VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

Department of Computer Engineering

Mini Project Report on

INTELLIGENT TRAFFIC MANAGEMENT SYSTEM

In partial fulfillment of the Third Year, Bachelor of Engineering (T.E.) Degree in Computer Engineering at the University of Mumbai Academic Year 2018-2019

Submitted by

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(2018-19)

VIVEKANAND EDUCATION SOCIETY'S INSTITUTE OF TECHNOLOGY

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Certificate

This is to certify that ***Shruti Kangne, Manali Gupta, Rinku Sahu, Pavan Satpute*** of Third Year Computer Engineering studying under the University of Mumbai have satisfactorily completed the mini project on "***INTELLIGENT TRAFFIC MANAGEMENT SYSTEM***" as a part of their coursework of MINI PROJECT for Semester-VI under the guidance of their mentor ***Dr. Gresha Bhatia*** in the year 2018-2019 .

Date:

Project Guide:

Mini Project Report Approval
For
T. E. (Computer Engineering)

This mini project report entitled ***INTELLIGENT TRAFFIC MANAGEMENT SYSTEM*** by *Shruti Kangne*, *Manali Gupta*, *Rinku Sahu*, *Pavan Satpute* is approved for the Third Year of **Computer Engineering.**

Internal Examiner

External Examiner

Head of the Department

Principal

Date:
Place:

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ACKNOWLEDGEMENT

We are thankful to our college Vivekanand Education Society's Institute of Technology for considering our project and extending help at all stages needed during our work of collecting information regarding the project.

It gives us immense pleasure to express our deep and sincere gratitude to Deputy Head of the Computer Department **Dr. (Mrs.) Gresha Bhatia** (Project Guide) for her kind help and valuable advice during the development of project synopsis and for her guidance and suggestions.

We are deeply indebted to Head of the Computer Department **Dr.(Mrs.) Nupur Giri** and our Principal **Dr. (Mrs.) J.M. Nair ,** for giving us this valuable opportunity to do this project.

We express our hearty thanks to them for their assistance without which it would have been difficult in finishing this project synopsis and project review successfully.

We convey our deep sense of gratitude to all teaching and non-teaching staff for their constant encouragement, support and selfless help throughout the project work. It is great pleasure to acknowledge the help and suggestion, which we received from the Department of Computer Engineering.

We wish to express our profound thanks to all those who helped us in gathering information about the project. Our families too have provided moral support and encouragement at several times.

Computer Engineering Department

LAB OUTCOMES FOR T.E. PROJECT

Learners will be to,

Lab Outcome	Description of the Lab Outcome
LO 1	Acquire practical knowledge within the chosen area of technology for project development.
LO2	Identify, analyze, formulate and handle programming projects with a comprehensive and systematic approach
LO 3	Contribute as an individual or in a team in development of technical projects
LO 4	Develop effective communication skills for presentation of project related activities

Lab Outcomes	**Overall Grade**
LO1,LO2,LO3,LO4	

Project Guide:

Abstract

As urban population growth continues to outpace the rural population, traffic across the globe continue to become congested and more chaotic. The essential problem in cities is growing traffic density. This problem affects many aspects of the modern society, including economic development, traffic accidents, increase in greenhouse emissions, time spent, and health damages. It is of high priority to ensure smooth flow of vehicle to avoid busy and populated roads and to decrease travel time. Presently, manual ways are used to operate & monitor traffic switching light.

Managing vehicular movements in cities is a cumbersome job. The system effectiveness improvement is possible to achieve by road network development.

In this context, modern societies can rely on traffic management system to minimize traffic congestion and its negative effects.

This subject, known as effective traffic management, including for example traffic lights control, is a part of Intelligent Transportation Systems (ITS). Traffic management systems are composed of a set of application and management tools to improve the overall traffic efficiency and safety of the transportation systems.

Furthermore, to overcome such issue, traffic management system gathers information from heterogeneous sources, exploits such information to identify hazards that may potentially degrade the traffic efficiency, and then provides services to control them.

We aim to build Intelligent Traffic Management System ensuring efficient traffic flow. To address this challenge, nascent technologies like Internet of Things (IoT) and data analytics are used. It would decide when and for how long traffic signals should be green, and also system is capable of monitoring the traffic pattern so that in future in case of emergency, political rallies, road repair etc., traffic can be diverted. The system can also report accidents to nearest police station and hospital, status of road damage to the respective concerned authorities.

This report is the comprehensive view of our system and proposed idea.

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Chapter 1.Introduction

1.1 Introduction:

It is predicted that, in few decades most of the world population will live in the urban regions. This may lead to many social economic challenges. In recent years the cities world over have grown by leaps and bounds. Smart cities are essential for a sustainable urban development. It can remove many major problems faced by most of our cities for example traffic jams, thefts, environmental pollution, public transportation issues etc. . One of the major problems faced by cities today is traffic congestion. Traffic jams causes a rise in the cost of transportation as well as it affects the routine lives of people. The problem of traffic congestion pervades everywhere, but megha cities are the ones that are most affected by it. The ever increasing nature of traffic makes it difficult to estimate the road traffic density in real time so as to make better traffic related decisions and manage the traffic more efficiently.

There are several reasons for this sudden surge in the traffic, in urban regions. The main reason can be attributed to rise in the population which in turn has caused rise in the number of vehicles on the road. Also there are several other reasons for congestion like insufficient capacity of roads, large red light delays, incomplete information regarding traffic, inefficient transport management, unrestrained demand etc. Insufficient capacity and unrestrained demand are interrelated but signal delays are hard coded and do not depend on the amount of traffic density. Therefore there is a need to optimize the traffic control system and make it more dynamic so as to accommodate the varying traffic density.

With inadequate space and funds for the construction of new roads, and the growing imbalance between traffic demand and transportation resources; it is increasingly obvious that countries must move beyond the traditional model of just building roads to solve traffic problems . This is demonstrated in a survey done by CBT in Britain. The report supports that expansion and building of new roads will do very little to help solve the congestion issue. CBT survey found that nearby local roads suffered up to 137% more traffic after the bypasses opened, and reductions on the roads intended to be relieved were less than expected . Therefore, managing of traffic flow needs to be a combination of physical infrastructure, new ways of thinking and new technologies. Smarter transport transcends infrastructure .

In light of this, intelligent traffic management systems have gained a lot of interest. These intelligent traffic management systems use advanced technologies such as image processing, computer vision, intelligent controls and artificial intelligence to make traffic routing decisions; a task typically done by traffic officers e.g. policemen or traffic marshals. Other application areas include: surveillance, management of freeway and arterial networks, intersection traffic light control, congestion and incident management.[4]

1.2 Motivation:

One of the major problem of today's society is on road traffic management. To reduce waiting and travelling times, save money and fuel an intelligent management technique is required. Cases when there is traffic and even pedestrian waiting to cross road and due to fixed signal duration a lane with nearly no traffic is allowed, brings to our notice the importance of considering real time data. This encouraged us to try to solve this by building a Intelligent Traffic Management System and analyze problem more thoroughly and to develop feasible solution.

A large number of methods and approaches have been suggested in the literature in order to allocate the problem.

In this report, we will investigate the possibilities to implement a next generation traffic control and management approach. This approach shifts away from a global roadside traffic management to a more vehicle-based and user-specific network-based traffic management. [7]

Following are some of the motivation of this intelligent traffic system.

1. To reduce traffic congestion.
2. To avoid traffic signal violation.
3. To maintain discipline in following traffic rules.
4. To reduce workload of traffic police.
5. To reduce accidents on road.

1.3 Problem Definition:

Traffic congestion is a main problem with foremost cities. In India the traffic lights are founded on timing system i.e. whether the vehicles are present or not the timing will remain constant which makes people to wait unnecessarily for longer time. The key characteristic of the traffic in cities particularly for developing the geographies is that even if the geographies are explicitly mentioned/marked on the roads it doesn't move through the lanes . In Emergency cases (VIP's) the signals are precise manually, which is a hard-hitting task and can't be executed successfully. Due to this man power is required in large amount and is a waste of time.

There are some drawbacks in the existing system like fixed time duration is allocated to signals,manual work to monitor the traffic during peak hours,emergency vehicles are not prioritised and these drawbacks can be eliminated by using automated Intelligent Traffic Management System which manage, monitor the traffic in an efficient way.

In order to reduce the problems and assist traffic policemen to manage/handle traffic easily and smartly so as to reduce the average waiting time at a signal, I and my friends have designed a complete solution which solves them all. And the solution is, Using computer vision technology we will classify and count the vehicles on a particular road and based on the count we can compare with other roads on the same junction using the cc cameras mounted at traffic signals. With this system we can dynamically control the priority and time duration of signals at real time automatically. Authorized personnel can also monitor the current traffic on any junction at real time through our portal. We can also have the flexibility to manually operate any traffic junction from a remote location. Best thing about this system is we can not only control the traffic but also record the traffic patterns on every junction and take necessary measures or actions to eliminate the causes for the traffic. The number of accidents which happen can be greatly reduced ensuring better road safety and we can have the flexibility of diverting the incoming traffic of a junction.

1.4 Existing Systems

Current traffic management system uses fixed time period method to switch traffic between different directions and uses fixed time table decided arbitrarily by traffic authorities.

During heavy traffic,management operation is handled manually from control room.
Though most of the cities in the world still use the conventional traffic management system, few developed and traffic congested cities like Los Angeles and Amsterdam have tried out big data to control traffic lights.

