IoT based Ambulance Prototype for Innovative Traffic Congestion Control System

D. Satheesh[1], T. Mounika[1]
[1]Department of Electronics and Communication Engineering, SreeDatthaInstitute of Engineering and Science, Hyderabad, Telangana, India

Abstract

Traffic congestion is a major problem in cities of developing Countries like India. Growth in urban population and the middle-class segment contribute significantly to the rising number of vehicles in the cities. Congestion on roads eventually results in slow moving traffic, which increases the time of travel, thus stands-out as one of the major issues in metropolitan cities. This paper presents an intelligent traffic control system to pass emergency vehicles smoothly. Each individual vehicle is equipped with special radio frequency device. We use radio frequency (Rf)transmitter (Tx) and receiver (Rx) modules at ambulance and traffic signal respectively. It monitors vehicles that passes on a path during a specified duration. It also determines the network congestion, and hence the green light duration for that path. If the ambulance passes through the path it switches on the green light until it passes the signal area.

Keywords: Raspberry Pi, Internet of Things, RF transceiver, Ardunio

1. Introduction

Traffic signs are the most advantageous technique for controlling in a bustling junction. But nowadays transportation has become a crucial role in everyday life and due to increase in vehicles, congestion of traffic is taking place. In this context, many methods are evolved for preventing this traffic congestion problem and giving a clearance way for emergency vehicles. Moreover, in Europe the automotive manufacturers have initiated the Car-to-Car Communication using wireless technology. This increases the road traffic safety, efficiency and reduces traffic congestion. Thus, in current developments of wireless technology to prevent this scenario number of developments are made in cities, heavy traffic junctions and urban areas [1]. There are several methods such as Laser tracking technology, Radiofrequency Identification (RFID), Global positioning system (GPS) and video-based tracking are available. As these methods are highly sensitive to the environment such as weather changes like rain, fog etc., they are less effective and error prone, costly and needs regular maintenance and cannot provide their effectiveness on long term basis. The emergency will occur anyway, anytime and anywhere which require quick responses. There is a gradual increase in number of vehicles on the limited road networks infrastructure leading to increase in traffic management problem. The most critical significance of road traffic problem is the delay in time for emergency vehicles such as hospital ambulance, fire protection vehicle and police emergency vehicle.

In recent studies, the traffic congestion contributes more towards the human death. Moreover, the traffic congestion on main pathways lead to peoples' long period of waiting on road and high cost on fuel consumption. Hence, it is necessary to control the traffic system by prioritizing the smooth flow of emergency vehicles through the congested traffic. Accordingly, with this proposed system the occurrence of the accidents can also be avoided by the installed modules in the emergency vehicles which provides an automatic controlling system. With the expanding number of vehicles on the street, it has turned into a matter of worry to oversee movement efficiently. According to [2], the density of the traffic congestion could be measured by utilizing the Programmable Logic Controller (PLC). Meanwhile speed sensors are placed to an intelligent vehicle which communicates with the surrounding vehicles to notify about the weather conditions. This involved embedded processors built with sensors integrated into the intelligent vehicle requiring a complicated and rigid implementation along with expensive sensors [3]. When considering about countries having less economy, the above

techniques are difficult to implement and maintain. The wireless sensor networks (WSN) are used to collect the data of each lane of traffic and transfer the data to Intersection Control Agent (ICA). So, these controlling agents are installed at every traffic light junction by [4]. The objective is to maximize the flow with enough vehicles in each lane; this decreases the latency of travel. One of the most inconveniences in ordinary vehicle identification technique is the recognition of vehicle in altered positions.

2. Proposed Implementation

In this proposed system a low cost and effective RF transponder which consists of a transmitter and receiver is used. The transmitter is placed in the emergency vehicle and receiver is placed at the signal pole so whenever the emergency vehicle approaches to the range of the transmitter a code is transmitted to the receiver at the pole and the signal is turned green so that way can be allocated for the emergency vehicle. Description of proposed system: The proposed system consists of RF transmitter, RF receiver, microcontroller for controlling the interrupts to the traffic lights and the RF modules. In the proposed model, a microcontroller is coded for both transmitting and getting part and set. The transmitter part is placed in the vehicle and the receiving part is set at the signal pole, so correspondence happens just when the transmitter part lands at the range.

The ambulance is setup with one RF Tx module which can be triggered using a small switch. Whenever it reached the signal point then the switch is pressed. The RF Rx module at signal receives the signal from Tx and make the signal to Green.

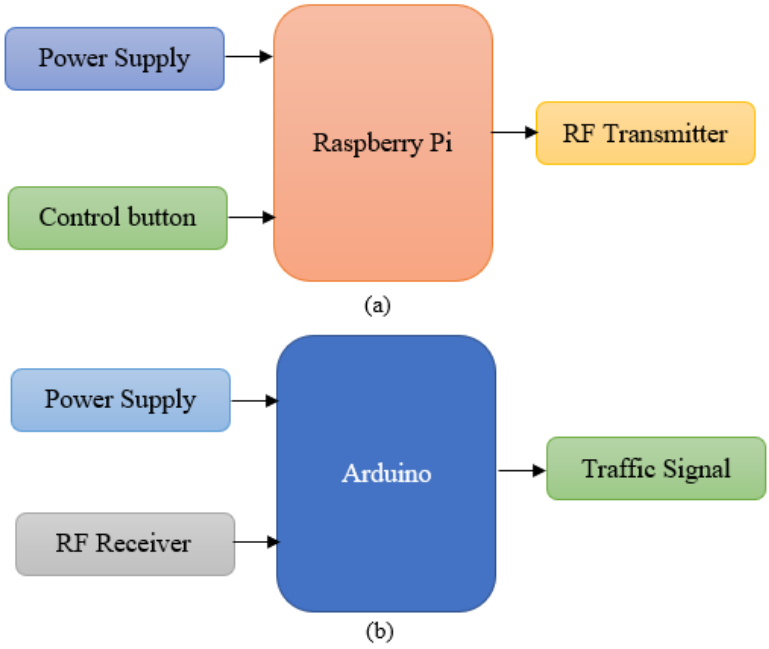

Figure 1. Proposed traffic congestion control system. (a) Transmitter at ambulance side. (b) Receiver at traffic signal side.

