A Project Report on

Autonomous Traffic Monitoring and Controlling

Submitted in partial fulfillment of the requirements for the award
of the degree of

Bachelor of Engineering

in

Computer Engineering

by

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UNIVERSITY OF MUMBAI

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Approval Sheet

This Project Report entitled ***"Autonomous Traffic Monitoring and Controlling"*** Submitted by ***"Yuvraj Yadav"(16102040),"Ashwin Shenolikar"(16102037),"Tanmay Sule"(16102032)*** is approved for the partial fulfillment of the requirenment for the award of the degree of ***Bachelor of Engineering*** in ***Computers*** from ***University of Mumbai***.

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Head Department of Computer Engineering

Place:A.P.Shah Institute of Technology, Thane
Date:

CERTIFICATE

This is to certify that the project entitled ***"Autonomous Traffic Monitoring and Controlling"*** submitted by ***"Yuvraj Yadav" (16102040),"Ashwin Shenolikar" (16102037),"Tanmay Sule" (16102032)*** for the partial fulfillment of the requirement for award of a degree ***Bachelor of Engineering*** in ***Computer***,to the University of Mumbai,is a bonafide work carried out during academic year 2017-2018.

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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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Date:

Abstract

Road travel is an everyday part of most of the people living in urban areas. It is essential for each such commuter to have a hassle-free journey when they travel by road. Traffic rules are introduced in order to make roads traffic-free and convenient. However, the enforcement of these is not always as good. This implementation proposes a way to enforce traffic rules in a way that violators are actually held liable for breaking traffic rules. This implementation aims to accomplish this using a combination of image processing, machine learning algorithms and optical character recognition. The points of input are video feeds from CCTV cameras mounted on traffic signals, which will be processed and trained to identify and classify vehicles into categories such as two-wheelers, four-wheelers, logistic vehicles and public transport vehicles. The vehicles identified to be breaking traffic rules will be scanned for their number plates, using which the information of the owner will be extracted, and a fine will be generated and charged to the owner. Another application of this project is to gather data and train a model which can identify the density of traffic in a given area, and accordingly modify traffic signal timings to avoid occurrences of traffic jams.

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Chapter 1

Introduction

The daily life of most people living in suburban and urban settlements today consists of a commute. The daily commute of each citizen usually consists of detrimental factors. Due to various reasons, delays are caused in the daily commute,leading to increased travel times which adds to the hectic schedule. Hence, the model aims to ease this part of the citizens life by enforcing traffic rules in an automated fashion. The usage of machine learning and image processing is done in order to achieve this.

1.1 Problem Definition

Daily commute of citizens in urban cities of India more often than not consists of facing the problem of slow travel due to various incidents.The root cause of this problem is as follows: Over speeding, lane cutting in dense traffic situations give rise to phantom traffic jams[1][2], vehicles crossing traffic signals irrespective of whether their lane had a green light or not, and other such reasons. The main issue faced while tackling these issues is the appropriate handling of recorded instances. The culprits may get away with breaking traffic rules without any repercussions. Minimization of such instances so that traffic rules are followed by everyone is the aim of the project.

1.2 Objectives

The objectives of current implementation are: Detection and categorization of vehicles from a live CCTV video feed Detection of violation of zebra crossing rule at traffic signals and enforcement of traffic rules Detection of lane cutting incidents and enforcement of traffic rules Data analysis done of vehicle density to avoid traffic jams and accumulation of vehicles at certain spots.

1.3 Scope

The scope of current implementation includes an autonomous system consisting of a vehicle classifier, which can distinguish classes of vehicles into two-wheelers, 4-wheelers, and transport vehicles in real time using CCTV cameras mounted at traffic signals. Enforcement and regulation of traffic rules such as lane cutting, zebra crossing violations can be implemented. The system will recognize those vehicles which are breaking traffic rules using deep learning algorithms. Recognition of traffic rule violation will lead to identification of vehicle number using Optical Character Recognition (OCR). After the recognition of these violators of traffic rules via their vehicles license plate numbers, the system will automatically generate a penalty bill for the violator and email it to their accounts. Finally, the data gathered at various traffic signals can be used to train the system to analyze traffic density at various points in an area in order to prevent traffic jams. To summarize, the scope of the project is divided into the following modules: Module 1:- Vehicle Identification Categorization. Module 2:- Enforcement of traffic rules. Module 3:- Data analytics training.

