Development of Smart Street Light System and Density based Traffic System using Internet of Things

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Abstract—**Normally, we have the traffic signal lights programmed for a specific interval of moment. But here produce traffic light signals depending on the density of traffic, on the specific moment. Here will keep few IR sensors apart from the highway to monitor the traffic density. The timing of the traffic signals will be altered depending on the signals produced from the sensors. The output of the sensors is provided to a comparator for digitizing the output. This system can be used to find the nearby ambulance services and nearby hospitals using GPS modem so that the necessary treatments can be given to the patient as soon as possible. When the ambulance goes to any traffic signal in an emergency, the key exchange method takes place, i.e. the other signals will be switched off immediately and all other signals will be red and subsequently replaced by green signals. In smart street light system make use of automated system which will automatically control the operation of street lights using LDR and timers. When a person or a vehicle enters the road they are sensed by the IR sensors and the light automatically glows, and when the person leaves the road the lights are switched off automatically. This avoids unnecessary power wastage during the night when there is no sign of pedestrian or vehicles.**

Keywords—Ambulance tracking, Dynamic signaling, IOT, Smart City, Smart street light.

I. INTRODUCTION

A smart city is an urban area that makes use of various IOT sensors and other electronic devices for the development of the city. When the concept of smart city is implemented in a country, it automatically leads to the development of a country. This would make the human life much easier and make the country digital. The development of smart city must be encouraged by the people in order to obtain the betterment and development in a country. The traffic signals works on number of vehicles present in a road, then the time management for traffic lights can be done and congestion could be reduced. Smart cities require smart traffic management .Usually traffic signals light are set to certain time intervals and are not able to recognize traffic density, therefore here make use of Dynamic signaling [1,2]. In dynamic signaling, traffic congestion data and status are acquired concurrently through sensors and cameras. The primary goal here is to regulate the system of traffic lights to decrease the flow of traffic. Hence traffic management plays a vital role in converting a particular city into a smart city. Here track the traffic density by maintaining few IR detectors off the highway and changing the timing of the traffic signals based on the signals obtained from the sensors. The microcontroller regulates the IR detectors and counts the amount of cars that pass between the detectors. The microcontroller decides on the glowing moment of the traffic lights based on distinct vehicle densities. [3, 4]. To make a surveillance system by installing cameras which can monitor the traffic density and the snap shot of it will be sent to the travelers via mail, so that they can choose an alternate route to reach the destination [5].

Ambulance tracking is also one of the important concepts of smart city. When the ambulance arrives at any traffic post, the traffic signals, stop the other signals automatically and give the ambulance a green signal. The IR- sensor consist of Transmitter at one side of the road and the receiver at the other side of the road. If any emergency vehicle arrives near the signal, the receiver receives the signal and the module sends the signal green command [6]. So whenever the ambulance approaches the traffic, the ambulance sends a code that says "emergency" to the receiver. Then it will immediately switch off the other signals, i.e. it makes all the other signals red and later make way for the ambulance of signaling green. This process is also called as a key exchange process [7] .When an ambulance arrives near the traffic signal, an emergency vehicle is identified and the traffic is cleared so that it can reach the destination as soon as possible [8, 9].
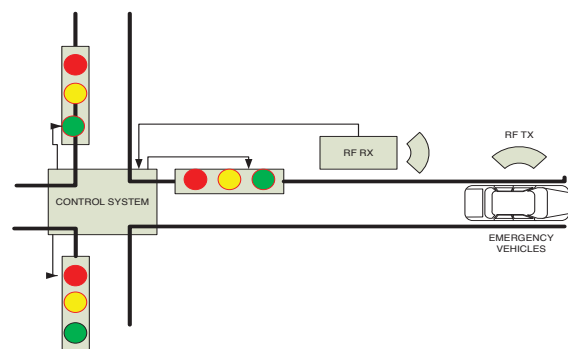

Fig. 1Ambulance tracking system

The figure 1 explains the ambulance tracking system. This application also enables us to find the nearest ambulance services available as well as nearest hospitals which are located in the surrounding area. So by doing

this the ambulance can reach the hospital on time without any problem.

