A Mini-Project Report

On

"TRAFFIC SIGN RECOGNITION"

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CERTIFICATE

This is to certify that the mini-project report entitled "**TRAFFIC SIGN RECOGNITION**" submitted by **Mr NEERAJ KUMAR GUPTA (Roll.No:69), Mr. PRATHAM KUMAR(Roll No:77), Mr. SHASHWAT SINGH (Roll.No:101)** to the Galgotias College of Engineering & Technology, Greater Noida, Utter Pradesh, affiliated to Dr. A.P.J. Abdul Kalam Technical University Lucknow, Uttar Pradesh in partial fulfilment the award of Degree of Bachelor of Technology in Computer science & Engineering is a bonafide record of the project work carried out by them under my supervision during the year 2021-2022.

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ABSTRACT

This paper describes a computer vision-based system for real-time robust traffic sign detection, tracking, and recognition. Such a framework is of major interest for driver assistance in an intelligent automotive cockpit environment. The proposed approach consists of two components. First, signs are detected using a set of Haar wavelet features obtained from AdaBoost training. Compared to previously published approaches, our solution offers a generic, joint modelling of colour and shape information without the need of tuning free parameters. Once detected, objects are efficiently tracked within a temporal information propagation framework. Second, classification is performed using Bayesian generative modelling. Making use of the tracking information, hypotheses are fused over multiple frames. Experiments show high detection and recognition accuracy and a frame rate of approximately 10 frames per second on a standard PC.

Important information can be provided to the drivers by the signs on the road like safety, warning and navigation, thus computer-based system for automatic recognition and detection of road sign grows popular these days. Designing a traffic sign detection and recognition use computer capabilities to aid the transportation systems can be very useful, it is also possible to add robotic assistance like cameras that are equipped with an auto detection system for traffic signs on the road. Traffic signs play a vital role in

transportation system. Many road accidents occur due to lack of traffic signs. Detecting and classifying different group of traffic signs can save our lives as well as resources. Traffic sign detection and recognition systems are essential components of Advanced Driver Assistance Systems and self-driving vehicles.

In this study we present a vision-based framework which detects and recognizes traffic signs inside the attentional visual field of drivers. Designing smarter vehicles, aiming to minimize the number of drivers based wrong decisions or accidents, which can be faced with during the drive, is one of hot topics of today’s automotive technology. In the design of smarter vehicles, several research issues can be addressed; one of them is Traffic Sign Recognition (TSR). In TSR systems, the aim is to remind or warn drivers about the restrictions, dangers or other information imparted by traffic signs, beforehand. In this study a Traffic Sign Recognition System, having ability of detection and classification of traffic signs even with bad visual artifacts those originate from some weather conditions or other circumstances, is developed.

Traffic sign recognition system (TSRS) is a significant portion of intelligent transportation system (ITS). Being able to identify traffic signs accurately and effectively can improve the driving safety. This paper brings forward a traffic sign recognition technique on the strength of deep learning, which mainly aims at the detection and classification of circular signs. Firstly, an image is pre-processed to highlight important information. Secondly, Hough Transform is used for detecting and locating areas. Finally, the detected road traffic signs are classified based on deep learning. In this article, a traffic sign detection and identification method on account of the image processing is proposed, which is combined with convolutional neural network (CNN) to sort traffic signs. On account of its high recognition rate, CNN can be used to realize various computer vision tasks. TensorFlow is used to implement CNN. In the German data sets, we are able to identify the circular symbol with more than 98.2% accuracy

Keywords: Traffic sign detection, traffic sign classification, traffic sign recognition, Traffic Signs Dataset

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ABBREVIATIONS :

- **A.I -** Artificial Intelligence
- **M.L -** Machine Learning
- **I.O.T -** Internet of Things
- **N.L.P -** Natural Language Processing
- **N.L.U -** Natural Language Understanding
- **ADAS -** Advance Driver Assistant System
- **TSR -** Traffic Sign Recognition
- **SVM -** Support Vector Machine

