INTELLIGENT TRAFFIC MANAGEMENT SYSTEM FOR EMERGENCY VEHICLES USING GPS AND GSM

[1]R.Sarath Kumar
Assistant Professor,
Department of Electronics and Communication Engineering,
Sri Krishna College of Engineering and Technology
sarathkumar@skcet.ac.in
[2]K.Madhan
Assistant Professor,
Department of Computer Science and Engineering,
Mailam Engineering College,Mailam
madhanckn@gmail.com
[3]Gokul A
UG Scholar,
Department of Electronics and Communication Engineering,
Sri Krishna College of Engineering and Technology
[4]Deepak Kumar KS
UG Scholar,
Department of Electronics and Communication Engineering,
Sri Krishna College of Engineering and Technology
[5]Harish M
UG Scholar,
Department of Electronics and Communication Engineering,
Sri Krishna College of Engineering and Technology

Abstract—

This work is an attempt to provide the efficient and intelligent traffic monitoring and management system for emergency vehicles like ambulance. The monitoring and control of city traffic is becoming a major problem in many countries. It is necessary to have a fast, economical and efficient traffic control as the population increases in urban areas. The Major problem is emergency vehicles like ambulance is getting stuck in a traffic jam. This problem can be addressed by ensuring that the lane in which the ambulance is travelling is cleared. That is, the arrival of the ambulance is to be communicated to the nearest traffic signal in advance, so that traffic signal is turn to green and hence clear the traffic in the ambulance lane. Thus, it provides the fastest route to reach the hospital and aid to the victims. With the help of GSM and GPS the routes and locations can also be found for the ambulance to travel without any traffic-jams. This will be as a massive support in the day-to-day life of increasing population and traffic.

Keywords—GPS; arduino; embedded c; sim800l, alert message (key words)

I. INTRODUCTION

The primary role of all ambulance services is emergency pre-hospital medical care, although they generally provide both emergency response and patient transfer on behalf of the health sector. They provide easy access to health services, particularly out of hours, and contribute significantly to telephone triage and telephone health services through sophisticated communications infrastructure. In recent times it has become apparent that increasing health system pressures cannot be resolved only by adding resources, but must also be addressed with new methods of service delivery. If ambulance services can develop towards an out-of-hospital, clinical care service rather than merely pre-hospital clinical care, they could substantially add to functionality of the health system. This could be through more efficient transfer of patient information; more efficient movement of patients; an ambulance service with a public service rather than profit driven philosophy; and patient treatment regimens consistent with the broader health system.

By integrating ambulance services into the health system generally, their respective strategic agenda are aligned, increasing efficiency, and providing an opportunity for an ambulance service, with its relevant expertise, to influence the outcome of 'health' initiatives.

The Traffic congestion can also be caused by large Red-light delays, etc. The delay of respective light is hard coded in the traffic light and it is not dependent on traffic. Therefore, for simulating and optimizing traffic control to better accommodate this increasing demand arises. One of the major problems faced by heavy traffic is by ambulances. But due to heavy traffic, one can often see the ambulances stuck in traffic for long durations thus causing danger to patient's life. Traffic research has the goal to optimize traffic flow of people and goods. As the number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future. However, some limitations to the usage of intelligent traffic control exist. Avoiding traffic jams for example is thought to be beneficial to both environment and economy, but improved traffic-flow may also lead to an increase in demand. There are several models for traffic simulation.

The problem of ambulance getting stuck in a traffic jam can be addressed by ensuring that the lane in which the ambulance is travelling is cleared. That is, the arrival of the ambulance is to be communicated to the nearest traffic signal, so that it can turn the light to green and hence clear the traffic. However, all the ambulances will not be carrying emergency cases. Hence, the traffic clearing system, if done for all the ambulances, will certainly pose a traffic problem. Present Traffic Light Controllers (TLC) are based on microcontroller and microprocessor. These TLC have limitations because it uses the pre-defined hardware, which is functioning according to the program that does not have the flexibility of modification on real time basis. All developed nations have a well-developed transportation system with efficient traffic control on road, rail and air. Transportation of goods, industrial products, manpower and machinery are the key factors which influence the industrial development of any country. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control. The monitoring and control of city traffic is becoming a major problem in many countries. The measures taken are development of new

roads and flyovers in the middle of the city; building of several ring such as the inner ring road, middle ring road and outer ring road; introduction of city trains such as the light rapid transit (LRT), and monorails; restricting of large vehicles in the city during peak hours; and also development of sophisticated traffic monitoring and control systems.

