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Cloud Computing based Smart Traffic Management System with Priority Switching for Health Care Services

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***Abstract*—Regular cities can be transformed into intelligent structures by leveraging information and communication technologies. Innovative city development could be significantly impacted by the Internet of Things paradigm, commonly called cloud computing. All urban locations have a lot of traffic. In this study, Internet-of-Things (IoT) based system is proposed for health care services to organize and to establish the traffic signaling and pick up a route under which road congestion can be administrated. Vehicle accident contraventions are identified by the traffic officers using an online service that is hierarchically carefully monitored or constrained. However, the suggested approach is generic and may be utilized in any major metropolis without losing its generality. Traffic lights linked to cameras in metropolitan areas can be upgraded by connecting to IoT. During a pandemic, this approach is precious. The police can easily regulate traffic from their homes using their cell phones and identify defaulters. The suggested technique aids in the separation of ambulance and rescue engines from ordinary traffic.**

Keywords—Intelligent traffic management system, Cloud computing, Healthcare unit, Internet of Things, Raspberry Pi

I. INTRODUCTION

Traffic management systems are computerized systems that use data about traffic conditions to maintain traffic flow and keep traffic moving. It uses sensors and cameras to detect when a traffic jam is starting to form and then send information about the backup to drivers, who can use it to adjust their routes. The sensors are used to detect when a road has been cleared of traffic jam so that it can be used more quickly, and cameras are used in maintaining a safe traffic flow. Some of the most advanced systems uses artificial intelligence to improve how it responds to traffic, which will help keep traffic moving on the road [1].

Traffic management systems are computerized systems that regulate traffic flow and keep roads clear. The proposed system uses cameras, sensors, and software to detect when roads are too congested or when vehicles have been abandoned and then use automated systems to adjust to keep roads moving. Many traffic management systems can also dynamically change traffic flow to keep roads flowing smoothly, which helps prevent traffic jams and saves fuel. Most traffic management systems are used to improve traffic flow in urban areas and on major roads, but some have been used to improve traffic flow on residential streets and highways in rural areas [2].

Traffic management systems aim to improve traffic flow and efficiency by removing bottlenecks and enabling vehicles to move more freely. These systems are used in dedicated and shared vehicle fleets and are often integrated with other technologies, such as parking sensors, lane control systems, and electric vehicle charging stations. One of the key benefits of a traffic management system is that it can be integrated into other vehicle systems, such as a GPS unit, and help the vehicle to navigate urban areas better. This improves the fleet's efficiency and helps reduce emissions while providing a better travel experience for passengers [3].

The World Economic Forum's (WEF) 2019 report "Smart City" includes a section on intelligent cities split into two main areas: smart infrastructure and intelligent people. The report discusses the role of smart infrastructure in the smart city. The smart city concept is one in which sensors, data analytics, and automation are used to optimize the efficiency and effectiveness of urban resources. This includes everything from the transportation system to the energy grid to the lighting system and everything in between. A smart city is where the system can use data analytics to identify problems, collect data, and then use it to make real-time decisions to improve our cities and lives [4].

The smart city is a new urban model that combines technology and people. Smart cities are data-driven, predictive, and responsive, and it connects people, data, and sensor data to make decisions and take action in real-time. The Internet of things (IoT) is a network of physical devices (objects) equipped with electronics, software, sensors, actuators, and connectivity. It can communicate over shortrange wireless technologies such as Bluetooth and Wi-Fi. The concept of IoTs has existed since the 1940s. Today, IoTs are employed in various environments and are a source of many data streams and information. It is also being used as a security measure [5].

The Internet of Things (IoT) is the next evolution in the Internet age. It is the interconnection of the physical world with the internet, where everyday objects can be sensed and controlled remotely through devices such as smartphones, tablets, and computers. It is the next step in the progression of the internet as a medium, transforming how the user live and work. The Internet of things in the smart city refers to the trend of implementing the Internet in all aspects of our lives. It connects physical objects to the Internet to be sensed and interacted with remotely. In a smart city, the Internet of things will connect all the physical objects in the city, and information will be available to all of them from anywhere through the Internet. The devices will be able to communicate with one another [6].

