

**MOTOR TRAFFIC VIOLATION
MONITORING SYSTEM FOR
SRI LANKA POLICE**

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2019**



MOTOR TRAFFIC VIOLATION MONITORING SYSTEM FOR SRI LANKA POLICE

**A dissertation submitted for the Degree of Master of
Information Technology**

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Abstract

Sri Lanka citizens are still rooted in the traditional social attitude and hence they are not still properly adhering to the laws and regulations ordered by the government. Therefore, we require a way to get them to the correct path to make a better society with law-abiding citizens. Therefore, motor traffic violations monitoring considered an initial step to the way of making a better society. The increase of the vehicles increases the traffic and it increases the motor traffic violations. In Sri Lanka, there is no exactly effective system to monitor motor traffic violations, according to the lack of police officers and lack of funding for the development of such a system. Sri Lanka Police take various actions to reduce motor traffic violations. But it is very difficult for them to cover up the whole road system to track them. Therefore, drivers can make violations without indecisions. These behaviours increase road accidents, deaths or injuries to the pedestrians or motorists in Sri Lanka.

Hence, the relevant authorities are required the system to monitor motor traffic violations to identify the law-breaking citizens for taking legal actions. To overcome this issue, the Motor Traffic Violation Monitoring System (MTVMS) is introduced. The users can register to the system voluntarily bearing in mind as it is a voluntary service. This system has advanced facilities and able to upload live images and videos to the system, and they are used in the verification and validation process. Through that, motor traffic violators can be identified, and we can inform them about the violations. Then, they will know someone observing them while they are on the road, and they are then reluctant to do motor traffic violations.

This proposed system is consisting of five modules and they are user management module, case upload & manage module, case action & decision module, vehicle registration & fine value module and Report Module. This system is developed using Hypertext Mark-up Language (HTML), Hypertext Pre-processor (PHP), MySQL, Cascading Style Sheet (CSS), JavaScript, AJAX, JQuery.

This system will reduce road traffic violations and increase the passion of being a law-abiding citizen. This system is cost-effective and volunteer manpower plays a vital role. Further, the motor traffic law rules and regulations should be updated to get maximum benefits of this system for the betterment of society.

Declaration

The thesis is my original work and has not been submitted previously for a degree at this or any other university/institute.

To the best of my knowledge it does not contain any material published or written by another person, except as acknowledged in the text.

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This is to certify that this thesis is based on the work of Mr. RW Wedage under my supervision. The thesis has been prepared according to the format stipulated and is of acceptable standard.

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Supervisor Name:

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Date:

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1 Introduction

1.1 Introduction

Sri Lanka has 12,390.43 km lengthy road system all over the country [1]. They are express ways, class ‘A’ roads and Class ‘B’ roads and have different road conditions such as dry roads, wet roads, damp road, slippery road, etc. In road side, use road signs (Pedestrian Crossing, Traffic Signals ahead, No Parking, Left Hand Curve, etc.) and road lane signs (Solid White Lines, double white lines, dashed lines, etc.) to control the drivers’ behavior and to develop disciplines and ultimate goal is safety of the people. Road network as at 2016 is shown in Figure 1.1.

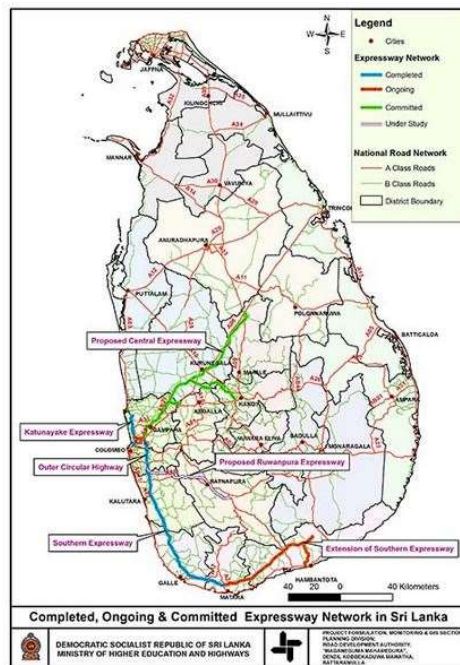


Figure 1.1: Road Network as at 2016 (Road Development Authority) [1]

According to the statistics of Ministry of Transport & Civil Aviation Sri Lanka in year 2017 vehicle population is around 7,247,122. Table 1.1 depicts the Vehicle Population. This increase of the vehicle population causes to the growth of road traffic in urban areas. Also, the development of new highways and the existing roads, increase the transportation of the vehicles on the road daily. Both above and the drivers’ attitude & knowledge on the road system causes to the breaking of motor traffic law and it became a violation. These violations are cause for the road accidents sometimes that ends with the loss of valuable human lives.

Table 1.1: Vehicle Population [1]

Year	2016	2017
Motor Cars	717,674	756,856
Motor Tricycle	1,115,987	1,139,524
Motor Cycles	3,699,630	4,044,010
Buses	104,104	107,435
Dual purpose	391,888	408,630
Motor Lorries	349,474	352,275
Long Vehicles	416,712	438,392
Total	6,795,469	7,247,122

To mitigate such violations, Traffic Police branch in Sri Lanka Police play the main role. Their main duties are as follows [2].

1. Enforce Traffic Laws, prevent violations of traffic regulations and prosecution of offenders
2. Investigate into accidents.
3. Control traffic on highways.
4. Provide pilot duties for VIPP
5. Assist the public in various social events and functions where motor traffic is involved.

As per the above duties, the followings are some serious violation factors that police is monitoring on the roads: Reckless and dangerous driving, excessive speeding especially in built-up areas, incorrect overtaking, disobeying road rules, turning without signals, not stopping before entering main road from a side road, failure to dip lights at night, parking illegally (e.g. near road bends causing dangerous obstructions), driving under the influence of liquor/drugs, noise pollution through tooting of horns excessively and driving without a license [2].

Police Department has less no of traffic police officers to cover up the whole road system to track and prosecute traffic violators. But, this amount of traffic police officers are not sufficient to cater the requirement of Sri Lanka Road system. Therefore, drivers are free to do traffic violations without hesitation.

Further, as a Developing country, Sri Lanka government is incapable of providing sufficient fund for the development of Traffic police. Therefore, it is required a cost-effective monitoring system to make a discipline & knowledgeable driver. This project is addressing the development of Road Traffic Violation Monitoring System. This is a cost-effective system and drivers play the main role on this system. This system has Web Portal, Database, Dash Cam with GPS & Wi-Fi and mobile application. When considering, myself as a registered user of this system, Violator always be the drivers who overtaking, drive in front of my vehicle or coming towards on the other side of the road. It implicates that always other drivers are the main target of this system. Otherwise, myself will be another drivers target. The ultimate goal of this proposed system is developing a discipline and knowledgeable drivers to increase the road safety and making of a better society.

1.2 Problem Domain

The Vehicle registration, road network and road accidents statistics give wide spectrum of the requirement of Road Traffic monitoring system in Sri Lanka due to lack of Police officers and government funding for the development of such system to prosecute the violators of Traffic Law. Presently, this duty is done by the traffic police officers and they are not sufficient for cover up total road network.

According to the above reasons, the people generally do motor traffic violations in Sri Lanka and some people know they have done a road traffic violation and others do not know that they have done motor traffic violation. The only way to track a motor traffic violator in Sri Lanka is by the police officers who stay side of the road and when they see a vehicle that doing traffic violation (double white line crossing, reckless driving, drunk driving, driving a vehicle without a valid license, violation of road rules and traffic signals, etc.) will be stop at the spot and make fines. This task is very difficult to police officers to do in 24/7 and due to that, lot of traffic violators stay free and make traffic violations day by day. Sometimes the drivers know the locations of the police officers who are staying on the road side for looking traffic violators by the signals informed by the passing drivers by flashing head lights of their vehicle.

Further, the existing society is not well disciplined and knowledgeable and difficult to guide them to a better society. Hence, this system will provide information with evidence to authorized personals to take relevant legal actions to the way of making a better society.

1.3 Motivation for the project

To overcome the above problem, we required a proper mechanism to track motor traffic violators and get them to take Legal action to increase the safety of the themselves and the other people in effectively and efficiently. This system will reduce the time wasting of police officers and make good drivers. The ultimate goal of this proposed system is developing a discipline and knowledgeable drivers to increase the road safety. This will transform existing society to a discipline and knowledgeable better society.

1.4 Aims and Objectives of the proposed system

The main objective is to develop a Road Traffic Violation Monitoring System (RTVMS) to reduce the road traffic violations and increase the safety of the people for better society. Followings are the objectives.

