Time Management in Traffic Signal Based on Vehicle Density and Emergency Vehicle

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Abstract - *Developing countries like India, 27% of air is being polluted by releasing carbon and sulfur dioxide in vehicle combustion due to heavy traffic congestion, it is the biggest contribution to air pollution. Every year, 2 million premature deaths are caused by releasing harmful gases in a traffic signal. Many advanced projects have been approved by the government to control air pollution. In that vision, "Intelligent traffic light control system: Towards smart city" ensures the maintenance of traffic congestion, clearance of emergency vehicles in traffic signal using RFID technology. But the implementation and maintenance of RFID tag are very complicated task and also it acquires time delay depends on IOT module in traffic signal which leads to air pollution from combustion of fossil fuels. The proposed system ensures the signal will change automatically by sensing the vehicle density by using IR Sensor and then release the emergency vehicle in a particular lane by receiving radio frequency. As a result, combustion of fossil fuel is limited to control air pollution and achieve time management by releasing the emergency vehicle quickly to reach the destination.*

Keywords: **IR Sensors, RF Transmitter and Receiver, Traffic Light, ATMEL 89S52 Micro-controller.**

1. INTRODUCTION

In modern life, everyone is facing many problems one of which is traffic congestion. The high volume of vehicles, the inadequate infrastructure and irrational distribution of the signaling system are the main reason for traffic congestion. This congestion causes air pollution due to the release of harmful gases (like Carbon dioxide, Nitrogen Oxides, and Hydrocarbon) and also leads to time delay, which may result in late arrival for employment, education, and also for emergency vehicle like ambulance, fire brigade, VIP vehicles. Hence this proposed system designed for controlling air pollution by releasing more vehicles in the desired direction on chaotic congestion based on vehicle density calculation using IR sensors on the roadside in a particular time and also managing the time delay of emergency vehicles in heavy traffic. The receiving of radio frequency on emergency vehicle that waiting at the traffic signal will get green signal immediately to cross the junction for emergency purpose. This proposed system designed better framework for managing time delay and controlling air pollution at heavy traffic congestion in highly crowed cities. Our research oriented reference paper describes many advanced technology to reduce traffic congestion in major cities.

Fig-1: Traffic congestion in major cities

In [1], one side of the junction is higher traffic density on longer green time as compared to standard allotted time, therefore here a mechanism is that the time period of green light and red light was assigned by the density of the traffic present at that time. The density is calculated by PIR Sensors, the glowing time of green light is assigned by the microcontroller (Arduino). The sensors which are present on each side of the road will detect the presence of the vehicles and transmit the signal to the microcontroller where it will decide how long will be open or change over the signal lights.

In [2], Traffic control system is proposed in Digital Image processing. Morphological image processing techniques are used for detection and removal of background noise. In this paper image of two roads are captured in the RGB format.

Afterwards, they are converted into gray scale monochromatic images. The captured images are subtracted from the reference image of respective roads. Finally edge detection is applied to the resultant image for object detection. The detected objects are counted and classified on pixels. The IOT (internet of things) based intelligent traffic light control system: Towards the smart city was designed to control the traffic signal in various ways like, Automatic signal control system, manual control system, clearance of emergency vehicles like ambulance, fire brigade, VIP vehicles and also detection of stolen vehicles in traffic signal. The automatic signal control system is designed with RFID Tags and RFID receiver when the vehicle enters into the range the receiver will transmit a unique RFID to the reader in [3], [4].

In [5] Same PIR sensor concept is implemented with similar variation in position. In [6] FPGA controller based Neuro-Fuzzy system with VHDL algorithm is designed to control the congestion at the current intersection and find the delay in traffic system and then synchronizing the signal at current interaction of neighboring signal. Th phase sequence module controls the phase sequence based on vehicle density and then extension time module allocates the green time based on the density of vehicle and flow of signal in the traffic system. In [7], Wireless Sensor Network (WSN) technique is used to control traffic congestion. Traffic System Communication Algorithm (TSCA) and traffic signal Time manipulation algorithm (TSTMA) both are used to change the traffic light. In [8], the Camera will be installed alongside the traffic light instead of electronic sensor. It will capture the image sequences that can be analyzed using digital image processing for vehicle detection.

