TRAFFIC MANAGEMENT SYSTEM

PHASE 5

INTRODUCTION:

Over the years, the focus of traffic management agencies has seemingly been limited to traffic policing. Primarily, this centres on the enforcement of national and state traffic regulations. Priority also looks in the direction of imposing penalties on violators of traffic rules and regulations. The contemporary challenges in the country are however reflecting the failure of enforcement strategies at managing traffic problems. It can be observed that despite the increased number of traffic management agencies, road traffic casualties are increasing. Likewise increase in journey time occasioned by incessant traffic congestion and delays is also a phenomenon. In trying to provide explanations, it is realised that other strategies to road traffic management are either not exploited or not employed at all by the traffic management agencies. In the face of predominant reliance on road transport mode in the country, coupled with the inadequacy of road infrastructure, and poor road users' culture, traffic management agencies need to re-tool their strategies. They need three basic traffic management strategies: education, engineering and enforcement to tackle the problem from the root. This book is devoted to explaining those three basic strategies. This is with a view to providing practitioners with fundamental knowledge of traffic management strategies and expose them to the best practices across the world.

In this stage, the problem statement will be defined, and a document summarizing our analysis of the issue and suggested solutions will be created.

Project Definition:

The project aims to address the issue of traffic congestion by leveraging IoT devices and data analytics. We will develop a real-time traffic monitoring system that provides commuters with access to traffic flow and congestion information through a public platform and mobile apps. The system will enable commuters to make informed decisions about their routes, thereby reducing traffic congestion and improving overall commuting experience.

Design Thinking:

Project Objectives:

- **Real-time Traffic Monitor:** Create a system that can track congestion and traffic movement in real-time.
- **Congestion Detection:** Utilize algorithms to spot traffic jams and pinpoint places with high traffic.
- **Route Optimization:** Create algorithms based on historical data and real-time traffic statistics to optimize commuter routes.
- **Public Platform and Mobile Apps:** To improve commuter routes, develop algorithms based on historical data and current traffic information.
- **IoT Sensor Deployment:** Plan the placement of IoT devices (sensors) to efficiently gather traffic data.
- **Data Analytics:** Create models and algorithms to assess the traffic data gathered by IoT sensors and reveal trends in traffic flow.

Literature Survey:

The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called ”connected” or ”smart” devices, can sometimes talk to other related devices, a process called machine-to-machine(M2M) communication, and act on the information they get from one another.

Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that are available these days, as well as the always-online nature of our home and business networks. Connected devices also generate massive amounts of Internet traffic, including loads of data that can be used to make the devices useful, but can also be mined for other purposes. All this new data, and the Internet-accessible nature of the devices, raises both privacy and security concerns. But this technology allows for a level of real-time information that we have never had before. We can monitor our homes and families remotely to keep them safe. Businesses can improve processes to increase productivity and reduce material waste and unforeseen downtime. Sensors in city infrastructure can help reduce road congestion and warn us when infrastructure is in danger of crumbling. Gadgets out in the open can monitor for changing environmental conditions and warn us of impending disasters.

Existing System:

The existing traffic system is generally controlled by the traffic police. The main drawback of this system controlled by the traffic police is that the system is not smart enough to deal with the traffic congestion. The traffic police official can either block a road for more time or let the vehicles on another road pass by i.e. the decision making may not be smart enough and it entirely depends on the official's decision. Moreover, even if traffic lights are used, the time interval for which the vehicles will be shown a green or red signal is fixed.

Therefore, it may not be able to solve the problem of traffic congestion. In India, it has been seen that even after the presence of traffic lights, traffic police officials are on duty, which means that in this system more manpower is required and it is not economical in nature.

Design Approach:

1. IoT Sensor Design:

- Determine the best places to install IoT sensors to keep an eye on traffic flow and congestion.

- Opt for IoT sensor technologies that are ideal for collecting precise traffic data, such as vehicle volume, density, and speed.

2. Real-Time Traffic Information Platform:

- Create mobile apps and a web-based platform that can collect and show real-time traffic data.

- Make sure the platform has simple, user-friendly interfaces so that commuters can readily access traffic data.

- Create tools that let commuters see how the traffic is moving, how congested it is, and possible routes.

