Research Progress Report

Project - ICT 3206

Bachelor of Information and Communication Technology (BICT)

Degree Program

Department of Information & Communication Technology

Faculty of Technology

Rajarata university of Sri Lanka

Details of the Research Project

Title :   Smart Traffic Light Control System Using Arduino
Group Number   :   11
Group Name   :   Trouble Makers
Submission Date   :   2022.07.08

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1. Introduction

In today's high-speed life, traffic congestion becomes a serious issue in our day-to-day activities. It brings down the productivity of individual and thereby the society as lots of work hour is wasted in the signals. Avoiding traffic jams for example is thought to be beneficial to both environment and economy, but improved traffic-flow may also lead to an increase in demand. It indirectly also adds to the increase in pollution level as engines remain on in most cases, a huge volume of natural resources in forms of petrol and diesel is consumed without any fruitful outcome. Therefore, in order to get rid of these problems or at least reduce them to significant level, another major problem is emergency vehicles such as ambulance, fire engines are affected by traffic jams and consequently many people could lose their lives because of an ambulance delay. Newer schemes need to be implemented by bringing in sensor-based automation technique in this field of traffic signaling system.

There are several models for traffic simulation. Our project, which will draw attention of all the faculties. So, we want to make a project through which everyone can relate to it. Also, in our day-to-day life we are always observing at the crossing of roads that in some lane there are lot of traffic compared to others lane but all the signals in our country is timing based. So, we cannot manage our time. Also due to timing based the more vehicles on roads sometimes empty due to which many people start crossing the road but due green signal in that lane vehicle moves at high speed which increases the risk of accident. So, the best solution of these problem is to make traffic control system which control the whole traffic.

This research proposes a simple, low cost and real-time Smart Traffic Light Control System, aimed at removing many flaws and improving traffic management. The system is based on Arduino mega 2560 microcontroller which controls the various functions, monitors the count of vehicle in traffic through the infrared sensor (IR), and accordingly changes the light transition slot. 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 the signal.

2. Problem Statement

Traffic congestion is an increasing problem in cities and sub urban spend more of their time commuting to work, school, shopping, and social event as well as dealing with traffic light jambs and accidents. Traffic became heavy in all directions, more to and from cities as well as between sub urban locations. Sub urban business locations required huge parking lots because employees have to drive; there were few buses trains, or trolleys to carry scatter workers to their work place. The hope of reduced congestion in the sub urban had not been realized; long commutes and traffic jams could be found everywhere.

3. Aim

Our project aims to eliminate the delay on roads by reducing traffic on road automatically using embedded system. It determines traffic on each road by using IR sensors. Using that traffic information, we can manage the signal time and handle the traffic on road. Each road we place IR sensors which detect the vehicle and give real time traffic information on each road. The timing of signal is adjusted according to traffic level on each road. The road which has more vehicle than other road then this road assign green signal and for others have red is assign. It is also providing the additional functionality of release the emergency vehicle on its occurrence that means when emergency vehicle occurs.

In our project we focus on optimization of traffic light controller in a city using IR sensor and developed system using microcontroller Arduino mega 2560, another part is emergency vehicles are using Portable Controller that can control the traffic lights so that lane opens and allow that vehicle. We present this project because to reduce traffic congestion which results in long waiting times to turn signal green, loss of fuel and money.

4. Objectives

1. Our project is reducing traffic congestion and unwanted long-time delay during the traffic light switch overs especially when the traffic is very low.
2. It is designed to be implemented in places nearing the junctions where the traffic signals are placed, in order to reduce the congestion in these junctions.
3. This system reduces the waiting time as traffic signal's light will change according to vehicle count. So, it also reduces traffic jams.
4. It keeps a track of the vehicles in each road and accordingly adjusts the time for each traffic light signals.
5. The higher the number of vehicles on the road. The timing of the signal will change automatically by counting the number of vehicles.
6. if there will be no traffic on the other signal, one shouldn't wait for that signal. The system will skip that signal and will move on the next one.
7. Saves the emergency vehicle passengers from any accident it avoids the time wasted by waiting the emergency vehicle for the red light.
8. Heavy traffic jam it wastes time as well as fuel also and it happened at the main junctions when people have emergency such as before office hour, morning and after office hours, evening.

5. Preliminary Literature Review

This section deals with a review of previous related work on Traffic Light System and Integrated Led Advertising Display.