CHAPTER-1

1.1 INTRODUCTION

Traffic signs are devices placed along, besides, or above a highway, roadway, pathway, or other route to guide, warn, and regulate the flow of traffic, including motor vehicles, bicycles, pedestrians, equestrians, and other travellers. Since safety becomes more important for customers, Traffic Sign Recognition (TSR) becomes one of today's research subjects aiming to improve safety of driving.
While, they are presently developed just to warn drivers about some important traffic signs, factors, such as tiredness, sleeplessness or so. As a result, the safety of driving is improved. For this purpose, TSR systems are developed, mainly to decrease the probability of missing some important traffic signs on the road. The problem may seem to be easy to handle, at the first glance.
However, since the process on a visual data is performed by human brain, based on all of his experiences, it cannot be easy for a computer to perform the same process. Instead of those experiences, just some knowledge about distinctive features of traffic signs can be used. These features mainly consist of colour and shape information.
Although, this knowledge is not enough to separate traffic signs from other objects, the segmentation can be improved by the help of some intelligence while using the knowledge. For example, since the illumination is changing from time to time or from scene to scene, the colour identification shall be performed accordingly. Additionally, since some traffic signs may be partially observed because of some conditions, the shape information shall be extracted despite of those conditions.

1.1.2 MOTIVATION

Traffic sign detection and recognition have received an increasing interest in the last years. This is due to the wide range of applications that a system with this capability provides:

1. Highway maintenance Nowadays, a human operator has to watch a videotape to check the presence and condition of the signs. It is a tedious task because the signs appear from time to time, and because the operator has to pay great attention. The Esprit European project AUTOCAT presents a van developed for the automatic gathering of the traffic sign position.

2. Sign Inventory It is basically the same application but in towns and cities. In this case the environment is more difficult than highways. The signs are not always placed perpendicular to the movement of the vehicles, producing a deformed image of the signs; besides, there are occlusions, and other objects with the same colour. There has been little work in this particular environment, as it will be mentioned later.

3. Driver Support Systems Traffic sign detection and classification is one of the less studied subjects in the field of Driver Support Systems. Research groups have been focused on other aspects, more related with the development of an automatic pilot, as the detection of the road borders or the recognition of obstacles in the vehicle's path such as other vehicles or pedestrians. The future Intelligent Vehicles would take some decisions about their speed, trajectory, etc. depending on the signs detected. Although, in the future, it can be part of a fully automated vehicle, now it can be a support to automatically limit the speed of the vehicle, send a warning signal indicating overspeed, warn or limit illegal manoeuvres or indicate earlier the presence of the sign to the driver. The general idea is to support the driver in some tasks,

allowing him or her to concentrate in driving. One of the most important and more general works was described by Eatable in about the research by Daimler-Benz on its vehicle VITA-II. As a particular application, a system for the detection of the Stop sign as a blind people support system is presented.

4. Intelligent Autonomous Vehicles Mobile robots use landmarks as means for their delocalisation. In the case of artificial landmarks, they can be designed as traffic signs. The advantage of this idea is that some precise information is added to the sign, for example, indicating the robot the path to follow or some tasks it has to perform in a particular location

1.2 BACKGROUND INFORMATION

Traffic sign recognition is an arena of active research. Although there are many different algorithms and approaches, some patterns do emerge as the existing body of work is examined. The following is a summary of some of the more recent and relevant work. Andrey et al. use a very similar approach involving colour segmentation and shape analysis. Histograms, however, are used as the shape classification method after connected regions are labelled. Actual sign recognition is done via template matching by using a weighted direct comparison of the interior portion of each shape to templates.

