SMART TRAFFIC CONGESTION CONTROL SYSTEM

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Abstract **- One of the biggest problems in today's world is traffic congestion. Emergency vehicles, such as ambulances, get trapped in traffic during rush hour. As a result, emergency services are unable to reach their destinations on time, resulting in human lives being lost. The proposed system is designed to avoid traffic congestion near traffic signals and, as a result, ensure a steady flow of traffic. This system is used to provide clearance to any emergency vehicle by turning green for the potential route and red for all lanes, allowing the emergency vehicle to reach its destination in a congestion-free state. This system would also be useful in detecting a stolen vehicle as it travels through traffic, in addition to providing way clearance for emergency vehicles. As a result, it is a self-contained two-tier system which will assist in the detection of emergency vehicles or any other desired vehicle. It's a model system that can be used to put the green wave concept in effect.**

Keywords: Traffic congestion, Traffic Control Management, RFID, Emergency, Theft.

1. INTRODUCTION

The most pressing transportation problem is the departure of emergency vehicles in the event of a traffic congestion. Ambulances, fire trucks, and police cars, among other emergency services, must arrive at their destination as quickly as possible to prevent loss of life or property. These vehicles must be withdrawn from traffic light intersections as soon as possible. It is common knowledge that delivering emergency medical care as soon as possible increases the likelihood of the victim(s) surviving. In several countries, any emergency vehicle approaching a traffic junction relies on an audible and noticeable alarming device to warn drivers. This warning system can only be detected from a certain distance. When several emergency services arrive at the same time, the situation becomes more complicated. It is incredibly difficult to decide the direction in which an emergency vehicle will arrive. While this system is not suitable for congested areas, it continues to be used as a normal mode of operation.

A traffic signal, which is controlled by timers, is the most common form of traffic management. They are configured to operate in a certain manner regardless of traffic conditions at any given time of day. Inevitably, they would struggle to stop blockage. However, detectors that use the most popular technique of inductive loop are now widely used. GPS systems, Radar technology are examples of other technologies. However, these systems have a number of disadvantages, including the fact that they fail in some cases, have installation and maintenance issues, and are limited in terms of cost.

The issue of providing a clear route for emergency vehicles during traffic congestion receives less attention in the current literature. To address these concerns, an RFID-based system is proposed, which controls and regulates traffic signals at intersections when an emergency vehicle approaches, allowing for quick departure from traffic congestion.

The rest of the paper is organised as follows. Chapter 2 discusses the previous works on the traffic congestion control systems. Chapter 3 presents the existing current technology involved in traffic congestion. The proposed system is explained in Chapter 4. Chapter 5 contains the results obtained. The paper is concluded in Chapter 6.

2. AUTOMATED TRAFFIC CONTROL

Various optimization has been made for effective implementation of traffic congestion control.

Changeable flows approaching junctions are not regulated by traditional systems. The high amount of traffic on one side of the intersection requires more green time than the normal allotment. The wireless sensor network, the localised traffic flow model policy, and the higher-level coordination of the traffic lights agents make up the system architecture [1]. To efficiently manage such traffic situations, a new system class and dynamic switching process. A software defined controller is also included, which allows for complex management of these communication opportunities at IoT devices and network Access Points [4].

Using RFID technology, different possibilities for enhancing this control are discussed. Access to zones with traffic limits, such as areas reserved for certain types of vehicles or vehicles that meet certain environmental requirements, may be regulated. RFID readers are installed in cars, not only in road networks, as part of the solution. A hybrid solution that could be used during the transitional period is also presented [5].

The entire interpretation of the anticipated investigational framework was carried out in the MATLAB context, demonstrating that the proposed research process, IoT-TM, can make better traffic management decisions than current research systems [6].

One of the most important things to investigate is traffic management. It requires traffic density control, coordination, and traffic rerouting to prevent more delays. The Internet of Things (IoT) will aid in the creation of a traffic management system that runs smoothly. Different traffic management approaches exist, including video analysis, wireless sensor networks, and adaptive traffic control systems. [8].

A traffic data collection system in which a dynamic traffic light control (DTLC) is installed at a road junction. It includes a few protocols that propose low-overhead algorithms to manage traffic congestion and promote efficient traffic flow. Despite the fact that this device efficiently handles traffic flow, it does not concentrate on emergency vehicles [10].