M. U. Khan, H. M. Salman, and S. B. H. Shah, "Traffic Density Based Light Control System Inam Ullah Khan," p. 6, 2017. In this research, it has been mentioned in connection with reducing the problems related to high traffic density. Efforts have been made to reduce vehicle delays by using computer configuration to reduce traffic-related problems such as traffic congestion. Based on the vehicle density calculation, the microcontroller determines the traffic light delays.

V. R, "Density based Traffic Management System using Image Processing," Int. J. Adv. Trends Comput.Sci.Eng.,vol.9,no.2,pp.997–1001,Apr.2020,doi:10.30534/ijatcse/2020/15922020. Real-time advanced traffic light control system is provided in this project. In image processing the model matching algorithm is used to measure the density of vehicles. It is measured by a drawing Diamond-shaped shape on the road. The required number of diamond-shaped shapes are pulled a little farther. The density of vehicles placed on top of any part of the drawn shape is taken into account. With this advanced model, people do not have to spend much time at the traffic junction for the signal.

MAHESHWARI M, KEERTHANA RAMESH, and Manikandan Durai Raj, "DENSITY BASED TRAFFIC CONTROL SYSTEM," 2020, doi: 10.13140/RG.2.2.23981.31207/1.This project proposed system aims to save the number of man-hours wasted at the signals and hence making effective utilization of time. They Use gas sensors to control the timing of timers on traffic terminals. Using GPRS as an additional step towards improvement in this project. "Automated Density Based Traffic Light Control System using Arduino Platform," Int. J. Eng. Adv. Technol., vol. 9, no. 1, pp. 5269–5271, Oct. 2019, doi: 10.35940/ijeat.A2956.109119.In this project numerous studies have been carried out to avoid traffic congestion on the road with a large number of vehicles. A traffic light control system has been developed using the PIC18F4550 microcontroller interfaced with an IR sensor to reduce traffic at road junctions.

S. S. Mahalingam and S. Arockiaraj, "DENSITY BASED TRAFFIC LIGHT CONTROL USING ARDUINO," vol. 4, no. 5, p. 8, 2018.An automated traffic light controller is required to reduce traffic latency and travel time. With the aim of developing an automated tool that can estimate traffic congestion and based on this variation, the traffic signal will vary. In this project density of the road is calculated using IR sensors.IR sensors are used to detect the number of vehicles based on the IR sensor, the traffic light is operated.

Proposed two protected smart traffic light control plans. The authors adopting fog computing whose safety is established on the stability of the computational Diffie-Hellman puzzle and the hash collision puzzle accordingly. The plans presume the traffic light is a fog device. When the vehicle density is high the 1st plan is not efficient while the 2nd plan is fog device friendly and more efficient even when the vehicle density is high. Therefore, the plans can avoid the problem of single point failure and it is fog device friendly.

Based on the literature review all the investigated systems did not handle an important case. Finally, we got solution, we rejected image processing technology because our system is a simple, low-cost, and real time traffic light control system that aims to overcome many defects and improve the traffic management.

We decided to develop our project in different way. Finally, we use the IR sensor to optimize the traffic light using the Arduino mega 2560 microcontroller. Traffic light adaptation is a complex problem we selected Arduino technology using IR sensor.

Our proposed system suggests another solution for emergency vehicles. The emergency vehicle uses ZigBee and Arduino UNO. Emergency vehicle communicates the main microcontroller that can control the traffic lights so that lane opens and allow that emergency vehicles.

6. Methodology

The Traffic control system 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 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 microcontroller system it is easy to determine the traffic intensity and the desired operation that is to be done.

The basic hardware concept in the methodology is the smart traffic light control system is composed of two separate devices: the traffic master controller and the portable controller. Figure 1 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 master control circuit includes: the Arduino mega 2560 microcontroller, which is the heart of the system, IR Sensors placed on top of every lane just far away from signal lights, IR sensors are arranged on each