(Ritter et. al., 1995). In the last few years, the TSR systems have become important components of advanced driver assistance systems (ADAS). (Gil et al., 2008). The main difficulty that TSR systems face is the poor image quality due to low

resolution, bad weather conditions or inadequate illumination. Pannapa Herabat was describing the rural road development they undergo major structural reforms account to the national economic and social development plan. They divided the rural to the sub

district levels. The objective of sub district levels to improve the quality of life and economic and social development in rural areas. A web-based technology used for easy linking to the between the remote areas for network and project levels. They developed process tools and technology. This system developed the regards on pavement, bridge,

drainage system, traffic sign, pavement marking and vegetation problems. The benefits are measured profitability and rural road user effects. Andrey et al. use a very similar approach involving colour segmentation and shape analysis. Histograms, however, are used as the shape

shape

classification method after connected regions are labelled. Actual sign recognition is done via template matching by using a weighted direct comparison of the interior portion of each shape to templates. According to Paclik. the first study of automated road sign recognition was reported in Japan in 1984. Since then, a number of methods have been developed for road sign detection and identification. For years, researchers have been addressing the difficulties of detecting and recognizing traffic signs. The most common automatic systems for traffic signs detection and recognition comprise one or two video cameras mounted on the front of the vehicle. Lai et al. present a sign recognition scheme aimed for intelligent vehicles and smart phones. Colour detection is used and is performed in HSV colour space. Template based shape recognition is done by using a similarity calculation. OCR is used on the pixels within the shape boarder to determine provide a match to actual sign. The description is purely algorithmic and implemented in software.

Drawback:

The extraction or detection of a traffic sign, for its posterior recognition, presents the same difficulties as object recognition in natural environments:

1. Lighting conditions are changeable and not controllable. Lighting is different according to the time of the day, season, cloudiness and other weather conditions, etc.
2. The presence of other objects. Except in the case of highways, the simple case, other objects often surround traffic signs. This produces partial occlusions, shadows, etc.
3. It is not possible to generate off-line models of all the possibilities of the sign's appearance, because there are so many degrees of freedom. The object size depends on the distance to the camera; the scale for each axis is different if the camera optic axis is not perpendicular to the sign, producing an aspect modification besides, physical condition of a sign changes depending on its age, accidents, etc. An example of a rotated sign is presented.

1.2.1 PURPOSE

The purpose of traffic sign detection is to find the locations and sizes of traffic signs in natural scene images. The well-defined colours and shapes are two main cues for traffic sign detection. Thus, we can divide the detection methods into two categories: colour-based and shape-based.

1.2.2 PRODUCT GOALS AND OBJECTIVES

The use of traffic sign recognition system is very challenging. Since rain, fog, snow etc. affect the whole system. Another thing is the light variation i.e., shadows, sun, clouds etc. The geometrical shape of the object and the perspective is also a big concern. So, we must be able to come up with a system which can work under light variation and geometrical transformation of the objects in a scene. If we narrow down the scope, we are particularly interested in detection of these signs under low light condition. In short, our objective is to make the system very accurate and efficient

The objectives of the present paper are:

1. The system has to be able to detect traffic signs

independently of their appearance in the image. Because
of that, it has to be invariant to:
* Perspective distortion.
* Lighting changes.
* Partial occlusions.
* Shadows.
2. In addition, it has to provide information about the
presence of possible problems:
* Lack of visibility.
* Bad condition.
* Bad placement

1.3 DEFINITION

1.3.1 ASSUMPTIONS

Numerous studies and researches have been done in the field of Machine Learning and Deep learning, especially involving self-driving cars. CNN is one of the famous architectures in image classification and is widely used in image classification. In this section, we share a few papers and projects that have inspired us the most, and helped us understand the problem. We started off by finding a solution to the problem using Support Vector Machines (SVM) In this research, automatic sign detection was integrated on roads, and their model was able to detect all types of signs like circular, triangular, rectangular, and octagonal shapes. Owing to the high success rate on the final predictions, they showed that SVM could be a good model for this purpose. In the next research that we studied 100000 street images of Tencent city in China, and 30000 traffic sign images were collected from them. The unique fact about their bench-mark is that they were able to gather all the pictures of traffic signs in the different weather forecasts. This can be a great help in terms of real predictions. They used CNN architecture to predict and detection of traffic signs. They tried not to just focus on the images of signs, and they tried to have images that the car views while driving, and they ran their model for those images. This paper gave us more insight into how we should choose our dataset wisely and opened our ways to think more about CNN. Furthermore, we studied the project that offered a novel CNN architecture [7]. They call their model Over Feat. They figured that the multiscale and sliding window approach would be very efficient for implementing CNN. According to this study, detecting object boundaries should be the main target to design the CNN model. CNN can learn the task in terms of classification simultaneously. After going through this research, we shifted our attention to how deep our model is and how its accuracy can be improved based on the sign’s boundary. This paper won the localization task of the ImageNet Large Scale Visual Recognition challenge and motivated us to choose CNN for our implementation.

