Vehicle Image Classification with Deep Convolutional Neural Networks Regional of Bangladesh

BY

Md Asiqur Rahman Asiq
ID: 171-15-9528

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

Supervised By

Mr. Aniruddha Rakshit
Senior Lecturer
Department of CSE
Daffodil International University

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APPROVAL

This Project/internship titled **"Vehicle Image Classification with Deep Convolutional Neural Networks Regional of Bangladesh"**, submitted by Md. Asiqur Rahman Asiq, ID No: 171-15-9528 to the Department of Computer Science and Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 2-Jan-2022 .

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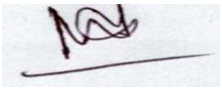

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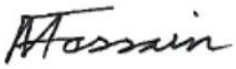

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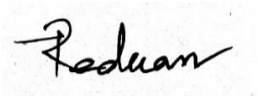
Department of Computer Science and Engineering

Faculty of Science & Information Technology

Daffodil International University



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Faculty of Science & Information Technology

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Professor

Department of Computer Science and Engineering

Jahangirnagar University

DECLARATION

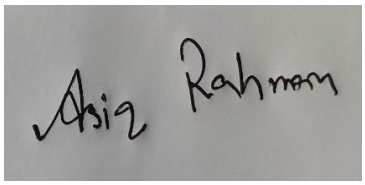
We hereby declare that, this project has been done by us under the supervision of **Mr. Aniruddha Rakshit, Senior Lecturer, Department of CSE,** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

_____

Mr. Aniruddha Rakshit
Senior Lecturer
Department of CSE
Daffodil International University

Submitted by:



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(Md. Asiqur Rahman Asiq)
ID: 171-15-9528
Department of CSE
Daffodil International University

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We would like to express our heartiest gratitude Mr. Aniruddha Rakshit and Head**,** Department of CSE, for his kind help to finish our project and also to other faculty member and the staff of CSE department of Daffodil International University.

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Finally, we must acknowledge with due respect the constant support and patients of our parents.

ABSTRACT

Road safety is a big issue for all over the world in today. Every country taking many steps to reduce road accidents, they are modernizing their traffic system by taking many scientific initiatives. And computer vision is ruling in this field. We proposed some model here which will help to detect the Bangladeshi native vehicle. In this paper we use our own dataset with six classes. In this paper we use two architectures of Convolutional Neural Network. We use DenseNet and ResNet50. From The ResNet50 we get a good accuracy in three variations. It obtain 99% accuracy. which will help in future works in this field.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Safe road is one of big issue in Bangladesh. Not only Bangladesh it is a global concern. Everyday many people loss their lives due to this road accident. And there are often movements about this. According to leading newspaper there are 6,686 people died and 8,600 were injured in a total of 4,891 road accident in 2020. So in 2020 there are in average 18 people died everyday according to the report of Bangladesh Passenger Welfare Association (BPWA). So it's a big issue for Bangladesh to manage this traffic system. In Bangladesh the traffic system is not well organized. The drivers are not well trained but also almost traffic system is not in a organized way. Considering these issues it is very important for Bangladesh to organize all system in a organized way. So now in today's world Intelligent Traffic System is well known term for road safety. Mainly it is the digitalized form of road transportation system.

Intelligent Traffic System (ITS) is huge used term for road safety. According to a report more than 80% accidents happen in under developed nations. So it is one of the big issue for them to handle this. Intelligent Traffic System are using in the modern developed countries so that road accident can't affect them in a big amount. Intelligent Traffic System contain all the traffic issues like Traffic rules, automatic tolling system, traffic monitoring and so on. To implement this term or make the traffic system digital it is important to take help of computer vision. Computer vision keeps a good impact in this field. Modernized or digitalized of traffic system is a long term process. Basically Intelligent Traffic System's (ITS) one outstanding feature is vehicle type classification. To use computer vision by the help of machine learning and deep learning it offers us a good outcome like automatic parking, type of vehicle , size of the vehicle and so on.

In this paper we try to find out some outcome using computer vision with our own dataset as the part of the Intelligent Traffic System (ITS) implementation in Bangladeshi road. We used our own dataset which images are collected from practically and various resources.

We collected 6,050 images with 6 classes. Classes are Bus, Car, SUV, Motorbike, Three wheeler and Truck. According to classes the amount is Bus(1,003), Car(1,003), SUV(1,002), Motorbike(1,037), Three wheeler(1,005) and Truck(1,000). In the dataset we use here all the Bangladeshi native images We don't think it's a huge dataset but expect that it is enough to complete our training. We trained this dataset according to two architecture DenseNet and ResNet50 of convolutional neural networks (CNN). Also we use 'adam' and 'adadelta ' as optimizers. According to our result as the result we get very good accuracy from ResNet50. From this architecture we get more than 90% as the accuracy rate. And we expect that it will help to the future work to build a safe Bangladeshi road.

1.2 Motivation

Road accident is a big issue in Bangladesh for all the time. And in this modern era it's a big concern for all the countries in the world. And many country taking different steps about this. And are taking help of computer vision, machine learning, Deep learning etc. we also take help of computer vision and machine learning. We make some classification to detect the native vehicle in our country we use two architectures DenseNet and ResNet50. And we use here adam and adadelta as the optimizer. And this training model can automatic detect the vehicle it will help our authority to take different steps.

1.3 Objectives

The prime persistence of our research is to detect the vehicle properly. Which will help our authority to decisions about a accident and so on.

- ➢ To make our native vehicle model.
- ➢ We will provide our law enforcement agency and road transport agency to detect vehicle .
- ➢ To participate to our road transport field.
- ➢ To use techniques for segmenting images.

1.4 Research Questions

It was pretty difficult for us to do this assignment. To provide a realistic, efficient, and correct answer to the problem, the researchers would like to offer the following questions to communicate the researchers' emotions and outcomes.

- ➢ Is it possible to collect huge data from road?
- ➢ How much it'll beneficial to reduce road accident in this way?
- ➢ Is it possible to obtain a good accuracy in this way?
- ➢ How will people benefit from this approach?

