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Accident Detection and Ambulance Rescue using Raspberry Pi

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Abstract:

Recently technological and population development, the usage of vehicles is rapidly increasing and at the same time the occurrence accident is also increased. Hence, the value of human life is ignored. No one can prevent the accident, but can save their life by expediting the ambulance to the hospital in time. The objective of this scheme is to minimize the delay caused by traffic congestion and to provide the smooth flow of emergency vehicles. The concept of this scheme is to green the traffic signal in the path of ambulance automatically so that the ambulance can reach the spot in time and human life can be saved. The main server finds the ambulance through mail. At the same time, it controls the traffic light according to the ambulance location and thus arriving at the hospital safely. This scheme is fully automated, thus it locates emergency vehicle and controls the traffic lights, provide the shortest path to reach the hospital in time.

Keywords — **Raspberry pi, accident detection accelerometer, motor, GSM, GPS, RF Transmitter and Receiver.**

I. INTRODUCTION

In today's world as the population increases day by day the numbers of vehicles also increases on the roads and highways. This result in more accident that interns leads to the traffic jams and public get help instantaneously. This module provides information about the accident to the hospital and police station. As a result, the sudden help may save public life and the traffic jams are reduced. The development of vehicular design brings public much convenience in life but also brings many problems at the same time, for example, traffic congestion, difficulty in monitoring dispersive vehicle, theft and other series of problems. The intelligent traffic light controller that was introduced saves the waiting time and avoids the traffic load. With an embedded sensor network technology, the congestion road is detected and managed accordingly with controllers. Alarm device predict the accident vehicle using the algorithm developed. Nowadays Wireless Sensor Networks (WSN) has been applied in various domains like weather monitoring, military, home automation, health care monitoring, security and safety etc. Satellite based navigation uses Global Positioning System (GPS) to send and receive the radio signals that serves the user with the required information. Cloud is used to send an exact location of the vehicle to the ambulance. With the help of GPS and GSM module vehicle is traced. Figure 1 shows the block diagram of accident detection and intelligent navigation system

Vehicle Module**:** This system has pressure sensor along with GPS module which are integrated in car. Whenever accident occurs GPS traces the current position and sends to cloud.

Ambulance Module**:** Emergency vehicles are equipped with GPS and GSM modules. GPS module finds out the current position of the vehicle which is the location of the accident and gives that data to the GSM module. The GSM module sends this data to the control unit whose GSM number is already there in the module as an emergency number.

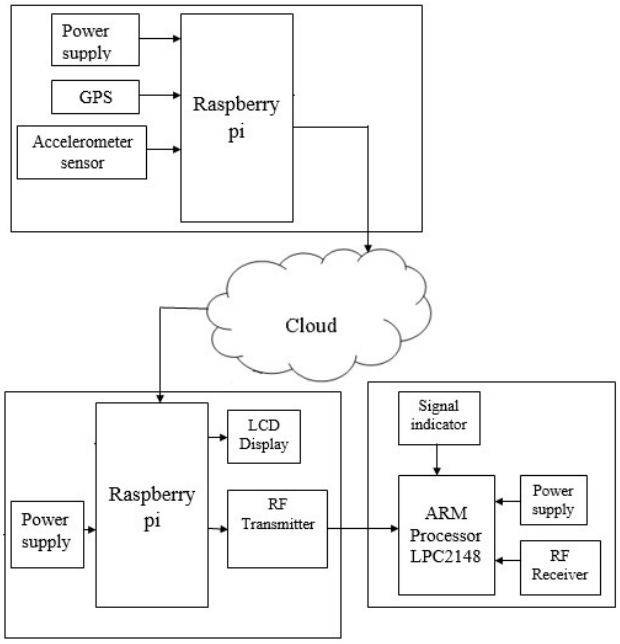

Fig 1: Block Diagram of Accident Detection and Intelligent Navigation System

Cloud Database: The cloud storage stores the all the information about nearest hospitals patient as well as current traffic density of each junction. This storage plays a central role in the emergency response and traffic monitoring system to correlate the data collected from the GPS to reach destination location in short time period.