1.3.2 THESIS

This thesis presents a system to recognise and classify road and traffic signs for the purpose of developing an inventory of them which could assist the highway engineers' tasks of updating and maintaining them. It uses images taken by a camera from a moving vehicle. The system is based on three major stages: colour segmentation, recognition, and classification. Four colour segmentation algorithms are developed and tested. They are a shadow and highlight invariant, a dynamic threshold, a modification of de la Escalera's algorithm and a Fuzzy colour segmentation algorithm. All algorithms are tested using hundreds of images and the shadow-highlight invariant algorithm is eventually chosen as the best performer. This is because it is immune to shadows and highlights. It is also robust as it was tested in different lighting conditions, weather conditions, and times of the day. Approximately 97% successful segmentation rate was achieved using this algorithm. Recognition of traffic signs is carried out using a fuzzy shape recogniser. Based on four shape measures - the rectangularity, triangularity, ellipticity, and octa gonality, fuzzy rules were developed to determine the shape of the sign. Among these shape measures octan gonality has been introduced in this research. The final decision of the recogniser is based on the combination of both the colour and shape of the sign. The recogniser was tested in a variety of testing conditions giving an overall performance of approximately 88%. Classification was undertaken using a Support Vector Machine (SVM) classifier. The classification is carried out in two stages: rim's shape classification followed by the classification of interior of the sign.

1.3.2 DELINEATION

In this era of Artificial Intelligence, humans are becoming more dependent on technology. With the enhanced technology, multinational companies like Google, Tesla, Uber, Ford, Audi, Toyota, Mercedes-Benz, and many more are working on automating vehicles. They are trying to make more accurate autonomous or driverless vehicles. You all might know about self-driving cars, where the vehicle itself behaves like a driver and does not need any human guidance to run on the road. This is not wrong to think about the safety aspects—a chance of significant accidents from machines. But no machines are more accurate than humans. Researchers are running many algorithms to ensure 100% road safety and accuracy. One such algorithm is Traffic Sign Recognition that we talk about in this blog.

When you go on the road, you see various traffic signs like traffic signals, turn left or right, speed limits, no passing of heavy vehicles, no entry, children crossing, etc., that you need to follow for a safe drive. Likewise, autonomous vehicles also have to interpret these signs and make decisions to achieve accuracy. The methodology of recognizing which class a traffic sign belongs to is called Traffic signs classification.

In this Deep Learning project, we will build a model for the classification of traffic signs available in the image into many categories using a convolutional neural network (CNN) and Keras.

1.4 PROBLEM STATEMENT

Traffic sign detection is a high relevance computer vision problem and is the basis for a lot of applications in industry such as Automotive etc. Traffic signs can provide a wide range of variations between classes in terms of colour, shape, and the presence of pictograms or text. In this project, I will develop a deep learning algorithm that will train on German traffic sign images and then classify the unlabelled traffic signs. The deep learning model will be built using TensorFlow and we will also understand various ways to pre-process images using OpenCV and also use a cloud GPU service provider.