1.5 Expected Outcome

Many countries in todays world trying to apply computer vision in traffic rules. They are implementing computer vision and machine learning in this in different way. In Bangladesh road accident has become a big headache for government and it is increasing day be day. So it is very urgent to do something with the help of computer vision in this sector. In our paper we implemented two architectures of convolutional neural networks. From which we get return a good accuracy. in this research we use DenseNet and ResNet50 and adam and adadelta as optimizer.

There are several points stated in this section, and those points were our minimum expected outcome. The desired goal of this research-based project is to provide an algorithm or a comprehensive, efficient technique for classification images using the training dataset's constructed model.

- ➢ Specific classes vehicle can be detect.
- ➢ Road will be safe.
- ➢ It will be helpful for the authority, etc

1.6 Problem Statement

We faced many problems to complete this thesis based project, data collection was one of the tough job. We collected data from many sources like practical field images and collection from different sources like internet and so on.

Every epoch took too much long time to complete the output in our system. It took a long time for the final output

1.7 Report layout

Chapter 1: Introduction

In this chapter, we have discussed the Introduction, Motivation of the work, Objectives, Rationale of the study, Research Question, Expected outcome and Problem Statement of the research, and the Report layout.

Chapter 2: Literature Review

We have addressed the context of our research in this chapter. We also share information on some related work, as well as the challenges of this study.

Chapter 3: Research Methodology

We explained our working method in this chapter. What's in our suggested answer, how it works—our study subject, and what we employed in our research We also spoke about sample data.

Chapter 4: Experimental Results and Discussion

In this chapter, we discussed our experimental results as well as our explanation of our outcomes.

Chapter 5: Conclusion, Recommendation and Future Works

In this chapter, we addressed the summary of our whole research as well as some recommendations. We also indicate what research needs to be done in the future.

CHAPTER 2

BACKGROUND STUDY

2.1 Introduction

This section will go through relevant works, study summaries, and research problems. In part on similar outcomes, we will review other research papers and their results, techniques, and accuracy linked to our study. We shall summarize our connected studies in the research summary section. We will examine how we enhanced the accuracy level in the challenges section.

2.2 Related Works

[1] Chuanguang et al. has proposed to lessen the laying-off of DenseNet stacked modules by SMG module. SMG module furnished with design like DenseNet that integrate all prior result, it congest the incoming informative but redundant structures by ordered difficulties. For the Hybrid Connectivity and Gated mechanism it is named as HCGNet.

DenseNet and ResNet50 used here to build a hybrid connectivity. But made some differences residual path and dense path build a here DPN. Where get advantage to use the both.

[2] JIAQUAN et al. has proposed a model which will save the computational power and pointedly advances the correctness of the finding where CNN models need a big amount of data but they propose that this model return improved finding with a short dataset. Named LD-CNN.

[3]Reza et al. proposed a process which add two autonomous hierarchical spatial pyramid pooling instead of the finishing step of CNN classifier. That added two autonomous layer pooled the features different from original CNN modified from ResNet50 and AlexNet which tested by well-grained vehicle classification dataset. Its don't need any preprocessing or postprocessing for classification.

[4]Zhedong et al. presented here the solution of large scale data set. Split into two stage, first stage actually gain the main knowledge and the second stage tune the trained model on the original training set. Its result a good accuracy.

[5]Charbel et al. proposed a methodology which will provide a good accuracy which help to ensure the quality control. Quality control is work of patience process for any automotive company. For that and to evade act deprivation it is very effective. Using ResNet here they achieve very accuracy. It will help future quality control management for automotive company.

[6]Jatuporn et al. proposed a photographic difference to obtain a good accuracy than the raw photographic dataset. It is focus on the object to obtain the good accuracy. In this they used AlexNet, ResNet and DenseNet in this all architecture obtain good accuracy on a large dataset. It will help in the future image recognition process to obtain a good accuracy.

[7]MOHAMED et al. proposed a super-learner collaborative for automobile system classification issue. To collaborate here used architectures are ResNet50, Xception, and DenseNet. By using own dataset they able to obtain a good accuracy report . expectation from this paper is it will help to localization task in future work in this field.

[8] Zhiming et al. proposed a MIOvision Traffic Camera Dataset from a single clip. In this paper they try to work on video clip. Collected data here separated into two part. In this two part first one contain clips and second one contain a huge image dataset.And compared that with single frame clip in life scenario. That obtain a good accuracy. This dataset will help future work on low frame rate clips analysis.

[9] Nimish et al. proposed a quick advanced system which will detect automatically any accident or burn vehicle to notify a instant checking. To build this methodology they used a big dataset by basically using ResNet50, DenseNet, EfficientNet. This system will help to detect the affected vehicle by any unpredictable circumstance. It also help to educe the risk factor of any vehicle.

[10] Meng et al. proposed a methodology which help to predict the weather specially rain. By gather the own dataset they build it by using different CNN architectures. ResNet50 usud here for classification. By using this it obtain a good accuracy rate. By doing this it can predict the future weather either will it rain or not as a safety measure for driving on the road.

[11] Long et al. proposed a finding method with proper balance and good accuracy. Which mainly work on self driven automobile. Now it is very needy technology, working a lot in this topic. To make the method they used CNN related architectures as like R-CNN, R-FCN,ResNet50, DenseNet and so on. Basically they works on two steps with some fast architecture like MobileNet_V2 and some slow architecture like DenseNet.

[12] Heechul et al. proposed a ResNet dependent automobile arrangement and localization. Where they MIOvision dataset, to improve the classification demoralized the performance of joint fine tunning. Here obtained a good result by using VGG16, AlexNet and resNet50 for classification and YOLO, R-CNN for localization. Expected that it will help to obtain a good result for further more work based on automotive.

[13] Md et al. proposed a prototypical of transfer learning on Bangladeshi native automobile. For classification here use different CNN aechitecture like ResNet50, AlexNet, and VGG16. But obtained a healthy accuracy from ResNet50. It outdoes based on pre-trained tactics. It will help future research work on Bangladeshi native works.

[14]Qiqiang et al. proposed a innovative tactic overcome difficulties on road transport detection. As it is a difficult task but using the CNN on this aspect very good in today. Mainly they classify the road damages not only that also build mask of the defected road. As it is a difficult task but using of convolutional neural network it is become easy. In future it will help in many native field about this work.

