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Smart Traffic Management System Using IoT

Anusha P V, Payyapilly Nidhi Wilson

Anusha P V, Department of Computer Application, St. Thomas College (Autonomous) Thrissur, 680001 , Kerala , India
Payyapilly Nidhi Wilson, Department of Computer Application, St. Thomas College (Autonomous) Thrissur, 680001 , Kerala , India

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Abstract-*The quantity of cars on the road has increased significantly in recent years. Every day, the problem of traffic congestion affects all of us more and more. It is necessary to undermine the effectiveness of traffic police's manual traffic control. Neither did the predefined set time for a signal fix this problem. In addition, neither the current nor the future generations can benefit from the current urban transportation management system. Additionally, there is an increasing need for an effective traffic control system. An efficient approach to addressing the previously described problems makes use of the Internet of Things (IoT). It improves the idea of the smart city with features like anti-theft security systems, smart parking, and serves as middleware on the foundation of the Internet of Things.The sole use of IoT is the use of embedded sensors, actuators and smart unique devices that help with the management of traffic with ease and tranquility thereby reducing the congestion and other problems faced by the people around.*

Keyword – Internet of Things, Actuators, Sensor.

I. INTRODUCTION

In the world where urban development is at its peak, the road infrastructure has also been increased to a greater extent which has led to extensive traffic, incidents relating accidents, collisions etc. In this, it has been seen that the manual traffic system is not reliable and is also causing a lot of sustainability issues such as causing a lot of pollution and so on. The traffic police system is now not reliable as in means that it is becoming impossible to manage such a heavy load of traffic. In this case the traffic management system should be changed and there is a huge need for that. With the help of smart technologies that we see in our day to day lives, this traffic problems can be solved and adjusted within just the tip of our fingers. With the help of such smart sensors and pins which communicate with each other and gives the exact traffic points our manual traffic managing system can be thereby solved easily.

With the help of hall effect sensors and the raspberry gpio pins they enable the smart technologies in such a way that they communicate with another and thereby provide a way to help enable a smooth trafficking system. The amount of time that the traffic signals flash green or red should vary depending on how many cars are in the area. Green lights should remain on longer when there is a lot of traffic in one way; less traffic should signify the red lights should stay on for a longer period of time when there is less traffic.

It is anticipated that this method will reduce traffic and pollution, as well as decrease inefficiencies at crossings. We are putting forth a potent method in this framework that makes use of radio wave flagging mechanism to identify the vehicles. Vehicles will be able to be detected and included in a framework that emits an SOS signal. This signal is recognized by a sign detection unit, which delivers a crisis trigger to the traffic inside the executive's framework. As per this framework, the crisis vehicle can be identified approximately 500 meters from the sign. At that point, the control unit issues a green signal towards the path the vehicle is approaching. This prevents the vehicle from stalling out of an automobile overload and gives a sign free hall. Even the signalling of each vehicle is given by the order of precedence. The order of the precedence is as follows:

- AMBULANCE
- FIRE TRUCK
- POLICE VEHICLES.

The element that comprises a combination of more than two types of emergency vehicles approaching the signal is also taken into consideration by the order of precedence.

The trigger is pulled when the source is in the same direction as the oncoming emergency vehicle, and this way is given priority over the other.

For emergency vehicles that do not currently have the necessary infrastructure for the signal-free movement of emergency vehicles, this offers an efficient means of supplying a signal-free path automatically.

Traffic congestion is a major problem for residents of smart cities like Delhi, Bangalore, Mumbai, Hyderabad, and others in the current situation. In the modern era, this has become a daily issue. Road congestion has increased the number of accidents in the city, making the

lives lost in these incidents even more important. Emergency vehicles, fire trucks, ambulances, and other vehicles are unable to arrive on time because of this traffic congestion. This leads to a significant loss of life. We offer a method in this work to address these problems to a large degree.

