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Traffic Monitoring System with Ambulance Safety

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Article Info
Volume 83
Page Number: 4335-4340
Publication Issue:
May - June 2020

Article History
Article Received:*19 November 2019*
Revised: *27 January 2020*
Accepted: *24 February 2020*
Publication: *12 May 2020*

Abstract

In a country like India, Traffic signals are one of the biggest obstacles in transportation and portage as sometimes these traffic signals are the major cause of traffic. A regular traffic signal operates in a fixed manner which results in non-uniform traffic flow and also overlooks the stalled emergency vehicles like Ambulances. With the increase in traffic density nowadays, several causalities or complications occur due to delay in carrying a patient to the hospitals. The proposed Traffic management system works in such a way that it can reduce traffic to some extent and also clear the path for an emergency vehicle like Ambulance or a fire-engine stuck at traffic signal junction by turning the signal from red to green when these vehicles come in the vicinity of the traffic signal. The above is achieved by the use of RFID Tags, RFID sensors, sound sensors and buzzers. This process is aimed to be automatic and efficient.

Keywords**:** *Smart traffic system, RFID Tags, RFID Sensors, Sound Sensor, Traffic congestion, Emergency vehicles, Ambulance.*

1. Introduction

Traffic is among the key problems in cities and has made the lives of individuals really difficult. Obviously, it ends up in non-productive activity. People experience delay for their important work. This might even end up in personal along with professional losses. Emergency vehicles like fire brigade and ambulance grind to a halt in traffic jams that cause delay in reaching the desired place. Survey says that more than 20 % of patients needing emergency treatment have died on the road before reaching the hospital due to delays because of traffic jams and uncooperative motorists [10]. This problem could be handled by giving way to emergency vehicle or clearing the lane wherever the emergency vehicle is moving using internet of things.

Internet of Things is a system of interrelated information processing devices, machines, objects etc. which does not need any human interference while working. IoT environment includes embedded system and many sensors which collects data from their environment and work upon that. Our proposed system uses sensors such as RFID sensor which uses electromagnetic field to detect a tag. The tag releases a digital data usually its manufacturing number and when this tag comes in the range of a reader, the reader can detect the inventory number of the tag [11]. The above mechanism is fully automatic. Another sensor used in our model is sound sensor which is used to detect the intensity of sound [12]. Using the above mentioned specifications of different components used, we design our model of smart traffic management.

While considering and testing for various scenarios of our project, one more problem that appeared is that, all the ambulance won't carry emergency cases, so to differentiate genuine or emergency case with others, RFID tag is employed together with the sound sensor. Therefore the ambulance which has both RFID tag mounted and buzzer or siren is going to be considered as an ambulance carrying emergency case and

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further it'll be given way to move and cross the traffic junction [13].

2. Literature Survey

Prof. Manjiri M. Kokate et al [1] proposed an IoT based intelligent traffic signal control system in this paper, which facilitates the movement of the ambulance in traffic. The main objective of this model is to reduce the delay for the ambulance in order to save the time for treatment. Here, this is done in two different ways, firstly, by providing the optimal route for the ambulance by considering traffic density and secondly, the stored medical data of the patient will help the doctors to provide the proper treatment to the patients. When it comes to the technique, GPS and RFID technology is used to suggest the nearby hospital and optimum route is provided. Now, for this system to run in a systematic way, every citizen is supposed to register themselves in the website named "Health Card". The detailed information will be stored in this website along with the medical history of each individual and when in need, this information will be used by the doctors in order to provide fast and efficient treatment. The project proposed in this paper could be considered as a "Life Saver" system.

Bassel Othman et al [2] proposed in this paper that the influence on environment due to increase in road transportation energy use, is emerging at an accelerating and alarming pace across the globe, and there is an urgent need in the fields of research and technology to develop new and inventive techniques to build a sustainable road traffic system. And hence, the aim of this paper is to provide a comprehensive literature review of the existing energy consumption and pollutant emission models to precisely understand traffic behaviour and then give an overview of the existing transportation problems as well as the vehicle and traffic control strategies to improve energy and environmental efficiency of transportation considering the connection and interaction between traffic congestion and environmental impact. As an outcome of this review, the limitations and drawbacks of the current skills and approaches are identified and discussed in order to inspire future works in eco-traffic management. This paper provides a total different aspect of traffic management with the focus mainly on eco-friendly and environment sustainable transportation.

