RAJALAKSHMI
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TRAFFIC VIOLATION ANALYSIS AND NUMBER PLATE RECOGNITION

For the course

IT19644 – INNOVATION AND DESIGN THINKING FOR INFORMATION TECHNOLOGY

Submitted by

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Bonafide Certificate

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1. Abstract

With the steady increase in the number of people preferring personal transport, across the world, managing vehicles has become a tedious task Management of vehicles and transportation square measure long tasks. If it's fally operated manually that reflects huge errors and difficulties. Therefore, it's necessary to develop automatic detection of auto range plate by recognition system. The need for residential parking areas, entails as profession management driven approach is rising unshackled. An awfully sizable amount of the world's population board cities and successively need secure and simple parking areas that they're use daily. Automatic number plate recognition (ANPR) is an image processing technology which makes use of the number(liceme) plate to spot and identify a vehicle. The main objective is to design and develop an effective and economical automatic licensed vehicle identification system by using number plate of the vehicle. The system is enforced on the doorway for security management of extremely restricted areas or regions, like military zones or space around high government offices eg, Parliament, Supreme Court etc. In some countries, ANPR systems are stalled on country borders that automatically detect and monitor border crossings Every vehicle is registered in an exceedingly central database and compared to a black list of purloined vehicles In traffic control, vehicles can be directed to totally different lanes for a more robust congestion management in busy urban communication throughout the frenzy hours. The developed system initially detects the vehicle and then captures the vehicle image Region that contains the vehicle number plate is extracted using image segmentation. The resulting information is then used to compare with the records on a database therefore to come, back, up with the precise data.

2. Introduction

2.1. Scope

The drastic increase in the vehicular traffic on the roadways stimulates a huge demand in the technology for traffic monitoring and management. In this scenario, manual tracking of vehicles running fast on the road is practically not feasible. There will be wastage of man power and time. Even if it is operated manually, that will reflect huge difficulties and enormous errors. There are already available solutions for tracking the vehicles and number plates using machine learning algorithms. But in real time, these algorithms literally fail due to its complexity for processing in real time background. Hence there is an instantaneous necessity to develop an automatic system that will help tracking the vehicles by tracing their number plates in a most efficient way. Besides playing an important role in vehicle tracking, Automatic Number Plate Recognition (ANPR) also plays an inevitable role in systems like parking management systems, toll payment processing systems etc., and several systems where authorization is a much needed. It greatly helps security officers to save their time by automating the process. In recent decades, computer vision technology has taken great strides on several real world issues. In earlier days vehicle number plates were identified using template matching techniques by identifying the width,

height, contour area etc., Now several deep learning models trained over an enormous amount of data is widely used in Number Plate Recognition. In this paper, two CNN models are used. License plate recognition is one of the important components of modern intelligent transportation systems, and it is widely used. Based on digital image processing, pattern recognition, computer vision and other technologies, the vehicle image or video sequence will be analyzed to obtain the unique license plate number of each car. Through some subsequent processing methods, it can handle parking lot charge management, traffic flow control index measurement, vehicle positioning, automobile anti-theft measures, highway speeding supervision, red light enforcement, highway tolling and so on. It is of practical significance to maintain traffic safety and urban security, prevent traffic jams, and realize automatic traffic management.This paper creates an efficient base system for all these applications. This ANPR is a very complex task. At the moving speed of the vehicles, the images captured must be sufficient enough in brightness, intensity and clarity to be processed further. Furthermore, the angle at which the images are taken forms a major part.

2.2. Acronyms , Definitions & Abbreviations

CNN – Convolutional Neural Network
RFID - Radio Frequency Identification Technology
ReLu - Rectified Linear Unit
ANPR - Automatic Number Plate Recognition
RGB – Red green blue

3. Literature Survey

In reference [1], the K-means algorithm was used to recognize the license plate characters from an image. The K-means algorithm in this study was developed by proposing an automatic cluster number determined by filtering scale-invariant feature transform (SIFT) key points. They performed a 6-layer cascaded classifier for license plate localization by applying global edge and local Harr-like features. The authors achieved a 94.03% accuracy on 578 images from Chinese license plates with 3502 characters, by applying several methods consisting of image binarization, vertical edge detection, horizontal and vertical image projections, and modified K-means segmentation algorithm. They also applied the Tesseract OCR software for character recognition. These methodologies are time-consuming and require several preprocessing techniques.

In reference [2], a combination of the K-Nearest Neighbors algorithm and the Multi-Class Support Vector Machines (KNN-SVM) model for the Iranian License plate recognition system was developed. To reduce the noise of images, they applied K-NN algorithms which is sufficient for big datasets. Multiple SVMs classification models with RBF kernel have been employed to resolve the license plate character recognition problem. The SVMs model has enhanced the

performance of the K-NN in character recognition specifically for similar characters. The authors claimed that their system obtained a 97.03% accuracy ratio for all their experiments. Although the system has an acceptable accuracy ratio, the most significant problem is in what the system is unable to recognize the screw from the character in some images. For instance, it is complicated to distinguish number '1' plus a screw from number '9' in Persian license plate's fonts.

