

Smart Traffic Management System using IoT Enabled Technology

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Abstract— In current scenario one of the serious concern for people in smart cities such as Delhi, Bangalore, Mumbai, Hyderabad etc. is traffic congestion. This has turned out to be a daily problem in current time. Due to this road congestion accidents in the city have are raised to a great extent so lives lost due to accidents are even more crucial. Due to this congestion on the roads, emergency vehicles such as ambulances, fire-cars and other vehicles cannot reach on time. This results in huge loss of life. To tackle these issues up to a great extent we present a solution in this paper. Through the use of IoT enabled technology we can solve these issues by creating “Green Corridors” for emergency vehicles. This can save their time expansion for reaching the proposed destination and can prevent the loss of human life up to great extent. IoT provides a method to tackle these issues by providing smart and intelligent traffic management system. The system gives emergency vehicles the benefit of green corridor and reach destination on time. The RFID reader scans the RFID tag applied on the ambulance and updates the upcoming traffic light to switch to green and displays a message to vehicles ahead of ambulance to provide a “Green Corridor” by shifting other lanes. This system comprises whole traffic system and functions for emergency situations in order to reach the destination without any delay.

Keywords—Intelligent Traffic Management System, Traffic Control System, Traffic congestion, Internet of Things, Arduino programming, Arduino IDE

I. INTRODUCTION

Urban cities have become the web of complex inter relations. This comprises of various interdependent subsystems. Out of these subsystems, the traffic system plays a major role. According to a study, the traffic system acts as a cornerstone to world's economy [1]. With the increasing rate of population, the numbers of vehicles on roads are increasing simultaneously. This results in increase of rate of traffic jams on daily basis [2][3].

The consequences of the above stated problem can cause damage to human lives. This is because road congestion causes delay in the required assistance from emergency vehicles like ambulances. The delay of fractions of time, impacts the lifesaving capabilities of emergency services. Results of a study states that, “Around 65-70% of deaths could have been prevented, if the emergency teams responded quickly”.

Thus we propose a new design which automatically controls the traffic signals. Using this system the emergency

vehicles can reach on time to their destinations without much delay. The IoT enabled STMS makes it possible to create Green Corridor for emergency vehicles when required. Emergency vehicles have RFID tag(s) installed on them. RFID scanners are placed at some distance from traffic lights. Traffic signals functionality is not altered when emergency vehicles are not in the vicinity of traffic lights. As soon as the RFID tag is scanned the traffic light switch to green and displays a message on the LCD screen to give way to the ambulance [4].

The previous manual methods of controlling traffic could not tackle these issues. The proposed system is capable to switch the traffic signal to green, when the vehicle approaches the traffic signal. The old manual methods of traffic control fails in managing traffic in metropolitan cities nowadays.

II. LITERATURE REVIEW

The proposed Smart Traffic Management System enables emergency vehicles to avoid the delay due to road congestions. Previously used manual methods were not able to control the traffic flow as per the requirements. Due to the increase in vehicles with growing years the road infrastructure is not able to fulfill the needs of the world. In urban cities this problem is even more. According to a study the present rate of increasing road infrastructures does not

traffic signals. It also helps by providing a “Green Corridor”

match with the expansions of economy for any nation [5].

Our proposed system is based on the implementation of Infrared Technology, visual sensing, RFIDs/radar system. All these together can help in controlling the traffic in more efficient manner whenever any ambulance or some emergency vehicle comes closer. The STMS eliminates the delay time faced by the emergency response vehicles on to the vehicle by displaying the arrival message of vehicle on LCD screen to the vehicles moving ahead and indicates them to shift to other lanes on the road.

The advantages and disadvantages of previous traffic management systems and our proposed smart traffic management system is shown in Table 1.

TABLE 1. The advantages and disadvantages of previous traffic management systems

Technology	Advantages	Disadvantages
Manual traffic control management	1) Easy to implement 2) Less chances of error due to human involvement	1) Time Consuming 2) It is possible that accidents happen on the crossings. 3) Chances of conflicts are very high 4) Emergency vehicles have only one human to communicate
Automatic traffic light system/ image processing methods [6].	1) It is less time consuming then the manual method. 2) Image processing can automate the traffic management according to the amount of vehicle congestion.	1) The fixed timing structure of automatic lights can cause time delay. 2) Emergency vehicles cannot communicate to system management efficiently. 3) Image processing is bound to cover a limited area with its camera.
Traffic Management system using Wireless Technologies	1) Time efficient 2) Allows emergency vehicle to pass quickly. 3) Helps creating "Green Corridor" for the emergency vehicle. 4) Less number of conflicts.	1) Need to make all traffic lights to behave smart according to the needs of the system.

As a matter of fact, the road congestion caused due to increased traffic is not always recurring i.e., something which is due to recurring demand, which has virtual existence daily. Rather it is nonrecurring many times which is caused due to traffic incidents like on road damage of vehicles, crashes on roads, work zone congestions, weather and special events in surroundings. To manage this type of nonrecurring congestion, researchers have suggested the idea of system which is based on sensors. These were for improvement over fixed timing controlled systems. It is necessary to have clear line of sight (LOS). These systems lacked to provide them and were not successful ultimately.