S.K.Janahan et al[3] proposed a smart traffic management system in this paper, which is based on IoT using vehicle count. Author has used IR sensor for counting the number of vehicle , on all the 4 lane IR transmitter and receiver is present to count and even clustering based KNN algorithm is used to fix signal timing according to the collected previous data so that vehicle queuing will not take place. This paper has 3 parts, first is mobile app which stores the data collected by sensors and shows the present scenario of the upcoming signal to the user. Second part is server communication; according to the data collected by sensors the algorithm is used to calculate the timing of signals for some area where traffic congestion is more. Third part is user communication; the user can decide which path to take after looking at the android application.

Roxanne Hawi et al [4] proposed in this paper the problems related to increased traffic in today's world and the consequences of unorganised traffic on our day to day lives, and a very popular method to deal with this problem nowadays is the smart traffic control systems (STCS) which makes smart decisions to route traffic based on human-like thinking capabilities. This paper provides an in-depth review of the various existing techniques of STCS like Fuzzy expert systems (FES), artificial neural networks (ANN) and wireless sensor networks (WSN) and states their usage in intelligent traffic management. These techniques are thoroughly discussed along with study of their architecture, merits, advantages and downsides. By reviewing all these approaches and techniques, their comparison is done to know the best possible methods of STCS. All are confirmed to be effective in controlling the traffic, managing it, and ensuring its uniform flow.

Summary of techniques used by other authors is depicted in Table 1.

3. Proposed Model

In this paper, to tackle the above mentioned problems of emergency vehicles getting stuck in traffic, we propose a scheme of smart traffic monitoring system with Ambulance safety. The presented scheme focuses on monitoring the traffic in a smart way along with the feature of Ambulance safety which manages the traffic in such a way that Emergency vehicles like Ambulances do not get jammed in a heavy traffic junction zone.

A. Design Objectives

Some of the prominent objectives which we intend to achieve through our proposed work are elucidated as follows:

- Optimize traffic flow and help proactively manage traffic conditions.
- Ensuring that the lane in which the ambulance is travelling is cleared so that it does not get stuck in traffic jams.

B. Architecture

The architecture comprises of RFID tags, RFID sensors, buzzer, sound sensors and LED lights connected to the Arduino Mega microcontroller via jumping wires and the code for the working is written using the Arduino(IDE) software.

1. *RFID Tag*- A Radio Frequency Identification (RFID) tag can be considered as a tracking system, which identifies items by making use of barcodes. This data stored in RFID tags is then transmitted through waves and is read by a valid reader.

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2. *RFID Reader*- A Radio Frequency Identification (RFID) Reader reads the data in the form of radio waves from a RFID tag and then this data is converted into useful information by using a RFID computer program.
3. *Arduino Mega 2560*- The Arduino Mega 2560 is a microcontroller board comprising of 54 digital input and output pins, 16analog inputs, a USB connection, a crystal oscillator-16 MHz an ICSP header, and a power jack which is programmed using the Arduino Software (IDE). It can be powered by a PC using a USB cable, or a battery or an AC-DC adapter.
4. *LED lights*- Green, Red and Yellow LED lights are used to showcase the three signals of a traffic signal light where Green indicates "Go", Red indicates "Stop" and Yellow indicates "Ready".
5. *Sound Sensors*- A sound sensor is used to identify a certain kind of sound or audio signal existing in a specified range of frequency.
6. *Arduino(IDE)*- It is an integrated development environment written in Java which can run on Windows, Mac OS X, and Linux. This is a software using which we can easily write code and upload it to the Arduino board.

C. Working

The proposed smart traffic management system is designed to work at a junction or intersection of four crossroads, where each road has two lanes. In absence of an emergency vehicle, the system is expected to work in a regular fashion, i.e., the signal will turn green in a clockwise pattern for each of the four roads for a defined interval of time. RFID Readers are installed on each road at a distance of 150 metres from the signal junction to detect emergency vehicles. Hence the existence of the detected vehicle will be known by the reader until it passes the junction or, in other words, goes off the limit of the reader. Similarly, sound sensors are also positioned on each road to capture sound signals coming out from sirens. An emergency vehicle will have a RFID Tag attached to it which when comes in the range of a RFID reader, will be detected and the existence of the emergency vehicle will be known. In addition to this, emergency vehicles will also have sirens which will produce sound to notify that it is on an emergency mission.

