Dynamic traffic light control system

A PROJECT REPORT

Submitted by

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CERTIFICATE

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ABSTRACT

Traffic congestion is a severe problem in most of the cities across the world and it has become a nightmare for the citizens. It is caused by delay in signal, inappropriate timing of traffic signalling etc. The delay of traffic light is hard coded and it does not depends on traffic. Therefore for optimizing traffic control, there is an increasing demand in systematic quick automatic system. This paper is designed to develop a density based dynamic traffic signal control. The signal timing changes automatically on sensing the traffic density at the junction. The microcontroller used in this project is ARDUINO. The system contains Ultrasonic sensors (transmitter and receiver) which will be mounted on the either side of the road on poles. It gets activated and receives the signal as the vehicles passes close by it.

KEYWORDS : ARDUINO.

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LIST OF ABBREVIATIONS

Symbol Name	Abbreviation
IR	Infrared Sensor(s)
PIC	Programmable Intelligent Controller
RF	Radio Frequency
ITLCS	Intelligent Traffic Light Control System
STC	Smart Traffic Control
OBU	On-Board Unit
DSRC	Dedicated Short Range Communication
GNSS	Global Navigation Satellite System

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CHAPTER 1 : INTRODUCTION

Traffic administration has the goal to constantly improve traffic system and regulation. As the number of vehicle users constantly increases and resources provided by current infrastructures are limited, intelligent control of traffic will become a point of focus in the future. The Traffic congestion can also be caused by large Red light delays, etc. The delay of respective light is hard coded in the traffic light and it is not dependent on traffic. Therefore for simulating and optimizing traffic control to better accommodate this increasing demand is arises . Avoiding traffic jams is beneficial to both environment and economy. In our paper we focus and optimization of traffic light controller in a city using Ultrasonic sensor and developed using Arduino. An intelligent transportation system (ITS) estimates the traffic parameters and optimizes traffic signal to reduce vehicle delays and stop. Fixed control on traffic is basically not control according to the density, but in a manner of programming which is already fixed in the system. This project proposes an intelligent system using Arduino for implementing it in the city.

CHAPTER 2 : PROBLEM DEFINITION

In this chapter I have mentioned in detail the problem statement, objectives and scope of my project. Problem definition defines our inspiration to build this software. Objectives are the pre-defined goals that we want to achieve from this system. Scope is the range or extent of our system that can be achieved in a limited time.

2.1 Problem statement:

Under present scenario, traffic control is achieved by the use of a system of hand signs by traffic police personnel, traffic signals, and markings. A comparable and matching education program is needed, through driver-licensing authorities, to assure that those who operate motor vehicles understand the rules of the road and the actions that they are required to take when a particular control device is present.

Traffic lights are set on in different directions with fixed time delay, following a particular cycle while switching from one signal to other creating unwanted and wasteful congestion on one lane while the other lanes remain vacant.

2.2 Objective:

The system we propose identify the density of traffic on individual lanes and thereby regulate the timing of signal's timing. Ultrasonic transceivers count the obstructions and provide an idea about the traffic density on particular lane and feed this response to controller unit which will make the necessary decisions as and when required also it works on number of cars passing through an assigned section of the road.

2.3 Scope:

An intelligent transportation system (ITS) estimates the traffic parameters and optimizes traffic signal to reduce vehicle delays and stop. Avoiding traffic jams is beneficial to both environment and economy.

CHAPTER-3 : LITERATURE REVIEW

In this chapter, I have given my critical evaluation & summary of all research papers that I read related to my project.

3.1 Literature Review:

Paper 1: Smart traffic control system.

Bilal Ghazal , Khaled ElKhatib , Khaled Chahine , Mohamad Kherfan has developed the system containing the detail survey of existing systems and proposed system to overcome common problem of having manual intervention while using IR sensors. The IR sensors are employed in numerous traffic systems. The IR transmitter and the IR receiver are mounted on either sides of a road. When an automobile passes on the road between the IR sensors, the system is activated and the car counter is incremented. The collected information about the traffic density of the different roads of a junction is analyzed in order to modify dynamically the delays of green light at the lane having the significant traffic volume. The whole system could be controlled by PIC microcontroller. To inform the traffic system about the arrival of the emergency vehicles toward the junction, they are supported by RF emitters that send warning signals to RF transceivers disposed at every traffic light intersection. The triggering sequences of the traffic lights are modified correspondingly in order to provide a special route to the emergency vehicles.

Paper 2: Dynamic Traffic Control System Based on Process Synchronization.

