Smart Traffic Control System

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Abstract

Traffic light control systems are widely used to monitor and control the flow of automobiles through the junction of many roads. However, the synchronization of multiple traffic light systems at adjacent intersections is a complicated problem given the various parameters involved. Conventional systems concentrate mainly on allotting equal time to all the lanes. In addition, the mutual interference between adjacent traffic light systems, the disparity of cars flow with time, the accidents, the passage of emergency vehicles, and the pedestrian crossing are not implemented in the existing traffic system. This leads to traffic jam and congestion. The paper propose a system based on ATMEG32 microcontroller that evaluates the traffic density using Laser sensors and accomplishes dynamic timing slots with different levels. Moreover, a portable controller device is designed to solve the problem of emergency vehicles stuck in the overcrowded roads and notifying the vehicles the current traffic scenario.

Keyword- Emergency Vehicle Priority, Laser Sensor, Microcontroller, Traffic Density, Traffic Light System, Zigbee

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I. INTRODUCTION

Traffic lights, developed since 1912, are signaling devices that are conceived to control the traffic flows at road intersections, pedestrian crossings, rail trains, and other locations. Traffic lights consist of three universal colored lights: the green light allows traffic to proceed in the indicated direction, the yellow light warns vehicles to prepare for shortstop, and the red signal prohibits any traffic from proceeding.

Nowadays, many countries suffer from the traffic congestion problems that affect the transportation system in cities and cause serious dilemma. In spite of replacing traffic officers and flagmen by automatic traffic systems, the optimization of the heavy traffic jam is still a major issue to be faced, especially with multiple junction nodes. The rapid increase of the number of automobiles and the constantly rising number of road users are not accompanied with promoted infrastructures with sufficient resources. Partial solutions were offered by constructing new roads, implementing flyovers and bypass roads, creating rings, and performing roads rehabilitation.

However, the traffic problem is very complicated due to the involvement of diverse parameters. First, the traffic flow depends on the time of the day where the traffic peak hours are generally in the morning and in the afternoon; on the days of the week where weekends reveal minimum load while Mondays and Fridays generally show dense traffic oriented from cities to their outskirts and in reverse direction respectively; and time of the year as holidays and summer.

Secondly, the current traffic light system is implemented with hard coded delays where the lights transition time slots are fixed regularly and do not depend on real time traffic flow. The third point is concerned with the state of one light at intersection that influences the flow of traffic at adjacent intersections. Also, the conventional traffic system does not consider the case of accidents, roadwork, and breakdown cars that worsen traffic congestion. In addition, a crucial issue is related to the smooth motion through intersections of emergency vehicles of higher priorities such as ambulances, rescue vehicles, fire brigade, police, and VIP persons that could get stuck in the crowd.

A better way is to make the traffic system intelligent and resourceful .The system should be interactive to the emergency vehicles. This can be accomplished by many different ways. The first choice is by adopting the IR sensors to the field. Although cheap and less complicated the major setback that it suffers is its lack of adequate range and error caused due to the sunlight intervention. The other method that can be proposed in considering the intensity parameter is the usage of image sensing and processing .Being the most modern tool it has many advantages when compared to the other methods the main difficulty faced was the cost and the complexity involved. It requires a good processor to get the output without any time delay as the time has the value as money in traffic control scenario. So finally the Laser sensors are taken as the method to analyze the field traffic condition. The laser sensors manages the situation in a faster and efficient way. It has a better range and lower complexity compared to others.

