Priority Based Intelligent Traffic Control

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Abstract **- In today's world, due to rapid development of cities, congestion in traffic is a serious problem. Especially India, the second most popular Country in the World and a fast-growing economy, is known to have a gigantic network of roads. Roads are the dominant means of transportation in India today. However, most of the roads in India are narrow and congested with poor surface quality and road maintenance needs are not satisfactorily met. No matter where you are in India, driving is a breath-holding, multi-mirror involving, potentially life-threatening affair. There can be different causes of congestion in traffic like insufficient capacity, unrestrained growth in cars, large Red-Light delays etc. In this project we aim to reduce congestion by controlling the traffic junctions using what we call a smart or Intelligent traffic light system. The discussed priority-based control system is designed to control the interval of traffic lights based on the density or number of vehicles present in their respective lanes, it is also designed to detect and allow free transit of emergency vehicles or VIP vehicles throughout the traffic junction.**

Index Terms **- traffic, congestion, Intelligent Traffic Light, Traffic Control, Emergency Vehicle, Priority based control.**

I.INTRODUCTION

The existing traffic signal control system works mainly on the delay time already set irrespective of the vehicle density on a particular lane and without giving any priority to the emergency vehicles such as ambulance, fire engines etc. While insufficient capacity and unrestrained growth of cars are somewhere interrelated, the delay of respective light is hard coded and not dependent on traffic. Therefore, there is a need for simulating and optimizing traffic control to better accommodate this increasing demand arises.

There is also a need to develop a system which can handle emergency conditions in a smoother manner by detecting and allowing free transit of emergency vehicles such as Ambu- lance, Fire Engine, etc through the traffic junctions.

In recent years, video monitoring and surveillance systems have been widely used in traffic management. The traffic density estimation and vehicle classification can also be achieved using simpler Infra-red sensory systems. We discuss the method to use IR sensor feed at the traffic junctions for real time traffic density calculation using level-based estimation of traffic. It also focuses on the control system coding for switching the traffic lights according to vehicle density on road being sensed by the IR sensor, thereby aiming at reducing the traffic congestion on roads which will help lower the number of accidents. In turn it will provide safe transit to people and reduce fuel consumption and waiting time.

The same system can be used to setup free transit for Emergency vehicles by using IR emitters attached to the emergency vehicles as ID for IR sensors to sense the vehicles position and control the traffic light sequence accordingly. This will save a lot of people by improving the response time of emergency vehicles which have been hindered by traffic congestion.

A. MOTIVATION

Traffic congestion is the major cause of tardiness in many important jobs, which get delayed mostly because of imbalance in timing of traffic signals or due to emergencies that occur at the traffic signals caused by impatient drivers and out of control vehicles. Out of all the important jobs that get delayed due to traffic jams the most detrimental of them all are Emergency vehicles that deal with Peoples life where every second matters with the life and death of one or more effected people.

Therefore there is a need to reduce traffic congestion and transit time for Emergency Vehicles, reducing

time taken to respond to said emergency or improve their response time hence decreasing the number of cases where people died due to late arrival of emergency vehicles.

There is also a need to improve traffic flow at junctions and lower the number of accidents involved in traffic junctions.

Improve the mode of controlling traffic lights or converting traffic light running on basic switching cycles into Intelligent traffic light that can switch based on sensory computed inputs. It will also provide significant data which will help in future road planning and analysis.

In further stages multiple traffic lights can be synchronized with each other with an aim of even less traffic congestion and free flow of traffic. And coordinate the signals based on route taken by the emergency vehicles.

B. PROBLEM STATEMENT

Developing a working detector model for emergency vehicle detection in traffic signals, which can estimate the direction and position with enough accuracy to control the switching of traffic lights. Developing a working detector model for traffic detection which can estimate traffic density with enough accuracy to control the traffic lights.

It has to be compact - we should not add to the reasons for congestion in traffic junctions by taking up too much space for sensory peripheral or other relevant setups required for detection of traffic, better sensing capabilities than visible wavelength sensors as they can get easily triggered by noise from other elements such as birds, the sun, reflections and background emissions. And it must work with Day-Night cycle without loosing efficiency or sensory capabilities.

We are going to control the traffic light sequencing using Arduino Uno control systems, for traffic detection we are going to use IR sensors as they are compact, Both active infrared and passive infrared detect presence and passage of vehicles, IR spectrum can be detected throughout the day night cycle.

Using IR sensors compared to the use of ultrasonic, LASER, Magnetic based sensors, Inductive loop based sensors and Microwave based sensors is more cost effective, providing higher accuracy and usability.

C. OBJECTIVES

Develop a low cost easy to install model for intelligent traffic management. using simple level-based traffic density estimation, using IR sensors placed at proper intervals which detect potential density of vehicles at junction based on their distance from the junction. And develop a working emergency vehicle detection system that can detect the position and direction of travel of emergency vehicle.

