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TRAFFIC MANAGEMENT SYSTEM USING INTERNET OF THINGS

A Traffic control system that helps in congestion using IOT

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Abstract: Over the years, there has been a sudden increase in the number of vehicles on the road. Traffic congestion is a growing problem everyone faces in their daily life. Manual control of traffic by traffic police has not proved to be efficient. Also the predefined set time for the signal at all circumstances (low and high traffic density) has not solved this problem. A model to effectively solve the above mentioned problems by using Internet of Things (IoT) is proposed. We use cloud for internet based computing, where different services such as server, storage and application are delivered for traffic management. A network of sensors is used to track the number of vehicles and the traffic congestion at the intersections on a road and rerouting will be done on the basis of the traffic density on the lanes of a road.

Keywords: **IOT, Microcontroller**

1. INTRODUCTION

The sustainability and smartness of the smart city concept rely on the technologies adopted to improve the people's quality of life. The smart city governance is one significant aspect of smart city initiatives, which will facilitate the planning techniques for better decision making. One of the key elements of the smart city governance framework is the public value generated out of the smart services provided .

The government has to work on different aspects of smart city solutions such as smart health care, smart building management, smart traffic management, smart parking solutions, smart transportation, etc. to generate public value for the service they provided. The emergence of the internet of things (IoT) has evolved theconcept of smart cities. In a smart city environment, the physical infrastructures of the city are equipped with smart devices, which continuously produce multidimensional data in different spaces and these data are processed to achieve intelligence for the infrastructure . Ultimately, intelligence is applied to improve the socio-economic activities of the society.

Smart traffic infrastructure is an essential component of smart city initiatives because traffic congestion is a severe issue that grows along with city development. Smart traffic management includes intelligent transport systems with integrated components like adaptive traffic signal controls, freeway management, emergency management services, and roadside units . Such systems collect real-time traffic data and take necessarymeasures to avoid or minimize any social issue created as part road congestions . For example, access to real- time traffic maps will assist the residents in selecting appropriate route to save time and effort.

The widely used mobile applications like Google Maps or Apple Maps accurately predict traffic congestion for urban roads based on the sensor data from monitoring devices installed on highways or urban roads . These application providers establish partnerships with various transportation entities to gather traffic information. The transportation governing authorities mostly install the traffic monitoring devices on urban roads, hence such application providers (e.g. Google application programming interface) deliver updates on urban traffic congestion. Besides, such applications also use crowdsourcing with location-based services to improve traffic density prediction. They do expect smart technologies within the vehicle or any smart mobile device with the driver of the vehicle to receive real-time traffic updates. The concern here is that the users require smart devices to access these applications and mostly the services are limited to urban roads.

The traffic pattern of urban roads or highways is different from that of collector roads. The users of collector roads include pedestrians, bicycles, motorbikes, and other vehicles; hence, the traffic pattern is different from the highways. Along with urban roads, the real-time monitoring of collector roads is also essential to improve the mobility of the entire city. The real-time traffic congestion updates, warnings from traffic authorities on non-recurrent traffic incidents such as accidents spilled loads, VIP visits, ambulance services, or any other unusual road incidents will support the collector road drivers in their decision-making. For instance, closed campuses such as universities and hospitals face heavy traffic congestions during peak hours. These campuses will have more collector road segments of different length that will connect to different entry/exit points. The real-time traffic updates of roads that connect to the exit points may help the driver for selecting the most suitable route from his current position. The drivers prefer to know about the congestion state of forthcoming intersections to plan themselves and save their time on the road by choosing alternate ways. The question that arises here is how to provide real-time road congestion updates to drivers even if there are no such smart devices with them or within the car, which is the real motivation of this research if it indicates the temperature greater than the threshold there would be a buzzer/led glow as a sign.

I. PROBLEM STATEMENT & OBJECTIVE

In 2014, 54% of the total global population was urban residents. The prediction was a growth of nearly 2% each year until 2020 leading to more pressure on the transportation system of cities. Additionally, the high cost of accommodation in business districts lead to urban employees living far away from their place of work/education and therefore having to commute back and forth between their place of residence and their place of work. More vehicles moving need to be accommodated over a fixed number of roads and transportation infrastructure. Often, when dealing with increased traffic, the reaction is just widen the lanes or increase the road levels. However, cities should be making their streets run smarter instead of just making them bigger or building more roads. This leads to the proposed system which will use a micro controller and sensors for tracking the number of vehicles leading to time based monitoring of the system.(Babu, 2016)(Zantout, 2017).