1. Traffic Control in Los Angeles:

Los Angeles, the Californian city, comes third in the Forbes list of most traffic affected cities in the world. This city has a system that uses big data to manage traffic on roads. Magnetic sensors in the road at every intersection send real-time updates about the traffic flow through fiber-optic cables to a bunker beneath downtown Los Angeles. The computer system, which runs software the city itself developed, analyzes the data and automatically makes second-by-second adjustments, adapting to changing conditions and using a trove of
past data to predict where traffic could snarl, all without human involvement. The system is intelligent in that it can automatically adjust the time delay between light changes
whenever issues arise. Alternatively, it can also be used to help keep public transport running on time – if the buses are late, the system can help them to pass through the lights faster and get back on schedule.This system slightly improved the traffic in the city. According to officials, the average time to drive 5 miles in the city before was 20 minutes. These smart traffic lights have reduced the time to just 17.2 minutes.[4]

2. Smart Traffic Management System in Amsterdam:

The Amsterdam city is one of the busiest regions of the Netherlands. Three road managers are active; the municipality of Amsterdam, the province of North Holland and the national government. They all try to optimize the traffic flow within their management area, but the measures they take sometimes conflict with each other. To improve traffic flow cooperation between all parties was necessary. This is how the centres can jointly and automatically manage traffic within the region. Since the initiative for regional cooperation and the implementation of intelligent traffic management, the percentage of vehicle loss hours in the Amsterdam area has dropped by 10 percent. Amsterdam's smart traffic management system can easily be prepared for connection with in-car and navigation equipment. This way, also in the future, Amsterdam can have its own modern digital road manager, which helps optimizing traffic flow within the whole region.[4]

Comparison of the existing system:

sr.	Input method used to acquire data	Based on	Traffic parameters acquired	Determine traffic density	Sensor used on vehicle	Hardware required?
1.	Intelligent traffic lights (ITLs)	VANET	Accident data, Location of every vehicle	Total number of vehicles gives density information	Yes. GPS used Yes.	ITLs need to be installed. RSUs need to be installed.
2.	Infrared signal	Infrared	Unique ID of every car	Total number of vehicles given by unique ID gives density information	Yes. IR sensor used.	Transmitter unit, receiver unit and LCD display
3	Sensors and RFID tags	Photoelectric sensors	Weight of road, Probability distribution of expected cars at rush hours	Yes. RFID on specific vehicles (ambulance etc.)	NA	Yes. Sensors need to be installed on the sides of road.
4.	Sensors Number of vehicles gives traffic density	Fuzzy logic	Number of vehicles, Average speed of traffic flow	Number of vehicles gives traffic density	No	No

Table .1 Comparison of different systems

1.5 Lacuna of the existing systems

- Conventional road traffic signaling system works by time set in a timer, in each crossing point for every incoming road traffic. The main problem is that even when there is no traffic in an incoming road, traffic of other incoming roads have to wait till the timer for that incoming road comes down to zero.
- The use of video surveillance hardware and software applications for addressing the planning and enforcement lacunae in traffic management, in Indian cities.
- Many other challenges will arise including tracking and managing the high number of devices that will be involved in such integration. Current open problems are as follows: how to define novel approaches for device identification and the generation of unique identifiers, how to use these identifiers as addresses to forward and route information.

- The key challenge is how to converge many different information into a single traffic condition representation. In other words, which information have more or less importance to the traffic and how each one will impact in the traffic.
- The challenge is how to provide a full scenario overview about the traffic condition to every vehicle to enable them to compute an efficient route without overloading the network. Another concern is how to compute an efficient alternative route without incurring in traffic congestion .
- Ensuring information privacy and security in TMS is essential for all involved people, transit agencies, government, and so on. Since the data may contain personal information and can track people and vehicles.

1.6 Relevance of the Project

- Our project aims to build an automated traffic management system, which will direct the traffic signal based on the real time traffic density. This will save the waiting time which exists in current system due to mismanagement of traffic.

- In our project,we make use of surveillance video cameras at the public places which results in increase in automated analysis of video contents. These automated systems can identify number of traffic rule violations. Video features at object, pixel, and semantic level are extracted for analysis. The basic purposes of surveillance video-based systems are vehicle tracking, analyzing their patterns and behaviors, abnormal event prediction, and detecting anomalies before their occurrence.

- We have used filtering method i.e defining region of interest which filters the image and released all waste objects and only showed the cars, and after it will show the number of cars in image. Using it we give only the required region to the detection model.

- Another advantage of using video surveillance is that it can be used to enforce traffic law and get hold of the culprit by tracking it through camera.

1.7 Methodology employed for development:

- ❖ Waterfall Model:

The Waterfall Model was the first Process Model to be introduced. It is also referred to as a linear-sequential life cycle model. It is very simple to understand and use. In a waterfall model, each phase must be completed before the next phase can begin and there is no overlapping in the phases.

The Waterfall model is the earliest SDLC approach that was used for software development.

The waterfall Model illustrates the software development process in a linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. In this waterfall model, the phases do not overlap.

In “The Waterfall” approach, the whole process of *software development* is divided into separate phases. The outcome of one phase acts as the input for the next phase sequentially. This means that any phase in the development process begins only if the previous phase is complete. The waterfall model is a sequential design process in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of Conception, Initiation, Analysis, Design, Construction, Testing, Production/Implementation and Maintenance.

To construct an ITS applied architecture is very important in the design phase of implementing the ITS application with the instructions of the national ITS architecture or regional architecture. The traditional methodology of constructing the applied architecture is usually the waterfall model which is borrowed from software engineering. The waterfall model is a sequential design process, used in software development processes, in which progress is seen as flowing steadily downwards (like a waterfall) through the phases of requirements, analysis, design, coding, testing and operation. In an ITS application design process, the usual steps are according to the waterfall model. The waterfall model provides a structured approach; the model itself progresses linearly through discrete, easily understandable and explainable phases and thus is easy to understand; it also provides easily identifiable milestones in the development process. Although the waterfall model is seen as an agile system development method, there are more and more critical arguments about it. Designers may not know exactly what their requirements are before they see working system and so change their requirements, leading to redesign, redevelopment, and retesting, and increased costs. Designers may not be aware of future difficulties when designing a new product or feature; in which case, it is better to revise the design than keeping a design that does not account for any newly discovered constraints, requirements, or problems.

Chapter 2: Literature Survey

2.1 Literature Survey


To unclog 610 junctions, BMC set to upgrade signal software

GREEN LIGHT FOR NEW STUDY

Fig.1 Newspaper Article

Source :-Hindustan Times, 4th June 2018

In this article of Hindustan Times newspaper, Traffic issues in the Mumbai regions are addressed and noticing those problems CM Fadnavis Sir states that state would work for this traffic issues and will build the Intelligent traffic management system which will specify the green light timing for the particular lane.We refer this article and trying to develop such Intelligent Traffic management system which will manage the traffic on the basis of the current status or density of traffic on each lane.

2.2 Research Papers Referred:

1) Priyankar Roychowdhury, Sarjo Das, “Automatic Road Traffic Management System in a City”, STM Journals, vol.1, 2014.

A. Abstract:

It is a system that manages the road traffic in a city automatically by combination of algorithms, equipment’s and communication networks without involvement of human personnel in decision making according to various kinds of situations of road traffic that arise in a city. The approach of this paper is traffic signaling at a crossing point by measuring traffic density in each road. Also, vehicles that will violate signals at crossing points can be tracked by this system. Sometimes, situations like road congestion and exceed of limit of maximum traffic capacity of a road can arise and this system can also take decisions automatically accordingly. Vehicles can never cross the speed limit under this system. The paper is written considering left-hand traffic rule.

B. Inference drawn:
Conventional road traffic signaling system works by time set in a timer, in each crossing point for every incoming road traffic. The main problem is that even when there is no traffic in an incoming road, traffic of other incoming roads have to wait till the timer for that incoming road comes down to zero. The system provides the advantage that human personnel need not to be involved throughout the roads of the city and traffic handling will be more efficient than conventional human aided systems.

2) Jiandong Cao, "Research on Urban Intelligent Traffic Monitoring System Based on Video Image Processing", International Journal on Signal Processing, vol. 9, pp.393-406, 2016.

A. Abstract:
In urban traffic monitoring, traditional methods use video image acquisition equipment to collect all the data and then rely on the manpower to complete the monitoring process, not only waste a lot of artificial resources, but also the efficiency is low, the error rate is high.On the basis of computer and intelligent technology, the video image processing technology is adopted in this paper, the prototype of a city intelligent traffic monitoring system is constructed, this paper focuses on the analysis of the functional design of intelligent traffic system, video image processing and database analysis module based on summary. The system can bring intelligent analysis to the traditional traffic control industry with the current increasing data quantity and increasing data analysis difficulty.

B. Inference drawn:
In this paper, a city intelligent traffic monitoring system based on video image processing is constructed from the view of video image processing technology. The system that bases on vehicle analysis completed the function of the vehicle detection, vehicle feature high-definition camera,vehicle identification, capture photos, identification record storage and remote auto update.

2.3 Patent search

Intelligent traffic control and warning system and method

Abstract

A system and method for controlling traffic and traffic lights and selectively distributing warning messages to motorists includes a controller to determine appropriate action based on traffic congestion parameters. Fuzzy logic is used to determine optimum traffic light phase split based on the traffic information from the traffic information units. Global Positioning System technology is used by the system and method in order to track moving vehicles and signs and be able to communicate with them.

