Density Based Traffic Management and Ambulance Detection Using RFID

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Abstract-Traffic congestion is a major issue in many Indian and global cities due to signal failures, poor law enforcement, and ineffective traffic management. It negatively impacts the economy, environment, and quality of life. This project proposes a smart traffic management system using the Internet of Things and decentralized algorithms to optimize traffic flow. It predicts traffic density to reduce congestion and prioritizes emergency vehicles by turning red lights green along their route. By improving traffic control and reducing delays, especially in emergencies, the system enhances safety, saves lives, and addresses the shortcomings of traditional traffic management methods.

I. INTRODUCTION

Traffic has different definitions in different forms that is like the vehicles, pedestrians, ships, or planes moving along a route, congestion of vehicles, the movement (as of vehicles or pedestrians) through an area or along a route. Each definition is having their own identity in it. On average, travellers in Delhi, Mumbai, Bengaluru, Chennai and Kolkata spend 1.5 hours more on their daily commutes than their counterparts in other Asian cities during peak traffic times. In fact, peak-hour congestion, which implies the additional time taken during peak traffic to travel a given distance. A traffic signal, or stoplight as it is also known, controls vehicle traffic passing through the intersection of two or more roadways by giving a visual indication to drivers when to proceed, when to slow, and when to stop. In some cases, traffic signals also indicate to drivers when they may make a turn. These signals may be operated manually or by a simple timer which allows traffic to flow on one roadway for a fixed period of time, and then on the other road-way for another fixed period of time before repeating the cycle. According to the density of vehicles, the time will reduce or increase. If in one lane the vehicle's density is less than in the other then the time will get added to that lane. An algorithm is used to predict the traffic density for the future to minimize traffic congestion. Besides this the system gives in modern society, quick mobility is one of the most basic needs. Therefore, people can use different transportation facilities such as automotive vehicles, subways, and bicycles. However, among all these transportation facilities, the automotive vehicle is still the most adopted due to its comfort and practicality. In this way, by considering continuous population growth, the number of vehicles in large cities will also increase continuously day by day, but much faster than the transportation system: consequently, traffic congestion will become a complex issue. It creates many several negative concerns for the environment and society such as increasing and many traffic accidents, economic impact, and high levels of greenhouse emissions. Priority to the emergency vehicle like Ambulance irrespective of the traffic density.

Traffic lights are used to control how quickly and safely vehicles and passengers can move through an area. Drivers who disobey the laws and guidelines outlined by traffic lights run a very high risk of getting into an accident. As a result, traffic lights contribute to a decrease in vehicle collisions. Traffic lights also aid in time savings because they coordinate traffic flows and routes without causing congestion. It also contributes to establishing discipline in people's daily lives because those who disregard traffic regulations and warning signs must pay fines to the authorities. Before traffic lights were installed, traffic was governed by the traffic police. Traffic lights shield traffic police officers from roadside air pollution by reducing the amount of time they must stand on the road directing traffic.

1. EXISTING SYSTEM

Several factors in traffic signals can cause a road to have too many cars and thus create a traffic jam. [5] Most people consider traffic happens from cars accidents or a vehicle that stops in between traffic. Construction of roads

also takes a lot of blame for causing traffic.

Traffic congestion mainly focuses on the signal's failure, decreasing law enforcement in the traffic systems, and non-proper traffic management. [1] Because the existing traffic system cannot be expanded further, the only option is to improve traffic management. As a result, many traffic system is used to effectively address control traffic congestion and make controlling vehicles in the system very easy to implement in traffic. Many different and advanced ways have been developed to manage traffic and reduce congestion. Some are Infrared sensors, inductive loop detection, video data analysis, wireless sensor network, and others are used to somewhat solve the congestion in the traffic and manage the traffic smartly. The papers reviewed based on the following points:

- Some approaches used to make traffic routing and a signal traffic controlling decision, i.e., adaptive versus nonadaptive, simulative versus real-time and hybrid strategies.
- Types of parameters like input and output such as traffic quantity, waiting for the time of traffic signal, previous and current traffic data information/knowledge to make free from traffic congestion.
- Traffic signal collection of data methods used and communication methods applied or considered.
- The way to improving in the performance of traffic control is to avoid traffic congestion in this system.