In reference [3], a K-Nearest Neighbors algorithm was proposed with pre-training steps to recognize numbers and letters on multi-style license plates. For instance, single-line and doubleline, and complex backgrounds and character's colors on Korean and the United State license plates. The authors evaluated 50 minutes video of 138 different vehicles with various styles and reached above 99% accuracy under 50 millisecond processing time on characters recognition, but the system has limitation of recognizing Korean and US license plates.

In reference [4], the authors used the morphological procedures such as the Fuzzy transformation and Fuzzy logic edge detection algorithm to extract the location of license 4 plates. Furthermore, they adopted character segmentation and template matching by utilizing correlation to recognize the license plate characters and achieved a 90.18% accuracy ratio in the extraction of number plates and a 79.30% accuracy ratio in character recognition which is not acceptable in terms of character recognition.

The work discussed in [5] is based on single-level wavelet transform, and their algorithm performed acceptably in different situations on Indian license plates. They conducted their experiments under various lighting conditions, and on different vehicle models with various shapes, sizes, and colors of license plates. The input colored images were 400 × 300 pixels, and they used 250 license plate images. In order to segment the characters, they plotted the vertical frequency's energy curve for license plates with two lines. The authors also utilized a statistical correlation-based method of template matching for character recognition. To overcome failure in determining the difference between some complicated letters and numbers such as 'O' and '0', they considered some special properties of each character, such as the aspect ratio of the character's horizontal to vertical length. Their method performed a 97.33% accuracy for plate localization, a 95.93% accuracy for character segmentation, and a 95.6% accuracy for character recognition. However, the system has adequate accuracy but incapable of recognizing complicated license plate's backgrounds and needs many preprocessing steps.

In reference [6], they discussed a new method for text localization and recognition in natural scene images with complex backgrounds. Their approach had several steps;" superimposed text regions in an image was extracted based on character descriptor features like Bounding box, Perimeter, Euler number, Horizontal crossings" [6]. Then they used SVM classifiers to test if the text region included letters or not. They did line segmentation by applying horizontal profiles. Subsequently, they segmented each character by utilizing vertical profiles. Toward character

recognition, they used Optical Character Recognition (OCR) tools. Their various accuracy outcomes for different methods such as the Ostu algorithm, AdaBoost and SVM were 64.40%, 75.04%, %78.80% respectively. Although this methodology works properly with complex backgrounds, we need a more accurate system for license plate character recognition.

In reference [7], a system for Indian vehicle license plates detection with different font faces (Arial, Courier and Times New Roman) was tested on a small private database. In the suggested approach, the morphological operations, and horizontal/vertical edge histogram were applied to localize and character segmentation. In this methodology, license plate localization, character segmentation, and character recognition had accuracies of 92%, 92%, and 87% respectively which are not acceptable for such a time-consuming algorithm.

3.1. Key Challenges

The purpose of this study was to investigate the characteristics of traffic violations,crashes and identify their trends, and describe the patterns for different demographic groups. The analysis showed that the number of crashes and violations is increasing with the huge increase in population during the same period

3.2. Motivation

Before starting this project a survey was conducted by us. The data collected were related to the traffic violations that's been happening. After performing an exploratory data analysis on the data collected, it was evident that most traffic violations and accidents occur during night time when there are no policemen and as there is no traffic during that time. Governments and private companies normally use cameras specifically designed for character recognition and vehicle detection . But as a matter of the fact, on the roads, specifically, when there is no governmental camera, police car's cameras are highly affected due to the car's speed, angles, or weather condition, and they do not provide acceptable resolution under certain weather conditions. The license plates convey much information from the vehicles, so, having such a system is vital. To mention some of the challenges we can point out to the low quality, blur, and uneven illumination as well as various types of font, number of characters, their size, color, direction, and complex background in different countries or even different provinces within a country. So without a doubt a better model for recognizing the number plate of the vehicle which overspeeds or violates the traffic rule can be easily recognized. The Deep Convolutional Neural Network (CNN) is one of the best machine learning techniques used for vehicle and license plate recognition systems.

4. Development life cycle

4.1. Empathize

In order to create desirable product, we need to understand who our users are and what they need. What are their expectations in relation to the product we are designing? What challenges and pain points do they facewithin this context?

The proposed system aims to build an application that will automatically detect and identify vehicles by making use of the number plated in them. The detection model uses Opencv for detection purpose. The proposed system aims to detect and recognize license plate in many number of situations like single vehicle, many vehicles at a time (or in one frame), insufficient lighting, video noise, etc. It plans to achieve maximum accuracy without compromising the speed of the process. Then we have successfully detecting the number plate, we crop the image using bounding box coordinates (bounding box is an expression of the maximum extents of a twodimensional object). Thus the number plate is identified in the images that been tested and the accuracy have been produced. Further the accuracy can be increased as the epoch value can be increased.