II. BLOCK DIAGRAM

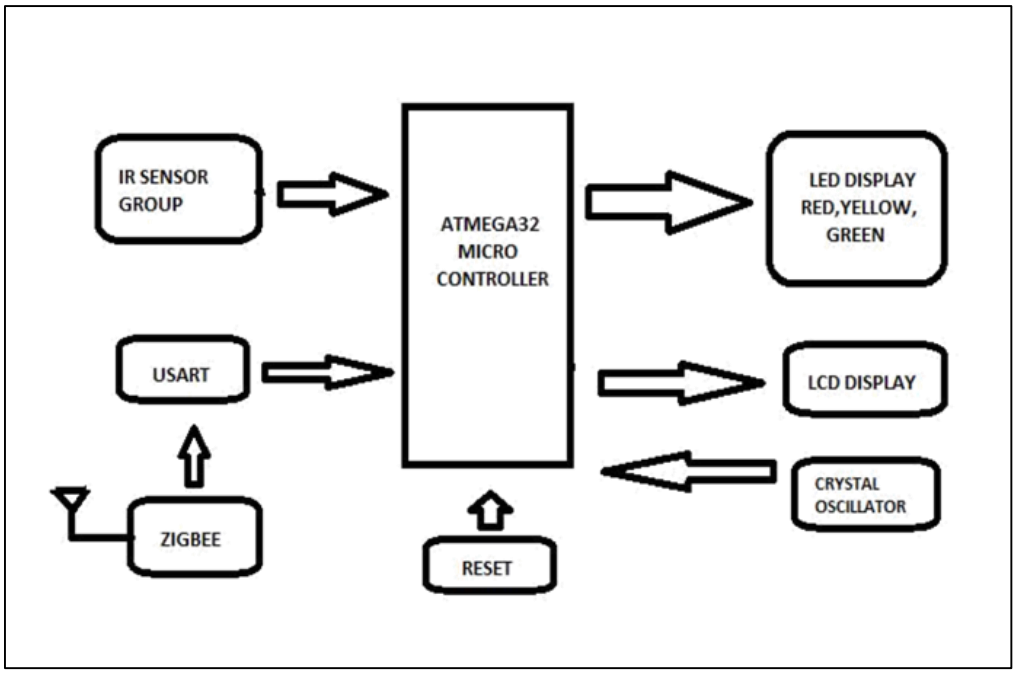

Fig. 1: Block Diagram

III. METHODOLOGY

The Smart Traffic control system is an intelligent approach in reducing the traffic related problems. Conventional traffic control systems work on the basis of the division of time in which each direction is allotted a specific time interval that drives the whole system. The pattern of opening and closing of traffic signal is changed in a regular pattern so that there is no actual study of the traffic situations happening on the road.

A Smart Traffic Control System is based on intensity of traffic that is prevailing on the each direction. The situation solves the main problem that conventional feedback system cannot do .Since there is an interaction happening between the external environment and the micro controller system it is easy to determine the traffic intensity and the desired operation that is to be done. Laser sensors fixed on the ground gives the information about the traffic intensity, when the vehicles pass by through them. The lanes where the most number of laser sensors are activated are figured out by the micro controller and analysis is done so that more time is allotted to that respective lane. Also arrangements are done so that that direction gets more time to clear the row and again the cycle repeats. In order to prevent the continues operation happening in only one lane the cycle after a definite repetition give chance to the whole lane to be opened.

The next attractive feature of the system is its preference given to the emergency vehicles. This is done by providing special communicating devices that can control the traffic lights so that lane opens and allow that vehicle to pass by. The interactive feature in the system helps the vehicles approaching the traffic system to get the immediate notification concerning the present traffic situation of the junction this helps the vehicle to get the idea of the traffic condition without even looking at the lights. The idea is also helpful in alerting the road users about an incoming traffic junction for those who are new to the area.

The basic hardware concept in the methodology is the smart light traffic control system is composed of two separate devices: the traffic controller and the portable controller. Figure 2 shows the hardware implemented circuit of the smart traffic control system the traffic master controller is mounted with the traffic lights at the roads intersection and is responsible for the lighting transition and their timing slots. Its implemented design circuit includes: the Atmega32 microcontroller traffic lights in each directions, the two Laser receivers to measure the traffic volume, the ZigBee transmitter system and receiver, and other basic components. The traffic master controller provides the duration and the schedule of the two configurations and their dedicated phases for different modes of traffic. The microcontroller is also connected to Laser detectors whose output voltages are responsible for giving the feedback based on the intensity of traffic. Finally, the ZigBee module receives the command orders form the portable controller and calls the corresponding emergency subroutines. The portable controller commands the trafficr controller by means of ZigBee transceiver that communicates wirelessly with the other ZigBee component. An ATmega 32 constitutes the hardware core of the portable controller. It is connected, in addition to ZigBee, to that start up the emergency subroutines. An LCD screen is employed to notify the present traffic scenarios that is happening in the system. The Zigbee receiver in the portable side will obtain this which is transmitted from the main controller sid.