3. TRAFFIC CONTROL MANAGEMENT SYSTEM

Traffic Control Management is one of the main focus in Metropolitan Cities to provide smart management assistance in providing congestion-free road management. The current traffic control system process consists of three methods. They are,

- Fixed Time
- Vehicle Actuation
- Green Wave

Fixed Time - The traffic signals would show green to each approach for the same amount of time per period under fixed time service, regardless of traffic conditions. This can be sufficient in congested areas, but if a lightly trafficked side road is included in the series, it can be

extremely inefficient if no vehicles are waiting in certain cycles, as the time could be better allocated to a busier approach.

Vehicle Actuation - The majority of Indian cities have fixed time signal settings, which are manually controlled during morning and evening peak hours. Manual control does not have significant benefits in terms of reducing all vehicle delays. Vehicle actuated (VA) with Virtual Loop detectors and the requisite control logic to respond to the demand imposed on serviced traffic movements.

Green Wave - A green wave occurs when a set of traffic lights (usually three or more) is synchronised to allow continuous traffic flow in one direction over multiple intersections. Any vehicle following the green wave will see a cascade of green lights and will not be required to stop at intersections. This allows for higher traffic loads while lowering noise and energy consumption. In practice, only a small group of cars can use the green wave until it is interrupted to allow other traffic flows to pass.

4. RFID BASED TRAFFIC CONTROL SYSTEM

Present technologies are inadequate to handle problems such as congestion control, emergency vehicle clearance, stolen vehicle detection, and so on, as seen in the current problem section. To solve this problem, we suggest implementing an intelligent traffic control system. Each line of the road has an ultrasonic sensor mounted away from the traffic junction to continuously track the distance to the traffic lights; if that distance is decreased, vehicle congestion occurs, and the traffic system is modified to provide congestion-free traffic in that particular intersection. Any vehicle undergoing registration is given an RFID tag, which stores information such as the vehicle's unique registration number and type. The tag specifies the vehicle type as e (for emergency) or n (for normal). These details are saved in the transport office's database. An RFID reader is mounted in the traffic control unit to read the information in the tags.

When a vehicle passes through the signal, the reader records the vehicle form and passes it on to the controller. If an e (emergency) vehicle is detected, the lane is turned green in relation to the other lanes. In addition, a system for detecting stolen vehicles is used. To locate a stolen car, the user must contact the transport office and request that the vehicle's database be updated (for theft). So, if a vehicle passes through a traffic signal, the buzzer sounds an alert and sends vehicle information to the owner through GSM, while the control unit picks up the tag details and sends them to the transport office via IOT. The transport office's computer compares the received value to the database. If a theft vehicle is discovered, the transport office's control unit will notify the police station that the vehicle has passed through the specific signal. As a result, the police were able to catch up with the vehicle on its next possible route. The block diagram of the proposed system is shown in Figure 1.

5.RESULTS AND DISCUSSION

The results and discussion obtained by the proposed RFID based Traffic Congestion Control system is discussed in this section.

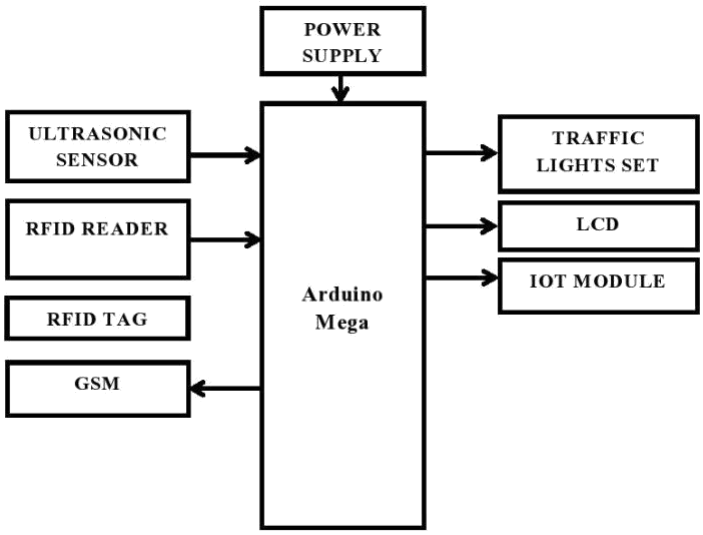


Figure 1 Block Diagram of Proposed System **5.1**

Experimental Setup

In this section, we evaluate the proposed system method's output using an Arduino Mega 2560 as its microcontroller, executing the instructions given to the Arduino and obtaining the desired results. Figure 2 depicts the RFID-based Traffic Congestion Control experimental setup.