4.2. Define

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are handengineered, with enough training, ConvNets have the ability to learn these filters/characteristics.[6] The architecture of a ConvNet is analogous to that of the connectivity pattern of Neurons in the Human Brain and was inspired by the organization of the Visual Cortex. Individual neurons respond to stimuli only in a restricted region of the visual field known as the Receptive Field. A collection of such fields overlap to cover the entire visual area. A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

CNN involves four key operational layers like

- Convolution,
- ReLu (Non-linearity),
- Maximum pooling and
- Fully Connected layer.

The schematic representation of the CNN based proposed methodology is shown in Fig. 1. The process of Convolution includes the formation of the featured layer by multiplying the values in the filter with the original pixel values of the image. Inputs from the convolution layer are smoothened to reduce the sensitive nature of the filters towards noise and variations. The process of pooling mainly reduces the

size of the image, or the color contrast across red, green, blue (RGB) channels. CNN is compatible to a wide variety of complex activation functions to model signal propagation. One of the common function is the Rectified Linear Unit (ReLU), is favourable for its faster training speed. The last layers in the network are fully connected, where the neurons of preceding layers are connected to every neuron in subsequent layers.

4.2.1. Overall Description

4.2.1.1. Product perspective

4.2.1.2. System Architecture

The concept of Convolutional Neural Networks (CNNs) first proposed by LeCun in 1989. CNN is a deep learning algorithm that is able to classify the objects from a given image by assigning learned weights and biases. Compared with other classification algorithms, the CNN needs less pre-processing and it is able to learn complex patterns mapped to high dimensional features. Inspired by CNN, many problems in the field of computer vision have been solved. Object detection ,object recognition, optical character recognition face detection and license plate recognition are all tasks where CNNs have achieved state-of-the-art results. The downside of the CNNs is that they usually are extremely computationally intensive for large datasets. Without preprocessing, the CNN requires more perceptron to see the patterns and it increases the time per training sample and the number of epochs to reach convergence. Hence, in some circumstances, preprocessing can make a positive effect to reduce the computation time. However, it may decrease the accuracy of the system. The output is a classification of the image, and the overall results can be improved by applying a loss function to minimize it over training.