- Reduce Traffic Congestion.
- Save time lost waiting at large red-light delays.
- Improve Traffic Flow and develop smart traffic detection methods.
- Improve response time of Emergency vehicles.
- Prevent accidents caused by impatient drivers.

D. APPLICATIONS

The main intention of this system is to benefit the vehicles by preventing any delay for the vehicles travel time and re- ducing their stay at the junction hence also reducing accidents caused due to impatient drivers. There is also the intention of allowing free transit to emergency vehicles, improving their response time and preventing loss of life. These can be used to deal with many kinds of emergency vehicles such as -

- Ambulance
- Defence vehicles in emergency cases.
- Fire extinguishing vehicles.
- Police vans in emergency cases.

Similar Concept can be used to develop other monitor- ing/controlling systems implemented in fields such as

- Railway Crossing gate automation.
- Parking lot early warning systems or Car counter systems.
- In Industry for Product flow monitoring systems and Production Line Balancing.

II. LITERATURE SURVEY

This section consist of the research and survey we have conducted before undergoing our project.

[1] Ishaan Gulati and R. Shrinivasan in their paper “Image Processing In Intelligent Traffic Management” have discussed the practical challenges of applications and implementation of traffic monitoring and controlling tasks. They have listed the types of detectors employed for traffic detection along

with their capabilities, strengths and weaknesses. They have also discussed about the topic of image processing and develop- ment for vehicle detection and classification, vehicle counting and density estimation with various different techniques used to achieve this like background subtraction technique, Edge detection, Algorithm technique, etc. . .

[2] Jian Liu, Jiangtao Li, L.Zhang, Feifei Dai, Yuanfei Zhang, Xinyu Meng, Jian Shen in their paper "Secure Traffic Light control using fog computing" have discussed the de- velopment of control schemes that are secure and combat the challenges like heavy roadside sensors, resisting malicious ve- hicles and avoiding single point failure. They have developed two control schemes using fog computing whose security are based on hardness of DiddieHellman puzzle and hash collision puzzle respectively. The first scheme is a simple extension of present schemes. The second scheme is and improved version taking higher traffic density into consideration.

[3] Anurag Kanungo, Ayush Sharma, Chetan Singla int their paper "Smart Traffic Lights Switching and Traffic Density Calculation using Video Processing" have designed a system that can switch traffic light using an algorithm that uses image processing to detect changing density of vehicles on road using a road diagram from live feed of cameras at junction. They have used software like c++, matlab, etc. . . to generate image processing algorithms and classified them into hard coded and dynamic codded algorithms and have compared results of both algorithms after experimenting 100 times each for 10 sets of results. Then they have discussed the relevant information obtained from the results, along with boundary limits of the system and testing instances.

[4] Aman Dubey, Akshdeep and Sagar Rane in their paper "Implementation of an intelligent traffic control system and real time traffic statistics broadcasting" have introduced development of intelligent traffic control using Beagle Bone Black/Rasp Pi to the traffic light system which provides numerous configurable options to turn a traditional traffic light into a smart one. A system containing microcontroller is established on traffic light to control traffic at road intersections. Image processing algorithms, such as Haar Cascade and Background Subtraction are used to achieve the control of light interval timer. They have also discussed the implementation if server based computing/ broadcasting where the real time traffic image, traffic density and other statistics will be sent to server. The data can be broadcast from server at any time on demand through digital solutions.

[5] Suhail. M. Odeh in their paper "Management of An Intelligent Traffic Light System by Using Genetic Algorithm" have discussed the system of intelligent traffic light that controls the flow of traffic by detecting levels of congestion and abnormal situations in two main highways and four intersections. The introduced system collects data from video imaging system to detect and count number of vehicles. This information is then sent to a system which uses genetic algorithm to make real time decisions to control the green light interval for each traffic light. The system is simulated theoretically and they have discussed the implementation of VANET and mobile tracking techniques to improve their system.

[6] Ashwini Y. Dakhole, Mrunalini P. Moon, in their paper "design of intelligent traffic control system based on arm" have presented solution to the Traffic jamming issue in several current municipalities around the globe by the designing of ARM7 based traffic control system. The main objective of this research is to improve an efficient process to classify the traffic which attempts to reduce the traffic signals efficiency. Their scheme provides uppermost precedence to urgent situation vehicles to pass the traffic signal efficiently. However it has problem along with congestion term in few cases.

[7] Khalil M. Ahmad Yousef, Ali Shatnawi, Mohammad Latayfeh in their paper "Intelligent Traffic Light Scheduling Technique Using Calendar-Based History Information" have proposed a new novel history based traffic management algorithm that relies on previously recorded traffic history information to compute green/red light interval times for each direction of traffic signal. The proposed algorithm is implemented and tested using MATLAB and SUMO. They have also provided detailed simulated results and shown the improvement observed by implementing their optimized algorithm and have also compared the outcome with other computing algorithms.

