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An Efficient Traffic Congestion Monitoring System Using IoT

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***Abstract*---Now a day's traffic controlling is Venture because the population growing day by day, also in emergency condition traffic controlling in very difficult. In emergency condition each and every second is important in saving a human's life. In urban areas, traffic system is one of the significant indicators to show the growth and progress of a city and it also influences the quality of life of people living in metropolitan cities. In recent years, there is a significant increase in usage of road vehicles which is becoming challenge for existing transportation system. The currently deployed traffic system is not based on the traffic congestion level and a predefined time is allocated for traffic lights at every road crossing which results in traffic congestion and situation becomes worst in the peak traffic hours. This high level traffic congestion contributes in the pollution by the emission of CO2 and several other pollutants in air. Moreover, it also causes tripling of the fuel consumption and consequently put adverse effects on the economy as well. To address the above problem, this paper presents the development of congestion level based dynamic traffic management system using IOT. It regulates the traffic lights duration based on the real-time congestion level of the traffic measured at the road crossings by using ultrasonic sensors. The development of this project is divided in three phase's i-e simulation and logic development, development of IOT based system and finally hardware implementation. In first phase the simulations are done in Proteus and results are presented in four cases i-e normal routine, low level congestion, medium level congestion and high level congestion. In second phase the IOT based system is developed by making the communication link between the end nodes and the gateway over the internet. Finally, the real-time prototype is implemented. And also the paper serves the delays caused by the lack of basic information about the patient and delay caused by the ambulance at the traffic signal.**

***Keywords*--- ESP 32 wifi controller, Internet of Things (IoT), Traffic management system, Ultrasonic sensors**

I. INTRODUCTION

The rapid development of IOT technology makes it possible for connecting various objects such as sensors connecting through the internet and providing more data interoperability methods for application purpose. The Internet of Things (IOT) is the interconnection of uniquely identifiable embedded computing devices within the existing Internet infrastructure. Emergency service should be provided correctly at the needed time. Transportation system plays a vital role in socio-economic development of a country. However, with an increasing number of population and vehicles in an urban areas traffic congestion is becoming one of the major and challenging issue in metro cities. It creates many problems such as travelling time delay between two major cities, fuel wastage at road junctions and air pollution due to emission of CO2 and other pollutants in air which results in various health hazards.

It also puts life at risk when ambulances get stuck in the congested traffic areas. Moreover, it also affects the personal life by increasing level of stress [2]. The major cause of this problem is that at road junctions the signaling of traffic lights has static operational time and it cannot handle the varying traffic density over time. Thus, it results in long queues of traffic at road crossings. The objective of this paper is to develop a IOT based dynamic traffic management system to regulate the duration of traffic lights according to the congestion level at different routes and also display real-time traffic situation on the cloud.

II. LITERATURE SURVEY:

[1] M.Buvana, Dr.K.Loheswaran, Dr.Karana Madhavi, Dr.Sivakumar Ponnusamy, Aradhana Behura, Dr.R.Jayavadivel This Paper document presents the XCS Classification System (LCS), by XCS and BCM-XCS, to ensure energy consumption at the end of the project which decreases the workloads of the processing time.

[2] Mohammed Sarrab, Supriya Pulparambil, Medhat Awadalla This research proposes an IOT based system model to collect, process, and store real-time traffic data for such a scenario. The objective is to provide real-time traffic updates on traffic congestion and unusual traffic incidents through roadside message units and thereby improve mobility.

[3] M.S. Roopa, S. Ayesha Siddiq, Rajkumar Buyya, K.R. Venugopal, S.S. Iyengar, L.M. Patnaik . In this paper, propose a traffic scheduling algorithm to gain the maximum throughput for the flow of vehicles at a road

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intersection with the formation of social relationships among the vehicles and with the Road Side Units (RSUs).

[4] Geraldo P. Rocha Filho, Rodolfo I. Meneguette , Jose R. Torres Neto , Alan Valejo , Li Weiganga, Jo Ueyama , Gustavo Pessin, Leandro A.Villas In this paper using artificial intelligence method, it propose a solution of inter-vehicle communication for estimating the congestion level to maximize the vehicle traffic flow in the transport system, called TRAFFIC.

[5] Shridevi Jeevan Kamble, Manjunath R Kounteb. . This paper highlight the ML approach to identify traffic congestion based on multiple parameters such as hard delay constraints, the speed available through GSP vehicle trajectory. Here, we have used the Gaussian process in ML for prediction of traffic speed which uses 3 datasets.