CHAPTER-2
LITERATURE REVIEW

2.1 INTRODUCTION

A system capable of automatic recognition of traffic sign could be used as assistance for drivers, alerting them about the presence of some specific sign (e.g., a one-way street) or some risky situation (e.g., driving at a higher speed than the maximum speed allowed Nowadays, recognition and classification of traffic signs are very important, especially for unmanned automatic driving. Extensive research has been done in the area of recognition and classification of traffic and road signs. In [1], the authors proposed a Convolutional Neural Network and Support Vector Machines (CNN-SVM) method for traffic
signs recognition and classification. The colouring used in this method is YCbCr colour space which is input to the convolutional neural network to divide the colour channels and extracting some special characteristics. SVM is then used for classification. Their proposed method achieved a 98.6% accuracy for traffic signs recognition and classification. In [2], the authors proposed a colour-based segmentation method with Histogram Oriented Gradients (HOG) for feature extraction followed by SVM for classification. The model used CIECAM97 for colour appearance, this model was applied to a segment to extract colour information. Another model used for shape features is FOSTS which achieved a 95% accuracy. In [4], the authors proposed feature extraction through HOG and local binary pattern (LBP) which are then input into an Extreme Learning Machine Network for classification and recognition. In [5], the authors propose a traffic sign recognition system based on extreme learning machine (ELM). Their method consists of feature extraction through extraction of histogram of the oriented gradient variant (HOG features followed by a single classifier trained by ELM.

2.2 BROAD

2.2.1 CONTENT

In this work, a study of the implementation of artificial neural networks for traffic sign recognition. The studied system used 13 different traffic signs with 16 different images for each sign to apply training and test of the neural network. In order to consolidate and improve the structure of artificial neural networks, the system was assisted with some image segmentation process. The segmentation of the captured traffic sign images helps emphasizing
on some required features while ignoring other undesired features prior to the application of artificial neural network. This process increases the performance of the artificial neural networks and helps obtaining better results out of the system.

The study of traffic sign recognition system is very important due to the modern developments in the field of smart systems that include smart homes, smart phones, smart cars, smart farms and many other smart technologies. These technologies investigate in the capability of computer devices and processors to build systems that can autonomously behave and condition with the changes that happen in the surrounding environment. Smart homes for example have the capability to keep track of sun shines, time, illumination, temperature, power consumption and behave accordingly to offer comfort environment without the need of any human intervention. Smart cars are able to self-drive and park based on the smart systems provided.

These cars drive in the roads safely with the least danger and error. The study of traffic sign recognition is important in assisting the function of smart cars by providing suitable idea of the road and required warnings. It is also important to help drivers to keep aware of the different warnings and instructions about the roads.

2.2.2 THEORY

A machine learning classifier is a system able to predict the class of a phenomenon being observed. The use of a classifier depends on the application and the nature of available data set. In (Ksantini, BenHassena and Delmotte, 2017) authors present a comparison between ML classifiers according to 5criteria: Speed of classification, accuracy, tolerance to noise and Robustness. There are a variety of applications areas in which ML classifiers can be applied like road safety. In this field of application, several ML classifiers provide good accuracy rates like:

- Multiple Layer Perceptions classifier (MLP) is a single-layer neural network organized in a cascade and subdivided in an input layer, one or. more hidden layers and an output layer. (Genevieve, Taif and Wasfy,2019)
- K-nearest neighbour classifier (KNN) is based on a distance function that calculates similarity between the object to classify and its neighbours. (Karthiga, Mansoor and Kowsalya, 2016)
- Support Vector Machine classifier (SVM) is based on the statistical learning theory. Thus, the goal of this method is a binary classification of data. (Anusha and Renuka,2019)
- Random Forest classifier (RF) is an ensemble of classification trees, where each tree contributes with a single vote for the assignment of the most frequent class to the input data. (Ellahyani, ElAnsari and El Jaafari, 2016)

Authors in (Gomes, Rebouças and Neto, 2016) presented obtained accuracy rates of several classifiers for the recognition of the segmented speed limit digits for embedded applications. Obtained results were 87.12%, 97.04%, 98.51% for MLP, SVM and KNN classifiers respectively. We notice that machine learning algorithms were used to classify different types of traffic sign images with proportional accuracy rates that can be improved by using the strengths of one method to complete the weakness of another algorithm. In the next part we introduce belief functions theory which has been applied to pattern recognition and specially to supervised classification.