2. PROPOSED SYSTEM

Traffic management is focusing on achieving maximum efficiency from the existing road network while minimizing other impacts of the traffic system without any sort of problem. The system is overcoming the flaws of previous traffic management systems. The system takes vehicles' density in traffic as input from cameras which is abstracted from RFID Reader. And IR sensors data, resultantly giving as output for signals management. It provides the best real-time dashboard to monitor the traffic management system. This can also save their time of waiting for a long time and help in reaching the proposed destination and can prevent any loss of human life up to a very great extent. IR sensor is to manage time in signal according to congestion in traffic. Congestion detection also enables adaptive control, which causes one of the best dynamic adjustments to traffic systems including traffic timing on the signal.

i. Reducing Traffic Jams

The objective behind the traffic system is to limit the stoppage time and also regulate the traffic flow using the introduction of some sensors for all controlling traffic signals. The proposal aims at reducing traffic jams to reduce traffic congestion, optimize traffic flow and help proactively manage traffic conditions. [1] If the numbers of vehicles decide the signals time, then automatically people have to wait less time in traffic and will get in touch with their work soon without any delay.

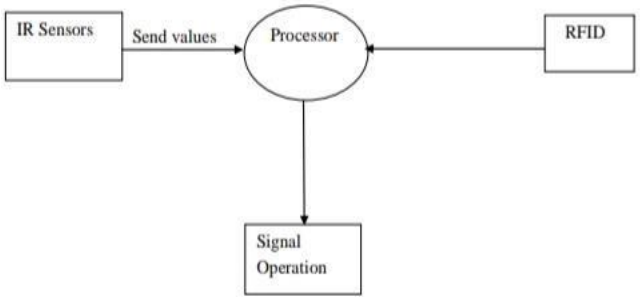
ii. Priority to an ambulance in traffic

A smart traffic management system aims to give priority to the ambulance, RFID Reader is used to scan the ambulance in traffic, and then an IR sensor will manage time and open that signal first where the ambulance is present. Some more objectives are as follows:

- Improving efficiency for safety on the road network
- optimizing traffic congestion flow on arterial and freeway networks
- reducing traffic congestion within and between cities
- coordinating agency traffic or transit operations
- managing more incidents in signal, reducing delays in traffic while in traffic jams and adverse effects of incidents and congestion, weather, roadwork, special events, emergencies, disaster, or some environmental situations
- Effectively managing maintenance and construction work of traffic signals to minimize the impact on safety and congestion which generally occurs in traffic jams.
- informing travelers with timely and accurate information
- improving the interfaces between modes of transport for passengers and freight
- eliminating bottlenecks due to inadequate road geometry
- providing reliable and convenient public transport services.

II. BLOCK DIAGRAM

These systems can optimize traffic flow and enhance safety by using sensors and cellular technology to dynamically adjust traffic systems. Following are the steps to designing this system.



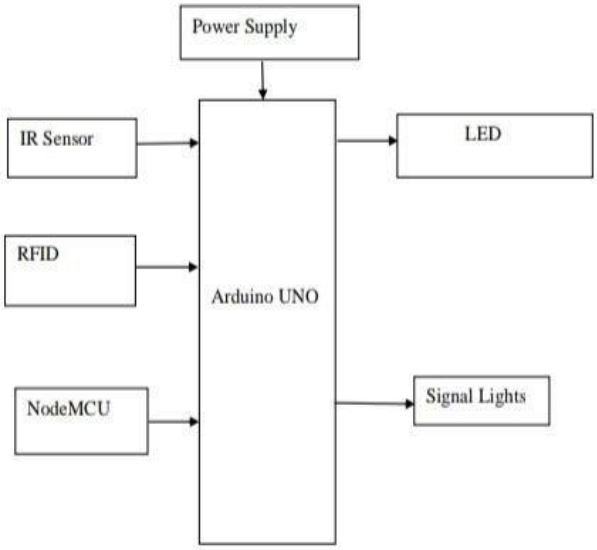


Fig.1: Block diagram of Model

- Arduino acts as the central controller, receiving inputs from IR sensors, RFID, and Node MCU.
- IR sensors detect vehicle density at intersections to adjust signal timing dynamically.
- RFID detects ambulances and overrides normal traffic signals to give them priority.
- Node MCU enables wireless communication for remote monitoring or control.
- Power supply powers the entire system.
- Signal lights and LED indicators display traffic signal status.

