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Microcontroller Based Advance Traffic Light System Using Voice Recorder

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Abstract: *This paper proposes an intelligent way of reducing the problem of traffic congestion on the road network which has become very severe nowadays. In this contemporary scenario this work suggests new and alternative method for improving the efficiency of the existing road network. In today's world most of the traffic light systems are based on Microcontroller or Microprocessor with fixed time delays for green light and red light with no or less arrangement for contingency situation. At this situation this paper explores an alternative approach to manage this problem in best apposite way. This Microcontroller based project has co-opted the density of the traffic on the road network as a prime focal irrespective of the conventional traffic system in which time is assigned without calculation of the density on the road crossing. In this paper time duration has been assigned on the basis of the traffic rather than on fixed time basis with an extra arrangement for the contingency situation. To handle the emergency situation, voice recorder is used with microcontroller where the voice of ambulance vehicle is already recorded and if the record voice math with the vehicle present on the road network then it will halt all the outgoing instruction and will furnish highest priority to the ambulance vehicle. 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. In this considered module three LED of different colour-RED, GREEN, YELLOW- has been used. In pursuance of this information, micro-controller will make a decision and then assign the glowing time of green light, yellow light and red light. It means that the timing of the traffic light is set according to the density of the vehicles. This is going to be very helpful in the reduction of the traffic congestion and it has a scope for further expansion in future.*

Keywords: *Intelligent Traffic light controller, Infrared Sensor (I.R), Voice Recorder, Robin Algorithm*

I Introduction

With the growth of the urbanization, industrialization and population, there has been a huge growth in the traffic. With growth in traffic, there is occurrence of bundle of problems too; these problems include traffic jams, accidents and traffic rule violation at the heavy traffic signals. In this situation traffic lights based on the voice intensity of the vehicle play an important role in traffic management. Traffic lights are the IR based signalling devices that are placed on the intersection points and employed to control the flow of traffic on the road. The history of the traffic light control goes back to 1868 when the first traffic lights system was installed in London and today this system could be found in all major cities of the world [4]. Most of the traffic lights around the world follow a predetermined timing circuit. Sometime the vehicles on the red light side have to wait for green signal even though there is little or no traffic. It results in the loss of valuable [1].

Traffic control at intersections is a matter of concern for large cities as shown in figure 1. Several attempts have been made to make traffic light's sequence dynamic so that these traffic lights operate according to the current volume of the traffic. Most of them use the sensor to calculate current volume of traffic but this approach has the limitation that these techniques based on counting of the vehicles and treats a emergency vehicles as the ordinary vehicles means no priority to ambulance, fire brigade or V.I.P vehicles. As a result, emergency vehicles stuck in traffic signal and waste their valuable time. Another limitation of this approach is that sensor based system needs the line of sight path between the sensor & vehicles which results in low performance [2].

The problem of traffic light control can be solved microcontroller based voice recorder system. With this system, we can consider the priority of different type of vehicles by gauging the intensity of voice level of the vehicle present on the crossing and also consider the density of traffic on the roads by installing IR Transmitter sensor and IR receiver sensor on the road intersections. Voice intensity recorder technique has been drawn enormous attention and is used for identification of the vehicle based on their voice intensity [4].

This paper is extremely useful in the context India where with scarcity of road network and ever increasing population exacerbated the problem of traffic management. In some cities the problem is so much so severe that the people have to wait for several hours. This given method of handling the problem of the traffic can be proved to be very beneficial for this country which is riding on the new initiative such as smart city mission, urbanization and migration settlement. Method employed here takes two dimension approaches for

handling the traffic i.e. both density present on the road and demand of the emergency vehicles such as fire arm, ambulance and VVIP caravan. After installation of this system we will not have to stop all vehicles on the road at the time of passing of the VVIP caravan which would have adverse implication over common citizen some time [7].