II. LITERATURE SURVEY

The Internet of Things (IoT), also sometimes referred to as the Internet of Everything (IoE), consists of all the web-enabled devices that collect, send and act on data they acquire from their surrounding environments using embedded sensors, processors and communication hardware. These devices, often called ”connected” or ”smart” devices, can sometimes talk to other related devices, a process called machine-to-machine(M2M) communication, and act on the information they get from one another. Humans can interact with the gadgets to set them up, give them instructions or access the data, but the devices do most of the work on their own without human intervention. Their existence has been made possible by all the tiny mobile components that areavailable these days, as well as the always-online nature of our home and business networks. Connected devicesalso generate massive amounts of Internet traffic, including loads of data that can be used to make the devices useful, but can also be mined for other purposes. All this new data, and the Internet-accessible nature of the devices, raises both privacy and security concerns. But this technology allows for a level of real-time information that we have never had before. We can monitor our homes and families remotely to keep them safe. Businesses can improve processes to increase productivity and reduce material waste and unforeseen downtime. Sensors in city infrastructure can help reduce road congestion and warn us when infrastructure is in danger of crumbling. Gadgets out in the open can monitor for changing environmental conditions and warn us ofimpending disasters.

Case Study 1: Traffic management for rectification on a road stretch
Authors: *Chander Mohan Kansal , Er. Sushant Gajbhiye*

Methodology: There are different types of method is used for collecting the data like Manual count & Automatic count[6,7]. In this study we used manual count. The data is collected on road Chandigarh Landran – Banur and Sirhind kharar . Two points in considered in every road A & B, the distance between each point is 1km. On those two points the two students one stand at the start of the line and other will stand at the end of the line. If the different types of vehicle is used for collecting the data the number of students or person will increase. The number of vehicles has to be counted manually, the data collected for different types of vehicles like Bull Carts, Two Wheelers (TW), Four Wheelers (FW), Low Motor Vehicles (LMV) and High Motor Vehicles (HMV)[8,9,10,11]. The time interval is taken 30 min & it is a two lane road. Figure 1; show s the layout plan of the different types of road stretch. The design hour flow is taken from PWD and PIDBdepartments. The traffic volume data is collected for this study. The data which is collected is shows in the followings figures.

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IV. Result

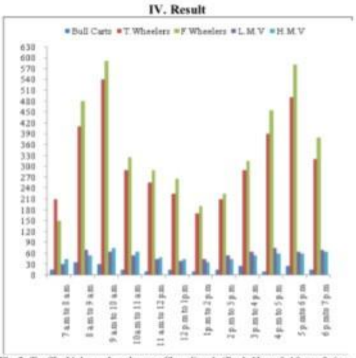


Fig.2. Traffic Volume Landran to Chandigarh (Peak Hour 9-10am, 5-6pm

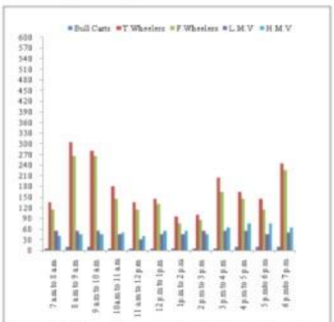


Fig.6. Traffic Volume Kharar to Landran (Peak Hour 9-10am, 5-6pm

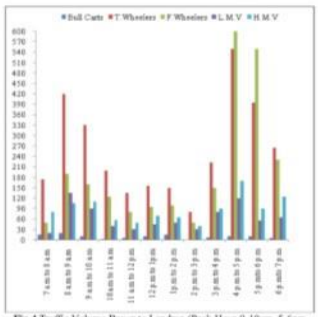


Fig.4.Traffic Volume Banur to Landran (Peak Hour 9-10am, 5-6pm

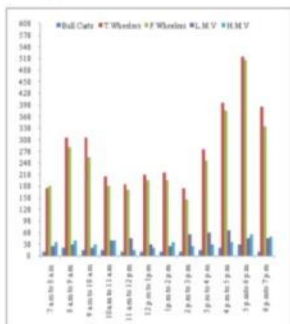


Fig.8. Traffic Volume Sirhind to Landran (Peak Hour 8-9am, 5-6pm)