[8] Ankit Dubey; Mayuri Lakhani; Shivansh Dave; Jignesh

J. Patoliya in their paper "Internet of Things based adaptive traffic management system as a part of

Intelligent Transporta- tion System (ITS)" have discussed the need for developing and implementing an adaptive traffic system which is connected to the internet so that different lanes can be monitored constantly. All the data is sent to one place, Central Traffic Control Office, where it is examined and controlled to give values of congestion in particular lanes according to which the traffic lights are programmed to work. This system allows complete traffic control by the Central Traffic control office hence useful in emergency or VIP clearance situations.

[9] Satya Priya Biswas, Paromita Roy, Nivedita Patra, Amartya Mukherjee and Ilanjan Dey in their paper " Intelligent Traffic Monitoring System" have presented the various ap- proaches made to enhance the traffic systems across the globe. They have classified these intelligent traffic control systems into real time systems and data analysis systems each based on their own speciality. A comparative study is made along with important key points of each research are highlighted and judged based on implementing them in developing countries like India. They have also proposed a model to use proximity sensors for ITS.

[10] Pradeep Kumar Agarwal, Jitendra Gurjar, Ashutosh Kumar Agarwal, Ramkrishna Birla in their paper "Applica- tion of Artificial Intelligence for Development of Intelligent Transport System in Smart Cities" present basic concepts and applications of Artificial Intelligence system for development of intelligent transport systems. They discuss the need to implement Artificial intelligence and its applications to control operations in smart cities like smart public transport system, Intelligent traffic management and control, smart traveller in- formation system, smart parking management and safe mobil- ity and emergency systems in smart cities. They have studied the theory of AI development based on KBS (knowledge based systems).

[11] P. Sahitya CSE, Swathi.S., Chethan.T.S, Aadith Narayan, Shivani.L, Elakya.R in their paper "RealTime Adap- tive Traffic System" have developed a model to decongest a four way junction road traffic in real time using self powered peizo-electric sensors, that act as weight sensors when vehicles tread over it. Using this as a method to count density of vehicles they have established a system which can change and control the time interval of the signal lights. They have also discussed the use of RFID tagging to develop methods to allow emergency vehicle transit by decongesting their respective lane. They have developed the model using arduino board and simulated inputs which they would have received from peizo- electric sensors to get response from controller to the traffic light system.

A. SUMMARY

After Researching various methodologies for vehicular de- tection in traffic, we chose to use IR sensors for its robustness and accuracy compared to other alternatives, for the use of vehicle detection and density estimation. It is also cheaper and easier to install and use, The disadvantages of the IR sensors are outweighed by its advantages. Image processing solutions tend to be more complicated and costly to install usually taking two configurations to work during day and night cycles, they also seem to have serious issues with high traffic density and data processing issues where data can easily get corrupted leading to false instruction cycles and breakdown of systems. There is a lack of VIP or emergency Vehicle detection systems in the researched papers where only a few attempt to develop models to detect and allow free transit of such vehicles, even they have not implemented this model along with the traffic density systems hence in our project we aim to also implement a method for Emergency or VIP vehicles to be detected and then, through the controlling of traffic lights, allow them free transit through the traffic junction. We aim to reduce the cost and complexity of our model compared to the models proposed in the research papers to allow ease of installation and maintenance for any city or town that decide to adapt a control system based on our model.

III.METHODOLOGY

Main aim is to develop a Integrated Controller model that can detect vehicle presence, count the number of vehicles and also process these information using the code and ultimately control the traffic light to get the appropriate response. To do which we will need set of LED lights to represent traffic signal lights, a controller system to control the sequence of LEDs and also need an assortment of transmitters and receivers that will work as detection system for both Level based density model and Emergency Vehicle Detection systems. We will need appropriate software to develop, compile and troubleshoot the program code

and also write the code into the controlling system, we will also need software to test run or simulate the working of the code.

A. PROJECT OUTCOME AND MODE OF DEMONSTRA- TION

Develop a model that uses IR sensors placed at certain distances from the traffic junction and developing control system code to read/detect traffic density based on sequence of input from these IR sensors and then adjusting the time interval for green light accordingly such that most if not all of the vehicles can leave the junction within the interval. The model will also have Multiple IR sensors that are oriented to detect arrival of emergency vehicle onto the lanes of the traffic junction, which then would turn the lights of the junction to green allowing free transit of emergency vehicle from the junction. Mode of demonstration would be using LED lights acting as Traffic lights controlled by Arduino board which gets input from IR Sensors which we can activate to show the change in time interval of green lights and also demonstrate control of lights when there is an emergency vehicle arriving at the junction.