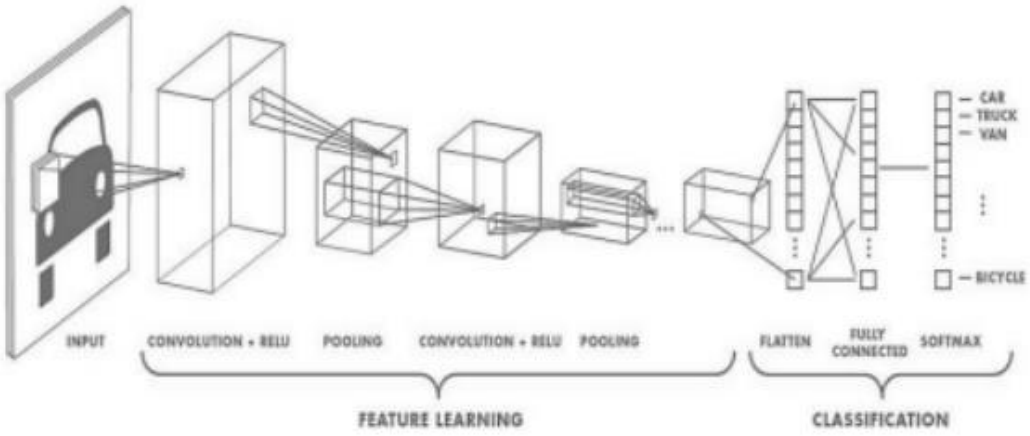

Fig 4.1 System Architecture

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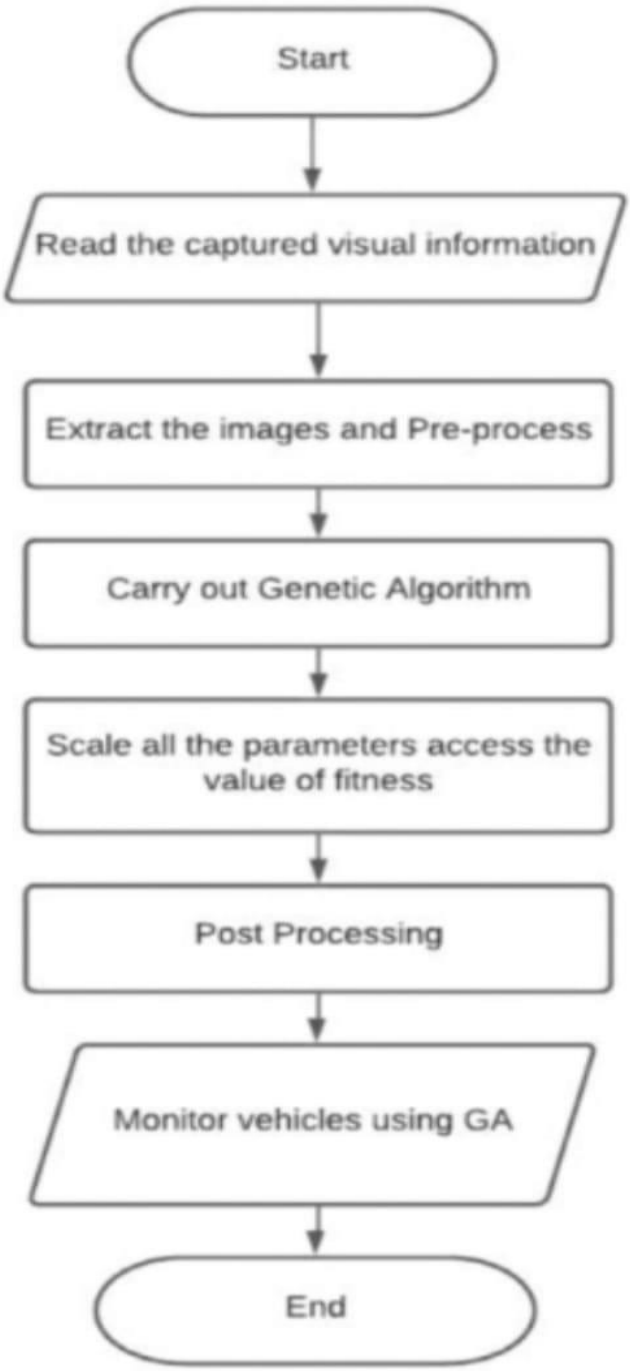
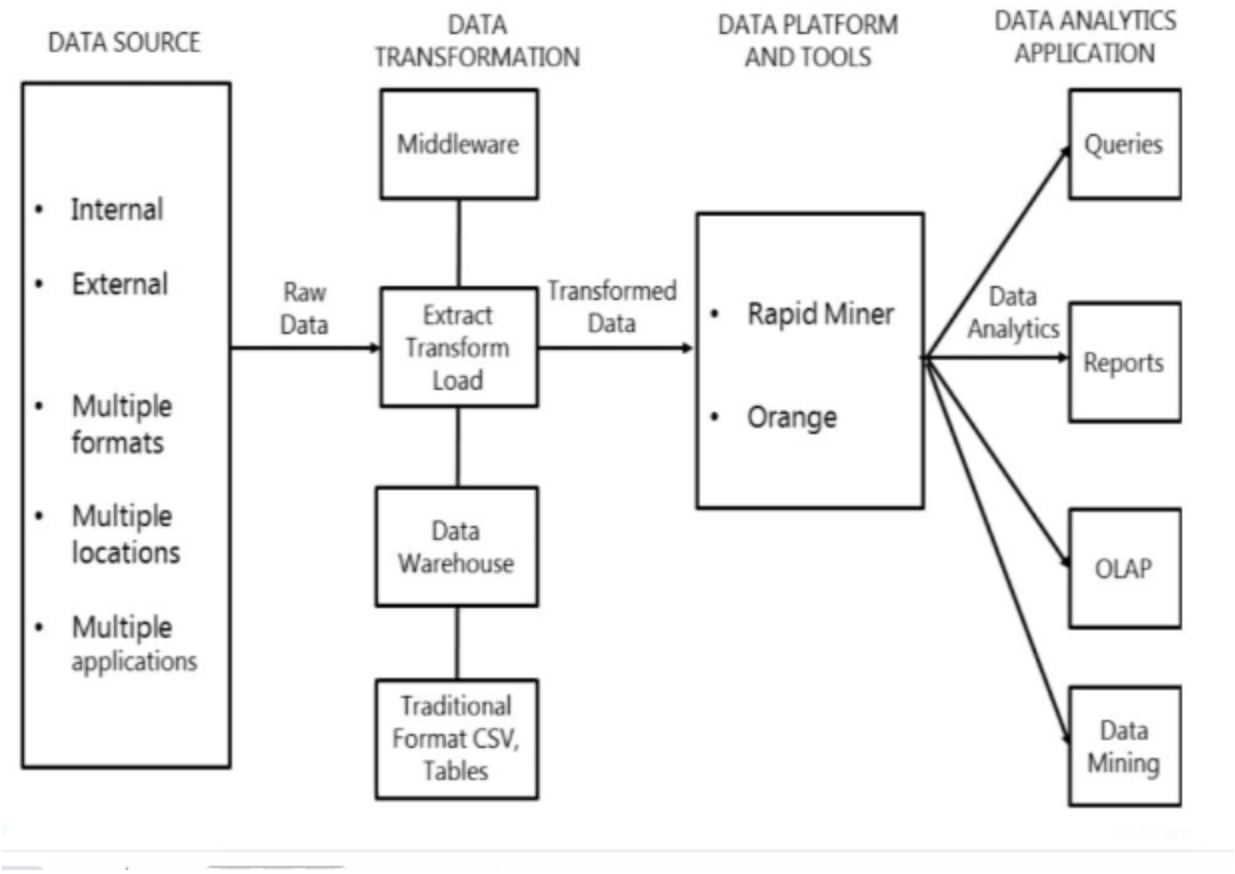
4.2.1.3. System Interface

At first the real images are captured through the mobile phone, these are sent to system, Then workflow the processing and testing takes place and finally the output of object detected is given in 18 audio. It also gives the distance the object. The given above are flowcharts and an overview of our project.



