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STOP LIGHT CONTROLLER USING FUZZY LOGIC

D. NITYA SREE (23C91DA502) [1],
Dr.P. SUMITHABASHINI [2]
PG Student [1], Professor [2]
DEPARTMENT OF ECE
HOLY MARY INSTITUTE OF TECHNOLOGY AND SCIENCE

ABSTRACT

In India, with the growing number of vehicles, traffic congestion at junctions has become a serious issue. The density of vehicles is increasing day by day and there is an urgent need of adaptive traffic signals which can do real time monitoring of traffic density. This paper describes a system which uses image processing for regulating the traffic in an effective manner by taking images of traffic at a junction. A step-by-step approach of image acquisition, image processing and implementation of algorithm to change the traffic light duration as per the density of vehicles on different roads at a traffic signal is followed. The number of objects in a given image is counted and priority is given to the densest road.

Keywords: Traffic Light Control, image processing, green light duration, traffic density calculation.

INTRODUCTION

In modern life, we have to stand up to various issues one of which is traffic blockage transforming into a huge issue for a long time. The major traffic blockage happens due to the huge number of vehicles at every nooks and corner of the city. To accord with this issue, researchers have recommended various plans. One of the presently used techniques is the timer model. Traffic can be managed to a great extent, by utilizing timers at each period of the traffic. Another model utilized is with the assistance of electronic sensors that perceive the presence of vehicles, and produce a suitable signal. The reason for traffic is dependent on many factors like peak time, special days, season, bad weather, or unpredictable crisis like accidents, special events, or constructional activities.

When we get stuck in traffic, we may need to wait for hours to get out of it. We can deal with this issue to a great extent by implementing this density-based traffic control system utilizing image processing which consistently deals with the traffic lights dependent on traffic. This system uses image processing techniques essentially uses background subtraction to perceive the count of vehicles present on the road which can be utilized to control the traffic signal light. The image processing tools which are accessible in Matlab can be used to program the code for finding the incorporate of vehicles in a lane. Diminishing of traffic blockage improves the safety, avoidance of accidents, and reduction of environmental pollution.

Fast transportation systems and rapid transit systems are nerves of economic developments for any nation. Mismanagement and traffic congestion results in long waiting times, loss of fuel and money. It is therefore utmost necessary to have a fast, economical and efficient traffic control system for national development. The monitoring and control of city traffic is becoming a major problem in many countries. With the ever increasing number of vehicles on the road, the Traffic Monitoring Authority has to find new methods of overcoming such a problem. One way to improve traffic flow and Safety of the current transportation system is to apply automation and Intelligent control methods.

As the Number of road users constantly increases, and resources provided by current infrastructures are limited, intelligent control of traffic will become a very important issue in the future [1]. Traffic congestion may result due to heavy traffic at a junction. To avoid congestion there are so many traffic management techniques available. But no technique is perfect by itself as the real time situations are generally continuously changing and the system has to adapt itself to change in the continuously changing circumstances. We have made an attempt to provide some traffic management strategy which is self-changing in nature, so as to fit into continuously changing real time traffic scenarios.

In this system time is assigned to traffic light of particular lane according to the traffic density on the road with priority given to ambulance. Also we can indicate signal break in a particular lane. If there is an obstacle LCD is used to display the message of obstacle detection to avoid inconvenience. Objective

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of proposed system is to improve efficiency of existing automatic traffic signalling system. The system will be image processing based adaptive signal controlling. The timing will be calculated each time change automatically depending upon the traffic load. Proposed system will be functioning based on traditional system along with automated signalling. System will have artificial vision with the help of digital camera mounted on motor for its rotation to face lanes and sense the traffic on the road. The camera is controlled by PC through microcontroller to change its direction in steps of 90 degree to face each lane and capture image.

This single image of lane will be processed using image processing techniques to estimate traffic load. Estimated traffic load on particular road will be used to calculate the required time duration for controlling of signal lights based on in comparison with experimental results. System will be intelligent and will calculate the time every time and operate in a cyclic clockwise signal lights control. Maximum and minimum time limit will be maintained to prevent over waiting of vehicle in queue of other lanes which would be found out experimentally. Controls of the signal will be routed through the microcontroller. MATLAB programming will be used for simulating and developing the proposed system. The signal will be controlled by interrupting the normal functioning. The emergency will set the priority and the requested lane will be open closing all others. After emergency is removed the system starts normal functioning.