The normal traffic flow is disrupted when the RFID reader senses a RFID tag in any one of the four roads. The RFID reader, then transmits the data sensed from the tag and translates it to confirm the presence of an emergency vehicle. But validating its existence only by the means of RFID Tag cannot be sufficient. And hence, at the same time the frequency of the siren mounted on the vehicle is also checked by a sound sensor to declare that the sensed vehicle is indubitably an emergency vehicle. For instance, the frequency of ambulances and fire truck sirens ranges from 650 Hz to 1550 Hz and if a siren produces sound in this frequency range the nit is acknowledged to be the above mentioned vehicle. So, to conclude the presence of an ambulance stuck in the traffic, RFID tag has to be sensed simultaneously with a sound of given frequency range from siren.

Table 1: Summary of techniques to manage traffic congestion

Ref. No	Methodology /Algorithm used	Advantages	Limitations/ Enhancements
[5]	Congestion control algorithm.	-Prevention of accidents, crimes, delay in transportation -Driver flexibility and security of passengers	-Usage of real time analytics on online traffic information must be very fast and precise.
[6]	Blob algorithm based on AI	-System can predict the traffic density for future. -Connects nearby rescue departments.	-GPS can be used to send the exact location of ambulance.
[7]	Raspberry Pi and Cloud Computing	-In case of sensor system failure, the values stored in the cloud will be useful.	-Emergency vehicles should be given highest priority.
[8]	IoT and Big Data analytics	- Low cost model. -A mobile application is also developed for the users to know about the traffic density.	-Current system only detects vehicles but not the vehicle types. By Adding more advanced feature like Image Processing can be used for the same.
[9]	KNN and Random Forest algorithm	-This model is helpful for traffic monitoring, pollution avoidance, route optimization, accident detection and vehicle tracking.	-Delay in real time data updating may cause confusion among drivers and further traffic congestion.

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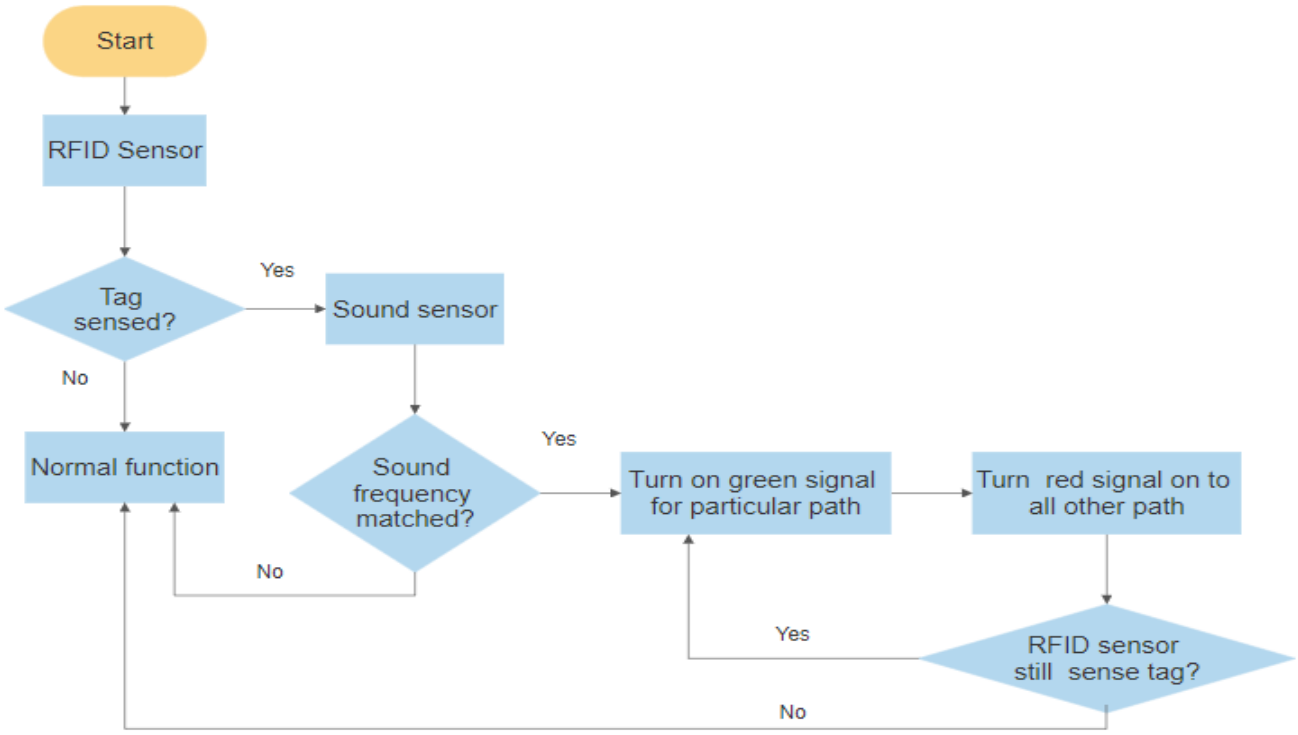