4.2.1.4. User interface



4.2.1.5. Hardware requirements

The following hardware and software requirements are used for this project.
Camera

4.2.1.6. Software interface

- **Python**

Python is a programming language that lets you work quickly and integrate systems more effectively. It is and interpreted language that follows various paradigms like functional, imperative, object-oriented, structured and eflective. Python is dynamically-typed and garbage collected. The language has various libraries such as NumPy, SciPy and Matplotlib which allow the efficiency in scientific computing (data science). It plays a major role in development of artificial intelligence projects and machine learning projects due to abundance of libraries such as TensorFlow, Keras, Pytorch, Scikit-learn etc,

- **Anaconda**

Anaconda is a distribution of the Python and R programming languages for scientific computing (data science, machine learning applications, large-scale data processing, predictive analytics, etc.), that aims to simplify package management and deployment. The distribution ncludes data-

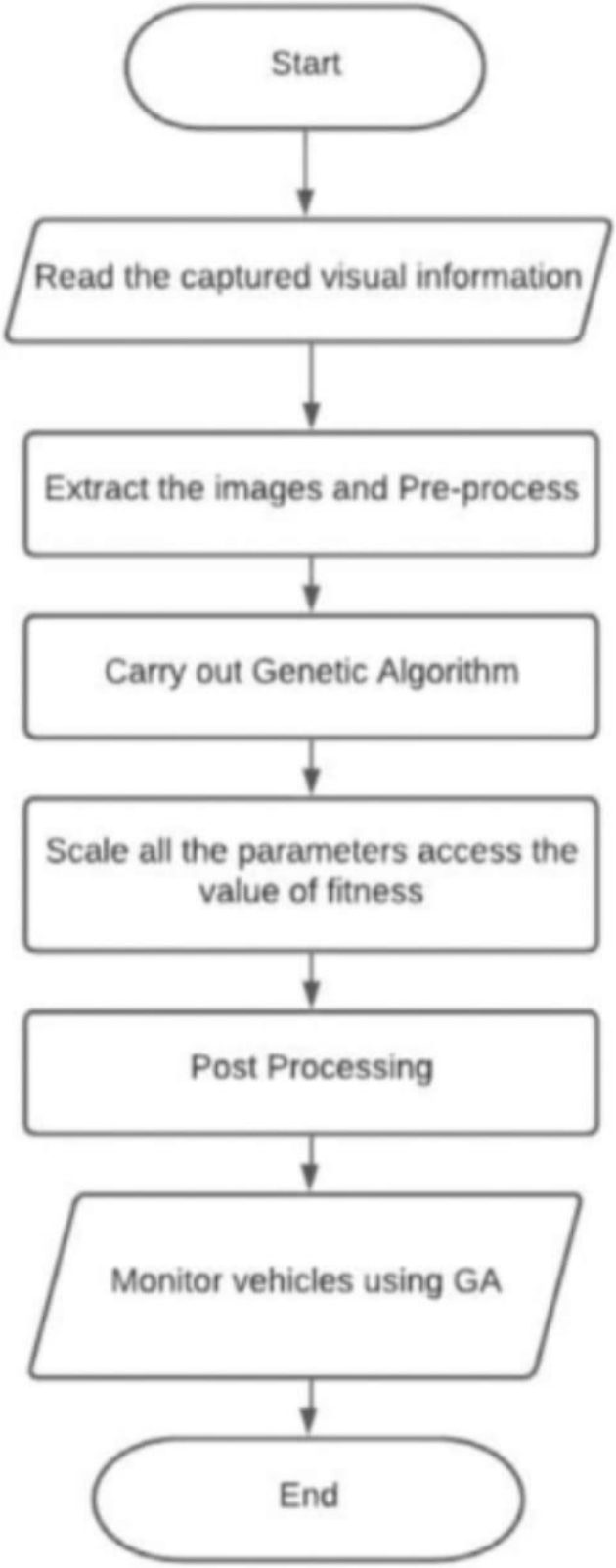
science packages suitable for Windows, Linux, and macOS. It is developed and maintained by Anaconda, Inc. It comes with over 250 packages automatically installed, and over 7,500 additional open-source packages can be installed from PyPI as well as the conda package and virtual environment manager. It also includes a GUI, Anaconda Navigator, as a graphical alternative to the command line interface (CLI). Anaconda Cloud is a also available. It is a package management service by Anaconda where users can find, access, store and share public and private notebooks, environments, and conda and PyPI packages.