The main aim in designing and developing of the Smart Traffic Signal Simulator is to reduce the waiting time of each lane of the cars and also to maximize the total number of cars that can cross an intersection given.

Traffic congestion has become a major problem in every large city of the world. To ensure a reliable transportation system it is important to have an intelligent traffic control system. The very first step to do that is to acquire traffic data. Traffic data may come from different sensors. Some examples are use of induction loop, infra-red light sensor, optical flow etc.

However, in recent days image processing techniques [1] has been very important and promising topic to deal with traffic related problems because of its ease of maintenance and being more intelligent system. Different techniques [2]– [5] have been proposed to acquire traffic information.

Most of the work detects edge of the vehicles and counts the number of traffic on the road. However the disadvantage of the method is that counting the number of vehicles may give faulty results when spaces between the vehicles on the road are very small (i.e. two cars very close to each other may be counted as one vehicle). Moreover, most of the methods treat only cars as traffic but in many part of the world rickshaws, auto rickshaws, bikes are major part of everyday traffic such as in south Asian countries.

In this project we propose a method that finds out total amount of pixels in a video frame which corresponds to the amount of area of occupied by vehicles on the road rather than finding number of vehicles. The greater the amount of area occupied by vehicles on the road the greater the amount of traffic congestion. This way every kind of vehicles can be accounted for traffic density. Using this traffic data we propose a model for traffic signal control depending on the amount of traffic on the road. Time allocated for each road is made variable by weighing its time allocation depending on the traffic density.

LITERATURE REVIEW

An article proposes the system which uses electrical IR sensor and controller. The Infrared (IR) sensor emits and detects the IR rays. The IR sensor used as an object detector, it emits an IR rays that hits the objects and get reflected. The reflected IR rays are received by the sensor receiver. By this number of vehicles count are determined and the required time for the traffic light and control signal are provided by the controller. [1] An article proposes an image processing technique. Here the system uses four cameras for all for lanes in the intersection. Each camera captures the image continuously and feeds to the controller. The captured image are compared to the reference empty road image by image processing technique. The controller processes the image by grayscale conversion, edge detection, image enhancement and image matching. Then the control signal for the traffic light is passed by the controller.

An article proposes a different image processing technique. The image processing is done by recording the live video of traffic congestion then the video photage are converted into frames. Finally the images are processed asusal with the image processing process. Here the multiple image frames are provided by the video photage so controller takes more time to process each image and takes more time to provide control signal to the traffic light. The performance and the efficiency of the system is not effective compared to the other image processing techniques.[3] This proposes a framework which uses the thickness based traffic sign control.

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Here as opposed to catching the picture they use video caught by the web camera mounted close by the sign. The video is isolated into outlines and by including the number of pixels in each edge the thickness of the vehicle is resolved to utilize the all-out territory canvassed by the vehicle in a path. This uses different picture handling systems. This picture preparation is finished utilizing MATLAB.[4] The proposed a paper that proposes an effective traffic framework that uses watchful edge recognition and article discovery. These recognitions are finished utilizing MATLAB programming. Vigilant edge recognition used to check the number of vehicles on every path. Accordingly, by looking at all the paths, the path with most elevated thickness is discharged first by utilizing green light.

[1] Ghazal, B., Elkhatib, K., Chahine, K., &Kherfan, M. (2016). Smart traffic light control system. 2016 Third International Conference on Electrical, Electronics, Computer Engineering and Their Applications.

Traffic cramming is one of the noteworthy issues in numerous urban territories around the world. As a result of the rapid increase population, the amount of vehicles was extending greatly. It causes many traffic issues like disasters, wastage of time, vehicle convergences, pollution, and various health issues. Currently, methodologies have more burdens in execution while controlling the traffic. So it is mandatory to direct and manage traffic blockage in an effective way. Traffic management techniques are based on the timer runs on the lane rather than the density of the lane. The proposed system uses a singular camera mounted on a stepper motor to recognize the traffic density on the intersection of road. The camera turns 90˚ for every one minute to get the accompanying the next lane traffic density. The captured pictures are processed by edge detection and image enhancement techniques. The system will measure the traffic density at each lane in the intersection and accordingly the number of vehicles was identified at each lane. By then the control signal will be given by the controller to open that lane traffic light. The system digital image processing techniques and MATLAB programming to manage and control traffic congestion.