B. DETAILED DESIGN

Our System Consists of two Systems namely Emergency Vehicle Detection System and "Level" Based Density and time Interval Control Systems. The following shows the Proposed Block Diagrams For each of the two system which is planned to be integrated into the same Controller using various Hardware and Software Peripherals.

1) Emergency Vehicle Detection System: In the proposed system, the block diagram consists Traffic junction where our controller has been setup to monitor and assist transit of emergency vehicles. As the ambulance (Shown in the Fig.) arrives to the junction say lane one, the signal turns from red to green on lane one and at the same time all the other lanes the signal is turned to red. This is achieved by IR link via transmitter and receiver pair.

The Components used for this are as shown -

- Transmitter - IR transmitter
- Receiver - IR Receiver
- Micro-Controller - Arduino UNO
- Traffic Signal Unit - LED Red, Yellow, Green.

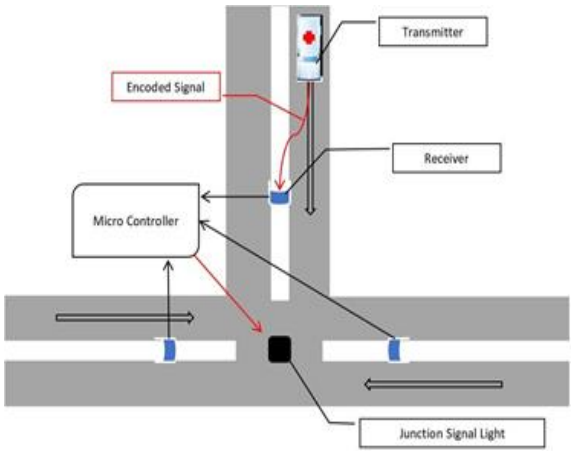

Fig. 1. Emergency Vehicle Detection System

Microcontrollers, timers and counters are used for controlling the traffic signal unit. It shows the logical flow behind the project which includes all the 3 units that is

(i) Ambulance which has been fitted with the IR Transmit- ter: The ambulance will have an IR emitter unit placed at the elevated place on the ambulance. At the time of emergency the Driver Switches on the IR Emitter.

(ii) IR receiver placed at an ideal position near the junction which has been decided based on the survey done on daily flow of traffic to know the usual traffic flow: When the driver switches ON the IR control unit, the emitter in the control continuously emits the encoded unidirectional IR radiation. This will lead to communicate with the traffic signal control unit.

(iii) Microcontroller is the third unit which receives the signal from the sensor and controls the traffic signal light based on the predefined instructions coded into the controller: The controller controls all the traffic signals in the path of the ambulance and makes it ready to provide free path to ambulance, which ensures that the ambulance reaches the hospital/emergency zone without any delay.

Whenever the ambulance reaches near the traffic signal, the IR TSOP receiver placed at the traffic signal post receives the encoded signal which is transmitted by the IR transmitter placed at the ambulance and decodes it to produce electrical output pulse. The output from the IR receiver unit is fed as an input to the microcontroller. Once the microcontroller receives input, the red signal at the traffic signal post is turned to green automatically until the ambulance crosses that

particular junction. Thereby the ambulance is expected to reach the hospital/Emergency zone in time.

2) Level Based Density System: In this proposed system we are going to use Proximity sensors placed at appropriate distances from the junction, each of which is labeled according to level of traffic. This method is a simplistic approach to detect traffic density, using Proximity sensory input which is then processed by microcontroller to determine the appropriate interval of green light.

The 'Levels' are to be determined after observing and recording the traffic density throughout the day and adjusted

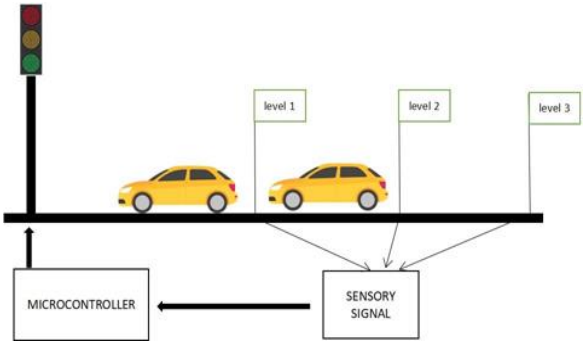

Fig. 2. Level Based Density

accordingly to represent -

level 3 (or highest) as the approximate maximum density at lane observed at peak traffic conditions. This level should not exceed the maximum allowable time interval for green light, as increasing the green light interval means that increasing Red Light interval on other lanes.

And level 1 (or Lowest) as the approximate minimum density at lane observed. This level should not be below the minimum allowable green light interval, as reducing the green light interval completely can cause distant vehicles arriving to speed up to try and cross the junction within the time interval which is dangerous and can lead to accidents.

