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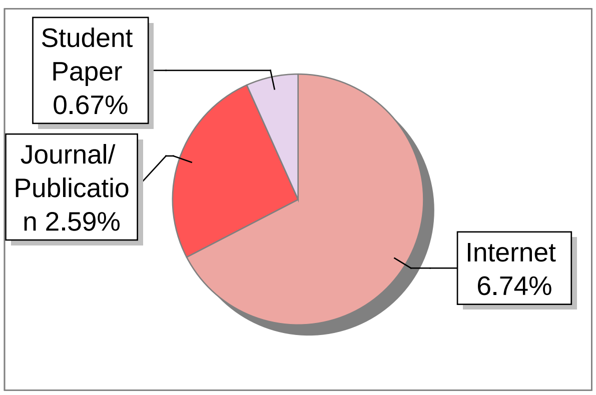


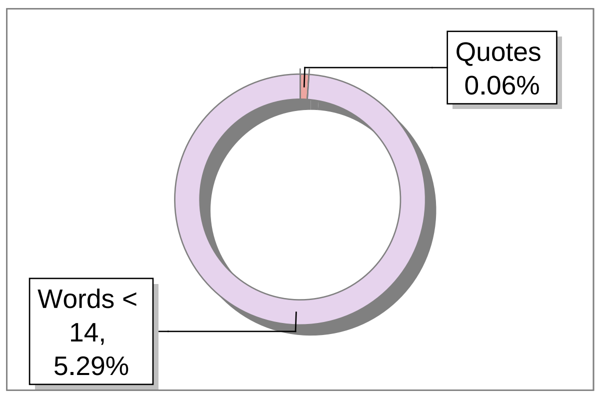


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## ABSTRACT

With the increase in the urbanization the population is increasing and the number of vehicles are also increasing rapidly which result in increase in congestion and accident on the road so, using Internet of Things (IoT) technologies, this study presents an enhanced road and traffic safety management system. Through the integration of state-of-the-art innovations, the system seeks to change traditional traffic management tactics. Using a rescheduling algorithm for traffic signals is one such innovation that improves the effectiveness and responsiveness of traffic flow control. By utilizing IoT-enabled solutions to optimize street light functioning, the system also tackles the crucial problem of power consumption.

Based on current traffic circumstances, the suggested traffic signal rescheduling technique is intended to dynamically modify signal timings. The algorithm makes use of information gathered from a variety of IoT sensors spread throughout road networks to optimize signal phases and timings in order to reduce traffic jams, decrease delays, and improve traffic flow in general. Compared to conventional fixed-time signal systems, this dynamic method to traffic signal control delivers considerable gains by quickly adjusting to changing traffic patterns and reducing congestion hotspots. Smart street light monitoring and control to maximize energy efficiency is also made possible by the incorporation of IoT technologies. Through the use of sensors to measure ambient light levels and traffic density, the system automatically modifies the brightness and timing of street lights to provide sufficient illumination while reducing wasteful energy consumption. This proactive method lowers carbon emissions linked to street lighting, which benefits the environment by reducing operational expenses as well.

Moreover, the gathered information is transferred to the cloud, which makes it easier to create graphical displays on a schedule. These graphs offer insightful information for additional research and decision-making procedures. Through the visualization of traffic patterns, hotspots for congestion, and trends in energy use, stakeholders can make well-informed decisions aimed at enhancing urban mobility, optimizing resource utilization, and improving safety. The system's scalability and accessibility are improved by the cloud-based data analysis, which also makes it easier to integrate the system with the current smart city infrastructure and promote cooperative efforts towards sustainable urban development.

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# ABBREVIATIONS

1. IoT- Internet of Things.
2. RFID- Radio Frequency Identification.
3. MHRD- Ministry of Human Resource Development.
4. LDR- Light Dependent Resisters.
5. LED- Light Emitting Diode.
6. IR- Infrared Sensors.
7. S1- Ultrasonic Sensor 1 (distance recorded by sensor 1).
8. S2- Ultrasonic Sensor 2 (distance recorded by sensor 2).
9. S3- Ultrasonic Sensor 3 (distance recorded by sensor 3).
10. S4- Ultrasonic Sensor 4 (distance recorded by sensor 4).

# CHAPTER 1: INTRODUCTION

## 1.1 Background

With the exponential growth of urbanization in India, there is also an increase in traffic congestion in day-to-day life, and the traditional traffic management system is ineffective. This makes road safety one of the prime importance because of the rise in deaths due to crashes or accidents on the road. And with the increasing rate of population, the number of vehicles on the roads are increasing simultaneously. This results in increase of rate of traffic jams on daily basis.

## 1.2 Brief history of Technology/concept

### 1.2.1 Early Concepts (1980s-1990s):

The concept of connecting physical devices to the internet was introduced in the 1980s, with the first known example being a modified Coke vending machine at Carnegie Mellon University in 1982 that could report inventory levels.In the 1990s, researchers at MIT and other institutions began exploring the idea of embedding sensors and connectingeveryday objects to the internet.

### 1.2.2 Development of IoT Terminology (2000s):

The term "Internet of Things" was coined in 1999 by Kevin Ashton, a British technology pioneer, to describe the concept of connecting everyday objects to the internet. In the 2000s, the term gained popularity, and industry experts and researchers started discussing the potential of IoT and its implications.

### 1.2.3 Standardization Efforts (2000s-2010s):

Various standardization efforts were initiated to ensure interoperability and seamless communication between IoT devices. For instance, the IPv6 protocol was introduced to accommodate the vast number of devices that could be connected to the internet.

### 1.2.4 Commercialization and Expansion (2010s-present):

The 2010s witnessed a significant increase in the commercialization and adoption of IoT technology. The decreasing costs of sensors, advancements in wireless communication, and the proliferation of internet connectivity contributed to its rapid growth.

Industries such as manufacturing, healthcare, transportation, agriculture, and smart cities embraced IoT applications to improve efficiency, automate processes, and enhance decision-making.

### 1.2.5 Current and Future Trends:

IoT technology continues to evolve, with advancements in edge computing, artificial intelligence, and 5G networks opening new possibilities. Edge computing brings data processing closer to IoT devices, reducing latency and enabling real-time decision-making. Artificial intelligence and machine learning algorithms enhance IoT systems' capabilities in data analysis, predictive modelling, and automation. The deployment of 5G networks promises fast speed, low latency, and increased device connectivity, further accelerating IoT adoption.

## 1.3 Applications

1.3.1 Smart Home: IoT enables the integration of devices and appliances within homes, creating a connected environment. Smart thermostats, lighting systems, security cameras, and voice assistants can be controlled remotely, providing convenience, energy efficiency, and enhanced security.