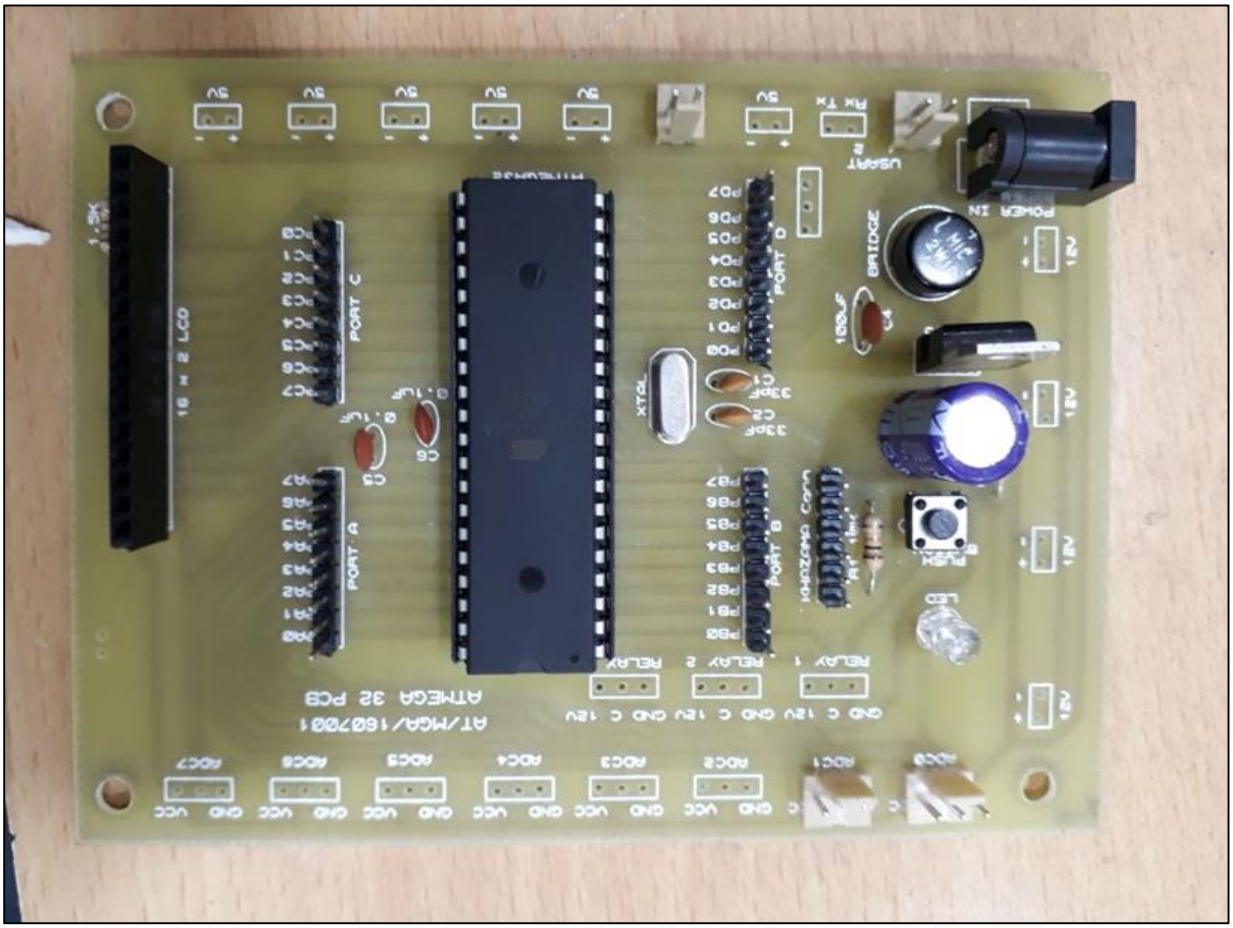

Fig. 2: hardware implemented circuit of the smart traffic control system

IV. HARDWARE

A. Microcontroller

AVR is a family of microcontrollers developed by Atmel beginning in 1996. AVR was one of the first microcontroller families to use on-chip flash memory for program storage, as opposed to one-time programmable ROM, EPROM, or EEPROM used by other microcontrollers at the time. The AVR is a modified Harvard architecture 8-bit RISC single chip microcontroller, where program and data are stored in separate physical memory systems that appear in different address spaces, but having the ability to read data items from program memory using special instructions.

