport facilitators, and medical firms material or logistic managers. The proposed system provides real time data of tracking such as exact location of the vehicle, speed at which vehicle is travelling and expected time of arrival of the vehicle at the desired location. All the information is in easy to read and store format. This information can further be recorded for analysis of the time taken by a particular vehicle and the drivers driving capabilities. This system also provides access to communicate between the driver and the managers to keep a contact and if any emergency appears to driver, driver can also inform about that and can ask for nearby help.

In general, GPS tracking ensures the safety of the travellers. GPS tracking is generally found in vehicles to prevent theft and also to rescue devices. It is mostly used in four wheelers; some two wheelers companies are also providing the GPS technology in the recent time. Navy operators also use this technology to do management task, routing. The applications can be also utilised for monitoring the driving performance of the teenagers and also to check their movement in the city. ATScan also be widely used for theft prevention and retrieval in various consumer vehicles. If any theft is identified by the ATS, it sends a SMS to the vehicle owner and can be switched off the engine from its location [3-5].

Arduino is widely used by hobbyists, design engineers to create new application with low cost as it is an open source and does not require any licensing as other software’s requires. Many models are available in market to implement the hardware based projects and it is highly recommended for designing low cost prototypes. The low cost of the Arduino make it suitable to be utilised as a controller in this project. It is also compatible with all types of operating systems, hence can be utilised by every users irrespective of the operating system available at the user end [6-7].

2. Features of Ambulance Tracking

Ambulance tracking system mainly benefits the transportation companies as it can show the exact location, necessary information about the various vehicles on the mobile phone of the owner. It may help the owner to visualize the data and create the expected data as per their requirement. ATS can store the data such as where the vehicle has going at current time or real time, where the vehicle stopped and also do analysis about the expected arrival of vehicle at the desired location.

Arduino is the main controller which controls the whole process with the help of GPS which acts as the receiver and with help of GSM module we can communicate with ATS. Vehicle coordinates are detected by the GPS Receiver and we utilize the GSM module for transferring the information of the coordinates to consumer by SMS. 16x2 Liquid Crystal Display (LCD) is used for displaying the current information to the owner, this an optional feature provided as per the need of the consumer. The SKG13BL module is used as GPS unit and SIM900A module is used as GSM unit.

After programming the setup, we can install this ATS in vehicle and provide power supply to start the ATS. “Ambulance Track” message is required to be send by using the SMS from mobile end to the receiver end in the vehicle. Message sent by the mobile end is received by the GSM unit which is available in the ATS. Now, Arduino start reading the message and will extract the main information
from the SMS. If any match occurs then $GPGGA$ string is extracted by the Arduino to reads the coordinates from GPS module data and send it to user by the help of GSM module. The basic methodology is shown with the help of block diagram in Figure 1.

![Figure 1. Block Diagram of Basic Methodology](image)

2.1 Circuit Diagram

The circuit diagram of ATS working model with the help of GPS and GSM is shown in Figure 2.

![Figure 2. Circuit diagram of GPS-GSM based ATS](image)

The model is prepared first for testing purpose by using the basic bread board and all the modules required. The testing model of ATS is shown in Figure 3. After the prototype is successfully tested, a final model is designed and developed to be utilized for further process. Figure 4 shows the final prototype model of ATS.

![Figure 3. Testing model of ATS](image)
2.2 Concept of Ambulance/Vehicle tracking
This vehicle/ambulance tracking system takes input from GPS and sends it through the GSM module to desired mobile/laptop using mobile communication. The concept is well illustrated with the help of Figure 5.

3. Process and Requirements

3.1 Arduino Uno

It is a 14 pin device which consists of ATmega Microcontroller. Arduino Uno (Figure 6) has 6 analog inputs, 6 PWM outputs, a USB connector, reset buttons, power jack to connect the power supply module. It also consists of 16 MHz crystal oscillator and can be started with the help of IDE software. IDE software is freely available and does not require license. It can be powered by the USB port through a laptop or computer or one can utilize an AC-DC adapter for providing the power supply. Several sensors such as temperature, smoke detector, infrared sensors, and proximity sensor can be utilized as physical or analog sources for data acquisition into the arduino module. Several modules with different features are available in market for researchers to overcome the complexity due to the other microcontroller boards.
3.2 ATmega328 Microcontroller

The ATmega328 is created by the AVR family of microcontrollers. It is an advanced version of a 8-bit RISC processor core [8]. ATmega328 microcontroller is shown in Figure 7.