1.3.2 Healthcare: IoT devices are used for remote patient monitoring, wearable health trackers, and smart medical devices. These technologies enable real-time monitoring of vital signs, medication adherence tracking, and proactive health management.

1.3.3 Industrial Internet of Things (IoT): In industrial settings, IoT is used for asset tracking, predictive maintenance, and process optimization. Sensors and connected devices collect data on machinery performance, energy usage, and production metrics, allowing for efficient resource allocation and proactive maintenance.

1.3.4 Smart Cities: IoT is instrumental in creating smart cities by integrating infrastructure, transportation, and public services. Connected sensors and devices monitor traffic flow, manage parking, optimize waste management, and enhance public safety through smart surveillance systems.

1.3.5 Agriculture: IoT is transforming agriculture through precision farming techniques. Sensors and actuators monitor soil moisture, temperature, and nutrient levels, enabling optimized irrigation, fertilization, and crop health management. Drones and satelliteimagery provide real-time monitoring and data analysis for improved crop yield.

1.3.6 Logistics and Supply Chain Management: IoT plays a crucial role in tracking and optimizing the supply chain. Connected sensors and RFID tags enable real-time tracking of goods, inventory management, and delivery route optimization, leading to increased efficiency and reduced costs.

1.3.7 Energy Management: IoT enables smart grid systems that monitor and control energy usage in real-time. Smart meters, connected appliances, and demand response systems help optimize energy consumption, reduce wastage, and enable better integration of renewable energy sources.

## 1.4 Research motivation

- According to the MHRD report present traffic scenario in India is very concerning. With the increasing population India exhibits huge traffic congestion problem. The main reason for this problem is that the country is emerging and developing at very rapid speeds.
- The present system is not adaptive to the traffic conditions and number of vehicles in a particular lane, which makes the traffic conditions more hectic and congested at times.
- Over speeding is one of the common reasons behind crashes. Humans tend to over speed and often lose control, leading to fatal accidents.

- We observe many accidents happening on the road due to many reasons like vehicles stoppage on the roadside, no streetlights on roads, lack of sleep etc.
- The existing streetlights system consumes more energy due to sodium vapor lamp andmore manpower is required and periodic check is necessary.

### 1.4.1 Problem statement

- **Ideal situation:** Optimizing traffic flow on arterial and freeway networks. Reducing congestion within and between cities. Coordinating agency traffic/transit operations. Managing incidents, reducing delays and adverse effects of incidents and congestion, weather, road work, special events, emergencies, and disaster situations.
- **Reality:** Every day, there are problems with the transportation system. When undesirable events occur, the reliability of the transportation system decreases. Among them are potentially hazardous occurrences. This shows that in order to reduce wasted travel time and aid quickly return to normal traffic conditions after the accident scene is cleaned, a systematic solution is needed.
- For the above consequences we proposed a system which will optimize traffic and road safety using IoT.

### 1.4.2 Objectives

The Objectives of the proposes research work are as follows:

- To conduct an extensive literature review on present traffic management system
- To reduce the traffic signal time in this if in any lane the vehicle is not present thenaccording to the traffic of other lane the traffic signal timer will adjusted.
- To enhance the streetlight for energy conservation by applying solar panels andcharging points for the electric vehicles.
- To design a model in which the lanes of highways have different speed limits indifferent lanes.

## 1.5 Summary

The present study focuses on all the various research made in road safety with the help of IoT. It is seen that, with the help of IoT, the safety system can be updated on a real-time basis which can help to create a smart, intelligent, and highly efficient road safety system.The true power of IoT in ensuring safe driving continues to be unleashed as cars move towards becoming fully autonomous and start interacting with their environment and making decisions on their own. This will prevent drivers from entering hazardous areas, assisting in avoiding collisions, selecting detours, and avoiding traffic congestion.

# CHAPTER 2: LITERATURE SURVEY

## 2.1INTRODUCTION

The Internet of Things refers to the network of physical devices, vehicles, sensors, and other objects embedded with connectivity capabilities that enable them to collect and exchange data. By integrating IoT into road safety management, a dynamic and proactive approach can be adopted to mitigate risks, enhance traffic management, and improve overall safety outcomes.

The proposed innovative road and traffic safety management system using IoT aims to create a comprehensive ecosystem that monitors, analyzes, and responds to real-time data related to road conditions, vehicle behavior, and environmental factors. This system utilizes a network of connected sensors deployed along roadways, on vehicles, and in infrastructure, enabling the collection of valuable data that can be processed and analyzed in real-time [1].

In the research article [2] extensive research is carried out street light management, in this the conventional street lighting system is analyzed and found that the power consumption is huge. The cost involve is largely on installation and power consumption. As this model is cost effective also not energy efficient so this is a major concern and we identified this research challenge and taken care to address in our proposed work.

The online network based on possession's implement us along a part of advanced automation that command go around sudden ongoing town in the direction of through to long haired capital. The SSLS continue the system that go around the street lights ON/OFF beyond one's control. The present system option introduces a street light monitor Arduino uno panel whatever intention management the integrated system [3].

## 2.2 RELATED WORK

Several studies and initiatives have explored the application of IoT technology in road and traffic safety management. The following is a summary of some notable related work in this area:

2.2.1 Intelligent Transportation Systems (ITS):

Intelligent Transportation Systems have been developed to enhance road safety through the integration of IoT technologies. These systems utilize connected sensors, cameras, and communication networks to collect real-time data on traffic flow, road conditions, and vehicle behavior. Advanced analytics and decision-making algorithms are employed to optimize traffic management and mitigate safety risks.

2.2.2 Vehicle-to-Vehicle (V2V) Communication:

V2V communication enables vehicles to exchange real-time data, such as speed, location, and road conditions, to enhance safety. By utilizing IoT connectivity, vehicles can provide warnings to nearby vehicles about potential hazards, improving collision avoidance and overall road safety.

2.2.3 Smart Traffic Signal Control:

IoT-based smart traffic signal control systems utilize sensors and data analytics to optimize traffic signal timings based on real-time traffic flow. By dynamically adjusting signal timings, these systems aim to reduce congestion, improve traffic efficiency, and minimize the likelihood of accidents at intersections.

2.2.4 Road Condition Monitoring:

IoT-based road condition monitoring systems employ sensors to collect data on factors such as temperature, humidity, and surface conditions. This information is used to detect hazardous road conditions, such as icy or slippery surfaces, and issue alerts to drivers, enabling them to take appropriate precautions.