Traffic Control Systems**:** Whenever a traffic signal section receives the information about the accident, the RF receiver in this section is turned ON to search for ambulance nearing the traffic signal. Control the traffic signal automatically with the help of RF module. Whenever the emergency vehicle reaches near to the traffic signal, the traffic signal will be made of green via RF communication. Thereby the ambulance is recommended to attain the hospital without delay.

II. RELATED WORK

This paper describes about a solution to block a vehicle by sending a SMS, and only a authorized person unlock using security code, and helps the injured person. They used GSM and GPS modem [2] the use of microcontroller based
GSM communication helps to recognize the missing vehicles. GSM modem had the authorized user registered details. The intelligent traffic light controller that was introduced saves the waiting time and avoids the traffic load. With an embedded sensor network technology, the congestion road is detected and managed accordingly with controllers [3]. Alarm device predict the accident vehicle using the algorithm developed. The acceleration sensors and angle sensors module provides the necessary data to the controller. The area of accident is detected using detection algorithm built in the controller [4]. Nowadays Wireless Sensor Networks (WSN) has been applied in various
domains like weather monitoring, military, home automation, health care monitoring, security and safety etc [1]. The vehicle system is placed inside the vehicle which detects the accident location by means of sending a message. With the help of GPS and GSM module anywhere in the vehicle is traced. GSM modem used to send an exact location of the vehicle [6].

III. HARDWARE COMPONENTS AND DESIGN

A. GPS (Global Positioning System)

It stands for "Global positioning system". It is having 24 satellites it will transmit the coded information. These 24 satellites will rotate one time over the earth in every 12 hours. In order to provide the information about velocity, time etc… GPS will help us identify the distance between the two different places on the earth and it will show the route to reach the required destination. Figure 2 shows the GPS module.

There are three different segments in GPS they are:

a. Space segment
b. Control segment
c. User segment

When satellites transmit information and each satellite will have a different code and it also transmit information at different frequencies so that the GPS can discriminate with the different signal received by the different satellites. This condition will help to calculate the time taken to travel the distance between the satellite and the GPS receivers and then the travel time is multiplied by the light speed gives the distance between the satellite and the GPS receiver The control segment will identify the satellite and it will guide with the proper orbit and proper time taken by the satellite to reach the GPS.

Fig 2: GPS Module

It is having four unmanned station with single master control station. These unmanned stations will receive the information from different satellites and this information is send to the master station and this is send to the GPS satellite. The user segments consist of users and the GPS receivers.

Working of GPS: When a GPS receiver is started to work, firstly it will start to download the orbit information about each and every satellite to download this information it will take around 12.5 min once this information is completely downloaded it will be stored in the receivers in order to use further. The GPS knows the exact location of the satellite but still it needs to know the exact distance between the satellite and the receiver. This distance can be calculated by the receiver, by multiplying the time taken by the signal to reach the receiver and the velocity of the transmitted signal. But the receiver already knows the velocity which is 18600 miles/ sec.

B. RF Transmitter and Receiver

In generally, the wireless systems designer has two overriding constraints: it must operate over a certain distance and transfer a certain amount of information within a data rate. The RF modules are very small in dimension and have a wide operating voltage range i.e. 3V to 12V.

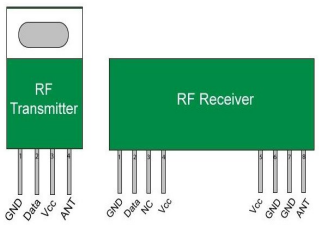

Fig 3: Pin Diagram of RF Transmitter and Receiver

Basically the RF modules are 433 MHz RF transmitter and receiver modules. The transmitter draws no power when transmitting logic zero while fully suppressing the carrier frequency thus consume significantly low power in battery operation. When logic one is sent carrier is fully on to about 4.5mA with a 3volts power supply. The data is sent serially from the transmitter which is received by the tuned receiver. Transmitter and the receiver are duly interfaced to two microcontrollers for data transfer. Figure 3 shows the Pin Diagram of RF Transmitter and Receiver.

Features of RF Module:

- Receiver frequency 433MHz
- Receiver typical frequency 105Dbm
- Receiver supply current 3.5mA
- Low power consumption
- Receiver operating voltage 5v
- Transmitter frequency range 433.92MHz
- Transmitter supply voltage 3v~6v

Main Factors Affecting RF Module's Performance: As compared to the other radio-frequency devices, the performance of an RF module will depend on several factors like by increasing the transmitter's power a large communication distance will be gathered. However, which will result in high electrical power drain on the transmitter device, which causes shorter operating life of the battery powered devices. Also by using this device at higher transmitted power will create interference with other RF devices.

