Design and Implementation of Traffic Density Controller using Wireless Communications

S Monika, T Anuradha, S V S Prasad

Abstract--- In large urban areas, vehicular traffic has been increasing day by day. As the number of road user's increase constantly and current resources & infrastructures being limited; a smart traffic control will become a very important issue in the future. This paper introduces a system which works with AVR Microcontroller interfaced with IR sensors and photodiodes which are used to detect density of traffic. In this model three LED's of different colors -RED, GREEN, YELLOW - have been used. For gauging the traffic density IR sensors have been used here and programming of the Microcontroller has been done on the basis of traffic density measurement. The microcontroller can be operated with the help of mobile app by connecting the controller with Bluetooth or Wi-Fi. This mobile app will on or off the traffic signals depending on the density of the traffic. This mobile app will allow the vehicles in high density traffic area to go first. So, this system solves problems like traffic jams, accidents etc and clear traffic for emergencies like ambulance vehicles and fire grade vehicles.

Key words: AVR Microcontroller (ATMEGA 328), Bluetooth Module or Wi-Fi Module, IR Sensors

1. INTRODUCTION

With the increasing traffic in metro cities, it is giving rise to number of problems like traffic jams, accidents and traffic rule violation at the heavy traffic signals. These problems have led to an ever increasing demand for an "intelligent" traffic control system. Getting stuck in between heavy traffic is a headache for each and every individual driving the vehicle and even to the traffic police in controlling the traffic. The traffic is increasing day by day due to increase in automobiles at faster rate and also because of large time delays between traffic lights. So, to solve this problem, we go for traffic density controller. In olden days the traffic was controlled by traffic policeman present at each junction and manually controlling the traffic through hand signaling. However this was clumsy and unmanageable and this led to different type of traffic control using traffic lights.

The history of the traffic light control started in 1868 when the first traffic light system was installed in London to control the traffic and today this system could be seen in all major cities of the world. A calculated timing circuit is found in almost all the traffic lights around the world.

Fig1.1: Traffic congestion in metro cities

Fig1.2: Traditional way of controlling traffic

The problem of traffic light control can be solved using microcontroller based traffic density controller system. With this system, priority to heavy traffic is given by considering the density of traffic on the roads by installing IR Transmitter and IR receiver on the road intersections.

2. LITERATURE REVIEW

An approach has been developed using differential techniques for detecting the traffic using real time traffic flux. The flux estimation is done by counting pixels of object and pixels of background. Traffic flux density changes depending on the variation of traffic on either side of the roads. Vehicle detection and counting is done using

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differential algorithm. The images are selected from the sequence and are implemented so that the time taken for computation is reduced. Threshold is fixed and according to that it is divided as low, medium and high traffic flux. There is a plot for traffic flux density; it's basically 1% flux density versus number of frames. Detection of vehicles is done according to this plot. Depending on the size of vehicle, flux changes. If the size of the vehicle is big then we have maximum amount of flux and if there is smaller vehicle there is minimum amount of flux [1].

P.F Alcantarilla proposed a traffic control system which automatically monitors the traffic using black and white camera. Computer vision techniques like event detection, motion estimation, recognition of objects are used to obtain the speed, size of and the count of number of vehicles. Frame-differencing algorithm is used to extract the information about objects which are moving. Finally, the Kalman filtering process is used to track the objects and measure the specifications such as location, size and the velocity with which the object is moving and according to these specifications the objects which are moving are divided as automobiles or any other unwanted problems [2].

3. PROPOSED MODEL

In the present existing traffic light system most of the traffic lights are allocated fixed time slots i.e., same time duration is allocated for both ON and OFF irrespective of the traffic intensity. In this system the traffic lights change automatically depending upon the traffic density on road.

