RESPONDERS- THE SMART TRAFFIC LIGHT AND STREET LIGHT SYSTEM

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report **"RESPONDERS- THE SMART TRAFFIC LIGHT AND STREET LIGHT SYSTEM"** is the bonafide work of **MERCY ALBINA.C (211420104158) & KOUSHIKA. S.S (211420104138)** who carried out the project work under my supervision.

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DECLARATION BY THE STUDENT

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ABSTRACT

To improve safety and energy consumption in smart cities, this proposal supports two essential tactics. The first attempt suggests implementing dynamic brightness management for optimal energy efficiency in fog computing-based smart street lamps (SSL). These SSLs can independently report, meaning that individual bulbs can identify and report anomalous conditions, including broken or pilfered lights. According to the study's findings, installing SSLs greatly reduces dangers and improves energy utilization in urban illumination.

By integrating machine learning technologies, the second strategy concentrates on intelligent traffic management. To improve traffic control, a system that uses automation and the Internet of Things to operate barricades on roads is being introduced. Deep learning algorithms and object identification distinguish between free and crowded highways, recommending alternate routes to ease traffic congestion. hese actions address careless driving, improve traffic flow, and increase road safety.

In summary, the combination of Fog Computing-Based Smart Street Lamps (SSLs) and intelligent traffic management systems hold the promise of ushering in smarter, safer, and more energy-efficient cities by effectively tackling issues associated with street lights, traffic congestion, and speeding vehicles. All things considered, this integrated strategy is a positive step toward developing technologically sophisticated and sustainable cities.

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INTRODUCTION

1.1 OVERVIEW

The Internet of Things (IoT) represents a groundbreaking technology capable of seamlessly integrating diverse and heterogeneous end systems to enable a broad array of digital services. This transformative innovation is propelling the world toward intelligent and automated management of systems.

The increase in the number of vehicles has led to traffic congestion, pollution, and disruptions in transit operations. Utilizing IoT for traffic regulation and effective congestion management becomes a crucial game-changer. The proposed concept aims to develop an IoT system for autonomous traffic management. This system, inspired by railway practices, summons a barricade when the traffic light is red and releasesit when the light turns green, ensuring a safe passage for pedestrians. This approach aims to raise awareness among drivers about theiractions, promoting a safer road environment.

To enhance traffic flow, object detection is employed. Object detectionidentifies busy and idle lanes, allowing for dynamic traffic signal adjustments. This adaptive strategy enables more efficient traffic management by facilitating increased vehicle passage on busy roads and reducing passage on less congested ones. The integration of IoT in these applications showcases its potential to revolutionize urban mobility and safety.

In the ever-evolving landscape of urban development, the principles ofsafety and energy efficiency stand out as fundamental pillars in shapingsmart cities. Within the intricate fabric of a metropolis, the synergy between safety and energy conservation converges uniquely in street lamps, making them indispensable components of the smart city paradigm. However, the current absence of intelligent elements in conventional street lighting poses challenges related to both risk and energy usage. To navigate this terrain, a forward-thinking strategy introduces the concept of fog computing-based smart street lamps (SSL) as a transformative solution for smarter cities. This innovative approach not only empowers dynamic brightness control but alsoinstills a heightened level of autonomy in each street lamp, enabling itto report and address unusual circumstances independently. As we delve into the advantages and findings of this proposed SSL system, itbecomes evident that the fusion of technology and urban infrastructureholds the promise of lowering risk and elevating energy efficiency in our urban spaces.

1.2 PROBLEM DEFINITION

- Over the past four years, Mumbai, Delhi and Bengaluru have consistently featured on TomTom's top 10 most congested cities in the world for traffic.
- There are plenty of reasons for extreme level of traffic in India.
- Increase in the number of vehicles in the country is one major issue causing heavy traffic congestion. In January 2019 alone, at least million-and-half vehicles were bought and registered across tthe country.
- Lack of proper implementation of traffic signals.
- The issue that is most Indian drivers fail to follow road rules.
- Due to this there are various pedestrian accidents near the zebra crossing area.
- As well as due to traffic or the traffic signals there are many possible chances of emergency vehicles getting stuck in the traffic signals or the nearby roads.
- These are the most common problems in the traffic signal structure in day to day life.
- As well as the management of street lights can be improved using the sensors available to provide a power efficient and all-purpose street light system.

1.3 OBJECTIVE

The objective of the project is to leverage Internet of Things (IoT) technologies to address various challenges in urban environments, with a focus on traffic management, road safety, and energy efficiency. The project aims to achieve the following key objectives:

a) Autonomous Traffic Management:

- Develop an IoT system inspired by railway practices to autonomously manage traffic flow at intersections.
- Introduce a mechanism where barricades are summoned during red traffic lights and released during green lights to ensure safe pedestrian passage.

b) Object Detection for Traffic Flow Enhancement:

- Utilize object detection technology to identify busy and idle lanes on the road.
- Dynamically adjust traffic signal timings based on detected trafficconditions to enhance traffic flow and efficiency.

c) Safety and Energy Efficiency in Smart Cities:

- Address safety and energy efficiency as fundamental pillars in the development of smart cities.
- Introduce fog computing-based smart street lamps (SSL) as transformative solution.
- Enable dynamic brightness control in SSLs and instill a heightened level of autonomy to report and address unusual circumstances independently.
- Empower SSLs with the ability to dynamically control brightness, optimizing energy usage.
- Provide SSLs with autonomy to report and address unusual circumstances independently, contributing to urban safety.

d) Overall Impact:

- Revolutionize urban mobility and safety through the integration of IoT applications in traffic management and street lighting.
- Lower the risk associated with conventional street lighting systems and elevate energy efficiency in urban spaces.

The overarching goal is to create a smart and interconnected urban environment where IoT technologies contribute to improved trafficmanagement, enhanced road safety, and increased energy efficiency.

1.4 SCOPE OF THE PROJECT

The scope of this project revolves around the transformative potential of the Internet of Things (IoT) in addressing key challenges in urban environments. The scope can be summarized into the following main themes

a) IoT in Traffic Management:

- The use of IoT for autonomous traffic management is proposed, inspired by railway practices.
- The focus is on summoning barricades during red traffic lights and releasing them during green lights to ensure pedestrian safety.
- The aim is to leverage IoT to enhance the efficiency of traffic regulation and congestion management.

b) Object Detection for Traffic Flow Enhancement:

- Discusses the use of object detection to identify busy and idle lanes.
- Enables dynamic traffic signal adjustments based on detected traffic conditions.
- Aims to enhance traffic flow and efficiency by adapting signal timings to the current road conditions.

c) Safety and Energy Efficiency in Smart Cities:

- Highlights safety and energy efficiency as fundamental principles in the context of smart city development.
- Introduces the concept of fog computing-based smart street lamps (SSL) as a transformative solution.
- Describes SSLs with dynamic brightness control and autonomy to report and address unusual circumstances independently.
- Focuses on the advantages of SSLs, including dynamic brightness control and autonomous reporting.
- Emphasizes the promise of lowering risk and elevating energy efficiency in

urban spaces through the fusion of technology and urban infrastructure.

1.5 FEASIBILTY STUDY

A feasibility study is an evaluation and analysis of a project's potential based on thorough investigation and research to provide decision-makers complete confidence. The goal offeasibility studies is to logically and objectively identify the advantages and disadvantages of a potential project or existing business, as well as the possibilities and dangers presented by the surroundingenvironment, the resources required to execute the plan, and, ultimately, the likelihood of success. The most important things to think about are: There are two levels of feasibility (i) economic and (ii) Technical

1.5.1 ECONOMIC FEASIBILITY

Economic feasibility is a crucial aspect of a feasibility study that assesses the financial viability and potential economic benefits of a proposed project. It involves analyzing the costsassociated with the project, as well as estimating the potential returns on investment. The primary goal is to determine whether the project is financially feasible and economically justifiable.

a) Potential Revenue Streams:

Purpose**:** To explore avenues for offsetting development and operational costsand achieving financial sustainability.

b) Return on Investment (ROI) Analysis:

Purpose: To assess the financial attractiveness of the project and its potentialimpact on healthcare outcomes.

c) Cost-Benefit Analysis (CBA):

Purpose: To provide decision-makers with a clear understanding of the economicvalue and feasibility of the project.

d) Payback Period Analysis:

Purpose: To assess the project's risk and provide insights into its financial payback period.

1.5.2 TECHNICAL FEASIBILITY

The proposed system demonstrates robust technical feasibility by seamlessly integrating hardware and software components. The Raspberr pi -based traffic and street light monitoring sensors ensure real-time data accuracy, reliability, and low-cost implementation.

The system leverages widely-used technologies, ensuring compatibility with various devices and platforms. Its modular design facilitates easy scalability and integration with emerging technologies. The technical infrastructure supports secure data transmission, storage, and retrieval, adhering to healthcare data standards. With a focus on user-friendly interfaces and responsive web design, the system guarantees an intuitive experience for both traffic and street light monitoring. The technical feasibility of the proposed system positions it as an adaptable, future-proof solution for personalized street and traffic light management.

CHAPTER 2

LITERATURE REVIEW

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LITERATURE REVIEW

In the TomTom World Traffic Index for 2021, Indian cities were reported at #2, #6, #8, and #16[4]. According to the 2022 TomTom World Traffic Index report, Delhi, Bangalore, and Mumbai ranked #11 and #21 in the world correspondingly for urban congestion during the year. And in 2023 Bengaluru and Pune were ranked at #6, #7. India's transportation systems have been expanding considerably about 30% over the last 10 years, while the number of registered vehicles has climbed by approximately threefold.[5] On the busiest roads, this leads to extreme traffic congestion combined with breaching traffic laws.

63,81,548 traffic infractions were reported by the police in 2021 in one city alone which was preceded by 50,95,478 in 2020 and 49,38,485 in 2019. This signifies a spike in traffic offenses of around 25%.

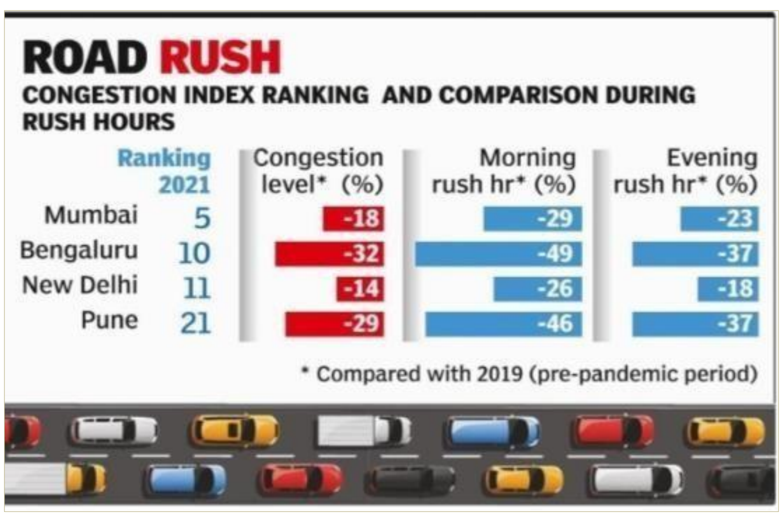


Figure 2.1 Indian Cities rank in Congestion Index List

These crimes not only result in traffic, but they also sometimes cause fatalities. The amount of deaths brought on by drivers' contempt towards traffic signals is steadily increasing. This even applies to pedestrians. The number of careless drivers is rising.It is now perilous to stroll on Indian highways. 176 people died in the city the year before after being hit by cars, with a rise in traffic light skipping of nearly 79% throughout COVID [7] (Chennai). Among them, 44% of the incidents involved two-wheelers. Private vans and buses run on behalf of Metropolitan Transport Company (MTC) regularly break this regulation. At designated crossing locations, 19% of respondents were involved in crashes.

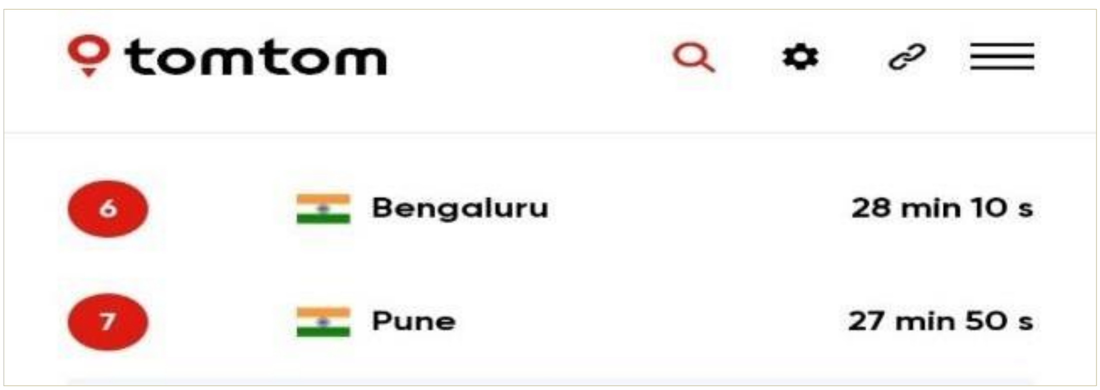


Figure 2.2 Ranking of Indian cities in tom tom 2023

Better cooperation between state agencies has been requested by road traffic expertsto increase the appearance of crosswalks, stop lines, and adjust lights so that pedestrians have enough time to cross the roads. To enhance pedestrian safety, the government needs to modify its rules to provide preference to pedestrians over drivers, according to Aswathy Dilip, senior Project Manager, at the Institute of Transportation and Development Policy (ITDP) [8]. Many of the laws that are designed to make sure individuals follow the rules are either disregarded or broken.[9]. This congestion problem is not only in India but throughout the world. Traffic jams are still a global issue despite the discussion and analysis of the circulation of traffic and its management by Mannering et al.(2012) [10], Gerloughet al.(1995) [11], and Sharma et al.(2011) [12]. To do away with it, consequently, devise a plan that will force everyone to abide by the traffic laws.

Here, we genuinely use traffic lights to control the circulation of traffic without the assistance of police officials. Then, the system for keeping the emergency vehicles and traffic signals in working order comes into play. Numerous subjects have been explored in earlier research [13–15], such as the monitoring element and automatic identification technologies that rely on a vehicle's license plate and image, among other methods.