- **Develop a database to store the information of users/cases/vehicle/ fine Data.**
This database has the information (Name, Address, Contact No, ID No, etc.) of the registered users of this system. Also this has traffic violation case information (Case id, Case type, Vehicle type, Vehicle No, image, video, etc.) and vehicle & fine information (vehicle no, owner, address).

- **Develop monitoring system and uploading violation scenario (image, video).**
This system is able to give facility for uploading images and videos to the RTVM system and will identify the number plate of the vehicle. Driver Can see the other vehicle traffic violation & they can upload it. But Driver cannot see his/her vehicle traffic violation.
- **Traffic violation identification and instructions.**
Database has some categories of violations related to the Motor traffic and able to analyze the received data to make instructions for further process. After analyzing, the system will send information to authorized personals to get necessary actions against traffic violators.
- **Generating Email and SMS notifications.**
This notification system sends SMS/ Email to the users who upload a MTV case and after violation identification and the instructions will be forwarded via SMS/email to the monitoring officer.

1.5 Scope of the project

This proposed system is focus on Sri Lankan Peoples attitude on adhering to the laws of Motor Traffic by addressing a mechanism to relevant authorities to take precautions (eg. punish, prosecute, etc.) as well as authorized personals to take decisions/ action to the people who have done motor traffic violations day to day. The drivers are the main role of the proposed system.

This system has mainly four parts, user enrollment, online monitoring systems and uploading violation scenario, traffic violation identifications and instructions, generating SMS and email notification.

User Enrollment:

The drivers are the key stake holders of the system. They are the people who drive on the roads and they visualize the motor traffic violators via dash board camera. First, they have to register in the system via web page or using mobile phone. Once they wanted to register, there is a register form with primary details (Name, Address, ID No, Driving, Photo) and further guest user should enter his/her Mobile No. and Email address. This Mobile No. and Email address is use to verify the details who is submitted are accurate.

Online monitoring and uploading violations:

Once the driver seen a traffic violation, he/she has to take that video/images to his phone from dash cam and need to upload this video/images to the system by their login. The system will give actual vehicle image and uploaded image in one location to identify the vehicle number on the number plate and authorized member able to identify the reality. Further, the uploaded video is displayed at the same location to further clarification.

Traffic violation identifications and instructions:

This module has selected pre-inserted categories of traffic violations that available in police department. Once the violation is uploaded to the system, it will identify the type of the violation

and category them to further actions, then system will generate the action which is required to be taken and forward this to relevant officers.

Ex: At least one vehicle number should receive from different driver in three times to take further actions. Otherwise the drivers use this to harass their enemies.

Generating SMS and email notification

Above three modules have SMS and email notifications. Once the driver registered to the system, they will notify by “You are now registered”. When this registered driver uploads a violation it will be also informed. Finally, further instructions to be taken are informed by the SMS/email.

This Database is centralized, and all the relevant module details are stored in the database and relevant authorities can access to the system and able to retrieve required data.

A. *User requirement*

This system mainly has three types of users,

- Administrator
- Monitoring officers (Police officers)
- Normal users (Drivers) or other person who is in the vehicle.

Administrator has the full privilege of the system and installation, maintenance, monitoring and development are the key attributes of him/her. Monitoring officer is the user that read the data received and take relevant actions with relevant authorities.

Drivers are the key stake holders of the systems. This system is depending on the data posted by the drivers. Otherwise this system is not successful. The drivers who wish to provide relevant road traffic violation should register to the systems providing his/ her personal details. Systems architecture is shown in Figure 1.2.

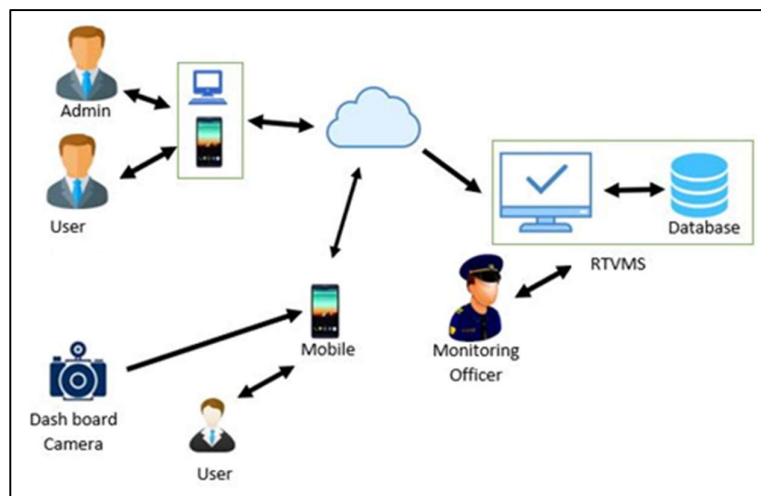


Figure 1.2: Systems Architecture

B. *System requirement*

The system requirement is concerned with the study of the available Motor Traffic violations systems and all systems are concern with the vehicle detection & tracking for traffic monitoring and vehicle traffic violation alert & management. More than that, this application is for identify the Motor traffic violations via peoples who are on the road. Hence, this application has mainly Four parts,

- Web Portal
- Database
- Vehicle Dash Board Camera with GPS module
- Mobile Device

All are interconnected except vehicle Dash Board Camera with GPS facility. GPS provide location tag on the video/ image. It is a standalone device and it should be able to access via mobile phone to capture the required image/video.

2. Background

2.1 Introduction

This chapter describe the existing systems that relevant to the Road traffic Monitoring systems in the world wide. Primary components of the traffic systems are, [3]

1. Road users (drivers, pedestrians, bicyclists, and passengers)
2. Vehicles: private and commercial
3. Streets and highways
4. Traffic control devices
5. The General environment.

There are different Road traffic monitoring systems developed based on the above components, designer perspective and the available technology. Traffic monitoring is the important element of the smart transportation system. Some systems are developed to monitor the motor traffic and controlling the traffic signals & the traffic control devices. Some systems are developed for vehicles, that give warnings and control the vehicle based on the characteristics and behavior of the vehicle. Further, CCTV footages are used to capture road traffic violations. In Sri Lanka, the police officers have to stay on the road to capture the traffic violators and it is very difficult task to them and traffic violators get more room to do traffic violation. Due to this, we required to develop more efficient and effective systems to capture traffic violators and reduce traffic violations with the help drivers to create lawful citizens.

2.2 Literature Review on the Present systems

All the systems available in the world are based on the motor traffic monitoring. They are using sensors and behavior of the environment to decide the motor traffic level. According to this techniques and mechanism it will control the traffic signals and the traffic control devices. Followings are the some referred and available systems relevant to motor traffic monitoring.

1. Global Vehicle Traffic Monitoring System (GVTMS) is an unprecedented proactive monitoring systems and it helps to control traffic infractions, avoid traffic accidents, proactively detect potentially dangerous drivers. Also it can recreate offline traffic-accident scenarios for the legal process. It is similar to the black box in an airplane and it collect GPS and record information. Once the vehicle stops at an intersection or refuels, the device uploads the information to a database or main network. Once this process is concluded, the internal memory can be deleted. The data is then analyzed and scanned for predefined patterns of driving behavior, or proximity in time and position to known traffic accidents and other irregular events. Applied nationwide, GVTMS could potentially encourage drivers to avoid speed infractions: It automatically detects traffic infractions and collects data on abnormal vehicle behavior that can be statistically related to alcohol, drugs,

dangerous driving, etc. Expected benefits are improving roadway security and congestion, and at the end of the day GVTMS will save lives. [4]

2. Another proposed system is using Charge Couple device (CCD) camera at the rear of the vehicle to view span of the camera. CCD (couple-charged device) cameras are a type of image capture device that utilize an image sensor to register visible light as an electronic signal. These types of cameras do not use photochemical film to capture stills or video. The timing of the traffic light can be adaptively adjusted according to the estimated traffic flow which is based on the video sequence captured by the camera in its span on the road, where the gaps between the vehicles are used to determine the density of vehicles appearing in the camera span. This method enables to implement a simple but efficient traffic flow control especially in crossroad context compared to other convenient methods. [5]

3. The other proposed systems is a real time traffic monitoring application. It is based on the object detection and tracking. It get the traffic parameters like vehicle velocity and no of vehicles drive on the road. In detection stage background modeling approach based on edge information is proposed for separating moving foreground objects from the background. An advantage of edge is more robust to lighting changes in outdoor environments and requires significantly less computing resource. In tracking step, optical flow Lucas-Kanade (Pyramid) is applied to track each segmented object. The proposed system was evaluated on six video sequences recorded in various daytime environment. [6]