The aim of the smart streetlight system is the conservation of electric energy by reducing electricity usage and to reduce the manpower. The energy which is conserved can be efficiently utilized for other purposes like residential, commercial, transportation etc. This is an automated system which will automatically control the operation of street lights using LDR and timers [10]. LDR's are light sensitive devices, they are also known as darkness detectors. Here the LDR sensor is used to ON and OFF the street light based on the intensity level which is set to the LDR. Therefore, when a person or a vehicle enters the road they are sensed by the IR sensors and the light automatically glows, and when the person leaves the road the lights are switched off automatically. This avoids unnecessary power wastage during the night when there is no sign of pedestrian or vehicles. Here we use a microcontroller for controlling street light [11].The structure of the paper, section 2 describes the related literature review, section 3 explains the methodology, section 4 elaborates the results and discussion, section 5 explains the conclusion of the paper.

II. LETARATURE REVIEW

When the ambulance arrives at any traffic post, the traffic signals, stop the lights automatically and give the ambulance a green signal. The IR- sensor consists of transmitter at one side of the road and the receiver at the other side of the road (opposite). Receiver will be adjusted in site, all IR-sensors that track the signals are placed here, if any emergency vehicle arrives near the signal. The Ambulance Tracking System works to provide patients and hospitals with real-time ambulance location data. The receiver will receive the signal and the module will send the order to switch on the green signal through the RF and there will be an RF receiver for each traffic post. So whenever the ambulance approaches the traffic, the ambulance sends a code that says "emergency" to the receiver [8, 12].

Usually traffic light signals are set to certain time intervals and are not able to recognize road density, therefore make use of Dynamic signaling here. Road congestion is the primary reason for lower velocity, longer waiting times, accidents and people's frustration. To resolve this problem, suggest the idea of dynamic signaling based on density using IOT to decrease traffic congestion through signal control. Conventional traffic light systems are based on fixed signal time concepts which are allotted to each side of the traffic signal which cannot be varied or changed as per the varying traffic density. The junction timings allotted to the traffic signals are fixed. Therefore, sometimes the higher traffic density present at one side of the traffic signal requires longer green time as compared to given standard allotted time [3, 13].

Streetlights are the elementary component of the town as it offers better night visions, safe highways and exposure to government fields, but it consumes a big percentage of electricity and its costs are extensive in nature. A smart city is an urban area that makes use of various IOT sensors and other electronic devices for the development of

the city. The development of smart city must be encouraged by the people in order to obtain the betterment and development in a country. IOT is connecting different application devices to each other through internet. This is possible because of sensors which aids to transmit a wide variety of data and location[1].Street light monitoring, control is an automatic system designed to improve the efficiency by automatically controlling the switching the street light. A lot of electricity is consumed by street light so it is imperative to save the power as much as we can [14].

Another unique feature of this system is that it provides an alternate route in case of the traffic congestion, which is very useful to the car drivers. If the signals sent by LDR is above the limited value set in comparator, then signal from the comparator is sent to the microcontroller. On the other hand, if the signal from the LDR is less than limit set in the comparator, output of the comparator will be zero [15].

III. METHODOLOGY

The main objective of this system is to make smart city using IOT application as have traffic signals scheduled for a specific time interval. But here going to produce traffic light signals depending on the specific moment. To monitor the traffic density, will keep in addition to the highway the few IR sensors. The timing of the traffic signals will be altered depending on the signals produced from the sensors. The output of the sensors is provided to a comparator for digitizing the output. This system can be used to perform functions of the patient health monitoring system for ambulance tracking using GPS Modem. The objective of an automated streetlight management scheme using IOT is energy conservation by decreasing waste of electricity.

A smart city is an urban area that makes use of various IOT sensors and other electronic devices for the development of the city. When the concept of smart city is implemented in a country, it automatically leads to the development of a country. This would make the human life much easier and make the country digital. The development of smart city must be encouraged by the people in order to obtain the betterment and development in a country. An IOT based smart city includes the following concepts they are smart street light management, smart traffic control management, smart health care management etc, and in many other fields.