Khac-Hoai Nam Bui, O-Joun Lee, Jason J.Jung , David Camacho decide to develop a kind of system that can reduce on road accidents and provide safety to the peoples. They then decided to bring up with the system which provides an interconnection between the vehicles. In connected vehicle concept, the vehicles can be identified based their id (number plate of the vehicle). The vehicle communicate

with infrastructure (V2I) and other vehicles (V2V) under the id as the address. Each vehicle is equipped the positioning system (VPS) to determine its location. In this regards, the traffic management system which located in the intersection is able to get the information of vehicles in term of their location and directions when they move into the intersection area. The wireless communication devices (Cellular Base Station) are designed in the intersection to enable the communications between vehicle and others. We assume that the transmission range of wireless devices are able to cover all of the intersection area. Moreover, the wireless channel is FIFO channel, it means the traffic management system will receive the request from vehicles as FIFO model. e. By this way, when a vehicle want to pass the intersection, they have to send a request to the controller. Based on the traffic flow at intersection, the controller will reply the permit passing message to vehicle or put the request in the pending list, and the vehicle have to wait until receive reply from controller. After passing the intersection, the vehicle has to send the release message to Controller.

Paper 3: Image Processng Based Intelligent Traffic Controller.

P.RaviKumar, P.Gowri Rekha, T.Narasimha Sai ; to solve Traffic congestion of emergency vehicles is becoming more and more serious day by day problem they made a dynamic system to avoid the traffic congestion over the roads.A camera is fixed at the polls .Images extracted from the video are then analysed to detect and count vehicles. Then depending on the signal-cycle time is allotted to each lane. The system also takes into account the emergency vehicles at the intersection. If such a vehicle is detected, the lane is given priority over the others. The image sequences from a camera are analyzed using various edge detection and object counting methods to obtain the most efficient technique. Subsequently, the number of vehicles at the intersection is evaluated and traffic is efficiently managed. The frequency of light is detected and the priority to the vehicle is given priority.The vehicle detected is sent to the traffic signals and automatically the traffic signal lights are turned to red except the lane which contains the

emergency vehicles such as ambulance, fire truck etc., in all the other lanes are red. The lane containing the emergency vehicle is turned to red and given way to the vehicle.

Paper 4: Traffic Light Control System for Emergency Vehicles by Radio Frequency.

India is the second most populous country in the world. Currently, India does not have a centralized body which provides guidelines for training and operation of Traffic system. N. M. Z. Hashim , A. S. Jaafar , N. A. Ali, L. Salahuddin, N. R Mohamad made a project where they made a circuit. This circuit utilizes the RF module, transmitter and receiver (TX-RX) for making a wireless remote, which could be used to drive an output from a distant place [7]. RF module, as the name suggests, uses radio frequency to send signals. These signals are transmitted at a particular frequency and a baud rate. A receiver can receive these signals only if it is configured for that frequency. A four channel encoder/decoder pair has also been used in this system. The transmitter module takes serial input and transmits these signals through RF. The transmitted signals are received by the receiver module placed away from the source of transmission. The RF module comprises of an RF Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz. An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.

Paper 5: Aerial observations of moving synchronized flow patterns in traffic.

Stefan Kaufmann, Micha Koller, Boris S. Kerner , Hubert Rehborn made a project with the aim of a complete spatiotemporal reconstruction of traffic from video data a supervised tracking approach, with the option for a later automation has been chosen. This solution allows us to set a tracker node upon any moving object (Fig. 1). The node learns the object's characteristics and tries to locate its new position within the next frame. The tracker then processes frame by frame and allows the user to act as a supervisor. In case of an error, the supervisor pauses the

process to reposition the tracker node. The new intermediate positions can be used to verify and adjust visually the interpolation with additional positions using the keyframe techniqueIf we try to determine the vehicle speed through measurements in two neighbouring video frames with the video frame rate of 25 fps, then there is a significant speed value can be calculated. By this traffic movements can be easily predicted.

3.2 Table of Comparison

Table 3.2 [Table of Comparison]

SrNo.	Title	Publication	Year	Limitations
(1)	Smart traffic control system.	EECEA	2016	• Less range • Difficult to control things which are not line of sight.
(2)	Dynamic Traffic Control System Based on Process Synchronization.	IAEEE	2016	• Costly
(3)	Image Processing Based Intelligent-Traffic Controller.	IJERECE	2017	
(4)	Traffic Light Control System for Emergency Vehicles by Radio Frequency.	IOSRJEN	2013	• Costly
(5)	Aerial observations of moving synchronized flow patterns in traffic	ELSEVIER	2017	• Costly • Not accurate.