Figure 1: Simplified flow-chart for the entire system

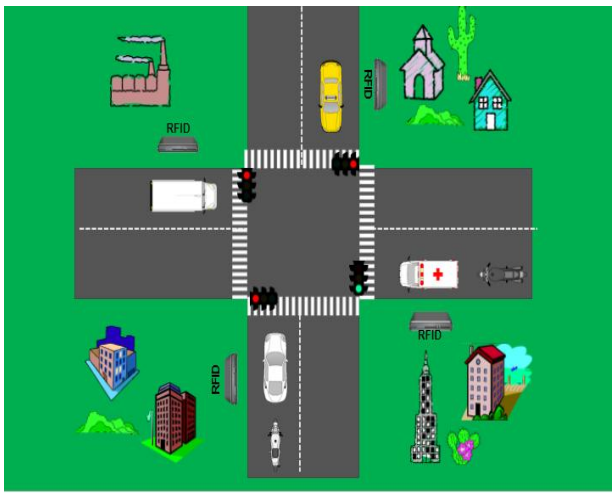

Figure 2: Real time scenario of smart traffic management system

When the Ambulance is detected to be stuck in the traffic and if the traffic signal for that particular lane is shown to be "Red", in that case, the traffic controller will immediately change the signal light to "Green" and will approve the traffic in that lane to move, in consequence to which the Ambulance can reach its destination without any delay. Meanwhile, when the Ambulance lane is being cleared, all the other three traffic signals show a red light indicating the traffic in those lanes to be halted (shown in Fig.2). In this way, the lane occupied by Ambulance has been given preference to move over the other lanes.

As soon as the Ambulance crosses the junction, the RFID reader will no longer be able to detect its presence as its range will be beyond limit. Therefore, it will be concluded that the Ambulance has successfully passed through the signal and is no longer stuck in traffic. By receiving this signal, the traffic signals will be restored to their previous state and will operate as per the standard rules.

The working procedure of the solicited strategy can be understood by means of the flowchart shown in Fig.1

4. Result

Results obtained by performing the above mentioned smart traffic management technique can be summarized as follows:

When the Ambulance is detected stuck in the traffic jam by the RFID reader and sound sensor, through a RFID tag and sound of siren of certain frequency, the traffic signal light is changed to green for that particular lane and other signals are turned red. The RFID tag is constantly monitored by the reader and once the Ambulance gets passed through the junction, the traffic signals for all the lanes are restored to the previous states. This outcome is successfully obtained.

The normal working of our proposed model is shown in Fig.3 in which the signal turns to green in clockwise fashion for some defined interval of time and the other three lane signal will be red for that time.

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Working of RFID sensor and tag is shown in Fig.4, picture 1 of this figure shows lane 2 with green light and other three lane with red light and when RFID card is brought near to the RFID sensor (mounted on lane 3) and at the same time sound sensor detects the desired frequency, the signal of lane 3 changes to green (picture 2 Fig.4).