4. Further, a real-time vehicular traffic violation detection system is in real demand. In this paper, they design and implement a real-time vehicular traffic violation detection system. Their system proposes a detection algorithm which can discover various types of violations taking place on the roadways as well as in the parking lots. In order to achieve real-time analysis, parallel computing techniques are used in our implementation. An optimization scheme as well as a well-design data structure is proposed to improve the performance of the parallel implementation. Both real data and synthetic data are applied in this experiments. Experimental results demonstrate that their proposed system can discover all the violations from the high-throughput traffic monitoring stream in real-time. Good scalability on multiple threads is also shown in the experimental results. [7]

5. The presented system is embedded inside the vehicle to provide surveillance of traffic violation. Driver is penalized for his offences at nearest checkpoint, so system enforces people to obey traffic regulations. The designed system mainly focuses two parameters of four wheelers i.e. seat belt and over speed. Firstly, the detection of over speed, and location of vehicle has been determined via GPS, and the measured speed is then compared to the set speed limit. In seat belt detection, seat occupancy is detected first. If seat is occupied only then fastening of seat belt is detected. The system monitors both the conditions continually, if the driver violates either or both norms, a short warning will flash inside the vehicle. After prescribed warning, if the driver continues the offence, a challan for that offence is generated; details of the vehicle and type of offence is uploaded to police database. [8]

6. The paper proposes a method, which utilizes mobile devices (smartphones) and Bluetooth beacons, to detect passing vehicles and recognize their classes. The traffic monitoring tasks are performed by analyzing strength of radio signal received by mobile devices from beacons that are placed on opposite sides of a road. This approach is suitable for crowd sourcing applications aimed at reducing travel time, congestion, and emissions. Advantages of the introduced method were demonstrated during experimental evaluation in real-traffic conditions. Results of the experimental evaluation confirm that the proposed solution is effective in detecting three classes of vehicles (personal cars, semitrucks, and trucks). Extensive experiments were conducted to test different classification approaches and data aggregation methods. [9]

7. The aim of this work is to evaluate a vehicle tracking scheme as a means of monitoring traffic on roads. The scheme can be used as a component in a traffic monitoring system which can provide traffic management systems and road maintainers with traffic information. Vehicle tracking is achieved by determining vehicle position, velocity and magnetic moment using a nonlinear weighted least squares method (*NWLS*) on readings from two 3-axes magnetic sensors. The tracking was performed both in simulation and in real life. The traffic monitoring system is composed of two adjacently glue attached wireless sensor nodes, which are placed at a distance of 1 m along the road. A potential misalignment of the sensors due to placement errors is analyzed in simulation and addressed. [10]

8. TrafficVision Application is designed to automate highway traffic monitoring. TrafficVision software turns any traffic monitoring camera into an intelligent sensor. Specifically built for Intelligent Transportation Systems (ITS), TrafficVision monitors digitally encoded video streams of traffic cameras on highways to immediately detect incidents and continuously collect real-time traffic data. Using existing camera infrastructure, TrafficVision helps traffic managers make proactive decisions based on immediate incident alerts that are visually verifiable, providing more information about what is happening on highways, bridges and tunnels. TrafficVision helps organizations get more use out of their ITS investment, leveraging both existing and new video assets. By providing the information needed to reduce the impact of incidents and recurring congestion on highways, TrafficVision helps traffic managers provide safer and more efficient travel for the public. It gives following benefits. [11]

9. Police Eyes is a mobile, real-time traffic surveillance system we have developed to enable automatic detection of traffic violations. Police Eyes would be useful to police for enforcing traffic laws and would also increase compliance with traffic laws even in the absence of police. The system detects illegal crossings of solid lines using image processing and efficient computer vision techniques on image sequences acquired from IP cameras. The automatic solid line crossing detection system can be used at locations where the traffic violations are notoriously high and are known to create traffic congestion and avoidable accidents. The system can be installed on an embankment, at an intersection area, at a lane change restriction area, at a no parking area or anywhere there is an observed pattern of drivers intentionally violating traffic laws. We have installed the system in an industrial grade embedded PC and deployed it in a police mannequin.

Results of an empirical field evaluation show that the system performs well in a variety of real-world traffic scenes. [12]

Sri Lanka Police use Surveillance Camera System and mobile vehicle that fixed with CCTV camera to monitor road traffic and violations occurred. [2]

DMT (Department of Motor Traffic) introduce RFID (Radio Frequency Identification) Technology to identify traffic congestions and to manage the traffic condition in the Roads for Traffic Management. By the help of RFID technology, vehicles are connected to computerized systems, intelligent light poles and other available hardware along the way. In this project, intelligent control system is capable of tracking all vehicles, crisis management and control, traffic guidance and recording Driving offences along the highway. [13]

When go through the all above mentioned researches and applications, all the systems are based on as following Table 2.1.

Table 2.1: Summary of Researches and applications

	Types of researches and applications	Using Device	Targeted Result
1	Global Vehicle Traffic Monitoring System (GVTMS)	Sensors (GPS),	Traffic infractions (Speed), Abnormal Vehicle behavior
2	Charge Couple device (CCD) camera at the rear of the vehicle	Sensor (image)	Density of Vehicles
3	Real time traffic monitoring application	Sensors (velocity)	Vehicle Velocity, No. of Vehicles
4	Real time vehicular traffic violation detection system	Sensors	
5	Embedded system in vehicle	Sensors (GPS)	Seat Belt status, overspeed
6	Mobile devices (smartphones) and Bluetooth beacons	Sensors	Vehicle type and class
7	Vehicle tracking scheme	Sensors	vehicle position, velocity and magnetic moment
7	Traffic Vision Application	Sensor (image)	Detect incidents
8	Police Eye	Sensors (image)	Line Crossing

Main source of the systems are sensors (image, velocity, magnetic, GPS, etc.) and some parameters and techniques are used to develop these systems. Without them it is difficult to make decision on the motor traffic. Other thing is these sensors are to be placed on road side or on the vehicle.

Followings are some draw backs of the using sensors on road side and in the vehicle,

Placed sensors in road side,

1. Sensors can't locate in every road side. The Sri Lankan roads are in different conditions and very difficult to locate devices in all road sides.
2. Sensors are expensive.
3. Difficult to protect sensor devices. Otherwise the people will steal these devices.

Placed sensors in vehicle,

1. In Sri Lanka we have vehicles with different manufacturing years. (Toyota DX wagon – 1984, Toyota Prius – 2017). Therefore, very difficult to place sensors on old vehicles according to structure and technology.
2. People need extra money to install sensors.

Further, these all systems are targeting motor traffic monitoring on specified locations (eg: highways,). They are not mainly targeting on the motor traffic violation detection.

2.3 Importance of The Study

Above all researches and applications are considering sensors and some parameters. If drivers know the motor traffic laws and regulation, they can drive carefully. But they are also sometimes break the law due to lack of proper mechanism to capture traffic violators. The driver involvement is not fully happening on this system and it will not give support to develop a law-abiding drivers. So in Sri Lanka it is very difficult to implement such system due to lack of technology and people awareness on this kind of systems. Also very difficult to teach them how to drive on road carefully and safely.

Therefore, I suggested that it is necessary to get support of drivers to make efficient and effective system. Then the drivers with right attitude will actively involve this and their strength will make this system success. Directly they will notify the motor traffic violators and indirectly they are also be witnessed by another driver. Then everybody who enroll this system will not be willing to make motor traffic violations. This will create their own self attitude on to be a lawful citizen.

3. Methodology

3.1 Introduction

This Chapter give an overview of the system that we used to analysis & design and implementation. The main process of this phase includes domain understanding, requirement gathering, clarification, structuring, prioritization and validation. Appropriate methods and processes were carried out at this chapter and describe functional, non -functional requirement for the development of the system.

3.2 Requirement Gathering

The main approaches using for the requirement gathering process were interview, observation, document review and studying of relevant scenarios. In interview process, police officers were interviewed and identify the motor traffic violation scenarios and fine values that charge for motor traffic violations. This values are change time by time and according to that the system need to be updated.

Rather than that, observe social media (youtube, facebook) videos and facebook pages and newspapers articles relevant to motor traffic violations to gather information.

Eg: Traffic Violations – Sri Lanka (facebook)
Sri Lankan Traffic Violations (facebook)
Sri Lanka Traffic Violations Community (facebook)

Relevant research papers, documents and existing systems were analyzed and studied to identify the new way of having this type of motor traffic violations monitoring system. This gathered facts were represented using use case diagrams and description for each module to get clear picture from the requirement gathering.

3.3 Analyzing the Current manual System

Following steps are the existing motor traffic violators identifying mechanism in Sri Lanka.

1. Traffic Police officers were staying at the road side and when the traffic violation occurred, the violated vehicle stopped.
2. Take the Driving license and check Revenue license & insurance of the vehicle.
3. Then provide Fines in lieu of Prosecution form to the Driver and keep license with police officers. (14 Days and another 14 days with surcharge was provided to pay the fine value)
4. The fine payment have to be done at any Post office and the payment receipt should be produced at the relevant police station to get the Driving License Back.