II. DESCRIPTION

The Internet of Things (IoT), or sometimes the Internet of Everything (IoE), is the collective term for any web-enabled devices that capture, communicate, and act upon data they get from their surrounding surroundings using embedded sensors, processors, and communication hardware. These devices—which are frequently referred to as "connected" or "smart" devices—can occasionally interact with one another by exchanging data in a process called machine-to-machine (M2M) communication. The development of sensor networks, mobile networks, wireless communications, networking, and cloud technologies has sparked a new Internet revolution known as the "Internet of things," which is gaining speed quickly [2]. Although the gadgets perform the majority of the job without human assistance, people can still interact with them to program, view, or give directions.

Our networks, personal and professional, have enabled them to exist because of a number of modest, portable components that are readily available combined with their ongoing online presence. When linked gadgets link to the Internet, they also produce large amounts of data. Either the gadgets themselves or other applications may mine this data. With all of this new data, along with the gadgets' Internet accessibility, security and privacy concerns are raised. But because to technological advancements, we can now obtain a level of real-time knowledge that was previously unattainable. To keep them safe, we may keep an eye on our families and homes from a distance. Increasing output while reducing costs is possible for firms through process optimization. The fundamental idea behind adjusting traffic light timing in accordance with current traffic circumstances is this. Data regarding the current number of vehicles on the road is gathered by the sensor.

- Sensor data is gathered and saved on cloud storage.
- The microcontroller receives this data and uses it to calculate the signal change for each lane.
- The microcontroller receives data directly in the event of an emergency, so it terminates the loop and changes the signalling immediately [2].

1. THE ESSENTIAL DUTIES FOR TRAFFIC MANAGEMENT USING THE IOT SYSTEM:

(a) IoT Control Systems and Traffic Lights: Although they resemble traditional stoplights, smart traffic signals use a range of sensors to track traffic in real time. Generally, the goal is to help vehicles reduce idle time. Additionally, the signals may communicate with one another through Internet of Things technologies. All of this is done in real-time as they adjust to changing traffic conditions, resulting in reduced time spent stuck in traffic and even lower carbon emissions.

(b) Parking Made Possible by IoT: Smart meters and mobile apps enable fast notifications for on-street parking spaces. When a spot becomes available, drivers are alerted so they can reserve it immediately. The app offers straightforward directions to the location.

(c) IoT-Powered Traffic Monitoring System for Emergency Assistance: In the event of an accident late at night or in remote areas, emergency responders can act more quickly thanks to this IoT-powered traffic monitoring system. When an accident is detected by the road's sensors, the traffic management system is notified right away. The appropriate authorities are notified of this request and will take appropriate action. For improved responsiveness and prompt intervention, emergency response staff would include members of the fire, police, and medical departments.

2. KEY FEATURES OF A SMART TRAFFIC MANAGEMENT SYSTEM

The salient features are listed below, and they vary depending on the size of the city and the extent of government regulation. It can be included into a system of intelligent traffic management. They include:

(a) Traffic Jam Detection: Experts can remotely monitor every street in real-time from the city's traffic control room by using sensors, cloud connectivity, and CCTV cameras to continuously monitor junctions.

(b) Connected Vehicles: By linking roadside monitoring sensors to an Internet of Things-based smart traffic system, it is possible to provide direct communication between intelligent vehicles and intersections.

(c) Modular Control: In the case of an auto accident or collision, the technologies in charge of traffic signals, express lanes, and entrance

alarms dynamically adapt their capabilities. This allows for real-time congestion monitoring.

(d) **Road Safety Analytics:** Systems that are able to recognize patterns can detect unsafe pedestrian behaviour, reckless driving, and high cruising speeds fast. [2].

III. APPLICATIONS USING IoT IN TRAFFIC MANAGEMENT SYSTEM.

1. SMART PARKING

It may be quite challenging to get a parking spot in a crowded city during rush hour, which can be time-consuming and irritating. Additionally, the careless drivers who hunt for parking spots exacerbate traffic congestion. This is the goal and practical use of smart parking techniques. Drivers may find parking spaces more easily and conveniently with the help of smart parking. The IoT technology that powers smart parking counts the number of available parking spaces and transmits the data to the back ends of smart parking applications via the internet. Drivers can use their smart phones, tablets, and in-car navigation systems to access these applications. Each parking space in smart parking has sensors to determine whether it is occupied or empty. This data is compiled by a local controller and then sent to the internet over the database.