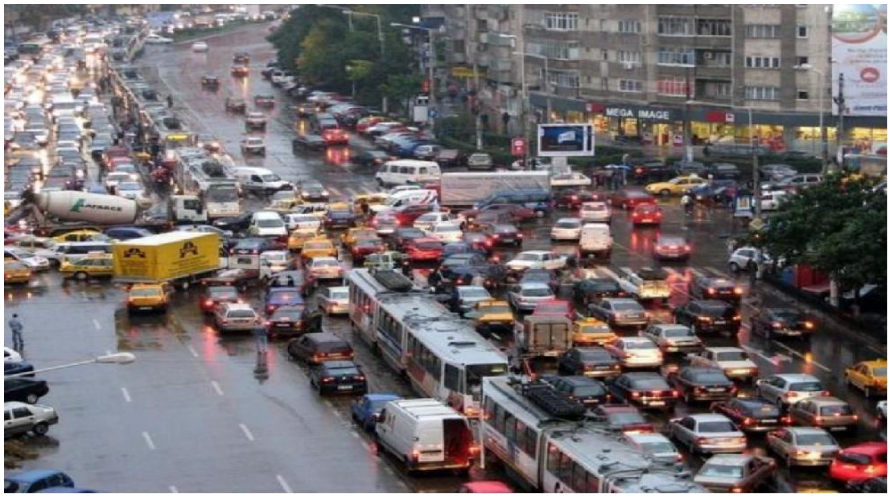

Fig. 1 Traffic congestion in metro cities

1.1 IR SENSORS

In this system we will use IR sensors to measure the traffic density. They are arranged on each side of the road and are interfaced to the microcontroller. Based on these sensors, controller detects the traffic and control the traffic system. IR sensors are connected to the microcontroller. If there is traffic on road then that particular sensor output becomes logic zero otherwise logic one. Based on logic 0 and logic 1 output, the microcontroller changes the glow time of the green LED of the corresponding junction to a higher value.

Thus as a number of vehicle increases, the green light glows for more time. An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings by either emitting and/or detecting infrared radiation. It is also capable of measuring heat of an object and detecting motion. Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation is the region having wavelengths longer than visible light wavelengths, but shorter than microwaves [6].

The infrared region is approximately demarcated from 0.75 to 1000µm. The wavelength region from 0.75 to 3µm is termed as near infrared, the region from 3 to 6µm is termed mid-infrared, and the region higher than 6µm is termed as far infrared.

1.2 LIGHT EMITTING DIODE

A light-emitting diode (LED) is a two-lead semiconductor light source as shown in figure 2. It is a p–n junction diode, which emits light when activated. When a suitable voltage is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the colour of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor.

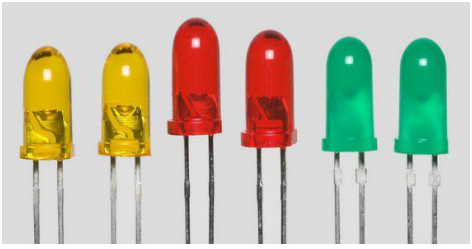

Fig.2 LED lights

1.3 MICROCONTROLLER

Micro-controller unit is constructed with ATMEGA32 Microcontroller chip. The high-performance, low-power Atmel 8-bit AVR RISC-based microcontroller combines 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. The device supports throughput of 16 MIPS at 16 MHz and operates between 4.5-5.5 volts. By executing instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power

consumption and processing speed.Its key parameters are mentioned in Table 1.

TABLE 1Key Parameters

S.N	PARAMETER	VALUES
1.	Flash (Kbytes)	32 Kbytes
2.	Pin count	44
3.	Max operating frequency	16 MHz
4.	CPU	8-bit AVR
5.	Touch channels	16
6.	Hardware acquisition	No
7.	Max i/o pins	32
8.	Exit interrupts	3
9.	USB speed	No
10.	USB interface	No

II Methodolgy And Algorithm

In presently used traffic light system most of the traffic lights are controlled on a fixed time basis i.e, same time duration will be for both ON and OFF irrespective of the traffic intensity. In considered paper the traffic light is managed depending upon the traffic density on road. Here the traffic lights changes dynamically based on the traffic density by using Microcontroller based system accompanying with IR Sensor and LED devices to continuously gauge the density of traffic. The IR receiver output is given as the input of microcontroller in serial communication. The microcontroller will allocate the time slot according to the input of sensors, and then the CPU sends appropriate time [5]. When the allocated time is completed then the process will be shift into the next road. The same procedure it follows on each road. This system is designed by using Microcontroller and three pairs of IR sensors on each lane. Here priority based operations by using the round robin algorithm is done. So that each road will be cleared simultaneously and this system is mainly used to reduce the waiting time, avoid fuel wastage, and also manage the traffic load at the intersection adaptively, so that the traffic can be avoided [5].
Algorithm used to implement this work is Robin Algorithm written below [4].