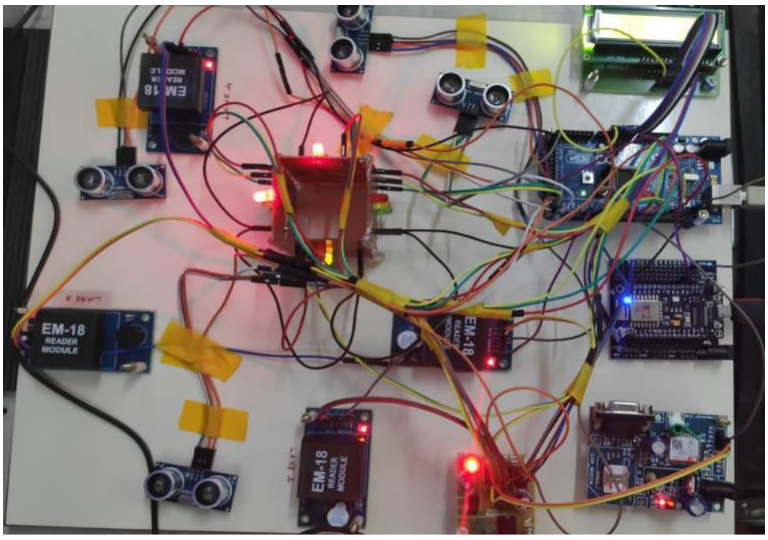


Figure 2 Experimental Setup of Proposed system **5.2 Traffic**

Congestion Control

Ultrasonic sensors are used to monitor traffic congestion (HC-SR04). At regular intervals, ultrasonic sensors emit small, high-frequency sound pulses. These travel at the speed of sound through the air. If they collide with something, the signals are then reflected back as echo signals to the sensor, which uses the time between transmitting the signal and receiving the echo to calculate the distance to the target. Figure 3 depicts the value obtained when traffic congestion occurs in each lane.

Figure 3 Continuous Monitoring for traffic congestions in each lane

When traffic congestion increased, the distance between the signal and the sensor started to shrink. As a result, the traffic signal for the relevant lane changes to green. As a consequence, traffic control is carried out effectively and without the need for human interaction. Figure 4 illustrates the change in traffic lights as a result of congestion.

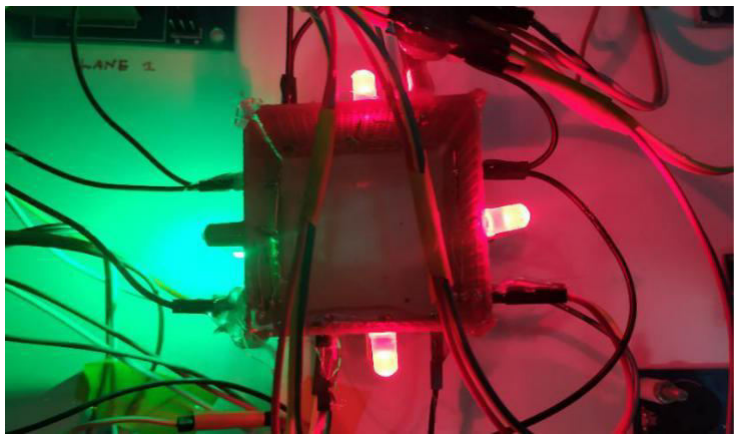


Figure 4 Congestion takes places at LANE1(L1), therefore green signal provided in L1 and Red for every other lane

5.3 Emergency Vehicle Way-Clearance

In this section, each emergency vehicle is assigned an E-mode using RFID tags. In the traffic system, a micro controller distinguishes between regular vehicles and emergency vehicles. When an emergency vehicle passes in front of an RFID reader in a lane, the reader sends the emergency vehicle's data to the microcontroller. Figure 5 depicts an emergency vehicle passing through the intersection. The emergency lane is turned to GREEN by the microcontroller, while the other lanes can stay RED for a few minutes. After a few minutes, the signal returns to its original (timer) state. Using a WIFI module linked to the microcontroller, data about the ambulance is stored in the cloud. The result will be identical to that shown in Figure 4.