lane, above the road at a certain distance, say 100 m (each side of the junction). So as vehicles pass through from the IR sensors the number of vehicles will be counted and the information will be sent to the microcontroller. It calculates the time slice of each vehicle to be projected as output in the form of a green light beam. For each vehicle crossover, the time calculated for each vehicle will be 2 sec. So, for additional vehicle pass through, multiple of 2 sec. will be added. If there is continuous vehicle blockage at IR sensor, it is a denotation that traffic has reached a certain maximum limit (maximum time limit is 100 seconds) and the green signal beaming time will be set depending on calculated time based.
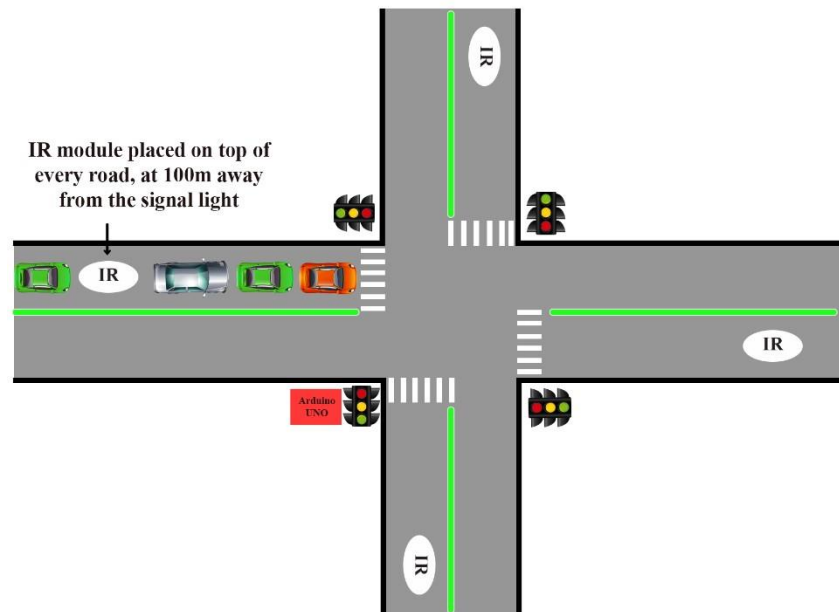

Figure 1 Intersection of four directional road

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. Its implemented design portable control it's circuit includes: the Arduino UNO and ZigBee transmitter system and receiver, and other basic components. ZigBee module receives the command orders form the portable controller and calls the corresponding emergency vehicle signal light will be green. The portable controller commands the master controller by means of ZigBee transceiver that communicates wirelessly with the other ZigBee component. An Arduino UNO constitutes the hardware core of the portable controller. It is connected, in addition to ZigBee, to that start up the emergency subroutines.
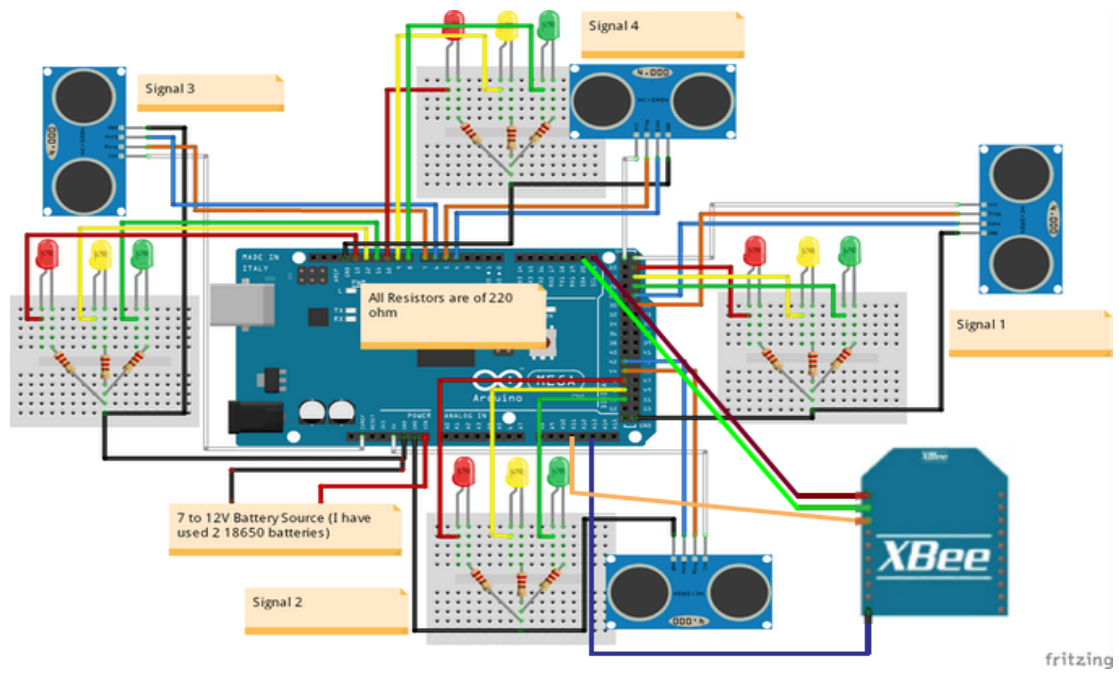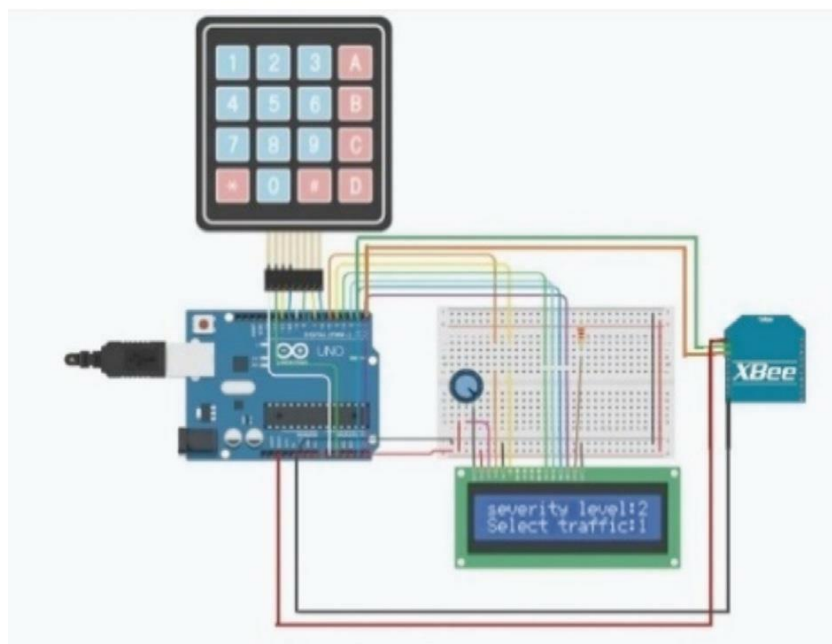
Figure 2Traffic Light Unit Circuit diagram

