Automatic Accident Detection and Intelligent Navigation System

[1]Akshatha.V, [2]K .Nirmala Kumari

[1] PG Student, BIT Bengaluru, [2] Associate Professor Dept. of Electronics and Communication, BIT,Bengaluru

Abstract⸺*According to the recent study of World Health Organization(WHO), every year over 1.2 million people die due to road accidents and almost 20 to 50 million people suffer from server injuries. This paper presents a novel methodology to automatically detect road accidents and provide an intelligent navigation system for the ambulance to reach the nearest hospital on time so that the passenger's health is not compromised due to the traffic congestion. In the proposed system, each vehicle has an onboard unit to detect an accident and report the GPS location of the crash and the blood group of the victim to the nearest hospital server and ambulances through e-NOTIFY system. The communication between the user vehicle and the ambulance is called vehicle to vehicle communication. In order to reduce the delay due to traffic signals, and to facilitate a smooth movement of ambulance from crash spot to the hospital, a control system is designed.*

Keywords⸺*e-NOTIFY, GPS, V2V, On-Board unit, Raspberry Pi, RF transmitter, RF receiver, Gyro sensor, SMTP protocol.*

I.INTRODUCTION

The improvement in technology and a steep increase in population from the past few decades had led a rapid pace of motorization .Between the years 2010 and 2013, a 16% increase in registered vehicles on road is observed. But this motorization has taken place without considering the measures to keep all the pedestrians, drivers and other road users safe.

The effect of increase in number of vehicles will in-turn lead to increase in number of road accidents. The primarily concern is to find ways to avoid crash but there might still be chances of occurrence of crash. A system is required to assist the injured people post-crash, provide the information about the crash to emergency services and reduce the time lag taken for treating the injured.

In this paper, a prototype architecture called e-NOTIFY is proposed, a novel method designed to improve the survival chances for passengers involved in vehicular accidents. The proposed system offers automated crash detection, and assistance to passengers involved in road accidents by efficiently sending the blood group details of the vehicle user and the location of the crash to the hospital server and to the ambulance. This system does not focus on reducing the number of accidents but on improving post collision assistance with fast and efficient time

management, thereby increasing the chances of recovery and survival of people suffering from road accident injuries.

II. PROPOSED SYSTEM

As shown in the block diagram in Fig 1, the proposed system is divided into modules, the details about each of the module is explained below:
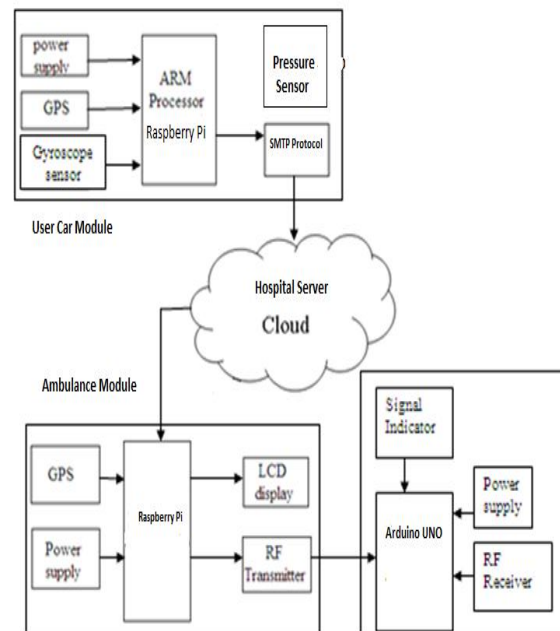

Figure 1: Proposed System Block diagram

1. Vehicle Module: This module has a Gyro sensor along with GPS module which are integrated to Raspberry Pi. A GUI is developed so that the driver of the vehicle can input his/her blood group when the vehicle is started. Whenever the user car has met with a rollover crash, GPS traces the current position and triggers Raspberry Pi module to send a mail to Hospital server which contains details of the blood group of driver along with the GPS coordinates of crash spot. A mail is also sent to the ambulances considering that all the ambulances will have one common mail ID. The motors are designed such that the vehicle stops once accident occurs.

2. Ambulance Module: Emergency vehicles are equipped with Raspberry Pi module and an LCD display unit. The GPS location sent from the vehicle module will be read by the ambulance module and displayed on the LCD display so that the driver of the ambulance can navigate towards the accident spot.

3. Cloud Database: This is the proposed Hospital server module which has a database of all the hospital names, their address and their GPS locations. The corresponding email IDs of ambulances belonging to the respective hospitals is also stored. When the mail is sent from user vehicle, the hospital server obtains the GPS coordinates from the mail and filter the nearest hospitals from the database. In turn the ambulances of the nearest hospital will also receive a mail from the server.

4. Traffic Control Systems: This module consists of controlling the traffic signal automatically with the help of RF module. Whenever the emergency vehicle reaches near to the traffic signal (approximately 100m), the traffic signal will be made green via RF communication. Once the ambulance crosses the traffic signal it is turned to Red again. Thereby the ambulance is assisted to reach the hospital without delay.

III. HARDWARE COMPONENTS AND DESIGN

3.1: Raspberry pi:

A Raspberry Pi is a credit card-sized computer originally designed for education, inspired by the 1981 BBC Micro. The Raspberry Pi is slower than a modern laptop or desktop but is still a complete Linux computer and can provide all the expected abilities that implies, at a low-powerconsumption level. The proposed system uses a Raspberry Pi 3 model B.The Raspberry Pi 3 Model B buildsupon the featuresof its predecessors with a new, faster

processor on board to increase its speed. It also features Wi-Fi, Bluetooth and Low Energy capabilities to enhance the functionality and the ability to power more powerful devices over the USB ports.