Inventor	Jerome H. Lemelson, Robert D. Pedersen,Steven R. Pedersen
2001-05-31	App filed by Jerome H. Lemelson, Robert D. Pedersen, Steven R.Pedersen
2003-10-14	Application granted
2019-04-17	Application status is Active
2003-10-14	Publication of US6633238B2
2019-09-15	Anticipated expiration

Chapter 3: Requirement Gathering

3.1 Definition of requirement gathering

The process to gather the software requirements from client, analyze and document them.If the feasibility report is positive towards undertaking the project, next phase starts with gathering requirements from the user. Analysts and engineers communicate with the client and end-users to know their ideas on what the software should provide and which features they want the software to include.Requirements elicitation (also known as Requirements Gathering or Capture) is the process of generating a list of requirements (functional, system, technical, etc.) from the various stakeholders.

The importance of requirements gathering is often underestimated on multiple levels. When budgets are thin, timelines are tight, and scope is creeping, requirements documentation tends to be the first deliverable to go and the last deliverable to be considered. This is surprising, especially when you consider that disregarding a thorough requirements gathering process means sacrificing a sound point of reference for checks and balances throughout production and QA, jeopardizing expectations between the client, your team, and the end users.

3.2 Functional Requirements

- Authenticate user should only be given access to system.
- Timing of signal lights should be customized according to real time traffic on road.
- System should process data in image form.
- Data coming from various roads should be identified, coordinated and analyzed to give output.
- Processed data should be stored in database.
- Option for manual operation should be present.
- Interface to monitor the system should be provided.

3.3 Non-Functional Requirements

- Secure System:

Traffic Management Systems is a comprehensive set of systems used for effective information capture and decimation to the road users for Safe & Secure journey on the highway.

- Scalability:

A system to handle a growing amount of work by adding resources to the system.In an economic context, a scalable business model implies that a company can increase sales given increased resources. For example, a package delivery system is scalable because more packages can be delivered by adding more delivery vehicles.

- Upgradability:

It is the process of replacing a product with a newer version of the same product. In computing and consumer electronics an upgrade is generally a replacement of hardware, software or firmware with a newer or better version, in order to bring the system up to date or to improve its characteristics.

- User friendly interface:

Traffic Signal Controllers is a PC based Windows Graphical User Interface that allows all level of workers from Electricians, Technicians . user interface provides a user friendly environment that makes interrogating the controller status and performance functionality such as timing and detector performance an easy task as access to all these functions can be viewed in both a Graphical or Numerical formats.

3.4.Constraints

- Heavy fog or rains:

Weather events such as rain, snow, sleet, fog, high winds, and flooding reduce roadway capacity. These events can cause slick pavement, lower traffic speeds, increase speed variability, affect traffic volume, increase delay, escalate crash risk, disrupt access to roads (e.g., lane obstruction, pavement buckling) and damage road infrastructure (e.g., traffic control devices). As congestion increases in urban areas, weather events will have even greater effects on arterial operations. On arterial routes, adverse weather can have an impact on the effectiveness of traffic signal timing plans designed for normal conditions. Signal timing plan parameters used in clear, dry conditions may not be optimal during adverse weather.

- Night time surveillance requires proper street lighting:

Blinking down at passersby in traffic intersections and lining dark alleys, sleek, energy-efficient LED streetlights have begun to replace old-fashioned, glitchy ones.

- Straight roads are prefered:

In this system mostly straight roads are preferred because the zig-zag roads are not properly capture by cameras and that is why we doesn’t count the vehicles in lane . because of zig-zag roads accidents are happen due to this for safety also prefered the straight roads.

- Defining ROI :

ROI i.e. Region of Interest is to be defined manually at the time of installation. It is defining coordinates of required region for object detection algorithm.

- ❖ Restricted Resources:

Minimum time for which we allow signal is 3.20 min due to processing limitations.

3.5.Various Hardware, Software ,Technology and tools available

- ❖ Hardware
    - Operating System and System type / version (Ubuntu 16.04, 64 bit or higher)
    - Processor type and speed: i5, 2.71GHZ
    - Graphics Processing Unit: 4GB
    - Ram : 8GB
    - Camera

- ❖ Technologies

    Machine learning, Image Processing

    - ❖ Libraries

        Tensorflow, keras, Opencv, Numpy, Anaconda

    - ❖ Tool

        YOLO V3

3.6 Selection of the Hardware, Software , Technology and tools

- ❖ Hardware:

1)Camera:

Along with monitoring the roads for accidents or major closures, footage from traffic cameras is influential in decisions regarding future road development and construction. Enforce laws - Cameras used to enforce speed and red light laws are effective in catching moving violations and issuing tickets.

2)Graphic user interface:

Traffic Control System regulates and optimises the passages of motor vehicles on internal roads with limited space. The traffic control system is suitable for roads with one-way passage, e.g. garage entries and exits, passages to yards of residential houses, etc. The traffic control system can be also used as a solution for entries, exits, parking and movement of vehicles around industrial zones. The movement of vehicles in a monitored area is assessed by the GP DET vehicle detector that is why we used graphical user interface.

❖ Software:

In software we used Linux is one of the most popular platforms used for development. Its widespread adoption stems from core design principles behind its kernel: to be extensible, efficient, modular, simple, robust and open source.Linux distributions offer native package management. Useful development tools, libraries, and updates are available for free from trusted sources.

❖ Technology:

1)Machine learning:Machine learning is a core sub-area of artificial intelligence; it enables computers to get into a mode of self-learning without being explicitly programmed. When exposed to new data, these computer programs are enabled to learn, grow, change, and develop by themselves.
2)Image processing: This method uses to count the number of vehicles on road and estimate the density. The number of vehicles found can be used for surveying or controlling the traffic signal. This is one of the best modern methods that countries are seeking to introduce into the traffic system.

❖ Tool:

YOLO V3 :

Detect, locate and track road elements from a video stream using YOLOv3 real-time object detection system. Among the elements to classify, the model will be trained to detect traffic lights, vehicles and some types of road signs.[9]

Chapter 4: Proposed Design

4.1 Block diagram of the system

Block diagram represents the basic blocks of system which are used for attaining the functionality of system.

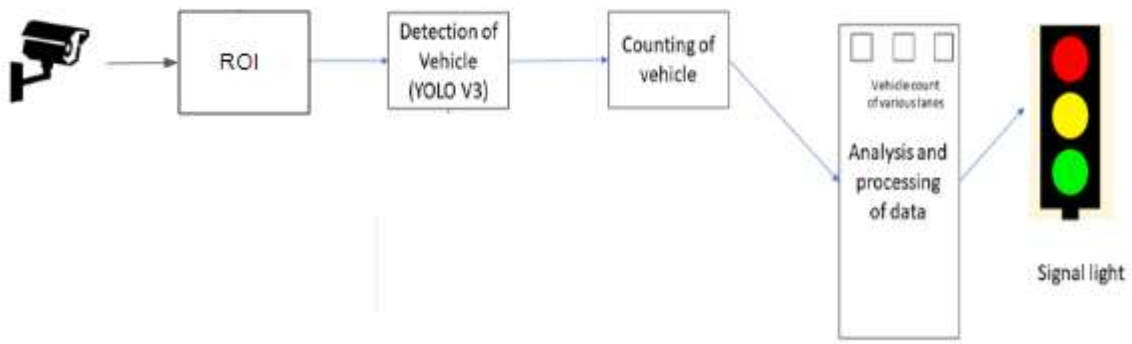


Fig 2. Block Diagram

4.2 Modular Diagram

ROI

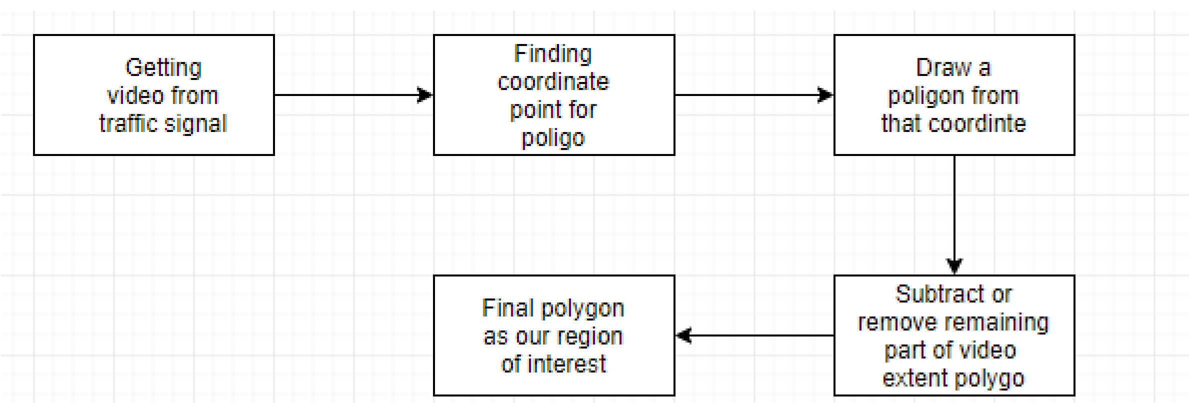


Fig 3.ROI

YOLO Object Detection

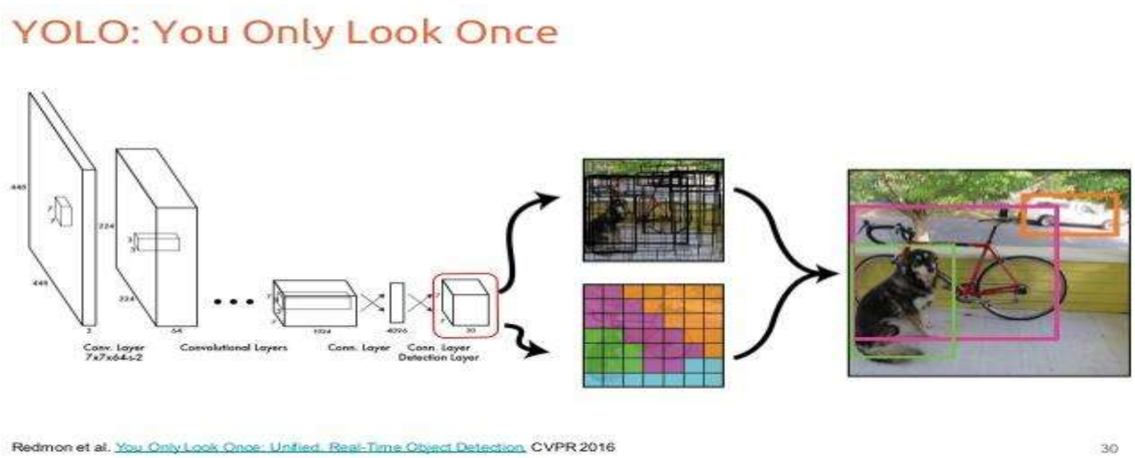


Fig 4. YOLO Architecture

Analysis module:

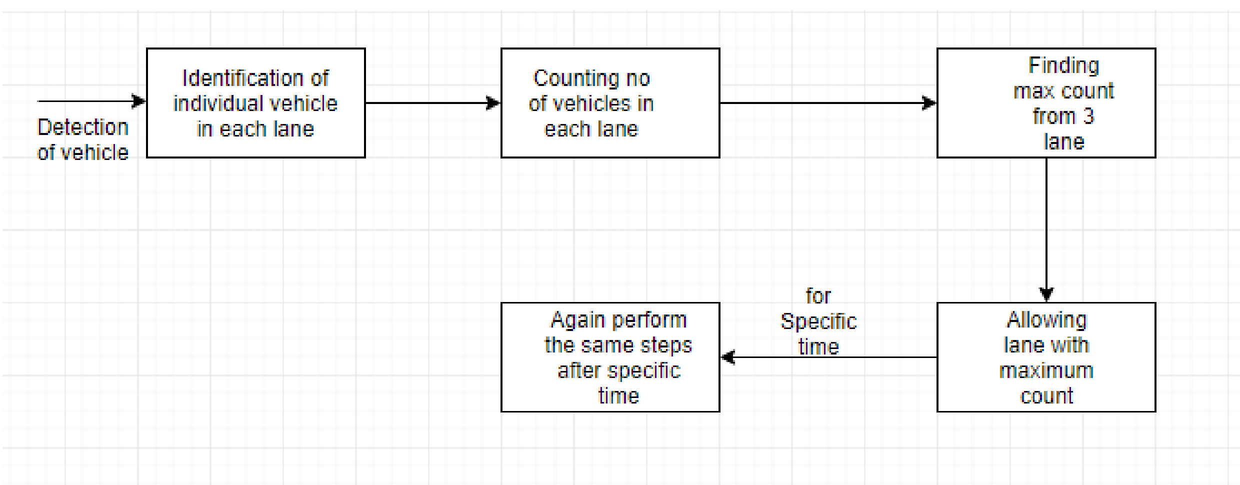


Fig .5 Analysis module

4.3 Detailed Design

Data Flow Diagram (DFD) shows the flow of data through various components of the system. DFD level 0 shows flow of data through various modules whereas DFD level 1 show data flow through the internals functioning of the system.

DFD Level 0:

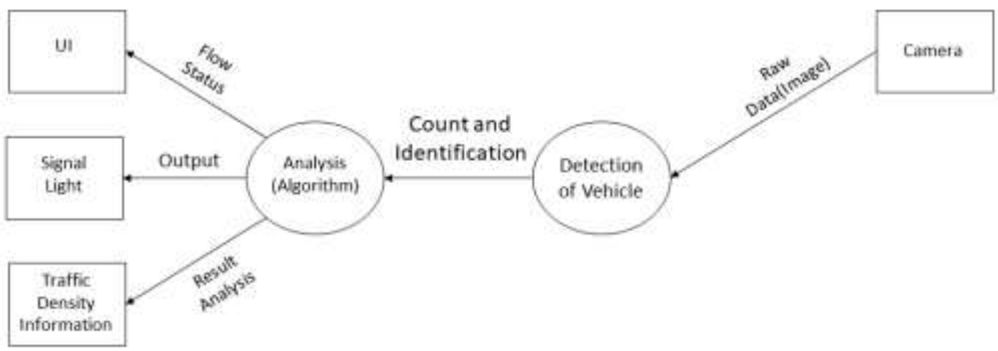


Fig 6. DFD level 0

DFD Level 1:

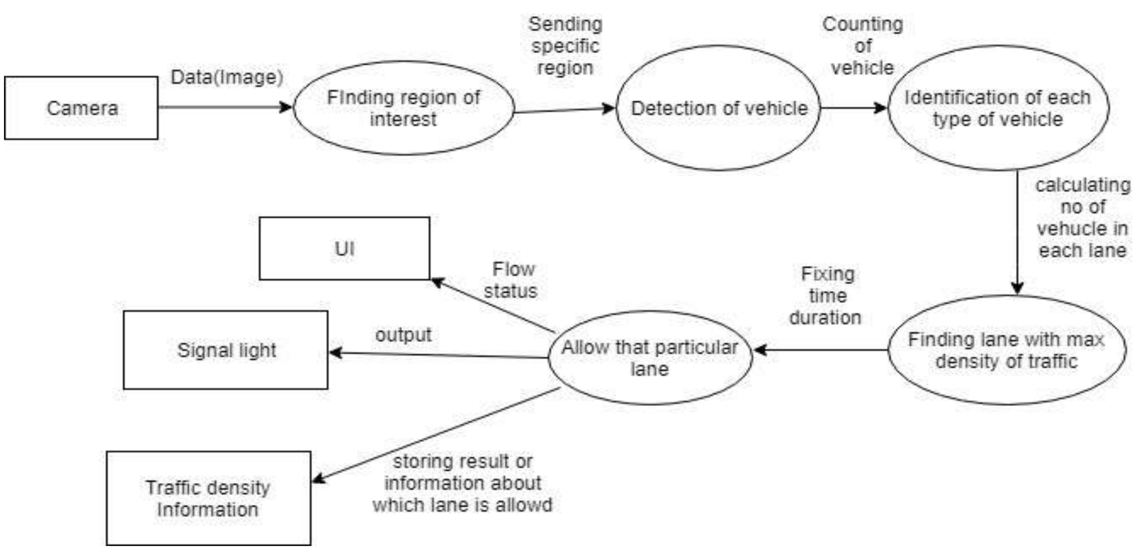


Fig 7. DFD level 1

4.4 Activity Diagram

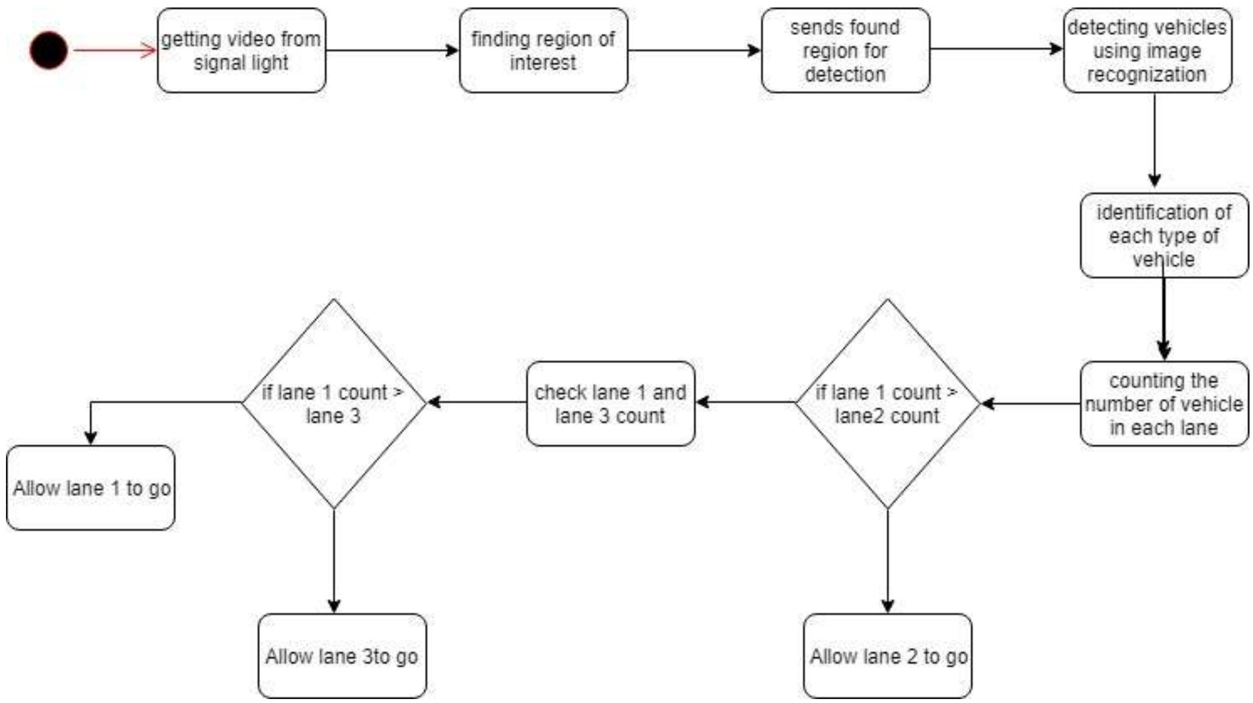


Fig 8. Activity Diagram

Chapter 5: Implementation Details

5.1. Algorithms and Module Description

Algorithm

Step 1:Initialize the time and subprocess

Step 2:Initialize the history of all signal array and status signal array and also initialize the rotation array

Step 3:also initialize the count of lanes array and set the signal time at 60 sec and lanecount at 0.