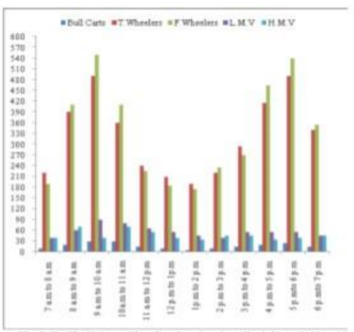


Fig.3. Traffic Volume Chandigarh to Landran (Peak Hour 9-10am, 5

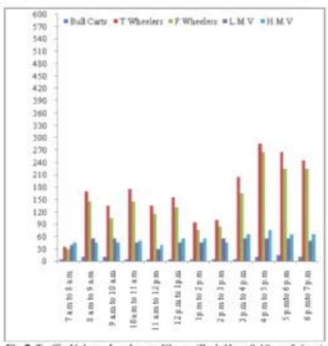


Fig.7. Traffic Volume Landran to Kharar (Peak Hour 9-10am, 5-6pm)

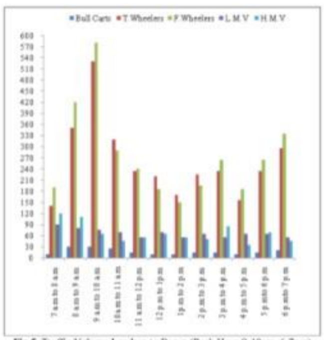


Fig.5. Traffic Volume Landran to Banur (Peak Hour 9-10am, 6-7pm)

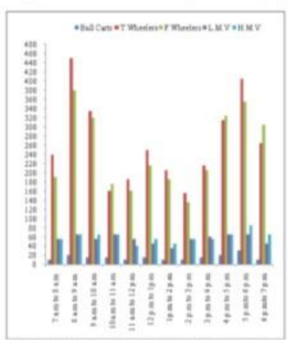


Fig.9. Traffic Volume Landran to Sirhind (Peak Hour 8-9am, 5-6pm)

Above data shows the traffic volume on different roads stretches. The traffic signal design is given below according to above data,

Table 1. Design of Traffic Lights

Direct on	**Chandigarh(C)**	**Sirhind(S)**	**Banur(B)**	**Kharar(K)**
Design hour flow	2300	1500	2700	990
Saturation on flow	4672	6247	7770	7770
Y	.49	.19	.37	.14
Y(max)	.49		.37	

Table 2. Signal Time

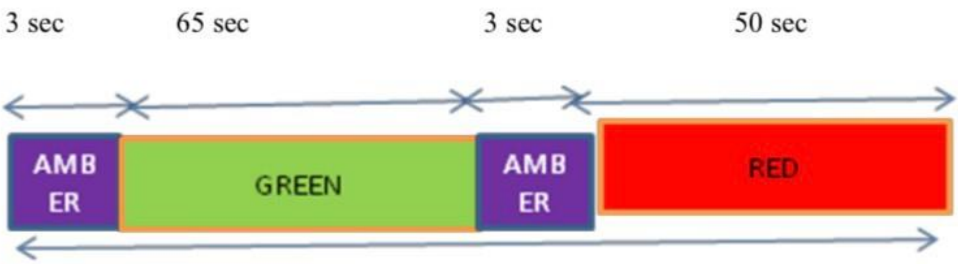
Signal	**Time In Seconds**
time loss	8
red	67
green	48
red/amber	3

Table 3. Signal Time

Signal	**Time In Seconds**
time loss	8
red	65
green	50
red/amber	3

Fig.10. Signal Time Interval

CHANDIGARH -SIRHIND PHASE



121sec

BANUR -KHARAR PHASE

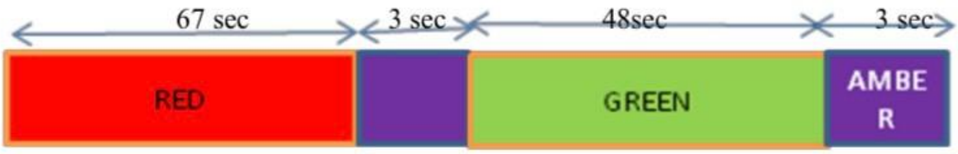


Fig.11.With Traffic Lights

Fig.12. Without Traffic Lights

Above figure shows the traffic time interval at junction. The amber time, green & red time for CHANDIGARH to SIRHIND road is 3 sec, 65 sec, 50 sec & for the BANUR to KHARAR road 3, 48, 67 sec is designed. The figure 11, show the layout plan on which the traffic light or signal is designed & the figure12, shows the layout plan without traffic lights.