Chapter 2

Literature Review

Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition
Muhammad Tahir Qadri , Muhammad Asif

This model draws from some established systems and develops on them in order to make a completely autonomous system. As explained in this paper, the model presented follows a structure as follows: The solution provided by the authors is divided into 3 major modules: Image Capture, Number plate recognition and extraction, and finally, Character Recognition. Similarly, the modules in this paper follows a similar structure, with key differences occurring in implementation methods, and to a lesser extent, in module structure. Features such as image extraction from camera feed, Image Filtering, and OCR application are used in this model in addition to modules not covered by the referenced paper.

Chapter 3

Technology Stack

The technology stack used for this project can be explained by the module for which it is being used as follows: Module 1:- Vehicle Identification Categorization:- Implementation will be done using Convolutional Neural Networks and OpenCV, an Image Processing Library. Module 2:- Enforcement of traffic rules:- 1. Deep Belief Networks used in conjunction with the You Only Look Once(YOLO) and some other approaches. 2. Backend implementation for fining violators. Module 3:- Data analytics training:- Tensorflow and Cloud based framework for Python

Chapter 4

Project Design

4.1 Proposed System

The main aim of our project is to make travelling by the roads of urban areas a much more pleasant experience than it is today. This means that our system will help in strengthening of traffic rules established by the government and make it so that violators of these rules are reliably caught and sentenced the appropriate fine. The key feature of our project is that it is almost entirely automated - meaning that there is little to no human interaction involved when it comes to its usual functioning. This system can ensure that there is a robust framework through which surveillance of vehicles is done and that wrongdoings, when it comes to traffic rules, are punished. By targeting these core problems when it comes to redundancies in the idealistic road commute, we aim to make it so that the traffic rules are followed by everyone, and that there are fewer incidents such as traffic jams, road rage, or crashes.

4.2 Flow of Modules

The entire project is classified into three main modules: 1. Vehicle Identification and Classification, 2. Enforcement of Traffic Rules, and 3. Data Analytics Training. The flow of modules is such that the working of each module depends on the working of the other modules, that is, they are interdependent on each other. For example, the model cannot detect a violation of a traffic rule by a vehicle if it cannot ascertain what the vehicle is in the first place. The first step in the basic flow is to identify objects from a live CCTV video feed and to classify them as vehicle or not vehicle. After that, it has to classify these vehicles into categories based on the class of the vehicle. This module runs all the time. The second module is responsible to determine when a vehicle commits a violation, such as lane cutting, and then use OCR to scan its number plate, following which it can take appropriate action using the details of the vehicle owner. This module is always active in search of rule violations. However, the further process of the flow only begins when such a violation is actually detected. Finally, the third module is also dependent on the first two, in the sense that it works on the data collected by the two in real time. This module ensures that in case of a possible traffic congestion situation, signal duration's can be optimized in order to avoid it.