3.3 Literature Review(2):

Paper 1: Automatic Intelligent Control System.

Linganagouda R , Pyinti Raju , Anusuya Patil has developed the system containing the detail survey of existing systems and proposed system to overcome common problem of having manual intervention while focus on optimization of traffic light controller in a city using IR sensor and developed visual monitoring using microcontroller. Traffic light optimization is a complex problem. In this paper, we propose three approaches, the firstly to give authority to ambulances to pass the respective lane without delay, secondly allow smooth passage of vehicles with maximum priority (VIP cars, POLICE cars), and thirdly – control traffic density of cross-roads by increasing the green light time. The project is a replica of a four-way lane crossing of real time scenario. In the first part, concentrated on problems faced by Ambulances, RFID concept is used to make the Ambulance's lane Green and thus providing a stoppage free way for the Ambulance. IR transmitter and receiver are used to make the vehicles' lane Green and thus preventing traffic congestion. IR transmitter and receiver are used to provide dynamic traffic control and thus increasing the duration of the Green light of the lane in which traffic density is high and hence, regulating traffic.

Paper 2: An intelligent traffic control (Based on Radio Frequency Identification)

. Kuei-Hsiang Chao and Pi-Yun Chen decide to develop The intelligent traffic light control system uses passive radio frequency identification (RFID) to detect the numbers of seconds spent by vehicles on main roads and side roads passing through road junctions during a green light period and to detect the number of vehicles on main roads and side roads passing through detectors during a green light period and then uses the RS232 interface to transmit the detected data to the program system on chip (PSoC) microcontroller. Subsequently, the ITLCS uses the extension evaluation method to estimate the duration of green light periods. An RFID sensor is used to

collect data on the quantity of traffic passing through the detector and records the number of vehicles passing through the intersection and the amount of time it took for all vehicles to pass through the intersection when the signal light is green, which is tested using different lengths of time for the green light.

Paper 3: Smart Traffic Light Controller Using Embedded System.

Vishakha S.Thakare , Snehal R. Jadav , Sananaj G.Sayyed; to solve Traffic congestion of emergency vehicles is becoming more and more serious day by day problem they mounted the infrared sensors on road to detect the vehicle on the road. The presence or absence of a vehicle is sensed by a sensor assembly mounted on each road. This acts as an input to the STC unit. The STC unit generates an output signals for Red, Green and Yellow Signal and monitor their timings taking into consideration the number of vehicles on each road. The same information is transmitted to the mobile user which will request for congestion status. If vehicle driver at junction send SMS on GSM mobile phone to STC unit, the driver will get message indicating congestion status of road. STC system will also give information about alternate route to the user, if present traffic is heavy. In addition to above, in the emergency mode, for a vehicle like ambulance, fire fighter or police car, the signals are altered for the fast and easy movement of these vehicle. If an emergency vehicle is passing by the route, the signals on the roads which are crossing this route will be immediately made red to stop vehicles on these routes. This is a very important feature which is very useful in case of emergency.

Paper 4: Synchronization of Traffic Light Systems for Maximum Efficiency.

India is the second most populous country in the world. Currently, India does not have a centralized body which provides guidelines for training and operation of Traffic system. M . A . Ahmad Rafidi , A . H . Abdul Hamid made a project where research was done by videotaping along a route. Observations were made only during the peak hours in the morning, in the afternoon, and in the evening. The survey shows that the densest traffic was on some days. These days were considered to have the

densest traffic because the traffic could not be cleared within the timespan of one green light. Such traffic blockage was evident on the road, where traffic was also being videotaped. Even after a three minute green light on such a large, main road, traffic still could not clear out. Because the traffic could not be cleared in the time given, it was assumes that the density of traffic on these days was doubled the normal rate. Most importantly, the distance between traffic lights as well as the time taken for a vehicle to reach the next traffic light must be taken into consideration. By using an offset traffic light system continuity in traffic lights could be achieved. An offset system works based on the time between the start of the green light at one junction and the start of the green light at another junction. The offset defines the movement of traffic along a major road, also referred to as "progression." It is very important to observe and fine-tune an offset system in order to plan for real traffic speeds and conditions to ultimately help reduce stops and slowing.

Paper 5: Urban traffic issues by ITS Technologies.