3. Data Analytics:

- Create models and algorithms to analyze the traffic data gathered by IoT devices.

- Use machine learning techniques to identify patterns in traffic congestion and forecast new congestion hotspots.

- By analyzing past traffic patterns, you can offer insights and suggestions for improving commuter routes.

4. Route Optimization:

- Create algorithms to optimize commute routes based on historical data and real-time traffic statistics.

- Create tools that advise travellers to choose other routes to avoid congested regions.

- In the event of unforeseen traffic incidents, give real-time alerts and rerouting choices.

5. IoT Technology:

- Choose the right IoT technology for data exchange between the IoT sensors and the information platform, such as LoRa, Wi-Fi, or cellular networks.

- Make sure data transfer is dependable and secure to ensure the correctness of real-time traffic data.

6. Data Security:

- Put in place strong security procedures to safeguard the information that IoT sensors acquire.

- To prevent unauthorized access, encrypt the traffic data both during transmission and storage.

- Put user authentication and authorization into place to make sure that only people with the proper permissions may access the traffic information platform.

7. Python Development:

- Create the required applications and software using the Python programming language.

- Use Python tools and frameworks for user interface development, route optimization, and data analytics.

8. Testing and Validation:

- Completely test the mobile apps, traffic information platform, and IoT traffic monitoring system.

- Confirm the reliability of current traffic data and the efficiency of route optimization algorithms.

- Assure that the system operates dependably and effectively in a variety of traffic situations.

9. Deployment and Maintenance:

- Create a thorough plan for the installation of IoT sensors in key areas.

- Install the scalable and dependable servers for the traffic information platform.

- To guarantee the system's continuing operation and incorporation of the most recent traffic data, regularly maintain and upgrade it.

Proposed System:

The first and primary element of this system is the camera. The cameras interact with the physical environment, meaning vehicles presence or absence while the camera data is sent to the database for training the module for further prediction. The cameras transmit status based on the presence of vehicles near it. The camera transmits the data at specified time intervals to the processor (raspberry pi), it processes the data and sends the processed data to the controller. The computed data from Raspberry pi is then transmitted to the controller through Wi-Fi connectivity. The controller makes use of the collected data to perform the Intelligent Traffic routing. In this system, the primary aim is to gather the information of moving vehicles and provide them a clear path till their destinations and traffic signals should switch automatically to give a clear way for these vehicles.

In this proposed system, the traffic lights are LEDs and the cameras. Both blocks are connected to a raspberry Pi using physical wires. The Node MCU is the traffic light controller which receives the collected camera data and manages the traffic lights by switching between green, yellow and red. The raspberry pi computes the number of vehicles in the street of the intersection it is monitoring based on the distances measured by the camera and the timing between those measurements. The raspberry pi then sends the number of cars every minute to the database. The database is used to train the module in order to better predict the changes in timings of the traffic light and its density. This communication is done using Wi-Fi. More specifically, the cloud server uses an equation that takes the data received (number of cars) as input then determines the time interval of LED's needed for a smooth traffic flow. This calculated time is then compared to the current actual time of the LEDs (this data is saved in a database). The processor then comes up with a decision. If the current actual green time is less than the calculated time, the decision is to increase the green time, else to decrease the green time.

PRINCIPLE:

The main principles of traffic control in civil engineering include efficient roadway design, proper signage and pavement marking, effective traffic signal timing, clear communication and education for drivers, and continuous monitoring and evaluation of traffic flow.

