Automatic Toll Collection System Based on Image processing

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APPROVAL

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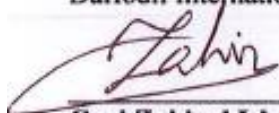
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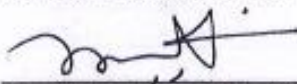Daffodil International University

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ABSTRACT

The ANPR (Automatic Number Plate Recognition) has a various use in many ways. The ANPR or automatic number plate recognition is a technology that captures the images of vehicles and perceives the number plates. It is a reconnaissance system to detect the vehicle license number. After tag discovery, it sends an action SMS to the proprietor of the vehicle immediately. We utilize three phases of ordinary Number Plate recognition system. Our propose system capture the vehicle image. Then the image segmentation Methods are used to excerpt the number plate region. Correlation method is utilized for contrasting the segmented image with the template images. Output Result will discover the Number Plate number. The resulting data is then used to compare with the records in the database. MATLAB software is used to extract the vehicle number plate from the digital image. In this case the vehicle does not need to pay the toll cost by cash. The system prepares a bill paper and sent it to vehicle owner through online. Then our server will send a text message to owner's contact number. So that, owner can get the actual location of his vehicle. So, there will be no hazard to lost/stole his vehicle. Close to this, the traffic will be also reducing near the toll plaza. This system also works as a tracking system.

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CHAPTER 1
PROJECT OVERVIEW

1.1 Introduction

In this section talks about a diagram of the investigation led. The title of our project is "Automatic Toll assortment System supported Image process ". It comprises of foundation issue declarations, inquire about research questions, anticipated yield and the extent of the investigation. The foundation quickly depicts the acknowledgment of the number plate characters by identifying the vehicle number plate. Issue articulation portrays the issues that emerge and make the chose tasks to be attempted. The examination question and expected yield are the objective rundown for the exploration to be accomplished. The extent of the examination talks about the impediments of the exploration. The diagram of the Automatic toll accumulation framework dependent on IoT appears in Figure1.1.
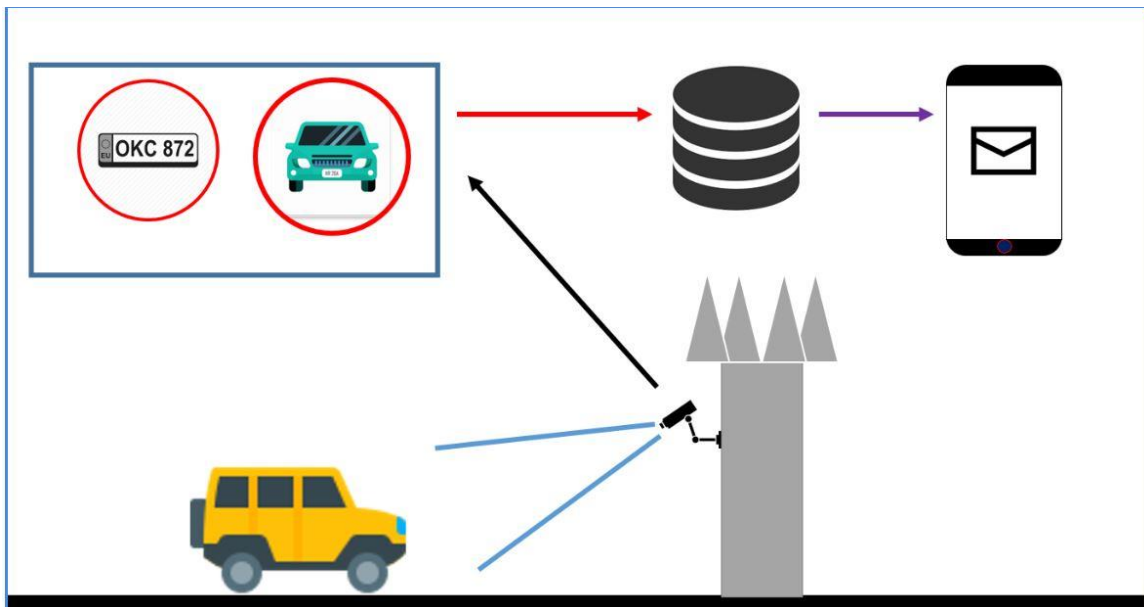

Figure 1.1: Overview of automatic toll collection system based on IoT

1.2 Motivation

In a Toll Plaza driver stuck there for a long time, our motive is we try to reduce this problem. We want to build an automatic toll plaza where owner can pay their vehicle toll tax automatically. For secure the vehicle location we try to build a system (sending location by a text message) based on IoT. The computerization of toll court can have the best arrangement over cash misfortune at toll square by decreasing the labor required for the accumulation of cash. For decreasing the whole manual framework issue, we attempt to fabricate this Automatic Toll System venture.

1.3 Background

In the existing system, we found lots of traffic in toll plaza for collecting toll fee against a vehicle. Day by day, the traffic took the place in a horrible situation.ANPR is easier method for Vehicle identification. Our system will perform and fulfill all the tasks that any bus or vehicle would desire. This framework is ordinarily utilizing an observation camera to snap the photo whenever. In this framework, when the vehicle on street towards the traffic signal in a toll court, its picture is caught and sent to the database right away. The picture is handled to extricate the enlistment number utilizing a superior picture preparing calculation. The further procedure incorporates sending a SMS to the proprietor of the vehicle whose contact number is connected with the enrollment number in the database.

Figure1.2: Toll Plaza [2]

1.4 Problem Statement

Now-a-days traffic is more horrible in our country. So, we propose to build a system on the toll plaza to control traffic in an alternative way. In this project, this "Automated Toll

assortment System "which based on IoT will make traffic more efficient and reduce number of major accidents and save our valuable time.

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1.5 Research Question

1. The Common research question is how we do the segmentation technique?
2. How to reduce image into an appropriate size?
3. How can we detect the number plate of any vehicles?
4. Finally, how could we give a sort notification to the vehicle owners?

1.6 Expected Output

The Development of the application has met its specification successfully. For the given captured pictures with the number plate of the vehicles, the application can recognize all them. Then it matched the given data with database. If data matches with database then the application charge the toll fee from owners account and sending message to the owner about vehicles location and also the amount of toll fee.