[15]Nusrat et al. proposed here a surveillance security method using vehicle image classification. They identified here and fixed the issues related to the vehicle collision. In this paper they followed the Convolutional Neural Networks and gained a well accuracy

report. and they gain 97% accuracy. To gain this result they followed two methods features exr=traction and classification.

[16] Youpan et al. proposed a process which is mixture of Haar features ab Histograms of Oriented Gradients (HOG) features. Mixtures of these two features will help to spot the automobile in the video.in this paper the outcome has gained a well accuracy which will help the future work about this field.

[17]Fukui et al. proposed a method named Deconvolution(D) and Pooling(P) Single Shot Multibox Detector(SSD), which helps to find the small vehicle perfectly. With only Single Shot Multibox Detector(SSD) it can not do perfectly. They present here the combination of the Deconvolution and pooling with the SSD. And its can detect the exact automobile perfectly.

2.3 Challenges

The primary problem of this project is gathering and analyzing the dataset. It was too difficult to deal with the data set. We utilized numerous stages and approaches to clean and normalize. After all, training with several layers with varied epoch sizes took a long time in our system, so we waited patiently to acquire the final output.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Research Subject and Instrumentation:

A research project's methodology is the essential aspect of its work. A research project can progress step by step and achieve excellence thanks to the technique. It is also feasible to discover new things with the appropriate procedures and planning. We also worked on a dataset for fish disease identification using multiple methods. The process consists of Data collection, Data preprocessing, Data Augmentation, Train Model (DenseNet & ResNet50).

Work Flow for Vehicle Detection System:

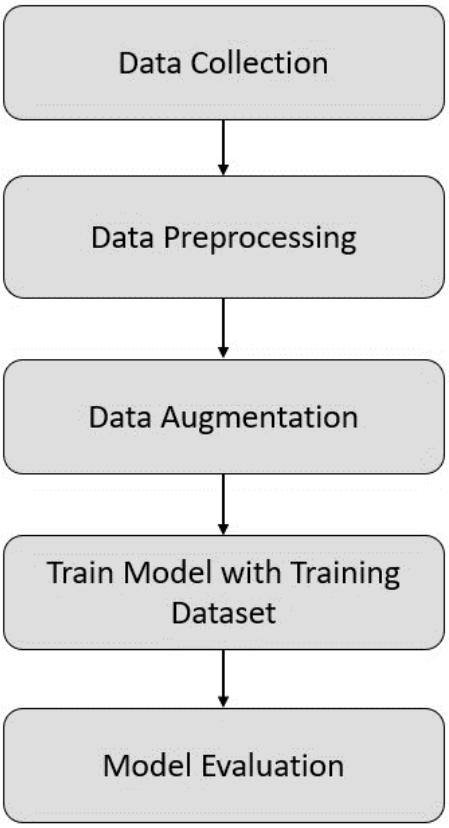

Figure 3.1: WorkFlow Diagram.

3.1.1 Data Collection:

As the part of this research data collection is very much tough job for us. We suffered a lot to collect the data. We took photos from different sources like practically ewe captured photos of different classes vehicle and also collected photos from internet. And it take very much long time to take all the photos we collected 6,050 photos from different sources. And it suffered us alot

3.1.2 Data Preprocessing:

Preprocessing data is a critical stage in the dataset creation process. This is because data in a dataset is frequently destroyed, making it harder to obtain correct findings. Data preparation is a procedure in which data is transformed or encoded so that the machine can quickly parse it. The properties of the information we have today are algorithms that are pretty simple to explain.

3.1.3 Data Augmentation:

Data expansion is a system that employs experts to basically fabricate various assortments of data. Without assembling new information and information available for ready models to prepare, I used data enlargement tools like zoom, share, flip, move, and splendor. Our convolutional neural network models.

3.1.4 Train Model with training dataset:

We chose two different convolutional neural network models and trained them on our training dataset of 6,050 images. The models we've chosen are as follows:

· DenseNet

· ResNet50

3.1.5 Model evaluation:

Model evaluation is a critical component of developing an effective convolutional neural network model. We used the accuracy, test accuracy, and plot diagram to evaluate our model.

3.2 DenseNet Model:

There are 16 weight layers in the DenseNet model. There are 12 convolutional layers with a 3x3 filter size and three completely connected layers in these layers. These convolutional layers are divided into five groups, with a max-pooling layer following each group. The convolutional filters are the filters that are used in convolutional neural networks. The layer of input for the DenseNet model begins with a 256 x 256 fixed-size RGB image and then processes it. A convolutional layer smorgasbord It also has the option of using a 1x1 convolutional filter. In this case, where the spatial padding of this layer's input is 1 pixel, the convolutional stride is fixed at 1 pixel. The way that after convolution, the spatial resolution is kept. The spatial work is done by the five max-pooling layers. This follows a section of the convolutional layers and has a stride of 2 and a 2x2 pixel size. The maximum pooling of windows is done.

Following the convolutional layers, there are three fully linked layers, the first of which is the most basic. Each of the first two layers has 4096 channels, whereas the third layer has seven tracks, one for each of the seven layers each and every class. The softmax layer is the topmost layer. All of the layers are totally connected. Similarly, networks are set up.

Model Architecture:

```
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
sequential (Sequential)      (32, 256, 256, 3)         0
_________________________________________________________________
sequential_1 (Sequential)    (None, 256, 256, 3)       0
_________________________________________________________________
conv2d (Conv2D)              (32, 254, 254, 32)        896
_________________________________________________________________
max_pooling2d (MaxPooling2D) (32, 127, 127, 32)        0
_________________________________________________________________
conv2d_1 (Conv2D)            (32, 125, 125, 64)        18496
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (32, 62, 62, 64)          0
_________________________________________________________________
conv2d_2 (Conv2D)            (32, 60, 60, 64)          36928
_________________________________________________________________
max_pooling2d_2 (MaxPooling2 (32, 30, 30, 64)          0
_________________________________________________________________
conv2d_3 (Conv2D)            (32, 28, 28, 64)          36928
_________________________________________________________________
max_pooling2d_3 (MaxPooling2 (32, 14, 14, 64)          0
_________________________________________________________________
conv2d_4 (Conv2D)            (32, 12, 12, 64)          36928
_________________________________________________________________
max_pooling2d_4 (MaxPooling2 (32, 6, 6, 64)            0
_________________________________________________________________
conv2d_5 (Conv2D)            (32, 4, 4, 64)            36928
_________________________________________________________________
max_pooling2d_5 (MaxPooling2 (32, 2, 2, 64)            0
_________________________________________________________________
flatten (Flatten)            (32, 256)                 0
_________________________________________________________________
dense (Dense)                (32, 64)                  16448
_________________________________________________________________
dense_1 (Dense)              (32, 6)                   390
=================================================================
Total params: 183,942
Trainable params: 183,942
Non-trainable params: 0
_________________________________________________________________
```