The sensor based system also made it difficult to do multiple detections simultaneously.

To overcome the above stated problems and give enhanced solutions, an intelligent traffic control system abbreviated as ITCS was introduced which works on the concepts of radio frequency identification (RFID) [7]. The concept stated behind the principle of RFIDs on vehicles has resulted in becoming a topic of research for various established organizations. The system proposed in this paper uses innovative ideas using a latest technology that differentiates it from the older methods. It comprises of RFID tag, RFID tag scanner, Arduino UNO and connects all these together for the required functioning. Fig. 1 shows depicts a road crossing which is installed with RFID readers for the ease of traffic management.

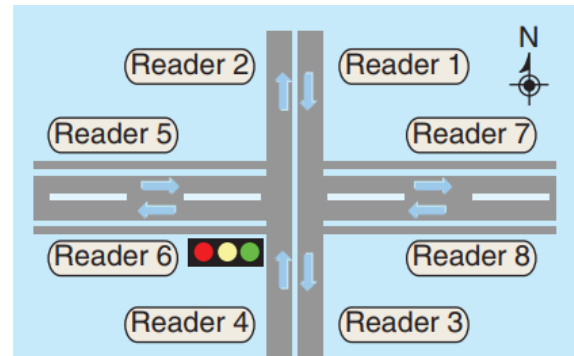


Fig 1. RFID scanners on Road Crossing

III. THE PROPOSED SYSTEM

Our proposed Smart Traffic Management System is based on Internet of Things (IoT) [8]. The STMS project contains two sections. These sections are the **ambulance section** and **traffic signal section**. Every ambulance has a RFID tag installed on it. Thus, this creates our first section i.e. ambulance section. It comprises of ambulance installed with RFID tag. The second section is the traffic signal section. It consists of a RFID reader which reads the RFID tag. The RFID readers stores information after reading the tag and sends it to server through cloud computing. Traffic signals are turned green and as a result the ambulance section goes through traffic signal without any traffic. This system ensures that all the emergency service vehicles reach their destination without facing traffic delays. As a result this saves the precious human life and contributes in building smart cities. The ambulance section is shown in the Fig. 2.

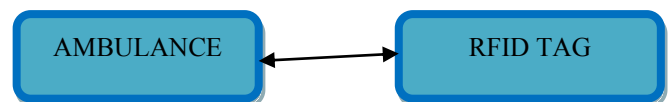


Fig.2: The Ambulance Sections

The second section of our proposed project is the traffic signal section. This section comprises of an Arduino Mega Microcontroller, RFID Reader, LCD Display, one Red LED, one Yellow LED and one Green LED. The traffic signal pole is made using the three LEDs. RFID reader is installed before the traffic light pole. Arduino Mega microcontroller is used in our project. The microcontroller is connected with traffic light, servo and RFID reader. Arduino Mega

microcontroller ensures the processing of data. The prominence of our project is determined by the LCD which is connected to Arduino Mega [9]. The moment when ambulance installed with RFID tag on it passes the RFID reader, a message is sent to display on the LCD. Message on the LCD is “WELCOME TO NH-24” which is converted to “AMBULANCE COMING- GO TO THE LEFT LANE”. Simultaneously the red LED turns to green. Like real world this shows that signal is free and the ambulance can pass through the “Green Corridor”. The traffic signal section is depicted in Fig. 3.

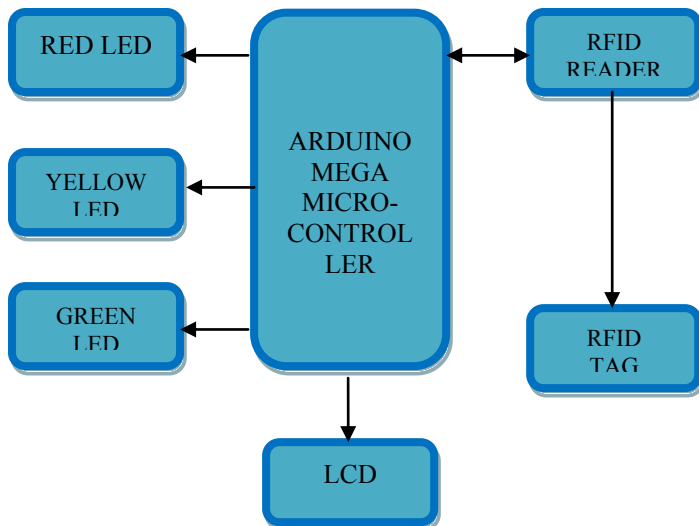


Fig. 3 Traffic Signal Section

Design Specifications:-

Arduino Mega 2560: Arduino Mega 2560 comprises of has ATmega2560 mc. This is a 8 bit microcontroller. 16MHz oscillator, USB connection, four UART is key components of AM2560. It also has 54 digital input and output pins and 16 analog inputs [10].