Figure 2: Raspberry Pi 3 model B board.

3.2: Gyro Sensor:

The Gyro sensor is used to detect the rollover of a vehicle. Rollover crash is detected by the amount of tilt angle of the vehicle. . Fig 2 shows the sensor which is employed here i.e MPU-6050.
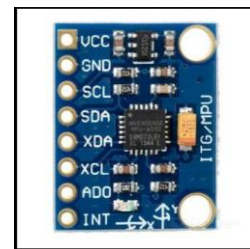

Figure 3: Pin Diagram of MPU-6050

MPU-6050 device is a combination of a 3-axis gyroscope and a 3-axis accelerometer on a single silicon die along with an onboard Digital Motion Processor(DMP).As it contains a 16 bit analog to digital conversion hardware for each channel, it captures the X,Y and Z axis data at same time. Therefore it is more accurate. The gyro sensor uses I2C- bus to interface with the Raspberry Pi board.

3.3: RF transmitter and RF receiver:

The RF module, operates at the Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK).

Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

This RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.
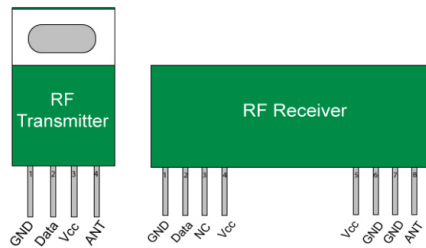

Figure 4: Pin Diagram of RF transmitter and receiver

3.4: L293D motor driver:

For the movement of any robot, motors are essential.L293D is a dual H-bridge Motor driver integrated circuit. Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Pin 1 & 9 (EN)	Pin 2 (1A)	Pin 7 (2A)	Pin 10 (3A)	Pin 15 (4A)	Function
1	0	1	1	0	FORWARD
1	0	1	X	X	TURN RIGHT
1	X	X	1	0	TURN LEFT
1	1	0	X	X	BACKWARD LEFT
1	X	X	0	1	BACKWARD RIGHT
0	X	X	X	X	STOP
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Figure 5: Working of L293D motor driver.

3.5: Global Positioning System (GPS):

A Global positioning System module is a device used to determine its location on earth in terms of latitude and longitude. In the proposed system SIM28ML (Fig 6) GPS module is being used.

SIMcom's SIM28ML is a small, high performance and reliable assisted GPS module. It's a standalone L1 range frequency module with high sensitivity navigation engine, which allows the user to achieve high accuracy, highest levels of sensitivity and lower power consumption.SIM28 can track as low as -165dBm signal without network assistance.

Figure 6: Pin description of GPS module.

Figure 7: GPS antenna
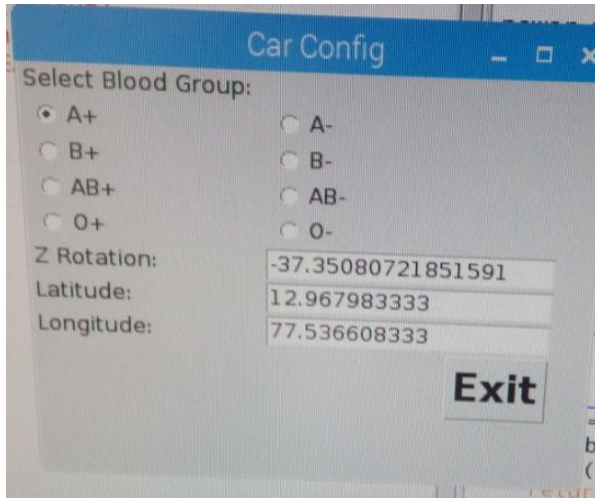
IV. RESULTS

Figure 8: A GUI showing the different blood groups and the tilt angle across Z axis.

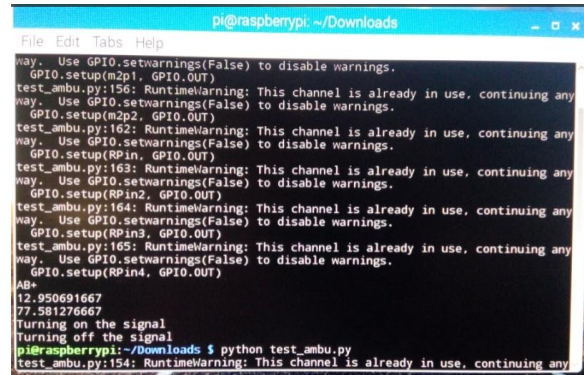Figure 9: Vehicle module.

Figure 10: Ambulance module

Figure 11: Output of the ambulance unit.

Figure 12: Database of hospitals and their ambulance's email IDs.

Figure 13: LCD display of the GPS coordinates in the ambulance module

V. CONCLUSION

This paper is proposed to detect the accident automatically and send the GPS coordinates of the accident spot to the hospital server. This paper is also proposed to send the GPS location and blood group of injured to the nearest ambulance through vehicle to vehicle communication. A system is proposed to control the traffic signals. By this, the time delay is reduced by applying the RF technology that controls the traffic signals. This ensures that the injured is treated as soon as possible.

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