Cities are becoming increasingly linked to the Internet of things, where physical objects are connected to the web, and information is shared. There are many different ways in which the internet of things can be used to improve the quality of life in cities. For example, the internet of things can automate processes and improve efficiency by tracking the flow of goods throughout the supply chain [7]. The Internet of Things will connect devices such as sensors, actuators, and computers in every aspect of our lives - from our homes to our cars, cities, industries, and beyond. It is a technology that is changing the way people live and work. It is also a technology that is profoundly impacting how people think about the world [8].

In urban areas, traffic management has become a significant challenge in recent years due to the need to prioritize emergency vehicles and the rising volume of traffic. Cloud-based smart traffic management systems with priority switching have emerged as a promising solution to these issues. In order to provide traffic management capabilities that are both efficient and effective, this system makes use of cutting-edge technologies like the IoT, machine learning, and real-time data processing. The system can quickly respond by analyzing traffic patterns and giving priority to emergency vehicles using a combination of sensors, cameras, and algorithms. The system will investigate the various parts and features of a cloud-based smart traffic management system with priority switching, as well as the ways in which it can assist in improving traffic management in urban areas, in this article. In this article, the system will look into the various components and attributes of a cloud-based smart traffic management system with priority switching, as well as how it might help to enhance traffic control in urban areas.

II. Literature Review

The following are the immediate and long-term causes of traffic congestion: Some primary reasons include mishaps, poor road conditions, faulty traffic signals, and insufficient law enforcement. Long-term factors include things like society's economic growth and lifestyle changes. As a result, one of the most critical research fields is traffic management. Traffic is rerouted, communications are maintained, and traffic density is monitored to cut down on delays. The Internet of Things (IoT) can make it easier to install a traffic control system [9].

This puts ongoing pressure on academics, government representatives, and urban planners to find ways to make traffic management systems safer and more affordable. Research has addressed this expanding problem, leading to meaningful solutions such as emergency vehicle dedicated lanes in urban areas. It can occasionally be challenging to fulfill the required arrival times for emergency vehicles, even with additional lanes [10].

This article focuses on advancing intelligent traffic control via the Internet of Things. It broadens the idea of the knowledge economy as an IoT intermediary by providing traffic observation, transportation planning, digital disaster response, anti-theft video surveillance, and other functions. Through the Network of Things, web devices can successfully communicate with traffic sensor technologies, apps, controllers, and other interconnected networks [11].

The Raspberry Pi is the data management control unit, and ultrasonic sensors are the data collection unit, gathering information on traffic density. As a result of getting information about the detected traffic density via the Android application, users receive a notification about the traffic density in that lane. They are thus assisted in taking an alternate route [12].

This research examines creating an Internet of Things (IoT) device for a traffic control system. Intel Edison interfaces with the Microsoft Azure IoT cloud server in real-time and monitors traffic flow. The cloud server prioritizes each bound route based on the current traffic volume. The green light phase time (GLPT) is then calculated dynamically. According to simulation data [13], dynamic cycle TLS reduces queue length and waiting time at a traffic intersection by 68 and 67 percent, respectively.

An efficient preventive strategy will result in a well-organized community system that can monitor cars, motorways, and traffic indicators. In addition, sophisticated surveillance may assist the government and authorities [14]. The community can determine the distance traveled with effective tracking, allowing them to arrive at their final destination swiftly and avoid road accidents. Speed sensor tracking, detector measuring, Passive Infrared (PIR) sensor supervising, and motion detector monitoring are examples of Internet of Things (IoT) monitoring [15].

One of the key advantages of a cloud-based smart traffic management system with priority switching is its ability to give drivers and traffic managers access to real-time traffic information. With sensors and cameras positioned at key locations, the system can gather data on traffic volume, speed, and congestion in real time. The data is then processed using machine learning techniques to produce precise and timely data on traffic conditions. The system can also give priority to emergency vehicles like ambulances, fire engines, and police cars in order to ensure quicker response times. When an emergency vehicle is spotted, the system has the ability to activate green traffic signals in the direction of travel, enabling the car to safely and rapidly navigate intersections. This function can speed up emergency service response times and increase the efficiency of those services.