Figure 3.2: DenseNet architecture

3.3 ResNet50 Model:

ResNet50 or Residual Networks is the winner of Imagenet challenge 2015 . it has 150+ layers. There are 16 weight layers in the ResNet model. There are 12 convolutional layers with a 3x3 filter size and three completely connected layers in these layers. These convolutional layers are divided into five groups, with a max-pooling layer following each

group. The convolutional filters are the filters that are used in convolutional neural networks. The layer of input for the ResNet model begins with a 256 x 256 fixed-size RGB image and then processes it. A convolutional layer smorgasbord It also has the option of using a 1x1 convolutional filter. In this case, where the spatial padding of this layer's input is 1 pixel, the convolutional stride is fixed at 1 pixel. The way that after convolution, the spatial resolution is kept. The spatial work is done by the five max-pooling layers. This follows a section of the convolutional layers and has a stride of 2 and a 2x2 pixel size. The maximum pooling of windows is done.

Following the convolutional layers, there are three fully linked layers, the first of which is the most basic. Each of the first two layers has 4096 channels, whereas the third layer has seven tracks, one for each of the seven layers each and every class. The softmax layer is the topmost layer. All of the layers are totally connected. Similarly, networks are set up.

3.4 Parameter Setting

As part of our research, we have predefined several model parameters that are also known as hyper-parameters. This will not work if we don't define those parameters for the model. We must first tune them to get the best results. In Table 3.1, we present the hyper-parameters of our model. We used the same parameters for all four Convolutional Neural Networks (CNN).

TABLE 3.1: PARAMETERS AND FUNCTIONS FOR TRAINING PROCEDURE FOR 60-20-20

Training Parameters	DenseNet	ResNet50
Epochs	40	40
Batch Size	32	32
Input Shape	256x256x3	256x256x3
Output Class	21	21
Train Samples	2179	2179
Test Samples	482	482
Validation Samples	482	482
Re-scaling	1/255	1/255
Weights	Imagenet	Imagenet
Optimizer	Adam & Adadelta	Adam & Adadelta
Loss Function	Categorical Crossentropy	Categorical Crossentropy

TABLE 3.2: PARAMETERS AND FUNCTIONS FOR TRAINING PROCEDURE FOR 70-15-15

Training Parameters	**DenseNet**	**ResNet50**
Epochs	40	40
Batch Size	32	32
Input Shape	256x256x3	256x256x3
Output Class	21	21
Train Samples	2179	2179
Test Samples	482	482
Validation Samples	482	482
Re-scaling	1/255	1/255
Weights	Imagenet	Imagenet
Optimizer	Adam & Adadelta	Adam & Adadelta
Loss Function	Categorical Crossentropy	Categorical Crossentropy

TABLE 3.3: PARAMETERS AND FUNCTIONS FOR TRAINING PROCEDURE FOR 80-20-20

Training Parameters	**DenseNet**	**ResNet50**
Epochs	40	40
Batch Size	32	32
Input Shape	256x256x3	256x256x3
Output Class	21	21
Train Samples	2179	2179
Test Samples	482	482
Validation Samples		
Re-scaling	1/255	1/255
Weights	Imagenet	Imagenet
Optimizer	Adam & Adadelta	Adam & Adadelta
Loss Function	Categorical Crossentropy	Categorical Crossentropy

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Introduction:

In this chapter we shows that we take 6,050 images. And divided into three variations training 60% – testing 20%- validation 20%, training 70% – testing 15%- validation 15%, training 80% – testing 10%- validation 10% and the structure is above.

Sample: A sample may be thought of as a single row of data.

Batch: A batch size is the number of samples to deal with before changing the internal model parameters.

Epoch: Epochs are hyper-parameters that specify how many times the training model will run on the whole training dataset.

4.2 Data Samples

TABLE 4.1: TOTAL DATA

Vehicle Image dataset	Total Images
Bus	1003
Car	1003
SUV	1002
Motorbike	1037
ThreeWheeler	1005
Truck	1000

Figure 4.1: Sample Training Image

4.3 Experimental Results & Discussion

The Outputs of the 2 models are shown in this section.

4.3.1Experimental Result and Analysis for DenseNet Model:

Accuracy:

The accuracy for each number of epochs is indicated. In this case, increasing the number of epochs leads to improved accuracy.

TABLE 4.3.1: MODELS REPORT OF 60% - 20% - 20%

	DenseNet		ResNet50	
	Adam	Adadelta	Adam	Adadelta
60% training	**74%**	**24%**	**99%**	**90%**
20% testing	**70%**	**26%**	**93%**	**88%**
20% validation	**73%**	**24%**	**92%**	**92%**