Traffic congestion, utilizing picture handling disposes of all the inadequacies of prior standard frameworks utilized for controlling traffic. Over the top, labouris required in manual controlling, while clock is utilized in modified controlling had a drawback of time being wasted by green light on an unfilled road. Picture handling kills every one of these traps. This strategy is unmistakably increasingly powerful in rush hour gridlock control. It reduces the utilization of additional equipment gadgets like sensors, remote switches, GSM modems, arrangement for an observing station and so forth. Nearness of vehicles discovery is predictable as we are utilizing genuine pictures of traffic here. The truth is envisioned and thus, usefulness is more powerful and proficient than all strategies. It accomplishes close to consummate precision and execution of framework is momentous. This system can be successful to battle the developing weight of traffic on Indian streets. It uses image processing to assess the thickness of vehicles on streets and controls the traffic at fixed interims of the time. It is cost-effective and doesn't require the establishment of complex hardware to screen the traffic. Conveying this framework won't just spare the time devoured in holding up at traffic intersections, yet will likewise ration a lot of assets that are generally squandered.

[2] Hasan, M. M., Saha, G., Hoque, A., & Md. Badruddoja Majumdar. (2014). Smart traffic control system with application of image processing techniques. 2014 International Conference on Informatics, Electronics &Vision.

This paper presents proposed SMART (Systematic Monitoring of Arterial Road Traffic Signals) traffic signal control in Brunei Darussalam. Traffic congestion due to stops and delays at traffic light signals has much been complained about in Brunei Darussalam as well as across the world during the recent years. There are primarily two types of traffic signal controls in Brunei Darussalam. The most common one is the fixed or pre-timed signal operation traffic light and the other one is the actuated signal operation traffic light. Although the actuated signal control is more efficient than the fixed or prefixed signal control in the sense that it provides fewer stops and delays to traffic on the major arteries, the best option for Brunei Darussalam would be to introduce SMART traffic signal control.

This type of traffic signal uses artificial intelligence to take the appropriate action by adjusting the times in real time to minimize the delay in the intersection while also coordinating with intersections in the neighbourhood. SMART signal simultaneously collects event-based high-resolution traffic data from multiple intersections and generates real-time signal performance measures, including arterial travel time, number of stops, queue length, intersection delay, and level of service. In Brunei Darussalam, where we have numerous intersections where several arterial roads are

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linked to one another, The SMART traffic signal control method should be implemented.

The SMART traffic signal control method has proven its effectiveness in a study con-ducted by associate professor Henry Liu of the University of Minnesota's Department of Civil Engineering to improve traffic management on urban arterial corridors. The system is now deployed at more than 100 intersections on major arterial corridors in Minnesota and Pasadena, California. In 2011, the University Of Minnesotas Office Of Technology Commercialization signed a licensing agreement with start-up company SMART Signal Technologies Inc. to commercialize the system. Funding and in-kind support for the SMART Signal system have been provided by the Minnesota Department of Transportation, the ITS Institute, the Minnesota Local Road Re-search Board, Hennepin County, and the National Cooperative Highway Research Program.

In Brunei Darussalam, we have the Lambak Kanan I/S situated in Berakas. This intersection leads to several destinations namely Jalan Penghubung Berakas: Lambak Kanan Housing and Industrial Estates, Salambigar, Tanah Jambu, Madang, Manggis, Brunei International Airport, and Bandar Seri Begawan. We also have another example of a complex intersection namely the BukitPanggal I/S situated in the district of Tutong. The roads emerging from this specific intersection lead to Alan Bukit Panggal (southwest-bound exit only): Bukit Panggal, Luagan Dudok, Sinaut, and Lamunin, Jalan Bukit Panggal (northeast-bound exit only): Bukit Panggal. We have several more complex intersections like these in Brunei Darussalam. The proposed model could therefore be implemented in Brunei Darussalam to overcome the problems actually being caused by the fixed or pre-timed signal operation traffic light and the actuated signal operation traffic light.

[3] Ashwin, S., Vasist, R. A., Hiremath, S. S., & Lakshmi, H. R. (2017). Automatic control of road traffic using video processing. 2017 International Conference on Smart Technologies for Smart Nation.