III. Proposed Methodology

The main reasons for traffic congestion include malfunctioning traffic lights, reduced law enforcement, and ineffective traffic management. Since the current foundation cannot be further expanded, the only alternative is to improve traffic management. As a result, there is still time to reduce traffic meaningfully. To manage traffic and relieve congestion, several different solutions have been created. To alleviate transportation overcrowding and improve traffic management, a low-power wireless system, inductance loop identification, audio-visual data analysis, and other approaches are used.

The system provides a remedy for bottlenecks in our proposed approach. The identification and ranking of Crisis vehicles might be made automatically or manually. The independent mode is obtained based on the Infrared sensor. It utilizes optimizing algorithms to streamline the process, including the decision strategy and the round-robin method. At the same time, the manual option is made by the transport supervisor, who analyses and controls the traffic himself. The Microcontroller serves as a statistical hypothesis, managing all framework aspects. Infrared sensors are used to assess traffic volume in a specific location. Figure 1 shows the implementation of the system.

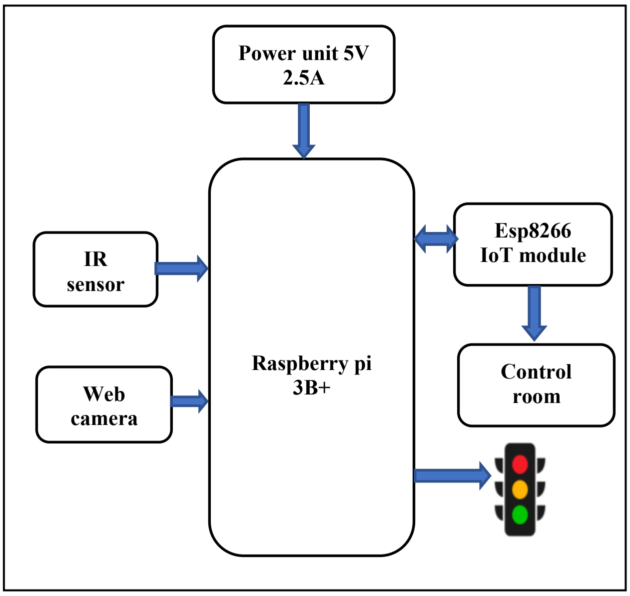

Fig. 1. System Implementation

A. Web camera

A webcam is part of the strategic application's manual control; it instantaneously captures still images of traffic. By watching these images, an authorized traffic control professional in the control booth will physically guide traffic. In the next section, the system examines why the spectrum-changing period interpolation approach, which will produce more positive outcomes than the prior method, works. Different positions only accompany the automated system, but it may increase the number of instructions based on the number of junctions on the route.

The web camera should be able to produce images of a high calibre, enabling accurate processing and analysis. The field of view must be sufficiently broad to include the target area without becoming overly broad and picking up irrelevant data. The web camera should have the necessary connectivity choices, like Wi-Fi or Ethernet, to transfer photos to the cloud server for processing.

B. Raspberry pi

Raspberry PI is a single-board computer developed by the Raspberry Pi Foundation, a charitable foundation. It is a small, low-cost, single-board computer with a processor, video camera, camera, microphone, and speaker built into a single circuit board. Initially released in 2012 as a low-cost, credit-card-sized computer for education and embedded development. The Raspberry Pi foundation has sold more than 10 million units, and worldwide sales continue to grow. The raspberry pi camera is a simple webcam that connects to the computer and lets's have access to take pictures and videos. When the user clicks the camera on their computer, it automatically launches the Raspberry Pi camera app and opens the camera. The module can then use to take pictures and videos.