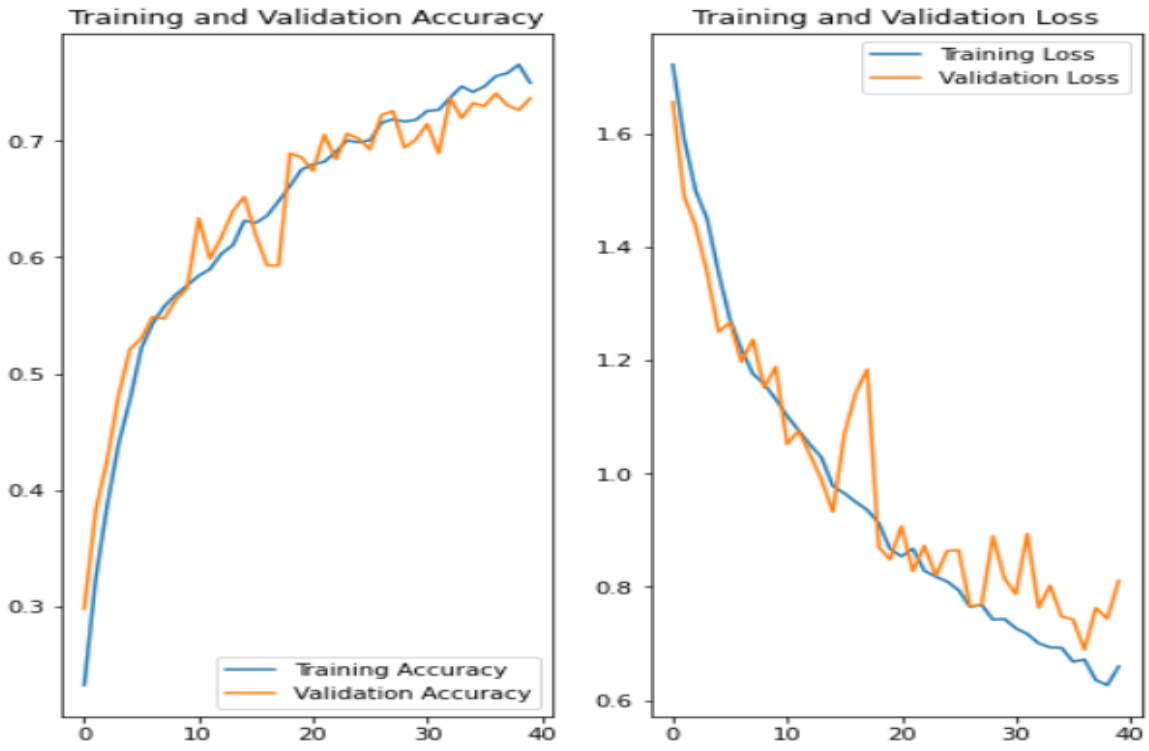

Figure 4.3.1: DenseNet 60-20-20 adam optimizer training and validation, accuracy and loss

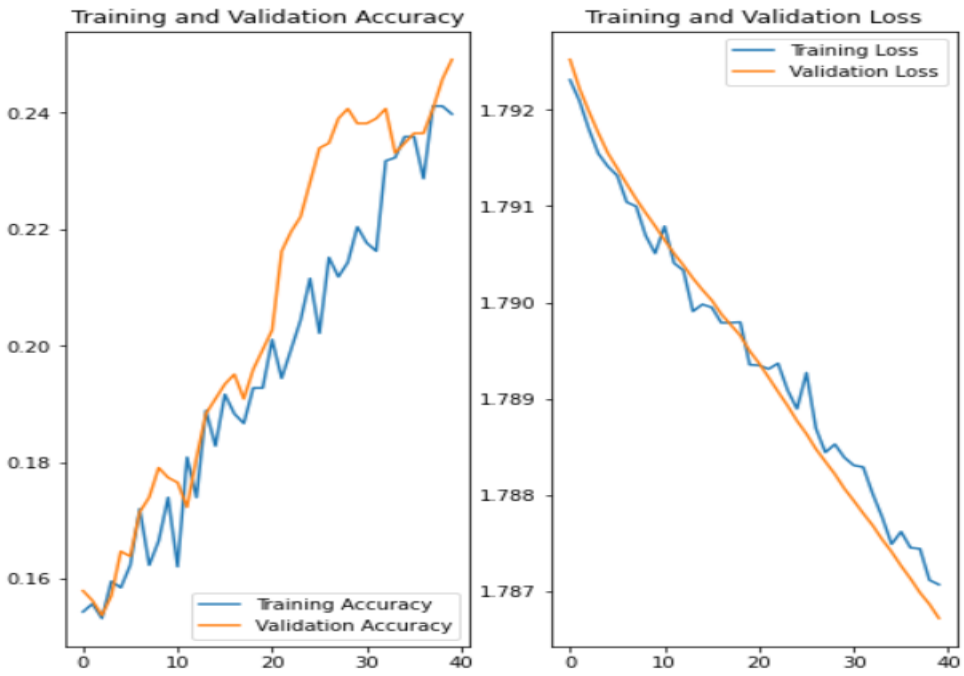

Figure 4.3.2: DenseNet 60-20-20 adadelta optimizer training and validation, accuracy and loss

TABLE 4.3.2: MODELS REPORT OF 70% - 15% - 15%

	DenseNet		ResNet50	
	Adam	Adadelta	Adam	Adadelta
70% training	**75%**	**25%**	**99%**	**90%**
15% testing	**69%**	**25%**	**92%**	**90%**
15% validation	**70%**	**25%**	**93%**	**91%**

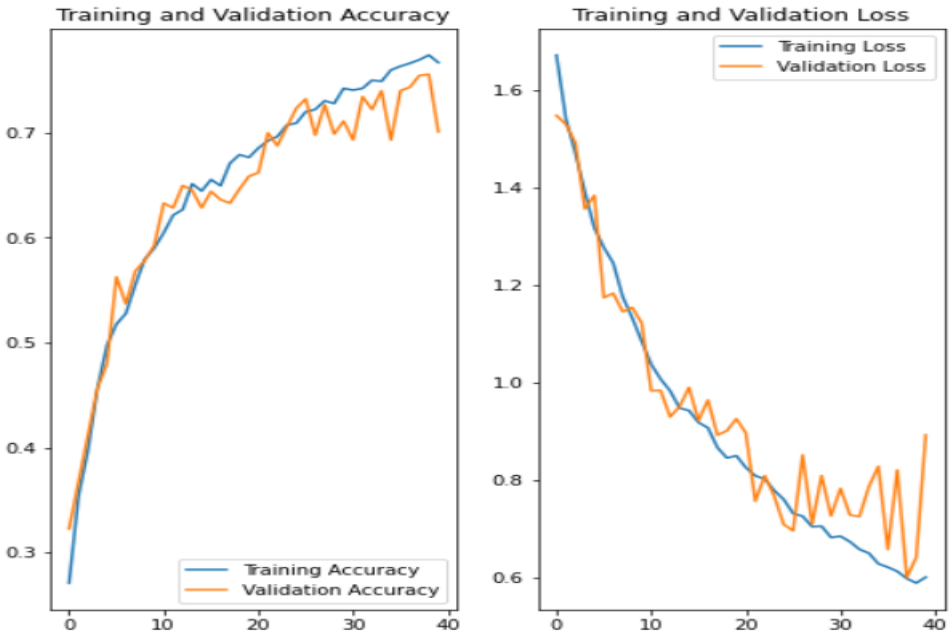

Figure 4.3.3: DenseNet 70-15-15 adam optimizer training and validation, accuracy and loss