Traffic Management at signals has been a major problem in India. Unscientific methods, negligence and overpopulation have led to mismanagement of traffic at traffic signals. It needs introduction of new technology and a better approach to improve the traffic condition. A possible solution to this problem is the density based automatic traffic control system. The proposed model checks for the density of traffic at the traffic signal and changes the traffic lights accordingly. A video camera and traffic lights are interfaced with Raspberry Pi board. The video is processed real time and the Raspberry Pi enables the traffic lights to change when required. This could make the movement of traffic easier and time saving. This is an improvement from the conventional timer based operation of traffic lights.

One of the major problems of modern India is Road Traffic. This is due to the enormous addition of vehicles every day. There are around 50-55 thousand new vehicles registered in India every day, but the number of vehicles removed off the road are very less. This has led to the explosion of traffic on roads, resulting in road rage, higher number of accidents, deaths and increase in commuting time over the years. The traffic on roads consists of cars, motorists, cyclists, buses, trucks, public transport, taxis, autos, pedestrians, etc. The road traffic rules apply to all these forms of traffic. Not many people tend to follow the traffic rules. This is due to poor knowledge, negligence, road rage, lack of time and peer pressure. It is resulting in traffic snarls, confusion, slow movement of traffic and mainly, accidents. If there is an accident in India, people block the roads as they wish and start fighting, taking law into their own hands. This leads to a roadblock and makes it very difficult for ambulance to reach the spot, sometimes even for hours.

The two main means of controlling traffic in India at present is by using a traffic signal and with the help of a policeman. These two methods have been mostly effective in controlling the traffic till date. But, we need an efficient and smarter way to control the traffic, using technology and less manpower.

[4] Er. KavneetKaur, Vijay Kumar Banga "Number Plate Recognition Using OCR Technique" IJRET: International Journal of Research in Engineering and Technology 09Sep-2013

Automatic Number Plate Recognition (ANPR) is a special form of Optical Character Recognition (OCR). ANPR is an image processing technology which identifies the vehicle from its number plate automatically by digital pictures. In this paper we have presented an algorithm for vehicle number identification based on Optical Character Recognition (OCR). OCR is used to recognize an optically processed printed character number plate which is based on template matching. This algorithm is tested on different ambient illumination vehicle images. OCR is the last stage in vehicle number plate recognition. In recognition stage the characters on the

number plate are converted into texts. The characters are then recognized using the template matching algorithm.

In this paper we have checked and evaluated the accuracy of the OCR technique. The Template matching affects the accuracy of number plate recognition. We have found that there are some factors which affect the effectiveness of template matching based on OCR technique i.e. font type, noise in image, tilting etc. In future the work can be done on these factors and efficiency may be increased further for better results. Number plate recognition is a form of automatic vehicle identification. A number plate is the unique identification of vehicle. It is an image processing technology used to identify vehicles by their own number plates. Real time number plate recognition plays an important role in maintaining law enforcement and maintaining traffic rules. It has wide applications areas such as toll plaza, parking area, highly security areas, boarder's areas etc.

Number plate recognition is designed to identify the number plate and then recognize the vehicle number plate from a moving vehicle automatically. Automatic number plate recognition has three major parts: vehicle number plate extraction, character segmentation and Optical Character Recognition (OCR). Number plate extraction is that stage where vehicle number plate is detected. The detected number plate is pre-processed to remove the noise and then the result is passed to the segmentation part to segment the individually characters from the extracted number plate. The segmented characters are normalized and passed to an OCR algorithm. At last the optical character information will be converted into encoded text. The characters are recognized using Template matching. The final output must be in the form of string of characters.

[5] VismayPandit, JineshDoshi, Dhruv Mehta, AshayMhatre and AbhilashJanardhan "Smart Traffic Control System Using Image Processing" International Journal of Emerging Trends & Technology in Computer Science (IJETTCS) Volume 3, Issue 1, January – February 2014 ISSN2278-6856

The fact is that, the population of city and numbers of vehicles on the road are increasing day by day. With increasing urban population and hence the number of vehicles, need of controlling streets, highways and roads is major issue. The main reason behind today's traffic problem is the techniques that are used for traffic management. Today's traffic management system has no emphasis on live traffic scenario, which leads to inefficient traffic management systems. This project has been implemented by using the Mat lab software and it aims to prevent heavy traffic congestion. Moreover, for implementing this project Image processing technique is used. At first, film of a lane is captured by a camera. A web camera is placed in a traffic lane that will capture images of the road on which we want to control traffic. Then these images are efficiently processed to know the traffic density. According to the processed data from mat lab, the controller will send the command to the traffic LEDs to show particular time on the signal to manage traffic. Mathematical function to calculate the waiting time. The traffic signal system consists of three important parts. the first part is the controller which represents the brain of the traffic system. It consists of a computer that controls the selection and timing of traffic movements in accordance to the varying demands.