A. Dynamic signal changing

In this proposed model The Smart Traffic Control (STC) technique that regulates traffic lights in a way that decreases traffic density in emergency vehicles while normal vehicles do not suffer significant delays.

B. Working of smart traffic control

The suggested strategy focuses on monitoring traffic density through IR sensors and communicating data to the comparator, then digitizing output. The sensor is an electronic device used to evaluate and transform physical quality to voltage, such as light, temperature, etc. Here use IR sensors (Infrared Sensor) which works on the principle that when a vehicle passes between IR transmitter and IR receiver. The micro controller is the core of the integrated

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scheme. To execute this system, 8051 architecture-based NXPP89V1RD2 microcontroller is used. It includes 1k RAM, 64k Flash, 3 Timer 2 internal interrupts, 1 UART, ISP support for 32 GPIOs, LDR, comparator and 7 segment display. In dynamic techniques, the status data is acquired instantly. By calculating a complete count of vehicles in red and green signals, this means that congestion can be predicted via sensors it manages congestion effectively and a lengthy queue of vehicles a red signal. Traffic lights therefore play an significant role in automatically reducing the traffic load and delaying time. Wireless Sensor Networks (WSNs) are used here to provide sophisticated computing characteristics to solve the issue. WSNs are a mixture of embedded systems and wireless networks that assist in information flow and wireless network interaction. Here depending upon traffic density the IR sensors notify weather it is low, medium or high density and it sends the data to the comparator then it is digitized for a particular time interval of the signal ,if traffic density is low it takes 20 sec of green signal, if its medium then 40 sec ,if its high then 60 sec respectively. By default it takes 20 sec of green light and red light. The figure 2 explains the traffic control system management.

In dynamic techniques, traffic density data and status are acquired instantly by sensor, lengthy vehicle queues at red signal are preserved by calculating a complete count of vehicles in red and green signals and the comparator is digitized as per received output.

C. Ambulance Tracking

The "Ambulance Tracking System" works to provide patients and hospitals with real-time ambulance location data.
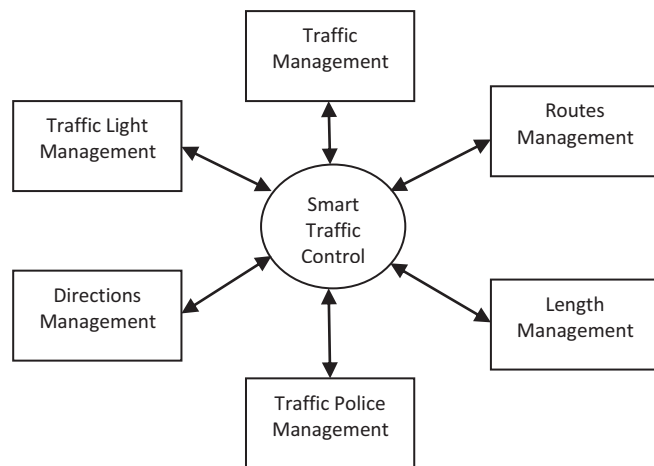

Fig. 2 Smart traffic control management system

When the emergency ambulance arrives at any traffic post, the traffic signals automatically prevent the signals giving this ambulance a green signal. The ambulance holds an IR transmitter and the IR receiver is at the border a few meters away. The receiver receives the signal and the module sends the command to turn green through the RF and each traffic post has an RF receiver. So whenever the ambulance approaches the traffic, the ambulance transmits a code saying "emergency" the receiver receives this signal. Then it switches off the other signal instantly, i.e. it turns all the signals red and then makes way for the ambulance by signaling green.