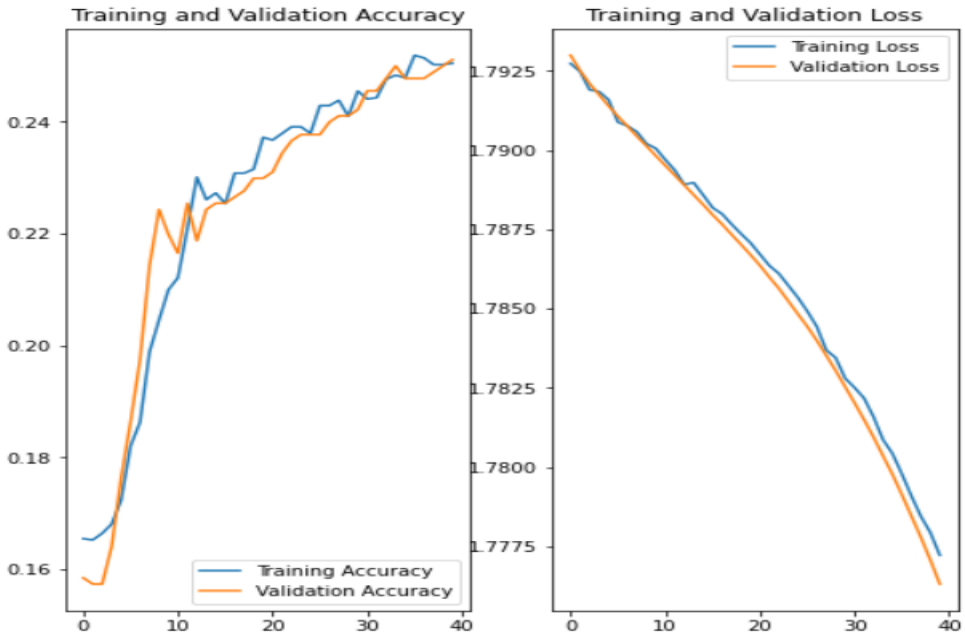

Figure 4.3.4: DenseNet 70-15-15 adadelta optimizer training and validation, accuracy and loss

TABLE 4.3.3: MODELS REPORT OF 80% - 10% - 10%

	DenseNet		ResNet50	
	Adam	Adadelta	Adam	Adadelta
80% training	**75%**	**18%**	**99%**	**90%**
10% testing	**77%**	**15%**	**92%**	**90%**
10% validation	**74%**	**17%**	**93%**	**87%**

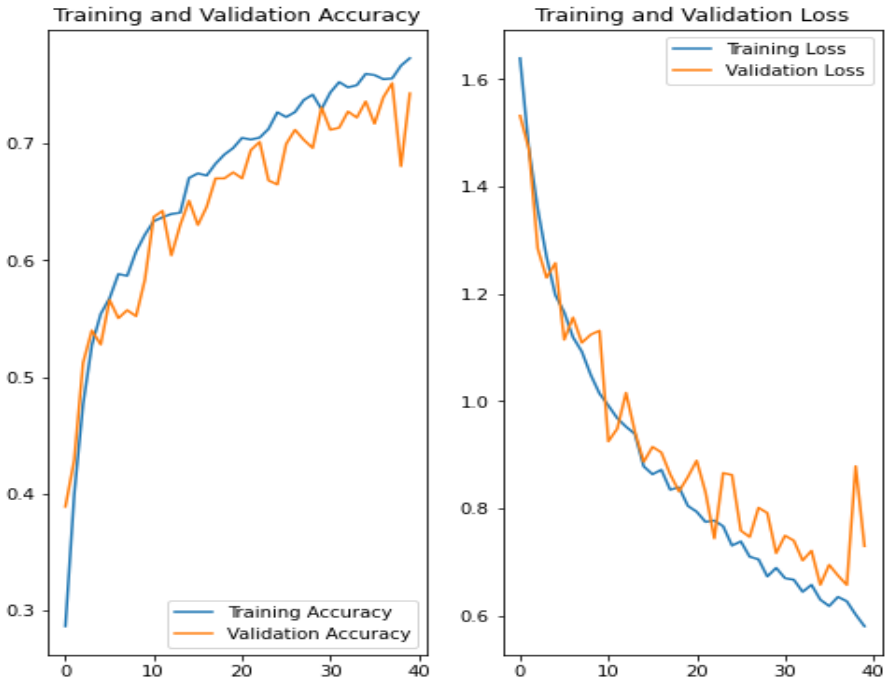

Figure 4.3.5: DenseNet 80-10-10 adam optimizer training and validation, accuracy and loss