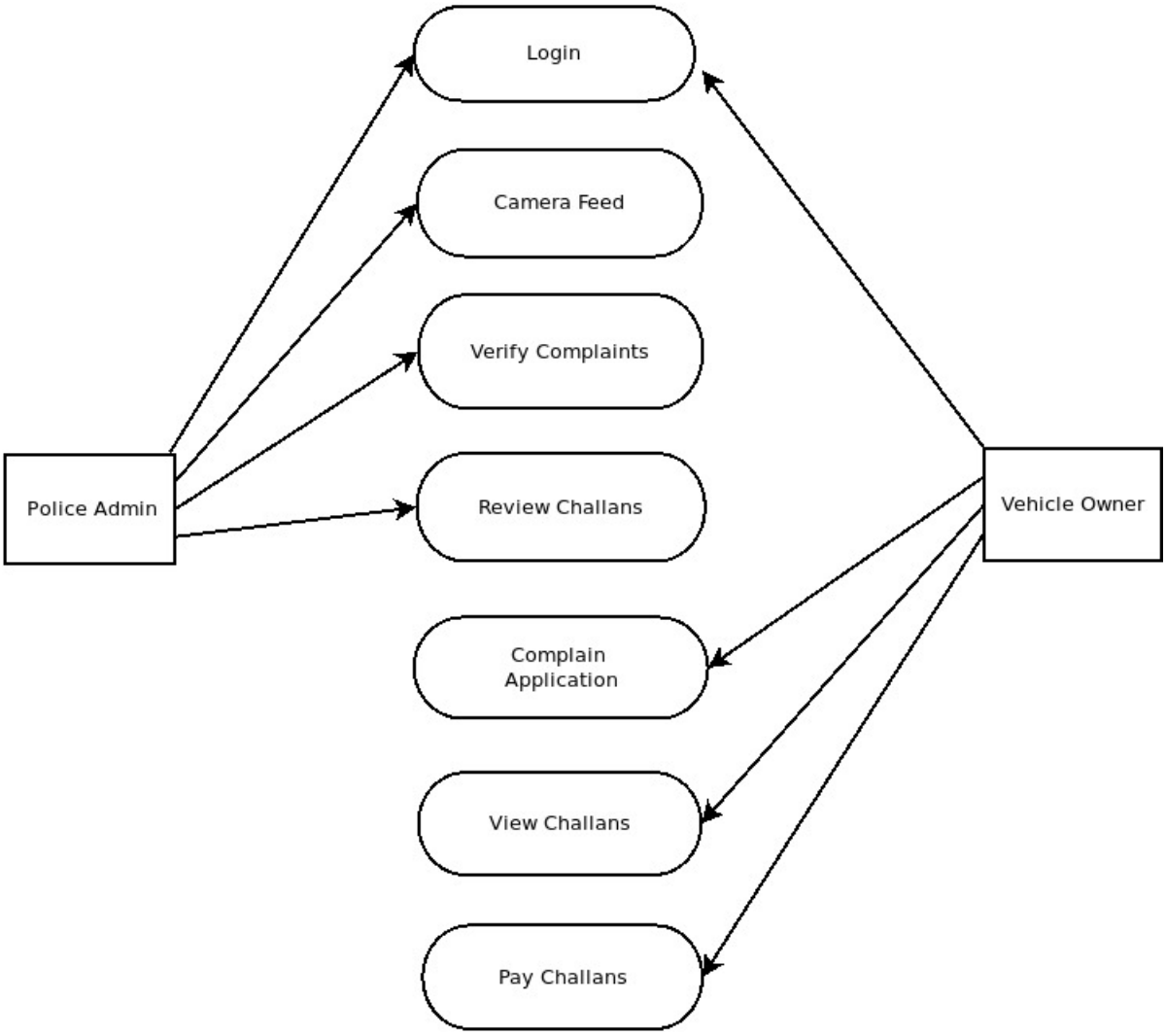

Figure 4.1: Use Case Diagram

4.3 Description of Use Case Diagram

The main working of the system is focused on automation. So, there are few to no human entities which are responsible to carry out any important actions. However, the system does require human personnel to ensure that it is working in a proper manner. The first entity is a traffic police admin, who has a unique login. This grants access to to the live camera feed, review challans, and complaint handling. On the other hand, a user login is given to other people who have obtained challans so that they may pay them, or in case of any complaints or criticisms, fill out an application as a complaint.