In this project, a method for estimating the traffic using Image Processing is presented. This is done by using the camera images captured from the highway and videos taken are converted to the image sequences. Each image is processed separately and the number of cars has been counted. If the number of cars exceeds a specific threshold, warning of heavy traffic will be shown automatically. The advantages of this new method include such benefits as use of image processing over sensors, low cost, easy setup and relatively good accuracy and speed. Because this method has been implemented using Image Processing and Mat lab software, production costs are low while achieving high speed and accuracy.

Advantages

- Reduces the number of accidents
- Over saturated and fluctuating traffic load can be handled easily
- Reduces the wastage of time by green light on empty roads

Applications

- To monitor and control the flow of automobiles through the junction of many roads
- A portable controller device is designed to solve the problem of emergency vehicles stuck in the overcrowded roads.
- Traffic Police can use such techniques to overcome workload and to manage time

PROPOSED METHOD

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In this, we start by initializing the MATLAB and then generating street traffic by creating roads and generating vehicles, then we write fuzzy rules for controlling green light and traffic density and displaying the demo output on the screen.

Fig. 1. Proposed Method Block Diagram for Traffic Light Controller

Depending on generated traffic density, fuzzy rules are generated to on and off green light.

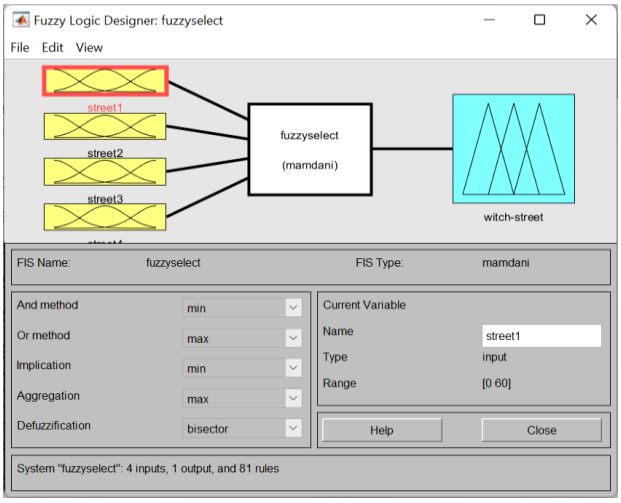

Fig. 2. All 4 roads are given input to the FuzzySelect rules (which selects the road)