[6] B.D.Deebaka, Fadi AI-Turjmanb, Moayad Aloqailyc, Omar Alfandid This paper an IoT-Based Smart CAN (IoT- BSFCAN) framework is proposed to monitor the smart environment continuously through smart computing devices over cloud-enabled networks. The objective of this framework is to minimize computation cost along with communication fairness, while it uses different kinds of user applications.

Motivation:

The development of congestion level based dynamic traffic management system using IOT. It regulates the traffic lights duration based on the real-time congestion level of the traffic measured at the road crossings by using ultrasonic sensors. The development of this project is divided in three phase's i-e simulation and logic development, development of IOT based system and finally hardware implementation.

III. METHODOLOGY:

The methods using in this project are,

IOT Technology, ESP 32 wi-fi controllers, Ultra sonic Sensor, The Traffic control logic.

BLOCK DIAGRAM:

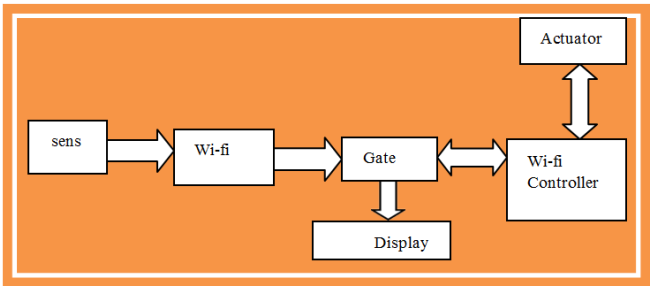

Fig1: Traffic controller system

In the above figure 1shows the sensors are used to measure the congestion level then that information is transferred to the gateway through wi fi controller. The gateway also receives information about current status of traffic lights through the actuator block and based on this complete information it uses the logic as shown in previous section to regulate the traffic lights. The real-time traffic situation is also seen and stored on the cloud to provide any further permanent solutions.

The details of each block are given below:

1) Sensors: The ultrasonic sensors are used in this project to measure the congestion. It sends ultrasonic waves through transmitter and receiver gets the reflected waves from the target to estimate the distance based on the time duration between transmission and reception.
2) Wi-Fi Controller: Two ESP 32 wi-fi controllers are used. One is used for unidirectional communication from sensor to the gateway and second provides bidirectional communication between the gateway and actuator node.
3) Gateway: Raspberry Pi 3B+ single chip computer is used as a gateway here and uses the developed logic to control the duration of lights based on the information received from sensor and actuator node.
4) Actuator: It represents the traffic lights and its driving circuit i-e relays.
5) Display: The real-time traffic information is displayed and stored on the Node-Red software of the gateway.

The schematic diagram of IOT based dynamic traffic management system is shown in Fig. 1.2

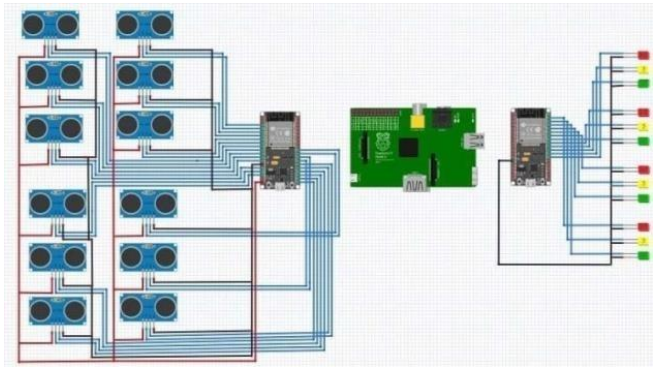

Fig2: Schematic of smart traffic management system

LOGIC DEVELOPMENT AND SIMULATION:

The regulation of traffic lights on the road crossing has to be done on basis of traffic congestion and it is measured through the ultrasonic sensors. At road crossing four routes are making junction and on each route three sensors are connected to measure three levels of congestion i-e low, medium and high. The sensors are identified as shown in Table 1.