A suitable and useful option for creating a cloud-based framework is the Raspberry Pi. It is a low-cost, credit card-estimated PC that can be used as a server, information titan, or innovative device. It is excellent for testing and prototyping a framework before distributing it for a wider audience. Also, it supports a wide range of operating systems, such as Ubuntu, Raspbian, and Windows 10 IoT. The needs of certain application can be met by modifying the Raspberry Pi platform. A sizable developer community has created numerous modules, sensors, and add-ons that can be utilised to increase its capability. Underlying network options for Raspberry Pi include Wi-Fi, Ethernet, Bluetooth, and USB. Because of this, a cloud-based traffic control system must have simple connections to other gadgets and the cloud.

C. IR sensor

An infrared sensor is an electronic sensor placed on something to measure how much heat is coming from that thing. An infrared detector can measure the temperature of anything, but it is most commonly used to measure a person's or object's temperature. The Infrared sensor is a light sensor used in computing to detect the presence of a specific object or light. Some infrared sensors are also used for non-visual applications such as night vision or to sense motion, temperature, or pressure.

The detection range of the IR sensor should satisfy the criteria of the traffic management system. The reach must be wide enough to appropriately cover the target area without collecting unnecessary data. The IR sensor should be sensitive enough to detect the intended signal, such as the infrared signal from an emergency vehicle, without being overly sensitive to detect undesired signals.

D. IoT module

The ESP8266 can be used to set up a communication link between the cloud-based server and the traffic management system. Because it can send and receive data through Wi-Fi, it is a fantastic option for a wireless communication system. The ESP8266 allows for real-time monitoring of the traffic management system. It can be programmed to alert the user to issues or particular events. The ESP8266 can be used to increase the security of the traffic management system. It can be programmed to carry out extra security procedures like user authentication and data encryption.

IV. Results and Discussion

Traffic control systems are used to manage traffic flow and keep roads clear. They are used on roads, highways, and parking lots. Traffic control systems are used in various situations, such as when a road must be closed for construction or when a traffic jam has occurred. They also manage traffic flow in a parking lot, allowing for efficient parking but keeping the road clear for emergency vehicles. Figure 3 shows the circuit diagram.

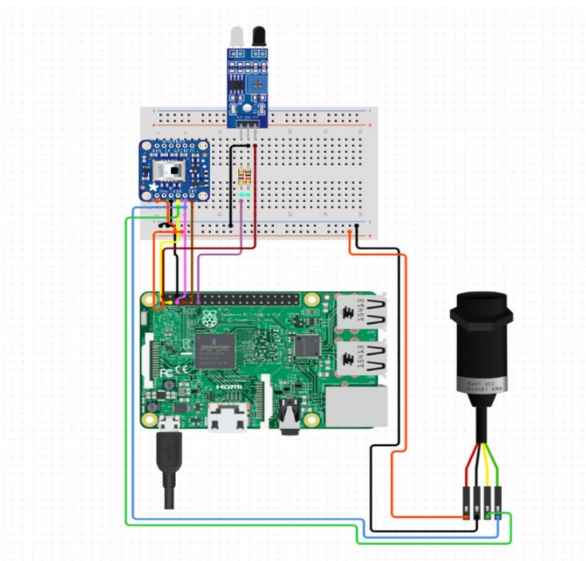

Fig. 2. Circuit Diagram

The component comprises one detection zone and one Microcontroller organization, which are used for monitoring and identifying causes to calculate the flow of vehicles instantaneously. Infrared sensors are placed from the signaling light to a preset distance behind the signaling light to measure traffic volume.

After connecting all of the components, those must interface them to the raspberry pi module and assign specific pins to the pi board. It uses Python to tell the pins of the code, and traffic lights in four directions begin signaling after a lapse of time. If an offender jumps a signal while driving, the IR sensor quickly recognizes outsourcing and sends an alert to the pi camera module, which takes a photo of it.

In the case of emergency transport, traffic shanks give instant access through transmission and reception. The signals become "GREEN" when the motorist of an ambulance presses the transmission switch. The path of an ambulance is depicted. Figure 5 shows the email alert in the system.