Hiroshi Makino, Kazuya Tamada, Koichi Sakai , Shunsuke Kamijo made a project called ITS. ITS uses a two-piece system that supports multiple users. Vehicle information is stored in OBU and personal information is stored on IC cards, enabling the separation of the vehicle owner. is able to guarantee security and to protect privacy because it uses an IC card having an IC chip with a builtin CPU, which enables a two-way authorization and the encryption of recorded data using DSRC security platform. Two-way communications also allow probe data collection from GNSS on it. By making use of the probe data, we can accurately identify the location and time of congestion. ITS technologies, however, have made this possible. CCTV cameras with image processing can detect a stopped vehicle on the blind carve. Sensors on the vehicle can detect the tail end of traffic congestions, objects on road, road surface conditions and other elements, potentially dangerous for vehicles. The DSRC employed on ITS has high-speed and high-capacity communications and can provide the detected information just before hazardous sections.

3.4 Table of Comparison(2):

Table 3.2 [Table of Comparison]

SrNo.	Title	Publication	Year	Limitations
(1)	Automatic-Intelligent Control System.	IJAREEIE	2016	• Less range • Difficult to control things which are not line of sight.
(2)	An intelligent traffic control (Based on Radio Frequency Identification).	IJDSN	2014	• Costly
(3)	Smart Traffic Light Controller Using Embedded System.	IOSR-JCE	2013	• Costly • Needs high speed Internet.
(4)	Synchronization of Traffic Light Systems for Maximum Efficiency.	SHS Web of Conferences	2014	• Not perfectly accurate.
(5)	Urban traffic issues by ITS Technologies.	IATSS	2017	• Costly

CHAPTER 4 : METHODOLOGY

In this chapter we have discussed about the hardware, software and working of our project.

4.1 Methodology

4.1.1 Gathering traffic control system cases:

Our first step would be collecting number of traffic control cases, We will visit and gather information of present system of different traffic control system and understand their problems.

4.1.2 Observation:

After gathering information of present system and problems of respective traffic control system, we will compile them to our system accordingly before implementation of our proposed project.

4.1.3 Resources required:

In our project, we will require Microcontroller which will fetch vehicle detection parameters from array of Ultrasonic sensors coupled in some interval distance in each lane and Microcontroller will analyze parameters and prioritize lane accordingly.

4.1.4 Building flow chart and algorithm:

Prepare a diagram of the flow our traffic control system and write down step by step procedure for implementation.

4.1.5 Testing:

After merging the different units in the system, we will test the system by dummy test cases.

4.1.6 Error corrections:

After testing the system, if any problem occurs, we will fix them and get global optimum flow of the system.

4.1.7 Refining:

After achieving functionalities of the system, we will refine them and correct algorithm to handle traffic queue in efficient way.

4.2 Proposed Hardware:

4.2.1 Arduino UNO:

The Arduino UNO is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits.