The concept of a "smart city" embodies a community that prioritizes energy efficiency, safety, utility, and overall livability. Achieving the vision of smart cities necessitates the enhancement of urban infrastructure, with a critical focus onelements like street lamps that play a pivotal role in both energy effectiveness and security. Streetlights, integral to municipal infrastructure, contribute significantly tothe safety and functionality of a city. Imagining a city without these fixtures raises concerns about increased risks of theft, robbery, and road accidents.

In the contemporary landscape, the management of street lamps requires improvement, especially considering their substantial daily energy consumption. The rapid evolution of data monitoring and gathering technologies in recent years has provided new avenues for addressing these challenges. The Internet of Things (IoT) has risen as a transformative force, simplifying the connectivity of gadgets and enabling efficient data transmission through wireless technologies.

Moreover, the convergence of IoT and Artificial Intelligence (AI) stands at the forefront of constructing environmentally friendly and energy-efficient smart cities. The complexity of these systems necessitates collaboration among various agents, including decision-making systems, sensors, and actuators. One promising approachto enhance the performance of these interconnected systems involves the implementation of a trust-based multi-agent learning strategy. This strategy empowers agents to assess their past performance, learn from errors, and continually improve decision-making processes, contributing to the advancement of smart and sustainable urban environments. Shobana Setal. (2023)[16] serve as the classic base for this system. Because every type of hardware, sensor, software, and cloud has been merged to create an efficient smart system, this proposed system has transformed the entire system into an IOT-based system. Smart cities have recentlybeen a major research topic. Including a smart traffic light system in our research will be a tiny step toward creating a smart city.

A. EMERGENCY VEHICLE SENSOR

The first concept is to equip each emergency vehicle with a specific transmitter to grant precedence through intersections when an ambulance is detected. Each intersection's traffic light controller should have a receiver, which receives the signal from the transmitter and then controls the movement of traffic. This techniquerequires manually activating cars and is rather expensive. The second optioninvolves utilizing detectors to catch the traffic light controllers' flashing lights. Emergency vehicles typically come with flashing lights that activate in an emergency. This strategy has certain cost and utility advantages. If the special lightis identified using a traffic signal manipulator, the expense becomes a drawback. As the use of flashing lights is not restricted to nonemergency vehicles, there may be instances of false detection. Hence, flashlights may be used to start those privatevehicles. The flashing lights could also be employed in advertisements or storefrontdisplays, which could lead to erroneous triggers. Preferable strategy. Given that emergency vehicles Using emergency vehicle's siren sound is are equipped with these sirens, a cost advantage is expected. These sirens are only activated in emergencies and are not built into nonemergency vehicles.

B. SMART TRAFFIC LIGHTS

In the system proposal, Mohd. Saifuzzaman et al. (2017) [17] suggested installing barriers. Depending on the necessity and efficacy, the barrier could be made of spikes or a traffic bollard. We build our model using this as one of the initial concepts. If not handled appropriately, the deployment of spikes or traffic bollards may be a bit too severe and result in deadly damage. Moreover, initialization is expensive since spikes are slightly more expensive. Here is where our second original concept, utilizing Puja Bhowmik et al. (2022) [18], comes in. We deploy the automated railroad level crossing concept by public roads. Barriers are being installed in the intersections with traffic signals to enforce discipline and order among the populace.

Figure 3 Barrier implementation using spikes

To deal with heavy traffic we need an adaptive traffic light system that works basedon the density of the roads. Naoki Kodama et al.(2021) [19] proposed the usage of Deep Reinforcement Learning to achieve this but since the work was not implemented but only stimulated this can cause various dangers while implementing. Hanaa Abohashima et al.(2020)[20] a framework of applying Vehicle-to-Everything (V2X) in the context of traffic lights management andcontrol in an Internet of Things, but the possibility of installing sensors in all vehicles is heavily impossible. This case is even applicable to Heru Nurwarsito et al. (2021)[21] who proposed the GPS device will send location data to the cloud using the MQTT protocol. Then the data will be processed and forwarded by the cloud to the traffic light device also using the MQTT protocol. Even though MQTTis one of the best methods due to the intervention of GPS in this system becomes risky. As GPS can fail at any given time. Therefore here we use a real-time systemthat can work with only a camera and provide much better results.

C. THE SMART STREET LIGHT SYSTEM

Al-khaykan et.al (2022) [25]studied that standard street lighting sources of sodium lights (400 watts), LED lighting (200 watts), and Solar Street Lights were thoroughly compared in this study. By employing the Dialux program for street lighting, all three types may provide excellent lighting and cover the entire area needed, but at varying wattages and with a different vision. Solar streetlights even provide greater vision. Utilizing solar streetlights will eliminate significant loads from the national grid and address the daily energy crisis. It compares every type based on installation, energy use and operating expenses, safety and warranty, maintenance and monitoring, life expectancy, and the price for the same level of lighting vision. It demonstrates that solar streetlights are the finest. So, in addition to having a long operating life, it will use less electrical energy, making it superior to other conventional lighting types that draw power from the grid.

In the H. Sun et al. (2022)[26] study, a smart street light management system is developed using the Internet of Things and wireless sensor network technologies, and urban street lights are integrated into the new system. Using a controller locatedon the pole and equipped with a variety of sensors, the system continuously collectsdata on the area around the street lamp. It then utilizes the LoRa network to obtain data from the street lamp unit and transfers that data using NB-IoT technology to aplatform via cloud monitoring. The city's street lamp data is effectively acquired and saved when WEBGIS technology is integrated, and it is also prominently exhibited in the digital map for other status-related information. The system examines, finds, and alerts for anomalous data to realize the information connectionthat exists between the street light and the cloud-based system, the precise control of the street light, smart monitoring, and administration.Urban street lighting management is hampered by a variety of problems, accordingto Y. Wang et al (2022)[27], including the difficulty to identify damage to the streetsin an accurate way and single-mode street lighting control. A smart lighting systemof urban street lighting built around the Cloud platform of the Internet of Things may effectively handle the challenges experienced in traditional management activities. Voice control, light control, infrared remote control, and remote-control street lamp switch operations are all possible with the system. The administrator canremotely control and observe the operation of street lights in the server to prevent potential safety issues caused by short circuits and current leakage. The installationof secure and efficient lighting over city street lamps provides a high degree of assurance for residents' nighttime movement.

J. Wang et.al(2022)[28] planned public power infrastructure, including power towers and street lighting, that are scattered across metropolitan road networks at alllevels, can be used to power the 5G wireless communication BSs. By employing the framework of the public distribution system for electricity as tower resources, a major percentage of the accessibility constraint for 5G wireless transmission may be overcome, which can also considerably increase the economic benefits. Utilizingdata from the State Grid's electricity supply companies in the Zhejiang Province, this paper offers a unique 5G wireless transmission coverage-enhancing aid that merges power poles and street lamp poles. Through a study into the ownership and liberalization capability of power masts as well as of the street lamp poles, the operation circumstances, goods, and service methods have been studied, and appropriate findings have been given.

X. Zeng et. al(2022)[29] inferred that intelligent street lights are embracing previously unheard-of development prospects as a key component of smart cities. In general, the traditional street light system of management makes use of computer-side web monitoring, human inspection, and consolidated line control. To overcomethe inadequacies of conventional street lamp administration, as well as the lack of monitoring in real-time and remote control, this thesis builds a set of sophisticated street light monitoring devices that utilize NB-IoT (Narrow Band-Internet of Things). The technology makes real-time controls for things like spray cooling, dust suppression, environmental monitoring, and street lighting systems possible. Every street lamp's geographic location and operational state are calibrated using cloud technology.

K. -K. Lai et al (2022)[30] addressed the topic of energy regeneration and sustainability. The need for energy-efficient technologies is on the rise as a consequence of worries regarding worldwide warming, climate change, IT contamination, carbon legislation, and the energy crisis. Cities consume a lot of electricity, with outside urban lighting contributing to around 20% of the budget allocated for electricity. About 35% of the electricity utilized by streetlamps annually is lost due to the constant power supply needed for outdoor lighting. As aresult, one strategy that promotes energy conservation and sustainable growth is theuse of a smart lighting pole to prevent excessive electricity waste. In commercial settings, metal halide or high-pressure sodium lamps have primarily been replaced by LED alternatives. Because there is still considerable opportunity for advancement in LED smart lighting, this study uses the main route analysis to investigate the advancement trajectory of scholarly research articles on LED smartstreet lighting.

S. Kanaseet.al(2022)[31] brought together An LED luminaire, an LED driver, a PV panel, a charge controller, a light sensor, a motion sensor, and an Arduino to makeup the built system. The quantity of traffic along the route and the specific momentof day or night are what regulate the smart streetlight. The system is set up to shut off automatically during the day and only function at night, during times of torrential downpours, or in other inclement weather. To reduce electrical waste and increase energy conservation, this work will promote the idea of a smart solar roadway lighting system that works in tandem with wind turbines. There is no requirement for electrical power coming from the electrical network because it employs solar thermal energy together with wind energy.

Y. Tan et.al (2022)[32] developed an energy-saving application that used DIALux to emulate various street lighting systems. The MS835 and JKR guidelines, as wellas the ideal campus plan for Universiti Malaysia Perlis, were all taken into consideration in this design. The design first generates street lights via the DIALuxas evo program to ascertain the luminous impacts, demand for electricity, cost, andsavings in energy usage of each forthcoming lighting system. To find an energy- saving replacement for the prevailing High-pressure Sodium (HPS) street lamp system, various lighting technologies were compared. The ideal lighting system is made up of Light Emitting Diodes, LEDs, and PIR.

CHAPTER 3

THEORETICAL BACKGROUND

CHAPTER-3

THEORETICAL BACKGROUND

3.1 EXISTING SYSTEM

The barricade system has already been implemented in various places. A few of them include, the barricades used to prevent pedestrians and vehicles to pass the railway tracks by closing the path to cross the track when a train passes by.The railway barricades are manually operated in some places whereas most foreigncountries use sensors to lift them automatically. The usage of barricade can also be witnessed in tollgates to stop the vehicle until the pass is given. But the tollgate system involves manual movement of the barrier.Automate Systems Ltd provides a range of automatic traffic barriers for vehicles. Themost popular being a RIB barrier. These barriers are highly effective and can be easily seen and as well as are easy to use.

The barriers can be based on multiple factors- the type of vehicles, the type of environment etc.

Philips CityTouch is the example model taken for this project, it has a remote monitoring and control and a dynamic brightness control for energy efficiency.

DISADVANTAGES

- There is no automation of barrier lifting in the previous existing models.
- Manual operation is required for the barrier operation.
- High upfront costs.
- Potential cybersecurity vulnerabilities.

3.2 IMPLEMENTATION ENVIRONMENT

A. HARDWARE:

a) Raspberry Pi:

- The main computing platform for running the code.
- GPIO (General Purpose Input/Output) pins on the Raspberry Pi are used tointerface with traffic lights, LEDs, and other components.

b) Sound Sensor:

- A sound sensor connected to one of the GPIO pins (e.g., pin 14) is used for ambulance detection**.**

c) Traffic Lights, LEDs, and Barriers:

- GPIO pins on the Raspberry Pi are used to control the state of traffic lights, LEDs,and barriers**.**

d) IR sensor :

- A IR sensor connected to the Raspberry Pi is identification of traffic densitythrough object detection.

e) NodeMCU Board:

- NodeMCU is an open-source IoT platform based on the ESP8266 WiFi module
- It has GPIO pins for sensor and relay connections.

f) Voltage Sensor:

- A voltage sensor to measure street lighting system voltage levels.

g) LDR Sensor:

- A Light Dependent Resistor (LDR) sensor to detect ambient light levels.

h) MQ-2 Gas Sensor:

- An MQ-2 gas sensor to measure various gases (smoke, CO, LPG).

i) DHT11 Temperature and Humidity Sensor:

- A DHT11 sensor to measure temperature and humidity.

j) Relays:

- Relays for controlling the ON/OFF status of the street lights.

B. HARDWARE COMPONENTS:

a) RASPBERRY PI 4

The Raspberry Pi serves as a low-cost, debit card-sized processor that can be attached to a workstation or TV and makes use of a regular keyboard and mouse.

Similar to a PC, it features a specialized processor, memory, and graphics driver. Additionally, a customized version of Linux called Raspberry Pi OS serves as its operating system.

Similar to a desktop computer, a Raspberry Pi may be used for word processing, spreadsheets, gaming, and internet browsing, including streaming HD video.

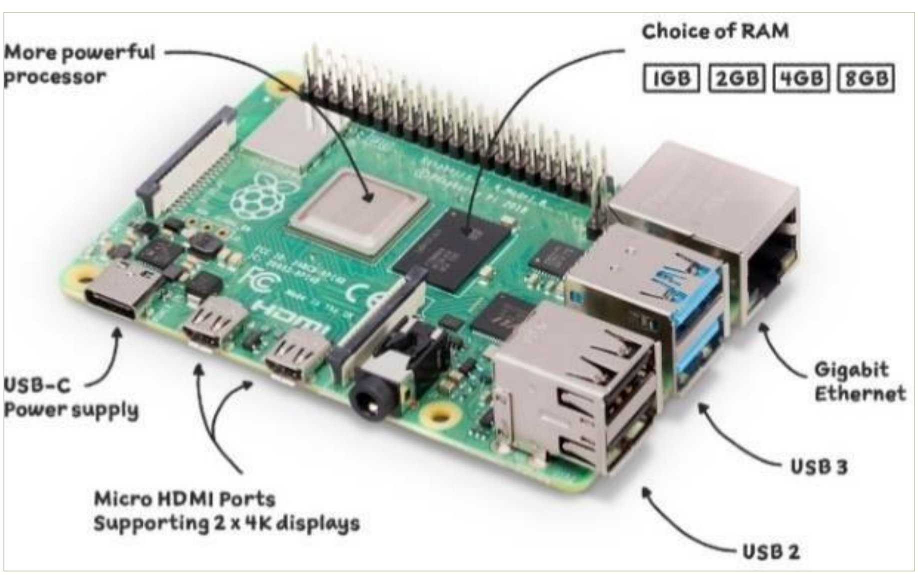


Figure 3.1.1: The Raspberry Pi 4 board

Weather stations, music machines, parent detectors, aviary structures with infrared cameras, and other digital maker projects have all made use of Raspberry Pi's abilityto connect with the rest of the world.