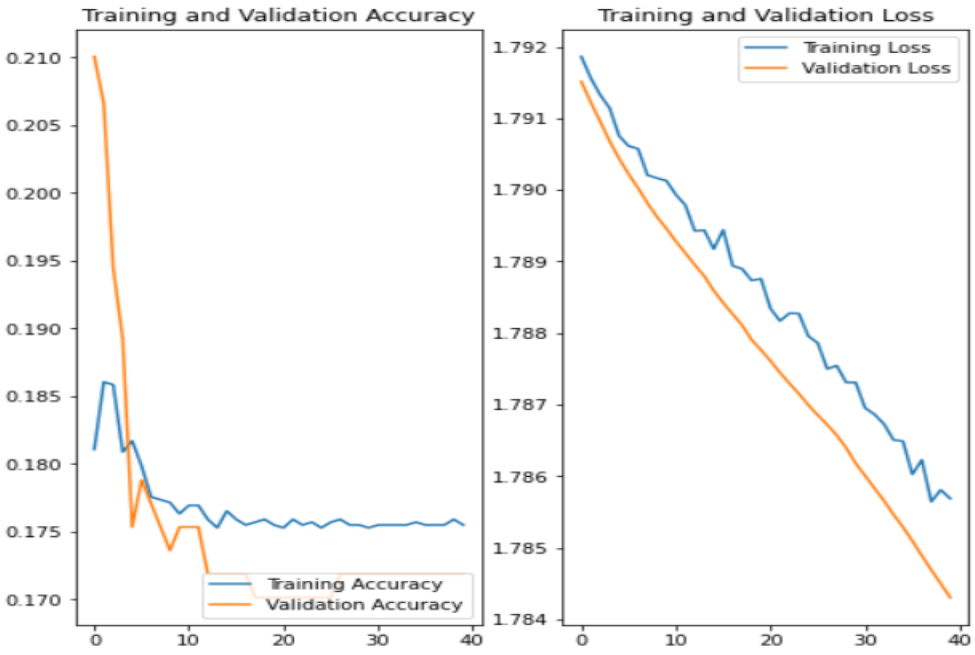

Figure 4.3.6: DenseNet 80-10-10 adadelta optimizer training and validation, accuracy and loss

4.3.2Experimental Result and Analysis for ResNet50 Model:

Classification Report:

Accuracy, Precision, Recall & F1 score on the ResNet50 architecture of the image classification are below