It works by sensing the arrival of cars at the junction, which turns on the input from sensors placed at the levels, this input is used to determine the time interval to be set for green light by microcontroller. The coding for this would require to sense stationary vehicles.

Using this "Level" Based Density Estimation, one can simplistically determine the congestion level of the vehicles at a junction and use it to determine the appropriate time intervals essential to ensure that all the vehicles in the lane can easily exit the junction without the need for over-speeding or the need to miss their chance to exit and have to wait in the junction for the next green light. This time interval must also be set optimally to ensure that there is no long delay for the signal to switch as it will effect the Waiting time of the vehicles in all other lanes of the same junction. This method of detection employed using Proximity Sensors allows us to detect the vehicles throughout the day as they are not effected by the time of the day.

C. COMPONENTS REQUIRED

The following hardware components are required to conduct the project -

1. Arduino Microcontroller
2. IR Emitter
3. IR Receiver
4. Proximity Sensor
5. LED
6. Resistor
7. Other Essentials: 5V DC power supply, Jumper wires, USB cable, Bread Board, etc.

The Description for which is as follows

1) Arduino Microcontroller: The main part of the Traffic Light Controller is the controller itself. Arduino UNO will serve the purpose in this project to handle all the switching of the LEDs and controlling their timings.

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started

TABLE I ARDUINO UNO ATMEGA328 SPECIFICATIONS

Micro-controller	ATmega328
Operating Voltage	5 V
Input Voltage (Recommended)	7-9 V
Input Voltage (Limits)	6-20 V
Digital I/O Pins	14 (of which 6 provide PWM Output)
Analog Input Pins	6
DC Current per I/O pin	40 mA
DC Current for 3.3 V Pin	50mA
Flash Memory	32 KB (ATmega328)

	(0.5 KB Used by BootLoader)
SRAM	2 KB (ATmega238)
EEPROM	1KB (ATmega238)
Clock Speed	16 Mhz

a) Input and Output Pins of Arduino: Each of the 14 digital pins on the Arduino Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-25 kOhms. In addition to this some pins have special functions such as -

- Serial pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to- TTL Serial chip.
- External Interrupts pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.
- PWM 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM (Phase Wave Modulated) output with the analogWrite() function.
- SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These

pins support SPI communication using the SPI library.

- LED: 13. There is a built-in LED connected to digital pin

13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

Additionally, some pins have specialized functionality: These are a couple of other pins on the board -

- TWI: A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- AREF: Reference voltage for the analog inputs. Used with analogReference().
- Reset Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board.

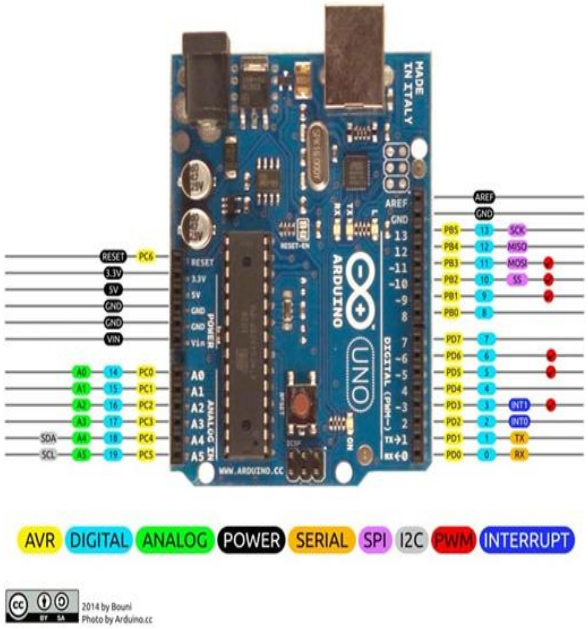

Fig. 3. Arduino UNO Pin Structure

2) IR Emitter: An infrared emitter, or IR emitter, is a source of light energy in the infrared spectrum. It is a light emitting diode (LED) that is used in order to transmit infrared signals from a remote control. In general, the more they are in quantity and the better the emitters are, the stronger and wider the resulting signal is. A remote with strong emitters can often be used without directly pointing at the desired device. Infrared emitters are also partly responsible for limits on the range of frequencies that can be controlled. An IR emitter generates infrared light that transmits information and commands from one device to another. Typically one device receives the signal then passes the infrared (IR) signal through the emitter to another device.

3) IR Receiver: An infrared receiver, or IR receiver, is hardware that sends information from an infrared remote control to another device by receiving and decoding signals. In general, the receiver outputs a code to uniquely identify the infrared signal that it receives. This code is then used in order to convert signals from the remote control into a format that can be understood by the other device. It is the part of a device that receives infrared commands from a remote control. Because infrared is light, it requires line-of-sight visibility for the best possible operation, but can however still be reflected by items such as glass and walls. Poorly placed IR receivers can result in what is

called" tunnel vision", where the operational range of a remote control is reduced because they are set so far back into the chassis of a device.