II. LITERATURE SURVEY

The GPS and GSM modules are used to send signals to the traffic control room about the emergency and make all the signals green in the route in which the ambulance travels and clears the traffic [1] Pressures on hospital systems are widely acknowledged with ED overcrowding reported regularly in the media and peer-reviewed literature. Strains on ambulance services are less well-documented or studied. [2]. In this paper, the authors present a symbiotic solution which has both reduced time to first on scene and provided training and experience in medical emergencies for senior medical students.[3] . This system consists of Ultrasonic sensors which detects the traffic on the road at a particular side. The Ultrasonic sensor is used to detect the obstacles, that is, vehicles on the road and this helps to intimate the ambulance driver about traffic. So, when the ambulance is nearing the traffic lane alert message is sent to the ambulance driver's mobile through android app.[4] This paper presents an intelligent traffic control system to pass emergency vehicles smoothly. Each individual vehicle is equipped with special radio frequency identification (RFID) tag (placed at a strategic location), which makes it impossible to remove or destroy. We use RFID reader, NSK EDK-125-TTL, and PIC16F877A system-on-chip to read the RFID tags attached to the vehicle. It counts number of vehicles that passes on a particular path during a specified duration.[5] The number of vehicles passing through a location well before the required traffic junction can be estimated using the help of image processing techniques. Further, the monitoring details can be shared to a distant controlling center situated anywhere in the city through internet usage. The performed experiments demonstrate the effectiveness of this Internet of Things (IoT) based technology.[6] Intelligent Transportation Systems (ITS) have been developed to improve the efficiency and safety of road transport by using new technologies for communication. Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I) are a subset of ITS widely used to solve different issues associated with transportation in cities[7] The occluded cerebral artery can be opened using recanalization therapy, but only within the first few hours after symptom onset. Early hospital admission is therefore essential. The aim of this thesis was to describe the current performance of the Finnish emergency medical service (EMS) system in prehospital stroke care and explore new innovations to improve it. The thesis was based on the analysis of emergency phone call tapes, prehospital patient reports and in-hospital data[8] . In order to increase the awareness of the driver, we can employ the vehicular network concept in which a vehicle can communicate with another vehicles or with the infrastructure installed along the road. For realizing that idea, we propose the implementation of communication equipped road sign system which consists of two components: Road Side Unit (RSU) module deployed at road sign and On Board Unit (OBU) module deployed at each vehicle.

In our proposed scheme, both of the devices communicate each other through the widely-used Wi-Fi protocol (IEEE 802.11n) operating in ad-hoc mode.[9] The study as described in this paper adopts a design science research methodology consisting of three phases. First, a case study in a transportation company has been performed to identify the problems faced when utilizing tracking technology. Second, to overcome these problems, a set of design principles has been formulated. Finally, a prototype system based on the design principles has been developed and subjected to experimental and observational evaluation. [10] We rely on a MEC architecture with three layers to propose a data dissemination protocol, which can be utilized by traffic safety and travel convenience applications in vehicular networks. Furthermore, we provide a simulation-based prototype to evaluate the performance of our protocol. Simulation results show that our proposed protocol can significantly improve the performance of data dissemination in terms of data delivery, communication overhead and delay. In addition, we highlight challenges and open issues to integrate MEC in vehicular networking environments for further research [11] Predicting demand in emergency medical services is crucial for saving people's lives. Most studies aggregate demand prediction within a zone, failing to offer insights at a more detailed level. This study aspires to fill this gap by introducing a novel, three-level, spatial-based approach that identifies the geographical location of expected emergency events. First, the proposed methodology introduces new concepts and notions to model emergency events, as sets of interconnected points in space, that create paths over time. [12]. Over time, a lot of research has proposed the wavelet transform-based OFDM as a better replacement of Fourier in the physical layer solutions because of its performance and ability to support network-intensive applications such as the Internet of Things (IoT). In this paper, we weigh the wavelet transform performances against the future wireless application system requirements and propose guidelines and approaches for wavelet applications in 5G waveform design. This is followed by a detailed impact on healthcare[13] Ambulance services try to preserve the life of such suffering souls. Though this sounds good, a major problem in the ambulance service is its delay due to traffic jams. Many people die due to such delay in reaching hospitals, being unable to access medical aid in time. Our project is going to be a solution for this issue: indicating vehicle drivers about emergencies using a transmitter and receiver. This can allow them to align their vehicles in a straight order, leaving space for ambulance vehicles so that they can reach their destination on time. This offers the needed medical attention to unwell civilians in time[14] Over the last 5 years, published figures demonstrate that STEMI networks increase the percentage of patients treated by any reperfusion strategy, and the percentage of patients receiving treatment within the recommended time frames has also improved, thereby reducing in-hospital and long-term mortality to very low levels. This manuscript demonstrates how STEMI networks can be adapted to local needs and circumstances against pre-existing barriers and despite the heterogeneity in local situations, patient's characteristics, treatment delays, and distances for transfer.[15]