Step 4:counting of lane =index of array and check which index has 0 or 1.

Step 5:start timer of lane =60 sec/4

Step 6:Input the number of cars Calculate the time quantum as k. 4. Select any lane from the inputs randomly.

i. Allocate one quantum k if the number of lane cars >=k.

ii. Else allocate the number of lane cars.

iii. Calculate the lane waiting time

iv.call the subprocess for detecting the number of cars.

V.then go to sleep for detecting in the background.

vi.then switch the lane with other index of lane is 1.

Vii.again same process will work in looping for every lane and terminate and go to step 6

Viii.else comparing count lane 1 and lane 2 and update index of lane .

Step 7: set lane index count is 1 as per the max number of cars of that lane after comparison. Else set 0 .

Step 8:set counter for lane which is allowed for max count and set time duration for passing the the vehicles

Step 9:update the signal timing

Step 10.rotate the index of lane for allowing to passing the vehicles.

And go to step 4.

Different Modules

- ❖ Image processing :- ROI

In this module, input video is given to ROI algorithm and defined region of video is obtained as output. This region is defined by the coordinates specified in algorithm.

The ROI output is then given to detection module for further analysis.

- ❖ YOLO Object Detection Module

YOLO is implemented as a 32 layer deep convolutional neural network (DNN). The open source implementation released along with the paper is built upon a custom DNN framework written by YOLO's authors, called darknet 1 . This application provides the baseline by which we compare our implementation of YOLO 2 . Redmon et al. have released several variants of YOLO. For our purposes, we chose the variant outlined in. In places in which the paper lacks details, we refer to the baseline darknet implementation to resolve ambiguities.

YOLO reframes object detection as a single regression problem, straight from image pixels to bounding box coordinates and class probabilities. YOLO divides the input image into an S ×S grid. If the center of an object falls into a grid cell, that grid cell is responsible for detecting that object. A description of the CNN architecture can be seen in below figure.[10]

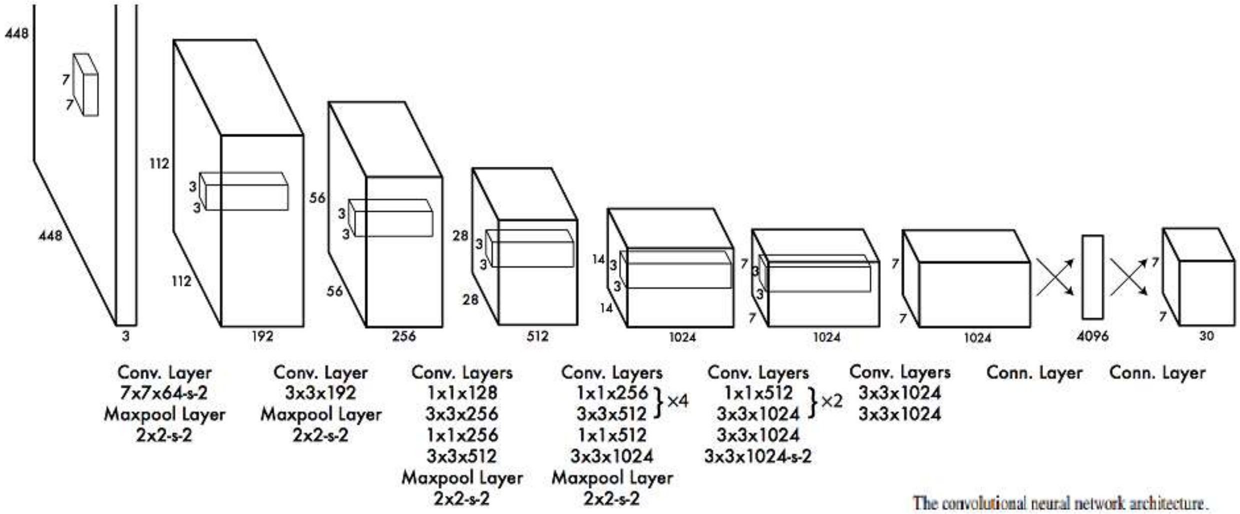


Fig 9. Convolution CNN Architecture

Observe the object centers (see pink dots) within each grid cell. These respective grid cells will be "responsible" for these chair objects.

Fig 10.YOLO detection

Output from detection model :

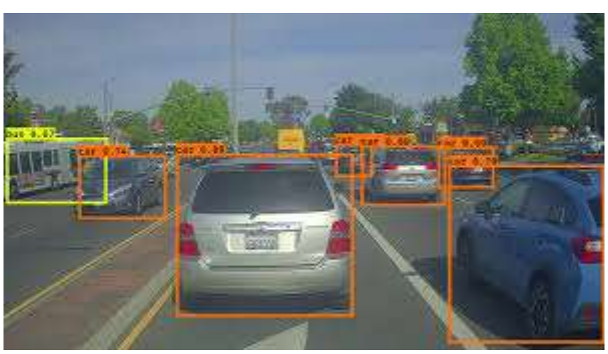


Fig 11. Object detection output

Chapter 6: Testing

6.1 . Definition of testing

Testing is defined as an activity to check whether the actual results match the expected results and to ensure that the software system is Defect free. It involves execution of a software component or system component to evaluate one or more properties of interest.

Software testing also helps to identify errors, gaps or missing requirements in contrary to the actual requirements. It can be either done manually or using automated tools .A process of analyzing a software item to detect the differences between existing and required conditions (i.e., defects) and to evaluate the features of the software item.

Testing assesses the quality of the product. Software testing is a process that should be done during the development process. In other words software testing is a verification and validation process.

Target of the test are -

- Errors - These are actual coding mistakes made by developers. In addition, there is a difference in output of software and desired output, is considered as an error.
- Fault - When error exists fault occurs. A fault, also known as a bug, is a result of an error which can cause system to fail.
- Failure - failure is said to be the inability of the system to perform the desired task. Failure occurs when fault exists in the system.

6.2. Types of tests

Testing can either be done manually or using an automated testing tool:

Manual :

This testing is performed without taking help of automated testing tools. The software tester prepares test cases for different sections and levels of the code, executes the tests and reports the result to the manager.Manual testing is time and resource consuming. The tester needs to confirm whether or not right test cases are used. Major portion of testing involves manual testing.

Automated : This testing is a testing procedure done with aid of automated testing tools. The limitations with manual testing can be overcome using automated test tools.

There are two basics of software testing: Black box testing and Whitebox testing.

Blackbox Testing :

Black box testing is a testing technique that ignores the internal mechanism of the system and focuses on the output generated against any input and execution of the system. It is also called functional testing.

White Box Testing :

White box testing is a testing technique that takes into account the internal mechanism of a system. It is also called structural testing and glass box testing.

Black box testing is often used for validation and white box testing is often used for verification.

Types of Testing :

- Unit testing:

  While coding, the programmer performs some tests on that unit of program to know if it is error free. Testing is performed under white-box testing approach. Unit testing helps developers decide that individual units of the program are working as per requirement and are error free.

- Integration testing:

  Even if the units of software are working fine individually, there is a need to find out if the units if integrated together would also work without errors. For example, argument passing and data updation etc.

- System testing:

  The software is compiled as product and then it is tested as a whole..

- Regression testing:

  Whenever a software product is updated with new code, feature or functionality, it is tested thoroughly to detect if there is any negative impact of the added code. This is known as regression testing.

- Beta/Acceptance testing:

  When the software is ready to hand over to the customer it has to go through last phase of testing where it is tested for user-interaction and response. This is important because even if the software matches all user requirements and if user does not like the way it appears or works, it may be rejected.[7]

6.3. Type of Testing considered with justification

Our project required through testing of the algorithm for management of traffic, thus we chose to go with White Box testing methodology.

White Box testing is a software testing method in which the internal structure/design/implementation of the item being tested is known to the tester.

We have chosen various inputs to exercise paths through the code and determines the appropriate outputs and to understand the implementation knowledge which is essential to know the nitty-gritty of a system.

We have implemented various type of testing to thoroughly check various modules and their integration.

Unit Testing:

In this we test various module individually for their functionality and working with various test case scenarios.

Integration Testing :

In this, integration of various module is tested using various test cases.

6.4 Various test case scenarios considered

In project focuses on the effective management i.e. managing the time for performinginternal operation, object detection, model loading.

Test Scenario	Checking functionality of Image processing module to get Region of Interest from video.
Test Cases	Check result on giving video as input.
Inference	Defined region is seen in output. Coordinates defined for selecting ROI give appropriate area for further analysis to be done.

Test Scenario	Checking functionality of object detection model.
Test Cases	Checking output file for detection count on giving video file as a input.
Inference	Detection model is working properly and giving count as output. We also come to know about it's accuracy and speed.

Test Scenario	Checking coordination between internal looping and various module.
Test Cases	Take different start "Signal time" and check for coordination between time loops and loading and processing of detection module. This test is performed many times to get most accurate time required for detection module loading and external error.
Inference	This time is then effectively incorporated in the algorithm to give output without any unwanted delay or synchronization.

Test Scenario	Checking Integrity between various modules to give overall module.
Test Cases	Run algorithm and check output at both front and backend.
Inference	All modules are running in properly.

Table 2. Test Cases

.

Chapter 7: Result Analysis

7.1. Module(s) under consideration

- ❖ Image Processing Module : Identifying Region Of Interest .