4 Applications are:

- Wireless security systems
- Remote controls
- Sensor reporting
- Automation systems

In many projects RF modules are used to transmit and receive the data because it has high volume of applications than IR. RF signals travel in the transmitter and receiver even when there is an obstruction. It operates at a specific frequency of 433MHz. RF transmitter receives serial data and transmits to the receiver through an antenna which is connected to the 4th pin of the transmitter. When logic 0 applied to transmitter then there is no power supply in transmitter. When logic 1 is applied to transmitter then transmitter is ON and there is a high power supply in the range of 4.5mA with 3V voltage supply.

Features of RF Transmitter and Receiver:

1. Receiver frequency: 433MHz
2. Receiver typical sensitivity: 105Dbm
3. Receiver current supply: 3.5mA
4. Receiver operating voltage: 5V
5. Low power consumption
6. Transmitter frequency range: 433.92MHz
7. Transmitter supply voltage: 3V~6V
8. Transmitter output power: 4~12Dbm

It has many applications in various areas like Remote lighting controls, long range RFID, wireless alarm and security systems, etc.

C. L293D motor

Whenever a robotics hobbyist talks about making a robot, the first thing comes to his mind is making the robot move on the ground. And there are always two options in front of the designer whether to use a DC motor or a stepper motor. When it comes to speed, weight, size, cost... DC motors are always preferred over stepper motors. Figure 4 shows the simple DC motor of toy car. There are many things which you can do with your DC motor when interfaced with a raspberry pi. For example, you can control the speed of motor; you can control the direction of rotation. In this part of tutorial we will learn to interface and control of a DC motor with a Raspberry pi. Figure 5 and table 1 shows the working of simple DC motor. Usually H-bridge is

preferred way of interfacing a DC motor. These days many IC manufacturers have H-bridge motor driver available in the market like L293D is most used H Bridge driver IC. H-bridge can also be made with the help of transistors and MOSFETs etc. rather of being cheap, they only increase the size of the design board, which is sometimes not required so using a small 16 pin IC is preferred for this purpose. By using two motors we can move our robot in any direction. This steering mechanism of robot is called as differential drive.

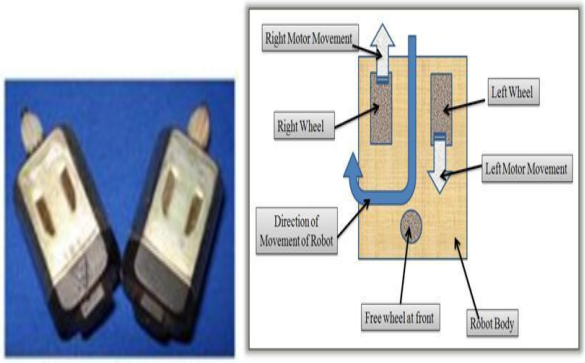

Fig 4: Simple DC Motor of Toy Car

Table 1: Working of Simple DC Motor

Left Motor	Right Motor	Robot Movement
Straight	Straight	Straight
Stop	Straight	Left
Reverse	Straight	Sharp left
Straight	Stop	Right
Straight	Reverse	Sharp right
Reverse	Reverse	Reverse

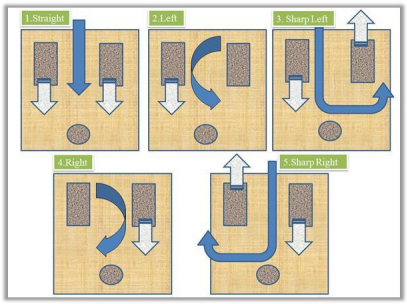

Fig 5: Working of Simple DC Motor

D. Accelerometer Sensor

For detecting tilt angle Accelerometer sensor is used. "Accelerometer sensor" plays a major role. Fig 6 shows the sensor which is employed here. The sensor is a 3-axis accelerometer sensor (MMA7660FC) which is capable of finding different physical changes like "tilt", "tap", "shake" etc. figure 7, figure 8 and figure 9 shows the 3 direction of the accelerometer tilt. Advantage of this sensor is it can sense the physical conditions in all the three directions (i.e., 3-Axis).