CHAPTER 2
BACKGROUND STUDY

2.1 Introduction

This chapter briefly reviews, explains, and discusses on the current project which is "Automated Toll Collection based on IoT" that will be grown later. This part includes six area. First section is about introduction. Second section describes the related works which we apply in this project. Third one is proportional study where we discuss about how we can be advantageous from this project. Fourth one is about research summery. Fifth one is scope of the problem where we discuss about the problems when develop the project. And the last one is challenges which we face in this project.

2.2 Related Works

Here we apply an algorithm for color segmentation, number plate detection, character recognition etc. Object detection is an interesting research topic due to its wide range of real-world application. In this era,with help of ANPR system world work so many things to consume time and manpower. To appreciating this system developer work with various algorithm. But the basic Algorithm is shown in figure 2.1 .

```
┌──────────────┐      ┌──────────────┐      ┌──────────────────┐
│ Scan Document│ ───> │ Preprocessing│ ───> │Feature extraction│──┐
└──────────────┘      └──────────────┘      └──────────────────┘  │
                                                                   │
┌──────────────┐      ┌──────────────┐      ┌──────────────────┐  │
│    Output    │ <─── │Recognized Text│ <── │  Segmentation    │<─┘
└──────────────┘      └──────────────┘      └──────────────────┘
```
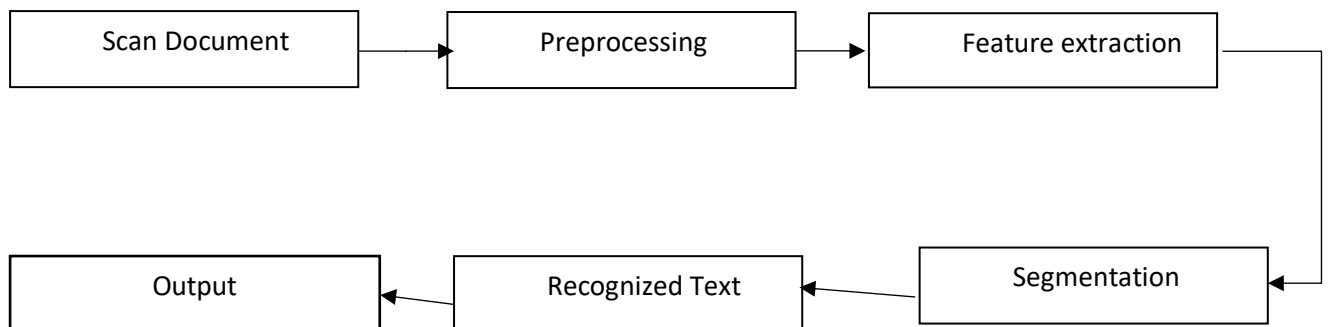
Figure2.1: Workflow of ANPR

2.2.1 Scan Document

Scan document means digital scanned image, which contains Bangla Numeric digits.

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Figure 2.2: Scan Input

2.2.2 Preprocessing

Noise Reduction: Here we apply mean filtering and high pass filtering in our process to reduce the noises of the image.

Figure2.3: Noise reduced

Binarization: After reducing the noises from the image apply threshold operation to convert it into binary image.[4]

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Figure2.4: Binary image of the capture image

2.2.3 Segmentation

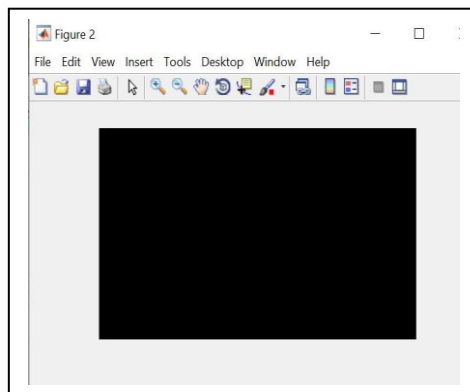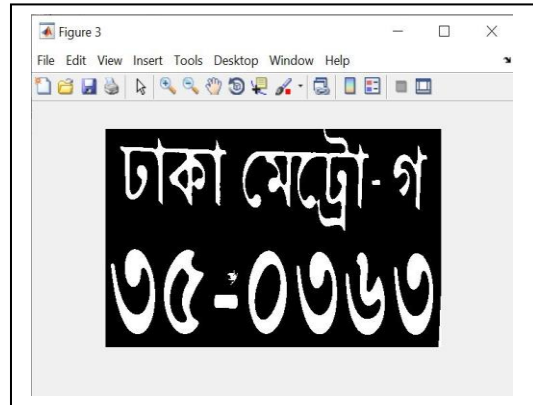In parallel picture segmentation, the picture is performed on various levels incorporates "line segmentation", "word segmentation", "character segmentation". In the division zone, we section the picture into numbers and digits. We fragmented the picture into level lines. Each line is an individual picture. Each line will be divided relying upon the spaces between the digits. After that numbers are sectioned. All digits will be isolated from the numbers in the info picture.

Line Segmentation: All the data pictures filtered on a level plane which recurrence of dark pixels in each line which is included so as to build the line histogram. The situation between two continuous lines, where the quantity of pixels straight is zero means a limit between the lines.

Word Segmentation: After line recognition, each line is examined vertically for word division. Subsequently, various lines are isolated. Along these lines, the picture record would now be able to be considered as an accumulation of words.

2.3 Comparative Studies

"Automatic toll collection system" is very useful and efficient application for every vehicles owner who wants to save their time and also their energy. This application reduced the traffic problem on toll plaza and it will also use for security purpose by sending message to the vehicle owner.

2.4 Research Summary

From the very beginning we started our work after studying the research papers which was related to ANPR. All those papers help us to develop our project in a better way. We got there

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many informatics ways to find a best solution. We also know about various Algorithm which is using for solve any image processing method. Very First concept of ALPR is, the application captures the image of a vehicle then it detects the number plate after applying many effective Algorithm. After that we recognize the character by applying image extraction, character segmentation etc. By this way we develop the project.

2.5 Scope of the problems

In this project there are many solutions like using RFID, Wi-Fi control device for detecting the vehicles but weuse image processing for recognize the number plate. Here we use MATLAB and Python for this project. We face some problems when develop this project. We want to work on real time number plate detection but for some unavoidable situation we work on still image detection. And this is the problem we face when develop this project.