3. Hardware Description

3.1. RF Module (Transmitter & Receiver)

The RF module, as the name suggests, operates at 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 stronger and more reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

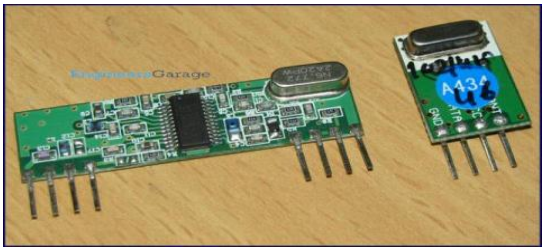

Figure 2. RF Module (Transmitter & Receiver).

This RF module comprises of transmitter and receiver, which operates at a frequency of 434MHz. 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.The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder. HT12E-HT12D, HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

3.2. Traffic Signal Controller

Housed in a grey metal box on a corner of the intersection, the controller is the 'brain' of the system. It is a computer that processes information received from the detector loops and pedestrian push buttons and changes the signal lanterns in accordance with its programming. Based upon the prevailing demands, the controller determines the length of the green signal for each traffic movement and controls the transition from one combination of green and red signals (known as phase) to the next. It can operate in a 'standalone' manner or be programmed to coordinate with a series of adjacent traffic signals.

3.3. Raspberry Pi

The Raspberry Pi is a series of small single-board computers developed in the U.K. by the Raspberry Pi foundation to promote the teaching of basic computer science in schools and in developing countries. The original model became far more popular than anticipated, selling outside its target market for uses such as robotics. It does not include peripherals (such as keyboards, mice and cases). However, some accessories have been included in several official and unofficial bundles.

Figure 3. Raspberry pi.

4. Software Requirements

According to the latest TIOBE Programming Community Index, Python is one of the top 10 popular programming languages of 2017. Python is a general purpose and high-level programming language. You can use Python for developing desktop GUI applications, websites and web applications. Also, Python, as a high-level programming language, allows you to focus on core functionality of the application by taking care of common programming tasks. The simple syntax rules of the programming language further make it easier for you to keep the code base readable and application maintainable. There are also several reasons why you should prefer Python to other programming languages

4.1. Cloud

Cloud storage is a model of computer data storage in which the digital data is stored in logical pools.The physical storage spans multiple servers (sometimes in multiple locations), and the physical environment is typically owned and managed by a hosting company. These cloud storage providers are responsible for keeping the data available and accessible, and the physical environment protected and running. People and organizations buy or lease storage capacity from the providers to store user, organization, or application data. Cloud storage services may be accessed through a co located cloud computing service, a web service application programming interface (API) or by applications that utilize the API, such as cloud desktops to storage, a cloud storage gateway or Web-based content management system.

5. Conclusion

The proposedsystem is a self-organized system for controlling the congestion of the traffic and thereby providing a way for the emergency vehicles. In this system the microcontroller is utilized to control the traffic light system and it can be easily reprogrammed. The RF transmitter and RF receiver used in this system is of 433 MHz ranging up to 100 meters. The components used in this system leads to low cost and easy installation. Thus, by making it work in real time environment the same design can be used for ambulances and fire emergency vehicles. The major advantage of this proposed intelligent system is that the power consumption is very low, and this system can be used for long term basis.

References

[1] M. N. Kabir, Y. M. Alginahi, A. I. Mohamed, “Modeling and simulation of traffic flow: a case study-first ring road in downtown Madinah”, International journal of software engineering and computer systems, vol. 2, pp. 89-107, 2016.

[2] D.S. Mohit and Prerna, “Smart traffic control system using PLC and SCADA”, International Journal of Innovative Research in Science, Engineering and Technology. vol. 1, no. 2, pp. 169- 172, 2012.

[3] E Samy and A. Mahmoud, “Real-time weather notification system using intelligent vehicles and smart sensors”, IEEE 6thInternational Conference on Mobile Ad-hoc and Sensor Systems, pp. 627 – 632, 2009.

[4] T. Malik and S. Yi, “Adaptive traffic light control with wireless sensor networks”, 72nd IEEE Vehicular Technology Conference Fall (VTC 2010-Fall), pp. 187-191, 2010.

[5] W Chen, L Chen, Z Chen and S Tu, “A realtime dynamic traffic control system based on wireless sensor network”, International Conference on Parallel Processing Workshops (ICPPW'05), pp. 258 – 264, 2005.

[6] K. M. Alhendawi, “A new framework for predicting the impact of traffic on the performance of mobile ad-hoc network (MANET): using regression as data mining approach”, International Journal of Software Engineering and Computer Systems, vol. 3, pp. 88-105, 2017.

[7] A.S. Sadiq et al., "A developed network layer handover based wireless networks", International Journal of Software Engineering and Computer Systems,vol. 1, pp. 113-122, 2015.