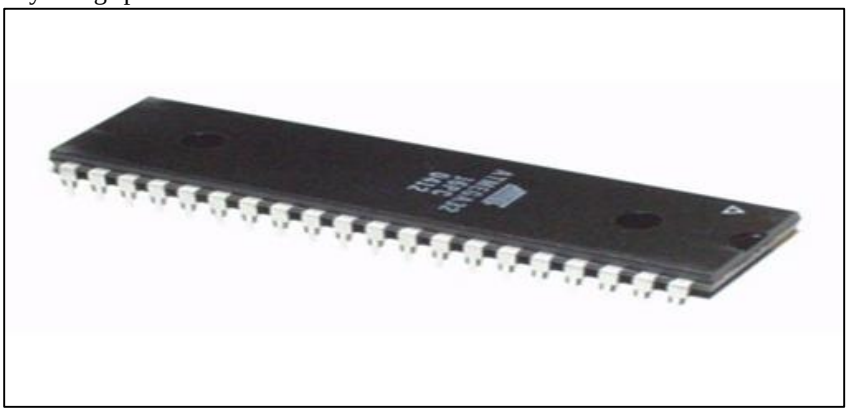

Fig. 3: Harvard architecture 8-bit RISC single chip microcontroller

B. LCD

The 16x2 LCD will have 32 characters in total 16in 1st line and another 16 in 2nd line. In each character there are 5x10=50 pixels so to display one character all 50 pixels must work together. The LCD can work in two different modes, namely the 4-bit mode and the 8-bit mode. In 4 bit mode the data is send nibble by nibble and in8 bit mode we can send the 8-bit data directly in one

stroke since we use all the 8 data lines. LCD display is the system attached to notify about the present traffic conditions in a junction.

C. LED

A light-emitting diode (LED) is a two-lead semiconductor light source. It is a p–n junction diode that 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 color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern.

D. Laser Sensor

Laser sensors are used where small objects or precise positions are to be detected. They are designed as through-beam sensors, retro-reflective sensors or diffuse reflection sensors. Laser light consists of light waves of the same wave length with a fixed phase ratio (coherence). This results in an important feature of laser systems that is the almost parallel light beam. Thus long range can be obtained.

E. Zigbee

Zigbee is an IEEE 802.15.4-based specification for a suite of high-level communication protocols used to create personal area networks with small, low-power digital radios, such as for home automation, medical device data collection, and other low-power low-bandwidth needs, designed for small scale projects which need wireless connection. Hence, Zigbee is a low-power, low data rate, and close proximity (i.e., personal area) wireless ad hoc network.

The technology defined by the Zigbee specification is intended to be simpler and less expensive than other wireless personal area networks (WPANs), such as Bluetooth or more general wireless networking such as Wi-Fi. Applications include wireless light switches, home energy monitors, traffic management systems, and other consumer and industrial equipment that requires short-range low-rate wireless data transfer.