2.6 Challenges

It is challengeable to implement such an application to identify the Bangla Number plate in such complex background, specific for us without image processing background before. We need to lean about image Processing and NLP also for working with this project. In this era machine learning is very famous to all. ML has many sub division category. for image processing we also need to conduct with machine learning. However, we worked hard and tried our best to learn and research some image processing and machine learning technique so that the application was applied which achieved the goals in the specification.

CHAPTER 3
PROPOSED METHODOLOGY

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3.1 Introduction

In this part we talk about in subtleties the methodology and framework for this Project. There are various techniques were proposed to perceive the tag and those strategies utilize multifaceted computations. Therefore, those are driving a high equipment cost and deferral. Then again, our framework incorporates straightforward counts. Furthermore, prompting less equipment cost and diminished deferral. These estimations will be clarified in this section 3.

3.1.1 Software Model

The significant part of the framework is the software model. The software model uses different picture handling procedures executed utilizing MATLAB. The square graph of the proposed software model is as appeared in Figure 3.2 .

3.2 Workflow

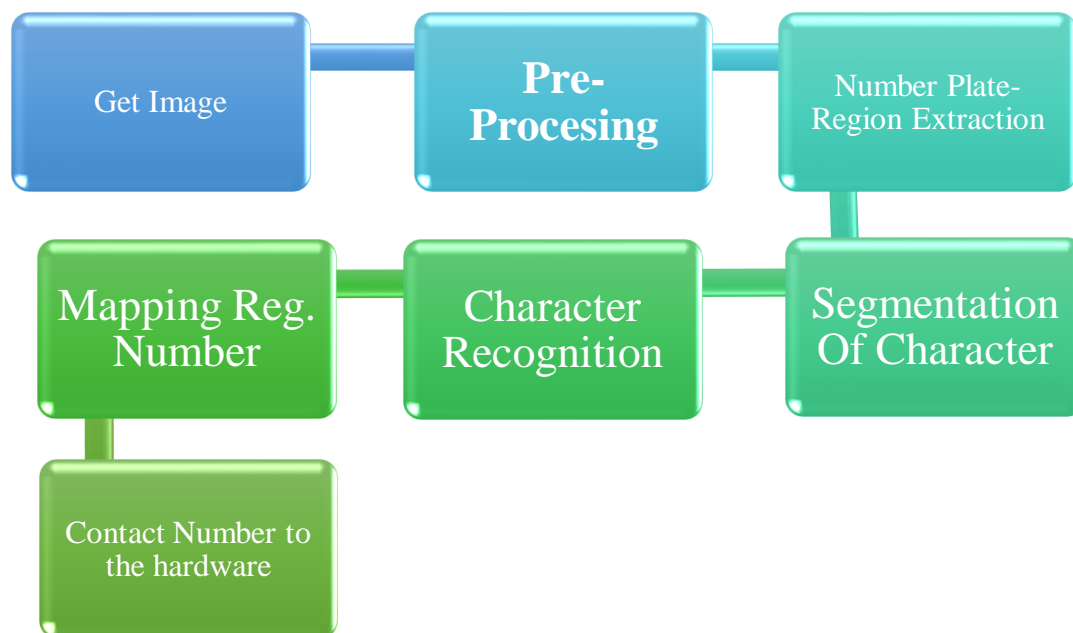The following Figure 3.2 shows basic working flow of proposed system

Figure 3.1: Workflow of proposed Model

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3.2.1 Get Image

Getting Image is the way toward getting a picture from an equipment based source like sensors Surveillance Cameras. For any vision-based frameworks this is the initial step. We capture the pictures utilizing an advanced camera situated by the roadside looking towards the approaching vehicles. Here Figure 3.2.1 show the camera placement. Our point is to get the frontal picture of vehicles that contain a tag as appeared in Figure 3.2.2. Then this caught picture is sent to the database.

Figure 3.2: Camera Placement

Figure 3.3: Captured Number Plate

3.2.2 Preprocessing

Algorithm for changeable the complexity and brilliance of the caught tag picture. There are two phases in pre-handling specifically RGB to dark scale transformation and Noise evacuation [11]. Right off the bat, the framework will change over RGB pictures to dark level pictures. Figure 3.3.2 is speaking to the dark Scale Conversion.
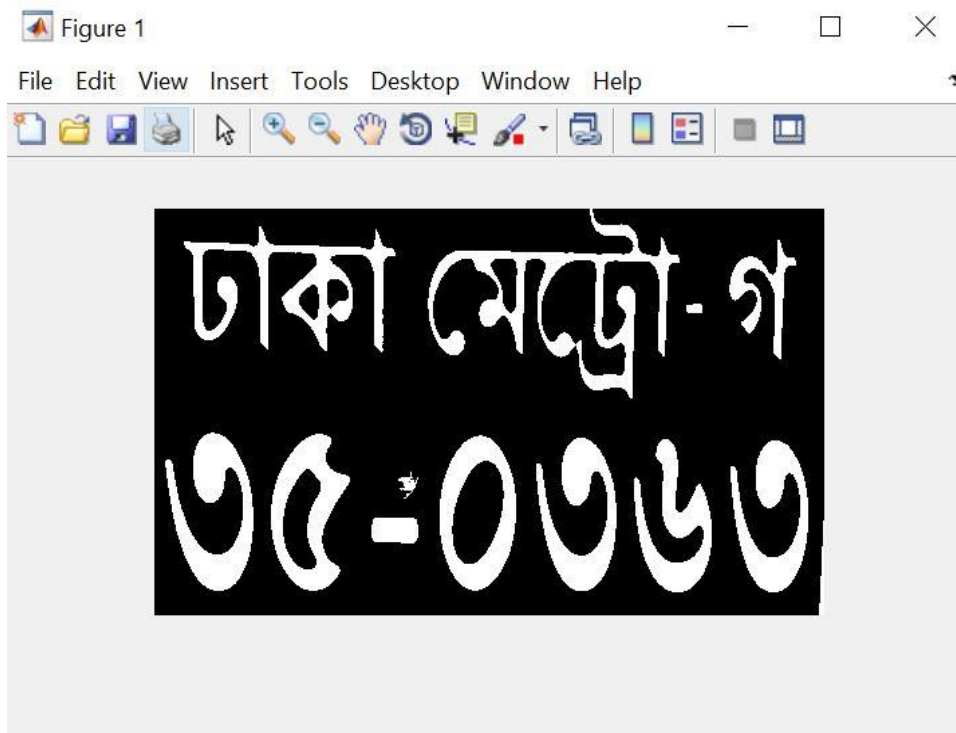
Figure 3.4: Dark Scale Number Plate

Then, the number plate will turn into a binary image from the original RGB image. so that the necessary portion of the plate can be easily extracted. Thesecond Stage is Noise Removal. Separating is utilized to evacuate commotion in a picture.