This mechanism is exhausting and time consuming effort to the both Police officers and Drivers. Relevant Use case diagram is shown as Figure 3.1.

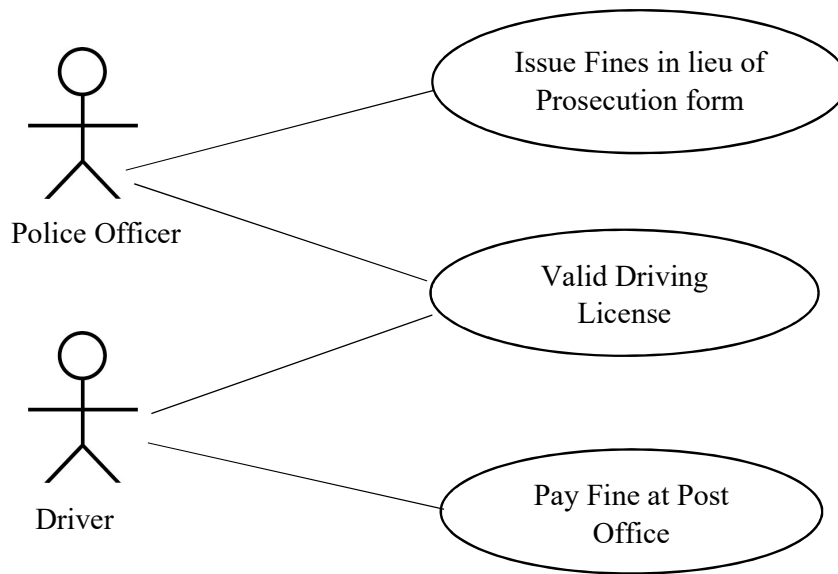


Figure 3.1: High level use case diagram for existing manual system

3.4 Proposed Solution to the Existing manual System

Propose system address following existing manual system shown in Table 3.1.

Table 3.1: Existing System and propose solution

Problem	Propose Solution
Need Police officer to capture the traffic violator	Upload cases (images. Videos) can be used
Cannot identify violation type after incident happens	Can use images/videos to identify the violation and confirmation.
Actual vehicle registration couldn't see on the spot	System will give full detail and able to compare with uploaded traffic violation cases
Not be able to capture violators except on the spot	Able to prosecute violators considering images/ videos uploaded
Not be able identify the drivers behavior	Able to identify the drivers behaviors and can change traffic laws according to that and easy to forecast

3.5 Requirement of the Proposed system

3.5.1 Functional Requirement

Functional requirement expresses the required behavior of the system to be built or what the system supposed to do. Below listed are the main functional requirement of the propose system.

- User Registration with proper information
- Login directed to relevant session considering user type.
- Ability to upload a case event with images and videos
- Ability to view full case with vehicle registration and fine value.
- Ability to maintain Vehicle Registration.
- Ability to maintain Fine value.
- Ability to take actions (send notification, review, not completed) to the cases.
- According to the action, send notification via email, post or sms.
- Download reports with different selections.
- Send Notification.

3.5.2 Non-Functional Requirement

Non-functional requirements are the requirements which are not directly affected with the exact basic functions delivered by the system. But, failing to meet non- functional system requirements may make the whole system unusable. Non-functional requirements are relevant with quality attributes, quality of service requirements and non-behavioral requirements. The non-functional requirements of the system are listed below.

- The system should provide a user-friendly environment including good interactive interfaces.
- The system should mobile responsive, because most of the users are login from mobile device.
- Person with average computer skills can work with the system with a short period of training.
- The system should be accurate and consistent, when manipulating the fed data in proper way and displaying correct information.
- The system should keep up security and reliability, because the system handles important data related to legal aspect.
- Daily, weekly, monthly and yearly data should be backup and keep in safe
- The system should be reusable and maintainable.
- This system should be able to update & upgrade and able to adopt future implementations to the system.

3.6 Design Techniques

Design techniques are used to model the system and Object oriented design technique was chosen from them because of code reusable and recycling facility, design benefits and maintainable facilities with Objects and classes.

- Use-Case diagrams with some narratives – shows what the system needs to do.
- Activity diagrams – shows object flow one activity to another.

3.7 Propose System Design

Diagram in Figure 3.2 and Figure 3.3 depicts the Use-Cases of the Normal User and Administrator of the proposed system. Description of Diagrams are shown in Table 3.2 and Table 3.3.

Actor : Normal User (Registered User)

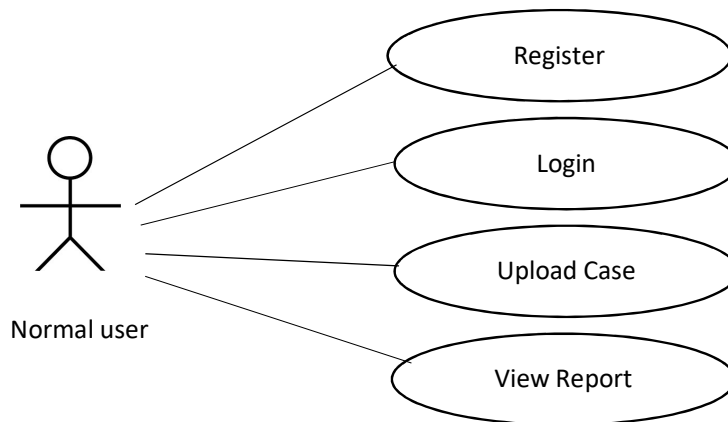


Figure 3.2: Normal user use case.

Use case description

Table 3.2: Normal user use case description

Use Case	Description
Register	User must be register with the system to login
Login	When user registered he/she will have username and password. Then he log into relevant home page
Upload Case	User able to upload case with images/videos
View Report	User able to see only his/her uploaded cases only

Actor: Administrator

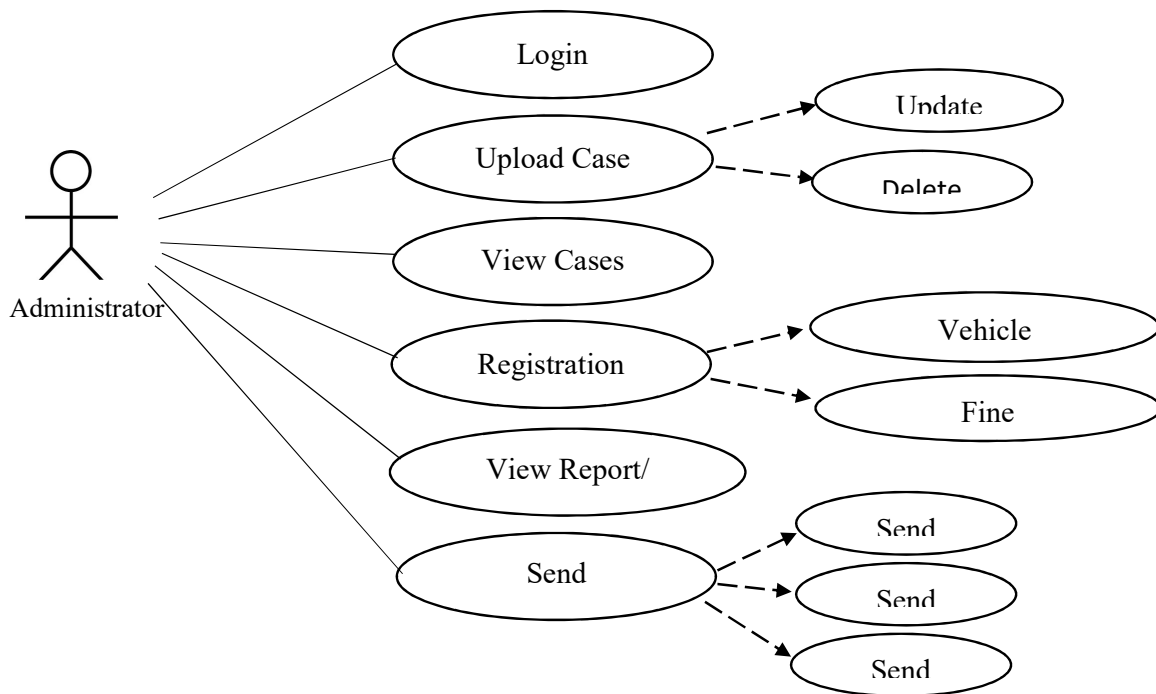


Figure 3.3: Administrator use case

Use case description

Table 3.3: Administrator use case description

Use Case	Description
Login	Log with relevant username and password, direct to admin pages
Upload Case	Admin able to upload case with images/videos and also able to update & Delete cases.
View Cases	Able to see upload cases with more details
Registration	Vehicle Registration and Fine Registration (similar to system runs in remote locations)
View Report	Able to see report with more details and able to view graphs
Send Notification	Send email message when upload case and after make decision on case send letter to the violator.