i. Data Flow Diagram-Level 0

A data flow diagram is the graphical representation of the flow of data through an information system. DFD is very useful in understanding a system and can be efficiently used during analysis. A DFD shows the flow of data through a system. It views a system as a function that transforms the inputs into desired outputs. Any complex systems will not perform this transformation in a single step and a data will typically undergo a series of transformations before it becomes the output. With a data flow diagram, users are able to visualize how the system will operate that the system will accomplish and how the system will be implemented, old system data flow diagrams can be drawn up and compared with a new systems data flow diagram to draw comparisons to implement a more efficient system. Data flow diagrams can be used to provide the end user with a physical idea of where the data they input, ultimately as an effect upon the structure of the whole system.

ii. Data Flow Diagram - Level 1

At level 1, uses an Arduino microcontroller to optimize traffic flow by monitoring vehicle density at intersections through sensors. Based on the real-time data, the Arduino adjusts traffic light durations, giving longer green signals to heavily congested lanes. Additionally, the system can detect ambulances using sensors or RFID, automatically turning the corresponding signal green to allow emergency vehicles to pass quickly. This approach improves traffic efficiency and saves lives by reducing delays. The system also enables data collection for analysis, helping authorities make better traffic management decisions.

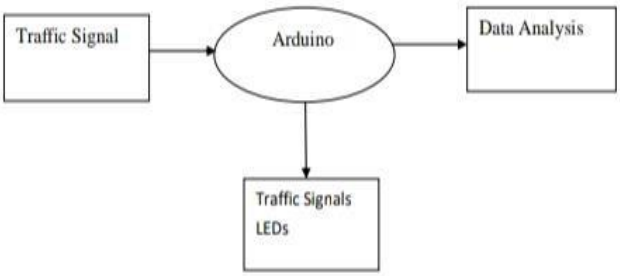


Fig.3: DFD level 1

iii. Data Flow Diagram - Level 2

DFD Level 2 then goes one step deeper into parts of Level 1 of Traffic. It may require more functionalities of traffic to reach the necessary level of detail about the traffic functioning. First Level DFD of traffic monitoring shows how the system is divided into sub systems. The 2nd level DFD contains more details of login, Vehicle type, diversions, traffic police, length, routes, traffic. This level also includes image resizing, rgb to gray conversion, image enhancement, image matching etc.

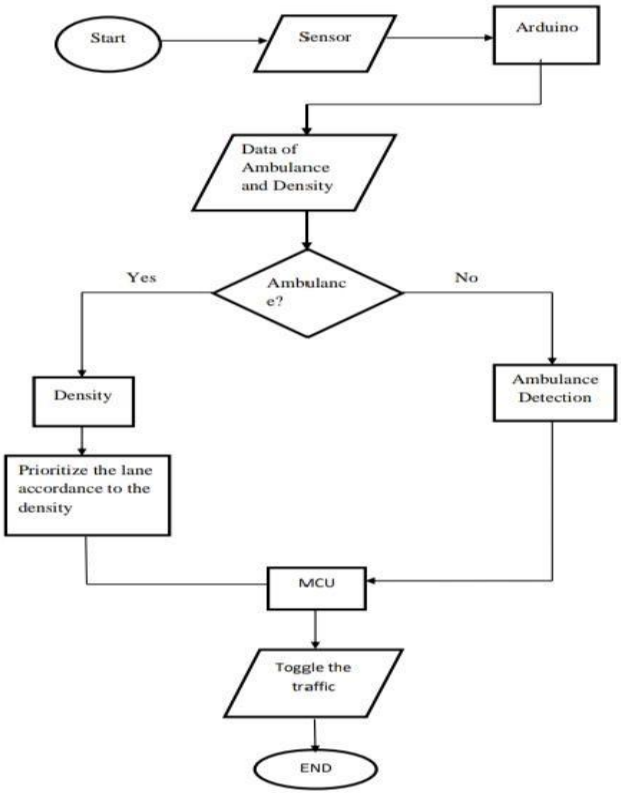


Fig.4: DFD level 2

III. IMPLEMENTATION

Flow Chart:

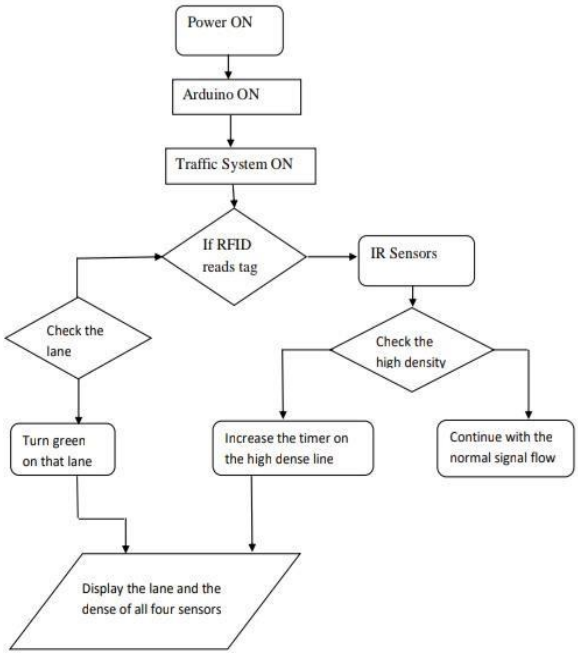
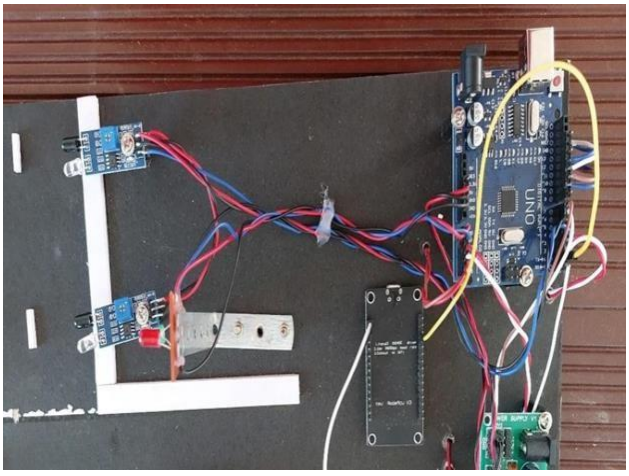


Fig.5: Flow Chart of working model

Step 1: - When power on through an adaptor, Arduino UNO and other sensors connected to that will be turned on.
Step 2: - After a delay of 2 seconds the traffic control system will turn on and follows the pattern i.e., for every 100ms the signal green will be changing from one lane to another
Step 3: - Here the conditional statement will come into place and checks for the detection of RFID tag through the RFID reader
Step 4: - If the system identifies the detection of RFID tag from RFID reader, it will be checking for the which lane tag is detected
Step 5: - the system will shift the signal from the present to the signal in which the tag is detected
Step 6: - If the reader fails to detect the tag, then from step 3 the condition statement will be checking into IR sensor reading
Step 7: - By using all those readers the comparison will takes place and look into the lowest reading from all the four reading (lowest reading is considered as the high density)
Step 8: - Based on that comparison the delay time for changing the signal will be increased
Step 9: - the output will be printed in the LED
Step10: - if no condition is satisfied the traffic signal will follow the regular flow that is changing the signal for every 100ms.