People from all over the world employ Raspberry Pi to acquire knowledge of computer science and programming.

b) MICRO SERVO MOTOR

A specific type of motor that is powered by an external source of direct currentis called a servo motor. A micro servo motor (SG90) is a small, lightweight, high-output servo motor. There are three components to it:

- Controlled device
- Output sensor
- Feedback system

Figure 3.1.2: (i) Micro Servo Motor (ii) Parts of a Servo motor

c) BREADBOARD

A Breadboard is a site for building electronic circuit prototypes that are semi-permanent. Breadboards are reusable since they don't require soldering or track destruction like a perfboard or strip board do.

Figure 3.1.3: Breadboard

The breadboard consists of a plastic block that has been perforated, and underneath the holes are several tin-plated phosphor bronze or nickel silver alloy spring clips. DIPs which include two integrated circuits (ICs), can be used to insert components that span the block's centerline. To complete the circuit, the remaining gaps can be filled with connecting wires and the leads of discrete components (such capacitors, resistors, and inductors).

d) SOUND SENSOR

In a number of applications, such as security and monitoring systems, mobile and landline phones, home automation, etc., a module known as the sound sensor records and captures sound signals, such as voice, claps, snaps, knocks, etc.It has a mic, high gain amplifier, and outlet effector. The microphone serves as an input sensor, detecting the sound signal, which is subsequently transformed into an electrical signal. After the signal has been triggered by the power amplifier, the peak detector evaluates its amplitude. This stronger electrical signal is transformed into audible sound by the output actuator, which functions similarly to a loudspeaker.

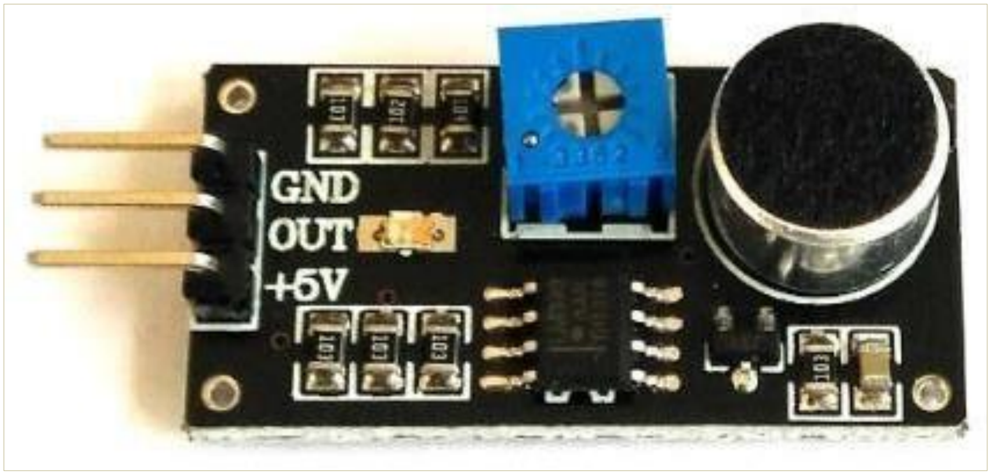
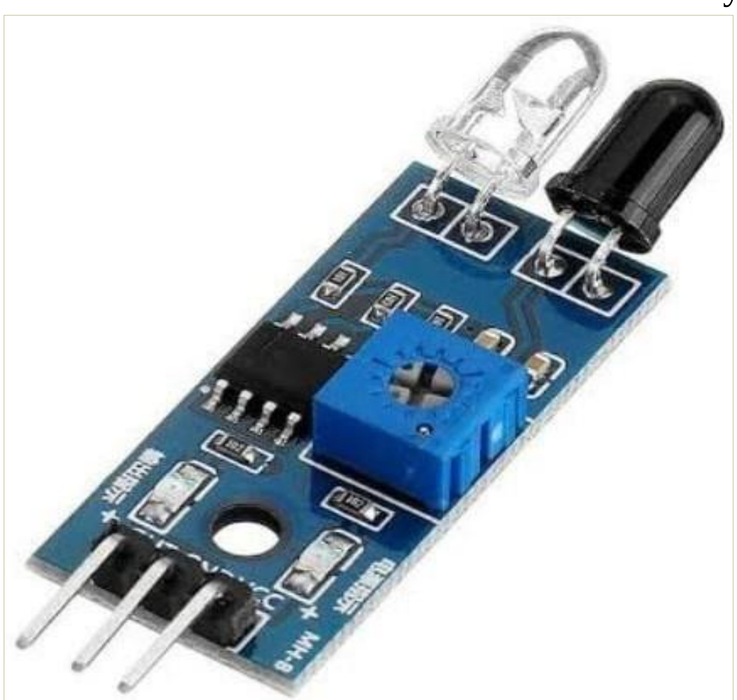


Figure 3.1.4: Sound Sensor

e) IR SENSOR

An infrared sensor is an electrical device that emits light to detect objects in its environment. In addition to detecting motion, an infrared sensor may measure an object's heat. Typically, all items emit some kind of thermal radiation in the infrared range. Although these radiations are undetectable to the human eye, they can be



recognized by an infrared sensor**.**

Figure 3.1.5: IR sensor

f) NODE MCU ESP 8266

An affordable System-on-a-Chip (SoC) known as the ESP8266 serves as the foundation behind NodeMCU (Node MicroController Unit), an open-source development for hardware and software environments. The CPU, RAM, connectivity (WiFi), and even a contemporary software operating system and SDKare all present in the Espressif Systems-designed and -manufactured ESP8266. Regarding Internet of Things (IoT) applications of all kinds, this makes it a great option.An affordable System-on-a-Chip (SoC) known as the ESP8266 serves as thefoundation for the NodeMCU (Node Microcontroller Unit), a freely accessible hardware and software creation environment. The CPU, RAM, connectivity (WiFi),and even a contemporary software operating system and SDK are all present in the Espressif Systems-designed and -manufactured ESP8266. For Internet of Things (IoT) projects, this makes it a great option.

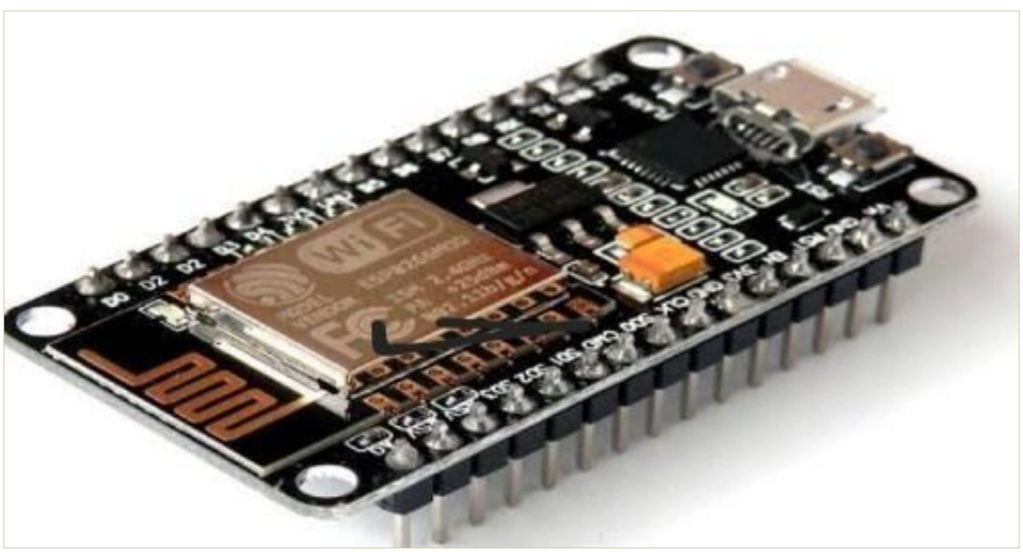


Figure 3.1.6: Node MCU ESP 8266

g) Mq 135 GAS SENSOR

Sulphur (S), CO_2, ammonia (NH_3), benzoene (C_6H_6), and other hazardous gases, as well as smoke, can all be detected by the MQ-135 Gas sensor. This gas sensor hasan analog and digital output pin, just like the other MQ series gas sensors. The digitalpin becomes high in response to an increase in these gases above a certain thresholdin the air. With the on-board potentiometer, you may adjust this threshold value. Onecan approximate the amount of these gases in the environment by using the analog voltage that is output by the analog output pin. Utilizing around 150mA, the MQ135air quality sensor module runs at 5V. It has to warm up a little before it can producereliable findings.

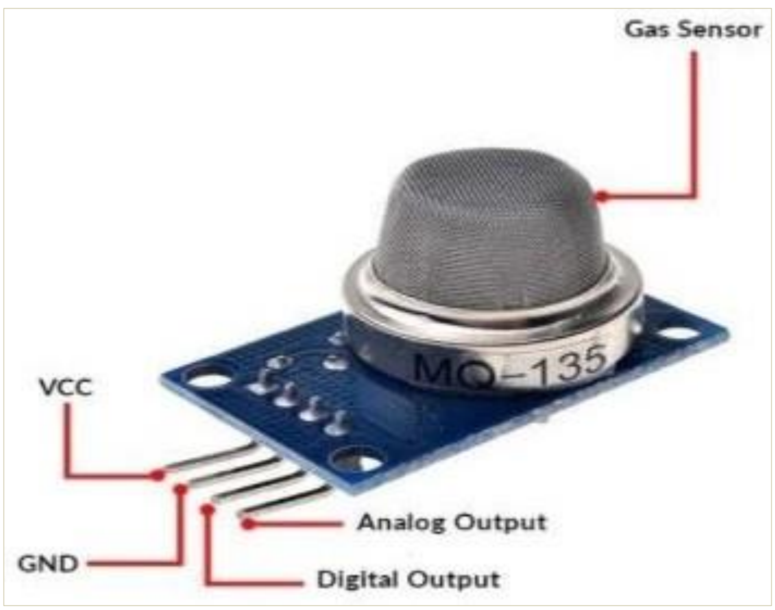


Figure 3.1.7: Mq135 Gas sensor

h) DHT 11

The DHT11 is a popular temperature as well as humidity sensor that has an 8-bit microprocessor to output the temperature and humidity measurements as serial data and a specialised NTC to detect temperature. A popular temperature as well as humidity sensor is the DHT11. The temperature and humidity readings from the sensor are output as serial data by an 8-bit microcontroller and a dedicated NTC. Additionally, the sensor comes pre-calibrated, making it simple for integration with other, microcontrollers.

Having a resolution of ±1°C and ±1%, the sensor is capable of measuring temperatures between 0°C to 50°C along with humidity from 20% to 90%. Thus, this sensor can be the best option for you if interested in measuring in this range.

Figure 3.1.8: DHT 11

C. SOFTWARE AND LIBRARIES:

a) OpenCV (cv2):

- Used for computer vision tasks, including image processing and YOLO object detection for measuring traffic density.

b) gpiozero:

- A Python library for controlling GPIO devices, such as traffic lights, LEDs, andbarriers.

c) RPi.GPIO:

- A Python library for Raspberry Pi GPIO control.

d) scipy:

- Used for the Fast Fourier Transform (FFT) in sound processing.

e) pyaudio:

- Utilized for audio input and sampling for sound sensor processing.

f) Arduino IDE:

- The NodeMCU is typically programmed using the Arduino IDE.
- Install the necessary ESP8266 board support in the Arduino IDE.

g) Arduino Libraries:

- Libraries for interfacing with sensors:
- Voltage Sensor Library (if required).
- Adafruit DHT Library for DHT11 sensor.
- Libraries for specific gas sensors (MQ-2).

h) NodeMCU Firmware:

- Ensure that the NodeMCU firmware is up-to-date.

i) Programming Language:

- The code can be written in C/C++ /Python.

D. DEPENDENCIES:

j) Wiring and Connections:

- Connect each sensor and relay to the appropriate GPIO pins on the NodeMCU,Raspberry pi
- Ensure proper power supply to the NodeMCU, Raspberry pi and sensors.
- Connect the sensors to the analog or digital pins based on their specifications.

k) Testing:

- Monitor the serial output for debugging and sensor readings.
- Test the system in various conditions.

l) Deployment:

- Once testing is successful, deploy the system in the target environment.
- Ensure proper mounting of sensors for accurate readings.
- Monitor and maintain the system as needed.