Case Study 2 Traffic Characteristics Evaluation
Author: Devaraj Hanumappa , Raviraj H.Mulangi

Methodology: The objective of this study is to obtain the traffic characteristics like spot speed, Speed and delay of the particular stretch road and the volume counts at the intersections of Dharwad city. The data is used to determine the level of service, amount of congestion and the measures that need to be taken in order to ease the situation.

III. LIMITATIONS OF EXISTING SYSTEM

The exiting traffic system is generally controlled by the traffic police. The main drawback of this system controlled by the traffic police is that the system is not smart enough to deal with the traffic congestion. The traffic police official can either block a road for more amount of time or let the vehicles on another road pass by i.e. the decision making may not be smart enough and it entirely depends on the official's decision. Moreover, even if traffic lights are used the time interval for which the vehicles will be showed green or red signal is fixed. Therefore, it may not be able to solve the problem of traffic congestion. In India, it has been seen that even after the presence of traffic lights, traffic police officials are on duty, which means that in this system moremanpower is required and it is not economical in nature.

Disadvantages of current system

i) Traffic congestion
ii) No means to detect traffic congestion
iii) Number of accidents are more
iv) It cannot be remotely controlled
v) It requires more manpower
vi) It is less economical

IV. METHODOLOGY

In this proposed system, the traffic lights are LEDs and the car counting sensor is an ultrasonic sensor. Both blocks are connected to a Microcontroller using physical wires. The Microcontroller is the traffic light controller which receives the collected sensor data and manages the traffic lights by switching between green, yellow and red. The Microcontroller computes the number of cars in the street of the inter- section it is monitoring based on the distances measured by the ultrasonic sensor and the timing between those measurements. The Microcontroller then sends the number of cars every minute to the local server. This communication is done using the Microcontroller serial port. The local server exchanges the data received with the cloud server in order to better predict the changes in timings of the traffic light. This communication is done using Wi-Fi. More specifically, the cloud server uses an equation that takes the data received (number of cars) as input then determines the time interval of LEDs needed for a smooth traffic flow. This calculated time is then compared to the current actual time of the LEDs (this data is saved in a database on the cloud server). The server then comes up with a decision. If the current actual green time is less than the calculated time, the decision is to increase the green time, else to decrease the green time.