STEP 1- start
STEP 2- check sensors output
STEP 3- compare output of all other sensors
STEP 4- if lane 1 high
Green it
STEP 5- compare other 3
If lane 2 high
Yellow it
STEP 6- red all others
STEP 7- if any emergency vehicle
Go to STEP-9
Else
Again repeat above cycle
STEP 8- interrupt whole system
Allow only interrupt
STEP 9- after interrupt execution
STEP 10- again goes to main program.
STEP 11- repeat process
STEP 12- stop

III. Implementation

3.1 Software Implementation

On the basis of vehicle count, microcontroller decides the traffic light delays for each side. Traffic light

delays are classified as LOW, MEDIUM, HIGH range. Three ranges are predefined by varying vehicle count. The simulated circuit diagram of advance traffic light system, implemented for this work using Proteus software is shown in figure 3.

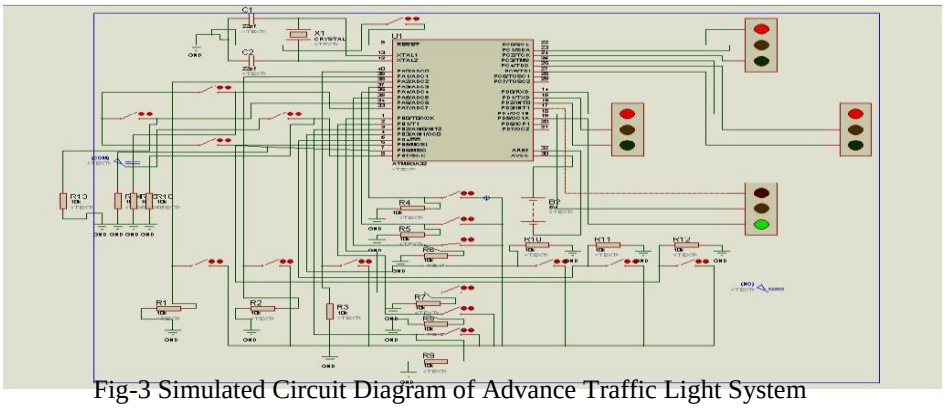

Fig-3 Simulated Circuit Diagram of Advance Traffic Light System

3.2 HARDWARE IMPLEMENTATION

The hardware implementation on Printed Circuit Board has been done in figure 4 where three pair of transmitter and receiver is used for checking the traffic density. In figure5 three different LED lights RED, YELLOW and GREEN are used in the circuit and according to the intensity of the vehicle on the road they will glow. These LEDs are later interfaced with Microcontroller. Preset circuit is seen in figure 6 which is used for the activation of the circuit and final PCB circuit are used in figure.7. These circuits are the basic building block of our hardware implementation.