3.3 SYSTEM ARCHITECTURE

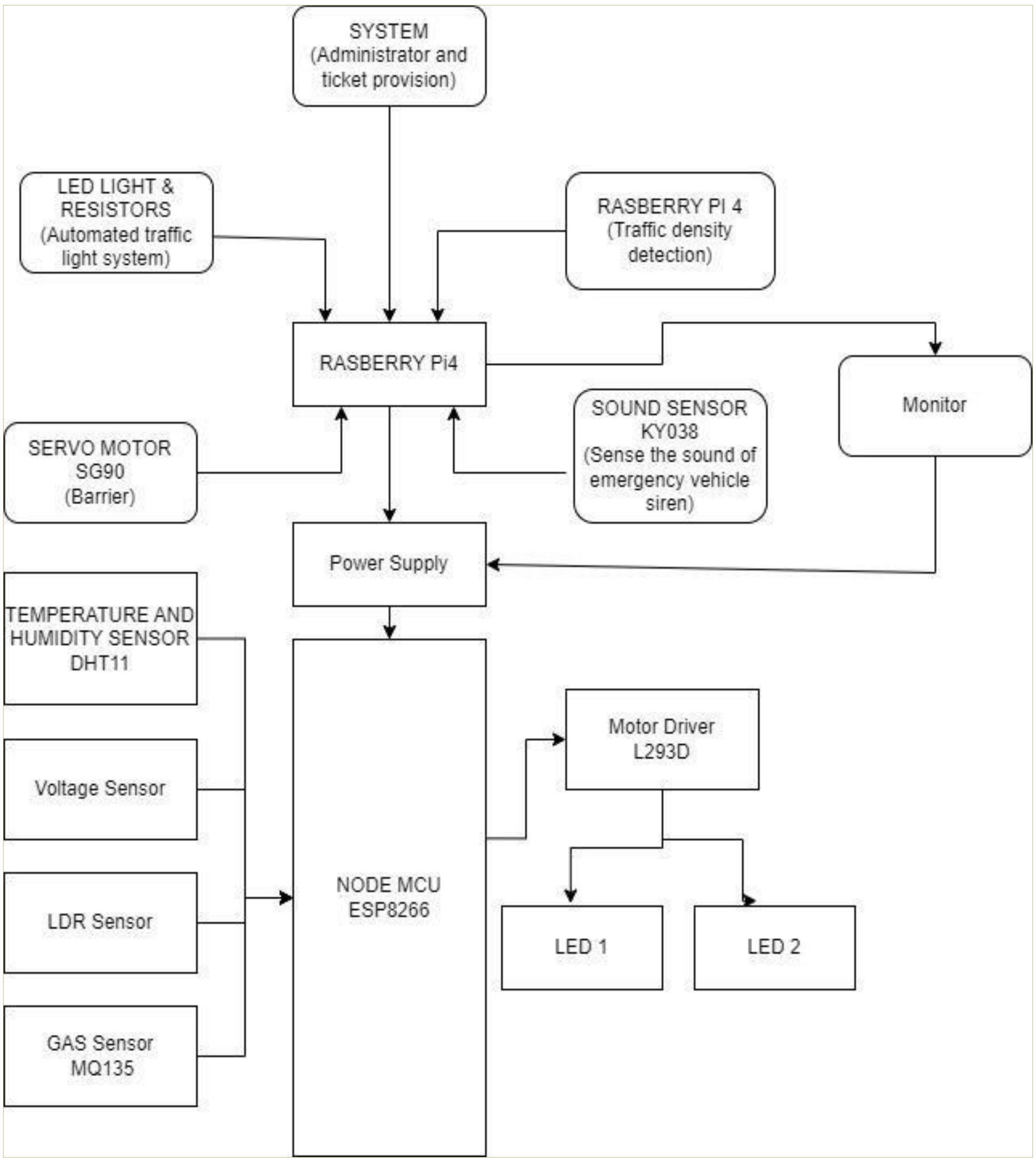


FIG 3.3 ARCHITECTURE DIAGRAM

3.4 PROPOSED METHODOLOGY

It is evident from the problem definition that the technology currently in use cannot manage issues like traffic control, emergency vehicle clearance, protection of pedestrians from vehicles that violate traffic signals, etc. We suggest using our Intelligent Traffic Control System to address these issues. Thebasic working of the system is as follows: The automated barricade summons the barrier when the traffic signal is red and expels it when it is green which allows a safe environment for the pedestrians to pass through and also helps us to control vehicles from jamming the roads without following the traffic light rules. The suggested system also has amenities to help emergency vehicles like ambulances to cross traffic quickly. The sensor identifies any ambulance that iswithin 100 meters from the traffic signal and if any exists, the sensor `does not summon the barrier until the ambulance crosses the traffic signal. The proposed system also consists of the traffic density detection function which helps in identifying the lanes with heavy traffic and helps alternate the traffic signal thus regulating traffic flow. The lighting system communicates information about street lamp problems to the control center, with an emphasis on energy saving and autonomous operation at low, affordable prices for the streets. Furthermore,errors done by hand can be reduced to a minimum or perhaps completely avoided. The street lighting system determines whether or not it should switch on or off the lights based on the weather. An LDR sensor determines how brightor dark the sky is. In bright weather, the electrical system will be off, and in darkweather, it will be on. The lamp's illumination is also checked using the light level and an LDR sensor.

The main components of the suggested system are as follows:

1) An intelligent, light-adjusting street lamp that detects inappropriate behavior and sounds an alarm.

2) A dependable network that allows for real-time communication. While many street lights are linked to servers using NB-IoT, managers are attached to servers via Wi-Fi as well as 5G internet technologies.

3) An adaptable management framework that can improve the distribution of resources for a straightforward, highly automated administration system.

4) An automated traffic barrier that drops when the traffic signal is red and rises when the signal is green.

5) The sound sensor that picks up the sound of emergency vehicles and creates a green lane using traffic signals for their passage.

6) And also identify the lane that has the heaviest traffic and alternate traffic signals accordingly to promote the flow of the traffic.

The system involves the following methodologies in order to achieve this,

A. WEBSTER'S METHOD FOR TRAFFIC SIGNAL TIMING:

- The Webster method class implements a traffic signal timing methodology inspired by Webster's method. It adjusts green and red signal durations based on traffic density.
- The cycle length is initially set to 30 seconds, and adjustments are made

depending on the traffic density.

B. TRAFFIC SIGNAL CONTROL:

- The Traffic Signal Control class manages the traffic lights at different directions (north, south, east, west).
- It uses the YOLO (You Only Look Once) object detection model to measure traffic density by detecting vehicles in a video frame.
- The update traffic signal method updates traffic light durations based on traffic density using Webster's method.
- Traffic lights are then controlled to signal green and red durations accordingly.

C. TRAFFIC SIGNAL AND BARRIER SYSTEM:

- The Traffic Signal and Barrier System class integrates traffic signal control, barrier control, overspeed detection, and ambulance detection.
- It initializes traffic lights, barriers, overspeed detection components, and an ambulance detection system.
- The calculate green duration method calculates the green time based on traffic density using a specified formula.
- The update traffic signal method controls traffic lights and barriers based on the calculated green time and predefined red time.
- Over speed detection involves capturing video frames, detecting moving objects, and checking if the detected speed exceeds a predefined threshold.
- Ambulance detection monitors sound sensor input and responds by turning traffic lights green.

D. AUDIO PROCESSING AND EMERGENCY SOUND DETECTION

- The sound sensor processing method collects audio samples, applies windowing, and performs FFT (Fast Fourier Transform) to detect peak frequencies. An emergency sound is detected if the peak frequency corresponds to predefined criteria.

E. DYNAMIC LIGHT ADJUSTMENT

- Based on the readings from the LDR sensor, dynamically adjust the brightness of the street lights. Save energy by dimming lights when sufficient natural light isavailable. Monitors the voltage levels in the street lighting system.

F. GAS MONITORING:

- Use data from the MQ-2 Gas Sensor to detect the presence of harmful gases and take appropriate actions (e.g., alerting authorities).

G. TEMPERATURE AND HUMIDITY MONITORING

- Monitor temperature and humidity levels for environmental awareness. Serially transmits temperature and humidity measurements. Measures temperature in the range of 0 to 50°C and relative humidity from 20% to 90% RH

H. RELAY CONTROL

- Utilize relays to control the ON/OFF status of the street lights.
- Programmatically adjust lighting based on external factors.

I. ENERGY EFFICIENCY

- Optimize street lighting based on surroundings and time of day to save energy.
- Lower light pollution by adjusting brightness levels

3.5 MODULE DESIGN

3.5.1 USECASE DIAGRAM

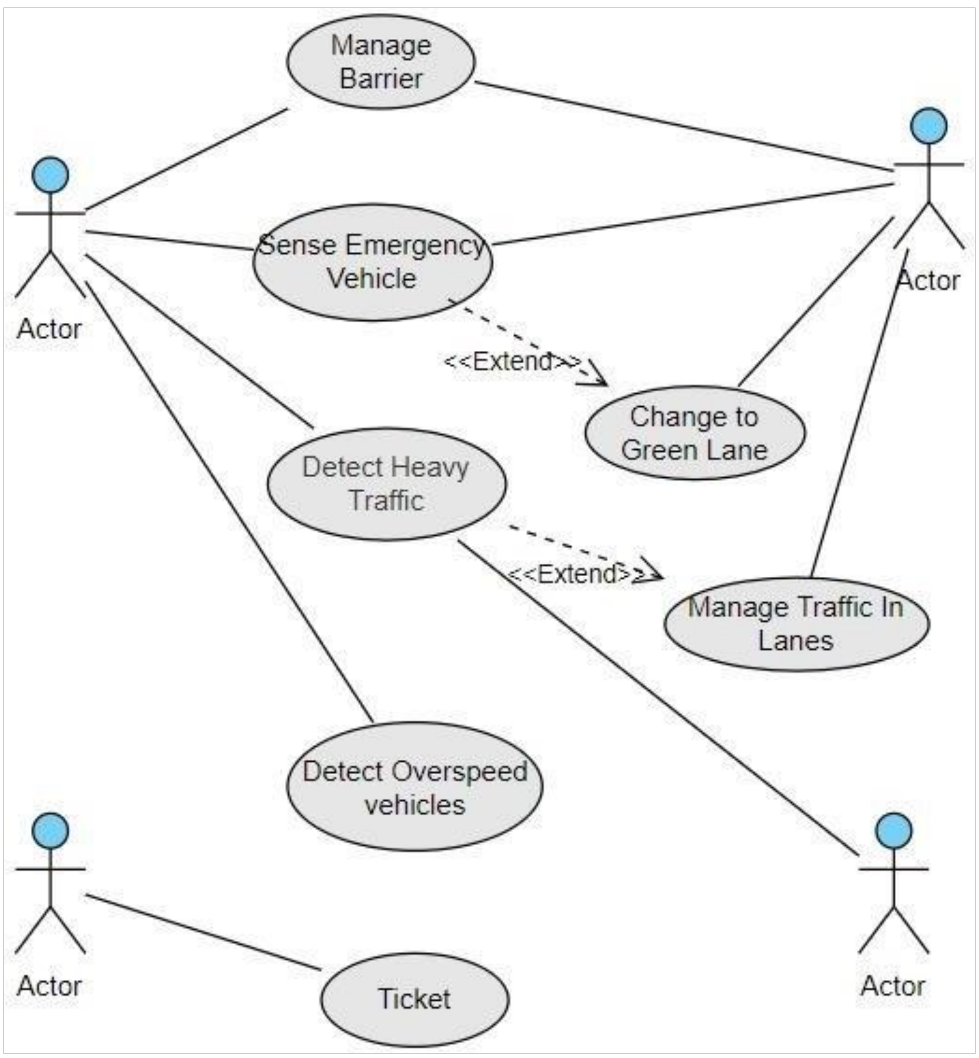


FIG 3.5.1 USE CASE DIAGRAM

The Use Case Diagram depicts interactions in the Traffic Light System, involving actors such as the Traffic Control System and Vehicle Detection System. It illustrates essential processes like initiating traffic signal management, analyzing traffic density, and handling emergency vehicle priority.

3.5.2 ACTIVITY DIAGRAM

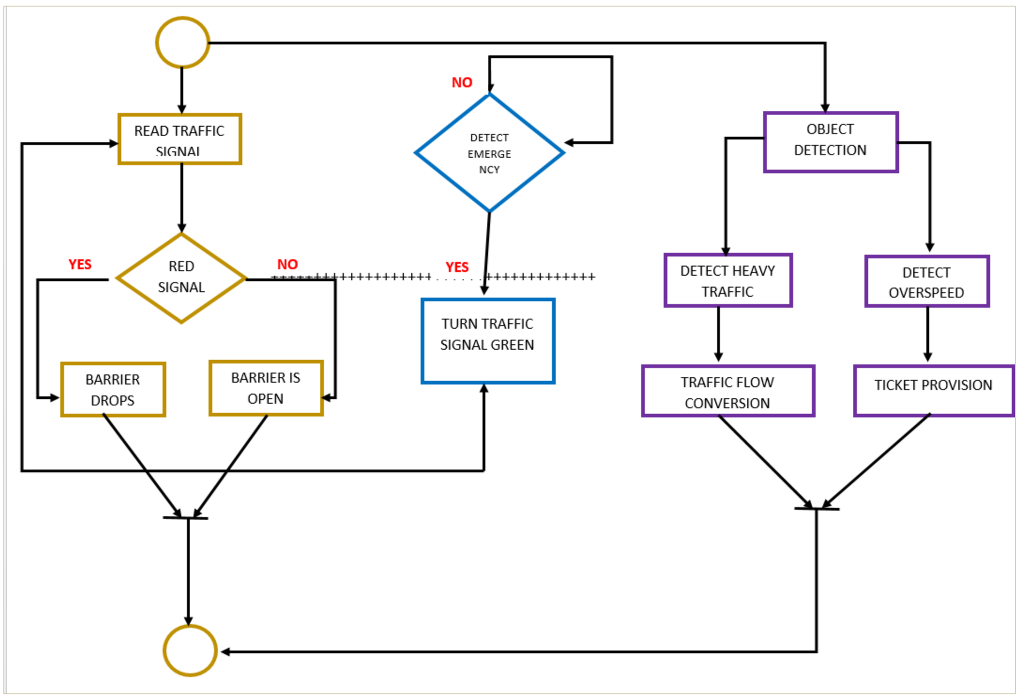


FIG 3.5.2 ACTIVITY DIAGRAM

The activity diagram for the Traffic Light System depicts a sequential flow of activities to manage traffic signals efficiently. It commences with the initiation of the system's activity, followed by vehicle detection and analysis of traffic density. The Webster Method is then applied to calculate optimal signal durations based on the assessed traffic conditions. The system proceeds to update the traffic signal accordingly, activating the green light and initiating a timer for its predetermined duration. Subsequently, the red light is activated, accompanied by a timer for its specified duration. The process then loops back to vehicle detection and analysis, ensuring continuous monitoring of traffic conditions. The activity concludes when the system reaches the endpoint, marking the completion of the Traffic Light System's cycle. This diagram provides a clear visual representation of the systematic sequence involved in managing traffic signals based on real-time traffic density assessments.