This system is created to the users to bring out their responsibilities effectively and efficiently by reducing the manual human effort and by generating reports, able to take decisions on time. This system is based on the attitude of the users and some instructions and procedures were used to make this system very effective. It has been separated into few modules in order to make the development easier.

1. User Management Module

This module is considered mainly on user creation and user type management. Users can create usernames with their own way and email verification is use to verify the reliability of the user. There are mainly three (03) types of users.

- i. Administrator
- ii. Monitoring officer
- iii. Normal Users (Drivers)

Normal users have less privileges and they are able to upload case and view Report on their uploaded cases. Administrator and Monitoring officer have administrative privileges (e.g.: search case, case action & decision vehicle registration & Fine value registration and report generation privileges.)

User types are created at the database and when the user login, the relevant allocated privilege page will display/.

2. Case Upload and manage module.

This module is concern on the case uploading procedures. It has case id, username, date, time, location, vehicle type, vehicle no, case type attributes and users are able to upload images and videos of the events that happens. Normal users are only able to upload case and other update, delete features are not available. The reason is, this system is based on the making drivers attitude to be a good driver and if user wants to change it, then this system will fail. The user who upload cases should required to read instructions and information before upload a event. From this manner this system will be success.

Administrative users are able to upload, delete, update events and they have all privileges to work with events.

3. Case Action and Decision module

This module is only available to the administrative users and they are able to read actions in different levels and able to make decisions on this event. To make a decision at least three (03) cases should be updated in the system from same vehicle no and the cases should be from three (03) different users. This will give idea on the behavior of the vehicle owner and able to get decision effectively. This decision can be justified and able to prove it successfully.

4. Vehicle Registration and Fine value module

This module has vehicle registration and fine value registration. These registrations are will be the external system integration to MTVMS. Vehicle registration system have vehicle data

and this part simulate the Motor traffic department system. Fine value registration have fine data and this part simulate the Police department traffic fine system.

5. Report Module

This module is able to create reports and graphs according to the requirement and they are useful to analyze the system and the case events. This module is only available to the administrative users. Table 3.4 depicts the user type and their permitted module of the system.

Table 3.4: User Type and permitted Modules

Module \ User Type	Normal User	Administrative User
User Management	✓ (partially)	✓
Case Upload and Manage	✓ (partially)	✓
Case Action and Decision	✗	✓
Vehicle Registration and Fine value	✗	✓
Report	✓ (partially)	✓

3.8 Database Design

Database design is the organization of data according to a database model. It helps to meet the requirement of users and produce high performance. Database design produce physical and logical design models. Two types of database techniques are used and they are Normalization and ER modelling. The database tables were normalized to 3rd normal form to avoid redundancies.

ER diagrams for user login, upload case & action and upload case & vehicle are shown in Figure 3.4, 3.5 and 3.6. Refer appendix A for detailed description of the database ER diagrams.