This module accurately gives the Region of Interest from the input file. ROI is explicitly defined (with the help of coordinates) for each hardware, at the time of installation. Output of this module is given to object detection module for counting the number of vehicles.

- ❖ YOLO Object Detection module.

Sizeof its .h5(weight file) file is 256 MB and thus requires approx. 16 sec to load.
Detecting vehicles is done by implementation of YOLOV3 Model.
Given a image of resolution 900 X 540 (below) following result is obtained.

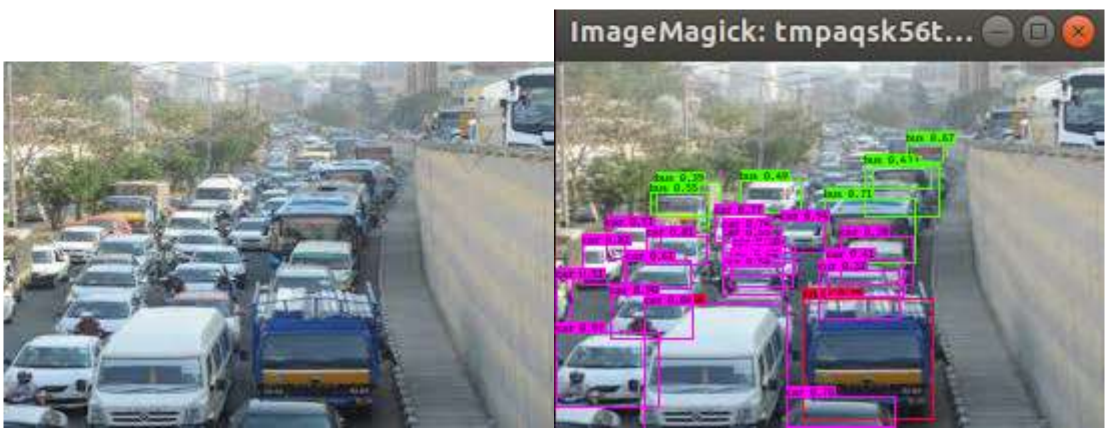


Fig .12 System result

Time required : 20 seconds

Count produced by model : 28

Actual count :45

%Accuracy :62.22%

Management module :

Management module comprises of the developed algorithm to effectively decide the time allocated to each traffic lane for efficient traffic management.

Minimum time of 3.20 minutes is required for the basic first model execution. This time is estimated considering the logic of the algorithm. Algorithm is explained in Implementation section. In further rounds of algorithm computation time is estimated using the count of vehicles from the input video file at that particular instant of time (this takes into consideration the density of traffic) and also considering the initial lag caused due to time required by the detection module to load when subprocess(call to detection module) is called.

Efficiency of this module can be increased by increasing the processing power of hardware i.e. using 8GB GPU, more accurate detection model.

7.2. Parameters considered

❖ Accuracy

$$\begin{aligned} Accuracy &= \frac{\text{Number of correct predictions}}{\text{Total of all cases to be predicted}} \\ &= \frac{a+d}{a+b+c+d} \end{aligned}$$

Fig. 13. Accuracy

Accuracy is not really a reliable metric for the real performance of a classifier when the number of samples in different classes vary greatly (unbalanced target) because it will yield misleading results. For example, if there were 95 cats and only 5 dogs in the data set, the classifier could easily be biased into classifying all the samples as cats. The overall accuracy would be 95%, but in practice the classifier would have a 100% recognition rate for the cat class but a 0% recognition rate for the dog class.

❖ Precision

Precision measures how accurate is your predictions. i.e. the percentage of your predictions are correct.

❖ Recall

Recall measures how good you find all the positives. For example, we can find 80% of the possible positive cases in our top K predictions.

$$Precision = \frac{TP}{TP + FP}$$

$$Recall = \frac{TP}{TP + FN}$$

$$F1 = 2 \cdot \frac{precision \cdot recall}{precision + recall}$$

TP = True positive

TN = True negative

FP = False positive

FN = False negative

		condition	
		present	absent
Test	positive	true positive	false positive
	negative	false negative	true negative

Mathematical formulas

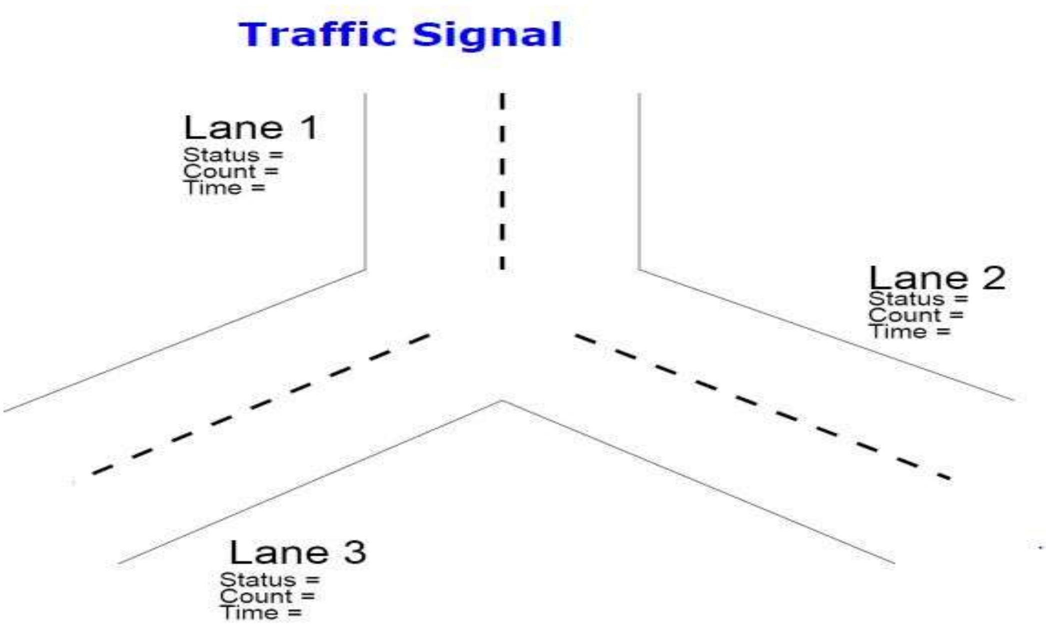
Fig 14. Mathematical formulas

❖ mAP/AP

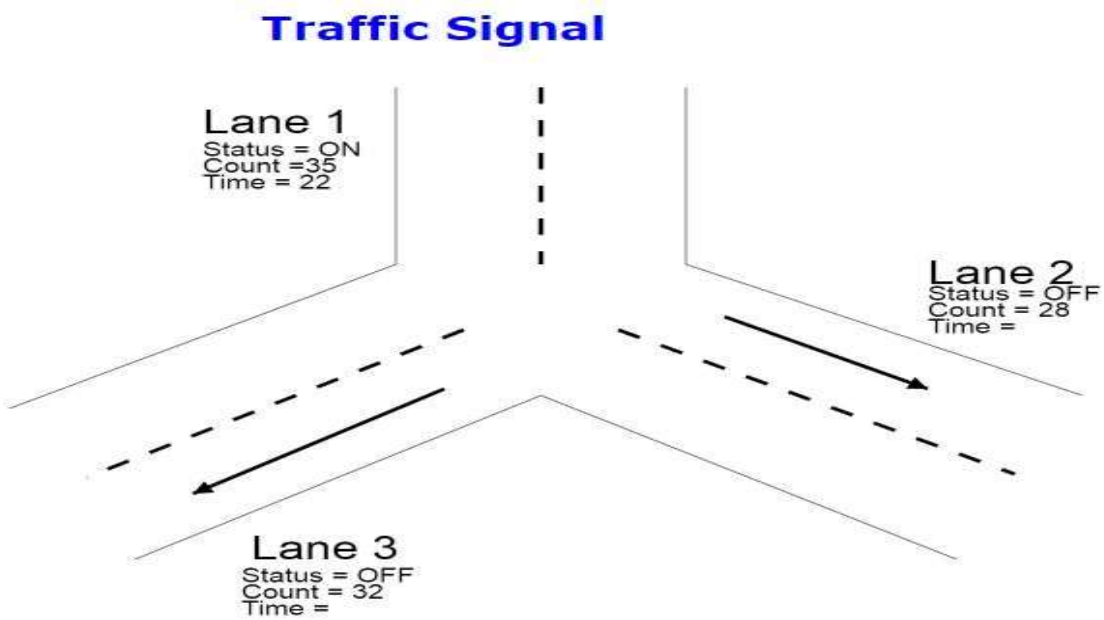
mAP (mean Average Precision) or AP (Average precision) is a popular metric in measuring the accuracy of object detectors like Faster R-CNN, SSD, YOLOv3 etc. Average precision computes the average precision value for recall value over 0 to 1.[3]