3.5.3 DFD DIAGRAM

0 LEVEL DFD

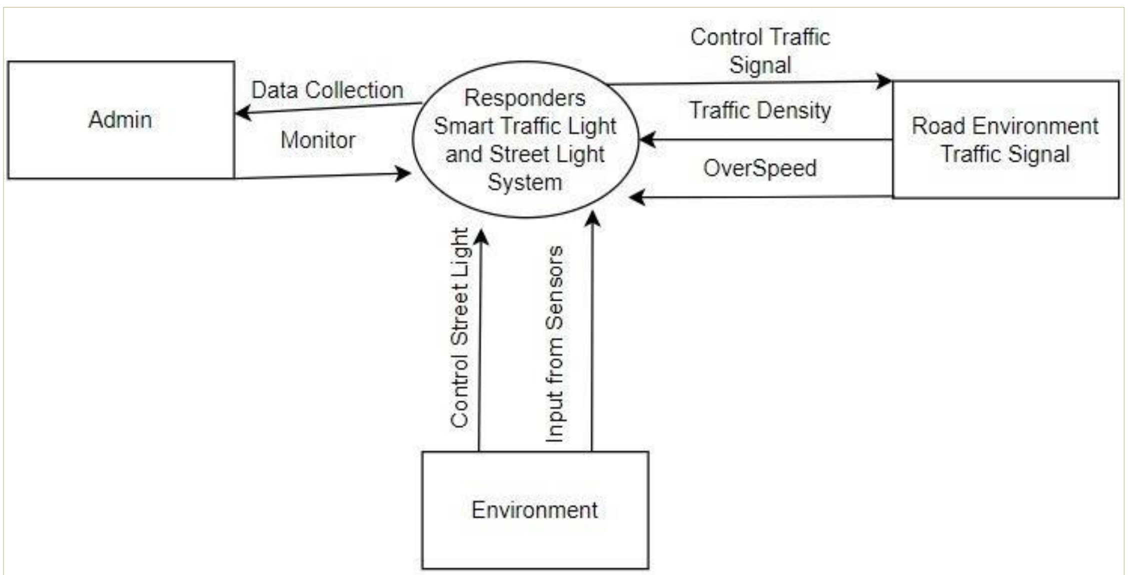


FIG 3.5.3 DFD DIAGRAM

DFD provides an overview of the interactions and data flows between both the traffic signal system and the street light system. It showcases how vehicle detection and traffic density analysis influence the traffic signal cycle duration, and how sensor inputs impact the control and output of the street light system

1ST LEVEL DFD

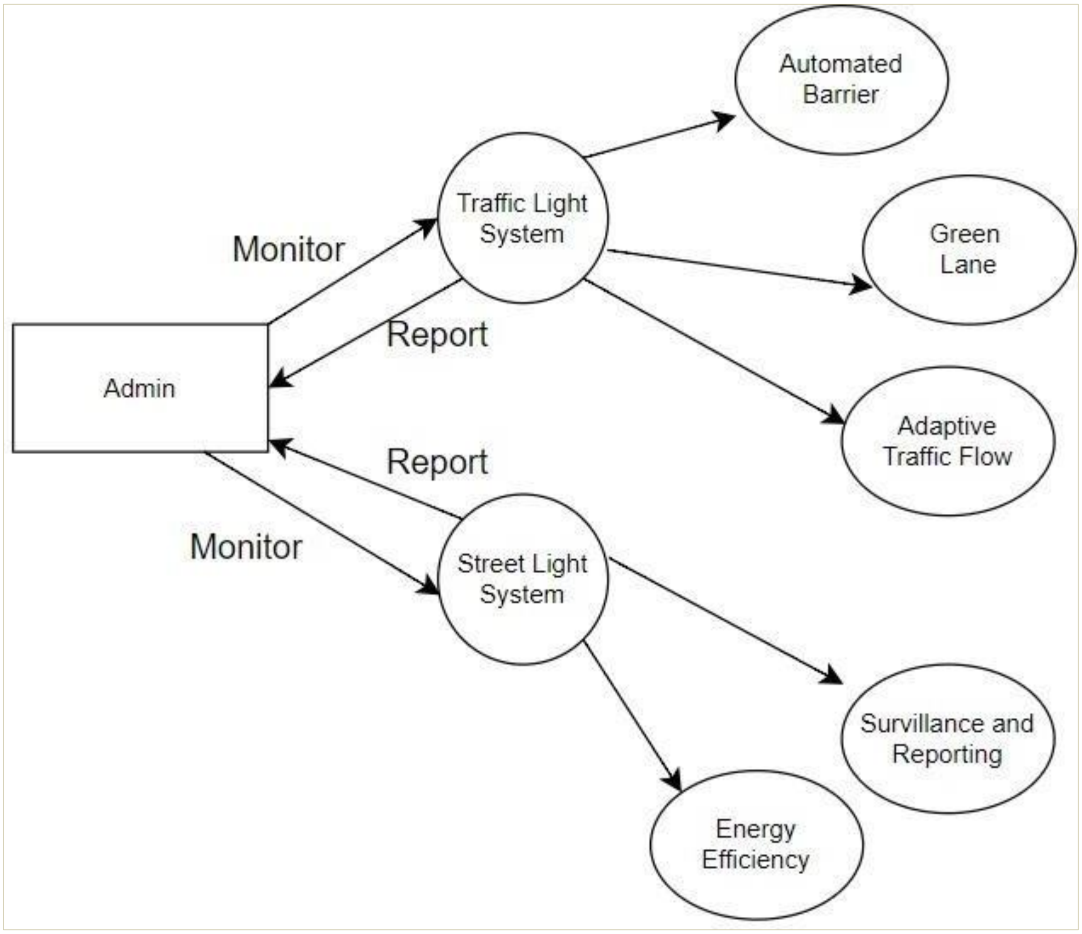


FIG 3.5.4 DFD DIAGRAM

DFD provides an overview of the interactions and data flows between both the traffic signal system and the street light system. It showcases how vehicle detection and traffic density analysis influence the traffic signal cycle duration, and how sensor inputs impact the control and output of the street light system.

CHAPTER 4

SYSTEM IMPLEMENTATION

CHAPTER - 4

SYSTEM IMPLEMENTATION

4.1 MODULE DESCRIPTION

a) Importing Libraries:

- `import RPi.GPIO as GPIO`: This imports the RPi.GPIO library, which allowsyou to control the GPIO pins on the Raspberry Pi.
- `from time import sleep`: Imports the sleep function from the time module, which is used for adding delays in the code.

a) Defining Pin Numbers:

- You've defined pin numbers for various components of the traffic light system, such as LEDs for traffic lights, servo motors, and sensors.

b) Setting up GPIO Pins:

- `GPIO.setmode(GPIO.BCM)`: Sets the numbering scheme for the GPIO pins (BCM numbering).
- `GPIO.setwarnings(False)`: Disables warnings about GPIO pin usage.
- `GPIO.setup()`: Configures GPIO pins for input or output.
- `GPIO.PWM()`: Sets up PWM (Pulse Width Modulation) for controlling servo motors.

c) Initializing Servo Motors:

- `ServoValueX = GPIO.PWM(SERVOX_PIN, 50)`: Creates PWM objects for servo motors.
- `ServoValueX.start(0)`: Starts PWM with an initial duty cycle of 0%.

d) Initializing Traffic Light LEDs:

- Loops through the `Traffic_light` list and configures each pin as an output.

e) Defining Functions:

- `Set1()`: A function to control the yellow light of the first lane.

f) Main Loop:

- The main loop continuously checks the status of the IR sensor.
- If the IR sensor detects something, it simulates traffic light operations for four lanes sequentially.
- If there's no detection by the IR sensor, it simulates high traffic in lane 1.

g) Handling Sound Sensor Input (Secondary Loop):

- There's another infinite loop that continuously checks the status of the sound sensor.
- If the sound sensor detects something, it simulates traffic light operations for four lanes sequentially.
- If there's no detection by the sound sensor, it simulates an emergency vehicle detected in lane 1.
- This script essentially simulates a traffic light system and responds differently based on inputs from IR and sound sensors.

5.1 YOLO(YOU ONLY LOOK ONCE)

a) YOLO Overview

- YOLO is an object detection algorithm that is designed to detect and classify objects in images or video frames. It divides the input image into a grid and predicts bounding boxes and class probabilities for each grid cell in a single forward pass.

b) Model Loading

- The code loads a pre-trained YOLO model. The model consists of weights and configuration files (`yolo_model_path` and `yolo_config_path`). These files contain information about the neural network architecture and learned parameters.

c) Input Processing

- Before feeding the image to YOLO, it is preprocessed into a format suitable for the model. This involves converting the image to a blob, a structured format that can be used as input to the neural network.

d) Forward Pass

- YOLO performs a forward pass on the input image through the neural network.
- The network outputs a set of bounding boxes along with class probabilities andconfidence scores for each object present in the image.

e) Post-Processing YOLO Outputs

- The output of YOLO is processed to extract information about detected objects. For each bounding box, the code extracts confidence scores and class probabilities.A threshold (0.5 in this case) is applied to determine if the object is confidently detected as a certain class (e.g., a vehicle).

f) Traffic Density Calculation

- Based on the number of detected vehicles and the total area of the image, the code calculates the traffic density. The formula used is `(number of vehicles / totalimage area) * 100`.

g) Traffic Signal Control

- The calculated traffic density is then utilized in the traffic signal control logic. Webster's method is employed to dynamically adjust the signal timings based onthe traffic density. This helps optimize traffic flow by allocating more green timeto directions with higher traffic density.

h) Integration into the Traffic System

- The YOLO-based traffic density estimation is a crucial component of the largertraffic signal and barrier system. It provides real-time information about traffic conditions, allowing the system to adapt and optimize traffic signal timings for efficient traffic management.

5.2 FTT(FAST FOURIER TRANSFORM)

- The Fast Fourier Transform (FFT) algorithm is utilized for processing audio datafrom a sound sensor. The primary goal is to analyze the frequency content of thecollected audio samples to identify specific patterns, particularly an emergency sound indicative of an ambulance.

a) Audio Sampling

- Audio samples are collected using a sound sensor. The PyAudio library is used tocapture audio data.

b) Windowing

- The collected audio samples are multiplied by a Hamming window before applying FFT. Windowing helps reduce spectral leakage, a phenomenon where energy from one frequency leaks into adjacent frequencies.

c) FFT Processing

- The Fast Fourier Transform (FFT) is applied to the windowed audio data. FFT is an algorithm that efficiently computes the Discrete Fourier Transform (DFT), revealing the frequency components present in the signal.

d) Magnitude Spectrum

- The magnitude of the FFT result is calculated. This represents the amplitude orstrength of different frequency components in the audio signal.

e) Peak Frequency Detection

- The frequency with the highest magnitude in the spectrum is identified. This is determined by finding the index of the maximum magnitude in the FFT result andconverting it to a frequency value.

f) Emergency Sound Detection

- The code checks whether the identified peak frequency corresponds to an emergency sound indicative of an ambulance.

g) Output and LED Control

- If an emergency sound is detected, the system responds by turning on an LED (Light Emitting Diode) connected to a specific GPIO pin. This visual indication serves as an alert or notification mechanism in response to the detected emergencysound.

CHAPTER 5

RESULT

AND

DISCUSSION

CHAPTER-5

5.1 SYSTEM TESTING

TEST CASES & REPORT

TEST CASE ID	TESTCASE/ ACTION TO BE PERFORMED	EXPECTED RESULT	ACTUAL RESULT	PASS/ FAIL
TC001	Red light displayed in traffic light	Barrier drops	Barrier drops as give in Figure A3.6	Pass
TC002	Yellow ligh displayed in traffic light	Barrier remains dropped.	Barrier remains dropped as given in Figure A3.8	Pass
TC003	Green light displayed in traffic light	Barrier is lifted	Barrier is lifted as given in Figure A3.7	Pass
TC004	Detects emergency vehicle.	The red signal is converted to green and the Barrier is lifted	The red signal is converted to green and Barrier is lifted	Pass
TC005	DTH 11 sensor senses humid or lowered temperature	The streetlight shines brighter	The street light shines brighter as given in Figure A3.2	Pass
TC006	LDR sensor senses bright lights	The streetlight shines less	The street light shines less as given in Figure A3.2	Pass
TC007	MQ-2 sensor senses smoke, CO, and LPG	Reports activity	Reports activity as given in Figure A3.1	Pass
TC008	YOLO algorithm detects objects (vehicles)	Detects vehicle and performs traffic flow conversion.	Detects vehicle and performs traffic flow conversion. as given in Figure A3.5	Pass

TABLE 5.1 TEST CASES

5.2 RESULT & DISCUSSION

A. SMART TRAFFIC LIGHTS

In this module, there are 2 parts. The automatic traffic light and the barrier- integrated traffic light. For the automatic traffic light, this Project has used a Raspberry Pi 4 board and we have connected it to the LED on the breadboard and set a timer value for the glow of each light. During the barrier integration, This Project uses a servo motor to connect to the board using jumper wires. Then the coding part is completed, to integrate the servo motor to the board, then the barrier is attached. Now the barrier is integrated into the Raspberry Pi 4 board and moves according to the change in traffic light. When the red light is on, the barrier drops, and when the green is on it rises. Al Also the presence of a traffic density checker using the camera strives to prove the fact that the traffic light system is intelligent. Using the camera attached to the Raspberry Pi board we recognize the traffic density to do this in real-time we use the YOLO (you only look once) algorithm. The algorithm helps in identifying the lanes with heavy traffic density and helps to adjust traffic signals such that the heavy traffic density lane will have reduced red signals and the lanes with less traffic will have an increased red signal.

B. EMERGENCY VEHICLE'S SENSOR AND CLEARANCE

In this module, we are going to attach a sound sensor to the Raspberry Pi 4 board, which in turn will be connected to the servo motor. The sound sensor senses the siren sound and controls the barrier to not drop and cause a delay in the path. The sensor is set in such a way that when the ambulance is within the vicinity of 100 meters, the siren is sensed and the barrier is held till the ambulance crosses the signal.

C. THE SMART STREET LIGHT SYSTEM

The functionality and unique features of a sophisticated street lighting system will determine its output. The following are the lighting control system's outputs: The system may turn on or off the lights based on preset schedules, motion sensing, and ambient light levels. Energy efficiency: The system can lower its energy use by adjusting illumination levels or shutting off lights when not in use. Surveillance along with reporting: The system may provide comprehensive reports and analytics and monitor energy consumption, lighting consumption, and other parameters. Signals and reminders: The system can send out notifications to users in response to certain occurrences, such as when a light bulb requires to be repaired or when energy use is above pre-established limits.

CHAPTER 6

CONCLUSION

CHAPTER -6

6.1 CONCLUSION

The methodology proposed in this paper tackles challenges related to green edge computing in smart cities. Introducing the concept of trust, this approach empowers agents to learn from each other's behavior, optimizing decisions for reliable and energy-efficient compute offloading. Thoroughly examined in a simulation environment, the Trust-based Multi-agent strategy exhibits superior performance compared to conventional methods in terms of energy consumption, work completion time, and resource utilization. In summary, this method stands as a viable solution for dependable and energy-efficient compute offloading in smart cities, with the potential to enhance the functionality of various smart city applications. Further research is warranted to delve deeper into these possibilities.As technology continues to advance, an increasing number of devices, products, and everyday items are incorporating wireless chips and sensors for seamless communication. The global economy appears poised to reap substantial benefits from the Internet of Things (IoT). The evolution of IoT into the broader concept of the Internet of Everything (IoE) encompasses the integration of people, data, and applications across all devices. Technologies once considered science fiction, such as driverless cars, wearable computers, and personalized advertisements, have transitioned into reality, marking a transformative era in technology. This ongoing technological revolution aims to continually enhance output and performance to meet evolving demands.