III. SYSTEM ANALYSIS

A. System architecture

There is a 5 volt regulator and an adaptor is connected to this and 5v regulator is connected to the onboard. A 5v supply is drawn to LCD, GPS and GSM. LCD there is 16x2 (16 columns and 2 rows) .

LCD runs in two modes

* 4 bit mode

* 8 bit mode

4 bit mode is used here. GPS and GSM runs in UART communication protocol. In hardware the available UART is 1. Pin 0 and 1 GSM is connected to this hardware. Hardware pin is enabled as software serial and connected to GPS. The data transmitted through the GPS is received in the Arduino. Switch is connected to 8th pin. The data is fed to the switch so in the default stage it is high. When the switch is pressed it is grounded. When the switch is deleted the GPS location scanning once for 3000 counts gives the location. After the location is received a message is sent through GSM

B. Arduino

Arduino is a prototype platform (open-source) based on an easy-to-use hardware and software. It consists of a circuit board, which can be programmed (referred to as a microcontroller) and a ready-made software called Arduino IDE (Integrated Development Environment), which is used to write and upload the computer code to the physical board.

The key features are −Arduino boards are able to read analogy or digital input signals from different sensors and turn it into an output such as activating a motor, turning LED on/off, connect to the cloud and many other actions. Control the board functions by sending a set of instructions to the microcontroller on the board via Arduino IDE (referred to as uploading software).Unlike most previous programmable circuit boards, Arduino does not need an extra piece of hardware (called a programmer) in order to load a new code onto the board. Use a USB cable. Additionally, the Arduino IDE uses a simplified version of C++, making it easier to learn to program. Finally, Arduino provides a standard form factor that breaks the functions of the micro-controller into a more accessible package.

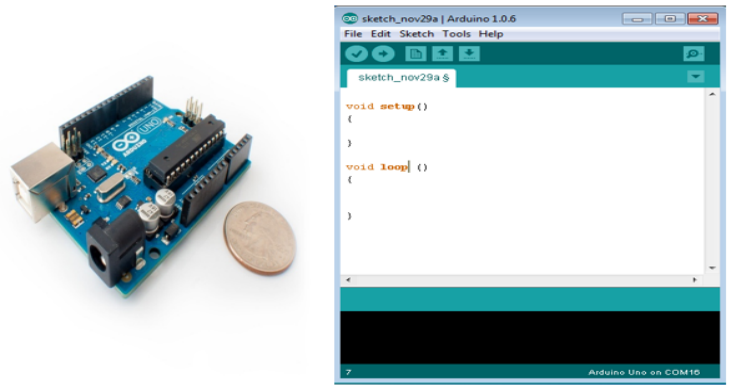

Fig 1. Arduino board and display screen

B. BOARD TYPES

Various kinds of Arduino boards are available depending on different microcontrollers used. However, all Arduino boards have one thing in common: they are programmed through the Arduino IDE.

The differences are based on the number of inputs and outputs (the number of sensors, LEDs, and buttons which can be use on a single board), speed, operating voltage, form factor etc. Some boards are designed to be embedded and have no programming interface (hardware), which need to buy separately. Some can run directly from a 3.7V battery, others need at least 5V.