## 2.3 STUDY OF TOOLS/TECHNOLOGY

2.3.1 Hardware Platforms:

- Microcontrollers: Study different microcontroller boards and chips used in IoT applications, such as Arduino, Raspberry Pi, ESP8266, ESP32, and Intel Edison.
- Sensors and Actuators: Explore the types of sensors and actuators commonly used in IoT devices, including temperature sensors, motion sensors, humidity sensors, actuators for controlling devices, etc.
- Gateways: Study IoT gateway devices that facilitate communication between IoT devices and the cloud or network infrastructure.

2.3.2 Communication Protocols:

- Wireless Protocols: Explore wireless communication protocols used in IoT, such as Wi-Fi, Bluetooth, Zigbee, Z-Wave, LoRaWAN, and NB-IoT.
- IoT-specific Protocols: Study protocols like MQTT, CoAP, AMQP, and HTTP that are designed specifically for IoT device communication and data transfer.

2.3.3 Networking and Connectivity:

- Network Infrastructure: Learn about network architectures and topologies suitable for IoT deployments, including star, mesh, and hybrid networks.
- Edge Computing: Study the concept of edge computing and its role in processing and analyzing data closer to the IoT devices, reducing latency and improving efficiency.
- Cloud Connectivity: Explore methods and technologies for connecting IoT devices to cloud platforms, enabling data storage, analysis, and management.

2.3.4 Data Management and Analytics:

- Data Storage: Study different approaches for storing IoT data, such as databases (SQL and NoSQL), time-series databases, and distributed file systems.
- Data Analytics: Explore techniques and tools for analyzing IoT data, including real-time analytics, machine learning, and predictive modeling.
- Big Data Technologies: Learn about technologies like Apache Kafka, Apache Spark, and Hadoop for processing and analyzing large volumes of IoT data.

## 2.4 IoT based traffic light control system

In the proposed work as in Fig 2.1 uses raspberry pi model along with Arduino to control the traffic lights. We have analyzed the system proposed in [1] uses more hardware and effective memory utilization is not taken care.

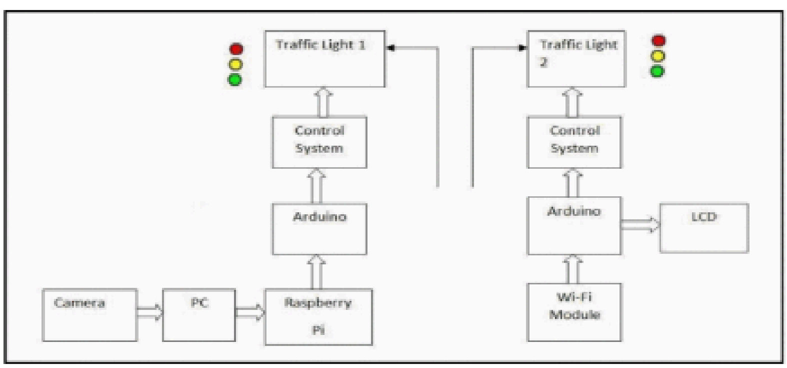


Fig 2.1 Proposed work of IoT based traffic light control system [1].

## 2.5 Intelligent Energy Efficient Street Light Controlling System based on IoT

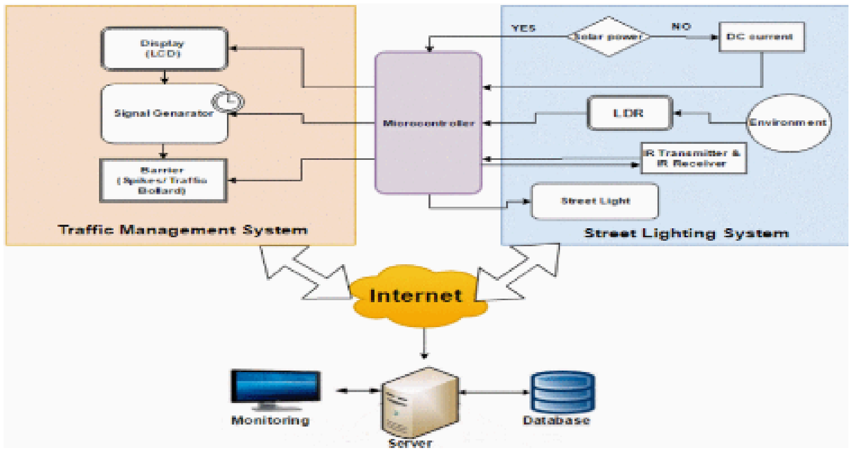


Fig 2.2 Proposed work of Intelligent Energy Efficient Street Light Controlling System based on IoT [2].

The proposed method [2] concludes that the Smart Intelligent Street Lighting system helps in providing minimal power consumption in towns, municipalities and cities. It can be monitored through Thing speak cloud. Maintenance cost is also minimal and the reduced power consumption in today's era makes it an immediate call at this hour. Since saving of energy plays an important role, this proposed method provides a good solution for reduced power consumption.

## 2.6 Smart Street Lighting System for Smart City

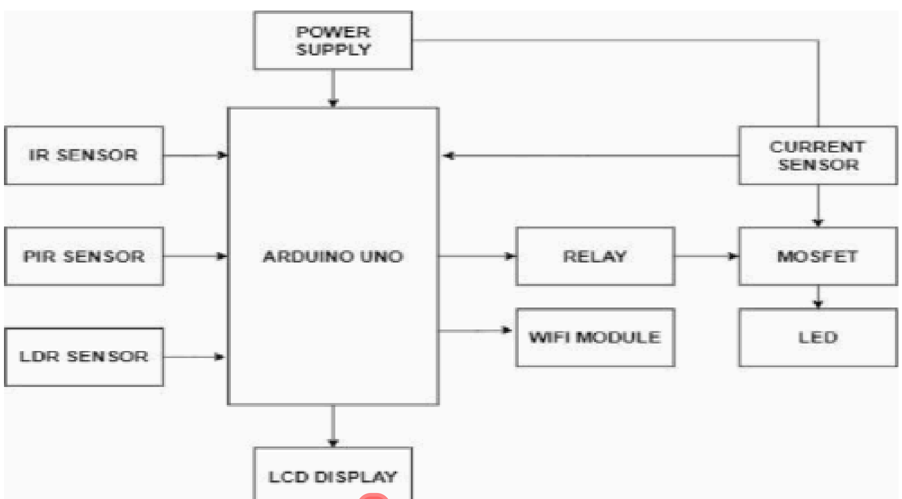


Fig 2.3 Proposed work of IoT based Smart Street Lighting System [3].