IV. RESULTS AND DISCUSSION

Fig 6: IR sensors to Arduino



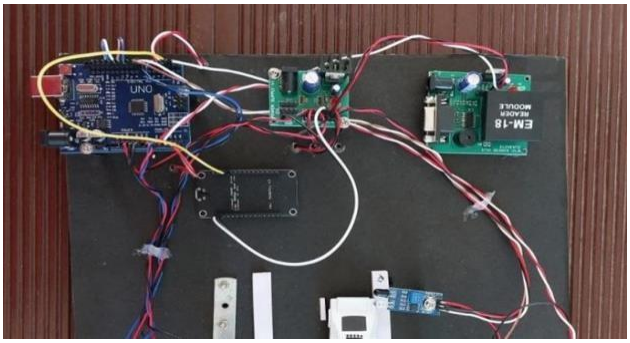


Fig 7: RFID to Arduino

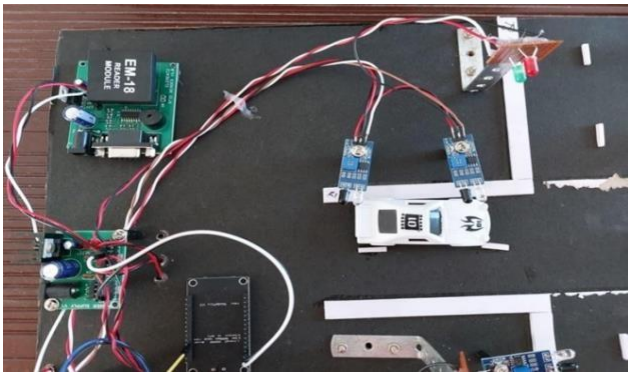


Fig 8: LED to power supply

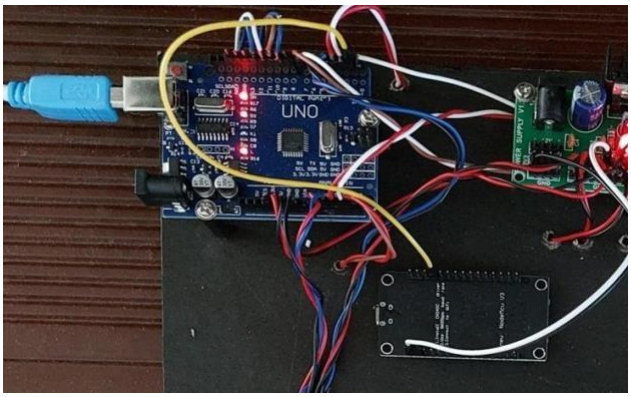


Fig 9: Node MCU to Arduino

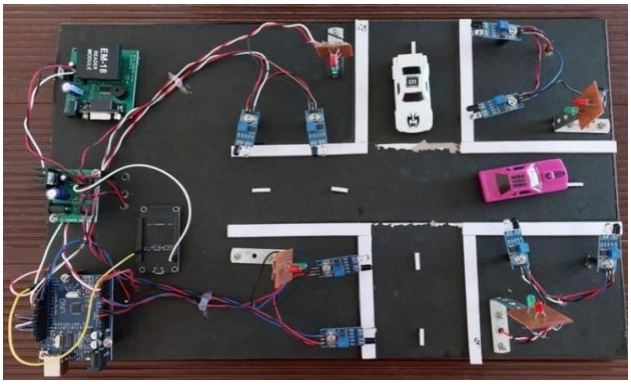


Fig 10: Complete Model

Density-based traffic management and ambulance detection using RFID is an efficient solution for optimizing traffic flow and prioritizing emergency vehicles. The system is built around an Arduino Uno, which processes inputs from multiple sensors. IR sensors are strategically placed at intersections to monitor vehicle density and dynamically adjust traffic signals based on congestion levels. An RFID reader module detects ambulances equipped with RFID tags, ensuring they receive priority clearance by overriding regular signal patterns. LED indicators simulate traffic signals, visually demonstrating real-time traffic control. This system not only reduces unnecessary waiting times but also ensures a smoother passage for emergency vehicles, improving overall road safety and efficiency. By integrating sensor- based automation, it minimizes human intervention and enhances urban traffic management. The project effectively showcases how smart technology can be applied to solve real-world transportation challenges.

V. CONCLUSION

By this project the problem of traffic can be easily sorted out: the timing of each signal can be automatically adjusted according to density of traffic which is real time operation. It will also clear the path for the ambulance, fire brigade in emergency cases and also it will help to public in taking decisions for reaching their destination in time using auto-routing method. It shows that it can reduce the traffic congestion and avoids the time being wasted by a green light on an empty road. It is also more consistent in detecting vehicle presence because it uses actual traffic images. It visualizes the reality so it functions much better than those systems that rely on the detection of the vehicles metal content.

The study showed that image processing is a better technique to control the state change of the traffic light. It shows that it can reduce the traffic congestion and avoids the time being wasted by a green light on an empty road. It

is also more consistent in detecting vehicle presence because it uses actual traffic images. It visualizes the reality so it functions much better than those systems that rely on the detection of the vehicles' metal content. Overall, the system is good but it still needs improvement to achieve a hundred percent accuracy.

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