![Figure 7. 3D View of ATmega328 microcontroller](image)

The pin diagram of ATmega328 microcontroller is shown in Figure 8.

![Figure 8. Pin diagram of ATmega328 microcontroller](image)

3.3 GSM Module

GSM module is a special type of modem which consists of SIM card tray similar to the mobile phone SIM module. GSM module is also called as Mobile phone without any display device [9]. Figure 9 shows the diagram of GSM module used in ATS device.

![Figure 9. GSM module used in ATS device](image)
Figure 10 shows the command used in the GSM module.

| Command   | Description                      |
|-----------|----------------------------------|
| AT+CMGD   | Delete SMS message               |
| AT+CMGF   | Select SMS message format        |
| AT+CMGL   | List SMS message from preferred store |
| AT+CMGR   | Read SMS message                 |
| AT+CMGS   | Send SMS message                 |
| AT+CMGW   | Write SMS message to memory      |
| AT+CMSS   | Send SMS message for storage     |
| AT+CMGC   | Send SMS command                 |
| AT+CNMI   | New SMS message indications      |
| AT+CMPx   | Preferred SMS message storage    |
| AT+CRES   | Restore SMS settings             |
| AT+CSAS   | Save SMS settings                |
| AT+CSCA   | SMS service centre address       |
| AT+CSCB   | Select cell broadcast SMS messages |
| AT+CSDH   | Show SMS text mode parameters    |
| AT+CSMP   | Set SMS text mode parameters     |
| AT+CSMS   | Select message service           |

Figure 10. AT Command for GSM module

3.4 GPS Module
A satellite-based navigation system (SBNS) is commonly used for satellite communication. In the ATS device, GPS technology is used, which is also a type of SBNS. The GPS module used in this prototype is shown in Figure 11.

Figure 11 GPS module For ATS

3.5 MAX232
MAX232 is an integrated circuit which is generally used for conversion of signals received from any RS-232 serial port. It is a dual receiver/driver IC and generally used for conversion of signals such as Receive (RX), Transmit (TX), etc.

3.6 LCD
Display devices are generally required to get the access of the information on the visual display. Several technologies are available in the market, but liquid-crystal display (LCD) is best suited for the small scale prototypes. Figure 12 shows the pin description of LCD used in this ATS device.
Figure 1. Pin Description of LCD

| Pin No. | Name | Description |
|---------|------|-------------|
| 1       | VSS  | Power supply (GND) |
| 2       | VCC  | Power supply (+5V) |
| 3       | VEE  | Contrast adjust |
| 4       | RS   | 0 = Instruction input  
|         |      | 1 = Data input |
| 5       | R/W3 | 0 = Write to LCD module 
|         |      | 1 = Read from LCD module |
| 6       | EN   | Enable signal |
| 7       | D0   | Data bus line 0 (LSB) |
| 8       | D1   | Data bus line 1 |
| 9       | D2   | Data bus line 2 |
| 10      | D3   | Data bus line 3 |
| 11      | D4   | Data bus line 4 |
| 12      | D5   | Data bus line 5 |
| 13      | D6   | Data bus line 6 |
| 14      | D7   | Data bus line 7 (MSB) |

Figure 12. Pin Description of LCD

LCDs are used in various applications such as instrument panels, cockpit display, sign boards, information display at railway stations, hospital and banks waiting time display. LCD is a seven segment display device with 14 pins available to perform the various tasks such as brightness, contrast, word adjustments. It also consists of data bus line and can display words as well as numeric digits.

4. Result and Conclusion

Vehicle tracking is used for several applications by the commercial operators. With recent pandemic situation, it is very important to get the information about the patients who are suffering from this ailment. Ambulance Tracking System (ATS) is a technique which can help to monitor the movement of vehicles or ambulance which carry these patients.

Input Command given to the ATS system is *1234, track#

Output is given in Figure 13 which shows “Message received on registered mobile number”.

Figure 13. Output on registered mobile phone
Figure 14 shows the developed Ambulance Tracking System (ATS). This ATS device can be used for real-time monitoring of patient moving vehicles and if any emergency persist during this process then hospitals coming in the way should be given an emergency alert to prepare the isolation ward and call the special task forces for this pandemic situation. This system is accurate and requires fast processing. It can be protected with some fingerprint or retinal sensors, so that personal information of the patient should be kept confidential. Highly accurate and processing is fast. It can also be applied to various other emergency vehicles and also special fleets which are currently working in this pandemic situation.

5. References

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