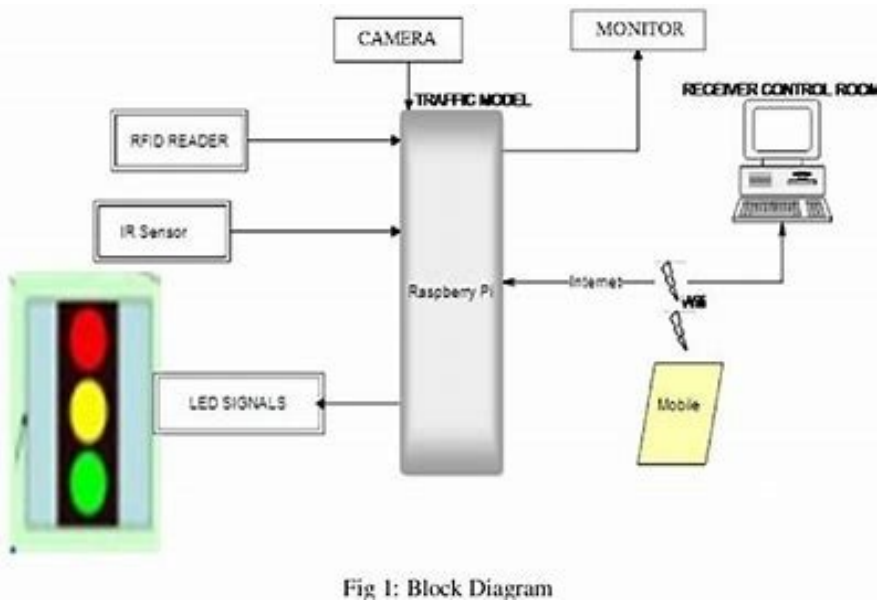


Fig 1: Block Diagram

COMPONENTS:

1. Camera:

Cameras integrated into smart traffic systems provide real time traffic insights and optimizes the traffic flow. Smart Traffic management has varied applications like ALPR, Traffic Enforcement, Vehicle Detection, Lane Occupancy, Traffic Violation Detection and Traffic Monitoring.

2. Monitor:

Traffic monitoring, also known as network monitoring, is the method of studying the incoming and outgoing traffic on a computer network via specialized hardware and/or software.

3. RFID readers:

The RFID readers are implemented on top of the traffic lights for the interrogation of vehicles that stop in the signals. The RFID tags along with the sensors are placed on the vehicles for the vehicle identification and inspection.

4. LED signals:

- VMS board consists of LED traffic signal system using graphics in monochrome or color to warn and guide the people while driving. Variable Message Sign are widely applicable as highway and traffic control equipments by using programmable LED lights.

- Through the integration of smart terminal technology and mobile communication, MCS technology provides a new way for the transportation system to reduce traffic congestion and vehicle traffic data collection costs [11]. Which is based on several mobile devices they including smartphones, sensor-equipped vehicles.

5. **Receiver control room:**
   - By definition, a control room is a central location where technicians and managers manage the everyday operations—as well as maintain and enact crisis operations—for a given entity. Whether it's a control room for a police station, refinery, or other process-intensive company or organization, the control room is where the magic happens.
   - Control. In this article, we are exploring the differences between several types of control rooms.

6. **IR sensor:**
   - IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion.
   - Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor c...
   - Detect vehicle movement and control traffic signals
   - Non-contact temperature measurement
   - Gas composition analysis and detection
   - Non-destructive testing
   - IR imaging and night vision
   - Optical power meters and sorting devices

WORKING PRINCIPLE:

1. **Data Collection:**

   IoT devices, such as cameras and sensors, are installed at various points in the city.

2. **Data Transmission:**

The data collected by these IoT devices is then transferred to a control room via wireless sensors 1. This allows for real-time monitoring of traffic conditions.

3. **Data Analysis:**

The data is analyzed to optimize traffic flow and keep drivers safe.

4. **Communication with Connected Cars:**

This aims to reduce accidents around traffic lights and reduce their violation too through better real-time monitoring.