3.2.3 Character Segmentation

One of the procedures in the number plate acknowledgment is Character segmentation. To move toward the segmentation, we have to think about certain Procedures. Those focuses areas are –

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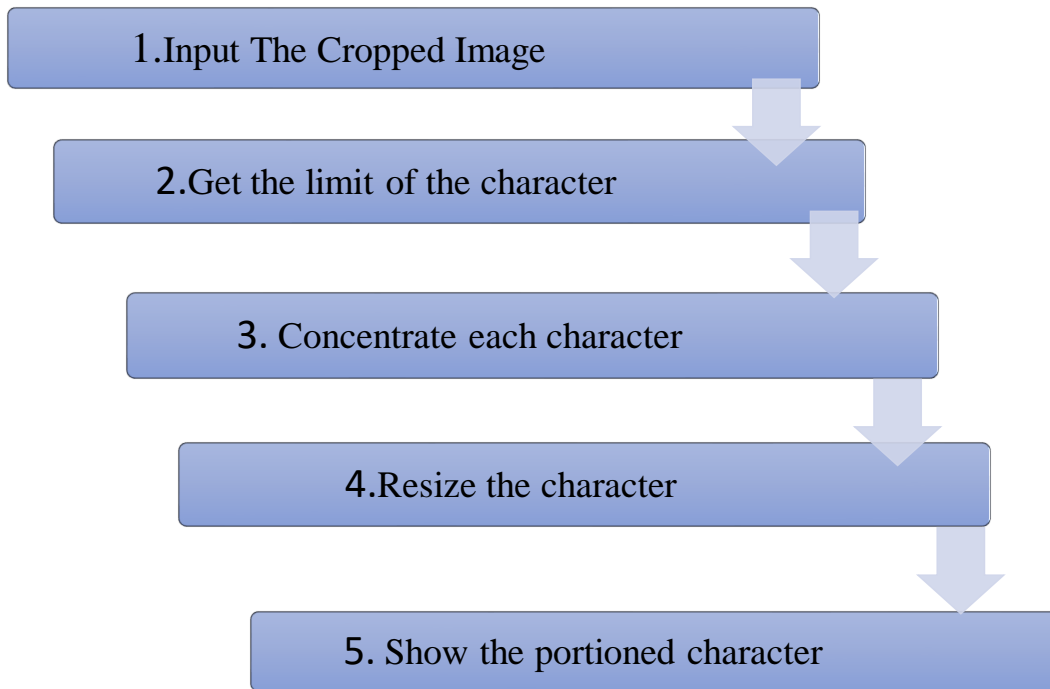
Figure 3.5: Flow Diagram of Segmentation

Input cropped image: Input the Resulted Image for segmentation. Basically, use the gray scale image for segmentation.

Get the limit:After the input cropped image it creates ae boundary over the character as the train data is given.

Resize the character: Character resizing is a procedure used to keep up the homogeneity in measurements between all the trimmed characters and the character formats.

Display the portioned characters: The characters portioned from the number plate are as appeared in Figure 3.6

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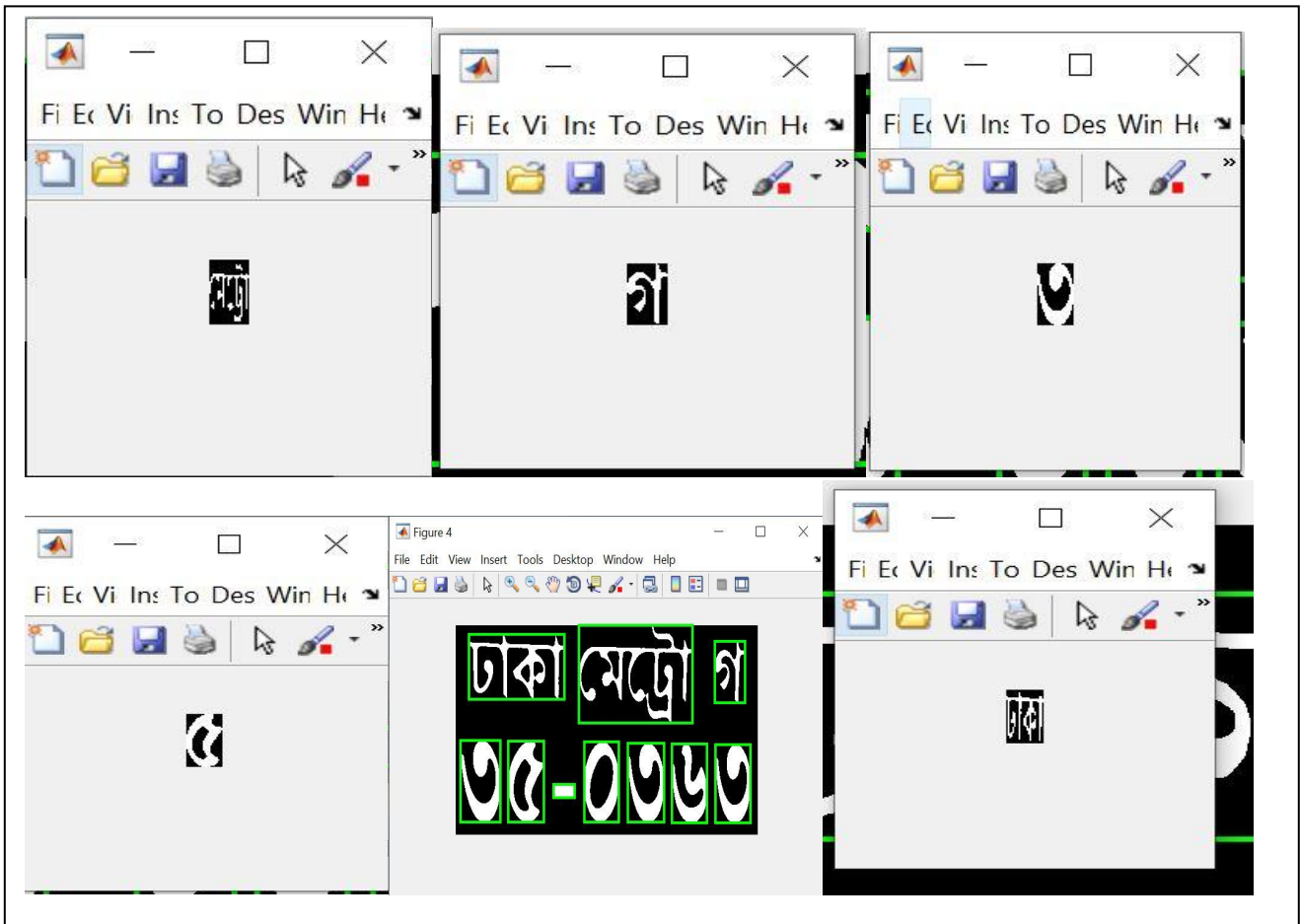
Figure 3.6: Segmented character images