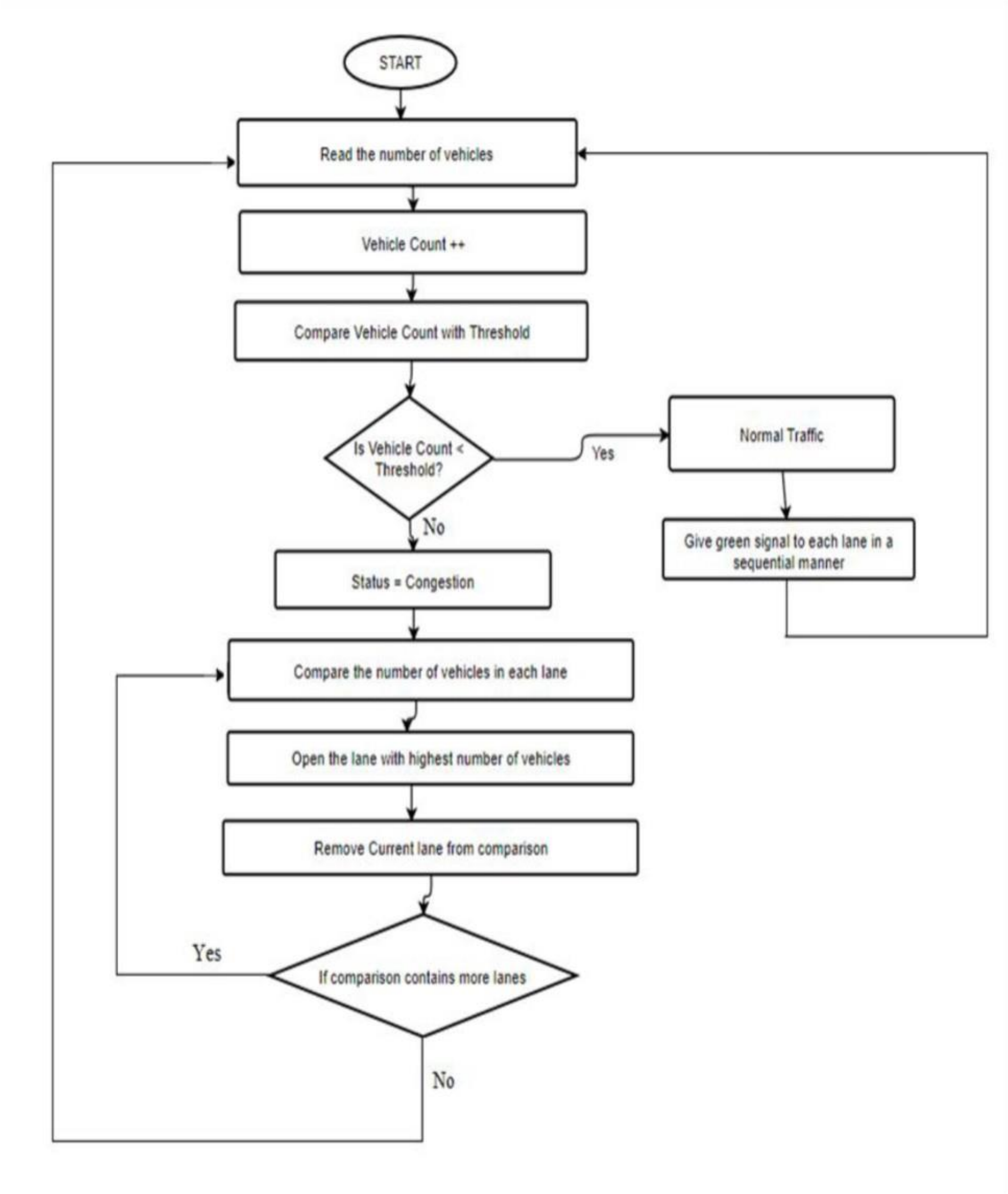


FIGURE 4.5: Flowchart.

2: Design Details

COMPONENTS:

- Microcontroller (Arduino Mega 2560:
  The Arduino Mega 2560 is a micro- controller board based on the Atmega 2560. It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), 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 a AC-to-DC adapter or battery to get started. The Mega 2560 board is compatible with most shields designed for the Uno and the former boards Duemilanove or Diecimila.

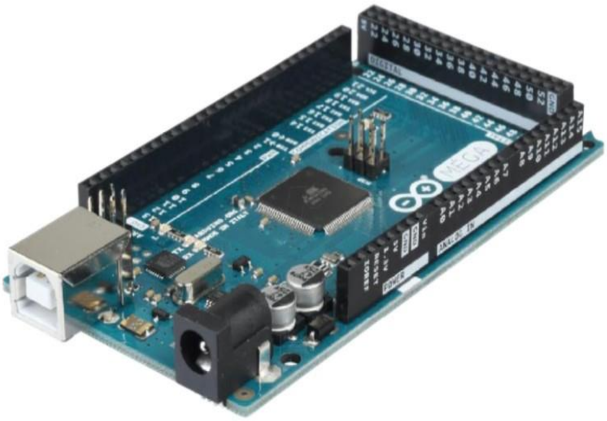


FIGURE 3.1: Arduino Mega 2560.

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- IR sensor
  IR sensor is an electronic device that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode. Photodiode is sensitive to IR light of the samewavelength which is emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

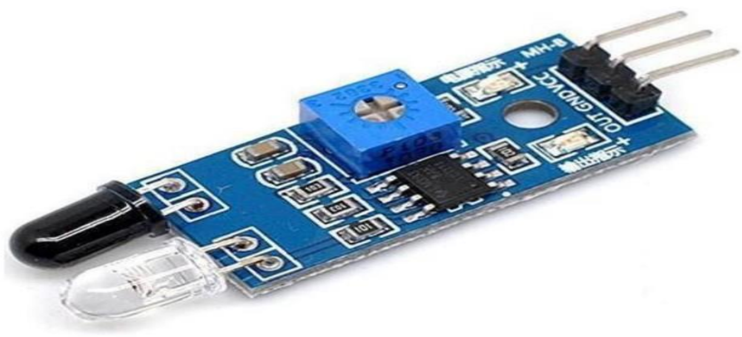

FIGURE 3.4: IR Sensors.

- LED for traffic light

  LEDS are used for the purpose of signaling according to the traffic condition

FIGURE 3.3: LED for Traffic Lights.