4.2.1.7. Communication interface

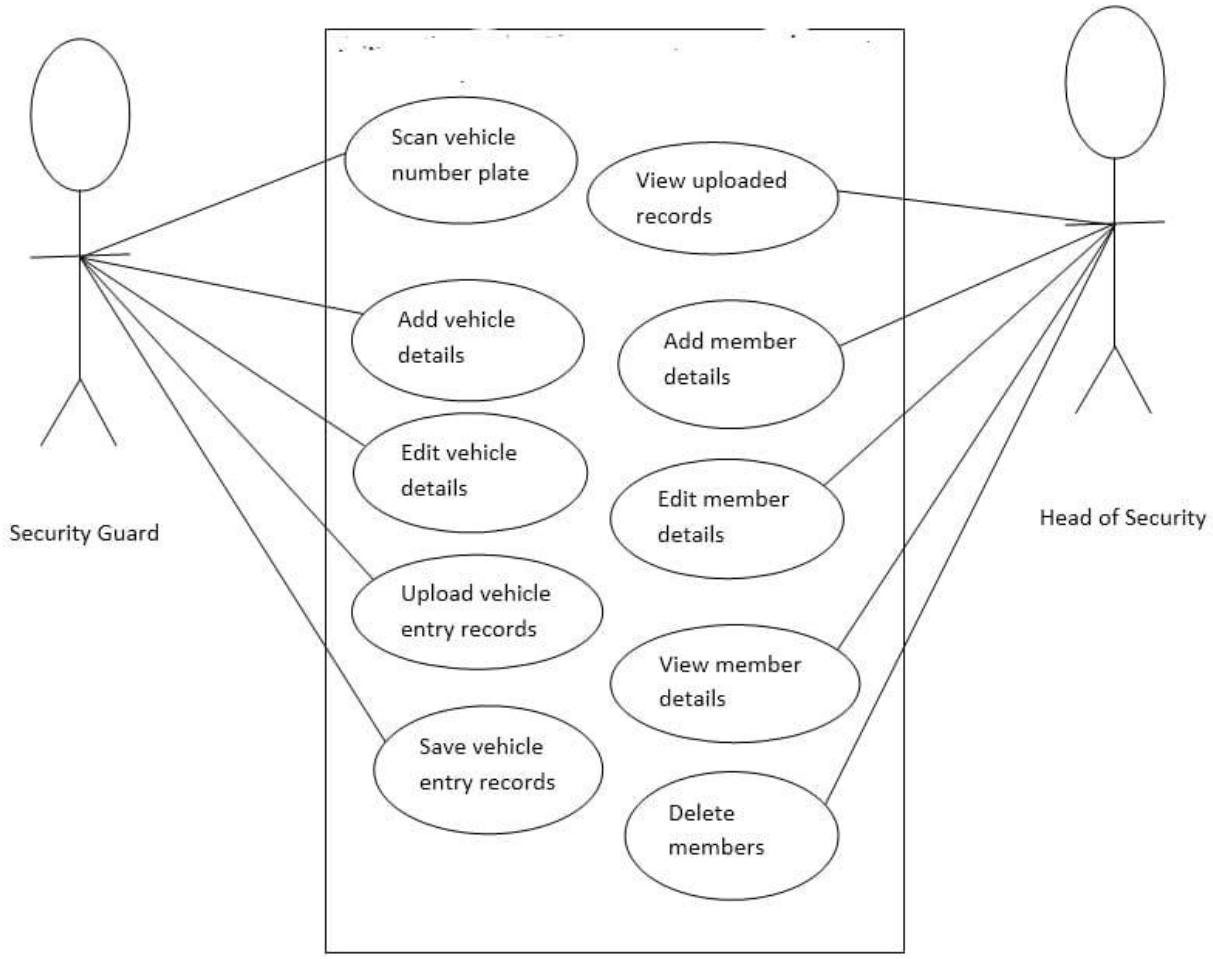
A ConvNet is able to successfully capture the Spatial and Temporal dependencies in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

4.2.2. Product functions

4.2.2.1. Context diagram


Start
Read the captured visual information
Extract the images and Pre-process
Carry out Genetic Algorithm
Scale all the parameters access the value of fitness
Post Processing
Monitor vehicles using GA
End

4.2.2.2. Use case diagram



4.2.2.3. User characteristics

The purpose of this study was to investigate the characteristics of traffic violations,crashes and identify their trends, and describe the patterns for different demographic groups. The analysis showed that the number of crashes and violations is increasing with the huge increase in population during the same period.

4.2.2.4. Constraints

The current means of vehicle management involves manual logging and physical checking. FASTAG is an existing system for vehicle management. FASTAG is a Radio Frequency Identification Technology (RFID) introduced by the Government of India in October 2017 by the

Ministry of Road Transport and Highway. This measure was taken keeping in scrutiny several inconveniences for both individual drivers and the nation at large.There are a few systems in which sensors are used to detect vehicles. If a vehicle is entering a parking lot, a sensor detects the vehicle and opens the barricade, letting it through.

4.2.2.5. Performance requirements

Performance Measures In this research, the method to measure accuracy of recognition rate is based on the objective evaluation. The number of error can be defined as the total characters to be recognized subtracted with the characters that do not match with the correct character or original character, such as character insertion, deletion and substitution. If there are n total characters to be recognized, the processing second in milliseconds was also recorded in our experiments. Additional complexity will be justified if the additional computational time is negligible

4.3. Ideate

Ideation is a creative process where designers generate ideas in sessions (e.g., brainstorming, worst possible idea). It is the third stage in the Design Thinking process. Participants gather with open minds to produce as many ideas as they can to address a problem statement in a facilitated, judgmentfree environment. It's challenging to gain the perspective to find design solutions. To have productive ideation sessions, you'll need a dedicated environment for standing back to seek and see every angle. First, though, your team must define the right problem to address. Ideation, or "Ideate", is the third step in the Design Thinking process – after “Empathize” (gaining user insights from research/observation) and “Define” (finding links/patterns within those insights to create a meaningful and workable problem statement or point of view).