IV. PROPOSED SYSTEM

There is a have 5 volt regulator and an adaptor is connected to this and a 5v regulator connected to the onboard. A 5v supply is drawn to LCD, GPS and GSM. LCD is 16x2 (16 columns and 2 rows) LCD runs in two modes

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This project is way better in locating the accidental area by sending a text message of the latitude and altitude of the accident spot to the ambulance driver so that he could reach the accident zone quicker. It makes the emergency ward in the hospital to be prepared for the ambulance arrival before it arrives so there can't be any clash or waste of time. The alert level sent varies based on the complications of the accident.

A. Arduino Program Structure

The Arduino software is open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL. **Sketch** − The first new terminology is the Arduino program called "**sketch**". Arduino programs can be divided in three main parts: **Structure, Values** (variables and constants), and **Functions**. In this tutorial, it explains about the Arduino software program, step by step, and how the program can be written without any syntax or compilation error.

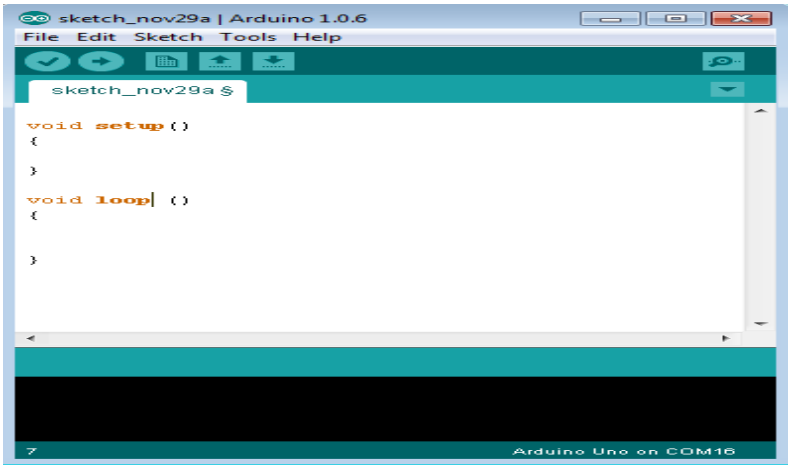

Fig 2. Program structure

B. Embedded C

Most C programmers are spoiled because they program in environments where not only is there a standard library implementation, but there are frequently a number of other libraries available for use. The cold fact is, that in embedded systems, there rarely are many of the libraries that programmers have grown used to, but occasionally an embedded system might not have a complete standard library, if there is a standard library at all.

Few embedded systems have capability for dynamic linking, so if standard library functions are to be available at all, they often need to be directly linked into the executable. Oftentimes, because of space concerns, it is not possible to link in an entire library file, and programmers are often forced to "brew their own" standard c library implementations if they want to use them at all. While some libraries are bulky and not well suited for use on microcontrollers, many development systems still include the standard libraries which are the most common for C programmers.

C. GPS

GPS receivers are generally used in smartphones, fleet management system, military etc. for tracking or finding location. **G**lobal **P**ositioning **S**ystem (GPS) is a satellite-based system that uses satellites and ground stations to measure and compute its position on Earth. GPS is also known as Navigation System with Time and Ranging (NAVSTAR) GPS.GPS receiver needs to receive data from at least 4 satellites for accuracy purpose. GPS receiver does not transmit any information to the satellites. This GPS receiver is used in many applications like smartphones, Cabs, Fleet management etc.GPS receiver uses a constellation of satellites and ground stations to calculate accurate location wherever it is located.

These GPS satellites transmit information signal over radio frequency (1.1 to 1.5 GHz) to the receiver. With the help of this received information, a ground station or GPS module can compute its position and time. GPS receiver receives information signals from GPS satellites and calculates its distance from satellites. This is done by measuring the time required for the signal to travel from satellite to the receiver.