User login

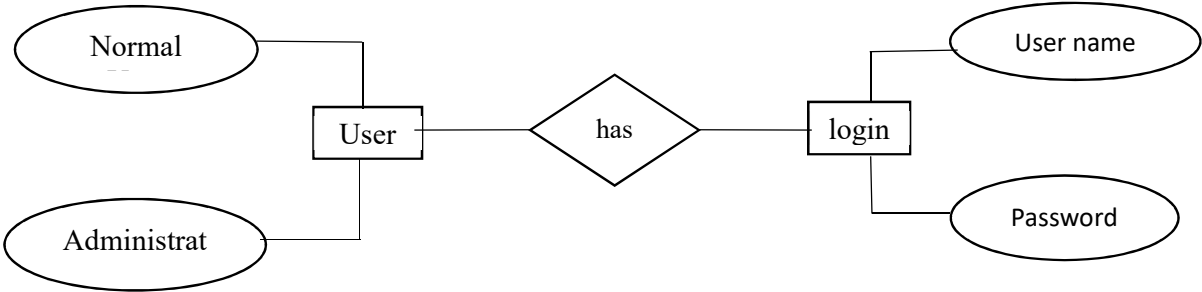


Figure 3.4: ER diagram for User Login

Upload case & action

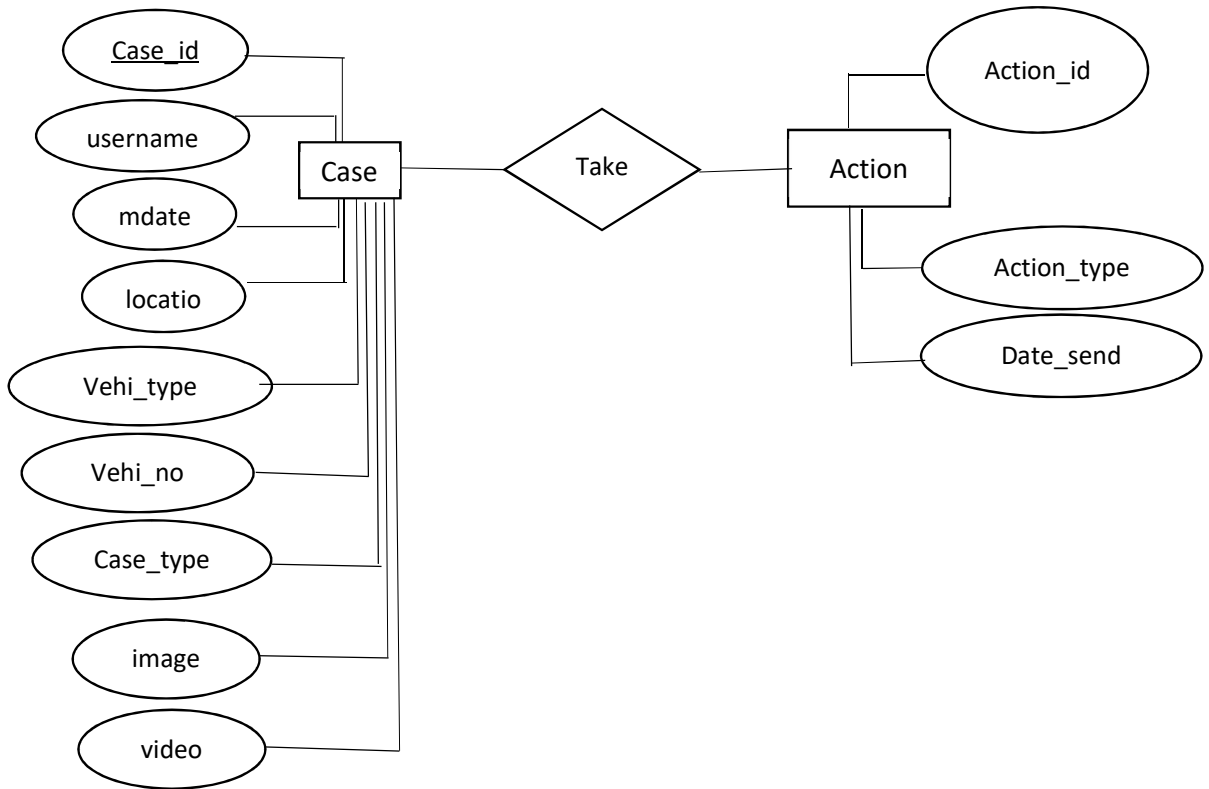


Figure 3.5: Entity Relationship diagram for upload case and action

Upload case & vehicle

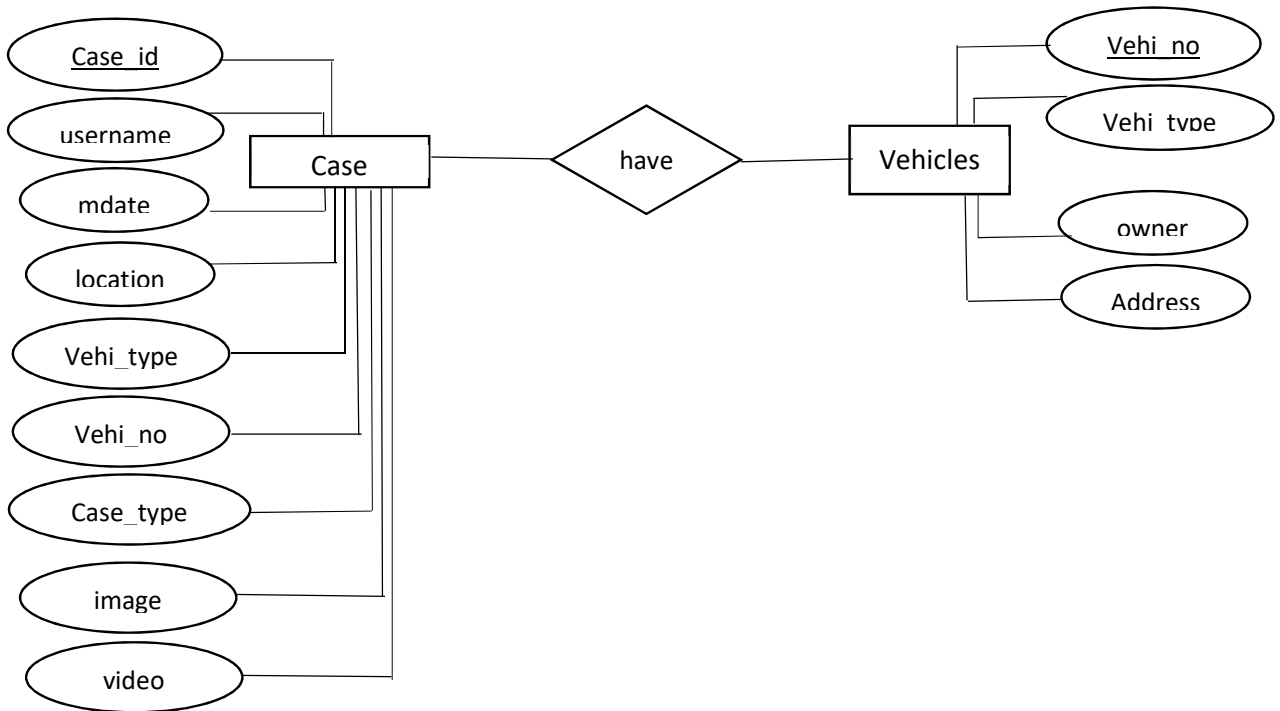


Figure 3.6: Entity Relationship diagram for upload case and vehicle

3.9 Activity Diagram of the System

The following diagram covers the activities from upload case to response of the identified traffic violator. Activity diagram of the system is shown in Figure 3.7.

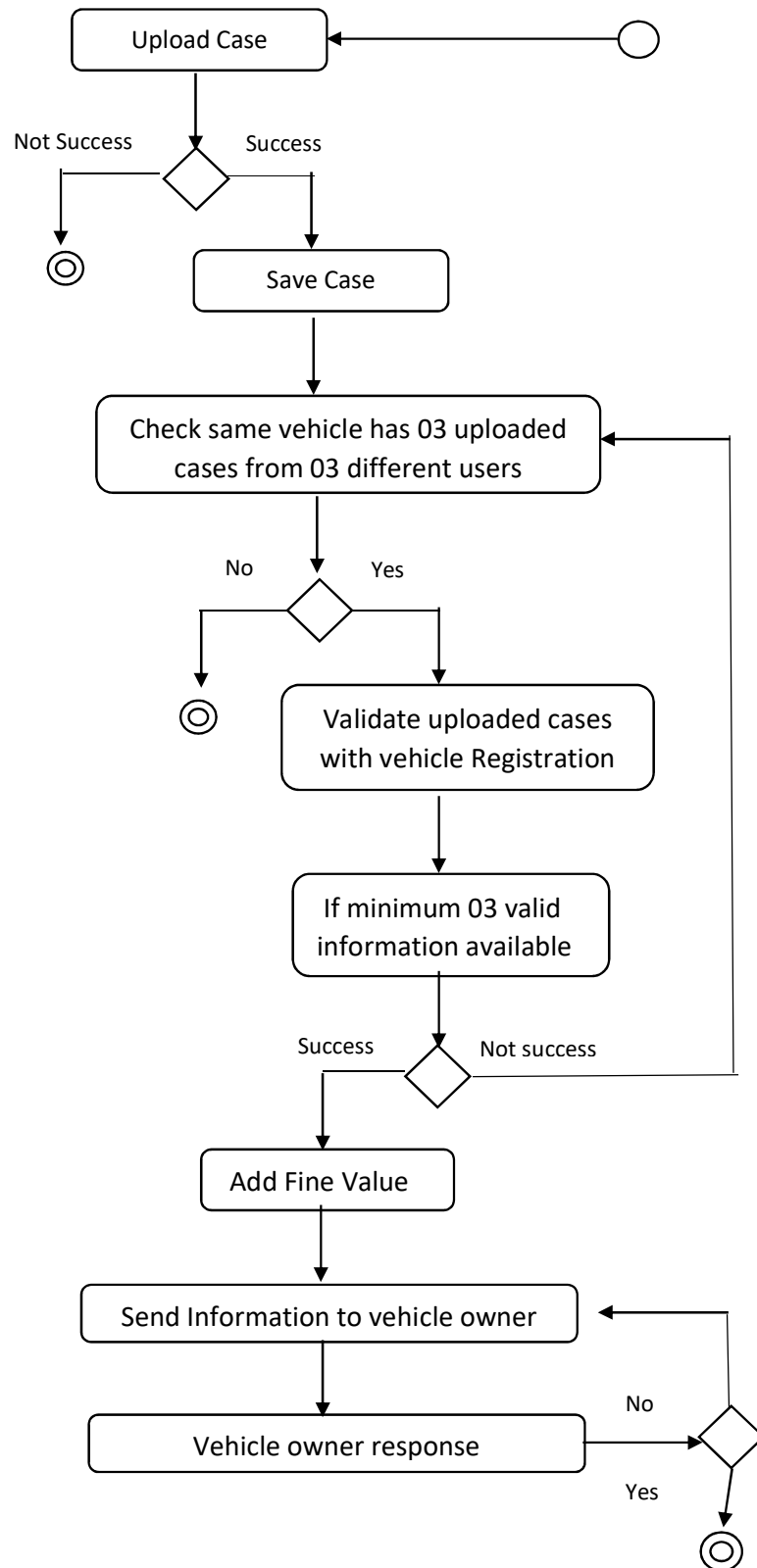


Figure 3.7: Activity Diagram of the system

3.10 User Interface Design

User interface is the primary and very first interaction with user and system. So it should interactive to user. User Interface (UI) Design focuses on what users expecting through system and ensuring that the interface has fundamental facilities which are easy to understand, access and use. There are some properties that user interface must have,

- Avoid unnecessary elements and keep interface simple,
- Purposefully use colour and texture: make direct attention toward or redirect attention away from items using colour, texture, contrast.
- Use auto select options as well as let the users select options for better flexibility.
- Use common UI elements and build consistency: By using more comfortable common elements, for users and able to get things done fast.
- Use typography to create hierarchy and clarity: Different sizes, fonts, and arrangement of the text to help increase scalability, legibility and readability.

3.11 Implementation Environment

Server-side environment and client-side environment were considered in implementation process. These environment requirements basically divide in to software requirements and hardware requirements. These requirements are described below.

3.11.1 Server Environment

System hosted location and client server architecture operators are considering in this environment. Server environment is used to host developed system, which can handle all the data processing activities. Server should be an upper range server with following main requirement. Server specification is shown in Table 3.5.

Table 3.5: Server Specification

	Specification	Minimum Requirement
01	Processor	Intel Xeon processor
02	RAM	Above 16 GB
03	HDD	2TB * 3
04	RAID	RAID 5 should support

Uploading case has image file and video file and this file size vary and it should be less than 50 MB.

If 20 cases are uploaded the HDD space is = $50 \text{ MB} * 20 = 1000\text{MB} \sim$ to 1GB

Therefore, higher HDD capacity should be required. When the system runs live, the capacity can be change.

3.11.2 Client environment

Client software run in between the user and server be responsible for a user interface for user to cooperate with the server. Web browsers (eg: Internet Explorer, Google Chrome, Firefox, etc..) act as client software. Updated web browsers should use to avoid browser compatible issues. This system is responsive and users with laptops, mobile, tabs, etc. will be able to access the system.

3.12 Tools & Technologies

Following tools and technologies were used to develop the system.

- PHP - PHP programming language to store and retrieve data from the MySQL database
- HTML -HTML was used to build the base Interfaces of the system
- CSS - CSS Styles was used to make interfaces more user friendly and attractive. Styles basically decided the look of the system.
- JavaScript- JavaScript was used to code all the client-side validation.
- AJAX - Which is based on JavaScript was used to get data from the server without refreshing it repetitively.
- JQuery - Which is also based on JavaScript was used to implement some features such as the pre-coded time picker module, Google Map.
- Adobe Photoshop - Used for photo edit
- Notepad ++ - Used for code editing

3.13 Main User Interfaces

User interfaces are the link between the user and the system and without proper interaction the system will fail. Following figures are some main user interfaces that created on system.