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Table 1. Sensor name with description

S/N	Sensor Name	Description
1	S11	Route 1 sensor1
2	S12	Route 1 sensor2
3	S13	Route 1 sensor3
4	S21	Route 2 sensor1
5	S22	Route 2 sensor2
6	S23	Route 2 sensor3
7	S31	Route 3 sensor1
8	S32	Route 3 sensor2
9	S33	Route 3 sensor3
10	S41	Route 4 sensor1
11	S42	Route 4 sensor2
12	S43	Route 4 sensor3

A specific value of 10 feet is used as a reference to detect the congestion level. The logic used to regulate the dynamic switching of traffic lights in simulations is presented in the algorithm flowchart as shown in Fig. 3

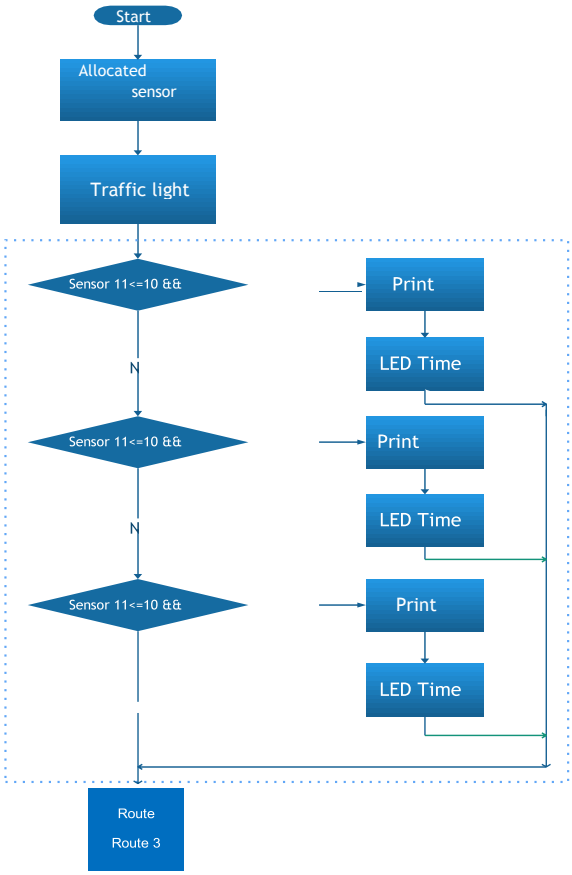


Fig 3: Algorithm flowchart

The above algorithm represents the strategy to control the traffic lights switching pattern of a single route. Similarly all routes are managed in the same way. The simulations are done in Proteus by using its virtual system modeling feature to simulate the aurdino microcontroller [7]. The Proteus circuit diagram is shown in Fig:4.

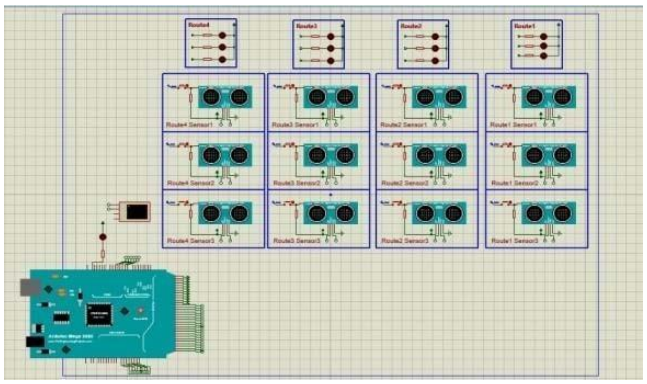
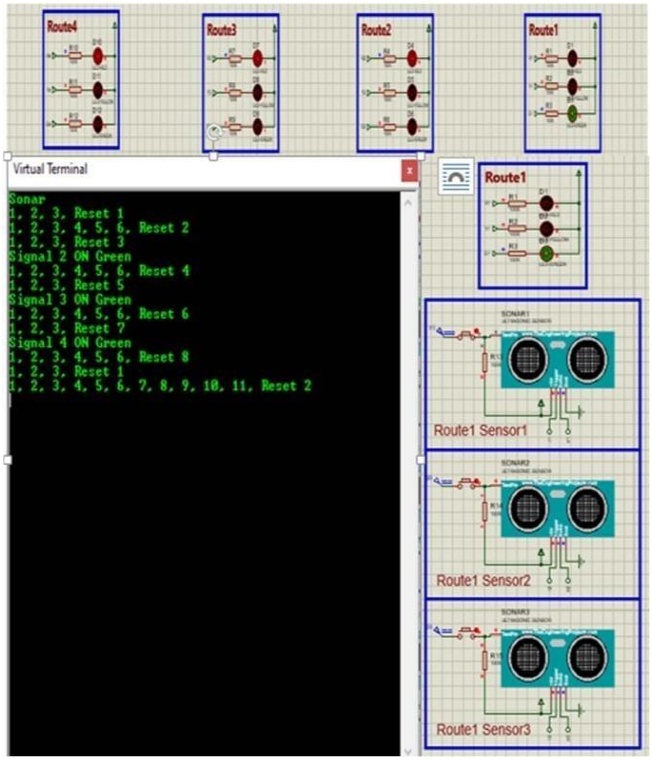