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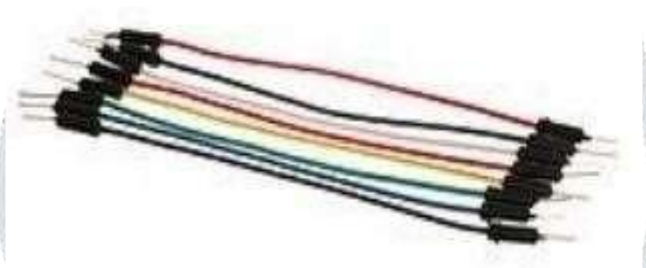
- Jumping Wires

  A jump wire (also known as jumper, jumper wire, jumper cable, DuPont wire or cable) is an electrical wire, or group of them in a cable, with a connector or pin at each end (or sometimes without them – simply "tinned"), which is normally used to interconnect the components of a breadboard or other prototype or test circuit, internally or with other equipment or components, without soldering



2.1 : Working of the system:

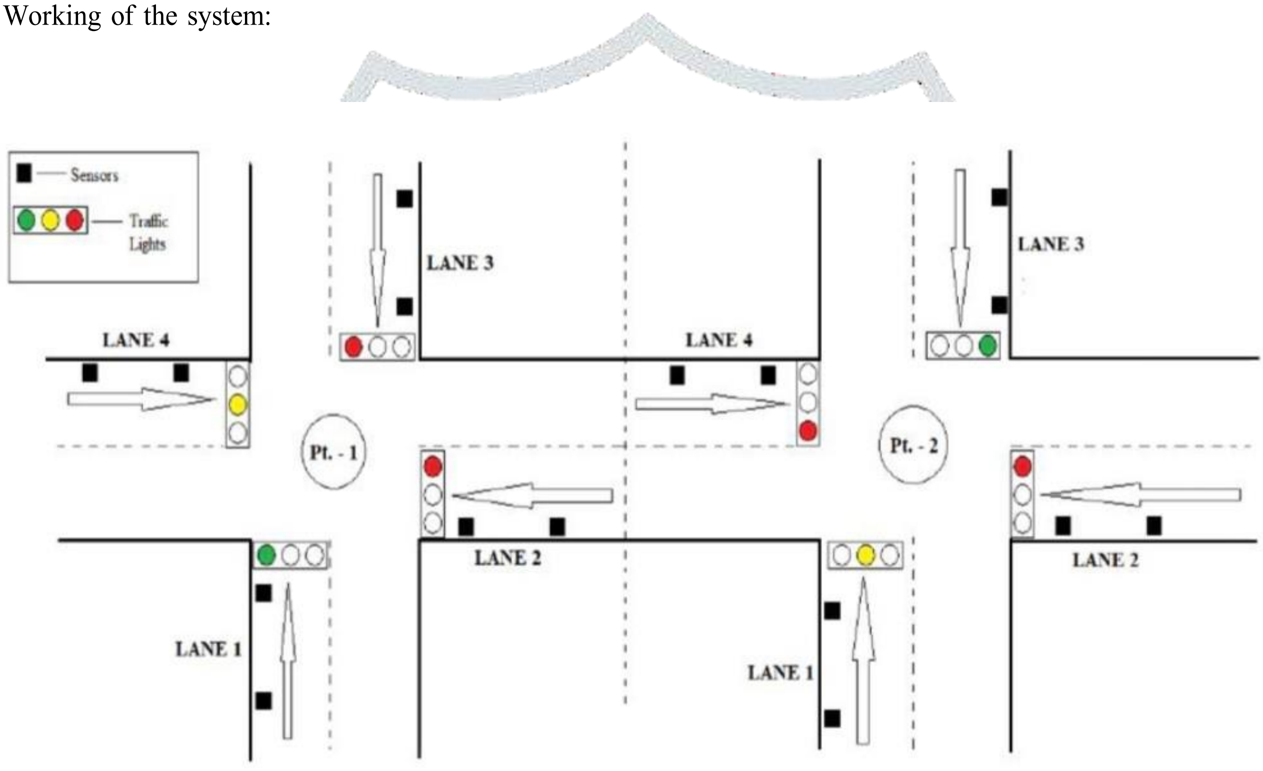


FIGURE 4.1: Control of previous Intersection

In the above figure, in Pt. - 1, LANE 1 is currently open with green signal and LANE 4 is ready with an yellow signal but LANE 2 and LANE 3 are blocked. In LANE 3, vehicle count is already greater than the threshold value, therefore the road coming to LANE 2 of Pt. - 1 is blocked in the Pt. - 2 itself. Thus re-routing them through another lanes. (Assuming that Pt. - 1 is the current intersection and Pt. - 2 is the previous intersection.)