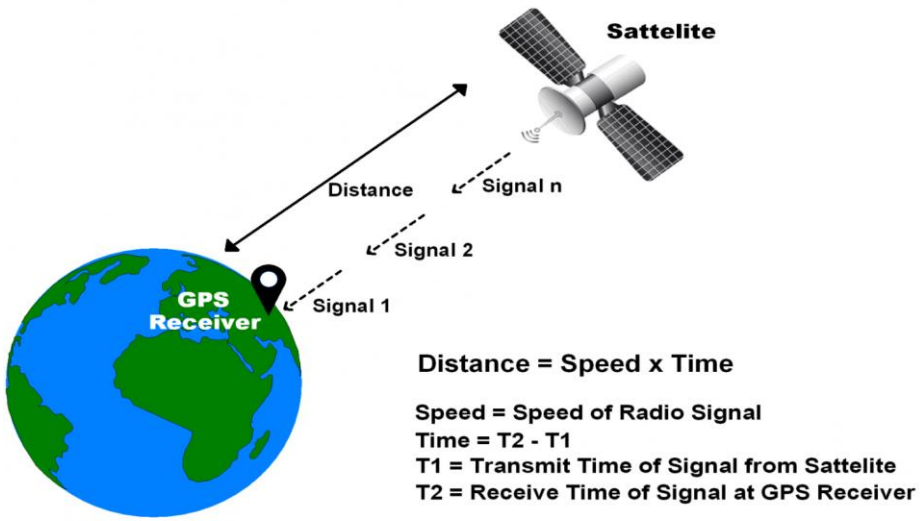

Fig 3 GPS Distance Calculation

Distance=speed x time

Where,

Speed = Speed of Radio signal which is approximately equal to the speed of light i.e.$3 * 10^8$

Time = Time required for a signal to travel from the satellite to the receiver.

By subtracting the sent time from the received time, the travel time can be determined.

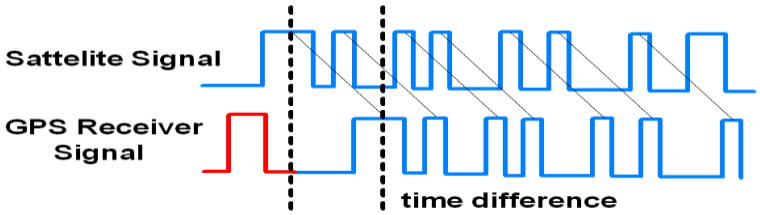

Fig 4 GPS Signal Time Difference

To determine distance, both the satellite and GPS receiver generate the same pseudocode signal at the same time. The satellite transmits the pseudocode; which is received by the GPS receiver. These two signals are compared and the difference between the signals is the travel time. Now, if the receiver knows the distance from 3 or more satellites and their location (which is sent by the satellites), then it can calculate its location by using Trilateration method.

D. SIM800L module

One of the most important parts of getting the SIM800L module working is supplying it with enough power. Depending on which state it's in, the SIM800L can be a relatively power-hungry device. The maximum current draw of the module is around 2A during transmission burst.

It usually won't pull that much, but may require around 216mA during phone calls or 80mA during network transmissions. This chart from the datasheet summarizes what expected.

Current consumption of SIM800L module at different states		
Modes	Frequency	Current Consumption
Power down		60 uA
Sleep mode		1 mA
Stand by		18 mA
Call	GSM850	199 mA
	EGSM900	216 mA
	DCS1800	146 mA
	PCS1900	131 mA
GPRS		453 mA
Transmission burst		2 A

Since SIM800L module doesn't come with onboard voltage regulator, an external power supply adjusted to voltage between 3.4V to 4.4V (Ideal 4.1V) is required. The power supply should also be able to source 2A of surge current, otherwise the module will keep shutting down.

V RESULTS

Select the serial device of the Arduino board. Go to **Tools → Serial Port** menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). Disconnect the Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.

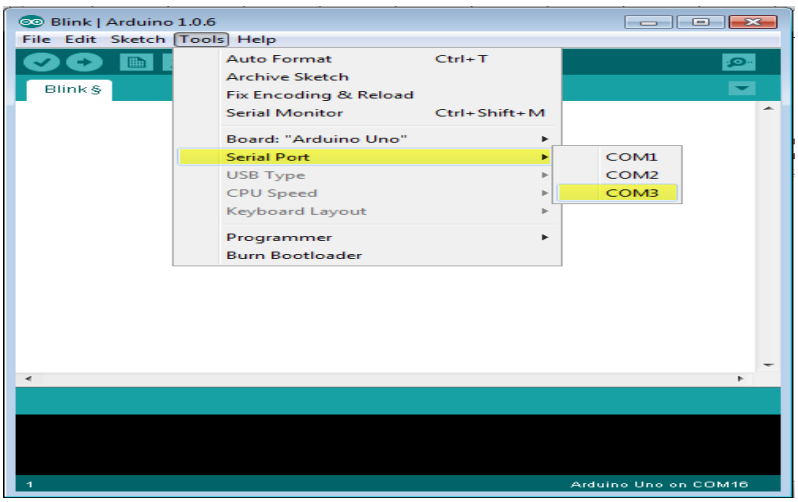

Fig 5 selection of serial port

After downloading Arduino IDE software, unzip the folder. Inside the folder, the application icon with an infinity label is present(application.exe). Double-click the icon to start the IDE. Similarly, an Admin module is created as seen in Fig.6 for the key controller to access information of the other modules. The admin can also edit the existing feature and add new features to the modules.