4) Proximity Sensor: A proximity sensor is a non-contact sensor that detects the presence of an object (often referred to as the "target") when the target enters the sensor's field. De- pending on the type of proximity sensor, sound, light, infrared radiation (IR), or electromagnetic fields may be utilized by the sensor to detect a target. Proximity sensors are used in phones, recycling plants, self-driving cars, anti-aircraft systems, and assembly lines. There are many types of proximity sensors, and they each sense targets in distinct ways. The two most commonly used proximity sensors are the inductive proximity sensor and the capacitive proximity sensor.

Fig. 4. IR Proximity Sensors - Reflection Based

The type of proximity sensor used is called a photoelectric proximity sensor. There are two main types of photoelectric proximity sensors: reflective and through-beam. Reflective proximity sensors detect objects when the light emitted from the sensor is reflected back at the photoelectric receiver. Through-beam sensors detect targets when the target breaks the beam of light between the sensor's emitter and receiver.

The proximity sensor device used here can sense or detect the presence of objects near it (either line of sight or surround- ing). This is achieved using an IR emitter-receiver pair that is connected to a chip that can process the encoding-decoding of signal sent in emitter and decodes the signals received by the receiver. Hence it can use the signal sent and received to determine the distance of object based on the changes observed in the sent and received signals.

5) LED: Light emitting diodes, are devices which emit light when current is passed through them. There is an LED connected to digital pin of controller. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

The LEDs used in the project are basic 5mm LEDs of Red, Yellow and Green colors. The maximum current that can be allowed through these LEDs (Red, Yellow and Green in particular) is 20mA. (Foe Blue LED, the maximum current can be up to 30mA)

The LEDs here Represent the LEDs of the Traffic light, the Traffic Light system uses an array of LEDs on a panel which light up all at once to depict the traffic light I.e Red, Yellow or Green this array can be controlled by trigger switches that can be connected to the Controller eliminating the need for connecting all the LEDs in the array to the controller separately hence ensuring minimum port/pins usage from the controller additionally the flash of yellow light that happens between the transitions from Red Light to Green Light can be hard coded i.e implemented by Hardware tools, further reducing the need to use the limited Ports of the Controller.

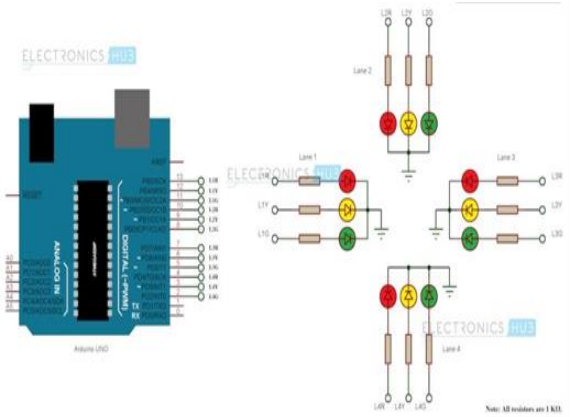

Fig. 5. LED Interfacing Circuit Diagram Example - Source: ElectronicsHub

6) Resistor: A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. In electronic circuits, resistors are used to reduce current flow, adjust signal levels, to divide voltages, bias active elements, and terminate transmission lines, and many other uses. Resistors are common elements of electrical net-works and electronic circuits and are ubiquitous in electronic equipment. Practical resistors as discrete components can be composed of various compounds and forms. Resistors are also implemented within integrated circuits. The electrical function of a resistor is specified by its resistance: common commercial resistors are manufactured over a range of more than nine orders of magnitude. The nominal value of the

resistance falls within the manufacturing tolerance, indicated on the component. The Resistors we use in our circuit is to ensure the operating condition (Current and Voltage) for the LEDs and sensors in our circuit. Most of the resistors used are 1Kohm resistors.

Fig. 6. Array of Axial Resistors - Color Coded to represent resistance

7) Other Essentials:

- 5V DC power supply: To power the Arduino Uno when it is running/operating in standalone condition i.e to power the control as it works in its operating condition con- nected to the traffic light system without the connection to the coding device.
- Jumper wires : Connecting Wires of the Traffic Light controlling System Circuit.
- USB cable : Connection to boot/programme the Arduino using a programming device.
- Bread Board : Connecting Board with detailed Internal Wiring to extend and connect the Wires of the Circuit utilized to optimize connections to common base like ground or Vcc.

D. IMPLEMENTED METHOD

In this project, a simple traffic light system for a 3 way intersection is implemented using Arduino UNO Controller that can control the LED lights of the traffic signal based on the inputs from "level" proximity sensors and IR receivers to undertake the operation of 'Level" Based Time interval Controlling and also Emergency Vehicle Detection and Response.