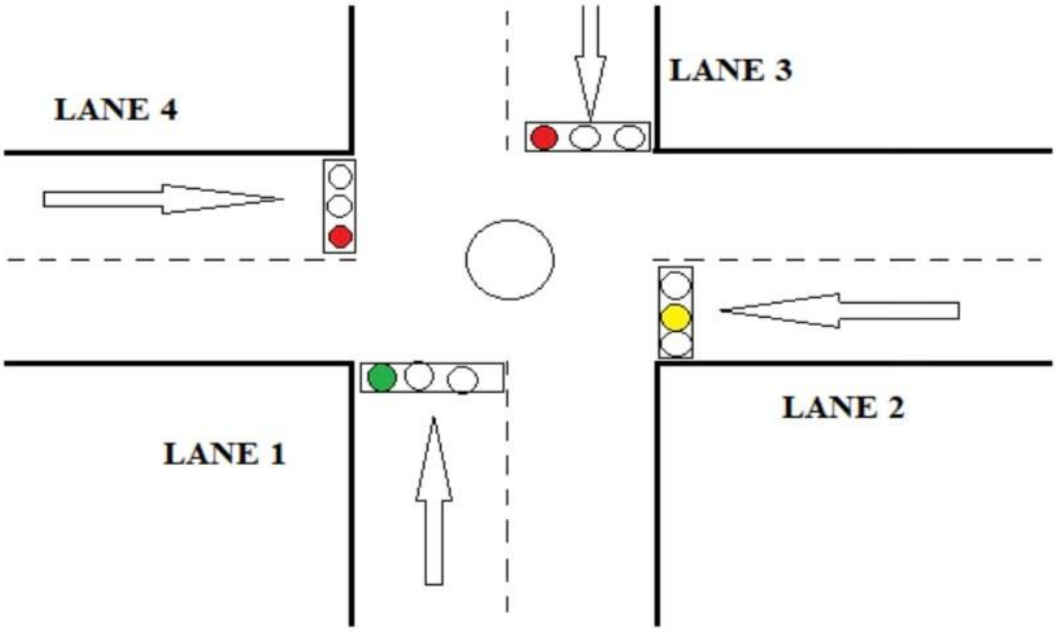


FIGURE 4.2: Signal at Lane 1

In the above figure, Lane 1 is open with green signal and other lanes are closed with red signal.