7.3. Screenshots of User Interface (UI)

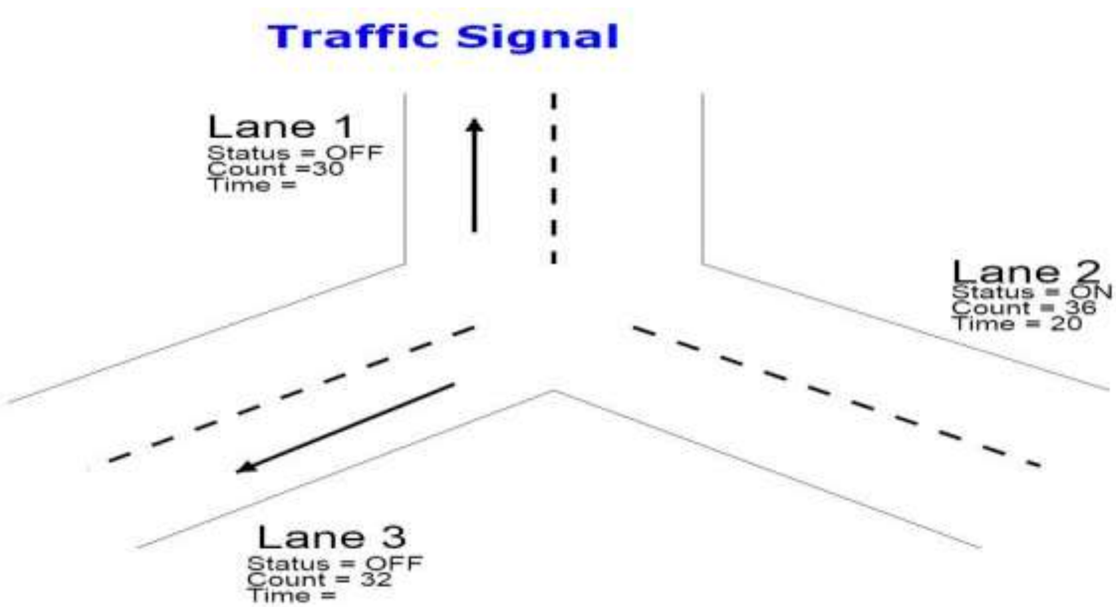
1: First Page



2: When numbers of vehicles in lane 1 are more, allowing lane 1:



3: When numbers of vehicles in lane 2 are more, allowing lane 2:



4: When numbers of vehicles in lane 3 are more, allowing lane 3:

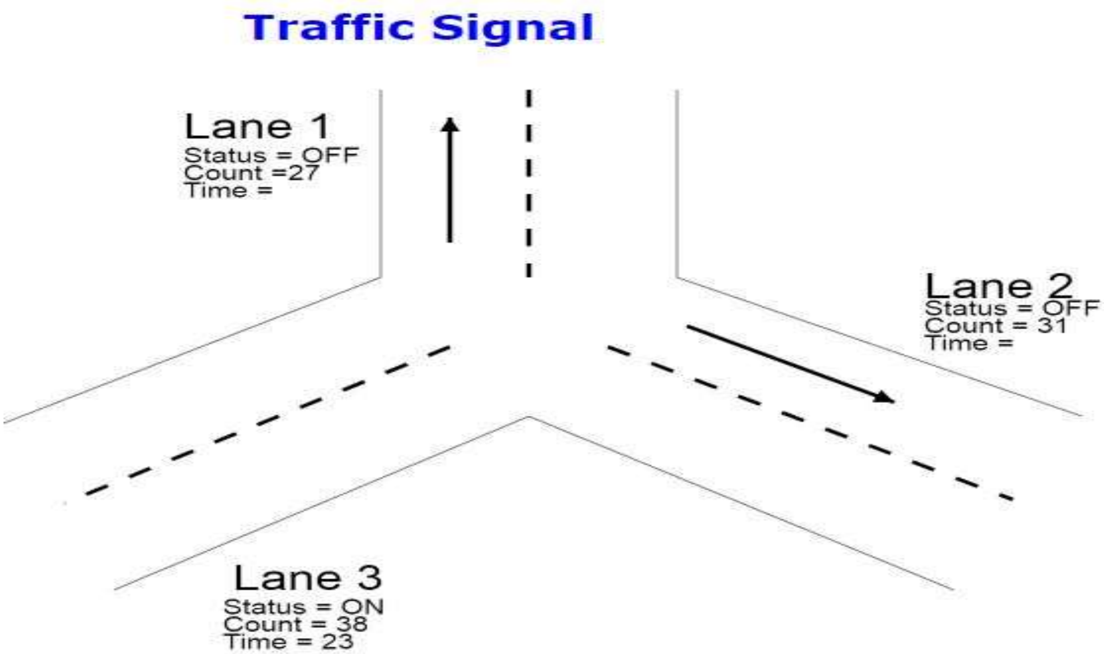


Fig 15. UI Screenshots

7.4. Evaluation of the developed system

❖ YOLOv3 Detection Model

The COCO dataset is an excellent object detection dataset with 80 classes, 80,000 training images and 40,000 validation images.

AP result for the YOLOv3 detector

	backbone	AP	AP_{50}	AP_{75}	AP_S	AP_M	AP_L
Two-stage methods							
Faster R-CNN+++ [3]	ResNet-101-C4	34.9	55.7	37.4	15.6	38.7	50.9
Faster R-CNN w FPN [6]	ResNet-101-FPN	36.2	59.1	39.0	18.2	39.0	48.2
Faster R-CNN by G-RMI [4]	Inception-ResNet-v2 [19]	34.7	55.5	36.7	13.5	38.1	52.0
Faster R-CNN w TDM [18]	Inception-ResNet-v2-TDM	36.8	57.7	39.2	16.2	39.8	**52.1**
One-stage methods							
YOLOv2 [13]	DarkNet-19 [13]	21.6	44.0	19.2	5.0	22.4	35.5
SSD513 [9, 2]	ResNet-101-SSD	31.2	50.4	33.3	10.2	34.5	49.8
DSSD513 [2]	ResNet-101-DSSD	33.2	53.3	35.2	13.0	35.4	51.1
RetinaNet [7]	ResNet-101-FPN	39.1	59.1	42.3	21.8	42.7	50.2
RetinaNet [7]	ResNeXt-101-FPN	**40.8**	**61.1**	**44.1**	**24.1**	**44.2**	51.2
YOLOv3 608 × 608	Darknet-53	33.0	57.9	34.4	18.3	35.4	41.9

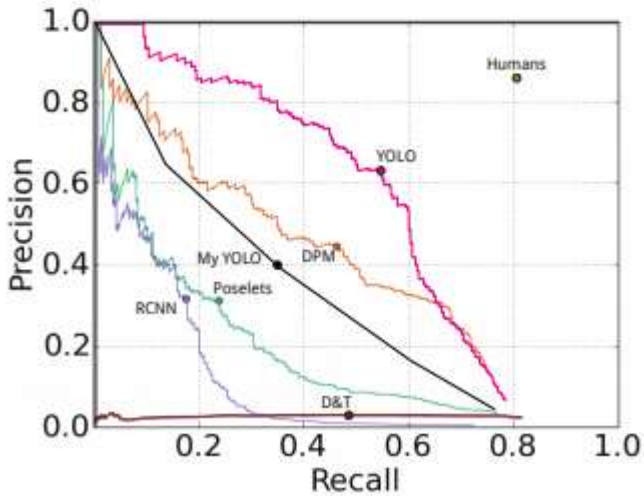
COCO for YOLOv3

Table 3. YOLO on COCO[5]

	AP	Best F1
YOLO	53.3	0.590
R-CNN	10.4	0.225
DPM	37.8	0.458
Poselets[4]	17.8	0.271
D&T[6]	1.9	0.051
Mine	34	0.373

AP and F 1 score evaluation of different algorithms on Picasso Dataset

Table 4. YOLO on PASCAL[5]



Picasso Dataset precision-recall curves

Fig .16 Accuracy Graph

❖ Management Module :

This module comprises of the algorithm developed to manage the time for which lane is allowed and which lane is allowed.

It checks the density of vehicle on the roads and then evaluate which lane is to be allowed. It also takes into consideration that all lanes are given chance and there is no starvation. It does not allow the same lane to be allowed twice in a row.

The minimum time for which the signal is on is 3.20 minutes.

This time is calculated by performing at least four analysis and detection round. Initial time is fixed at 3.20 minutes since model needs time to load at each processing call.

Below is the analysis of the time laps for giving one signal output.

11	+ 00:07.59	02:58.84
10	+ 00:28.25	02:51.25
09	+ 00:13.03	02:23.00
08	+ 00:28.26	02:09.97
07	+ 00:00.20	01:41.71
06	+ 00:13.45	01:41.51
05	+ 00:28.97	01:28.06
04	+ 00:14.02	00:59.09
03	+ 00:28.40	00:45.07
02	+ 00:04.10	00:16.67
01	+ 00:12.57	00:12.57

Table 5. Result time analysis

Using above time analysis, we come know the time required for loading detection model which is approx 16 seconds.

Using it we can also verify that detection model is running for 1/4th of switching time calculated. Running detection model for at least twice on each lane (in consideration to allow it next) alternatively increases the chances of predicting correct lane (based on count of that lane few seconds earlier) at the time of allowing signal.

❖ Project Improvement :

This speed and performance detection module (and of the overall system) can be increased using the model with small .h5 file (which makes it load faster in each switching) and less switching overhead. And thus model will take less time to load.

This will allow algorithms to compare 1)more lane at time and to build more effective algorithms, 2) ability to fasten the switching and increase number of switching.

1) Will allow us to be more efficient with saving time of motorists to pass through traffic and easy traffic flow.
2) Will make us able to predict which lane to allow more accurately.