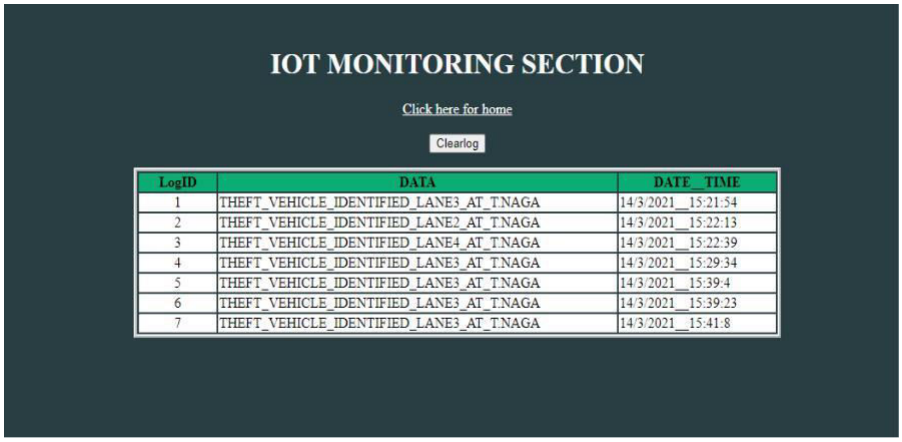
Figure 5 Identification of Emergency Vehicle at LANE4

5.4 Theft Vehicle Identification

The registration of all vehicles with RFID tags is the first step in the theft vehicle identification process. Each RFID tag is identified by a unique number. The vehicle is marked when the stolen vehicle's identification number is read under a specific lane, as seen in Figure 6.

Figure 6 Identification of Theft Vehicle at LANE3

The microcontroller then uses a WIFI module to send the data to the control room, indicating the location, as well as the date and time, at which it crossed the particular junction, as shown in Figure 7.



LogID	DATA	DATE_TIME
1	THEFT_VEHICLE_IDENTIFIED_LANE3_AT_T.NAGA	14/3/2021__15:21:54
2	THEFT_VEHICLE_IDENTIFIED_LANE2_AT_T.NAGA	14/3/2021__15:22:13
3	THEFT_VEHICLE_IDENTIFIED_LANE4_AT_T.NAGA	14/3/2021__15:22:39
4	THEFT_VEHICLE_IDENTIFIED_LANE3_AT_T.NAGA	14/3/2021__15:29:34
5	THEFT_VEHICLE_IDENTIFIED_LANE3_AT_T.NAGA	14/3/2021__15:39:4
6	THEFT_VEHICLE_IDENTIFIED_LANE3_AT_T.NAGA	14/3/2021__15:39:23
7	THEFT_VEHICLE_IDENTIFIED_LANE3_AT_T.NAGA	14/3/2021__15:41:8

Figure 7 Identified data stored at cloud using IOT

Simultaneously, the GSM SIM900 module sends an SMS to the vehicle's user with critical details such as the signal's location, lane number, and time. As a result, the user can access the details, as shown in Figure 8.

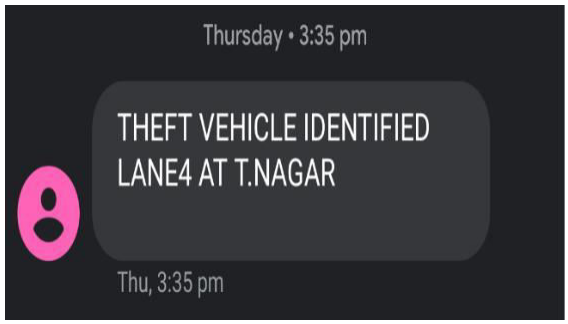


Figure 8 SMS sent to the user using GSM SIM900

6. CONCLUSION

As a result, the proposed system has reached its goal of implementing a smart solution for navigating through and overcoming traffic congestion. Because the whole system is automated, it needs very little human interference. Because automatic traffic light control supported the traffic density along the road, the manual effort on the part of the traffic policeman is saved. The stolen vehicle's information is stored in the database, making it simple to track it down. Additionally, SMS will be sent so that they can plan to intercept the stolen vehicle at potential intersections. Ambulances and fire engines, for example, arrive at their destinations as quickly as possible. If they spend a lot of time trapped in traffic, the lives of many people could be jeopardised. As long as the emergency vehicle is waiting inside the traffic intersection, the traffic light turns green with emergency vehicle clearance. Only after the emergency vehicle has passed through the traffic signal does the traffic light turn red. The prototype can be developed further by testing it with longer-range RFID readers.

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