From the present project our own selves achieve a certain here is a entity and that essential utilization as long as to our Nation, chiefly due to the street lights act no more exploit accordingly aside the authority. In this project we have added some advanced technology we can operate the entire system with mobile or laptop, beyond this it also displays the lifespan of the lamps. This project also has a more development we have a chance to trustworthy in the future scope.

## 2.7 Summary

**Table 2.1 Explains the summary of the literature survey of the IEEE research paper.**

| PAPER NAME | OBJECTIVES | CONCLUSION |
|---|---|---|
| Paper 1: IoT based traffic light control system. | Distinguish the presence and absence of vehicle in road images. | Updated signal timing based on the density on the road. |
| Paper 2: Intelligent energy efficient street light controlling system based on IoT for smart system. | Controls the street lights by automatically switching them when there are vehicles around. | Provides minimal power consumption. |
| Paper 3: IoT based smart street lighting system for smart cities. | The present system option introduces a street light monitor. | Operate the entire system with mobile laptop. |

Using these surveys, we conclude our objectives to enhance the traffic light for rescheduling algorithm. Another objective is to provide minimal power consumption using intensity of surrounding, and at last we upload all the data that comes from the sensors to the cloud for further enhancement of the project. Along with the research work proposed in the above section we also review research articles [13-20] helped in analyzing the challenges in traffic management and IoT.

# CHAPTER 3: SYSTEM REQUIREMENTS SPECIFICATIONS

## 3.1 System Requirements -

refers to the specifications and capabilities necessary for a computer or software application to run efficiently.

3.1.1 Hardware Requirements – The physical devices that are use to run the program and perform the task are:

1. Arduino Mega

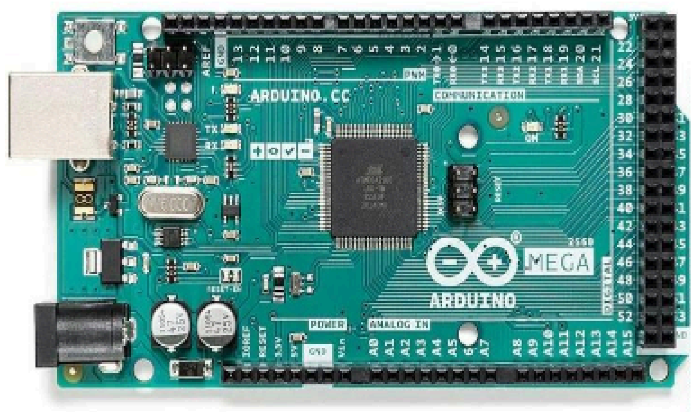


Fig 3.1 Arduino Mega 2560.

2. Ultrasonic Sensor


Fig 3.2 Ultrasonic Sensor.

3. LED

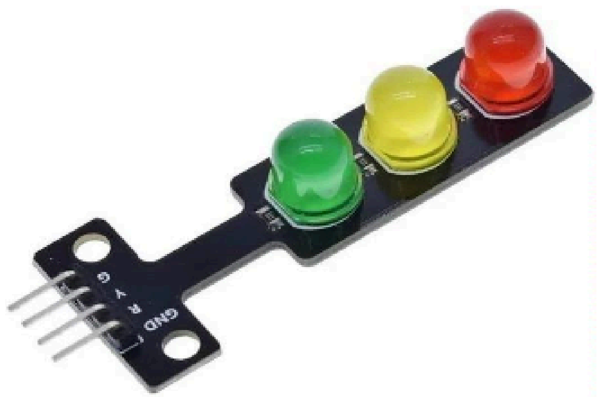


Fig 3.3 Represents Traffic LED Lights

4. Jumper wires

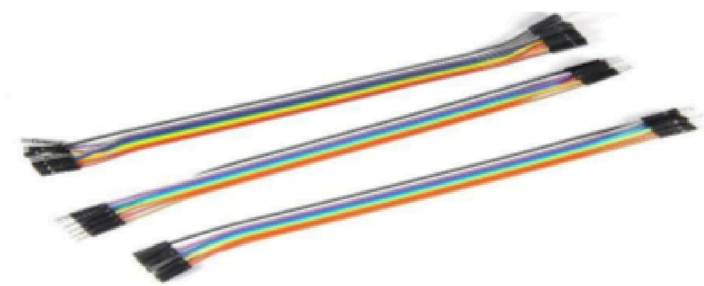

Fig 3.4 Represents Jumper Wires

3.1.2 Software Requirements – Computer software that are use to run the code and perform the task are:

1. Arduino IDE

2. Things Board

3. Google Colab

4. Tinker cad

**CHAPTER 4:**
**DESIGN AN INNOVATIVE RESCHEDULING ALGORITHM OF TRAFFIC LIGHT.**

## 4.1 Dataflow Diagram

- Rescheduling algorithm of traffic light.