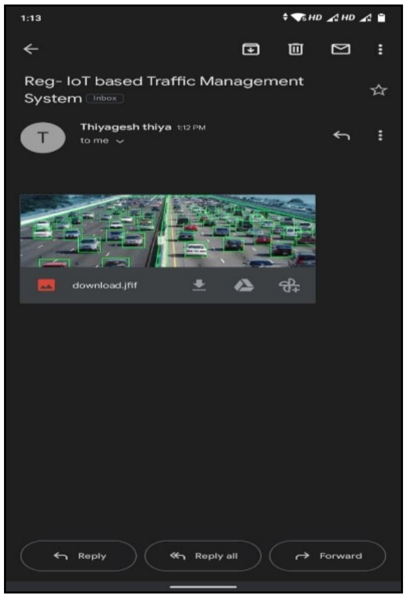

Fig. 3. Email to Control Room

The system's software code can be made more efficient and faster by being optimized. By optimizing memory usage, reducing code redundancy, and employing effective algorithms, this can be accomplished. To speed up the system's response time, data that is frequently accessed, like traffic patterns, can be stored in cache. At various levels, including the server, database, and sensors, caching can be implemented. To reduce latency and improve performance, the system's network infrastructure, which includes routers, switches, and cables, can be monitored and optimized. Utilizing tools for network monitoring and optimizing network protocols and configurations are two ways to accomplish this.

A prototype was made to show how well our suggested solution works. Several real-world traffic data trials were used to gauge the effectiveness of the proposed algorithm. To measure and compute the traffic density, vehicles were detected. When the traffic density reaches the threshold, the system suspends regular operation and gives the green light until the road condition returns to normal. Additionally, getting real-time data were the local and centralized servers.

In an emergency, the central server contacts the nearest rescue agency, ensuring human safety as soon as possible. To prevent sitting in traffic, a user can also inquire about the expected traffic volume on a specific road in the future. Furthermore, the system gives data to higher authorities for road design and resource optimization.

The suggested system surpasses the current method in various areas, including a reduced accident rate, lower fuel costs, remote control, and more. This is because it improves time-based monitoring. The suggested system is designed to manage traffic and track the number of vehicles on the road. The local server is accessible to the system administrator to maintain system functionality.

High-quality sensors that generate precise data must be used in order to attain high precision. For example, sensitive infrared sensors and high-resolution cameras can give exact information regarding traffic flow and the presence of emergency vehicles. Continuous information handling can help to ensure that the system reacts quickly to shifting traffic conditions. By processing data in real-time, the system can make choices and modifications quickly, potentially improving accuracy. Cloud-based computing can provide the computational capacity needed to process enormous volumes of data and make decisions based on that data. By employing cloud computing, the system may scale up or down in response to variations in traffic volume and other factors that might have an impact on accuracy.

However precise and effective a cloud-based smart traffic management system with priority switching is depends on the amount and quality of data gathered. Yet, obtaining accurate and trustworthy data might be challenging given that it may require numerous sensors, cameras, and access to real-time traffic data. When creating and implementing a cloud-based smart traffic management system with priority switching, there are a number of technical challenges that must be overcome, including integrating various components and technologies, optimising algorithms and models, and ensuring the system's reliability and security. While designing and implementing a cloud-based bright traffic the board structure with requirement exchanging, there may be administrative and legal considerations that need to be made. Data collection and use, as well as rules governing the use of traffic signals and emergency vehicle priority, may all raise questions about data privacy.

V. Conclusion

The suggested framework ensures excellent movement framework management and addresses activity obstruction. The proposed framework completes time management for traffic lights. This means that determining the ease of movement in volume at each junction will reduce the issue of activity bottleneck. The freedom of action for the crisis automobile is successfully used. Furthermore, the architecture includes both automated and manual operations. Sensors and cameras are used to regulate and discover the structure. This suggested technology can be implemented to manage the timing of signal lights, which helps to alleviate traffic congestion. The same technique can be improved by including an incident warning indication. For the present term, the system has only carried out the concept for one traffic junction. This can be scaled up to a large number of connections. An 'app' that shows traffic conditions at various places from the controlling center information might be developed to aid ordinary people.

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