1) Density Based Time Interval Estimation: As discussed in the block diagram, the method is to simply receive inputs from sensors and develop a program, to use this input and convert it into required information for controlling the traffic signals.

The IR Sensor when detecting presence in its proximity Line of Sight, will send out a logic high (i.e value 1 or +5V at pin) which would represent the presence of vehicle at the sensor. This input is then taken to a controlling unit here Arduino Uno microcontroller, which has been programmed with the code, which processes the input and decides the response or output logic signal, which is then used to control the LED in the traffic lights.

The method can be summarized as:

- Check for vehicle presence at the lane 'level' - done by Proximity sensors placed at level these proximity sensors will detect the presence of vehicles at their Line of Sight or proximity and hence can give us an estimated count based on the presence of vehicle as vehicles stack behind each other on the lane.
- Determine the time interval for green light for that lane based on the 'level' - time interval is determined based on survey of time taken to clear traffic in lane for 'level' density. That is time taken for vehicles to leave the junction when they were of the set 'level' density i.e for all the vehicles to safely exit the junction.
- Switch to Green light for next lane after the set time interval, and the time interval for the next lane is also calculated based on the vehicle density for that lane this is done by another set of "level" proximity sensors through the use of which we can get optimal time intervals for all the separate lanes.
- Repeat the cycle for all other lanes while also keeping check of the Emergency vehicle Sensor.

2) Emergency Vehicle System: The priority is given to the lane where the ambulance is approaching. In this, first the Lanes are switching according to the "level" based density cycles and only when an Emergency vehicle approaches the junction The cycle should switch from previous to Emergency Condition cycle. Say vehicle approaches the junction from lane-1, Then lane 1 must be switched to Green Light and all other Lanes must Switch to Red light, only after a pre- determined Time interval of say 5 seconds to allow smooth transition between the lane light switching. This interval is also to prevent Accidents arising from Sudden switching of Lights.

As a warning indicator, the Yellow light in Lane 1 is tuned on indicating that the green light is about to light up. Similarly, the yellow light in the Lane 2 and 3 is also turned as an indication that the red light about to be turned on. The yellow lights in Lanes 1, 2 and 3 are

turned for a small duration say 2 seconds after with the green light in the Lane 1 is turned on and red light in Lane 2 and 3 is also turned on. The red light in Lane 2 and 3 is also turned on for a predefined time and the process moves forward. In addition to this, our project involves interfacing a transmitter and receiver in the ambulance and the signal post respectively due to the prioritization of which the traffic signal will change.

Ambulance consists of an RF transmitter which transmits a forward only encoded signal which is received by the RF receiver placed at the signal post. This received signal is de- coded by the decoder which is in turn converted to an electrical signal and then passed on to the microcontroller placed at the signal post. This received signal by the microcontroller helps in the execution of the desired operation i.e. conversion of the red signal at the signal post to green when the ambulance approaches the respective signal post.

The method For Emergency vehicle response control can be summarized as:

- Check for Emergency vehicle Presence in lane - achieved by placing special IR receivers that detect IR emitted from emitters placed on the Emergency vehicles. The emitters are oriented in two directions in each lane to detect arrival and departure of emergency vehicle.
- Turn the Light Green for Lane with Emergency Vehicle- this is done by interrupting the normal cycle or density-based cycle and switching green to lane with Emergency vehicle.
- Detect transit and departure of Emergency vehicle - This is done by the IR sensor oriented to detect departure of Emergency vehicle in the four lanes, hence signaling the controller to revert to normal operation.
- Resume normal Operation of Signals - after the sensor detects transit of Emergency vehicle the normal condition or Density based condition is Resumed by turning the lane signals to red for all lanes and starting cycle from green light at lane that was interrupted.

E. PROGRAMMING

The programming of the Arduino uno is done using the Arduino IDE 1.8.13v. The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board. If you have a reliable Internet connection, you should use the online IDE (Arduino Web Editor). It will allow you to save your sketches in the cloud, having them available from any device and backed up.