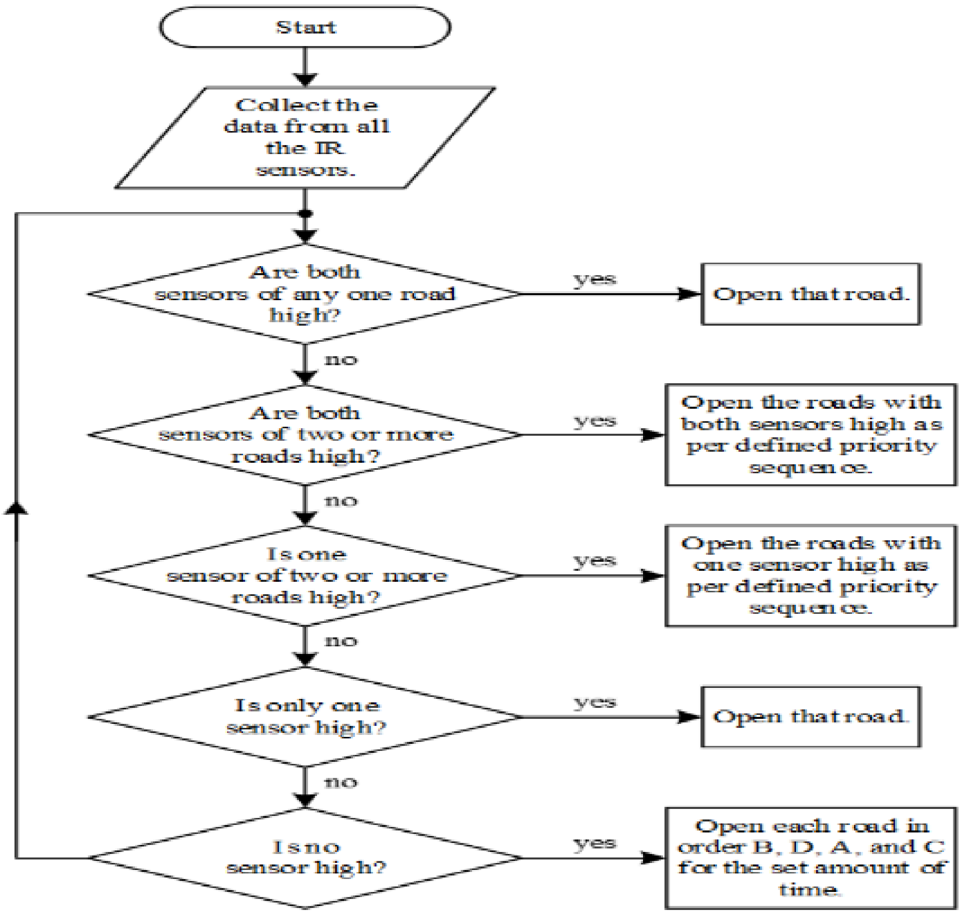


Fig 4.1 Dataflow diagram of rescheduling algorithm of traffic light.

Fig 4.1 Explains the working of the traffic light that we use for rescheduling algorithm in which the data come from the ultrasonic sensor is analyzed and based on the density of the lane the algorithm changes or remain unchanged.

- Enhancement of road safety street light

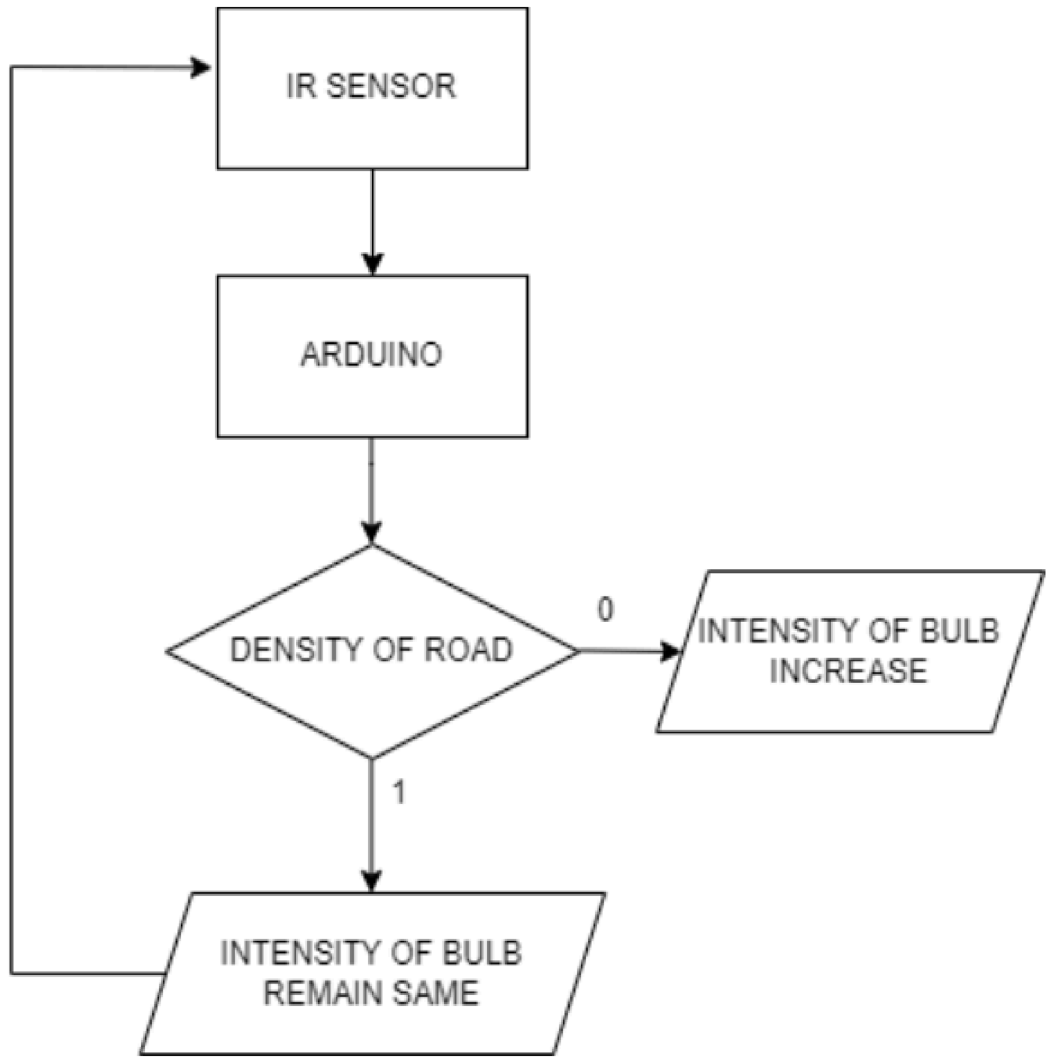


Fig 4.2 Dataflow diagram of enhancement of road safety street light.

Fig 4.2 Explains the working of road safety enhancement by using IR sensors to decrease or increase the intensity of street light.

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**19 4.2 Schematic Diagram of Rescheduling algorithm of traffic light. Fig 4.3 Schematic of rescheduling algorithm of traffic light. 1. Ultrasonic Sensor – To determine the density of road. 2. Traffic light – To give the preferred output. 3. Arduino Mega – To store the code take the input and give the preferred output. Fig 4.3 Explains how the traffic light rescheduling algorithm works. It uses an Arduino Mega and ultrasonic sensor to measure the density of the road, and it uses this information to control the traffic light's timing. This allows people to save time, and in an emergency, the emergency vehicles are given preference.**

