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IOT Based Traffic Control for Smart Cities Using Wireless Sensors Networks

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Abstract: The project aims to design a dynamic traffic signal system based on density, where the timing of the signal will adjust automatically when the traffic density is detected at any junction. In most cities around the world, traffic congestion is a serious problem and it is therefore time to change more manual or fixed timer mode to an automated decision-making system and also to provide special schedule for emergency vehicle. The current traffic signalling system is based on fixed time, which may make it inefficient if one lane is operational than the other lanes. In addition, the proposed system has innovative services that allow drivers to remotely monitor the traffic rate and the number of parking spaces accessible to their destination using an Android smartphone app to prevent traffic jams and take another alternative route to avoid getting stuck and also to make it easier for drivers to avoid unnecessary trips while searching for a free parking space. In order to connect people to a smart city, our system combines three linked smart subsystems (cross-road management, parking space management, and a mobile application). It also implements the proposed Spherical Routing Protocol (SpRP) and tests its performance metrics.

Keywords: traffic signal, Arduino, microcontroller, automated system.

I. INTRODUCTION

In today's high-speed life, traffic congestion in our day-to-day activities is a serious concern. This decreases the productivity of the individual and thus the group as the signals waste a lot of working time. The key factors for this chaotic congestion are the high number of traffic, insufficient infrastructure and the unreasonable distribution of the signalling system. It also indirectly contributes to the rise in the amount of emissions because, in most cases, engines remain on, a huge volume of natural resources in the form of petrol and diesel is consumed without any fruitful result. In this article, in order to make roads and cities smarter, we will present an intelligent and connected system focused on the deployment and implementation of Wireless Sensor Networks (WSNs) at road intersections and even in car parks. This system differs from current systems in that it integrates two intelligent systems (a traffic light control system and an intelligent parking system) into one revolutionary system in order to connect people remotely and in real time to roads and parking spaces in their city using only one mobile application [1].

II. LITERATURE REVIEW

A new intelligent traffic management and traffic light control framework (S5) based on wireless sensor networks is proposed by the authors in [3]. This sensor nodes are placed along the roads that form a road junction. The data collected by the sensors is sent to the two-traffic signal controller to determine the traffic congestion conditions at the intersection of each road and to forecast the status of traffic jams. This device uses a protocol of self-organization (Alg5) that establishes a star topology between the network's various nodes. However, for some nodes, the algorithm implemented by this system will generate dark areas far from their corresponding central node, which they will not be able to interact with and which will allow the consistency and feasibility of this system to deteriorate. This approach allows traffic lights to be continuously controlled in compliance with the traffic congestion status achieved at the intersection, and also enables the synchronization process of traffic light management to be programmed in order to prevent traffic jams prior to their creation. This system's knowledge is beyond the control of drivers and people because they do not communicate with the remote system and do not connect in real time to roads either.

The writers in [2] suggest a scheme based on mobile devices and Bluetooth beacons with low energy consumption to track road traffic. In order to measure the intensity of the RSSI signal when receiving radio frequency frames generated by Bluetooth beacons across the street, the vehicle tracking provided by this method incorporates mobile devices (e.g. smartphones) mounted on the side of the lane. To distinguish and classify the type of vehicles driving on the route, Bluetooth beacons are mounted along the road at various heights (cars or trucks). In order to calculate the density of road congestion and track road traffic, the RSSI values identified by mobile devices on each route, as well as their

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locations, are transmitted to a server through a cellular network or Wi-Fi communication. Bluetooth technology, on the other hand, can cause significant synchronization problems and contact breakdowns between the BLE beacon and the mobile, which, especially in the case of heavy traffic, have a negative effect on the system's feasibility. So, to restore contact, an agent must be on-site to connect the two machines.

III. OBJECTIVE OF THE PROJECT

- Our project aims to minimize traffic congestion and unnecessary long time delays, at traffic signals.
- In order to minimize congestion at these junctions, it is planned to be used in areas close to the junctions where the traffic signals are located.
- This keeps track of the cars on each route and sets the timing for each traffic light signal accordingly.
- The higher the number of cars on the lane, the longer the time interval assigned for the required traffic light signal would be.
- The key aim of this project is to not wait for the signal if there will be no traffic on the other signal. The computer will ignore the signal and switch on to the next one.

IV. BLOCK DIAGRAM

The method we propose defines the traffic density of individual lanes and thereby controls the synchronization of the timing of the signals. IR sensors count the obstructions and provide an indication on a specific lane of the traffic density and feed this response to a controller device that will make the required decisions as and when necessary.