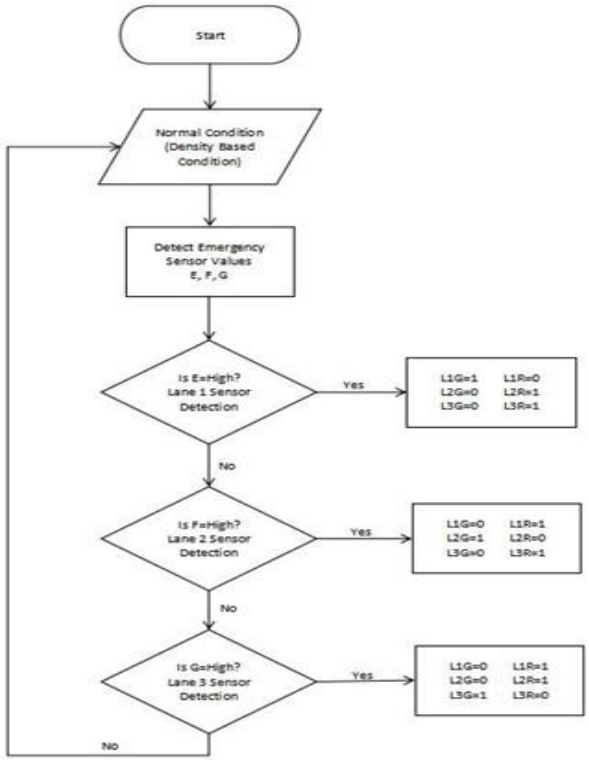

Fig. 7. Emergency Condition Flow Chart

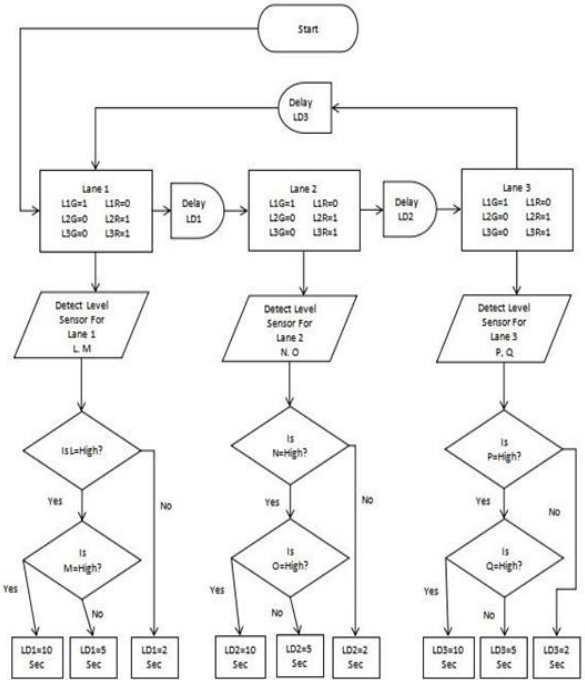

Fig. 8. Density Based Time Interval Flow Chart

You will always have the most up-to-date version of the IDE without the need to install updates or community generated libraries. If you would rather work offline, you should use the latest version of the Desktop IDE.

For a complete list of Guides visit the Foundations section, where you will find in-depth knowledge about the principles and techniques behind the Arduino platform. Making the Arduino StarterKit projects and reading the book 'Getting Started with Arduino' are great ways to start learning and tinkering with coding and electronics.

IV. RESULT AND INFERENCE

The Working of the model confirms the viability of the Project, all the sensors, circuits and controller seem to be operating as per the objectives of the project. The Feasibility of the Project as Determined in the Initial Stages has also been met.

From proper analysis of working and constraints of the system it is inferred that the system is working as per the objectives of the project. Installation and maintenance of the system is cost effective and takes less time. The system-user interface is user friendly and does not require specialized training or skills to operate it.

The project has been designed to substantially enhance the performance by ensuring smooth mobility of emergency services (like ambulance etc.). The implementation of the algorithm is done is such a way that it not only paves way to emergency vehicles but its auto reinstatement of the older status of traffic light helps in smooth transition of traffic along the road. The system also reduces the workload of traffic personnel as it totally automated the whole prospect of traffic signalling which also greatly reduces the domain of error.

V.CONCLUSION AND FUTURE SCOPE

An idea is proposed in this project for controlling the traffic signals in favour of emergency vehicles and regulating time intervals based on density.

With this system the vehicles can be cleared from traffic efficiently by reducing waiting time lost in red lights, through fixing time intervals, which are determined automatically by the system, allowing easy transit for vehicles. This system also allows Emergency Vehicles to be maneuvered from the Traffic Junction without major loss of time and hence improving the chances of survival of victims in the Point of Emergency.

This system is an entry level idea to develop Smart Traffic Signals which can respond to traffic intervals based on density and also mange free transit of Emergency vehicles. This system in the future can be Implemented with additional features that will aid to further improve the flow of traffic in cities combating the problems that arise due to traffic congestion.

Thus the intelligent traffic system if implemented in countries with large population like India, it can produce better results, is more accurate with no loss of time. By implementing this traffic signal control system the emergency situations are controlled in a much optimized manner. This helps the society in a much better way as it helps the Emergency situations to be resolved with much ease. Being an automated signaling system it eliminates the chances of human error which often results in road accidents and mishaps.

Being an automated signaling system it eliminates the chances of human error which often results in road accidents and mishaps. Thus, this project is practically feasible, economically viable, and reliable in nature. It's robust as well as easy to handle mechanism makes it easy and quite simple to be understood and brought in use by the masses.

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