Main Page

The main page has login and instructions for the users to use this system with responsible manner. They have to read the instructions and information to be a part of this system and advise them how to use system in proper way. Login is able to give access to the valid user. Online cases uploaded, no of registered vehicle, cases solved are displayed on slider and this will give the good impression of the system and motivation to the system users. Main Page is shown in Figure 3.8.

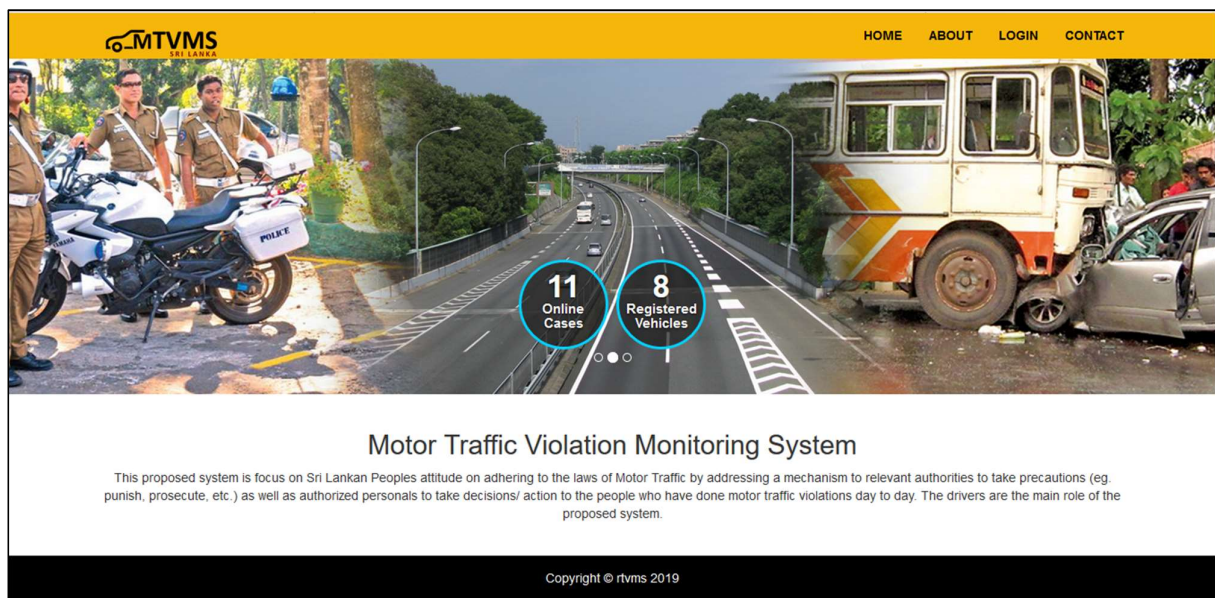


Figure 3.8: Main page user interface

Case Upload Page

This page is the main input page of the system. Once the user login to the system, the case id will be auto incrementally appearing and username will be displayed. Then user have to insert relevant data (Date, Time, Location, Vehicle Type, Vehicle No, Case type, Remarks) and able to upload relevant capture image and video. Case upload page is shown in Figure 3.9.

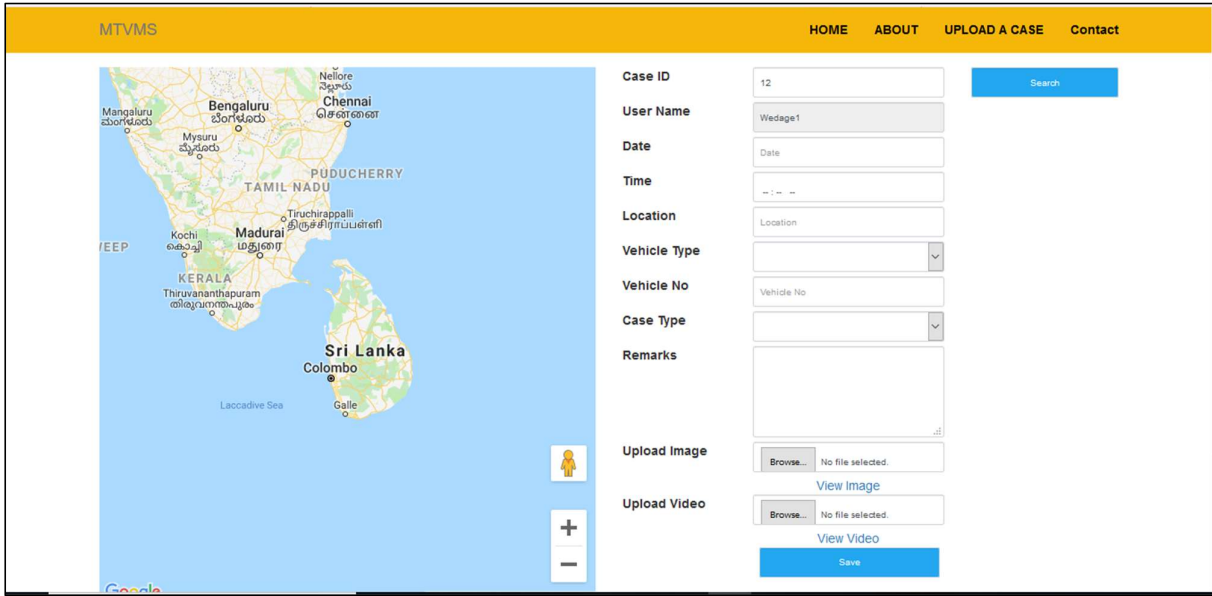


Figure 3.9: Case upload page user interface

View Case Page

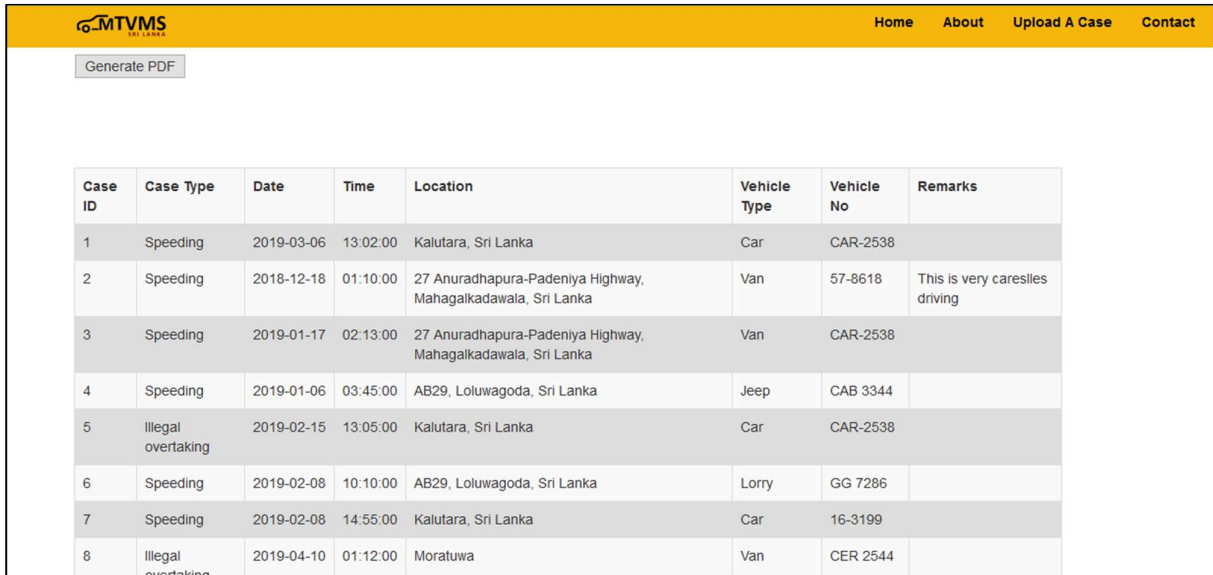
This view case page is able to give view uploaded cases by selecting different categories (case type, date, vehicle no, Action taken). View link in this page will display full upload case details with other system details (vehicle registration). View case page is shown in Figure 3.10.

Vehicle No	Username	Case ID	Case Type	Date	Time	Location	Vehicle Type	Action Taken		
CAR-2538	rajitha	1	Speeding	2019-03-06	13:02:00	Kalutara, Sri Lanka	Car	-Not Taken-	VIEW	SAVE
CAR-2538	rajitha	3	Speeding	2019-01-17	02:13:00	27 Anuradhapura-Padeniya Highway, Mahagalkadawala, Sri Lanka	Van	-Not Taken-	VIEW	SAVE
CAR-2538	rajitha	5	Illegal overtaking	2019-02-15	13:05:00	Kalutara, Sri Lanka	Car	-Not Taken-	VIEW	SAVE

Figure 3.10: View case page user interface

Report view

This view has report view features and able to view relevant report and able to take PDF document. Report view page is shown in Figure 3.11.