4.4. Prototype

More than 100 records were collected from people and exploratory data analysis was performed on the dataset after cleaning it. Many observations and insights were taken from it like the sex which violates traffic much, etc. It was obvious that people tend to violate it in the night and it was the motivation for the later. A CNN model was successfully made with test size as 10%. The model works with an accuracy of 84% when 10 epochs are run. It gives an accuracy of 95% when 50 epochs are run. Depending on the system capability the epochs can be changed and the accuracy can be increased. Due to low system power, results were given for 10 epochs.

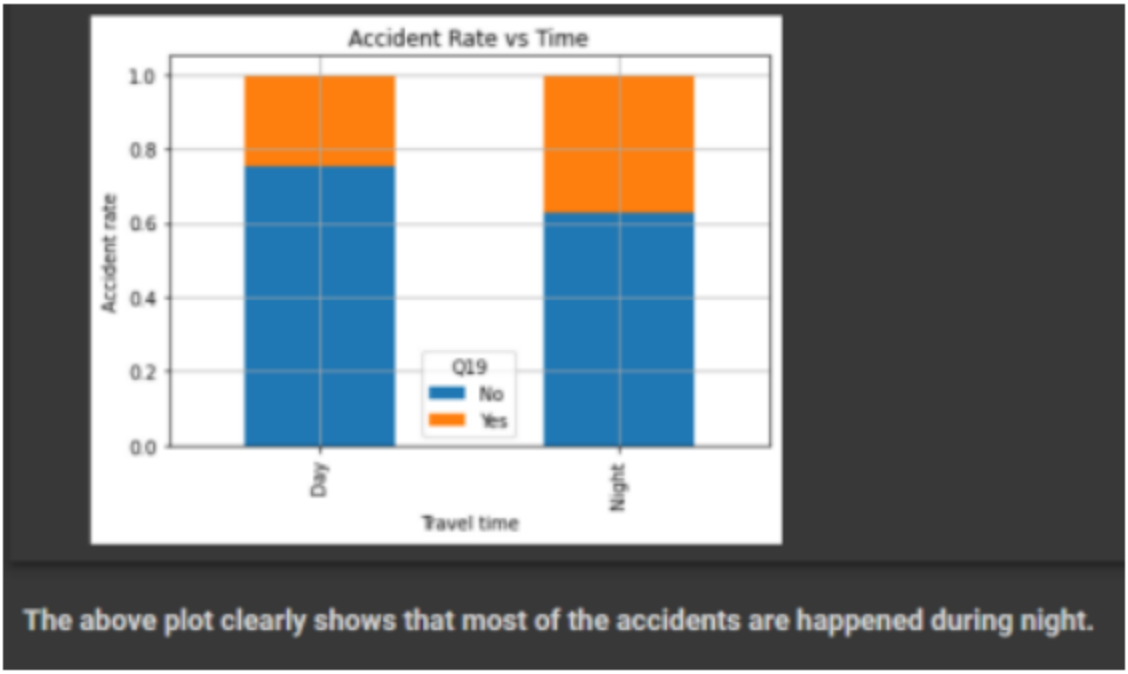
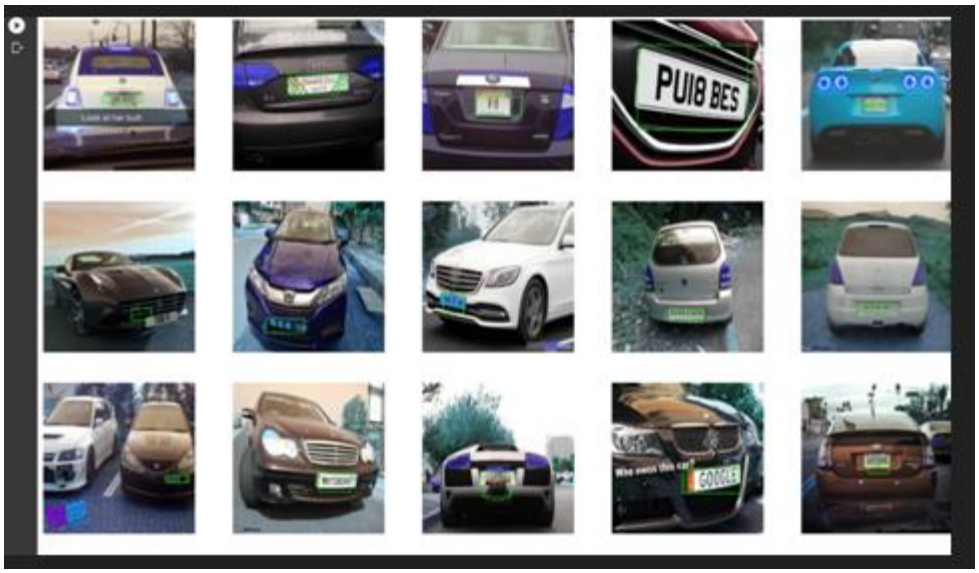


Fig 5.2 Change in epoch value



4.5. Test

The testing phase of the software development lifecycle (SDLC) is where you focus on investigation and discovery. During the testing phase, developers find out whether their code and programming work according to customer requirements. And while it's not possible to solve all the failures you might find during the testing phase, it is possible to use the results from this phase to reduce the number of errors within the software program.