**4.3 Schematic diagram of Street light power consumption.**

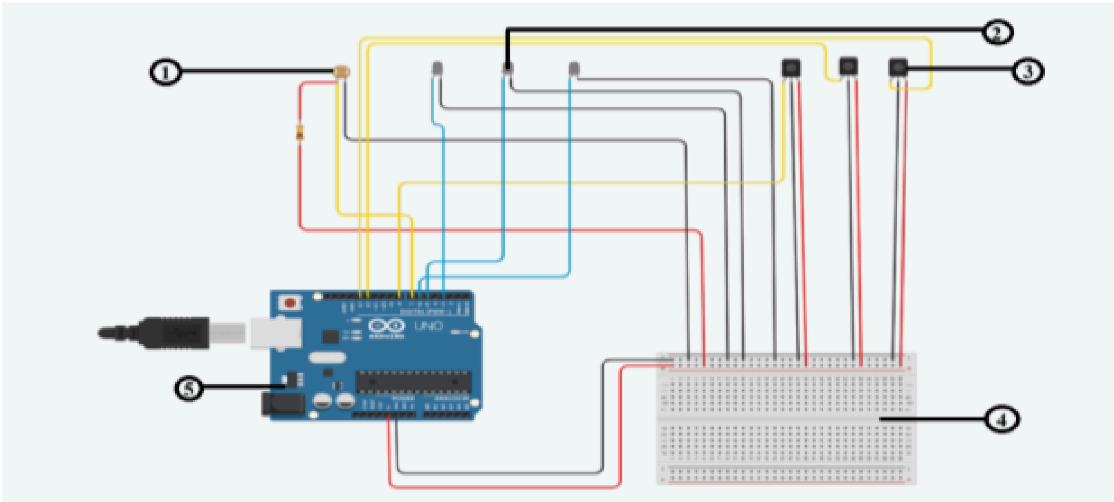

Fig 4.4 Schematic diagram of Street light power consumption.

1. LDR – To note the surrounding intensity.
2. LED – To give the preferred output.
3. IR sensor – To determine the motion.
4. Bread board – To connect the circuit.
5. Arduino UNO – To store the code and take the input and give the preferred output.

Fig 4.4 Explains the working of our objective of street light power consumption and road safety enhancement in which we are using Arduino in which algorithm is set, we are using IR sensors and LDR sensors for detecting the intensity of surrounding and any object in the specific path is detected by IR sensors which are sent to the algorithm and some specific conditions are executed based on which the street lights get ON/OFF and the intensity of light changes.

**4.4 Summary**

From the above objectives we proposed a rescheduling algorithm of traffic signals based on the density of the other lanes, the signal will automatically turn green based on the density of the other lane, as well as the data is sent on the cloud which can be used to analyze in traffic in a proper way. In the second objective we proposed the energy conservation model of street lights.

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**21 CHAPTER 5: RESULTS Vehicles are detected by ultrasonic sensors placed along roadsides or close to intersections when they are within a specific range. Using IoT communication protocols, the sensor notifies a central control system once a vehicle has been detected. Real-time data from several sensors is received by the central control system. [21] Whether there are cars approaching or waiting at the intersection is determined by processing this data. Fig 5.1 Distance Recorded by Sensors – 2 Fig 5.2 Representation of Actual Experiment – Sensor 2 turning Green. Fig 5.3 Distance Recorded in Sensor - 4 Fig 5.4 Representation of the Actual Experiment - Sensor 2 turning Yellow**

The control system determines whether to turn the traffic signal green based on the data it has received. When a vehicle is detected within a certain range, the sensor modifies the traffic light accordingly. When there are two or more signals in that range and there are vehicles in them, the system will consider the first signal the vehicle entered and keep going until all traffic has cleared from that signal.

Fig 5.1 shows the distance which are recorded by the four ultrasonic sensors and when the distance recorded is within the range of 10, then the signal turns green for that sensor.

Fig 5.2 shows the connection of the sensors and the LEDs with the Arduino Mega 2560. In this the second signal turns green when the distance recorded in the sensor is within the range of 10 as shown in the fig 5.1.

Now, in the second case when the vehicle is moved from sensor-2 to the sensor-4, the distance recorded by the sensors are changed and the readings are displayed in fig 5.3.

Fig 5.4 Since, the distance in the sensors changed so the light changes to yellow in the sensor-2 toanalyze the distance of the vehicles and keep the signals at hold for that amount of time.

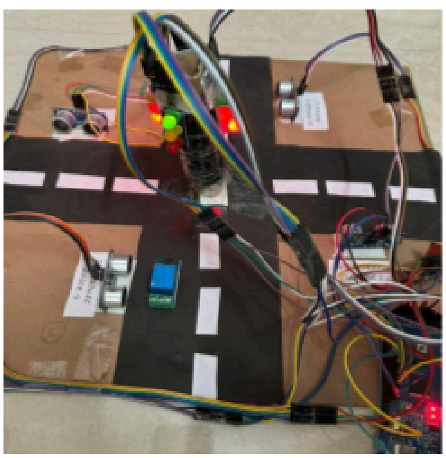

Fig 5.5 Sensor 4 turning green when vehicle is kept near sensor 4.

```
S1: 3  S2: 223  S3: 57  S4: 17
S1: 3  S2: 223  S3: 57  S4: 17
S1: 3  S2: 223  S3: 57  S4: 17
S1: 3  S2: 223  S3: 57  S4: 17
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S1: 3  S2: 221  S3: 54  S4: 17
S1: 3  S2: 222  S3: 54  S4: 17
```

Fig 5.6 Distance Recorded in Sensors – 1

Fig 5.5 Now, after analyzing the distances which are recorded by the sensors, the sensor-4 turns greenbecause the distance recorded in sensor-4 as observed in the figure 5.3 is within the range of 10.

Fig 5.6 The distance recorded by the sensor when a vehicle is placed from sensor 4 to sensor 1 as shown in the above figure when the sensor detects the objects near them.