Figure 1Emergency Vehicles Portable unit circuit diagram

7. Research Project Designing Techniques

Hardware Interfaces (Intended to design)

Figure 1 Arduino mega 2560

Figure 2 Arduino UNO

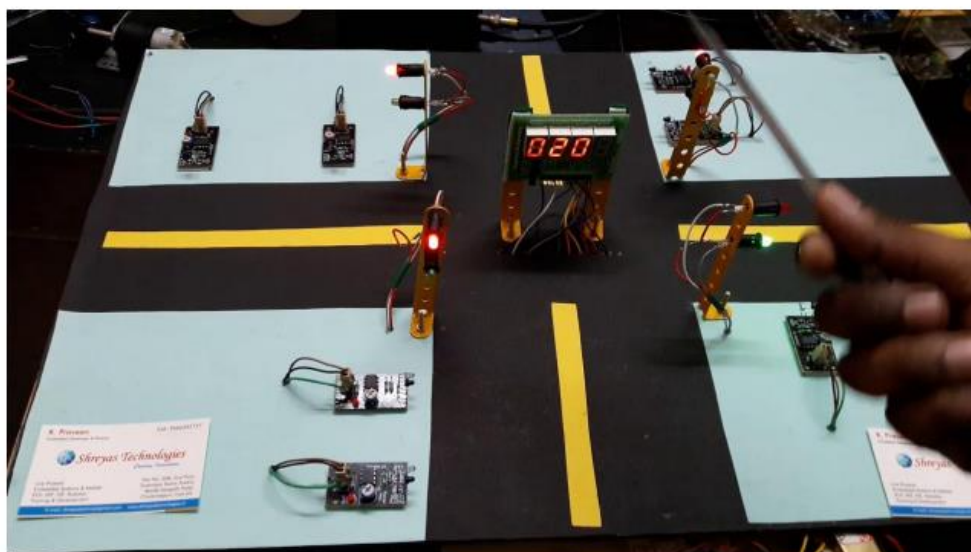
Figure 3 LED

Figure 4 Zigbee Module

Figure 5 Display

Figure 6 Keypad

Figure 7 Sample implementation

Software Interfaces (Intended to design)
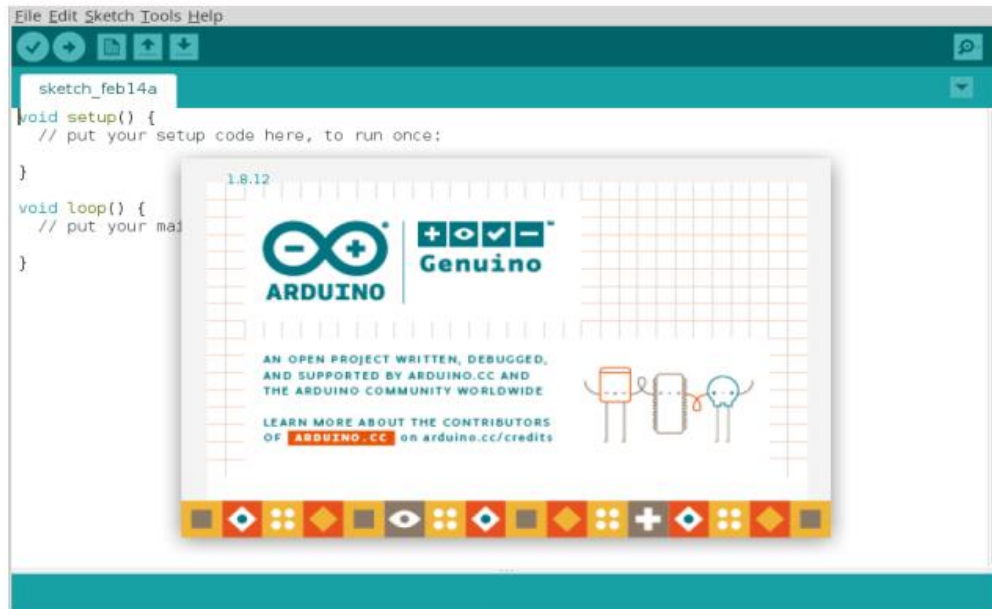
Figure 7 Arduino IDE

Figure 2 Zigbee Module IDE

8. Data Collection and Analysis

So far, we had gone through with many videos, audios and research articles. During the literature survey we got an opportunity to look closely into the problem that people are facing traffic congestion in the current environment.

9. Scope of the research project completes up to now

The main part of our project is Identify the vehicle

Using Infra-Red Sensor, microcontroller Condition:
The IR sensor should be transferring the real time vehicle count to microcontroller

      i. Start IR sensor

     ii. Count the vehicle

    iii. Send the real time count to microcontroller

    iv. Check if microcontroller received the vehicle count

     v. If didn't receive the count, the traffic light will be yellow color

    vi. If there is more than one IR counts received, it will analyze every lane has how much vehicles have.

   vii. Then green signal will be assigned to vehicle count and signal Light work with clockwise.

How it work:

First Set the IR sensor. And vehicle cross the sensor. Sensor sense the vehicle and send the vehicle count to microcontroller collect details from all sensor. Allocate the time for every signal light base on IR count. Set the time for green light then check for the signal. If granted signal from Cecile move. Otherwise if the granted signal red vehicle waiting queue.
This way it works.