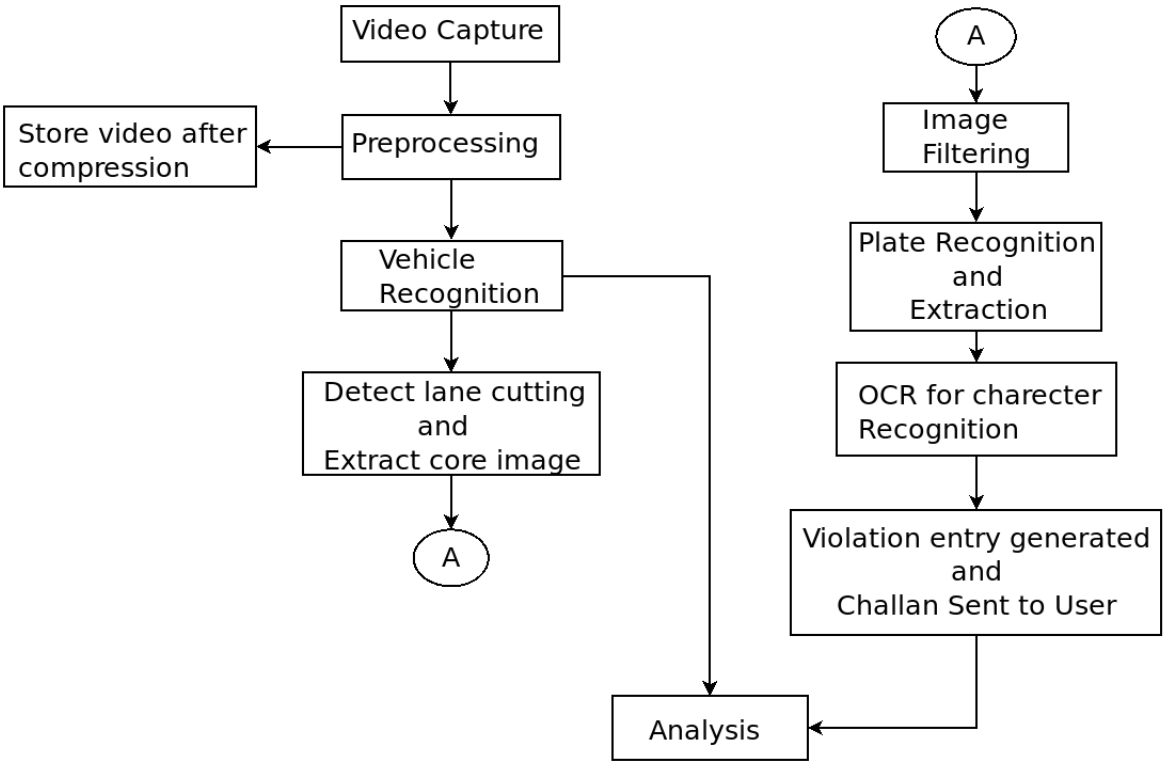

Figure 4.2: Activity Diagram

Chapter 5

CNN

Haar Cascade
Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video and based on the concept of features proposed by Paul Viola and Michael Jones in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001
It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images.

Alexnet
AlexNet was much larger than previous CNNs used for computer vision tasks (e.g. Yann LeCun's LeNet paper in 1998). It has 60 million parameters and 650,000 neurons and took five to six days to train on two GTX 580 3GB GPUs

Yolo
Introduction of YOLOv2 and YOLO9000, real-time detection systems took place recently. YOLOv2 is state-of-the-art and faster than other detection systems across a variety of detection datasets. Furthermore, it can be run at a variety of image sizes to provide a smooth tradeoff between speed and accuracy.

YOLO9000 is a real-time framework for detection more than 9000 object categories by jointly optimizing detection and c'lassification. It uses WordTree to combine data from various sources and our joint optimization technique to train simultaneously on ImageNet and COCO. YOLO9000 is a strong step towards closing the dataset size gap between detection and classification.

Chapter 6

Modules

Module 1: Vehicle Identification and classification
Initially, a video clip is read and segregating into number of frames. Each frame is then considered as an independent image, which is in RGB format and is converted into Gray scale image. In the proposed project, we assume a stationary background for all video sequences. The next phase is identifying the foreground dynamic objects (vehicle), which is obtained by subtracting background image from the given input video frame. The difference between the frames at certain intervals is computed to detect the moving object. The vehicle attributes (width, height, perimeter and area) are obtained by feature extraction technique of image processing. These features are feed into a classifier model to classify the vehicle as big or small by neural network architecture. The total architecture for vehicle classification system used in proposed project.

Module 2: Enforcement of traffic rules
This module deals with the actual detection and handling of traffic rule violations. This is done using Optical Character Recognition using OpenCV, which identifies rule violators and detects vehicle and owner information using its number plate. With this information, appropriate action can be taken. Current scope includes violations such as lane cutting and crossing limit during red signal.

Module 3: Data Analytics Training
This module is mainly focused on managing traffic conditions on a city-wide scale, using cameras to detect traffic density at various points in the city. This information can be very useful in managing traffic by avoiding potential congestion scenarios. Applications include dynamic determination of traffic signal duration, and also analytics based on patterns that the model can observe.

Chapter 7

Benefits and Applications

7.1 Benefits

Smoke emission done by vehicles greatly harms the environment and makes up for 94.5% of the carbon footprint in the years 20032004 and has increased since then. With this system, it is possible to reduce occurrence of traffic jams by punishing those who cause them, and by extension reduce the time individual vehicles spend on roads.

Incidents of traffic violation are often mixed with those of road rage and traffic situations. A simple lane cutting incident can slow down an entire lane and subsequently, the entire commute. Reducing these incidents is one of the main goals of the project. This will hold liable only those people who have done the traffic violation, and not the bystanders who have nothing to do with it. Additionally, this can reduce occurrences of traffic jams which will save people a lot of time.