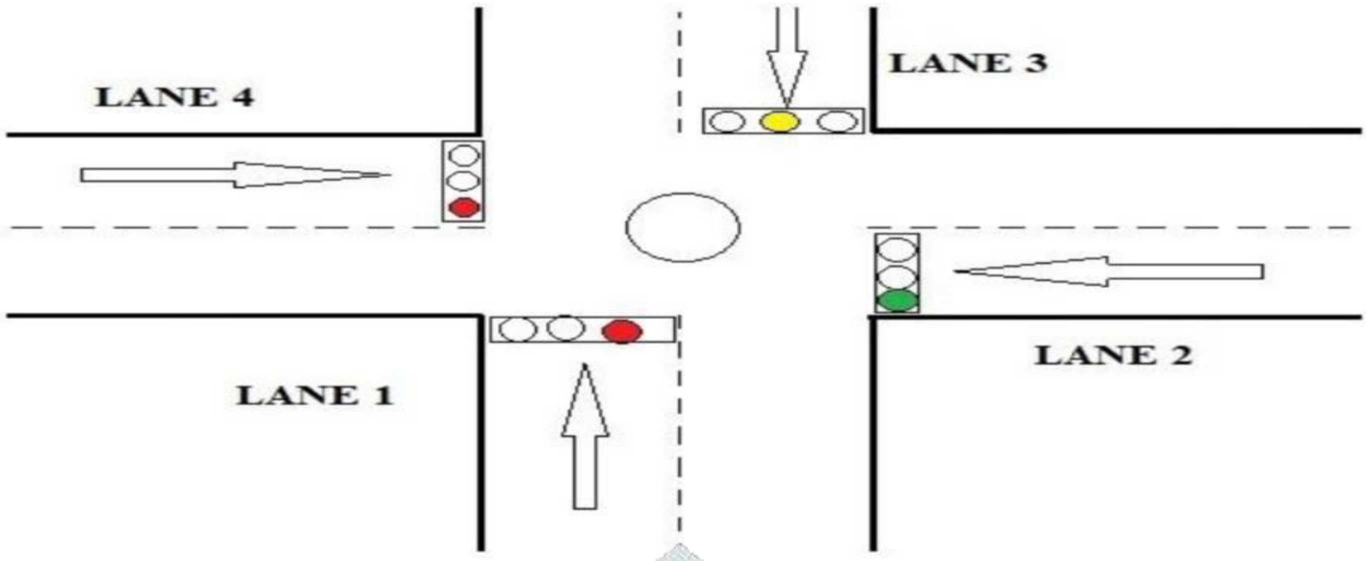


FIGURE 4.3: Signal at Lane

In the above figure, Lane 2 is open with green signal and other lanes are closed with red signal.

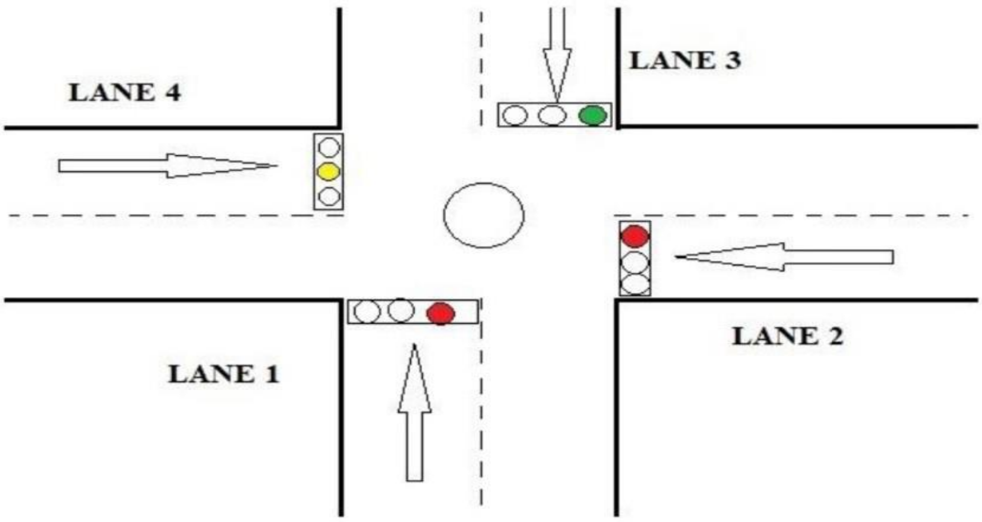


FIGURE 4.4: Signal at Lane 3

In the above figure, Lane 3 is open with green signal and other lanes are closed with red signal and after that Lane 4 will get the green signal automatically.

2.2 : Software Used

Arduino Integrated Development Environment (IDE):-

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuine hardware to upload programs and communicate with them. The Arduino Integrated Development Environment (IDE) is a cross platform application (for Windows, mac OS, Linux) that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards The source code for the IDE is released under the GNU General Public License, version 2. The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many common input and output procedures. User-written code only requires two basic functions, for starting the sketch and the main program loop, that are compiled and linked with a program stub main() into an executable cyclic executive program with the GNU tool chain, also included with the IDE distribution.

V. CONCLUSION

Smart Traffic Management System has been developed by using multiple features of hardware components in IoT. Traffic optimization is achieved using IoT platform for efficient utilizing allocating varying time to all traffic signal according to available vehicles count in road path. Smart TrafficManagement System is implemented to deal efficiently with problem of congestion and perform re- routing at intersections on a road. This research presents an effective solution for rapid growth of traffic flow particularly in big cities which is increasing day by day and traditional systems have some limitations as they fail to manage current traffic effectively. Keeping in view the state of the art approach for traffic management systems, a smart traffic management system is proposed to control road traffic situations more efficiently and effectively. It changes the signal timing intelligently according to traffic density on the particular roadside and regulates traffic flow by communicating with local server more effectively than ever before. The decentralized approach makes it optimized and effective as the system works even if a local server or centralized server has crashed. The system also provides useful information to higher authorities that can be used in road planning which helps in optimal usage of resources.

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