Monitoring vehicle and pedestrian traffic in a parking lot is another responsibility that an IoT Smart parking management system handles. By restricting which vehicles are allowed entry, video surveillance can be integrated into the system to enhance parking management and address possible issues like theft or traffic accidents [1].

2. SMART LIGHTING

Smart Lighting Systems using IoT, which is revolutionizing the way we illuminate and interact with our surroundings. Imagine a home where lights adapt to your needs, creating an atmosphere of comfort and efficiency. With IoT-enabled smart lighting, this is no longer a distant dream but a reality.

Smart lighting systems using IoT allow us to control our lights remotely through connected devices, such as smart bulbs or switches, which this system allow us to control our lights remotely through smartphones or other devices. Forget about manually switching off lights; now you can do it with a simple tap on your phone screen. Moreover, scheduling features enable lights to automatically adjust based on your routine, dimming and colour changing enhancing energy efficiency and user convenience reducing unnecessary consumption.

3. SMART ROADS

When a smart road is fitted with sensors, it may give information on the driving conditions, predict trip times, and send out alarms in the event of poor driving conditions, heavy traffic, or accidents. By providing this information, traffic congestion can be decreased and road safety can be increased. Drivers who subscribe to these programs might receive information gathered from the roadways over the Internet and shared with social media and cloud-based services. A distributed and autonomous sensor network node system is proposed in HTTP to increase driving safety on public roads. In order to enable them to respond to possible hazards before they arise, the system can give drivers and passengers a consistent view of the road conditions a few hundred meters or a few dozen miles ahead of them. The integration of IoT technology into our road infrastructure is reshaping the way we travel, ensuring safety, efficiency, and sustainability [1].

4. EMERGENCY RESPONSE

The way emergency response teams manage crises and disasters has been completely transformed by the Internet of Things (IoT) integration. IoT-enabled devices, sensors, and real-time data analytics contribute to more efficient, timely, and coordinated emergency responses, enhancing overall public safety. The deployment of sensors, connected devices, and real-time data analytics enables emergency responders to act swiftly and intelligently. One of the key features of IoT to emergency response is in early detection and prediction. Sensors placed in vulnerable areas can detect environmental changes, such as rising water levels or seismic activity, triggering immediate alerts. This early warning system empowers authorities to evacuate areas at risk and mitigate potential disasters. The integration of IoT into emergency response is a beacome of hope in times of uncertainty. It transforms our approach from reactive to proactive and to save lives and minimize the impact of disasters.

III. SYSTEM ANALYSIS

A. EXISTING SYSTEM

Generally speaking, traffic police are in charge of the outgoing traffic system. The primary flaw in this traffic police-controlled system is that it lacks the intelligence to handle traffic congestion. An official in charge of traffic enforcement may decide to block a road for an extended period of time or to allow traffic on another road to pass; in other words, their decision-making may not be as sound as it could be and it will always be at their discretion. Furthermore, the duration of the green or red signal for a vehicle is set, even in the case of traffic lights being used. Consequently, it might not be able to address

the issue of traffic congestion. It has been observed in India that even in the presence of traffic lights, traffic police officials are on duty, which means that in this system more manpower is required which is not economic in nature [4].

Disadvantages of Existing System

- Traffic congestion
- No means to detect traffic congestion
- Number of accidents are more
- It cannot be remotely controlled
- It requires more manpower
- It is less economical