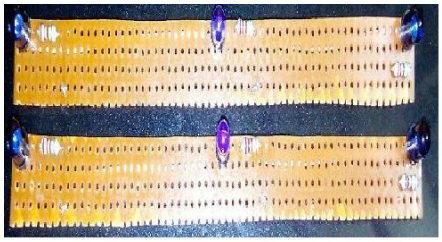

Fig.4 IR SENSOR

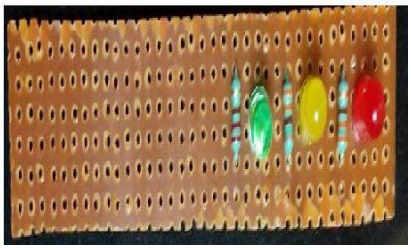

Fig.5 TRAFFIC LIGHT

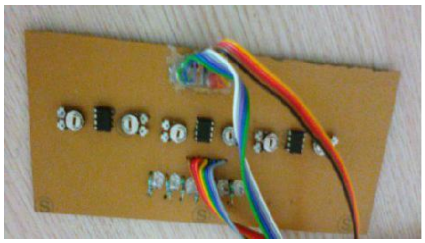

Fig.6 PRESET CIRCUIT

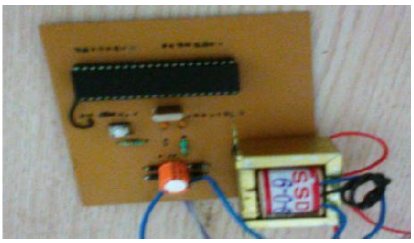

Fig.7 PCB CIRCUIT

IV. Result

Results include the successful operation of the intelligent traffic light control and monitoring system. The IR sensor with IR transmitter is placed at a gap. Gap acting as a prototype indicating a road. The system is placed near road as a standalone device. Whenever any obstacle like vehicle passes between IR transmitter and IR sensor, microcontroller detects and increase number of vehicle count in a recording interval for particular traffic light. Traffic light is placed ahead of IR sensor at a distance so that decision taken by microcontroller to control traffic light can help in reducing the congestion at traffic light. On the basis vehicle count microcontroller decide the traffic light delays for next recording interval. Traffic light delays are classified as LOW, MEDIUM, HIGH range. Thee ranges are predefined by varying vehicle count [6].
The working of the system can be demonstrated in the following tabular form.

Lane 1 is selected when the vehicle density is highest in lane 1 and second highest would be turned yellow i.e. lane2 as shown in Table 2.
Lane 2 is selected when the vehicle density is highest in lane 2 and second highest would be turned yellow. I.e.lane3 as shown in Table 3.

Lane 3 is selected when the vehicle density is highest in lane 1 and second highest would be turned yellow. i.e..lane4 as shown in Table 4.
Lane 4 is selected when the vehicle density is highest in lane 1 and second highest would be turned yellow. i.e.lane1 as shown in Table 5.

TABLE 2 LANE 1

LANES	GREEN LIGHT	YELLOW LIGHT	RED LIGHT
LANE 1	ON	OFF	OFF
LANE 2	OFF	ON	OFF
LANE 3	OFF	OFF	ON
LANE 4	OFF	OFF	ON

TABLE 4 LANE 3

LANES	GREEN LIGHT	YELLOW LIGHT	RED LIGHT
LANE 1	ON	OFF	OFF
LANE 2	OFF	ON	OFF
LANE 3	OFF	OFF	ON
LANE 4	OFF	OFF	ON

TABLE 3 LANE 2

LANES	GREEN LIGHT	YELLOW LIGHT	RED LIGHT
LANE 1	ON	OFF	OFF
LANE 2	OFF	ON	OFF
LANE 3	OFF	OFF	ON
LANE 4	OFF	OFF	ON

TABLE 5 LANE 4

LANES	GREEN LIGHT	YELLOW LIGHT	RED LIGHT
LANE 1	ON	OFF	OFF
LANE 2	OFF	ON	OFF
LANE 3	OFF	OFF	ON
LANE 4	OFF	OFF	ON

V. Conclusion

Thus in this paper authors have developed an advanced traffic light controller for densely populated Cities using IR sensors and microcontroller. By using this system configuration the possibilities of traffic jams are reduced, caused by traffic lights, to an extent and same is implemented successfully with the help of above mentioned techniques. Number of passing vehicle in the fixed time slot on the road will be decided on the basis of the density of vehicle present on the crossing and on the basis of vehicle count microcontroller decide the traffic light delays for next recording interval.

VI. Future Scope

In future this system can be used to inform people about different places traffic condition. Data transfer between the microcontroller and computer can also be done through telephone network .This technique allows the operator to gather the recorded data from a far end to his home computer without going there. Traffic lights can be increased to N number and traffic light control can be done for whole city by sitting on a single place.

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