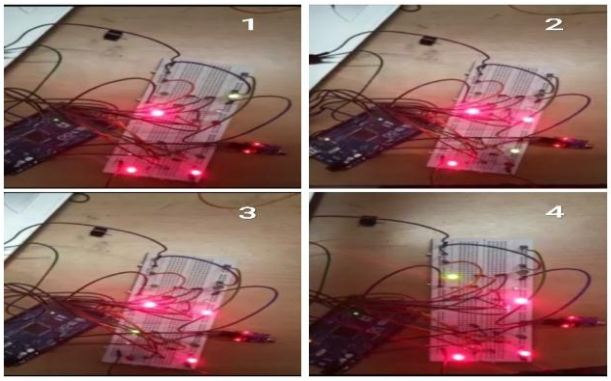

Figure 3: Shows the normal functionality of the traffic signal

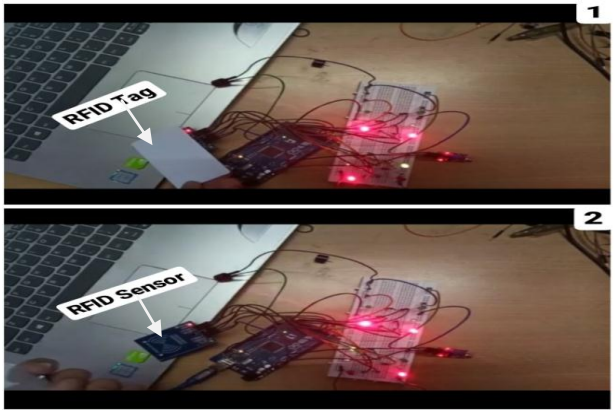

Figure 4: Shows working of RFID sensor and tag

The most commonly used method for controlling traffic in the present state is the traditional traffic signal technique which operates in such a way that it provides green signal to each lane for a fixed amount of time in a repeated manner. It has two essential aspects- duration of green light and sequencing of green light. However, it is only efficient when the traffic is regular or steady and does not differentiate the emergency vehicles from normal vehicles, thus, resulting in stalling of ambulances or other emergency vehicles in the traffic for a decent amount of time causing delay. This problem is our prime concern and in order to tackle this, our proposed system prioritizes the emergency vehicle by clearing the lane as soon as they are detected near traffic light with the help of RFID tags and sensors. It solves the most prominent drawback of traditional traffic signal approach. Hence, this technique is proved to be more efficient when compared to the traditional traffic signal method, as it helps in passing of emergency vehicles without any delay by detecting them in the real time and helps in clearing the traffic in a more systematic manner.

Table 2: The tested performance matrix

Sl.No.	Distance from RFID Sensor	Tag sensed	Frequency between 600Hz to 1200Hz?	Signal light of that lane
1	< 7 cm	Yes	Yes	Changes to Green
2	< 7 cm	Yes	No	Remains as it is
3	> 7 cm	No	Yes	Remains as it is
4	> 7 cm	No	No	Remains as it is

5. Conclusion and Future Work

Monitoring the traffic by taking emergency vehicles like ambulance, fire-brigade and police cars into consideration is an important role to play when it comes to the traffic management system for smart cities. The proposed traffic monitoring system provides ambulance safety which uses specified sensors to make it work accordingly. The use of RFID tags and sensors along with the frequency identification systems helps us to differentiate a real case of emergency. As the proposed system is completely automatic, it will reduce the manual work for controlling the signal. This project has still some scope for further improvement. Each of the RFID sensor requires 3.3V of power supply and since we have four lanes, i.e., we need four RFID sensors so all these sensors will not be able to meet their desired level of power. Now, in order to provide sufficient power to these RFID's, we need to equip them with external supply. Hence, we have presented our project for only one lane which can be further extended to all the four lanes in future. In addition, a software application can also be developed for improvising the overall system and making it more efficient. A GPS tracking system will come into picture which will track the ambulance with the help of the mobile application which in turn will be operated by the paramedics present in the ambulance with the patient. The paramedic will provide the necessary details in the application and it will be sent to the hospital so that the doctors will prepare themselves accordingly, without any delay.

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