In [9] Image acquisition, RGB to grayscale transformation and image enhancement system is designed to control traffic signal. This paper is similar to [5] because same RGB to grayscale transformation is implemented. MATLAB software is used here to generate a pixel signature count and then timer allocating time is controlled by MATLAB. And then microcontroller based hardware unit receives the code by serial port. Finally timer will allocate the traffic time depends on the signature code. In [11], the Microcontroller based RFID system is used to alter the traffic lights upon its arrival at traffic light junction which would save lives at critical times. Radio frequency identification is a tiny electronic gadgets that comprise of a small chip and an antenna. The small chip is embedded with information's about patience's status and the ambulance current location. The RFID reader located at the traffic signal reads the information from the RFID locator installed at the ambulance.

2. PROPOSED SYSTEM

The proposed system based on the domain of embedded system. Embedded system plays a major role in communication protocols. An embedded system is an electronic system or device which employs communication between hardware and software. In this system embedded function provides the physical connection from the microcontroller to IR sensors and virtual communication between radio frequency transmitter and receiver. Depends on the input from the sensor and radio transmitter, the microcontroller will perform that specified functions. ATMEL 89S52 microcontroller plays a major role in this proposed system. Traffic density can be identified by sensing of IR sensors on the road side, it will send the perfect density of vehicles in the traffic to the microcontroller. Based on the vehicle density from each lane that microcontroller will assign signal at the traffic light. If the vehicle density is low on any lane, the microcontroller will assign minimum timing of 30 seconds to that lane or else if the vehicle density is high, the microcontroller will assign fixed timing of 60 seconds to that lane.

The emergency vehicle in the particular lane of the traffic is identified by receiving radio frequency from that vehicle handling driver using four sets of buttons that mention the four lanes. When the driver presses any one of the button and the value indicate the lane number in his position to RF receiver in digital format by using analog to digital converter. The RF transmitter will send the digital signal to the RF receiver in the microcontroller to assign the green signal to that particular lane and red signal to remaining lane. After crossing of emergency vehicle the microcontroller will allocate certain time for each signal basis of IR output from each lane. Releasing of an emergency vehicle is the interruption process to the microcontroller, completion of that interruption microcontroller will perform the normal function of signal allocation on the basis of vehicle density.LCD Display is used to monitoring each function on traffic system.

3. Microcontroller Overview

3.1 ATMEL89S52

Fig-2: ATMEL Microcontroller

3.2 Technical Specifications

Table - 1: ATMEL Specifications

Microcontroller	ATMEL(AT89S52)
Core size	8 bit
Number of pins	40 pins
Operating voltage(v)	4v to 5.5v
Input output pins	32 pins
Timer module	16 bit(1)
External oscillator	Upto 23MHz
Program memory type	Flash
Program memory	8Kb
RAM bytes	256x8bit

4. MAJOR COMPONENTSDESCRIPTION

4.1 IR SENSOR: An infrared sensor is a device, which emits so as to sense some aspects of the environment. An IR sensor can measure the warmth of an object also as detects the motion. Usually within the spectrum, all the objects radiate some sort of thermal radiations. The emitter is just an IR LED (Light Emitting Diode) and therefore the detector is just an IR photodiode which is sensitive to IR light of an equivalent wavelength as that emitted by the IR LED. The resistances and the output voltages, change in proportion to the magnitude of the IR light received, when the IR light falls on the photodiode.

4.2 RF MODULE: An RF module (radio frequency module) may be a (usually) small device want to transmit and/or receive radio signals between two devices. In an embedded system, it's often desirable to speak with another device wirelessly. This wireless communication may be accomplished optical communication. For many applications, the medium of choice is RF since it doesn't require line of sight. RF communication incorporates a transmitter or receiver.

4.3 RELAY: A relay is a switch that opens and closes under the control of another circuit. The switch is operated by an electromagnet to open or close one or many sets of contacts. It was invented by Joseph Henry in 1835. Because a relay is in a position to regulate an output circuit of upper power than the input circuit, it is often considered, during a broad sense, to be form of an electrical amplifier.

4.4 LCD DISPLAY: A liquid display (commonly abbreviated LCD) may be a thin, flat display device made from any number of color or monochrome pixels arrayed ahead of a light-weight source or reflector.

4.5 RECTIFIER: A rectifier is a device that converts AC to DC or a minimum of current with only positive value, a process referred to as rectification. Rectifiers are used as a component of power supplies and detectors of radio signals. Half wave rectifier and Full wave rectifier are two kinds of rectifier. Both the rectifier is used for different purpose in different application.