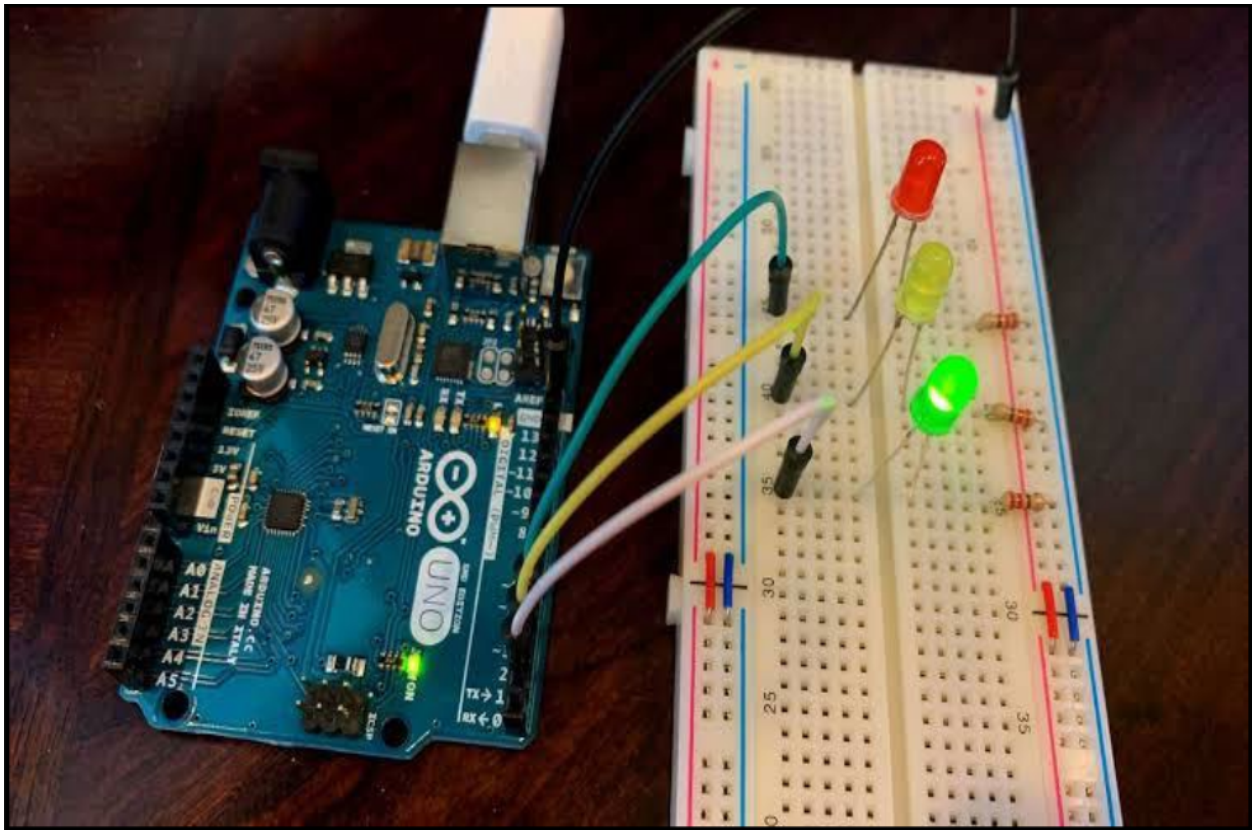
5. **Real-time Updates:**

The system can transmit accurate information about available parking spaces to citizens in real-time1. It can also alert drivers in case of over-speeding.

6. **Maintenance Monitoring:**

IoT has proved its potential in vehicle maintenance, navigation, monitoring leading to improved transportation2. Vehicle performance and maintenance monitoring help in evaluating the quality of the vehicle and need for maintenance of the vehicle2.

By leveraging these capabilities, an IoT-enabled intelligent traffic management system can help regulate heavy traffic, road blockages at signals & congested networks, thereby improving the comfort and safety of drivers, passengers & pedestrians1.



PYTHON PROGRAM USING ARDUINO:

1-Assign the traffic lights pins to variables

```
int d_red =10;
int d_yellow =9;
int d_green =8;
int r_red =4;
int r_yellow =3;
int r_green =2;
int l_red =13;
int l_yellow =12;
int l_green =11;
int u_red =7;
int u_yellow =6;
int u_green =5;
```

2-Configure the traffic lights as outputs

```
void setup()
{
  pinMode(d_red, OUTPUT);
  pinMode(d_yellow, OUTPUT);
  pinMode(d_green, OUTPUT);
  pinMode(r_red, OUTPUT);
  pinMode(r_yellow, OUTPUT);
  pinMode(r_green, OUTPUT);
  pinMode(l_red, OUTPUT);
  pinMode(l_yellow, OUTPUT);
  pinMode(l_green, OUTPUT);
  pinMode(u_red, OUTPUT);
  pinMode(u_yellow, OUTPUT);
  pinMode(u_green, OUTPUT);
}
```