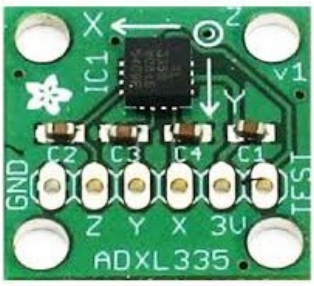

Fig 6: Accelerometer Sensor

Fig 7: When vehicle position is in x-axis

Fig 8: When vehicle position is in y-axis

Fig 9: When vehicle position is in z-axis

E. Raspberry pi

The Raspberry Pi is a series of credit card-sized single-board computers developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools. The Model B+ is the final revision of the original Raspberry Pi. It replaced the Model B.

Fig10: Raspberry pi board

IV. RESULTS

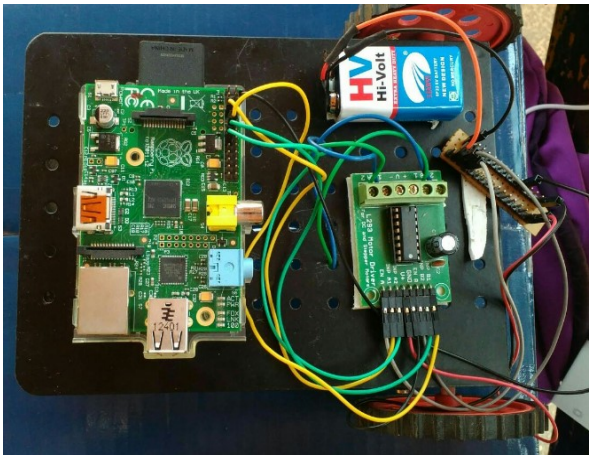

Fig 11: vehicle unit

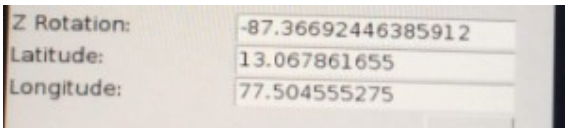

Fig 12: latitude and longitude of the accident spot with accelerometer rotation

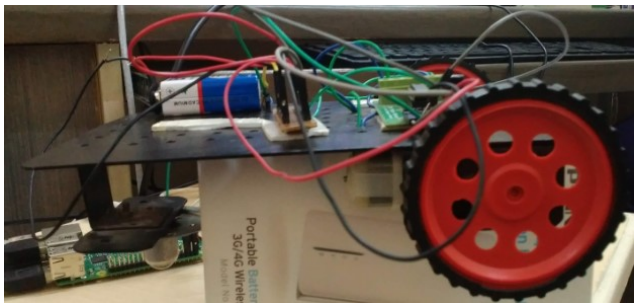

Fig 13: ambulance unit

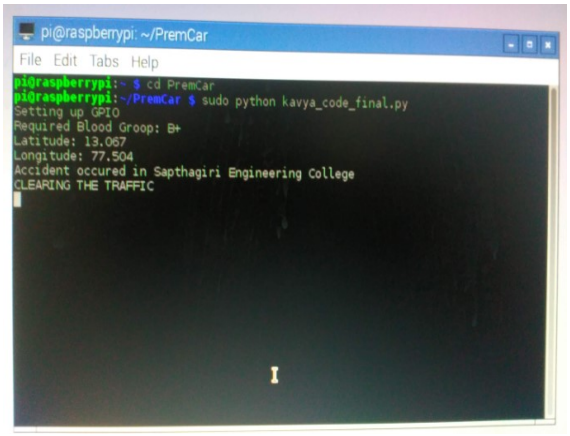

Fig 14: latitude and longitude of the accident spot displayed in ambulance unit

V. CONCLUSIONS

The proposal of the paper is to find the shortest path by controlling traffic signals in favor of ambulance. By this new system the time lag is reduced by applying the RF technologies that controls the traffic signals. The priority of service to the ambulance follows the queuing methodologies through server communication. This ensures the reduced time lag between the accident spot and hospital.

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