APPENDIX

APPENDIX

A.1 SUSTAINABLE DEVELOPMENT GOALS (SDG)

The system described, involves smart city components like sensors, edge computing, and environmental monitoring, aligns with several Sustainable Development Goals (SDGs) outlined by the United Nations.

1. SDG 11: SUSTAINABLE CITIES AND COMMUNITIES

This goal focuses on making cities and human settlements inclusive, safe, resilient, and sustainable. Your smart city system, with its ability to optimize street lighting based on environmental conditions, contributes to creating more sustainable and efficient urban environments.

2. SDG 9: INDUSTRY, INNOVATION, AND INFRASTRUCTURE

Your system incorporates innovative technologies such as IoT devices, edge computing, and sensors. It aligns with the goal of building resilient infrastructure, promoting inclusive and sustainable industrialization, and fostering innovation.

3. SDG 7: AFFORDABLE AND CLEAN ENERGY

The system's ability to modify street lighting brightness based on surroundingsand time contributes to energy efficiency and aligns with the goal of ensuring access to affordable, reliable, sustainable, and modern energy for all.

4. SDG 13: CLIMATE ACTION

By optimizing street lighting and monitoring environmental conditions, your system can contribute to climate action by reducing energy consumption and minimizing light pollution.

5. SDG 3: GOOD HEALTH AND WELL-BEING

Monitoring air quality using the gas sensor (MQ-2) contributes to the well- being of citizens by providing insights into potential health hazards related to airpollution.

6. SDG 12: RESPONSIBLE CONSUMPTION AND PRODUCTION

The system, by optimizing `energy usage in street lighting, promotes responsible consumption and contributes to sustainable production practices.

A2 SOURCE CODE

```
import RPi.GPIO as GPIOfrom time import sleep
Traffic_light = [17, 27, 22, 23, 24, 25, 5, 6, 13, 16, 20, 21]

RED1_PIN = 17
YELLOW1_PIN = 27
GREEN1_PIN = 22

RED2_PIN = 23
YELLOW2_PIN = 24
GREEN2_PIN = 25
RED3_PIN = 5
YELLOW3_PIN = 6
GREEN3_PIN = 13

RED4_PIN = 16
YELLOW4_PIN = 20
GREEN4_PIN = 21
SERVO1_PIN = 18
SERVO2_PIN = 19
SERVO3_PIN = 26
SERVO4_PIN = 12
Ir_Sensor = 8
Sound_Sensor = 7
GPIO.setmode(GPIO.BCM)GPIO.setwarnings(False)
```

```
GPIO.setup(Ir_Sensor, GPIO.IN) GPIO.setup(Sound_Sensor, GPIO.IN)

GPIO.setup(SERVO1_PIN, GPIO.OUT) GPIO.setup(SERVO2_PIN,
GPIO.OUT)GPIO.setup(SERVO3_PIN, GPIO.OUT)GPIO.setup(SERVO4_PIN,
GPIO.OUT)

ServoValue1 = GPIO.PWM(SERVO1_PIN, 50)
ServoValue1.start(0)

ServoValue2 = GPIO.PWM(SERVO2_PIN, 50)
ServoValue2.start(0)

ServoValue3 = GPIO.PWM(SERVO3_PIN, 50)
ServoValue3.start(0)

ServoValue4 = GPIO.PWM(SERVO4_PIN, 50)
ServoValue4.start(0)

  for pin in Traffic_light: GPIO.setup(Traffic_light, GPIO.OUT)
GPIO.output(Traffic_light, GPIO.LOW)

def Set1():
GPIO.output(YELLOW1_PIN, GPIO.HIGH)
sleep(1)
GPIO.output(YELLOW1_PIN, GPIO.LOW)
sleep(0.2)
```

```
while True:

if(GPIO.input(Ir_Sensor) == True):# Set 1
print("Lane 1 Open") GPIO.output(GREEN1_PIN, GPIO.HIGH)
ServoValue1.ChangeDutyCycle(12) GPIO.output(RED2_PIN, GPIO.HIGH)
GPIO.output(RED3_PIN, GPIO.HIGH)GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(9)
GPIO.output(GREEN1_PIN, GPIO.LOW) GPIO.output(YELLOW1_PIN,
GPIO.HIGH)
sleep(3)

GPIO.output(YELLOW1_PIN, GPIO.LOW)
ServoValue1.ChangeDutyCycle(7.5) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW)
GPIO.output(RED4_PIN, GPIO.LOW)

# Set 2
print("Lane 2 Open") GPIO.output(RED1_PIN, GPIO.HIGH)
GPIO.output(GREEN2_PIN, GPIO.HIGH)
ServoValue2.ChangeDutyCycle(12) GPIO.output(RED3_PIN, GPIO.HIGH)
GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(9)
GPIO.output(GREEN2_PIN, GPIO.LOW) GPIO.output(YELLOW2_PIN,
GPIO.HIGH)
sleep(3)

GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(YELLOW2_PIN,
```

GPIO.LOW)

ServoValue2.ChangeDutyCycle(7.5) GPIO.output(RED3_PIN, GPIO.LOW)

GPIO.output(RED4_PIN, GPIO.LOW)

Set 3

print("Lane 3 Open") GPIO.output(RED1_PIN, GPIO.HIGH)

GPIO.output(RED2_PIN, GPIO.HIGH) GPIO.output(GREEN3_PIN,

GPIO.HIGH)

ServoValue3.ChangeDutyCycle(12) GPIO.output(RED4_PIN, GPIO.HIGH)

sleep(9)

GPIO.output(GREEN3_PIN, GPIO.LOW) GPIO.output(YELLOW3_PIN,

GPIO.HIGH)

sleep(3)

GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(RED2_PIN, GPIO.LOW)

GPIO.output(YELLOW3_PIN, GPIO.LOW)

ServoValue3.ChangeDutyCycle(7.5) GPIO.output(RED4_PIN, GPIO.LOW)

Set 4

print("Lane 4 Open") GPIO.output(RED1_PIN, GPIO.HIGH)

GPIO.output(RED2_PIN, GPIO.HIGH) GPIO.output(RED3_PIN, GPIO.HIGH)

GPIO.output(GREEN4_PIN, GPIO.HIGH)

ServoValue4.ChangeDutyCycle(12)sleep(9)

GPIO.output(GREEN4_PIN, GPIO.LOW) GPIO.output(YELLOW4_PIN,

GPIO.HIGH)

sleep(3)

```
GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW) GPIO.output(YELLOW4_PIN,
GPIO.LOW)
ServoValue4.ChangeDutyCycle(7.5)
if(GPIO.input(Ir_Sensor) == False): print("High Traffic in Lane 1")
GPIO.output(GREEN1_PIN, GPIO.HIGH)
ServoValue1.ChangeDutyCycle(12) GPIO.output(RED2_PIN, GPIO.HIGH)
GPIO.output(RED3_PIN, GPIO.HIGH)GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(15)
GPIO.output(GREEN1_PIN, GPIO.LOW) GPIO.output(YELLOW1_PIN,
GPIO.HIGH)
sleep(3)

GPIO.output(YELLOW1_PIN, GPIO.LOW)
ServoValue1.ChangeDutyCycle(7.5) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW)GPIO.output(RED4_PIN, GPIO.LOW)
while True:

if(GPIO.input(Sound_Sensor) == True):# Set 1
print("Lane 1 Open") GPIO.output(GREEN1_PIN, GPIO.HIGH)
ServoValue1.ChangeDutyCycle(12) GPIO.output(RED2_PIN, GPIO.HIGH)
GPIO.output(RED3_PIN, GPIO.HIGH)GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(9)
GPIO.output(GREEN1_PIN, GPIO.LOW) GPIO.output(YELLOW1_PIN,
GPIO.HIGH)
sleep(3)
```

```
GPIO.output(YELLOW1_PIN, GPIO.LOW)
ServoValue1.ChangeDutyCycle(7.5) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW)GPIO.output(RED4_PIN, GPIO.LOW)


# Set 2
print("Lane 2 Open") GPIO.output(RED1_PIN, GPIO.HIGH)
GPIO.output(GREEN2_PIN, GPIO.HIGH)
ServoValue2.ChangeDutyCycle(12) GPIO.output(RED3_PIN, GPIO.HIGH)
GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(9)
GPIO.output(GREEN2_PIN, GPIO.LOW) GPIO.output(YELLOW2_PIN,
GPIO.HIGH)
sleep(3)

GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(YELLOW2_PIN,
GPIO.LOW)
ServoValue2.ChangeDutyCycle(7.5) GPIO.output(RED3_PIN, GPIO.LOW)
GPIO.output(RED4_PIN, GPIO.LOW)
# Set 3
print("Lane 3 Open") GPIO.output(RED1_PIN, GPIO.HIGH)
GPIO.output(RED2_PIN, GPIO.HIGH) GPIO.output(GREEN3_PIN,
GPIO.HIGH)
ServoValue3.ChangeDutyCycle(12) GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(9)
GPIO.output(GREEN3_PIN, GPIO.LOW) GPIO.output(YELLOW3_PIN,
GPIO.HIGH)
```

```
sleep(3)

GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(YELLOW3_PIN, GPIO.LOW)
ServoValue3.ChangeDutyCycle(7.5) GPIO.output(RED4_PIN, GPIO.LOW)

# Set 4
print("Lane 4 Open") GPIO.output(RED1_PIN, GPIO.HIGH)
GPIO.output(RED2_PIN, GPIO.HIGH) GPIO.output(RED3_PIN, GPIO.HIGH)
GPIO.output(GREEN4_PIN, GPIO.HIGH)
ServoValue4.ChangeDutyCycle(12)sleep(9)
GPIO.output(GREEN4_PIN, GPIO.LOW) GPIO.output(YELLOW4_PIN,
GPIO.HIGH)
sleep(3)

GPIO.output(RED1_PIN, GPIO.LOW) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW) GPIO.output(YELLOW4_PIN,
GPIO.LOW)
ServoValue4.ChangeDutyCycle(7.5)

  if(GPIO.input(Sound_Sensor) == False): print("Emergency Vehicle detected ")
GPIO.output(GREEN1_PIN, GPIO.HIGH)
ServoValue1.ChangeDutyCycle(12) GPIO.output(RED2_PIN, GPIO.HIGH)
GPIO.output(RED3_PIN, GPIO.HIGH)GPIO.output(RED4_PIN, GPIO.HIGH)
sleep(15)
GPIO.output(GREEN1_PIN, GPIO.LOW) GPIO.output(YELLOW1_PIN,
GPIO.HIGH)
```

```
sleep(3)

GPIO.output(YELLOW1_PIN, GPIO.LOW)
ServoValue1.ChangeDutyCycle(7.5) GPIO.output(RED2_PIN, GPIO.LOW)
GPIO.output(RED3_PIN, GPIO.LOW)GPIO.output(RED4_PIN, GPIO.LOW)
```

A3 SCREENSHOTS

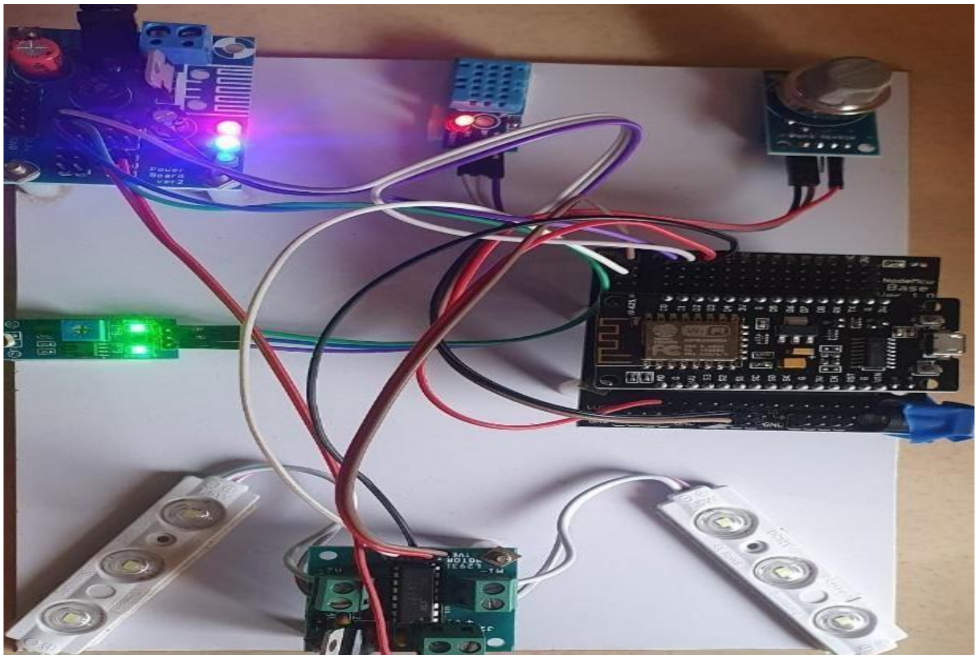


Figure A3.1 System working

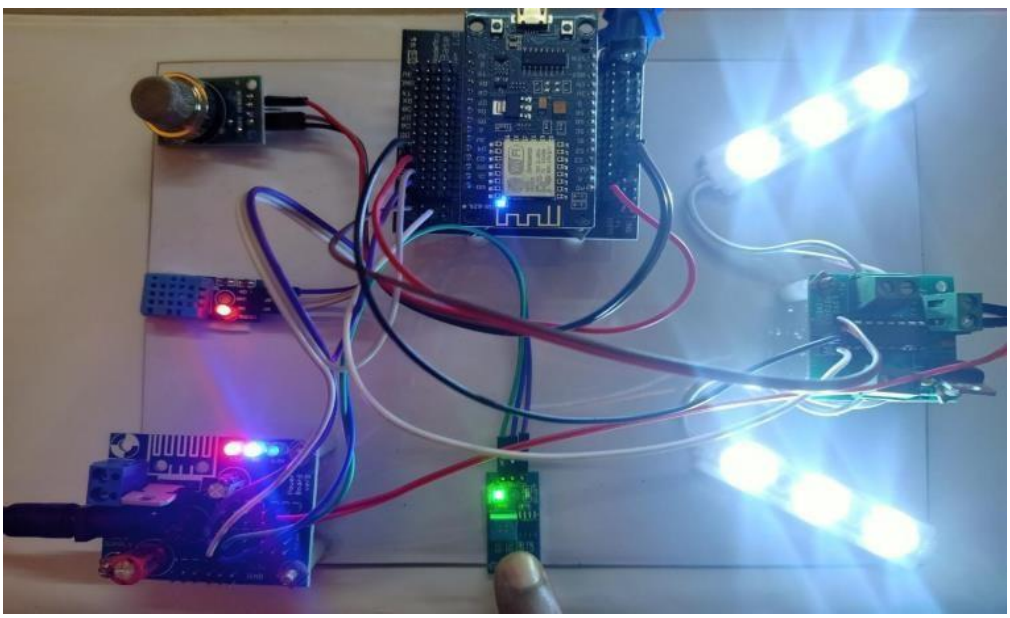


Figure A3.2 LED working under conditions given.