3.2.4 Character recognition

It is applying with the end goal of the change of character pictures into txt format. The subsequent stage is to look at every individual character against the total dataset utilizing relationship or format matching.The coordinating procedure contrasts each fragmented picture and all the layout pictures that are utilized for the dataset. The layouts are as appeared in Figure 3.2.4.
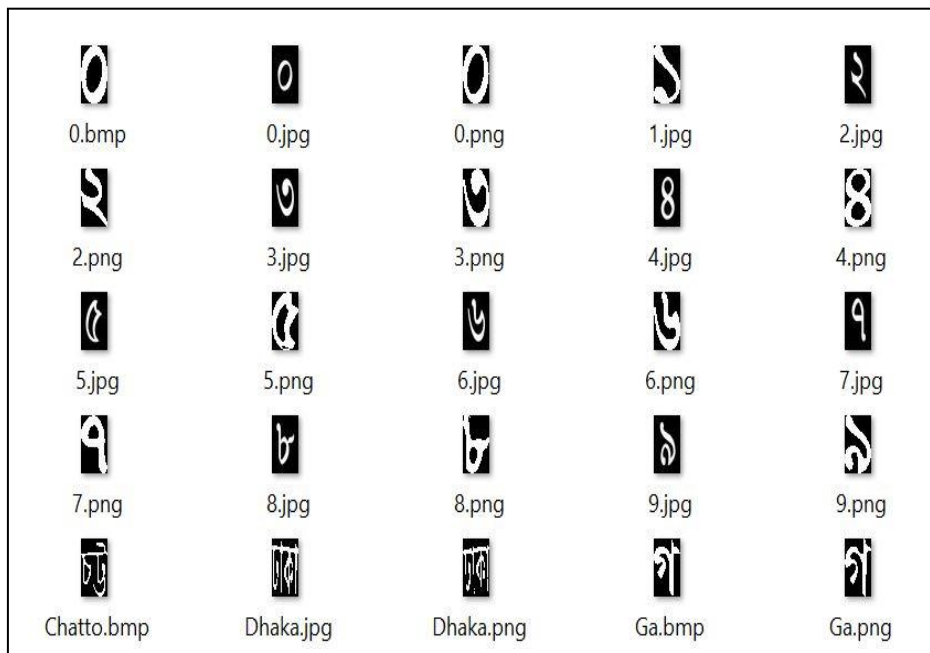
Figure 3.7: Character Templets

When the character is remembered, it is kept in the string design in a variable. This progression yields the enlistment number of a vehicle as appeared in Figure 3.2.5
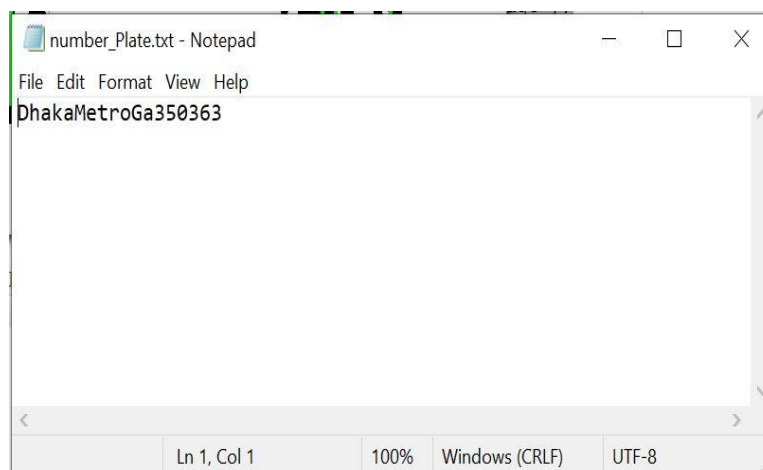
Figure 3.8: NLP Output

3.2.5 Map registration number to contact number

There is a different database is made to spare the vehicle subtleties and the proprietor's contact numbers. The yield vehicle number is contrasted and the vehicle numbers in the database and concentrates the relating contact number. This number is spared in a book document and it is given as contribution to the server.

3.3 Using API for sent Message

For sending a SMS we need to connect the system with GSM module. But it seems to be more complex and low efficiency. Because of this we use an API called "Twilio". For run the "Twilio" API we need to use PYTHON code. Twilio can-

- SMS marketing

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- Push notifications
- Alerts and notifications
- Phone verification

3.3.1 SDKs in Server-Side

SDKs in Server-side make it simple to utilize Twilio's REST APIs, produce Twi ML, and Twi ML do other basic server-side programming assignments. These assistant libraries are accessible in an assortment of mainstream server-side programming dialects, Like as C#. Java. Node.js. PHP Python. Ruby. Salesforce. Here we utilize the PYTHON programming language. Figure 3.3.1 speaks to the Server arrangement Code in PYTHON.

```python
client = Client(account_sid, auth_token)

message = client.messages \
    .create(
        to="+15558675310",
        body="Hey there!",
        from_="+15017122661"
    )
```

Figure 3.9: Configure Server

Figure 3.3.2 Represent the over viewing of Server-Side Dashboard. In This API server we need to create an account. And from this API we can generate the message for appropriate purpose