Before testing can begin, the project team develops a test plan. The test plan includes the types of testing you'll be using, resources for testing, how the software will be tested, who should be the testers during each phase, and test scripts, which are instructions each tester uses to test the software. Test scripts ensure consistency while testing.

There are several types of testing during the test phase, including quality assurance testing (QA), system integration testing (SIT), and user acceptance testing (UAT).

Program code

```
import pandas as pd
import numpy as np from matplotlib
 import pyplot as plt
import seaborn as sns
 import cv2
import os
import glob
IMAGE_SIZE = 200
```

```
img_dir = "/content/dataset/images"
data_path = os.path.join(img_dir,'*g')
files = glob.glob(data_path)
 files.sort()
X=[]
for f1 in files:
img = cv2.imread(f1)
 img = cv2.resize(img, (IMAGE_SIZE,IMAGE_SIZE))
 X.append(np.array(img))
from lxml import etree
def resizeannotation(f):
tree = etree.parse(f)
for dim in tree.xpath("size"):
width = int(dim.xpath("width")[0].text)
 height = int(dim.xpath("height")[0].text)
for dim in tree.xpath("object/bndbox"):
 xmin = int(dim.xpath("xmin")[0].text)/(width/IMAGE_SIZE)
 ymin = int(dim.xpath("ymin")[0].text)/(height/IMAGE_SIZE)
xmax = int(dim.xpath("xmax")[0].text)/(width/IMAGE_SIZE)
ymax = int(dim.xpath("ymax")[0].text)/(height/IMAGE_SIZE)
 return [int(xmax), int(ymax), int(xmin), int(ymin)]
 path = '/content/dataset/annotations'
 text_files = ['/content/dataset/annotations/'+f for f in sorted(os.listdir(path))]
y=[]
for i in text_files:
y.append(resizeannotation(i))
 plt.figure(figsize=(10,20))
 for i in range(0,17) :
plt.subplot(10,5,i+1)
plt.axis('off')
 plt.imshow(X[i])
X=np.array(X)
y=np.array(y)
X = X / 255
y = y / 255
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1, random_state=1)
from keras.models import Sequential
from keras.layers import Dense, Flatten
from keras.applications.vgg16 import VGG16
model = Sequential()
```

```
model.add(VGG16(weights="imagenet", include_top=False, input_shape=(IMAGE_SIZE, IMAGE_SIZE, 3)))
model.add(Flatten())
 model.add(Dense(128, activation="relu"))
 model.add(Dense(128, activation="relu"))
model.add(Dense(64, activation="relu"))
 model.add(Dense(4, activation="sigmoid"))
model.layers[-6].trainable = False
model.summary()
model.compile(loss='mean_squared_error', optimizer='adam', metrics=['accuracy'])
train = model.fit(X_train, y_train, validation_data=(X_test, y_test), epochs=10, batch_size=32, verbose=1)
y_cnn = model.predict(X_test)
plt.figure(figsize=(20,40))
 for i in range(0,43) :
plt.subplot(10,5,i+1)
 plt.axis('off')
ny = y_cnn[i]*255
 image=cv2.rectangle(X_test[i],(int(ny[0]),int(ny[1])),(int(ny[2]),int(ny[3])),(0, 255, 0))
  plt.imshow(image)
```

5. Conclusion and Future Enhancement

In this paper, the automatic number plate recognition system using vehicle license plate is introduced. This paper presents a recognition method in which the vehicle plate image is obtained by the digital cameras and the image is processed to get the number plate information. rear image of a vehicle is captured and processed using various algorithms. The system utilizes image processing techniques for recognizing the vehicle from the database stored in the computer by user. Further we are planning to study about the characteristics involved with the automatic number plate system for better performance. The system works agreeably for wide variation of conditions and distinctive sorts of number plates. In the existing work, work has been done on contorted number plates. This method has an issue of commotion and image is taken from separation. In proposed work a system has been proposed for denoising and for the better character reorganization using standard classifiers of neural networks and give better body detection. Today advances technology took Automatic Number Plate Recognition (ANPR) systems from hard to set up, limited expensive, fixed based applications to simple mobile ones in which point to shoot" method can be used. This is possible because of the creation of software which ran on cheaper PC based and also non specialist hardware in which their no need to give pre- defined direction, angels, speed and size in which the plate would be passing the camera field of view. Also, Smaller cameras which can read license plates at high speed, along with

smaller, more durable processors that can fit in police vehicles, allowed law enforcement officers to patrol daily with the benefit of license plate recognition in real time.

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