4.2.2 Relay:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solidstate relays.

4.3 Working:

4.3.1 Diagram Description:

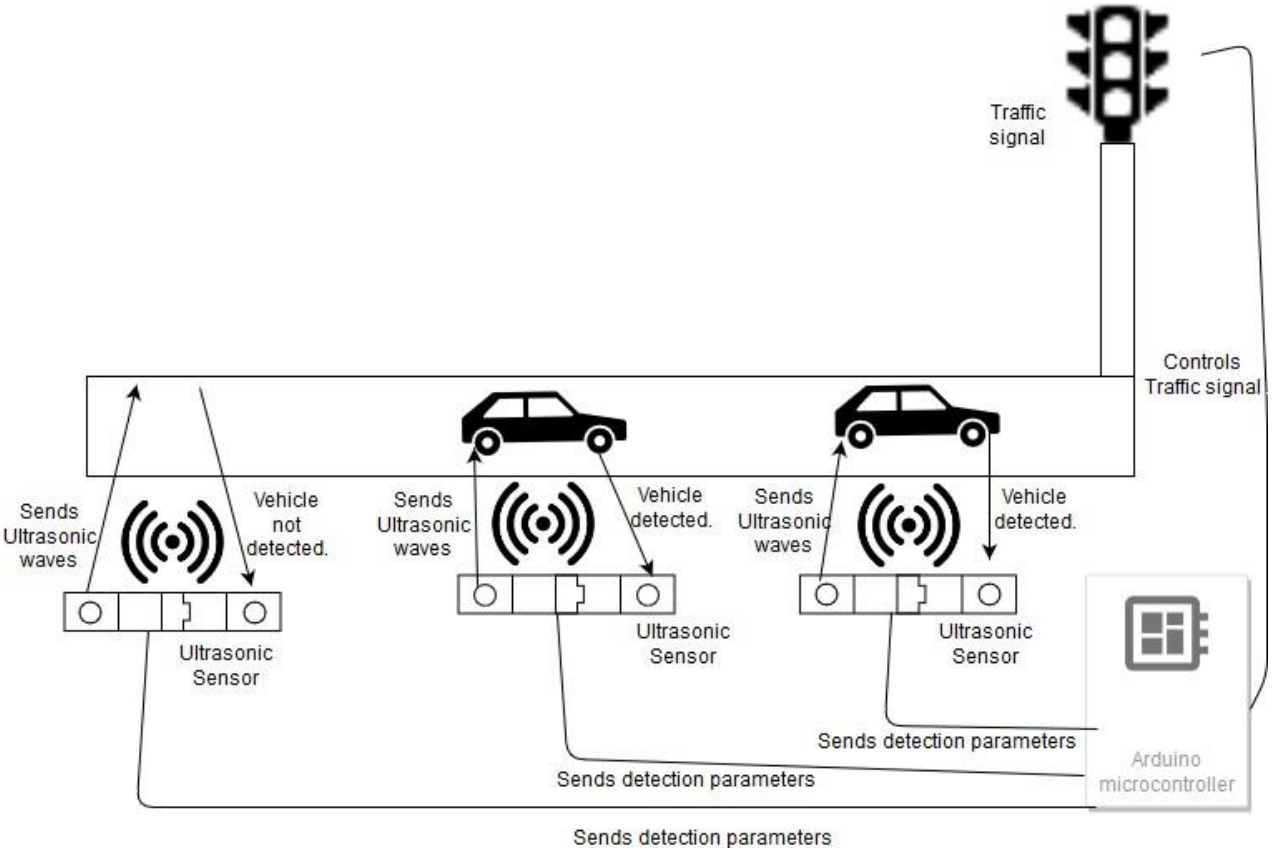

Fig.4.3.1 Working Model

4.3.2 Detecting vehicle(s)

Array of Ultrasonic sensors coupled in some interval in a lane will send detection parameters which we will help us to find out number of vehicles presented on the single lane queue.

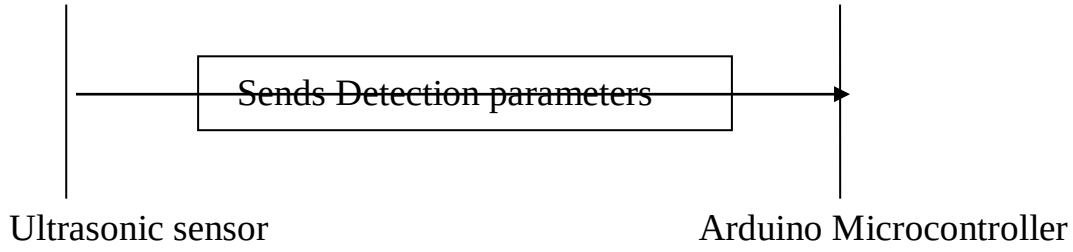

Fig 4.4.2 Seeking Emergency Support

4.3.3 Controlling traffic signals

Arduino Microcontroller will analyze detection parameters of different lanes and set priority accordingly.

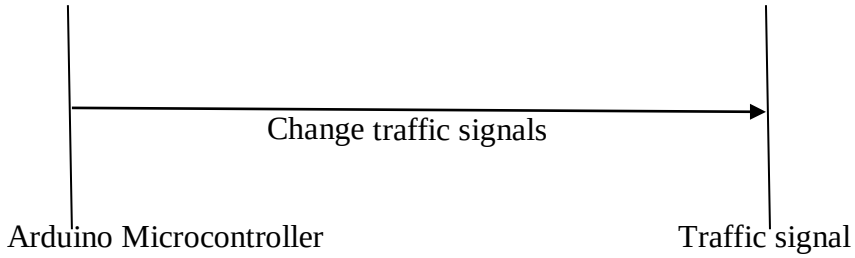

Fig 4.4.5 Clearing path to affected area

4.4 Advantage:

- It has sensing capability to sense all the material types.
- This sensor is not affected due to atmospheric dust, rain, snow etc.
- It has higher sensing distance and also provides good readings in sensing large sized objects with hard surfaces.

4.5 Disadvantage:

- We have to arrange IR sensors in accurate manner otherwise they may not detect the traffic density.
- Still accuracy is not enough for indian roads.

CHAPTER 5: CONCLUSION

In this project we have studied the optimization of traffic light controller in a city using Arduino and IR sensors. A traffic light system has been designed and developed with proper integration of both the hardware. This interface is synchronized with the whole process of the traffic system. Automatically, this project could be programmed in any way to control the traffic light model and will be useful for planning proper road system.

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