V. SIMULATION DIAGRAM

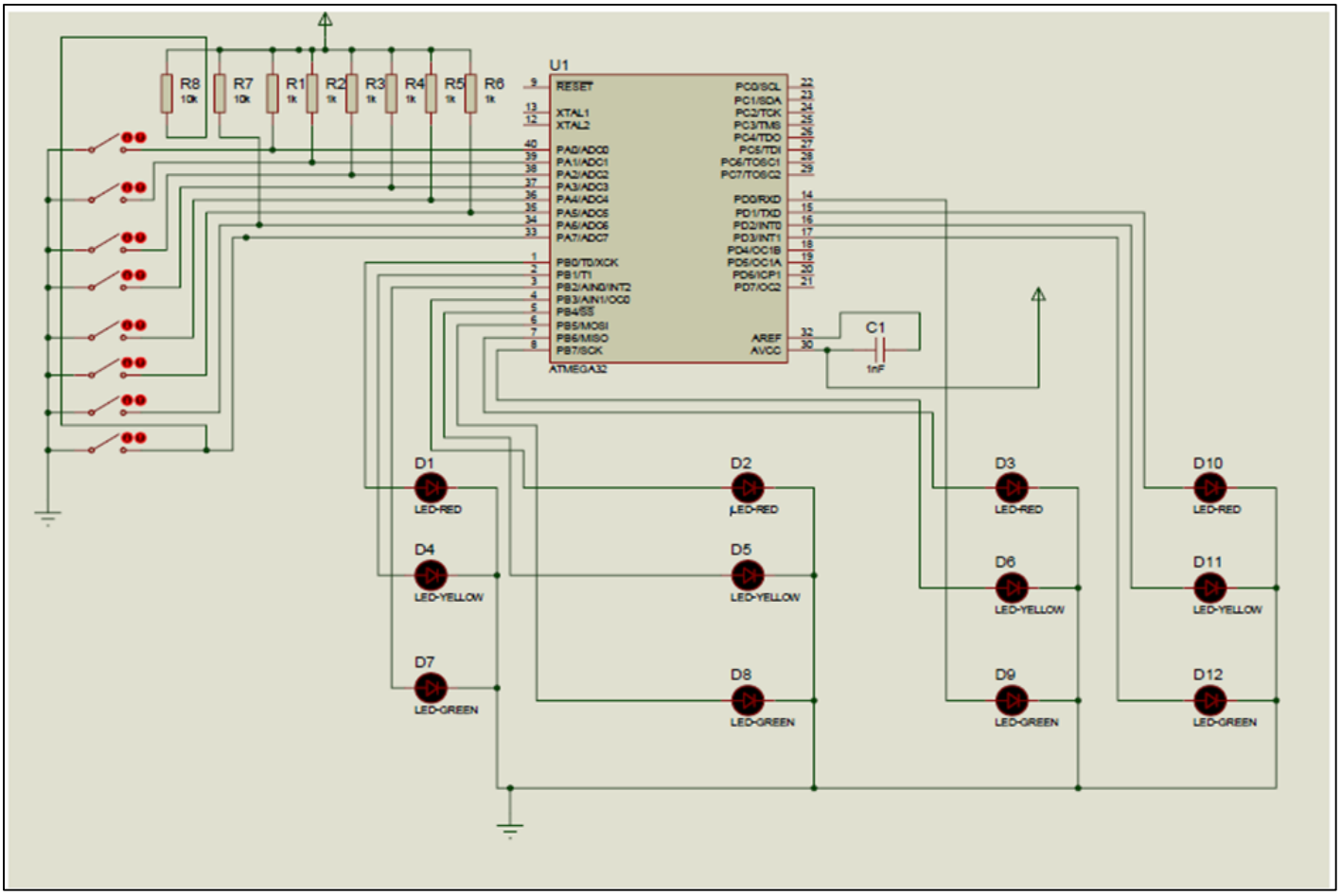

Fig. 4: Simulation Diagram

VI. CONCLUSION

The traffic light issue is obviously a critical problem that worries citizens and governments. The influence of low efficient conventional traffic system affects the economic, health, financial, and environmental domains.

The main highlights of the project are the intensity based feedback system that helps in interacting with the outside environment. Thus the implementation of this system helps in saving time and money. Traffic burden in an aftereffect consumes fuel in large amount and is one of the main reasons behind air pollution. Thus environmental pollution can be reduced in a control is kept over the serious traffic prevalent junctions. The other serious issue that the project aims at is life lost due to the emergency vehicle get trapped in traffic jams at junctions. The Zigbee system incorporated helps in notifying the vehicles concerning the approaching traffic light conditions.

The limitation concerning the project is actually the intensity of traffic is different in each junctions and hence timing of the laser sensor feedback should be changed accordingly. Also more sophisticated system can be developed using neural networks that adds brain to the controlling system.

The future product can be made more attractive by incorporating more features to the present one. Red light violation and pedestrian friendly road traffic control are few among them. Image processing and neural networks are some other ways to modify the present network.

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