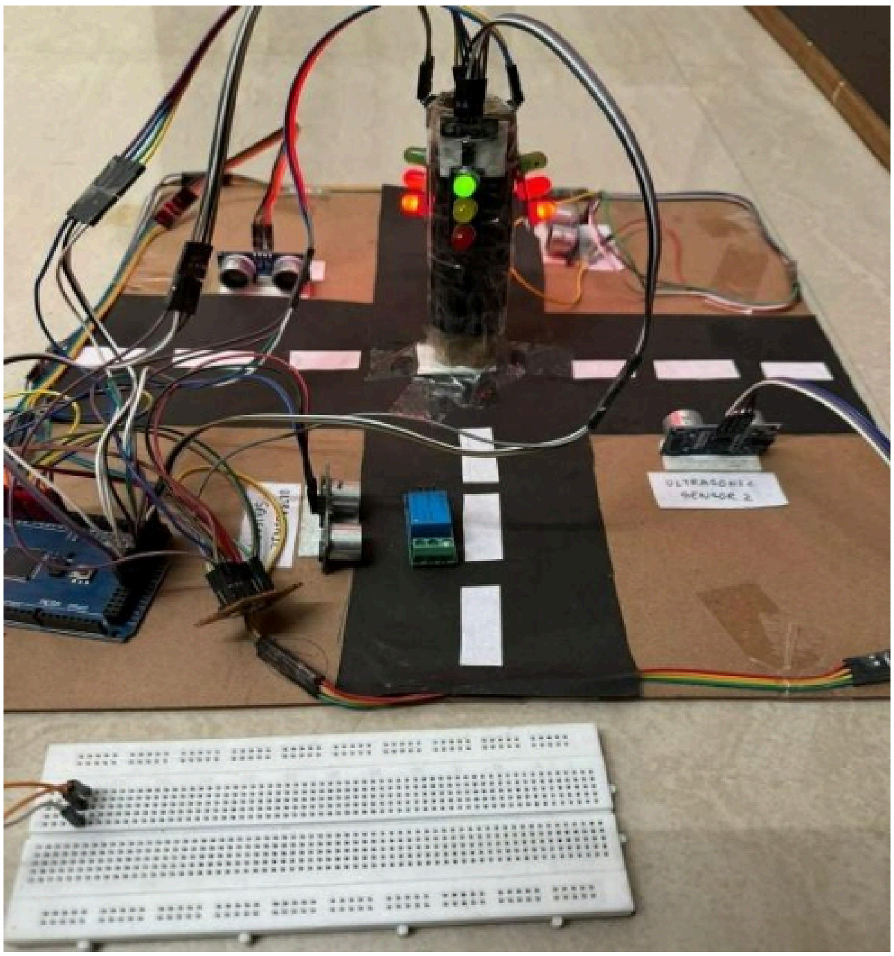
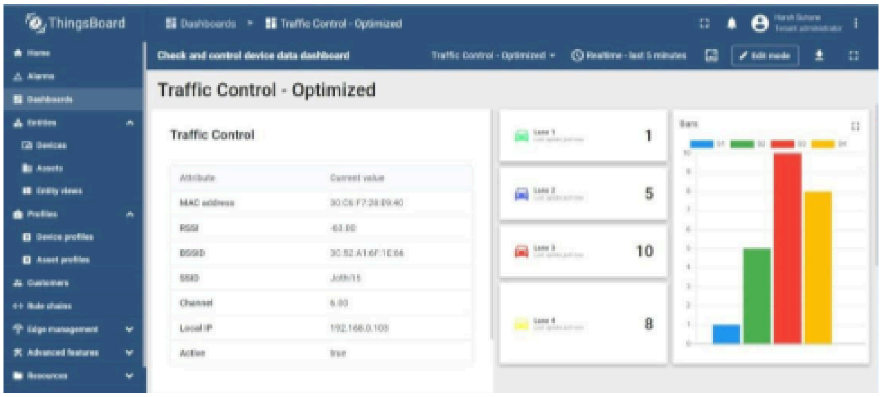


Fig 5.7 Sensor 1 turning Green when vehicle was kept near Sensor 1 after Sensor 4

When the vehicle is kept Infront of sensor 1, after changing the vehicle from sensor 4 to sensor 1. The first traffic light changes to green.




```
Data sent successfully: {'S1': 2, 'S2': 10, 'S3': 7, 'S4': 10}
Data sent successfully: {'S1': 5, 'S2': 6, 'S3': 10, 'S4': 8}
Data sent successfully: {'S1': 8, 'S2': 5, 'S3': 6, 'S4': 6}
Data sent successfully: {'S1': 3, 'S2': 3, 'S3': 9, 'S4': 10}
Data sent successfully: {'S1': 3, 'S2': 6, 'S3': 5, 'S4': 2}
Data sent successfully: {'S1': 8, 'S2': 2, 'S3': 2, 'S4': 10}
Data sent successfully: {'S1': 5, 'S2': 7, 'S3': 3, 'S4': 4}
Data sent successfully: {'S1': 3, 'S2': 2, 'S3': 10, 'S4': 5}
Data sent successfully: {'S1': 3, 'S2': 2, 'S3': 6, 'S4': 5}
Data sent successfully: {'S1': 6, 'S2': 4, 'S3': 9, 'S4': 8}
Data sent successfully: {'S1': 2, 'S2': 2, 'S3': 9, 'S4': 2}
Data sent successfully: {'S1': 7, 'S2': 8, 'S3': 3, 'S4': 5}
Data sent successfully: {'S1': 6, 'S2': 2, 'S3': 2, 'S4': 8}
Average Sensor Values:
Lane 1: 4.6923076923076925
Lane 2: 4.538461538461538
Lane 3: 6.230769230769231
Lane 4: 6.384615384615385
```

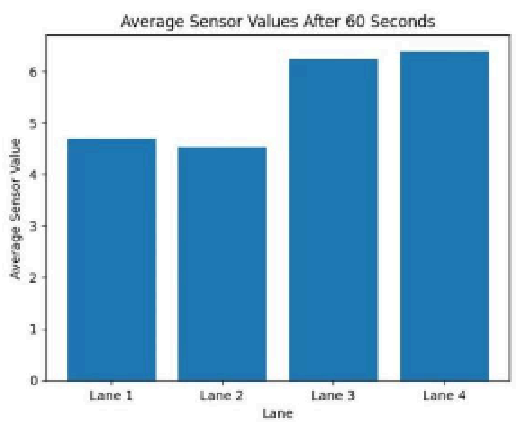



Fig 5.8 Cloud implementation of data coming from the ultrasonic sensors.

The data coming from the sensors are send to the ThingsBoard cloud for future analysis using the Google Colab.

```
Data sent successfully: {'S1': 8, 'S2': 9, 'S3': 5, 'S4': 10}
Data sent successfully: {'S1': 4, 'S2': 2, 'S3': 2, 'S4': 1}
Data sent successfully: {'S1': 10, 'S2': 5, 'S3': 10, 'S4': 3}
Data sent successfully: {'S1': 8, 'S2': 6, 'S3': 4, 'S4': 10}
Data sent successfully: {'S1': 4, 'S2': 9, 'S3': 3, 'S4': 1}
Data sent successfully: {'S1': 7, 'S2': 1, 'S3': 8, 'S4': 10}
Data sent successfully: {'S1': 3, 'S2': 4, 'S3': 9, 'S4': 9}
Data sent successfully: {'S1': 1, 'S2': 4, 'S3': 8, 'S4': 8}
Data sent successfully: {'S1': 6, 'S2': 6, 'S3': 9, 'S4': 1}
Data sent successfully: {'S1': 8, 'S2': 5, 'S3': 3, 'S4': 7}
Data sent successfully: {'S1': 10, 'S2': 8, 'S3': 2, 'S4': 1}
Data sent successfully: {'S1': 2, 'S2': 7, 'S3': 3, 'S4': 7}
Data sent successfully: {'S1': 4, 'S2': 6, 'S3': 6, 'S4': 7}
Data sent successfully: {'S1': 9, 'S2': 1, 'S3': 1, 'S4': 7}
Data sent successfully: {'S1': 10, 'S2': 3, 'S3': 7, 'S4': 10}
Data sent successfully: {'S1': 5, 'S2': 8, 'S3': 6, 'S4': 5}
Data sent successfully: {'S1': 6, 'S2': 10, 'S3': 1, 'S4': 9}
Data sent successfully: {'S1': 8, 'S2': 7, 'S3': 9, 'S4': 9}
Data sent successfully: {'S1': 4, 'S2': 3, 'S3': 3, 'S4': 3}
```

Fig 5.9 Data for the use case 1.