4.6 SWITCH: In electrical engineering, a switch is an electrical component which will break a circuit, interrupting the present or diverting it from one conductor to a different. The mechanism of a switch may be operated directly by a human operator to control a circuit (for example, a light switch or a keyboard button), may be operated by a moving object such as a door-operated switch, or may be operated by some detector for pressure, temperature or flow.

4.7 TRANSFORMER: A transformer may be a device that transfers electricity from one circuit to a different through inductively coupled wires. A changing current within the first circuit (the primary) creates a changing magnetic field; successively, this magnetic flux induces a changing voltage within the second circuit (the secondary). Step-up and Step- down transformer are the two kinds of varying transformer.

5. BLOCKDIAGRAM

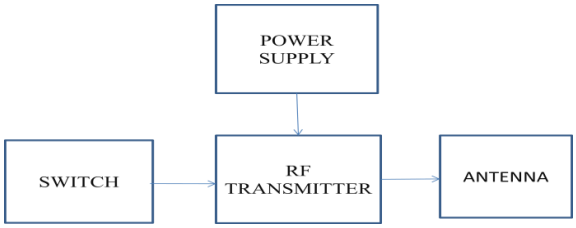

Fig-3: Transmitter Module in Emergency Vehicle

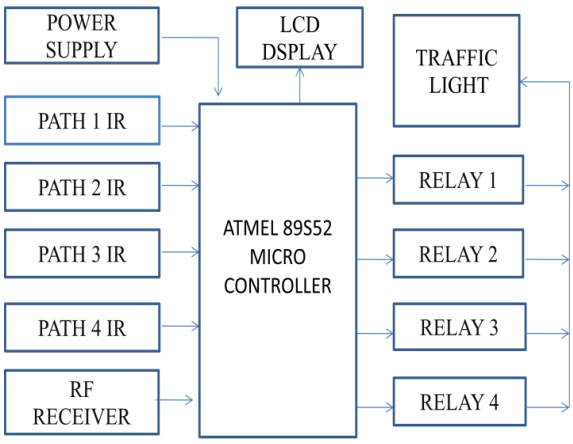

Fig-4: Receiver Module in Traffic Signal

6. RESULT &DISCUSSION

This proposed system satisfies the major problem with traffic congestion around the metro cities on the basis of embedded system. Reduction of time consumption, pollution control in traffic signal and then quick reach out of emergency vehicle on the traffic zone is successfully designed on the basis of above discussed prototype.

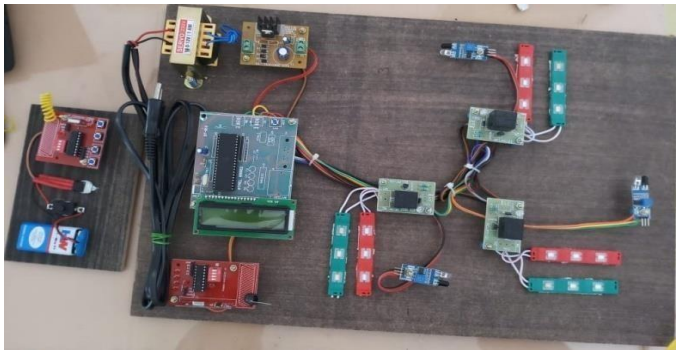

Fig - 5: Proposed Traffic System

In future work, each vehicle will get turned off their engine automatically on certain distance during traffic time. This future work completely reduces the air and sound pollution in traffic signal by turn off the vehicle. Economically fuel combustion of vehicle will reduce.

7. CONCLUSION

In recent times, there has been a rapid increase in the number of vehicles all over the world. There were approximately one million licensed vehicles as per census last year. As a result of this, traffic problems have increased in the last few years and along with that, the present traffic light controllers have limitations because they use the same old traditional hardware. With this proposal, we present techniques to control traffic and prevent accidents in traffic system as prevalent in most developing countries. In this paper, we have proposed the use of sensors along with embedded technologies. The traffic on the road will decide the timings of the green or red traffic signals and release the emergency vehicle. This traffic light controller system is more flexible and efficient than the ones in existence previously. Some additional features include the ability to let emergency vehicles such as ambulance, fire brigade, etc pass smoothly.

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