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Intelligent Traffic Signal System using Energy Saving WSN Mechanism

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Abstract:- In India traffic is the most important concern of major metropolitan cities. Traditional traffic signal system only gives instructions to stop and not to vehicle driver. But if someone is breaking the signal then this system is not able to catch them and there are chances of taking bribe also includes lots of human efforts. The current situation of the system is tracing violation. But the drawback of this current situation is, engaging lot of human efforts also the tracing of the violation is not continuous as it is done manually. Therefore to increase the security of traffic signal and to reduce human efforts and to avoid the bribery we are introducing Intelligent/Smart Traffic Signal System through this research paper. In this paper, an approach to make the traffic signal adaptive to the dynamic traffic flow using wireless sensor network is proposed.

Keywords:- *Intelligent Traffic; Microcontroller; Tracking Violation.*

I. INTRODUCTION

In today's date traffic is the foremost concern and there is tremendous responsibility on Traffic Control Department of Government. It looks like traditional traffic control system is not helping anymore. As even if public violates the traffic rule there is no hindrance or stoppage. Even if there are traffic police controller we have bribery issues. Intelligent traffic signal is based on the microcontroller & Infra-Red (IR) sensors, in which IR sensors are placed at one both the sides of road in a way so as to cover particular necessary area of road. Also the IR sensors (transmitter & Receiver) are placed on both the side of zebra crossing. So if the signal is red and if any vehicle even touches the zebra crossing then the IR sensors immediately detect it and take immediate action to buzz the alarm along with camera capture the image of that vehicle. The advantage of the buzzer is, people will get aware if anyone is violating rules hence it avoids accidental issues. It also makes record of when, where, which vehicle is breaking the signal by saving image in particular folder as name of current date and time and later on can host it on the web server. As not only the safety issue is concerned, but also to make the traffic signal adaptive to the traffic flow (density). As mentioned above IR sensors are mounted across the road covering the specific necessary area. According to the IR sensors, the traffic density is determined. Whichever route has the highest traffic flow, priority will be given to that route. This will help in no traffic congestion and will also minimize the probability of avoiding accidents and violation of rules.

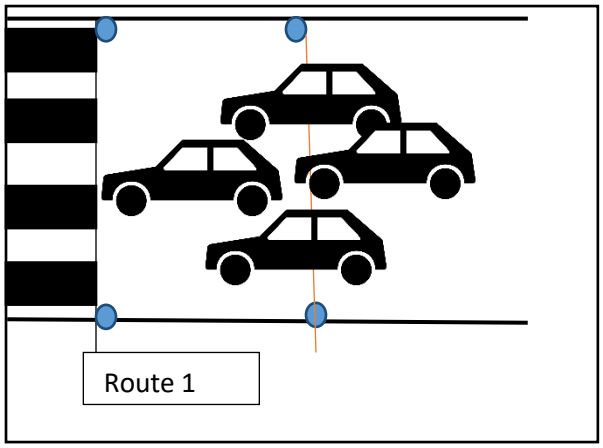

Fig 1:- Overview of the Density Concept

II. PROPOSED SYSTEM

Intelligent traffic signal device is made of these fourbasic things that are infra-red sensor for detecting the vehicle passing or touching the zebra crossing when signal is red, Microcontroller (AT89C205)for examining the input coming from infra-red sensor and give instruction to camera to capture image. Wi-Fi Moduleis used to transmitting and receiving signals of all inputs. Raspberry Pi B3 Model for all the processing. The IR sensors covers the area horizontally. The number of sensors on the both sides is increased for more accuracy.This same system is applied on the opposite side of road. Range of these two sensors are fixed as width of the road required to block with respect to signal. With the help of this Smart Signal System most of the road mishaps can be avoided.

III. CONCEPT OF ITSS

Objective 1.

To enable the system to detect vehicle and capture image with respect to RED, YELLOW and GREEN Traffic signal is the base. The input to the system is provided by Infra-red sensors signal for accomplishing the given task. When the green signal is turned off, this system will start working, IR sensor detects the vehicle passing through the zebra crossing and give input to the controller and it will capture image through camera and store it in the given memory. By this violation of traffic signal rules can be avoided, also the mishaps of road accidents can be minimized.