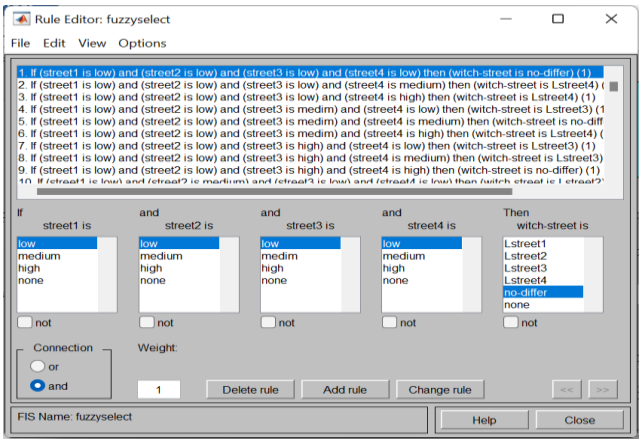

Fig.3 Fuzzy Rules for street selection

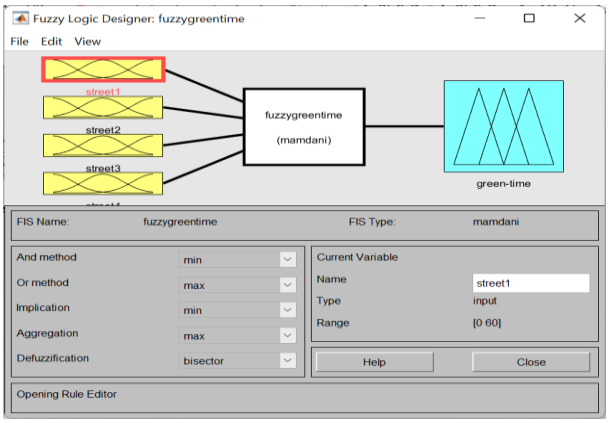

Fig.4 Fuzzy Logic Generated for Green Light Time

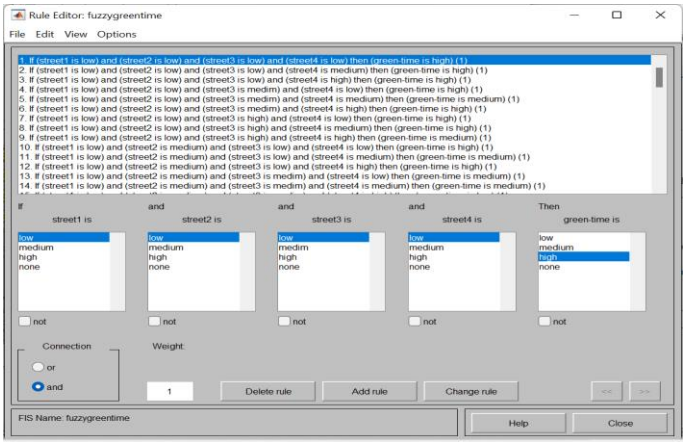

Fig.5 Fuzzy Rules Generated for Green Light on/off

Generated both road selection and green time selection fuzzy rules. Generated Fuzzy logic keep maintaining road traffic based on traffic density.

MATLAB

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MATLAB® is an excessive-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment wherein issues and answers are expressed in familiar mathematical notation. Typical uses encompass

Typical makes use of MATLAB:

- Math and computation
- Algorithm development
- Data acquisition
- Modeling, simulation, and prototyping
- Data evaluation, exploration, and visualization
- Scientific and engineering pictures
- Application improvement, along with graphical consumer interface constructing.

Introduction

MATLAB is a immoderate-overall performance language for technical computing. It integrates computation, visualization, and programming in an clean-to-use surroundings wherein troubles and answers are expressed in acquainted mathematical notation. MATLAB stands for matrix laboratory, and become written first off to offer smooth get entry to to matrix software application advanced by using LINPACK (linear system bundle) and EISPACK (Eigen system package deal deal deal) responsibilities.

MATLAB is consequently constructed on a basis of sophisticated matrix software program application in which the important element is array that does not require pre dimensioning which to resolve many technical computing issues, especially people with matrix and vector formulations, in a fragment of time. MATLAB talents a own family of programs specific answers referred to as toolboxes. Very important to most customers of MATLAB, toolboxes permit analyzing and utilizing specialised era. These are complete collections of MATLAB features (M-documents) that growth the MATLAB environment to remedy unique commands of problems. Areas in which toolboxes are available embody sign processing, manipulate device, neural networks, fuzzy appropriate judgment, wavelets, simulation and plenty of others.

Typical uses of MATLAB encompass: Math and computation, Algorithm improvement, Data acquisition, Modeling, simulation, prototyping, Data evaluation, exploration, visualization, Scientific and engineering pics, Application development, along with graphical character interface constructing. Boom the MATLAB environment to remedy unique commands of problems. Areas wherein toolboxes are to be had embody signal processing, control device, neural networks, fuzzy appropriate judgment, wavelets, simulation and lots of others.

Typical uses of MATLAB include: Math and computation, Algorithm improvement, Data acquisition, Modeling, simulation, prototyping, Data analysis, exploration, visualization, Scientific and engineering photos, Application development, along side graphical character interface constructing.

INTRODUCTION TO DIGITAL IMAGE PROCESSING

An image may be defined as a two-dimensional function f(x, y), where x & y are spatial coordinates, & the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point. When x, y & the amplitude values of f are all finite discrete quantities, we call the image a digital image. The field of DIP refers to processing digital image by means of digital computer. Digital image is composed of a finite number of elements, each of which has a particular location & value. The elements are called pixels.

Vision is the most advanced of our sensor, so it is not surprising that image play the single most important role in human perception. However, unlike humans, who are limited to the visual band of the EM spectrum imaging machines cover almost the entire EM spectrum, ranging from gamma to radio waves. They can operate also on images generated by sources that humans are not accustomed to associating with image.