7.5 Graphical outputs

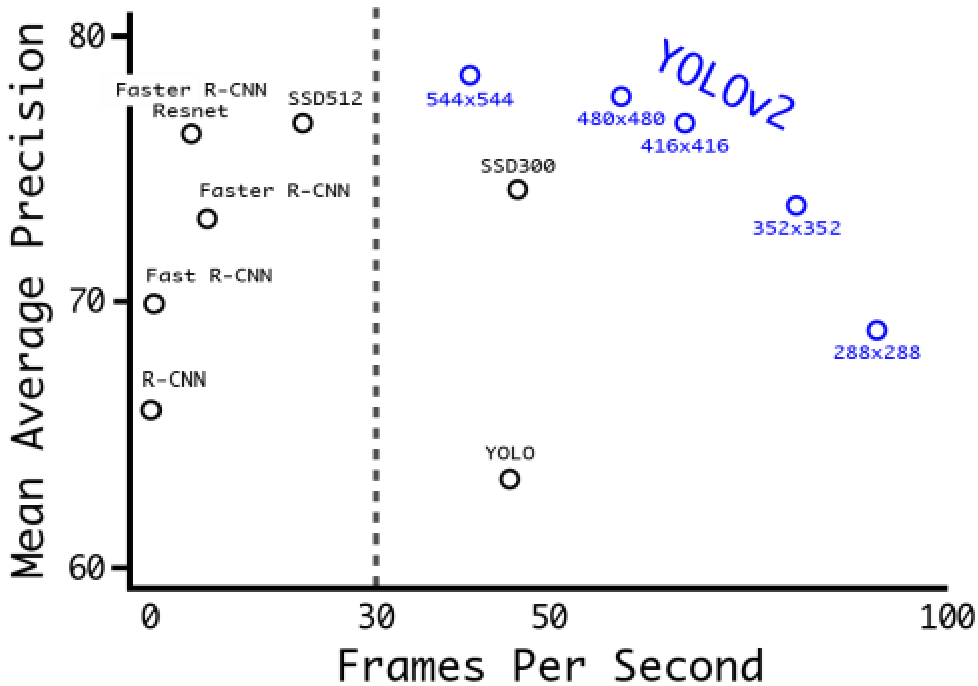


Fig 17. Frames vs precision

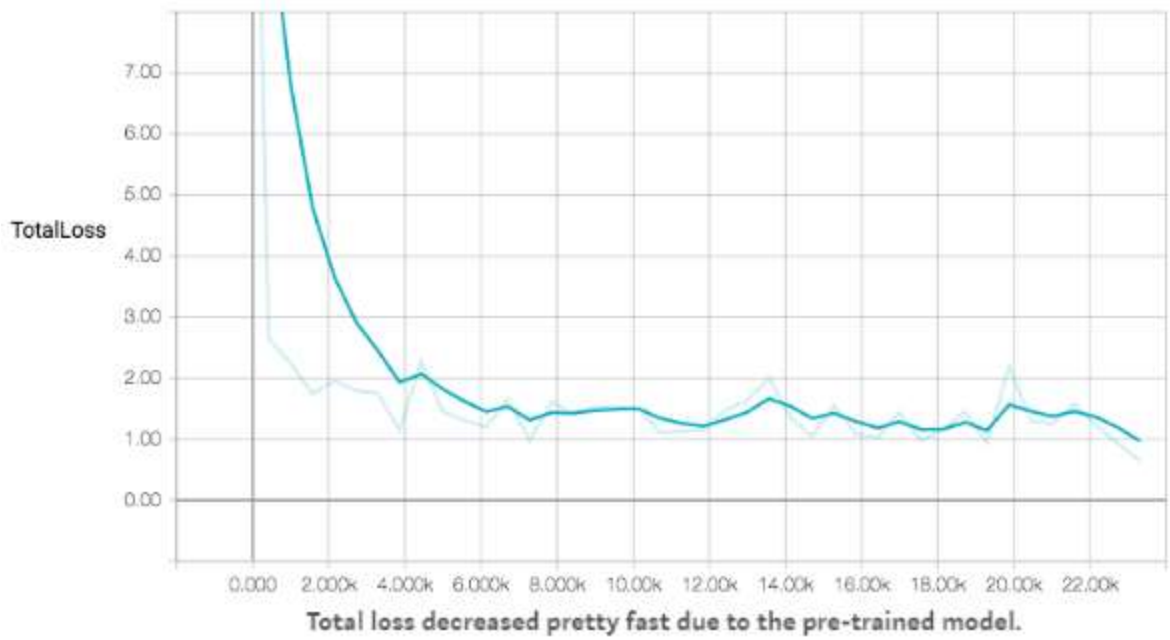


Fig. 18 modelling vs loss

Chapter 8: Conclusion

8.1 Limitations:

- Night time surveillance and heavy fog
- Limited processing power - GPU.
- Region of Interest has to be defined manually for every installation of camera hardware.
- Detection of small vehicles at back side.

8.2 Conclusion

The report presents review of our project on Intelligent Traffic Management System which tries to develop a system suitable for developing countries to manage traffic.
The project has two objectives, whichare, first, calculating the count of the vehicles on the road for the flow of the traffic smoothly without congestion and, second, developing time-based signaling which will help to manage traffic effectively and reduce waiting time.The proposed system aims at effective management of traffic system and thus reduce the major problem of transportation in metropolitan region.
We present our system with motto More Efficiency, More Convenience !

8.3 Future Scope

- Keeping the track of vehicles on different lanes by recognizing the number plates. By this we can track which types of vehicles are most probably passing by route. We can use the GSM module to track the location of cars.

- Implementing algorithms to allow multiple lane at a same time based on density of vehicle during peak hours. This will keep roads occupied/busy for more time, thus easing the flow of vehicles.

- Developing Priority-based signaling which will give priority to emergency vehicles such as ambulance. This will give us way to clear traffic in various emergency situations like security issues, disaster management, etc.

Chapter 9: References

9.1. Newspaper articles referred

Newspaper Article, Hindustan Times, dated 4th June 2018.

9.2 Research Papers Referred

[1] Priyankar Roychowdhury, Sarjo Das, “Automatic Road Traffic Management System in a City”, STM Journals, vol.1, 2014.

[2] Jiandong Cao, “Research on Urban Intelligent Traffic Monitoring System Based on Video Image Processing”, International Journal on Signal Processing, vol. 9, pp.393-406, 2016.

[3] Jonathan_hui, “map-mean-average-precision-for-object-detection”, medium.com, 45c121131173

[4] Ms.Saili Shinde ,Sheetal Jagtap,”Intelligent Traffic Management Systems Review”, International Journal for Innovative Research in Science & Technology,Vol. 2,2016.

[5] Yihui He, “Object Detection with YOLO on Artwork Dataset”, Computer Science Department, Xi’an Jiaotong University.

[6] Allan M de Souza , Celso ARL Brennand, Roberto S Yokoyama ,”Traffic management systems”,vol.17,2017.

[7] Kritika, “software testing and types”, geeksforgeeks.org, article.

[8] Md. Khalilur Rhaman, ”An Efficient Algorithm for Detecting Traffic Congestion and a Framework for Smart Traffic Control System”,2015.

[9] yolo, darknet, pjreddie.com.

[10] Konstantine Buhler, John Lambert, Matthew Vilim, “YoloFlow Real-time Object Tracking in Video”, CS 229 Course Project, Departments of Computer Science and Electrical Engineering Stanford University.

[11] Akarsh Zingade, “logo-detection-using-yolov2”, medium.com, 8cda5a68740e

[12] Ninad Lanke, Sheetal Koul, ”Smart Traffic Management System”, International Journal of Computer Applications (0975 – 8887) Volume 75– No.7, August 2013.

[13] Biplav Srivastava, “A New Look at the Traffic Management Problem and Where to Start”, IBM Research Report, RI 10014, 19 November 2010.

9.3. Patents Referred

[1] Jerome H. Lemelson, Robert D. Pedersen,Steven R. Pedersen. “Intelligent traffic control and warning system and method”, U.S. Patent US6633238B2, 10, 14, 2003.

Project progress review sheets:

Review 1:

Inhouse / Industry : ✓

Mini Project Evaluation Sheet 2018 - 19 GROUP NO.: 27 Class: D12 A/B/C

Title of Project: Intelligent Traffic Management System , TE Group No. - 27

Group Members: Rinku Sahu (63 D12A) Pavan Satpute (66 D12A) Shruti Kargne (29 D12C) Manali Gupta (24 D12A)

	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage I	4	3	3	3	4	2	1	1	2	1	1	3	2	2	32

Comments: Literature Survey missing. Execution didnt capture vehicles, nor number plates as expected

Vidya S. Zope
Name & Signature Reviewer1

	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage I	4	5	3	2	4	2	1	1	2	1	2	2	3	3	35

Comments: No Literature Survey and many constraints not considered, like lane & no plate

Date: 12th FEB 2019

Richard J
Name & Signature Reviewer2

Review 2 :

Inhouse / Industry

Mini Project Evaluation Sheet 2018 - 19 GROUP NO.-27 Class: D12 A/B/C

Title of Project: Intelligent traffic Management System

Group Members: Shruti Kangne (D12C) [illegible] Pavan D. Satpute ([illegible]) Rinku Sahu ([illegible]) Manali Gupta

	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage 1	4	4	4	3	4	2	2	2	2	3	2	3	4	4	43

Comments: ① For small objects in video are not considered

② Restrict to few output classes.

③ Emergency vehicles (Ambulance) not detected yet.

Vidya S Zope [illegible]
Name & Signature Reviewer1

	Engineering Concepts & Knowledge (5)	Interpretation of Problem & Analysis (5)	Design / Prototype (5)	Interpretation of Data & Dataset (3)	Modern Tool Usage (5)	Societal Benefit, Safety Consideration (2)	Environment Friendly (2)	Ethics (2)	Team work (2)	Presentation Skills (3)	Applied Engg & Mgmt principles (3)	Life-long learning (3)	Professional Skills (5)	Innovative Approach (5)	Total Marks (50)
Review of Project Stage 1	4	4	4	3	4	2	2	2	2	3	3	3	4	4	44

Comments: doesnot detect far objects, Need to finalize no of classes to be detected.

Date: 12th March 2019

Anuya N [illegible]
Name & Signature Reviewer2