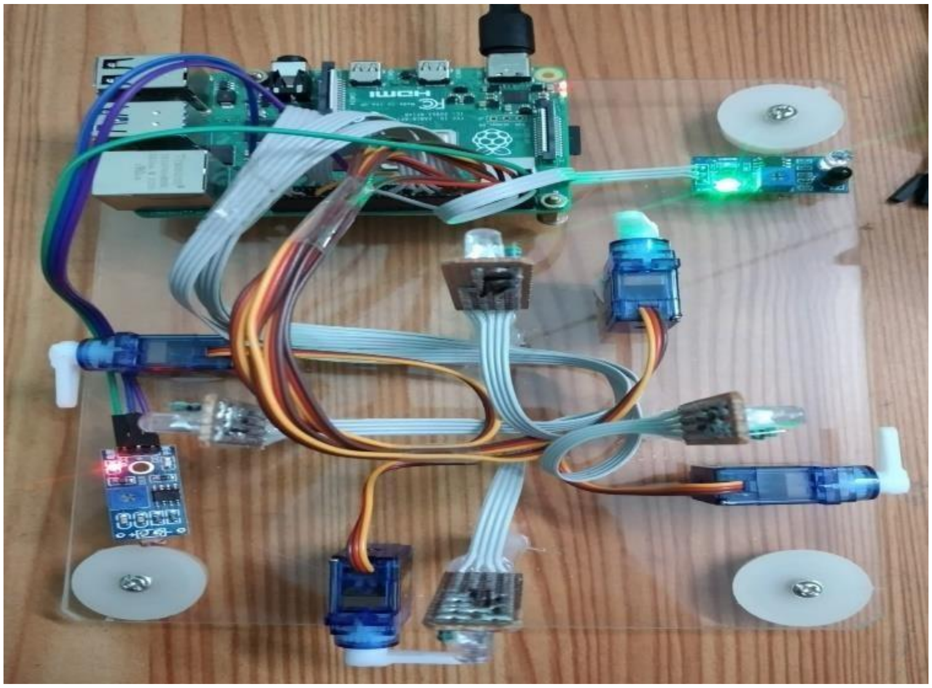


Figure A3.3: System working

Figure A3.4: System operating in lane 4 .

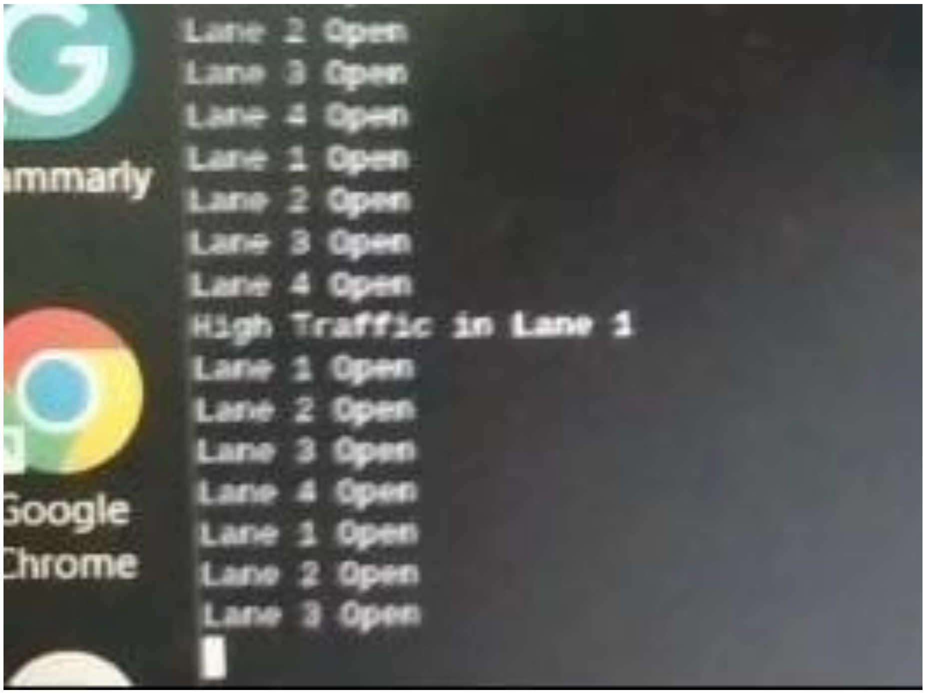


Figure A3.5: Traffic flow control .

Figure A3.6:Red Light

Figure A3.7:Green Light

Figure A3.8:Yellow Light

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RE-2022-220667-plag-report

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RESPONDERS- THE SMART TRAFFIC LIGHT AND STREET LIGHT SYSTEM

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Abstract— To improve safety and energy consumption in smart cities, this proposal supports two essential tactics. The first attempt suggests implementing dynamic brightness management for optimal energy efficiency in fog computing-based smart street lamps (SSL). These SSLs can independently report, meaning that individual bulbs can identify and report anomalous conditions, including broken or pilfered lights. According to the study's findings, installing SSLs greatly reduces dangers and improves energy utilization in urban illumination.

By integrating machine learning technologies, the second strategy concentrates on intelligent traffic management. To improve traffic control, a system that uses automation and the Internet of Things to operate barricades on roads is being introduced. Deep learning algorithms and object identification distinguish between free and crowded highways, recommending alternate routes to ease traffic congestion. These actions address careless driving, improve traffic flow, and increase road safety.

In summary, the combination of Fog Computing-Based Smart Street Lamps (SSLs) and intelligent traffic management systems hold the promise of ushering in smarter, safer, and more energy-efficient cities by effectively tackling issues associated with street lights, traffic congestion, and speeding vehicles.. All things considered, this integrated strategy is a positive step toward developing technologically sophisticated and sustainable cities.

Keywords: Internet of Things (IoT), Raspberry Pi, node mcu ESP8266 servo motor, barrier, sensor, camera, smart city, smart traffic light, smart streetlight.

I. INTRODUCTION

The Internet of Things (IoT) represents a groundbreaking technology capable of seamlessly integrating diverse and heterogeneous end systems to enable a broad array of digital services. This transformative innovation is propelling the world toward intelligent and automated management of systems.

The increase in the number of vehicles has led to traffic congestion, pollution, and disruptions in transit operations. Utilizing IoT for traffic regulation and effective congestion management becomes a crucial game-changer. The proposed concept aims to develop an IoT system for autonomous traffic management. This system, inspired by railway practices, summons a barricade when the traffic light is red and releases it when the light turns green, ensuring a safe passage for pedestrians.

To enhance traffic flow, object detection is employed. Object detection identifies busy and idle lanes, allowing for dynamic traffic signal adjustments. This adaptive strategy enables more efficient traffic management by facilitating increased vehicle passage on busy roads and reducing passage on less congested ones. The integration of IoT in these applications showcases its potential to revolutionize urban mobility and safety.

In the ever-evolving landscape of urban development, the principles of safety and energy efficiency stand out as fundamental pillars in shaping smart cities. Within the intricate fabric of a metropolis, the synergy between safety and energy conservation converges uniquely in street lamps, making them indispensable components of the smart city paradigm. However, the current absence of intelligent elements in conventional street lighting poses challenges related to both risk and energy usage. To navigate this terrain, a forward-thinking strategy introduces the concept of fog computing-based smart street lamps (SSL) as a transformative solution for smarter cities. This innovative approach not only empowers dynamic brightness control but also instills a heightened level of autonomy in each street lamp, enabling it to report and address unusual circumstances independently. As we delve into the advantages and findings of this proposed SSL system, it becomes evident that the fusion of technology and urban infrastructure holds the promise of lowering risk and elevating energy efficiency in our urban spaces.

II. LITERATURE SURVEY

The rankings of Indian cities according to the TomTom World Traffic Report for 2021 were #2, #6, #8, and #16[4]. As per the 2022 TomTom World Traffic Rankings paper, Delhi, Bangalore, and Mumbai had respective rankings of #11 and #21 in the world for the year's urban congestion. And in 2023 Bengaluru and Pune were ranked at #6, #7. India's transportation systems have been expanding considerably about 30% over the last 10 years, while the number of registered vehicles has climbed by approximately threefold.[5] On the busiest roads, this leads to extreme traffic congestion combined with breaching traffic laws.

63,81,548 traffic infractions were reported by the police in 2021 in one city alone which was preceded by 50,95,478 in 2020 and 49,38,485 in 2019. This signifies a spike in traffic offenses of around 25%.

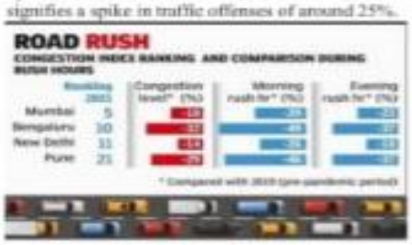

Figure 1 Indian Cities rank in Congestion Index List

These crimes not only result in traffic, but they also sometimes cause fatalities. The amount of deaths brought on by drivers' contempt towards traffic signals is steadily increasing. This even applies to pedestrians. The number of careless drivers is rising. It is now perilous to stroll on Indian highways. 176 people died in the city the year before after being hit by cars, with a rise in traffic light skipping of nearly 79% throughout COVID [7] (Chennai). Among them, 44% of the incidents involved two-wheelers. Private vans and buses run on behalf of Metropolitan Transport Company (MTC) regularly break this regulation. At designated crossing locations, 19% of respondents were involved in crashes.

Figure 2 Ranking of Indian cities in tom tom 2023

Better cooperation between state agencies has been requested by road traffic experts to increase the appearance of crosswalks, stop lines, and adjust lights so that pedestrians have enough time to cross the roads. To enhance pedestrian safety, the government needs to modify its rules to provide preference to pedestrians over drivers, according to Aswathy Dilip, senior Project Manager, at the Institute of Transportation and Development Policy (ITDP) [8]. Many of the laws that are designed to make sure individuals follow the rules are either disregarded or broken.[9]. This congestion problem is not only in India but throughout the world. Traffic jams are still a global issue despite the discussion and analysis of the circulation of traffic and its management by Mannering et al.(2012) [10], Gerlough et al.(1995) [11], and Sharma et al.(2011) [12] to do away with it, consequently, devise a plan that will force everyone to abide by the traffic laws.

Here, we genuinely use traffic lights to control the circulation of traffic without the assistance of police officials. Then, the system for keeping the emergency vehicles and traffic signals in working order comes into play. Numerous subjects have been explored in earlier research [13–15], such as the monitoring element and automatic identification technologies that rely on a vehicle's license plate and image, among other methods.

The concept of a "smart city" embodies a community that prioritizes energy efficiency, safety, utility, and overall livability. Achieving the vision of smart cities necessitates the enhancement of urban infrastructure, with a critical focus on elements like street lamps that play a pivotal role in both energy effectiveness and security. Streetlights, integral to municipal infrastructure, contribute significantly to the safety and functionality of a city. Imagining a city without these fixtures raises concerns about increased risks of theft, robbery, and road accidents.

In the contemporary landscape, the management of street lamps requires improvement, especially considering their substantial daily energy consumption. The rapid evolution of data monitoring and gathering technologies in recent years has provided the avenues for addressing these challenges. The Internet of Things (IoT) has risen as a transformative force, simplifying the connectivity of gadgets and enabling efficient data transmission through wireless technologies.

Moreover, the convergence of IoT and Artificial Intelligence (AI) stands at the forefront of constructing environmentally friendly and energy-efficient smart cities. The complexity of these systems necessitates collaboration among various agents, including decision-making systems, sensors, and actuators. One promising approach to enhance the performance of these interconnected systems involves the implementation of a trust-based multi-agent learning strategy. This strategy empowers agents to assess their past performance, learn from errors, and continually improve decision-making processes, contributing to the advancement of smart and sustainable urban environment. Shobana S et al. (2023)[16] provide this system traditional foundation. This proposed solution has made the entire system an IOT-based system since all kinds of hardware, sensors, software, and cloud have been combined to build an effective smart system. Lately, smart cities have become a hot research subject. Our research will take a small step towards developing a smart city by incorporating an intelligent lighting system.

A. EMERGENCY VEHICLE SENSOR

The first concept is to equip each emergency vehicle with a specific transmitter to grant precedence through intersections when an ambulance is detected. Each intersection's traffic light controller should have a receiver, which receives the signal from the transmitter and then controls the movement of traffic. This technique requires manually activating cars and is rather expensive. The second option involves utilizing detectors to catch the traffic light controllers' flashing lights. Emergency vehicles typically come with flashing lights that activate in an emergency. This strategy has certain cost and utility advantages. If the special light is identified using a traffic signal manipulate, the expense becomes a drawback. As the use of flashing lights is not restricted to nonemergency vehicles, there may be instances of false detection. Hence, flashlights may be used to start those private vehicles. The flashing lights could also be employed in advertisements or storefront displays, which could lead to erroneous triggers. preferable strategy. Given that emergency vehicles Using emergency vehicle's siren sound is are equipped with these sirens, a cost advantage is expected. These sirens are only activated in emergencies and are not built into nonemergency vehicles.