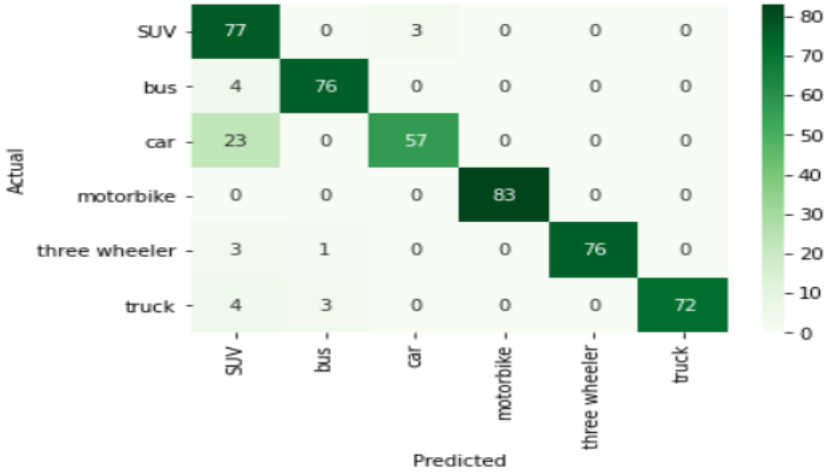

Figure 4.3.7:Figure of Confusion matrix of ResNet50 60-20-20 adam optimizer

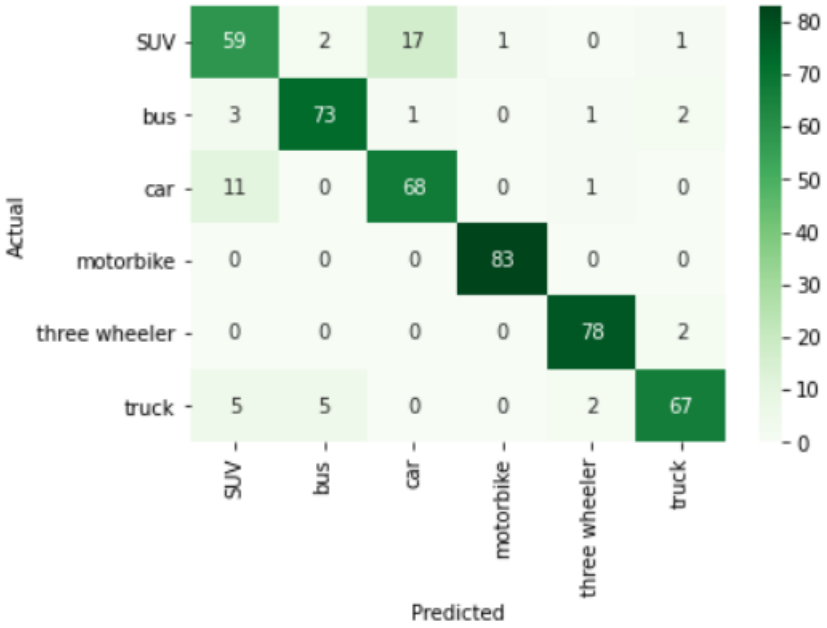

Figure 4.3.8:Figure of Confusion matrix of ResNet50 60-20-20 adadelta optimizer

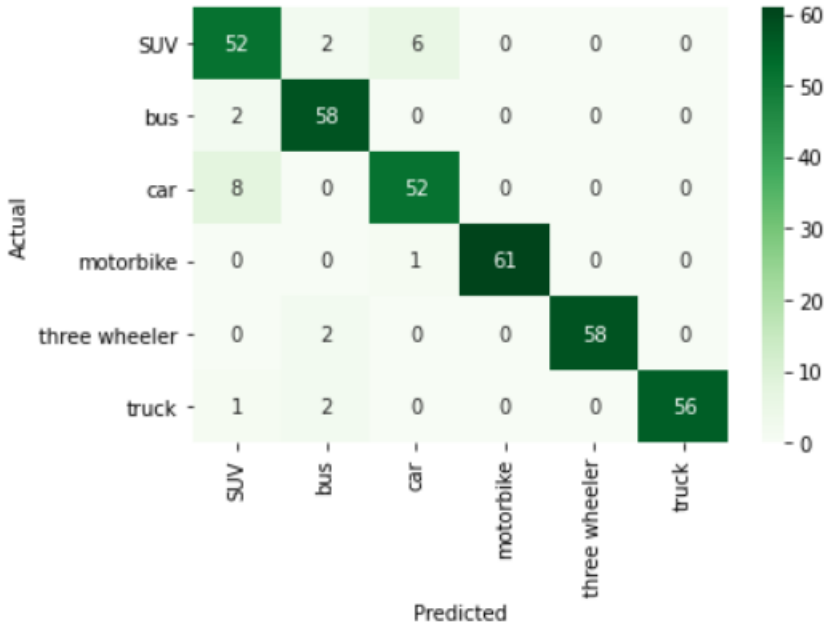

Figure 4.3.9:Figure of Confusion matrix of ResNet50 70-15-15 adam optimizer

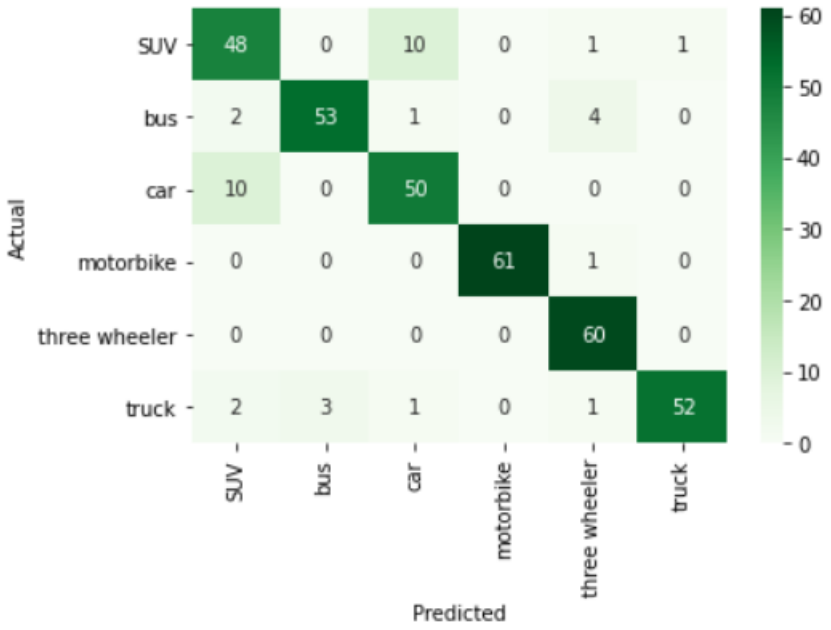

Figure 4.3.10:Figure of Confusion matrix of ResNet50 70-15-15 adadelta optimizer

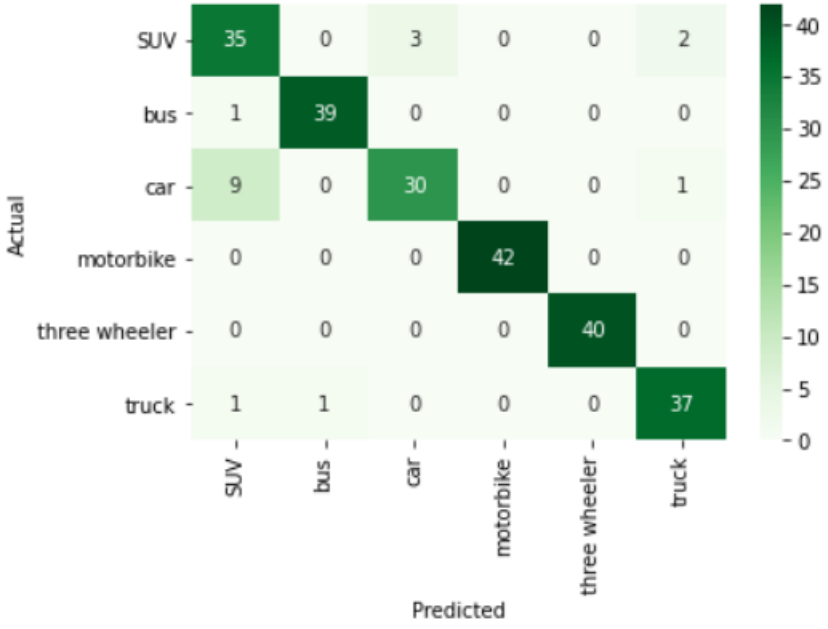

Figure 4.3.11:Figure of Confusion matrix of ResNet50 80-10-10 adam optimizer

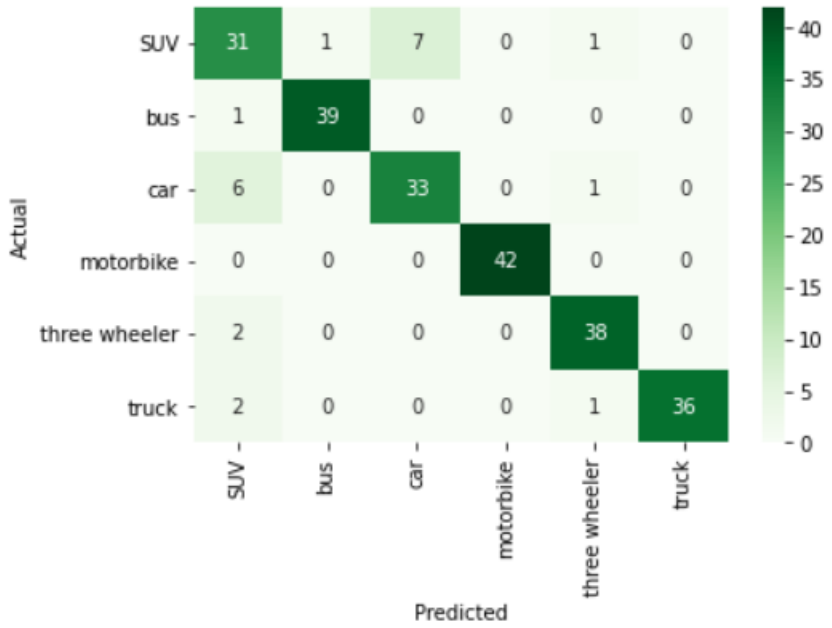

Figure 4.3.12:Figure of Confusion matrix of ResNet50 80-10-10 adadelta optimizer

CHAPTER 5
CONCLUSION, RECOMMENDATION AND FUTURE WORKS

5.1 Conclusion

Our paper is based on Bangladeshi vehicle image classification. We present here classified model of Bangladeshi native vehicle image. It is a aspect to digitalize traffic system. As we use here computer vision, machine learning etc. we buold model with the help of convolutional neural network. We wish it will help in future automatic vehicle detection in the part of modernize and build a organizing road traffic system in Bangladesh. Also it will help the present authority to prevent road accident

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