LCD Display: The display is made up of 16 columns and 2 rows. This results in a display of 32 characters. 5x8 pixel dots is the character size of LCD. Both alphabetical and numerical values can be displayed on screen.

Traffic Signal LED: Made using LEDs of 8mm. RED, YELLOW and GREEN LEDs are used to build traffic signal. Microcontroller provides the 5V power which is used to run the LEDs.

Arduino IDE: Projects based on arduino platform are backed by Arduino IDE software. File, Edit, Sketch, Tools and Help are some of important options provided in the menu bar. Coding part is performed in the middle section. The output is visible in the last section. C++ or C programming are the core of Sketches [11].

IV. IMPLEMENTATION AND FUTURE SCOPE

Laboratory Prototype Implementation:

The implementation of our STMS is performed using the following hardware:

- 1) Arduino Micro-Controller

- 2) LED Lights(RED, YELLOW & GREEN)
- 3) RFID Tag
- 4) RFID Scanner
- 5) Wires
- 6) Dummy Ambulance
- 7) LCD Screen with Arduino

All the setup for the implementation of the STMS is shown in Fig. 4, 5 & 6.

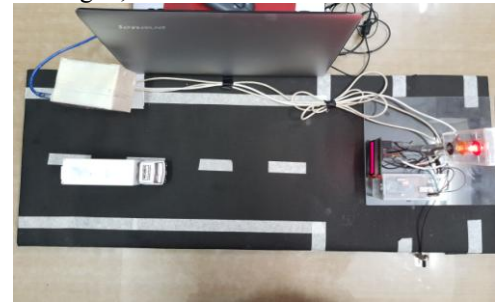


Fig. 4 Setup of STMS using IoT [12]

The IoT enabled project provides a “Green Corridor” for emergency vehicles. Use of internet of things make this a smart project which is the base of any smart city. The project can be enhanced by introducing the cloud computing and going deep in the concept of smart commuting [13] [14] [15].

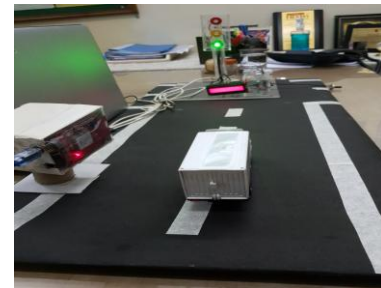


Fig. 5: Traffic Light Detection

Using this concept we can continuously update the traffic updates and can store them using cloud computing. This can be operated using an android based application [16]. Using this technology the time and coordinates of the emergency vehicle can be recorded and thus the traffic signals can be operated automatically in a more efficient manner. This paves our way to the golden aid system of traffic management [17].



Fig. 6 STMS LCD Display & Traffic Light

To decrease the time delay for emergency vehicles, we can also implement the algorithm to find shortest path in our application [18] [19]. This will help us find the shortest route to reach the destination and will result in increase of life saving capacity of emergency units. The system model is shown in Fig. 7.

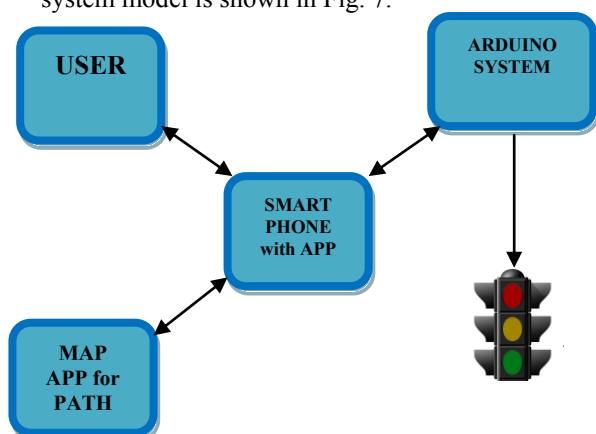


Fig. 7: Smart Traffic Management using Android App

The proposed STMS can be enhanced with the use of cloud computing. Linking it with an android application and map techniques can bring the best versions of the system.

V. CONCLUSION

We witness the heavy road congestions on daily basis. Somewhere they have become a part of our daily routines due to rate of increasing vehicles. The demand for modern world is made up with these vehicles; hence they become an important part of life and cannot be eliminated. But the consequences which they produce can be tackled using smart methods. We have proposed one such method to bring ease in the working of emergency vehicles on these congested roads.

This needs to be done to tackle the time delay which is faced by emergency vehicles. Due to this delay, every year a lot number of people have to pay the cost of their lives.

We have proposed a project which deals with these problems. Our project Smart Traffic Management System (STMS) works on the Internet of Things (IoT) technology. It uses a RFID Tag and RFID Scanner to instruct the traffic signal about the arrival of emergency vehicle. This instruction turns the traffic lights to green and also creates a "Green Corridor" for the emergency vehicle. Thus, saving the time and lives of people.

The proposed system is much better than the old methods of traffic control. The project also gives rise to future enhancements to make the current technology even better. Like we can add cloud computing using android application to it. We can also implement the use of map techniques and shortest paths algorithm to save time.

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