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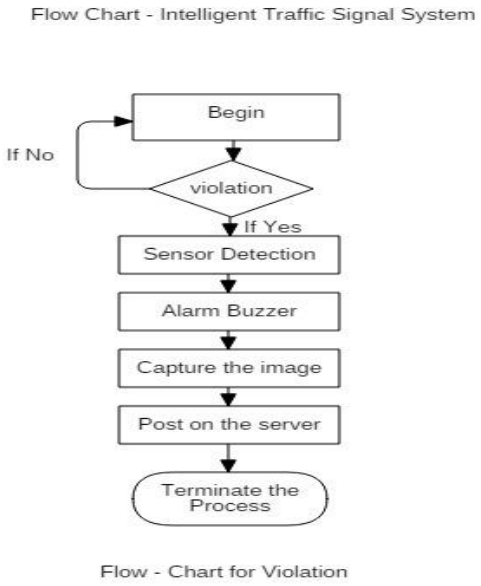

Fig 2. Flowchart for Violation

Objective 2.

To enable the system to map the density of the road, to avoid the unnecessary congestion in traffic which leads to the violation of rules and mishaps. In this concept, IR sensors (pair) which are stacked on the side of the road leaving a specific area will map the density of the vehicles.

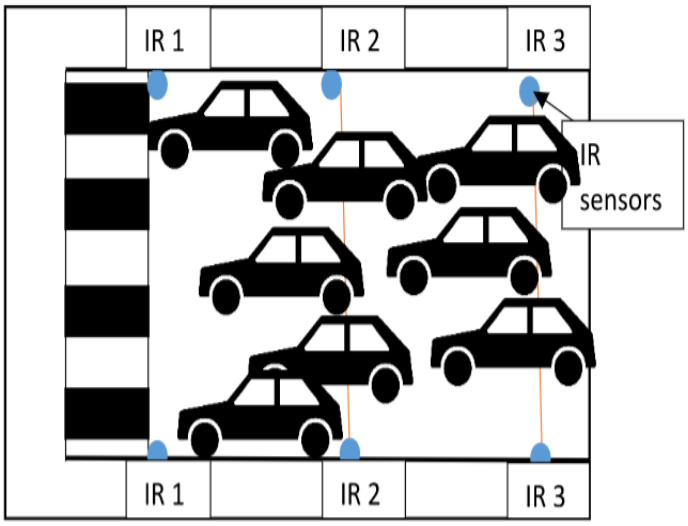

Fig 3:- Density Concept

In this figure, the density of the vehicle is till IR 3, hence the density is high in this route. Taking this scenario into consideration, timer of the traffic signal can be changed, it can be minimized to the route that is having the maximum density. The route which is having the highest density will be given the first priority. This will not lead to the congestion of the traffic.

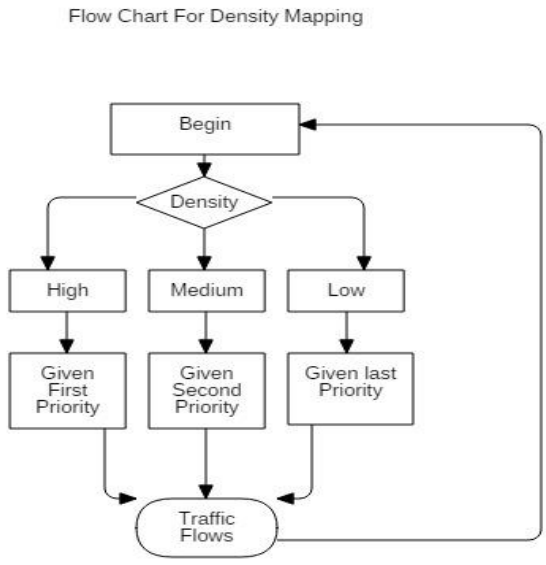

Fig 4:- Flowchart for Density

IV. WORKING OFITSS

- *Density Mapping*

```
int L1H, L1M, L1L;                    //All Active Low
int L2H, L2M, L2L;                    //All Active Low
State portmap = state_Lane;
Switch (Portmap)
{
Case 1: (L1H)
    //let L1 move for 3mins
Case 2: (L1M)
    //let L1 move for 2 mins
Case 3: (L1L)
    //let L1 move for 1 min
Case 4: (L2H)
    //let L2 move for 3 mins
     Case 5: (L2M)
    //let L2 move for 2 mins
Case 6: (L2L)
    //let L2 move for 1 min
     Case 7: (L1H=L2H)
    //Set the L1 Timer =90 secs
    //Set the L2 Timer = 90 secs
}
Here,
L1 = lane 1; L2 = lane 2,
H = High, M = Medium, L = Low.
```

We have taken two routes (L1 & L2), according to their traffic density, they have been given the priorities. If L1 has the high density then the timer for L1 is increased to 3mins (for an instance). If L1 has the medium density then its timer is 2 mins and if the density of L1 is low then timer is 1 min.

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Same statistics is used for L2. Now taking into consideration rarest situation of both the lanes having heavy flow of traffic, then timers of both the lane are made equal (in case of high density).