D. Street Light

Street lights are an essential component of any city because they facilitate night visions, safe highways and government exposure, but they consume a more electricity. Street light is a system which aims to save power from unnecessary usage. All street light is ON for a period of 6PM to 10PM.After 10PM street lights will be alternately switched ON and OFF for every 30 minutes up to 6AM. Here you can identify the day and night mode by setting a specific intensity value to the LDR sensor. IR sensor, relays and some electronic parts can control street lights. Figure 3 explains the proposed street light model system.
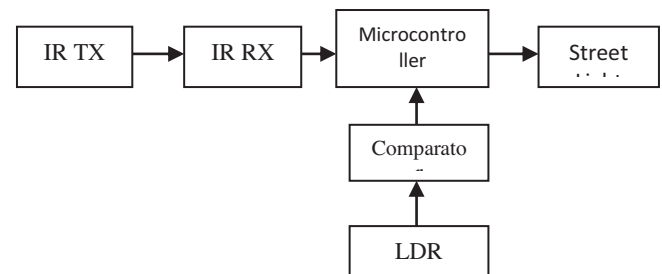

Fig. 3 Block diagram of proposed street light model

When a person or a vehicle enters the road they are sensed by the IR sensors and the light automatically glows, and when the person leaves the road the lights are switched off automatically. This avoids unnecessary power wastage during the night when there is no sign of pedestrian or vehicles. Therefore, with the help of this system, energy can be conserved.

IV. RESULTS AND DISCUSSION

In this section discussing the different types of traffic densities, an emergency vehicle prioritizes and motion detection intensities in a smart cities.

Fig. 4 Low traffic density

a. Working of low traffic density - As per the system, fix three sensors alongside the road which senses the density of the traffic and decides whether it is low, medium, high. Here from figure 4can see that when there is low density traffic the green signal takes 20 seconds as the vehicles will be less. Digitized output from comparator will be displayed on LCD display.

Fig. 5 Medium traffic density

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b. Working of medium traffic density - Here can see from the figure 5 that there is medium density traffic as two sensors are on means it is medium density traffic as there are more vehicles compared to low density traffic vehicles hence the green signal takes 40 seconds of time interval for medium density. They take 40 seconds of time interval as vehicles are more and digitized output from comparator will be displayed on LCD display.

c. Working of high density traffic - Now you can observe from figure 6 where all three sensors are on which indicates high density traffic as there are more number of traffic vehicles compared to medium density traffic vehicles hence the green signal takes 60 seconds of time interval for high density.

Fig. 6 High traffic density

They take 60 seconds of time interval as vehicles are more than medium density traffic vehicles and digitized output from the comparator will be displayed on LCD display.

d. Proposed Traffic Control System in Emergency Situation - Working of emergency vehicles prioritized in traffic density

Fig. 7 Emergency vehicle prioritize

In case of any emergency vehicles , like ambulance are heading towards density traffic an emergency buzzer will indicate which will be installed in ambulance, after buzzer indicated an information is sent to comparator and it automatically changes the red signal to the green signal by taking 60 seconds of time interval irrespective of the density levels. Observe from figure 7 how the comparator is digitized to 60 sec from output and it's displayed on LCD display. After the ambulance passes the road signal changes to red light and normal procedure continues.

This application also enables us to find the nearest ambulance services available as well as nearest hospitals which are located in the surrounding area, so that the patient can be give necessary treatment on time.

e. Observation of motion detected intensity

The motion or object detected by sensor, the streetlights are on when the person or vehicle steps in, likewise if they are passed certain distance away from the sensor, then automatic street lights will be off. Later the object continues to move, then it is detected by another sensor of streetlights placed a little distance apart from first street light and it goes on until road ends.

V. CONCLUSION

In this paper the major concentration is given on density based traffic system and smart street light system. To find out the density traffic use IR detectors next to the roads i.e. close to the traffic signal, the timing of the traffic signals is altered based on the signals from the sensors. Ambulance tracking is one of the major concepts of the smart city. In this paper make use of key exchange process in order to make way for the ambulance. When an ambulance arrives at any traffic post, the traffic signals stop the other signals automatically and give the ambulance a green signal. This application also enables us to find the nearest ambulance services available as well as nearest hospitals which are located in the surrounding area. In smart street light system make use of LDR's and timers to control the operation of street light automatically. When a person or a vehicle enters the road they are sensed by the IR sensors and the light automatically glows, and when the person leaves the road the lights are switched off automatically. By using this concept save the energy. These system applications are used in smart city.

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