International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 05 | May 2019 www.irjet.net p-ISSN: 2395-0072

IoT Based Adaptive Traffic Monitoring

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Abstract: *Trespassing the traffic rules and increasing vehicular traffic are the considerable problem every country in the world is facing. Therefore, it is required to explore the options to better accommodate the increasing demand of traffic control and stop breaching the traffic rules. One of them is the development of simulated model and optimization of traffic control. The new architecture and design theory of this system is integrated with a lot of hardware modules such as AVR 328 microcontroller as a control unit to combine with raspberry pi by the hardware/software co-design, the new traffic control system can be designed. The possibilities of traffic jams, caused by traffic lights can be dodged by simply retiming traffic lights can provide significant benefits by reducing vehicle stops, travel times, and fuel consumption. Also, the breaching of red light can be evaded by using a camera with raspberry pi. This can be done with the help of IR sensors.*

Key words: traffic control, AVR 328 microcontroller, Arduino, raspberry pi, traffic lights, camera, IR sensors, TSOP sensor.

1.INTRODUCTION

Traffic research has the goal to optimize traffic flow of people and goods. As the number of vehicles running on the road is increasing continuously, the infrastructure of traffic regulation system must be updated.
The increasing number of vehicles and the lower phase of highways developments have led to traffic congestion problem. There are many factors that lead to traffic congestion such as the density of vehicles on the roads, human habits, social behavior, and traffic light system. One major factor is due to the traffic light system that controls the traffic at junction. No doubt traffic police are there to regulate the traffic congestion, but what if there is an automated system which regulates the traffic and also keeps an eye on the people who are violating the traffic rules? In this paper, the idea of automated traffic control is suggested. This project has main three parts viz. Density detection and varying time according to density of vehicles, detecting signal jump, capturing the image of the person jumping the signal and sending it.

1.1 Hardware Platform

Hardware platform contains all the hardware that are going to be used to implement it. To detect the density of vehicles, we need IR sensors. A set of four IR sensors are used. Three are used for showing low, medium and high density and one is used to detect the signal jump. Along with IR sensors, we need a microcontroller to collect the results of sensors and take further action. We are using AVR 328 for this project. A LCD is used to show the density status. Three LED represents the traffic light viz. red, yellow and green. For capturing images and sending mails we are using Raspberry pi 2B. A memory card is inserted in raspberry pi. Apart from these, a 12V DC motor, LAN/WiFi and camera are needed.

1.2 Software Platform

Software required for the raspberry pi are as follows:

1. Raspbian OS (for Raspberry Pi)
2. Python (Development)
3. SMTP Client Software (Mail)
4. ssmtp(delivers email)
5. fswebcam(To take pictures from camera)
6. Mailutils(for delivering email through command line)
7. Mpack(Processing of signals received from sensors)

Apart from these raspberry software, we need Arduino to write a code for microcontroller.

2. Detecting vehicle density[1]

It is easy task as compared to others. This will be done by the three IR sensors. These three IR sensors are placed on either side of the road at a distance from each other. The reason of using IR sensor is that it detects the obstacle. When the vehicles comes in the range of the sensor, it detects an obstacle. On the RED light, when only one IR sensor detects the obstacle, it means the density of vehicles is low. When two IR sensors are ON at the same time, it means the density is medium. And when all three sensors are ON at the same time it means the density is high. These IR sensor's output is given to comparator IC LM393. These ICs are used to convert the analog signal into digital for the further processing of microcontroller as it requires digital signals.

This data is given to microcontroller. Now, microcontroller varies the timing of green signal to clear the traffic according to the vehicle density. The code for this condition is written in Arduino.

2.1. Detecting signal jump[2]

To detect a signal jump, IR sensor is used. It will work only when RED signal is ON. The logic of using IR sensor here is that, whenever a person breaks the signal, he/she will come in range of the IR sensor and this will turn it ON. The signal will be sent to microcontroller and it will turn the raspberry pi ON. Now, raspberry pi will click the picture of the number plate of the vehicle. Also, if anyone stops the vehicle on the zebra crossing, then it will be considered as a signal jump. This is done to prevent people from stopping on zebra crossings.
There's one more feature added to slow down the speeds of vehicles. When the RED signal is ON, a speed breaker will come up to discourage people from jumping the signal. It will go down automatically when the signal turns GREEN. This will be done with the help of 12V DC motor. This motor is driven by microcontroller and a motor driver IC L293D.
The motor is rotated clock-wise and counter clock-wise on RED and GREEN light respectively.

2.2. Capturing image and sending it

Here comes the role of raspberry pi. First install the raspbian OS to get it functional.
When a signal jump is detected, the raspberry pi turns ON and it captures the image by the camera. To capture the image, fswebcam must be installed in raspberry pi. Without this, it will not capture the images. After capturing the image, the image is saved in memory card. Now, to mail the captured image, SMTP and ssmtp must be installed in raspberry pi. Also, if you want to deliver the mails through command line, then you have to install mail utils.
This mail is sent to the authorized mail id which was given in the code. The authorized person gets the image of the vehicle's number breaking the signal and the action to be taken place is easier.

2.3. Special remote for ambulance

It will be difficult for ambulance to go through the traffic when there are vehicles stopped in front of it because of red light. So, to overcome this problem, ambulances are to be given an IR remote to change the signal from RED to GREEN so that traffic will be cleared and ambulance can go without any problem. We need a TSOP sensor for this purpose. TSOP sensor is the IR receiver sensor. It will receive the signal from IR remote and give signal to microcontroller so that microcontroller will change the signal light accordingly.
The IR remote is any ready-made simple IR remote. To get it compatible with the project, we need to write a code for it. This can be done with the help of programming in Arduino. Write a code to decode[3] the IR remote buttons, make a simple circuit on Arduino board with TSOP sensor and you will be able to decode the remote. After this you can assign any desired button to change the red light to green.

3. Conclusions

The project was implemented on small scale and all the methodologies described above are full proof and functional. The timing of the green signal is varied as defined according to the density of vehicles. Photo of number plate of the vehicle jumping the signal captured and mailed successfully. Also, the IR remote works fine with the TSOP sensor.

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