3-Use **loop** function to keep the lights in a loop and use **changeLIght()** function to carry out the logic

```
void loop()
{
  changeLights();
}
void changeLights()
{
//Start (all yellow)
digitalWrite(u_red,LOW);
digitalWrite(d_red,LOW);
digitalWrite(r_red,LOW);
digitalWrite(l_green,LOW);
digitalWrite(u_yellow,HIGH);
digitalWrite(d_yellow,HIGH);
digitalWrite(r_yellow,HIGH);
digitalWrite(l_yellow,HIGH);
delay(5000);

//upper lane go
digitalWrite(u_yellow,LOW);
```

```
digitalWrite(d_yellow,LOW);
digitalWrite(r_yellow,LOW);
digitalWrite(l_yellow,LOW);
digitalWrite(u_green,HIGH);
digitalWrite(r_red,HIGH);
digitalWrite(l_red,HIGH);
digitalWrite(d_red,HIGH);
delay(10000);

//ALL YELLOW
digitalWrite(u_yellow,HIGH);
digitalWrite(d_yellow,HIGH);
digitalWrite(r_yellow,HIGH);
digitalWrite(l_yellow,HIGH);
digitalWrite(u_green,LOW);
digitalWrite(r_red,LOW);
digitalWrite(l_red,LOW);
digitalWrite(d_red,LOW);
delay(5000);

//RIGHT LANE GO
digitalWrite(u_yellow,LOW);
digitalWrite(d_yellow,LOW);
digitalWrite(r_yellow,LOW);
digitalWrite(l_yellow,LOW);
digitalWrite(u_red,HIGH);
digitalWrite(l_red,HIGH);
digitalWrite(d_red,HIGH);
digitalWrite(r_green,HIGH);
delay(10000);

//ALL YELLOW ON
digitalWrite(u_yellow,HIGH);
digitalWrite(d_yellow,HIGH);
digitalWrite(r_yellow,HIGH);
digitalWrite(l_yellow,HIGH);
digitalWrite(u_red,LOW);
digitalWrite(l_red,LOW);
digitalWrite(d_red,LOW);
digitalWrite(r_green,LOW);
```

```
delay(5000);

//DOWN LANE GO
digitalWrite(u_yellow,LOW);
digitalWrite(d_yellow,LOW);
digitalWrite(r_yellow,LOW);
digitalWrite(l_yellow,LOW);
digitalWrite(u_red,HIGH);
digitalWrite(l_red,HIGH);
digitalWrite(r_red,HIGH);
digitalWrite(d_green,HIGH);
delay(10000);

//ALL YELLOW
digitalWrite(u_yellow,HIGH);
digitalWrite(d_yellow,HIGH);
digitalWrite(r_yellow,HIGH);
digitalWrite(l_yellow,HIGH);
digitalWrite(u_red,LOW);
digitalWrite(l_red,LOW);
digitalWrite(r_red,LOW);
digitalWrite(d_green,LOW);
delay(5000);

//LEFT LANE GO
digitalWrite(u_yellow,LOW);
digitalWrite(d_yellow,LOW);
digitalWrite(r_yellow,LOW);
digitalWrite(l_yellow,LOW);
digitalWrite(u_red,HIGH);
digitalWrite(d_red,HIGH);
digitalWrite(r_red,HIGH);
digitalWrite(l_green,HIGH);
delay(10000);

}
```

OUTPUT:

The output of this program is a simulation of a traffic light system. The traffic lights will cycle through different states according to the code logic.