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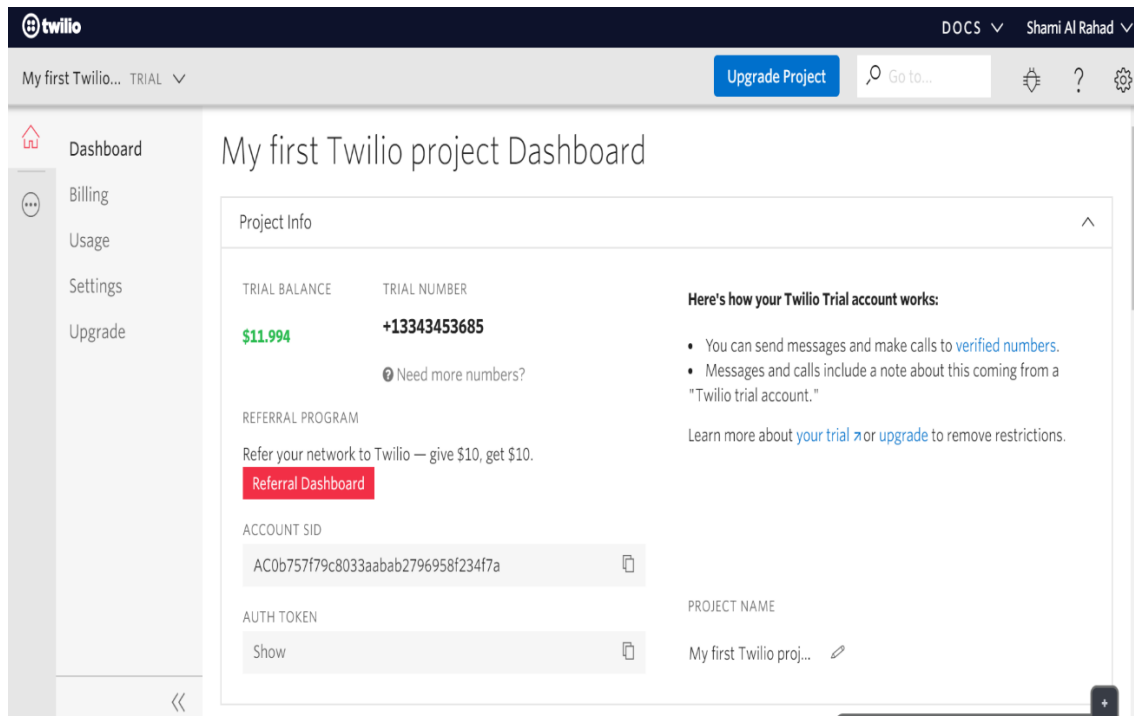
Figure 3.10: Server Dashboard

3.3.3 Send Text message:

After setting up Twilio account and setting up our database, when a car passed through a toll plaza area the system will be send a text message to owners contact number and reduce her/his account money. First of all, the system matches the vehicle plate number with the database and the output result. Then Twi ML get the owners number from the database. And send a valid message with an informative message. Figure: 3.11 represent the overview of text message with this system.

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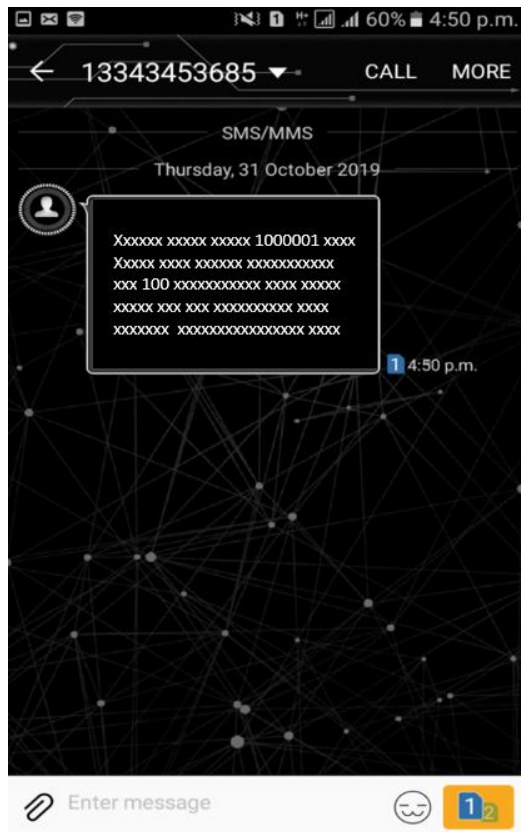
Figure 3.11: text message

3.4. Database Design

A database is a composed component that has the ability of putting away data through which a client can recover put away data in a compelling and productive way. The information is the reason for any database and must be ensured. The database configure ration is a two-level procedure. In the initial step, client necessities are assembled and a database is structured which will meet these prerequisites as plainly as could be expected under the circumstances. This progression is called Information Level Design and it is taken free of any individual DBMS. In the subsequent advance, this Information level structure is moved into a plan for the particular DBMS that will be utilized to execute the framework being referred to. This progression is called Physical Level Design, worried about the attributes of the particular DBMS that will be utilized. A database configure ration runs parallel with the framework plan.

3.4.1 Database Field Design

Table: vehicle info

Primary Key: plate Number

Table 3.1 vehicle Database

Attribute	Data Type	Constraints	Details
Plate Number	Number (10)	Primary	
Image	Image		
Date	Date		

Table: Owner Info

Primary key: plate Number

Table 3.2 Plate Number Database

Attribute Name	Data Type	Constraints	Details
Plate Number	Number (10)	Primary	
Name	char (30)		
Contact No.	Num (15)		
Date	Date		
Address	char (30)		
Remaining Taka	Number		

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CHAPTER 4
EXPERIMENTAL ANALYSIS

4.1 Introduction

We have proposed another ALPR framework to perceive the Bangla tags in Chapter 4 with a calculation for identification, division and acknowledgment stage considering different highlights of the Bangla tag. These calculations are applied utilizing MATLAB 7.1 and applied on 250 greyscale pictures of Bangladeshi vehicles snapped under various conditions like stormy, bright, overcast. The investigation set up and parameter estimations of these calculations in discovery, division, and acknowledgment stages are appeared in Table 4.1, 4.3, and 4.6 separately. This section will quickly portray the yield aftereffect of each stage.

4.1.1 Experimental Setup

Our Proposed framework investigation procedures are done on a PC with a Core-i5,7200U processor having 8 centers with each center having 2.5GHz Speed. Additionally, the framework had 8GB of RAM and 2GB of inner intel HD video memory. For programming MATLAB Version 9.5.0.944444(Release R2018b).