B. PROPOSED SYSTEM

The wireless sensor nodes, which are made up of sensors, are the initial and most important component of this system. While the local server transmits the sensor data to the central microcontroller, the sensors interact with the actual environment—that is, the presence or absence of cars. The 4*2 array of sensor nodes is used in this system in every manner. This denotes two lanes in each direction and four traffic levels. The ultrasonic sensors are designed to provide status information based on the proximity of a vehicle. Every junction has a central microcontroller that receives transmissions from the sensor nodes at predetermined intervals. After receiving the signal, the microcontroller determines which lane and which road should be selected depending on the traffic density. Next, the microcontroller's computed data is sent to the local server through the Wi-Fi connectivity. The controller makes use of the collected data to perform the intelligent Traffic routing. In this system the primary aim is to gather the information of moving vehicles based on WSN to provide them a clear path till their destinations and traffic signals should switch automatically to give a clear way for these vehicles. In addition to reducing traffic congestion, the proposed system will provide an option for continuing traffic in the event of an emergency or other roadblock issue. This option will be based on the density of the traffic lanes, meaning that specific times will be allotted for vehicles to pass. Since lane one has a 100% density, other traffic lights are red and lane one's traffic light will remain green until the oncoming traffic is cleared, as can be seen from the image provided.

Advantages of Proposed System

- Minimizes number of accidents.
- Reduces fuel cost and saves time.
- Low budget.
- Easy implementation and maintenance.
- Remotely controllable.
- Minimizes hassle and cost of communication.

IV. METHODOLOGY

In order to identify the existence of the radio wave emitter located within the emergency vehicle, a radio waves detector is installed at every intersection.

Every intersection has a microprocessor that gathers data from numerous sensors positioned at different angles, calculates the resultant time, and activates the LED lights for the determined amount of time.

THERE ARE 2 PHASES AND THEY ARE:

PHASE 1: To simulate a four-direction intersection junction, we are assuming four separate breadboards and placed three sides have hall effect sensors, and each side has a single green and red light. The Raspberry Pi's gpio pins are connected to every terminal on the LED lights and the hall effect sensor. All of the sensors in every direction record the instantaneous data of a given moment. The program then compares and determines which side has the maximum volume of traffic; the side with the maximum volume receives the green light, while the other three sides stay red. The program begins as soon as the final operational sensor notices that a vehicle is missing when it pulls out.

PHASE 2: Upon activation, the autonomous managing traffic management system gathers data from multiple sensors, including ultrasonic detectors and radio wave sensors. The control unit gathers data from the sensors (S1 S2 S3 S4), identifying the side with the most traffic as well as the separation between each side's traffic. The best moment to release the green signal to the side that has been determined to have the greatest traffic distance is then determined by the raspberry pi controller. When the microcontroller's allotted time runs out, all of the other sensors' sensor data is gathered, and the side with the greatest traffic distance is determined to receive the green light. In the next case the last two sensor data is ignored and the other sensors readings are identified and green light signal preference is given to the side which has the highest traffic distance compared to the other sensor values. This process is continued till all the sides leading to an intersection has been given at least one green signal in the first loop.

When the second loop starts, all of the sensor data are collected once more, identifying the side with the most traffic and allowing the microcontroller to determine when it is best to release the green signal in that specific direction. This procedure keeps going until the system is manually shut off.

In the unlikely event that the radio wave detectors pick up an incoming radio signal indicating the arrival of an emergency vehicle.

As a result, the system detects the incoming emergency vehicle and fires a trigger. The control unit monitors this radio wave signal once more, and when the radio wave emitter gets 500 meters away from the junction, the microcontroller fires the last trigger, activating all the running process is cancelled and the preference is transferred in the direction of emergency vehicle is approaching. The microcontroller immediately changes the other direction signals to red and provides green signal to the direction in which the emergency vehicle is approaching. If there are emergency vehicles approaching in more than one direction then the order of preference is as follows: Ambulance> Fire Truck > Police trucks In the condition in which there are two emergency vehicles approaching in one direction and single emergency vehicle in another direction, the preference is given to the direction in which there are 2 or more than 2 emergency vehicles are approaching [5].

V. CONCLUSION

Smart traffic management system has proven to be an effective way to prevent large amount of traffic on roads and also reduces the causes behind accidents and collisions. The main criteria is its sustainability as it prevents pollution and conserves energy thereby reducing the amount of energy consumed. There are much more updations to be brought about such as android and IoT based applications which will help us navigate real time bus parking systems and also bus tracking as we see these days on train. The further upgradations will be brought about in future which will be sure be known to be as useful as the management of traffic enabled by IoT.

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