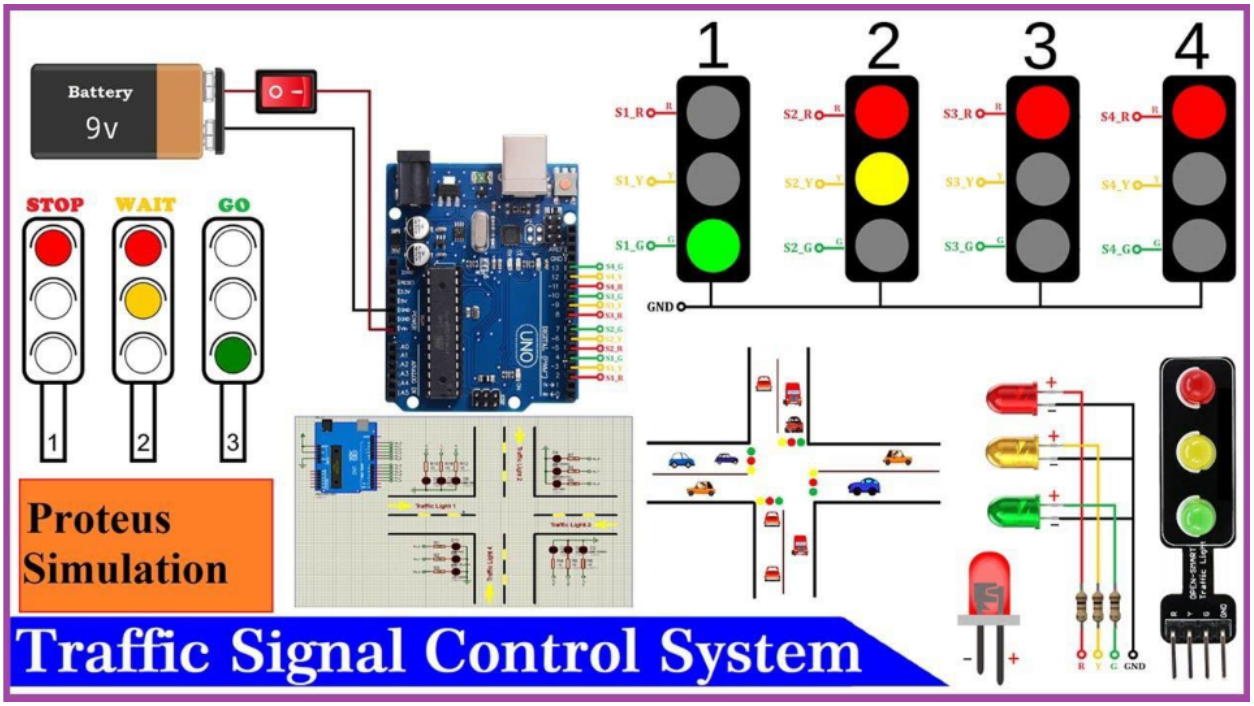
Here is the sequence of the traffic light states:

1. Start (all yellow): All lights are yellow.
2. Upper lane go: Upper lane lights are green, while the rest are red.
3. All yellow: All lights are yellow.
4. Right lane go: Right lane lights are green, while the rest are red.
5. All yellow: All lights are yellow.
6. Down lane go: Down lane lights are green, while the rest are red.
7. All yellow: All lights are yellow.
8. Left lane go: Left lane lights are green, while the rest are red.

The program will keep cycling through these states indefinitely in a loop. Each state lasts for a specified duration controlled by the delay() function in the code.

CONCLUSION:

In all urban areas, with the modernisation and reduction of industries, traffic has become the main cause for air pollution. Both in Winter (smog) as in summer (ozone) pollution is present. In all cities the main effort is to control and monitor the pollution level trough a wide network of measurement stations for a real time representation (AURORA and NEBULA, Milan, BLUME, Berlin) and even forecast (ATMOSFERA, Rome) in order to activate traffic reduction measurements.Therefore the main maps show the pollution levels for different pollutants (NO, ozone, CO, Benzene) not only along the principal roads but also represented in isolines (see also the contributions on Air). But controlling and reducing the air pollution from traffic is mainly a political decision on a national and European wide scale, so that for now the most important achievement is a better informed public.



- In conclusion, an IoT based traffic management system using Arduino can greatly improve the efficiency and effectiveness of traffic control.
- The use of Arduino microcontrollers allows for easy connectivity and communication between different components of the system. This enables effective coordination between traffic lights, road signs, and other elements to ensure the smooth movement of vehicles and pedestrians.
- The IoT aspect of the system enables remote monitoring and control.
- Overall, an IoT based traffic management system using Arduino has the potential to significantly enhance traffic control, reduce congestion, and improve overall transportation efficiency.
- IoT based traffic management system using Arduino in traffic signal control enhances traffic flow, reduces congestion, and improves road safety through intelligent and adaptive signal control.