COMPONENTS REQUIREMENT

A. MICA MOTE

Mica Mote Block Diagram shown in fig. 1.

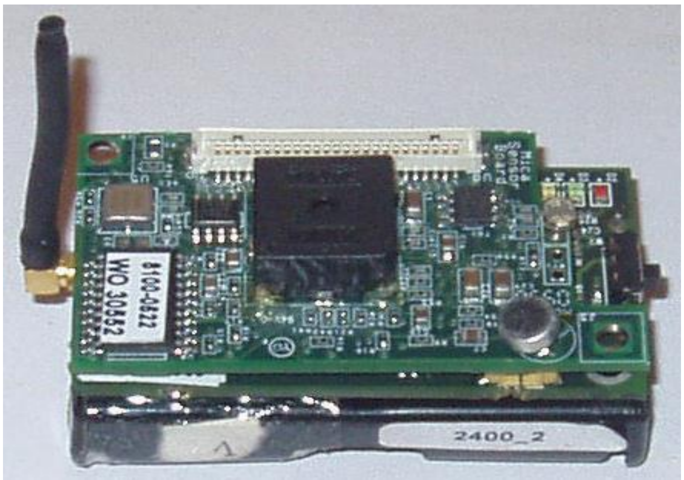

Fig. 1: Mica Mote Block Diagram

B. *TECHNICAL SPECIFICATIONS:*

- Microcontroller: Microchip ATmega328P
- Operating Voltage: 5 Volts
- Input Voltage: 7 to 20 Volts
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz

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- Length: 68.6 mm
- Width: 53.4 mm
- Weight: 25 g

C. *Radio Frequency Identification (RFID)*

RFID: A Radio Frequency Identification (RFID) system consists of RFID controller and RFID Tag.

RFID Controller: The RFID controller consists of an interrogator of RFID. This interrogator is used for RFID tag contact. Then the RFID handler gets the signals/data the interrogator receives. To transmit commands and data messages from the controller modules, messaging interference is used. The center of the controller is inside the RFID controller. Depending on the setup, the controller core listens to the interrogators and the controller core can perform read/write operations on the RFID tag, or can perform both listening and executing operations. The RFID controller will provide a serial port from which it can be interconnected with external GSM/GPRS systems to make a dual radio system.

RFID Tag: RFID tags are wireless sensors that are used to transmit data using radio frequency electromagnetic fields, which are used to mark and trace objects. There are two kinds of RFID tags: Active and Inactive. Active RFID has an installed battery and does not have passive RFID. Passive RFID has to rely on external source for running. Details about tags may be stored in a non-volatile memory.

D. *IR Sensor*

Two kits include an IR sensor or infrared sensor, a transmitter and a receiver. The infrared waves are emitted by transmitters traveling through space. If the object is observed, the receiver sends waves that are reflected to the receiver and more instructions to the electronic circuitry. Vehicles on board with an IR sensor are capable of warning the driver about surrounding vehicles [1].

V. METHODOLOGY

A big concern is road congestion. Owing to this issue of congestion, the time required for travelling would be increased. Using wireless technologies with ELB-REV4 iSCADA development boards and sensors, a concept was developed. An algorithm has also been developed so that a signal can travel through a larger number of vehicles. Different types of vehicles will be assigned priorities. Emergency vehicles will have the highest priority, such as ambulances, fire engines, etc.

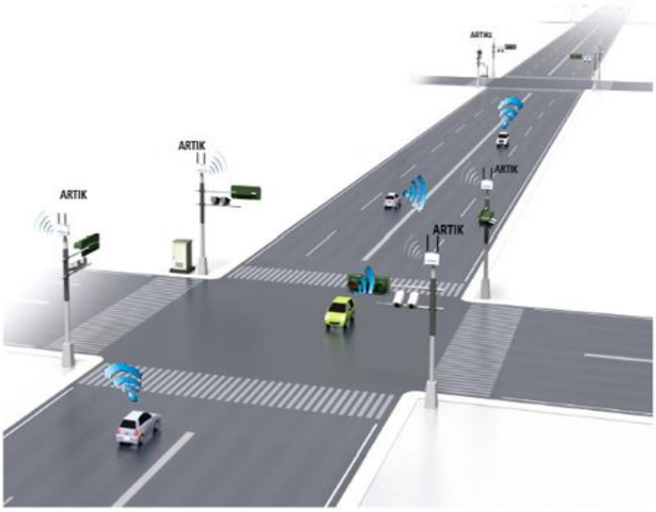

Fig. 2: Deployment of wireless sensor networks

The next one will be given to VIPs. Oh, next to regular cars. Depending on the vehicle density on one side of the lane, priority was also granted. The route that has a higher number of cars will have the highest priority. RFID is used specifically to map objects. In showrooms, RFID readers and tags are used so that after paying the bill, no one makes off with any item or content. This RFID is also used for tracking vehicles that are missing. When the special RFID tag ID of missing vehicles is identified, so their location is retrieved from where they are located. The green route for