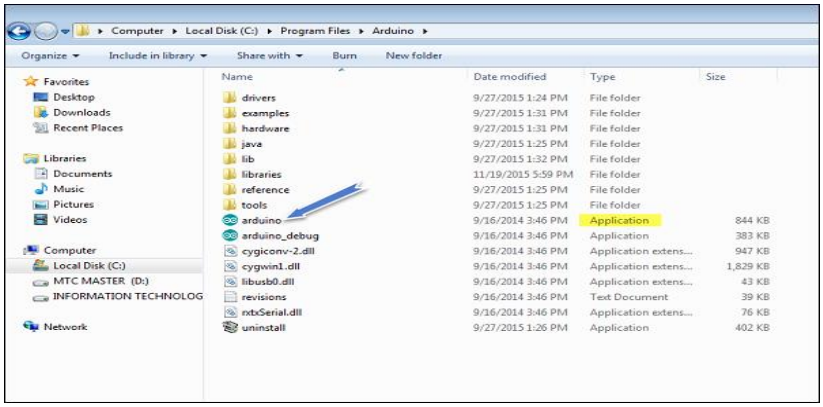

Fig 6 Launching Arduino IDE

The emergency alert message is sent to the phone after the triggering in the harwqare model.

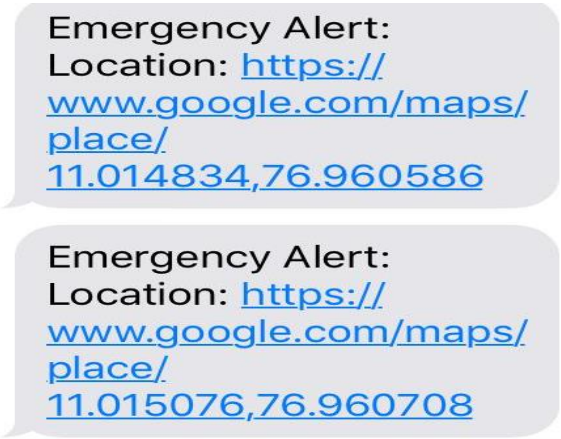

Fig 7 Alert message

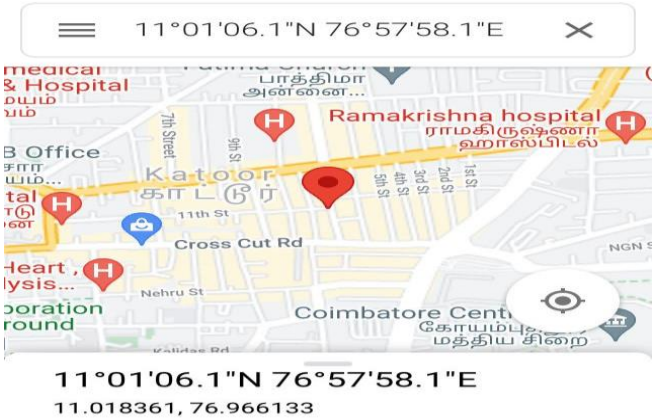

Fig 8 Location from alert message

Fig 8 Hardware setup

V. CONCLUSION

A new medical emergency system has been proposed and developed by using advancement in technologies. The proposed system will respond to the needs of an efficient and comprehensive emergency medical system from the initial emergency request and ambulance dispatch, until the admission of the patient to the emergency department of the hospital. This system includes modules to send a message to the number embedded in the Arduino along with the location. A switch is present in the vehicle which when pressed alerts the corresponding person. This avoids the time delay of ambulance arrival and plays a major role in the recovery of patients. The GSM and GPS module makes the process easier to send the location faster and accurate.

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