Fig 5.10 result for the use case 1.

```
Data sent successfully: {'S1': 2, 'S2': 10, 'S3': 7, 'S4': 10}
Data sent successfully: {'S1': 5, 'S2': 6, 'S3': 10, 'S4': 8}
Data sent successfully: {'S1': 8, 'S2': 5, 'S3': 6, 'S4': 6}
Data sent successfully: {'S1': 3, 'S2': 3, 'S3': 9, 'S4': 10}
Data sent successfully: {'S1': 3, 'S2': 6, 'S3': 5, 'S4': 2}
Data sent successfully: {'S1': 8, 'S2': 2, 'S3': 2, 'S4': 10}
Data sent successfully: {'S1': 5, 'S2': 7, 'S3': 3, 'S4': 4}
Data sent successfully: {'S1': 3, 'S2': 2, 'S3': 10, 'S4': 5}
Data sent successfully: {'S1': 3, 'S2': 2, 'S3': 6, 'S4': 5}
Data sent successfully: {'S1': 6, 'S2': 4, 'S3': 9, 'S4': 8}
Data sent successfully: {'S1': 2, 'S2': 2, 'S3': 9, 'S4': 2}
Data sent successfully: {'S1': 7, 'S2': 8, 'S3': 3, 'S4': 5}
Data sent successfully: {'S1': 6, 'S2': 2, 'S3': 2, 'S4': 8}
```

Fig 5.11 Data for the use case 2.

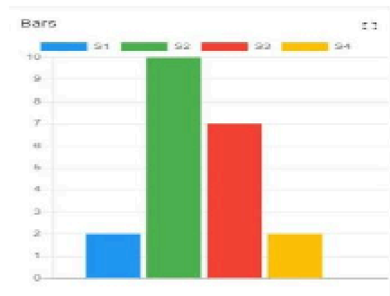



Fig 5.12 result for the use case 2.

```
Data sent successfully: {'S1': 2, 'S2': 4, 'S3': 6, 'S4': 6}
Data sent successfully: {'S1': 1, 'S2': 5, 'S3': 1, 'S4': 9}
Data sent successfully: {'S1': 4, 'S2': 6, 'S3': 9, 'S4': 4}
Data sent successfully: {'S1': 2, 'S2': 5, 'S3': 7, 'S4': 4}
Data sent successfully: {'S1': 9, 'S2': 2, 'S3': 8, 'S4': 10}
Data sent successfully: {'S1': 10, 'S2': 3, 'S3': 4, 'S4': 8}
Data sent successfully: {'S1': 6, 'S2': 4, 'S3': 8, 'S4': 4}
```

Fig 5.13 Data for the use case 3.

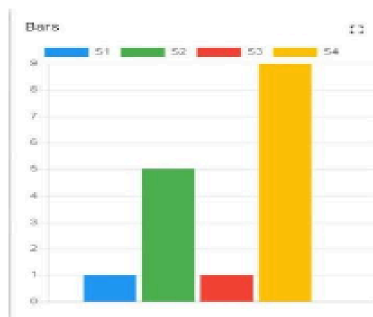



Fig 5.14 result for the use case 3

In the above fig from 5.9 to 5.14 we have passed the random values from range 1 to 10 for three random test cases to analyzed the real time traffic patterns and the results formed are presented in the form of bar graphs. Note: In fig 5.10, 5.12 and 5.14 the bar graphs are generated by taking the average value of the data that are sent in the random way.

This pge is extracted due to viral text or high resolution image or graph.

**26 (a) (b) Fig 5.15 Energy conservation of street light In figure 5.15 represents the energy conservation of street light, which has two case, in first case that is Figure 5.15 (a) in which the street lights are off when the intensity of surrounding is high. Figure 5.15 (b) the street light turn on when intensity of surrounding is low and the intensity of light increases when an vehicle come infront of the sensor.**

## CHAPTER 6: CONCLUSION

In conclusion, a major breakthrough in contemporary transportation infrastructure is the creation of an Innovative Road and Traffic Safety Management System that makes use of IoT. This system offers a comprehensive method for improving traffic management and road safety through the integration of cutting-edge technology, including cloud computing and Internet of Things sensors. Our suggested traffic signal rescheduling technique, which dynamically adjusts signal timings in real-time to maximize traffic flow and minimize congestion, constitutes a significant advance. This flexible strategy enhances overall effectiveness while also fostering a more secure and sustainable urban environment.

Furthermore, our solution tackles the urgent problem of energy consumption by incorporating smart street lighting that can modify their power consumption according to traffic situations in real time. These lights proactively conserve energy without sacrificing safety or visibility by utilizing IoT connectivity, which leads to significant cost savings and environmental advantages. This focus on sustainability highlights the technologies' wider impact and is in line with international initiatives to reduce climate change and advance green infrastructure.

There is a great deal of room for improvement and improvement to this cutting-edge system in the future. Future research and development could focus on integrating machine learning and predictive analytics to anticipate traffic trends and make proactive adjustments to signal schedules. Furthermore, improvements in connectivity and sensor technology may make it possible for cars to be seamlessly integrated into the ecosystem of traffic management, enabling more responsive and dynamic control over traffic flow. Furthermore, to fully utilize IoT-enabled solutions for road and traffic safety management, ongoing investments in infrastructure and data analytics skills are essential.

To sum up, the Road and Traffic Safety Management System that is being showcased here is an innovative method of managing urban transportation that makes use of IoT technology to enhance effectiveness, security, and sustainability. Through the utilization of adaptive algorithms, cloud-based infrastructure, and data analytics, this system provides an insight into the future of smart cities—a place where innovation and connectedness come together to create safer, more livable urban settings. There is always room for progress and revolutionary change in urban transportation management as long as we keep pushing the envelope of technology.