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emergency services was also planned to include a green light in order to get the right-of-way for the ambulance. But the downside of this is that all cars would try to start going in that open road, which, as seen in figures 2 and 3, will generate still more emergency traffic.

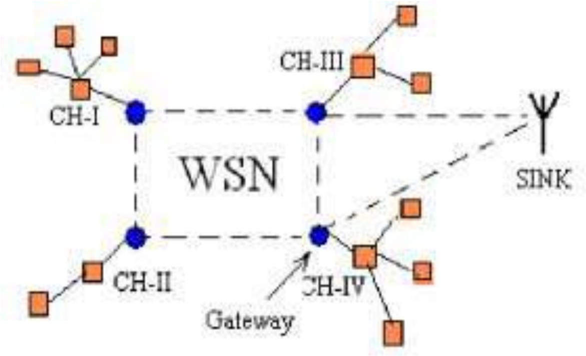

Fig. 3: Wireless Sensor Networks

Sensors are used to record environmental changes, such as temperature, wind velocity, pressure, fog, etc. The data recorded is sent to gateways such as Ethernet, a mobile cellular network. With regard to the traffic control system, the wireless sensor network is divided into three architectures-adhoc, infrastructure, and hybrid. Three types of sensors are used in the Adhoc architecture: path, car, road and vehicle sensors. Infrastructure design focuses on road infrastructure upgrades, while hybrid architecture is a mixture of the two [6].

VI. RESULT AND DISCUSSION

The project is a production of study and execution for one year. When applied separately, the circuits operate according to the specified output, but during the convergence of both, output fluctuates and each time displays distinct responses. This may be an issue with the loose ties of the wires or the bread board internal wiring used. This project lists the findings collected from the practical work and discusses whether the actual implementation follows the ideas / solution methods proposed in science. The primary contact for this project is through the use of IR technologies. The following findings were derived from a series of experiments:

- Traffic can be cleared without any irregularities
- Time can be shared evenly for all intersections
- Effective time management.

Fig. 4: Traffic Monitoring

We would provide alternatives to congestion, road clearing for emergency services and monitoring of stolen vehicles under this proposed approach. And one of the system's key plus points is that we built it in automatic mode and manual mode. The decision can be taken in the automatic mode, based on the performance of the sensors. But the driver takes over in manual mode. The proposed Spherical Grid Routing protocol (SGRP) performance metrics are evaluated as i.e.

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transmitted packet, received packet, packet distribution ratio, average throughput and average residual energy output metrics estimates.

Video analysis consists of a smart camera consisting of sensors, a processing unit and a contact unit. By making use of a smart camera, traffic is constantly tracked. To decrease the transmitting bandwidth, the video captured is compressed. This collected video is then used to quantify various statistics on traffic, such as speed, vehicle frequency, and lane occupancy.

VII. CONCLUSION

The need for an effective traffic management system in our country is demanding, as India faces 384 road accidents every day. In this initiative, an innovative infrastructure is planned to reduce this congestion and unnecessary time gap in traffic. The maddening confusion of traffic can be efficiently channelized with the field implementation of this technology by spreading the time slots depending on the merit of the vehicle load in such multi junction crossing lanes. We have successfully applied the prototype with impressive performance on a laboratory scale. The next step forward is to apply this scheme with first-hand consequences of real life situations, before applying it on the largest scale. We assume that this will bring about a fundamental shift in the traffic management framework in its real field area implementation.

An ambulance will be able to coordinate with all base stations in the potential progress of the Traffic Monitoring Signal (TMS) in order to secure an open lane to arrive at the hospital on schedule.

Using various features of hardware components in the IoT, TMS timing was developed. Using IoT platforms for optimal use, traffic optimization is accomplished by allocating differing times to all traffic signals according to the number of vehicles on the route. In their respective areas, TMS can help consumers understand correct signal timing and traffic flow rate.

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