There is no general agreement among authors regarding where image processing stops & other related areas such as image analysis& computer vision start. Sometimes a distinction is made by defining image processing as a discipline in which both the input & output at a process are images. This is limiting & somewhat artificial boundary. The area of image analysis (image understanding) is in between image processing & computer vision.

There are no clear-cut boundaries in the continuum from image processing at one end to complete vision at the other. However, one useful paradigm is to consider three types of computerized processes in this continuum: low-, mid-, & high-level processes. Low-level process involves primitive operations such as image processing to reduce noise, contrast enhancement & image sharpening. A low- level

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process is characterized by the fact that both its inputs & outputs are images. Mid-level process on images involves tasks such as segmentation, description of that object to reduce them to a form suitable for computer processing & classification of individual objects. A mid-level process is characterized by the fact that its inputs generally are images but its outputs are attributes extracted from those images. Finally higher- level processing involves "Making sense" of an ensemble of recognized objects, as in image analysis & at the far end of the continuum performing the cognitive functions normally associated with human vision. Digital image processing, as already defined is used successfully in a broad range of areas of exceptional social & economic value.

RESULT

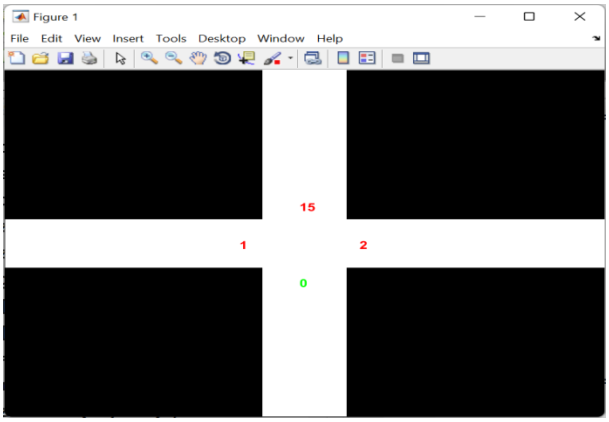

Fig 6 there is traffic density of 15 vehicles on 1 road so next road is giving green signal automatically

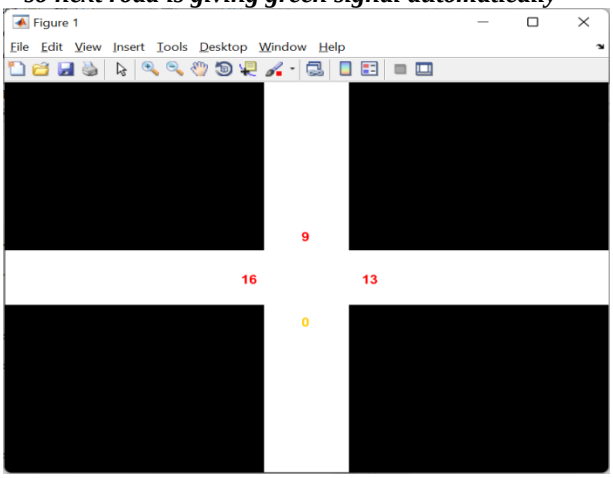

Fig.7 Orange Signal Is Indicated as Per Fuzzy Rules

CONCLUSION

Traffic congestion, utilizing picture handling disposes of all the inadequacies of prior standard frameworks utilized for controlling traffic. Over the top, labouris required in manual controlling, while clock is utilized in modified controlling had a drawback of time being wasted by green light on an unfilled road. Picture handling kills every one of these traps. This strategy is unmistakably increasingly powerful in rush hour gridlock control. It reduces the utilization of additional equipment gadgets like sensors, remote switches, GSM modems, arrangement for an observing station and so forth. Nearness of vehicles discovery is predictable as we are utilizing genuine pictures of traffic here. The truth is envisioned and thus, usefulness is more powerful and proficient than all strategies. It accomplishes close to consummate precision and execution of framework is momentous. This system can be successful to battle the developing weight of traffic on Indian streets. It uses image processing to assess the thickness of vehicles on streets and controls the traffic at fixed interims of the time. It is cost-effective and doesn't require the establishment of complex hardware to screen the traffic. Conveying this framework won't just spare the time devoured in holding up at traffic intersections, yet will likewise ration a lot of assets that are generally squandered.

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