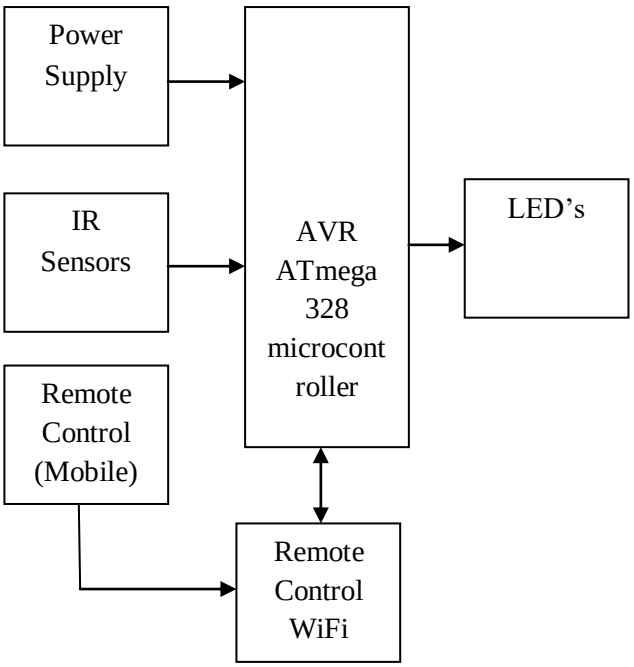

Fig 3.1: Block Diagram

Here the traffic lights change depending on the traffic density by using a Microcontroller based system accompanied with IR Sensor and LED devices which continuously monitor the density of traffic. The IR receiver output is given to microcontroller and this controller will allocate fixed timings according to the sensors input. When the traffic is cleared on one lane, the same process repeats for another lane. Each lane has a microcontroller and three pairs of IR sensors placed near to traffic signals. This process repeats for other three lanes based on the priority of traffic and an algorithm called round robin algorithm is used. So the traffic on each lane is cleared simultaneously by avoiding the waiting time and fuel loss of vehicles [3].

3.1 IR Sensors

In this module IR sensors are interfaced to the microcontroller to measure the traffic density. These sensors are fixed on each side of the road to detect the heavy traffic on the lanes. If there is heavy traffic on a particular side of the road then that particular sensor output becomes either logic zero or logic one. Based on logic 0 and logic 1 output the microcontroller decreases or increases the glow time of the green LED of that particular side of the lane. If the output is logic 0 then the microcontroller decreases the glow time of the green LED and if the output is logic 1 then the microcontroller increases the glow time of the green LED.

3.2 AVR Microcontroller

The microcontroller used in this proposed model is AVR ATmega328 Microcontroller. The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller has 32KB of programmable flash memory, 2KB SRAM, 1KB EEPROM, an 8-channel 10-bit A/D converter, and a JTAG interface for on-chip debugging. This controller operates between 4.5v to 5.5v and has a frequency of 16MHz and a throughput of 16MIPS. Single clock instructions evenly distribute the power consumption and processing speed by achieving output of 1MIPS per MHz.

4. RESULT

An intelligent traffic density controller using wireless communication is implemented successfully. The IR sensors are arranged on all four lanes to detect the vehicles. Whenever an automobile passes through the sensor, microcontroller detects the vehicle and increases the time for green signal for that particular lane. The IR sensors are fixed in front of signals at some distance so that the microcontroller controls the traffic and reduces the traffic congestion.

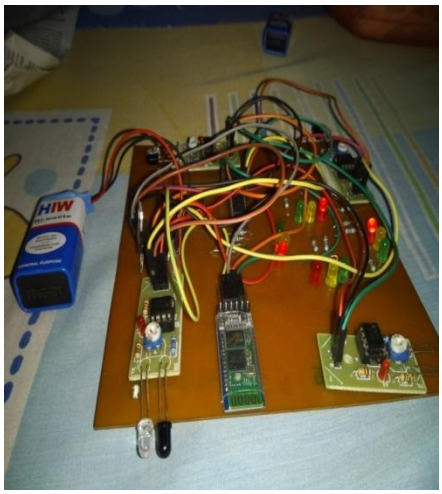

Fig 4.1: Hardware Module

Depending on the number of vehicles on each side, microcontroller decides the time for each lane. A simple demonstration is given below. Suppose there is heavy traffic on lane 1 then the time of green signal is increased for lane 1. Then again it checks for heavy traffic in other lanes, and again the same procedure repeats in round robin fashion. Thus it simultaneously clears the traffic on all four lanes.

5. CONCLUSION

Thus in this proposed model, an advanced traffic light controller for densely populated areas using IR sensors and microcontroller is implemented. By using this system we can avoid many problems like traffic jams, accidents and violation of traffic rules to a great extent. We can save our most valuable time for various other purposes rather than in heavy traffic jams. The traffic signals change depending on the priority of heavy traffic on four sides. Based on the density of traffic present on roads and on the basis of vehicle count, the microcontroller decides the delays in traffic lights for next recording interval.

6. FUTURE SCOPE

In future this system can be implemented in a more advanced way by installing cameras at the traffic signals and based on these images captured by the camera the traffic lights can be ON and OFF depending on the density of traffic. This system can also be used to inform people about different places traffic condition. The data can be transferred using a telephone network between microcontroller and computer. By using this technique an individual can accumulate the data recorded from remote places to his home computer without going there. The traffic can be controlled for the whole city by sitting at one place.

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