4.2 Number Plate Detection

Test instances of tag identification stages are appeared in Figure. 4.1. Unique info pictures, edge pictures, and the RFIDs are appeared in Figure. 4.1(a), 4.1(b), separately. Exploratory consequences of the vehicle and the tag identification stages are appeared in Table 4.2. Within the sight of complex foundation and profoundly factor tag designs in the info pictures, the normal discovery pace of our calculation is 92.8%. It demonstrates that the presentation of our calculation is superior to anything that of different calculations in identifying Bangla tag.

Table 4.1: Examination set up for tag discovery arrange

Algorithm	Attribute	Output values
Proposed Scheme	Similar window: Height	0.75 portion of input picture height
	Similar window: Width	0.75 portion of input picture width
	Check Window (CW)	5.5x5.5
	Finding area	18 pixels

The other Algorithm required neighborhood sudden changes and a limit that should be set by experimentation, relies upon the separation between the camera and the vehicle, relies upon the situation of the tag in the info picture. Specific conditions caused the calculations to neglect to find the Bangla tag in a picture, where the necessary conditions are absent unequivocally.

Table 4.2: Experimental results in Number Plate detection stage

Algorithms	Conditions	No. of image	Similar detection	Similar detection rate (%)	Number plate detection	Success rate (%)
RFID	Sunny	150	135	89.8	136	90.1
	Cloudy	80	65	82.0	59	78.8
	Night	50	38	76.0	37	95.7
	Total	280	238	85.2	232	83.8

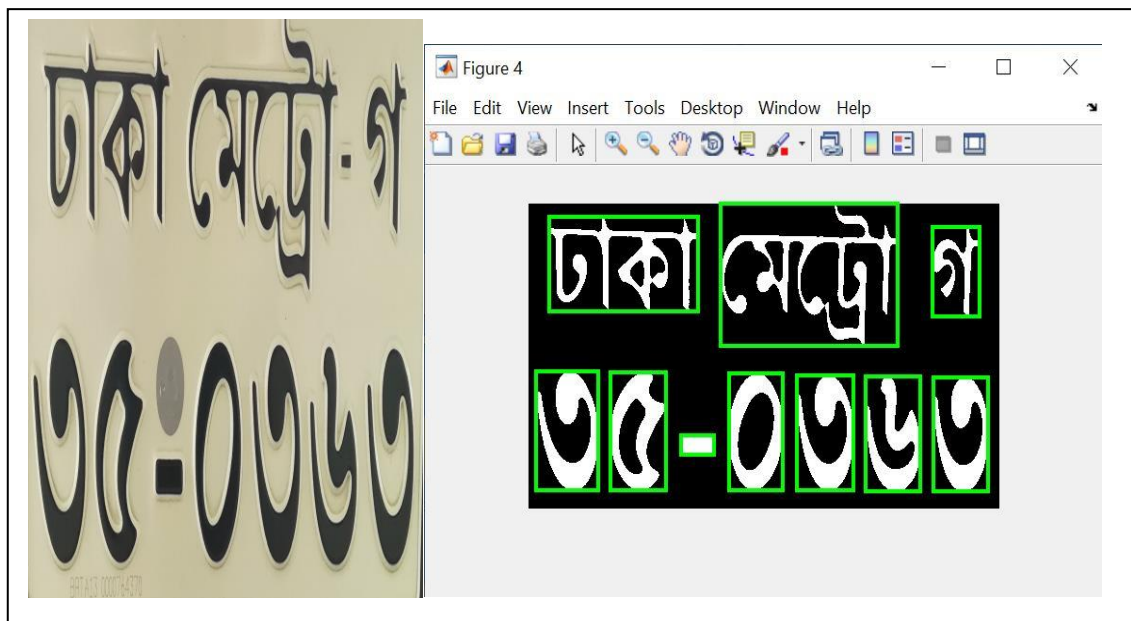Figure. 4.1: LP detection: (a)Input images, (b) Edge images,

4.3 Number Plate Segmentation

The exploratory aftereffects of the line partition calculation are appeared in Table 4.4. The achievement pace of our calculation is 98.4%. Out of the 250 tags, it effectively isolatesthe columns of 246. It neglects to isolate just 4 tags because of the nearness of commotion in the information pictures.

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Table 4.3: Experiment set up for Number Plate segmentation stage.

Algorithms	Attributes	Output
Proposed Scheme	SMA: Window size (W)	6
	Tn	0.01 portion of LP area
	Td	0.125 portion of row height

4.4 Number Plate Recognition

Table 4.4 shows the trial consequences of the character and digit acknowledgment organize. It shows that the right acknowledgment paces of our digit and character classifiers are 97.5% and 88.7% individually. The right acknowledgment pace of the characters which is little lower than that of the digits in light of the fact that the Bangla characters are joint to one another by Marta and the space between two neighboring characters is less contrasted with that of between two contiguous digits.

Table 4.4: The investigation set up for digit and character acknowledgment arrange

Algorithm	Attributes	Output values
Proposed Scheme	No. of Training picture	2150
	Performance Factor	Mean squared error (MSE)
	Training Factor	One Step Secant Back-Prop
	Learning rate	0.06
	Number of loop	570
	Performance goal	10^{-5}

Table 4.5: Experimental results in digit and character classification stage using neural network.

Models	Neural network	No. of Cases	Correctly Classified	Success Rate (%)
Proposed Method	Digit Sorting	650	634	97.5
	Character Sorting	570	506	88.7