7.2 Applications

Classifying vehicles according to their type is a basic step in most projects which involve vehicular traffic. Achieving high accuracy in this is very important, and in doing so it can also be used for other projects based on it, such as centralized traffic regulation in an area. In India, some aspects of this project are being implemented in a partial way. That is, vehicle recognition for traffic violators may be done in an automated fashion, but the action to be taken is done manually and so is prone to human error, such as inability to actually charge a few vehicles. However, this project aims to remove such vulnerabilities in the system. Some classes of vehicles have restricted allowance in terms of transport, such as huge carrier vehicles which are only allowed to commute in the night as they are slow and bulky and extremely prone to cause traffic jams if allowed to travel during the day. In case this does happen, the system can catch those vehicles and penalize them accordingly. On rare occurrences such as criminal activity, training of the model can be done to keep track of a singular suspect vehicle. While this is not in the immediate scope, it may be developed at a later stage.

Chapter 8

Result

This shall form the penultimate chapter of the report and shall include a thorough evaluation of the investigation carried out and bring out the contributions from the study. The discussion shall logically lead to inferences and conclusions as well as scope for possible further future work.

Parameters	**Wormhole Attack**	**AODV**
Total No.of Sent Packets	85068	85068
Total No.of Received Packets	16252	68068
Total No.of Drop Packets	61948	16864
Throughput	98.01	410.24
Delay	0.0244	0.1528
Jitter	23.93	100.16

Table 8.1: Wormhole Attack Comparison with AODV Protocol

Chapter 9

Conclusions and Future Scope

To conclude, the main implementation of the project consists of reporting of traffic rule violators using deep learning convolutional neural networks in order to train an autonomous system to carry out traffic law enforcement. Future scope includes tracking of specific vehicles, such as those which are suspect. Also, dynamic assignment of traffic signal durations can be done.

Bibliography

[1] Joseph Redmon, Ali Farhadi,University of Washington, Allen Institute for AI - "YOLO9000: Better, Faster, Stronger"

[2] Muhammad Tahir Qadri, Muhammad Asif, 2009 International Conference on Education Technology and Computer - "Automatic Number Plate Recognition System for Vehicle Identification Using Optical Character Recognition"

[3] Joseph Redmon, Santosh Divvala, Ross Girshick, Ali Farhadi,University of Washington, Allen Institute for AI, Facebook AI Research- "You Only Look Once:Unified, Real-Time Object Detection"

Appendices

Detailed information, lengthy derivations, raw experimental observations etc. are to be presented in the separate appendices, which shall be numbered in Roman Capitals (e.g. Appendix I). Since reference can be drawn to published/unpublished literature in the appendices these should precede the Literature Cited section.

Appendix-A: NS2 Download and Installation

1. Download ns-allinone-2.35.tar.gz from http://sourceforge.net/projects/nsnam/

2. Place ns-allinone-2.35.tar in your desired directory; like /home/vishal.

3. Go to terminal and do as following commands
sudo apt-get update
sudo apt-get install automake autoconf libxmu-dev build-essential

4. Extract ns-allinone-2.35 and after extracting go to folder ns-allinone-2.35 from Terminal as
$cd ns-allinone-2.35
$./install

5. Path Setting
$ gedit .bashrc

This command will open an existing file in editor. Just put the following path which is given bellow. [Remember that our ns-allinone path is /home/vishal. we will change this path according to our ns-allinone folder's path]

export PATH=$PATH:/home/vishal/ns-allinone-2.35/bin:/home/vishal/ns-allinone-2.35/tcl8.5.10/unix/home/vishal/ns-allinone-2.35/tk8.5.10/unix

export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/home/vishal/ns-allinone- 2.35/otcl-1.14:/home/vishal/ns-allinone-2.35/lib

export TCL_LIRARY_PATH=$TCL_LIBRARY_PATH:/home/vishal/ns-allinone-2.35/tcl8.5.10/library

After this save and exit.

6. Now type in terminal to check that, is all command we entered in .bashrc is correct or not? And To take the effect immediately
$source .bashrc

7. Then perform the validation test using this command.
$ ./validate

8. Run ns2 using this command
$ns

We will get % prompt in our terminal. Now ns2 has been installed.