Case ID	Case Type	Date	Time	Location	Vehicle Type	Vehicle No	Remarks
1	Speeding	2019-03-06	13:02:00	Kalutara, Sri Lanka	Car	CAR-2538	
2	Speeding	2018-12-18	01:10:00	27 Anuradhapura-Padeniya Highway, Mahagalkadawala, Sri Lanka	Van	57-8618	This is very caresles driving
3	Speeding	2019-01-17	02:13:00	27 Anuradhapura-Padeniya Highway, Mahagalkadawala, Sri Lanka	Van	CAR-2538	
4	Speeding	2019-01-06	03:45:00	AB29, Loluwagoda, Sri Lanka	Jeep	CAB 3344	
5	Illegal overtaking	2019-02-15	13:05:00	Kalutara, Sri Lanka	Car	CAR-2538	
6	Speeding	2019-02-08	10:10:00	AB29, Loluwagoda, Sri Lanka	Lorry	GG 7286	
7	Speeding	2019-02-08	14:55:00	Kalutara, Sri Lanka	Car	16-3199	
8	Illegal overtaking	2019-04-10	01:12:00	Moratuwa	Van	CER 2544	

Figure 3.11: Report view user interface

4. Evaluation

4.1 Introduction

This chapter give an overview on the developed software testing process. Software testing is a critical component of software quality assurance that represents the ultimate analysis of specification, design, and code generation of software product. This software testing has testing procedures and these testing practices, process and techniques used to ensure that the software is tested and validated before deployment. The testing method is basically combined with Verification and Validation. Validation refers to testing whether the system satisfies the requirements while verification refers to whether the system implements the specified functions properly. Basic goals of test evaluation are determining whether the system outcome is in acceptable level with the requirement of end user. We discuss on the Testing procedures, Test plan, Test Cases and results.

4.2 Testing Procedure

Software testing and implementation are iterative processes. Most of the time both stages work as simultaneous system components. The testing procedures were started in the requirement phase of the SDLC. The propose system was tested while the development was ongoing.

Testing Procedures were done in Software Planning Phase, Software Construction Phase and Software testing phase. Software test plan and Software Test cases are created at the Software test planning phase. Building of Test Cases and Test scenario planning were done at the Software construction phase. Test reporting was done at the Software testing phase.

4.3 Test Plan and Test Cases

Test plan describe software testing scope and activities. Testing begins with the implementation, code is reviewed while developing stage for testing. Test plan included all phases of testing and also used as a guide for the overall testing process. Before the system implementation, the test plan was designed. A test plan includes: the scope, approach, resources and schedule of intended **test** activities.

Test cases were created according to the designed test plan. That contains data, actions, procedure, and expected result and represents which use to system or part of the system run. The status will give the validity of the process and the module. To reduce complexity of the testing process test cases were designed for each module independently. The login module, upload case module, view case module, vehicle registration module and report modules are shown in Table 4.1, Table 4.2, Table 4.3, Table 4.4 and Table 4.5 respectively.

4.3.1 Login Module

Table 4.1: Login Module test case

Test case Id	01		
Tested component	Login		
Module Name	Login Module		
Test case	Login screen		
Expected Output	User friendly view. When invalid login occur display the error message.		
Test Case description			
No.	Action	Actual output	Status
1	Login (positive)	Enter Valid username and password. Validate and redirect to correct user home page	Pass
2	Login (Negative)	Enter invalid username and password. Error message display with reason	Pass

4.3.2 Upload Case Module

Table 4.2: Upload case module test case

Test case Id	02		
Tested component	Upload Case		
Module Name	Upload Module		
Test case	Upload new case		
Expected Output	User friendly view. According to the user type view relevant upload screen. Empty text field appear message.		
Test Case description			
No.	Action	Actual output	Status
1	Auto generate case id	When page load new case id generated in un-editable textbox field.	Pass
2	Normal user login success	Load user upload screen. Able to do only insert new case.	Pass
3	Admin user login success	Load admin upload screen. Able to insert, update and delete.	Pass
4	Empty Text field	When save case data with empty field, message will appear (please fill the field).	Pass
5	Save record successful	Save successful message display and direct to upload page.	Pass
6	Save record successful	Save successful message display and direct to upload page.	Pass

4.3.3 View Case Module

Table 4.3: View Case Module test case

Test case Id	03		
Tested component	View Case		
Module Name	View Module		
Test case	View required case		
Expected Output	User friendly view. Display the requested values.		
Test Case description			
No.	Action	Actual output	Status
1	Auto generate case details	When select and click view, the relevant data should view.	Pass
2	View link	When click view, message appear and when click 'Yes' full details will display otherwise back to view page	Pass
3	Delete link	When Click delete, message appear and when click "yes" and the record will be delete and message appear.	Pass

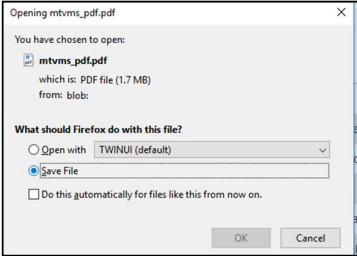
4.3.4 Vehicle Registration Module

Table 4.4: Vehicle registration module test case

Test case Id	04		
Tested component	Vehicle registration		
Module Name	Vehicle Registration		
Test case	Registration of vehicle		
Expected Output	User friendly view. Save relevant values.		
Test Case description			
No.	Action	Actual output	Status
1	View vehicle registration link	This vehicle registration link is available to the Administrator users only	
2	Insert Vehicle No	When insert same vehicle no, error message will display	Pass
3	Save Data	When click save, message appear and when click 'Yes' full details will save and back to registration page	Pass
4	Update Data	When Click update, message appear and when click "yes" and the record will be update and back to registration page	Pass
5	Delete Data	When Click delete, message appear and when click "yes" and the record will be delete and back to registration page.	Pass

4.3.5 Report Module

Table 4.5: Report module test case

Test case Id	03		
Tested component	Reports		
Module Name	Report Module		
Test case	View Reports		
Expected Output	User friendly view. Display the requested reports and able to generate PDF.		
Test Case description			
No.	Action	Actual output	Status
1	Auto Generate Report details	When click relevant values, the expected report will display.	Pass
2	Click PDF	When click Generate PDF button, the report will convert to pdf and notify to save as message box. 	Pass

4.4 Acceptance Testing

I would have done more testing with the selected users and gave them opportunity to work with relevant modules with relevant system access privileges. Activities were monitored while they are working with system. These data were analyzed by the reports generated. To consider as a successful project the final outcome need to be accepted by the end users. Therefore, this developed system need to handover to relevant authorities to get more feedback and make effective and efficient MTVMS System.

5. Conclusion

5.1 Introduction

This final chapter discuss about the objectives achieved and the future enhancements of the developed system. Initially this system will be depending on the users with the attitude to be a good citizen and this will gradually create a path to make law-abiding citizens. The reason is the person who are registered, will drive carefully, because he/she knows that someone will capture his/her motor traffic violation. The motor traffic law should be changed to punish the violated driver using this system and system should update with latest technologies.

5.2. Problems Encountered

This system is newly creating and similar systems are not available. Therefore, difficult to identify correct requirement and processes to be done. Also without valid no. of data, difficult to identify errors and this will slow the development process. But some major requirements were changed while developing the system and also database structure was changed according to the changed requirement. Therefore, required to re modify code segments of those specific modules which consumed lot of time.

Other major problem which encountered during the development process is the lack of knowledge regarding the development tools, and languages. Online tutorials and books were used to capture the essential level of knowledge.

5.3 Lessons Learnt

The knowledge added throughout the project was actually valuable. Starting from the feasibility studies, to the end of development this process gave incomparable experience in many ways. This project gave a chance to test and implement most important theories and technologies learnt throughout the MIT degree programme.

Furthermore, working on the project encourage me to improve technical skills as well as intellectual skills by collaborating with many individuals from collective fields. Proper management and planning is very important aspects learn out during this project.

5.4 Future enhancements

This system was originated with the concept and developed with the gain knowledge and studying is created this system to this level. This system should have legal framework to make more efficient and effective. Therefore, all the legal level officers and institutions have to be together and need to make proper mechanism to get the best out of the system.

Video uploading capability and the required space management of the server should be identified and need to make proper technology to cater in future.

Further, behavior of drivers, motor traffic violations areas can be identified by the system and need to add this analysis part to this system.

This system can be used to similar systems that have higher level of user involvement which effecting to the society. (eg: Public Health Inspector Duty)

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APPENDIX A – DESIGN DOCUMENTATION