- *Mathematical Model for Violation*

```
int L1A, L2A, L3A;              //All active Low
Alert = lane;
Switch(alert)
    {
    Case (L1A): (A==1)
    // Buzz the alarm, capture the image &generate alerts.
    Case (L2A): (A==1)
    // Buzz the alarm, capture the image &generate alerts.
    Case (L3A): (A==1)
    // Buzz the alarm, capture the image &generate alerts.
    Case (default): //sleep mode
    }
```

Here L1= lane 1, L2= lane 2, L3= lane 3;
A= Alert

If the alert is generated, IR sensors are triggered, alarm is buzzed and the image is captured.

Otherwise, the sensors are in sleep mode.

V. COMPONENTS INVOLVED IN THE SYSTEM

A. Raspberry Pi B3 Model

The Raspberry Pi is a series of smallSingle- board computers developed in the United Kingdom by the Raspberry Pi Foundation.

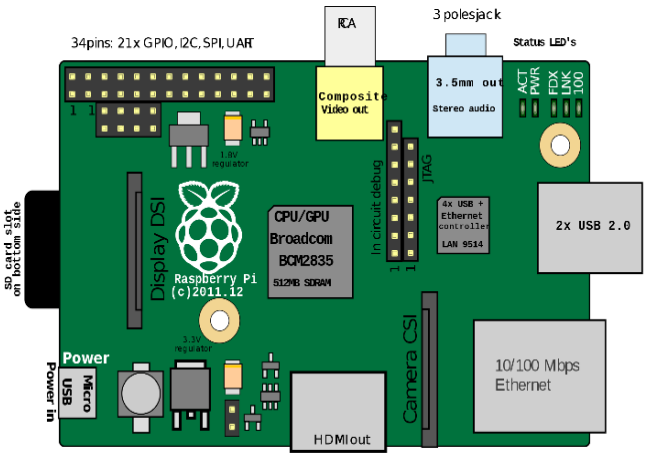

Fig 5:- Raspberry Pi B3 Model

B. IR Sensors

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measures only infrared radiation, rather than emitting it that is called as a passive IR sensor. A passive infrared sensor (PIR sensor) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.

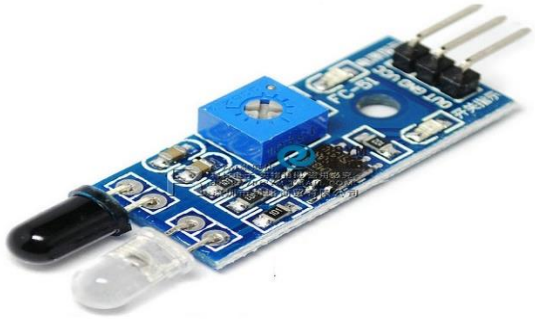

Fig 6:- IR Sensors

C. WI-FI Module ESP8266

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation. The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.The successor to these microcontroller chips is the ESP32.

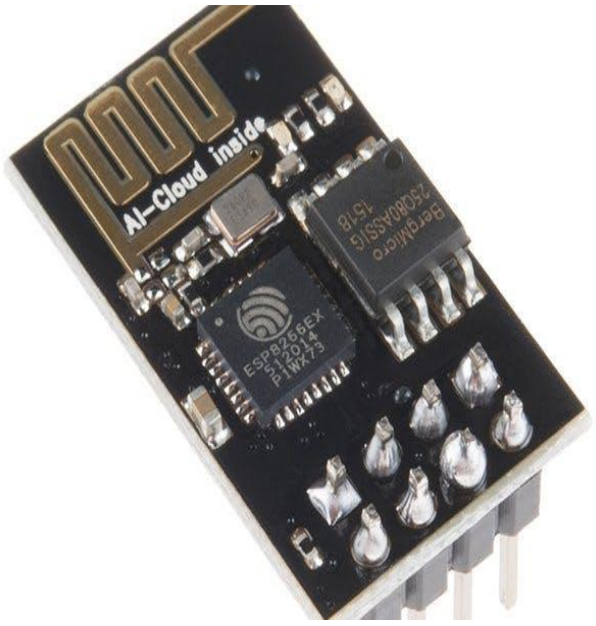

Fig 6:- WI-FI Module ESP8266

VI. CONSLUSION

Signal	Violation	IR
Red	Yes	Active mode
Red	No	Sleep Mode
Green	--	Circuit breaks

To develop self-decision making “Intelligent Traffic Signal System” using Energy Optimized WSN Mechanism for better Traffic Control. This system creates a secure zone on the road also gives advantages of reducing human efforts, automation of the system to the existing system.

VII. ACKNOWLEDGEMENT

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