Annexure

Annexure-A: Gantt Chart

GANTT CHART

PROJECT TITLE	Autonomous Traffic monitering and controlling	COLLEGE NAME	A.P.Shah Institute of Technology
PROJECT GUIDE	Amol Kalugade	DATE	

WBS NUMBER	TASK TITLE	TASK OWNER	START DATE	DUE DATE	DURATION (Weeks)	PCT OF TASK COMPLETE
1	**Project Conception and Initiation**					
1.1	Research paper search	Tanmay,Yuvraj	7/10/19	7/26/19	3	100%
1.1.1	Research paper finalization	Yuvraj	7/10/19	7/26/19	3	100%
1.2	Project Title	Ashwin,Yuvraj	7/10/19	7/26/19	3	100%
1.3	Abstract	Ashwin	8/23/19	8/30/19	1	100%
1.4	Objectives	Yuvraj	8/23/19	8/30/19	1	100%
1.5	Literature Review	Tanmay,Ashwin	8/23/19	8/30/19	1	100%
1.5	Problem Definition	Ashwin,Tanmay,Yuvraj	8/23/19	8/30/19	1	100%
1.5	Scope	Tanmay	8/23/19	8/30/19	1	100%
1.5	Technology Stack	Ashwin	8/23/19	8/30/19	1	100%
1.5	Benifits for Environment	Tanmay	8/23/19	8/30/19	1	100%
1.5	Benifits for Society	Yuvraj	8/23/19	8/30/19	1	100%
1.5	Applications	Tanmay	8/23/19	8/30/19	1	100%
2	**Project Design**					
2.1	Proposed System	Ashwin	9/19/19	9/27/19	1	100%
2.2	Design(Flow Of Modules)	Yuvraj	9/19/19	9/27/19	1	100%
2.3	Activity Diagram	Tanmay	9/19/19	9/27/19	1	100%
2.4	Use Case Diagram	Tanmay	9/19/19	9/27/19	1	100%
2.4	Description of Use Case	Ashwin,Yuvraj	9/19/19	9/27/19	1	100%
2.4	Modules	Ashwin,Tanmay,Yuvraj	9/19/19	9/27/19	1	60%
2.4	Module-1	Tanmay	9/19/19	9/27/19	1	100%
3	**Project Implementation**					
3.1	Module-1	Tanmay,Ashwin,Yuvraj	10/3/19	10/11/19	0	80%
	1.1 Frame Seperation	Tanmay,Yuvraj	10/3/19	10/11/19		100%
3.2	Module-2	Ashwin,Tanmay,Yuvraj	10/3/19	10/11/19	0	20%
3.3	Module-3	Ashwin,Tanmay,Yuvraj	10/3/19		0	5%
4	**Testing**					
4.1	Design of Test Cases				0	0%

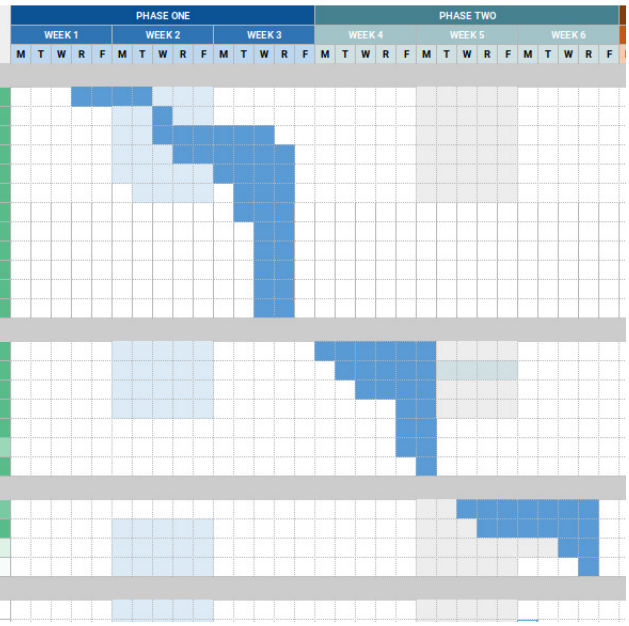

Figure 9.1: Gantt Chart

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We have great pleasure in presenting the report on **Autonomous Traffic Monitoring and Controlling.** We take this opportunity to express our sincere thanks towards our guide **Prof. Amol Kalugade** Department of Computer, APSIT Thane for providing the technical guidelines and suggestions regarding line of work. We would like to express our gratitude towards his constant encouragement, support and guidance through the development of project.

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Publication

Paper entitled **"Paper Title"** is presented at **"International Conference/Journal Name"** by **"Author Name".**