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 other basic components is ZigBee transmitter system (portable controller). ZigBee module receives the command orders form the portable controller and calls the corresponding emergency subroutines. The portable controller commands the master controller by means of ZigBee transceiver that communicates wirelessly with the other ZigBee component. An Arduino UNO constitutes the hardware core of the portable controller. It is connected, in addition to ZigBee, to that change signal light to green to emergency vehicle. The ZigBee receiver in the portable side will obtain this which is transmitted from the main controller side.

(But we don't have hardware components to run this part. We tried to get this hardware components for this part but we can't get them. So, we hold this part of our project).

10. Future Works

We will decide to develop an app to use drivers for collect details for that traffic congestion, how to work that road traffic lights. So they can easily identify the road traffic congestion.

11. Individual Contribution

One of the most challenging parts of coming to the devising process was learning how to constructively work in a group over a long period of time. While we were used to being part of a group member, we had always had the influence to keep things fresh and solve conflicts. Before we tried to begin doing any work we first sat down and discussed and agreed upon a number of ground rules that we would be working to during our devising. These rules were not there to keep members of the group constrained but were there so that we knew what was expected of us during this process. Much of what was decided came from common sense, but it was beneficial to have everyone's contribution as this was created.

In our group, we have 7 members. There are M.P.Paisul Paree, S.Sabras, T.Vergin Priyanka, J.Keerththana, P.A.L.Chanaka, K.G.S.Dineth, and W.G.A.Abeyanayake. M.P.Paisul Paree, S.Sabras are covering the coding side and implementation parts and also helping other sides. keerththana and Priyanka are covering the documentation part and also helping other parts.P.A.L.Chanaka, K.G.S.Dineth and W.G.A.Abeyanayake are helped to find hardware components, helped to collect data, and implement the project. All members are helping to do a project.

12. References

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