Fig4: Proteus Circuit Digram

The simulation results are presented in four cases i-e on the basis of traffic congestion i-e normal routine, low congestion, medium congestion and high congestion as shown in below figures in three cases (a), (b), (c)



(a) Case1: Normal Routine

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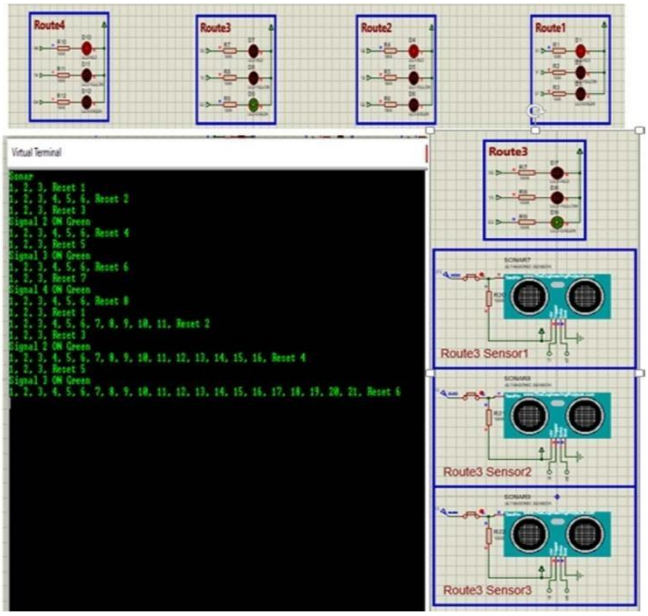
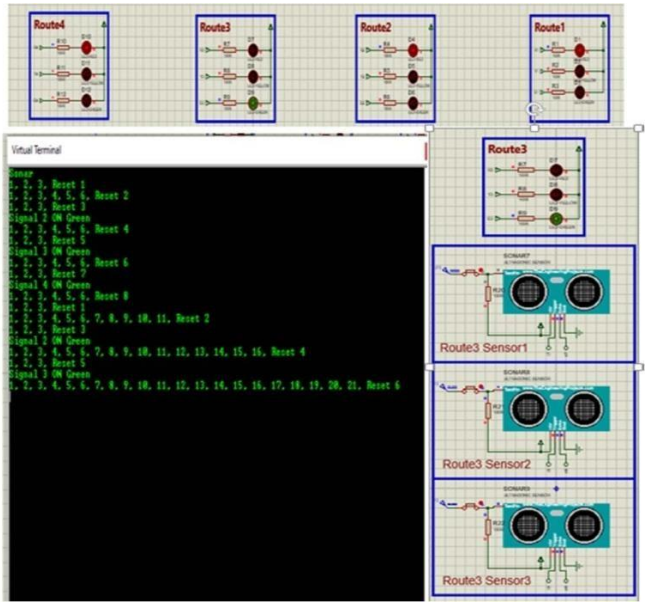


(b) Case2: Medium level congestion at route 2



(c) Case 3: High level congestion at route 3 fig3 Simulation Results

In the above results it is clear that in normal routine there is no congestion and duration of green signal of each route remain same. In second case low level congestion is observed at route 1 and its green signal duration is increased twice. Similarly, medium congestion and high congestion levels observed at route 3 and 4 respectively and green duration is increased accordingly as shown in figures.
The real-time implemented prototype of the dynamic traffic management system using IOT is shown in fig.6.

Fig6: Prototype of smart traffic management system

In this research work, a congestion level based dynamic traffic management using IoT is developed in three phases. In first phase the logic used to regulate traffic lights and simulations are done in Proteus. To test the logic the simulations are presented in four cases i-e normal routine, low, medium and high congestion levels. In next phase the real-time development of IoT in terms of unidirectional communication between the sensor node and gateway and bidirectional communication between the gateway and actuator node is done using the Node-Red software.

Finally, real-time implementation in terms of prototype is developed. The real-time traffic situation is presented on Node-Red and it is also stored in terms of congestion levels at particular route to improve the logic for further improvement in traffic management. In future, a dynamic solution for emergency vehicles can also be integrated within this traffic management solution using IoT. Moreover, AI can be incorporated to the system to make robust traffic management system.

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