B. SMART TRAFFIC LIGHTS

In the system proposal, Mohd. Saifuzzaman et al. (2017) [17] suggested installing barriers. Depending on the necessity and efficacy, the barrier could be made of spikes or a traffic bollard. We build our model using this as one of the initial concepts. If not handled appropriately, the deployment of spikes or traffic bollards may be a bit too severe and result in deadly damage. Moreover, initialization is expensive since spikes are slightly more expensive. Here is where our second original concept, utilizing Puja Bhowmik et al. (2022) [18], comes in. We deploy the automated railroad level crossing concept by public roads. Barriers are being installed in the intersections with traffic signals to enforce discipline and order among the populace.

Figure 3 Barrier implementation using spikes

To deal with heavy traffic we need an adaptive traffic light system that works based on the density of the roads. Naoki Kodama et al.(2021) [19] proposed the usage of Deep Reinforcement Learning to achieve this but since the work was not implemented but only stimulated this can cause various dangers while implementing. Hanaa Abohashima et al. (2020)[20] while placing sensors in every car is highly unlikely, there is a framework for using Vehicle-to-Everything (V2X) in the larger setting of traffic signal administration and management via an Internet of Things. This situation even pertains to Heru Nurwarsito et al. (2021)[21], who suggested that a GPS device use the MQTT method to transmit location data to the cloud. Subsequently, the cloud will use the MQTT mechanism to process and transfer the data into the traffic light device. Despite being one of the greatest approaches, MQTT gets dangerous when GPS is used in the system.. As GPS can fail at any given time. Therefore here we use a real-time system that can work with only a camera and provide much better results.

C. THE SMART STREET LIGHT SYSTEM

Al-khaykan et.al (2022) [25] In-depth comparisons were made between the 400-watt sodium street lighting sources, the 200-watt LED street lighting sources, and the solar street lighting sources in this study. By employing the Dialux program for street lighting, all three types may provide excellent lighting and cover the entire area needed, but at varying wattages and with a different vision. Solar streetlights even provide greater visionThe daily energy problem will be resolved and substantial demand via the national grid will be removed by using solar streetlights. Initial set up, usage of energy as well as operational costs, warranty and safety, upkeep and monitoring, lifespan, and price for the same degree of lighting vision are all compared for each type. It proves why solar-powered streetlights are the best available. It is therefore better when compared to typical illumination varieties that rely on electrical power via the grid since it consumes considerably fewer electrical energy and have a longer operating life.

In the H. Sun et al. (2022)[26] study, a intelligent street lighting system is developed using the Internet of Things and wireless sensor network technologies, and urban street lights are integrated into the new system. Using a controller located on the pole and equipped with a variety of sensors, the system continuously collects data on the area around the street lamp. It then utilizes the LoRa network to obtain data from the street lamp unit and transfers that data using NB-IoT technology to a platform via cloud monitoring. The city's street lamp data is effectively acquired and saved when WEBGIS technology is integrated, and it is also prominently exhibited in the digital map for other status-related information. The system examines, finds, and alerts for anomalous data to realize the information connection that exists between the street light and the cloud-based system, the precise control of the street light, smart monitoring, and administration.

Urban street lighting management is hampered by a variety of problems, according to Y. Wang et al (2022)[27], considering the challenge of accurately identifying street damage and the use of a single-mode control system for street lights. The difficulties encountered in conventional administration tasks may be successfully addressed by an intelligent street lighting system for cities based on the Internet of Things Cloud platform. With the technology, you may operate street lamp switches remotely, control lights with voice commands, and use an infrared remote. The street lighting in the system can be remotely controlled and observed by the administrator to avert possible safety hazards brought forth by short circuits as well as electrical leaks. There is a high level of guarantee for residents' nighttime mobility with the installation of efficient and safe illumination over local street lamps.

J. Wang et.al(2022)[28] planned public power infrastructure, including power towers and street lighting, that are scattered across metropolitan road networks at all levels, has the potential to power 5G wireless communication base stations. Much of the accessibility barrier for 5G transmission over wireless networks may be removed by using the public distribution system's structure as tower resources, which may also significantly boost the financial gains. This study presents a novel 5G transmission method with wireless coverage-enhancing assist that combines electrical power lines and street illumination poles, using data from the Zhejiang Province's State Grid electricity supply businesses. The ownership, liberalisation potential, and operation conditions, products, and servicing techniques of electricity masts and street lamp poles have all been investigated, and pertinent conclusions have been drawn.

X. Zeng et. al(2022)[29] inferred that intelligent street lights are embracing previously unheard-of development prospects as a key component of smart cities. In general, the traditional street light system of management makes use of computer-side web monitoring, human inspection, and consolidated line control. In order to address the shortcomings associated with conventional street lamp management, comprising real-time monitoring and control via remote control, the research paper develops a series of advanced NB-IoT (Narrow Band-Internet of Things) street light monitoring devices. Real-time controls for many systems, such as spray cooling down dust obliteration surveillance of the environment, and illumination on streets, are made possible by technology. Every street lamp's geographic location and operational state are calibrated using cloud technology.

K. -K. Lai et al (2022)[30] addressed the topic of energy regeneration and sustainability. The need for energy-efficient technologies is on the rise as a consequence of worries regarding worldwide warming, climate change, IT contamination, carbon legislation, and energy crisis. Urban areas require large amounts of electricity, with outdoor urban lights accounting for about 20% of the total electricity budget. The continual power supply required for outdoor illumination results in the annual loss of approximately 35 percent of the electricity used by streetlamps. With a smart lighting pole, you can avoid wasting too much electricity and instead encourage sustainable growth and energy conservation. The majority of metal halide and high-pressure sodium lights in commercial settings have been replaced by LED substitutes. Since there is yet a great deal of room for improvement in LED intelligent lighting, this research examines the trajectory of advancement in scholarly research publications on LED intelligent street lighting using the primary path assessment method.

The system was assembled by S. Kanaset al. (2022)[31] using an Arduino, a sensor for lighting, a sensor for motion, a PV panel, an LED driver, and a charge controller. What controls the smart street lamps is the amount of traffic on the path and the time of day or night. When there are heavy downpours or other unfavourable weather conditions, the system is programmed to automatically turn off when the daylight hours and only operate at night. The goal of this project is to advance the concept of developing a intelligent photovoltaic roadside lighting system that synchronises with wind turbines to minimise electrical waste and boost energy conservation. Because it uses solar thermal energy, there is no need for electrical power from the electrical network.

Y. Tan et.al (2022)[32] developed an energy-saving application that used DIALux to emulate various street lighting systems. The MS835 and JKR guidelines, as well as the ideal campus plan for Universiti Malaysia Perlis, were all taken into consideration in this design. The design first generates street lights via the DIALux as evo program to ascertain the luminous impacts, demand for electricity, cost, and savings in energy usage of each forthcoming lighting system. To find an energy-saving replacement for the prevailing High-pressure Sodium (HPS) street lamp system, various lighting technologies were compared. The ideal lighting system is made up of Light Emitting Diodes, LEDs, and PIR.

III. PROPOSED METHODOLOGY

It is evident from the problem definition that the technology currently in use cannot manage issues like traffic control, emergency vehicle clearance, protection of pedestrians from vehicles that violate traffic signals, etc. We suggest using our Intelligent Traffic Control System to address these issues. The basic working of the system is as follows: The automated barricade summons the barrier when the traffic signal is red and expels it when it is green which allows a safe environment for the pedestrians to pass through and also helps us to control vehicles from jamming the roads without following the traffic light rules. The suggested system also has amenities to help emergency vehicles like ambulances to cross traffic quickly. The sensor identifies any ambulance that is within 100 meters from the traffic signal and if any exists, the sensor does not summon the barrier until the ambulance crosses the traffic signal. The proposed system also consists of the traffic density detection function which helps in identifying the lanes with heavy traffic and helps alternate the traffic signal thus regulating traffic flow. The lighting system communicates information about street lamp problems to the control center, with an emphasis on energy saving and autonomous operation at low, affordable prices for the streets. Furthermore, errors done by hand can be reduced to a minimum or perhaps completely avoided. The street lighting system determines whether or not it should switch on or off the lights based on the weather. An LDR sensor determines how bright or dark the sky is. In bright weather, the electrical system will be off, and in dark weather, it will be on. The lamp's illumination is also checked using the light level and an LDR sensor.

The main components of the suggested system are as follows:

1) An intelligent, light-adjusting street lamp that detects inappropriate behavior and sounds an alarm.

2) A dependable network that allows for real-time communication. While many street lights are linked to servers using NB-IoT, managers are attached to servers via WiFi as well as 5G internet technologies.

3) An adaptable management framework that can improve the distribution of resources for a straightforward, highly automated administration system.

4)An automated traffic barrier that drops when the traffic signal is red and rises when the signal is green.

5)The sound sensor that picks up the sound of emergency vehicles and creates a green lane using traffic signals for their passage.

6)The camera that identifies the vehicles that overspeed and provides a ticket.

7)And also identify the lane that has the heaviest traffic and alternate traffic signals accordingly to promote the flow of the traffic.

The system involves the following methodologies in order to achieve this

1. Webster's Method for Traffic Signal Timing:

The Webster method class implements a traffic signal timing methodology inspired by Webster's method. It adjusts green and red signal durations based on traffic density.

The cycle length is initially set to 30 seconds, and adjustments are made depending on the traffic density.

2. Traffic Signal Control:

The Traffic Signal Control class manages the traffic lights at different directions (north, south, east, west).

It uses the YOLO (You Only Look Once) object detection model to measure traffic density by detecting vehicles in a video frame.

The update traffic signal method updates traffic light durations based on traffic density using Webster's method.

Traffic lights are then controlled to signal green and red durations accordingly.

3. Traffic Signal and Barrier System:

The Traffic Signal and Barrier System class integrates traffic signal control, barrier control, overspeed detection, and ambulance detection.

It initializes traffic lights, barriers, overspeed detection components, and an ambulance detection system.

The calculate green duration method calculates the green time based on traffic density using a specified formula.
The update traffic signal method controls traffic lights and barriers based on the calculated green time and predefined red time.
Overspeed detection involves capturing video frames, detecting moving objects, and checking if the detected speed exceeds a predefined threshold.
Ambulance detection monitors sound sensor input and responds by turning traffic lights green.

4. Audio Processing and Emergency Sound Detection:

The sound sensor processing method collects audio samples, applies windowing, and performs FFT (Fast Fourier Transform) to detect peak frequencies. An emergency sound is detected if the peak frequency corresponds to predefined criteria.

5. Dynamic Light Adjustment:

Based on the readings from the LDR sensor, dynamically adjust the brightness of the street lights. Save energy by dimming lights when sufficient natural light is available. Monitors the voltage levels in the street lighting system.

6. Gas Monitoring:

Use data from the MQ-2 Gas Sensor to detect the presence of harmful gases and take appropriate actions (e.g., alerting authorities).

7. Temperature and Humidity Monitoring:

Monitor temperature and humidity levels for environmental awareness. Serially transmits temperature and humidity measurements. Measures temperature in the range of 0 to 50°C and relative humidity from 20% to 90% RH

8. Relay Control:

Utilize relays to control the ON/OFF status of the street lights. Programmatically adjust lighting based on external factors.

9. Energy Efficiency:

Optimize street lighting based on surroundings and time of day to save energy. Lower light pollution by adjusting brightness levels.

IV.RESULTS AND DISCUSSION

A.SMART TRAFFIC LIGHTS

In this module, there are 2 parts. The automatic traffic light and the barrier-integrated traffic light. For the automatic traffic light, this Project has used a Raspberry Pi 4 board and we have connected it to the LED on the breadboard and set a timer value for the glow of each light. During the barrier integration, This Project uses a servo motor to connect to the board using jumper wires. Then the coding part is completed, to integrate the servo motor to the board, then the barrier is attached. Now the barrier is integrated into the Raspberry Pi 4 board and moves according to the change in traffic light. When the red light is on, the barrier drops, and when the green is on it rises. Also the presence of a traffic density checker using the camera strives to prove the fact that the traffic light system is intelligent. Using the camera attached to the Raspberry Pi board we recognize the traffic density to do this in real-time we use the YOLO (you only look once) algorithm. The algorithm helps in identifying the lanes with heavy traffic density and helps to adjust traffic signals such that the heavy traffic density lane will have reduced red signals and the lanes with less traffic will have an increased red signal.

Figure 4 Smart traffic light system

In this module, we are going to attach a sound sensor to the Raspberry Pi 4 board, which in turn will be connected to the servo motor. The sound sensor senses the siren sound and controls the barrier to not drop and cause a delay in the path. The sensor is set in such a way that when the ambulance is within the vicinity of 100 meters, the siren is sensed and the barrier is held till the ambulance crosses the signal.

Figure 5 Monitor for traffic lights

C.THE SMART STREET LIGHT SYSTEM

The functionality and unique features of a sophisticated street lighting system will determine its output. The following are the lighting control system's outputs: The system may turn on or off the lights based on preset schedules, motion sensing, and ambient light levels. Energy efficiency: The system can lower its energy use by adjusting illumination levels or shutting off lights when not in use. Surveillance along with reporting: The system may provide comprehensive reports and analytics and monitor energy consumption, lighting consumption, and other parameters. Signals and reminders: The system can send out notifications to users in response to certain occurrences, such as when a lightbulb requires to be repaired or when energy use is above pre-established limits.

Figure 5 Smart street light system

V.CONCLUSION

The methodology proposed in this paper tackles challenges related to green edge computing in smart cities. Introducing the concept of trust, this approach empowers agents to learn from each other's behavior, optimizing decisions for reliable and energy-efficient compute offloading. Thoroughly examined in a simulation environment, the Trust-based Multi-agent strategy exhibits superior performance compared to conventional methods in terms of energy consumption, work completion time, and resource utilization. In summary, this method stands as a viable solution for dependable and energy-efficient compute offloading in smart cities, with the potential to enhance the functionality of various smart city applications. Further research is warranted to delve deeper into these possibilities.

As technology continues to advance, an increasing number of devices, products, and everyday items are incorporating wireless chips and sensors for seamless communication. The global economy appears poised to reap substantial benefits from the Internet of Things (IoT). The evolution of IoT into the broader concept of the Internet of Everything (IoE) encompasses the integration of people, data, and applications across all devices. Technologies once considered science fiction, such as driverless cars, wearable computers, and personalized advertisements, have transitioned into reality, marking a transformative era in technology. This ongoing technological revolution aims to continually enhance output and performance to meet evolving deman

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