4.5 Execution Time Comparison

Assuming in a true situation, vehicles are moving at a speed of 50kmh−1 = 15.33ms−1 towards the camera and the separation between two vehicles is 5m. Thus, an ongoing ALPR framework must process an information picture in 6m/15.33ms−1 = 0.4s. Our proposed LPR framework takes on a normal of 0.16s to perceive a tag in an information picture, though the other LPR frameworks displayed in taking on a normal of 2.3s and 1.8s individually as appeared in Figure. 4.2. Along these lines we can say that our proposed framework is most effective to work and catch a picture and accomplish the entire things in an interim.
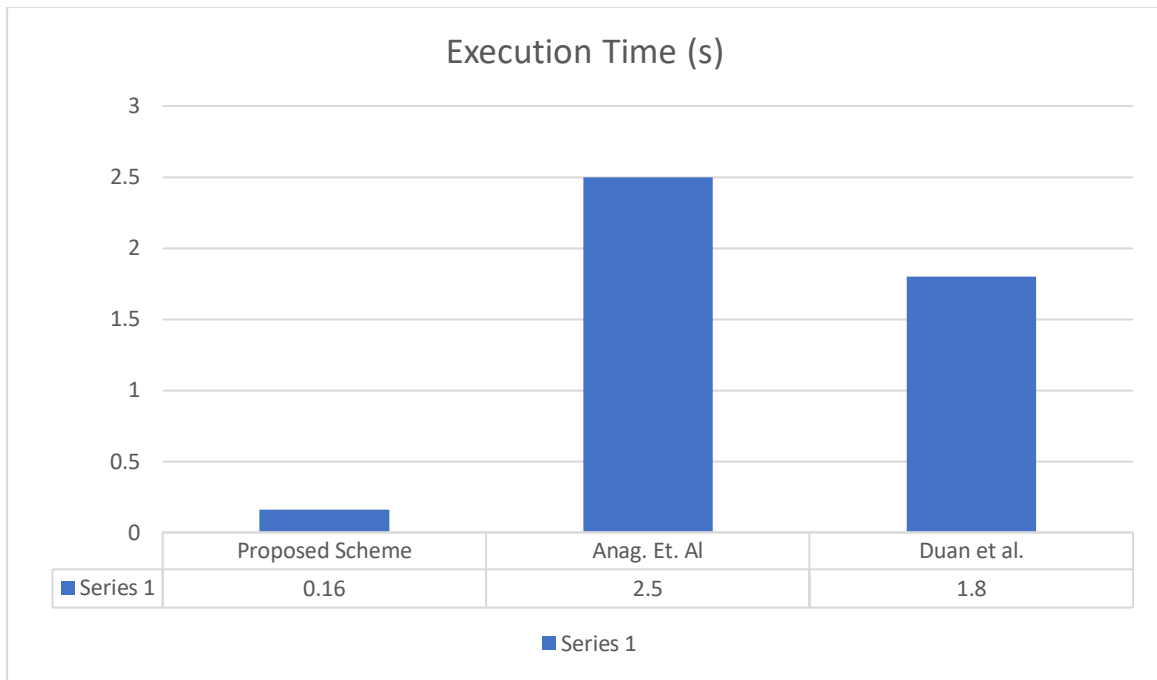
Figure. 4.2: Execution time comparison among the algorithms.

4.6 Summary

The outcomes acquired from our proposed ANPR framework are contrasted and those of the current ANPR frameworks. All the trial results demonstrated that our proposed ANPR framework performs significantly superior to that of the current ANPR frameworks in perceiving Bangla tags also.

CHAPTER 5
CONCLUSION

5.1 Introduction

This chapter summarizes the features and evaluation of the software that is an overall success in the project specification. We also try to review about System limitation. And also talked about to show what more functions could be added and which part of the application can be optimized. And finally, future work will be discussed on the possible extension of this project if further development needs to be done.

5.2 Summary

The proposed technique is intended to actualize digitized that could supplant the present arrangement of manual section and gather toll expenses. Our advancement of the application has met its detail effectively. The division program can effectively fragment the quantity of plates. The framework utilized a progression of picture preparing procedures for recognizing the vehicle from the database put away in the PC. ANPR is an innovative apparatus that is utilized in offering help to the requirement of the law just as guaranteeing the proceeded with wellbeing of all street clients. ANPR is supporting the wellbeing and security of residents all through the world Overall the undertaking is fruitful for recognizing the vehicle number plates dependent on its plate appearance. It very well may be a focal model to be utilized by the transportation business to improve the current framework digitalized.

5.3 System Limitation

There are a few challenges that postpone the positive acknowledgment of a tag in the ALPR framework:

1. Poor picture goals: Poor picture goals may influence if the objective tag is far away from the camera. The utilization of a low-goals camera may likewise cause this issue.

2. Foggy pictures: Snapped pictures may be obscured due to high vehicle speed. A camera with high screen speed can be utilized to maintain a strategic distance from this issue.

3. Poor lighting and low differentiate: Sometime it may be very hard to separate the tag from the foundation because of overexposure, reflection or shadows. Picture differentiation can be balanced by dark scale histogram examination to conquer this issue.

4. Distinctive escape systems before the vehicle close to the tag is a significant trouble in finding tags.

5.4 Suggested Future Works:

The number plate of vehicles acknowledgment phase of our proposed ALPR framework depends on the recognition of rectangular limit of the tag. Perhaps, a tag might not have one kind of limit if the shade of both the vehicle. We can get the foundation of the tag are same constantly. For those situation, our proposed tag discovery framework won't have the option to discover the tag. Moreover, the Bangla language likewise has two covering vowels. They are at times utilized in the Bangla tags. Our proposed division calculation isn't equipped for sectioning these covering vowels. In future work, we hope to improve our tag location and acknowledgment calculations to tackle these issues. Shading data and shading edge locators can be utilized to build the precision of finding tags. Besides, we propose to make the framework mineral quick and flawless to give the best exactness. So as to apply our proposed framework progressively applications all the more efficiently, which require a great deal of research in these fields.

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APPENDIX

Appendix A: Research Reflection

Appendix is about research reflection. The main feature of our application is automated toll collection. Using our application vehicle owner can easily know the location of his vehicle. And this also save time. Conjointly victimization our application individuals will simply establish automatic number plate detection. Within the terribly 1st days, we have a tendency to studied plenty of papers regarding ANPR at all. We've studied plenty to discover the unwellness. Since no same application exists in software package store and plenty of researcher's area unit learning this subject. However, we have a tendency to worked exhausting and tried our greatest to be told and analysis some image process and machine learning technique so the appliance was enforced that achieved the goals within the specification. On the opposite hand, with few demand and constraints, the goal is evident and also the system style is versatile. Firstly, we have a tendency to engineered a model for our project. Then we have a tendency to enforced our project step by step. After several exhausting works and disbursal plenty of your time finally we have a tendency to were ready to reach our goal. The project "Automatic Toll Collection System based on IoT" are going to be terribly useful for drivers or any vehicle owner. Individuals are going to be happy terribly simply. Thus, we have a tendency to believe that our "Automatic Toll Collection System based on IoT" application are going to be terribly positive and effective for users.

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