2.2.3 SYSTEM REQUIREMENTS

- **Hardware Requirements**:

Input Device: Keyboard
Output Device: Computer Screen

- **Software Requirements:**

There is no specific requirement of software in running this program. Any python editor/compiler will run this program.

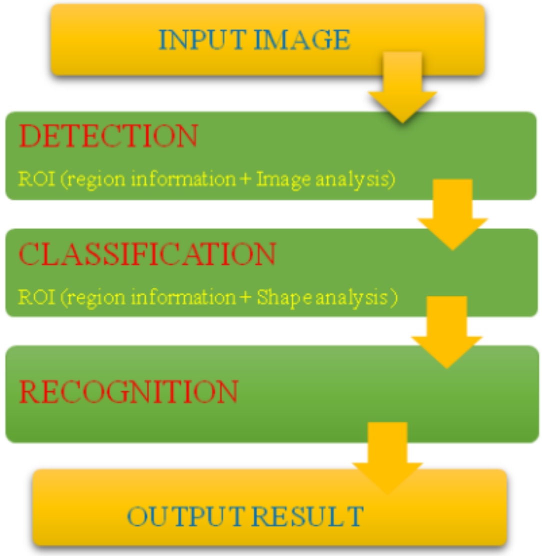
2.3 DETAILED

2.3.1 HOW IT WORKS

The use of traffic sign recognition system is very challenging. Since rain, fog, snow etc. affect the whole system. Another thing is the light variation i.e., shadows, sun, clouds etc. The geometrical shape of the object and the perspective is also a big concern. So, we must be able to come up with a system which can work under light variation and geometrical transformation of the objects in a scene. If we narrow down the scope, we are particularly interested in detection of these signs under low light condition. In short, our objective is to make the system very accurate and efficient. The advantage of using a speech recognition system is that it overcomes the barrier of literacy. A speech recognition model can serve both literate and illiterate audience as well, since it focuses on spoken utterances.

- In the detection stage, colour information is exploited to detect regions of interest (ROI) that may correspond to traffic signs.
- The shape of these regions is tested in the classification stage, allowing rejecting many of the initial candidates and grouping traffic signs into classes.
- The pictogram contained on each ROI (if exist) is extracted, analysed and compared with the pictogram database. The best match between the ROI and database pictogram, if high enough, is considered the sign that is more likely to appear in that ROI. Each recognized sign is part of the output result of the recognition stage.

Figure 1: Flowchart of proposed system



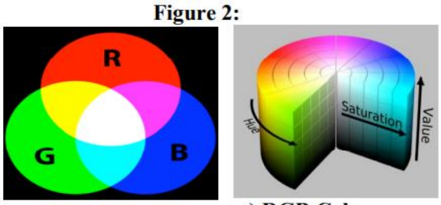
1. Detection of traffic sign

The detection of traffic signs, assumes a crucial role in any traffic sign recognition application. In fact, a sign that is not correctly detected cannot be classified and recognized to inform the driver. In detection step, the distinctive features of traffic signs shall be considered. Since, traffic signs are regulated to be in specific colour and shape; it is convenient to use those features to decide the candidates. Additionally, in recent years, several feature extraction techniques are preferred to get more distinctive features those cannot be observed directly, like colour or shape. Therefore, the detection algorithms can be studied under "Colour Analysis"

1.1. Colour analysis

There are dominant colours used on traffic signs which are red, blue, green, orange, brown, yellow and white. These colours can be set with certain thresholds and their inter-relationships can be used to localize traffic sign. On captured images of real-world scenes, it is not always possible to obtain required coloured regions by applying thresholds directly to RGB colour space, because of the changing illumination of the environment. Therefore, this uncontrollable factor shall be separated from colour information. For this purpose, preferred approach is to work on different colour spaces. The most common examples of different colour spaces are: RGB, HSI/HSV, YUV, YCbCr, CIE Lab, etc.

Figure 2:



a) RGB Color Space b) HSV Color Space

Figure 3: RGB threshold levels

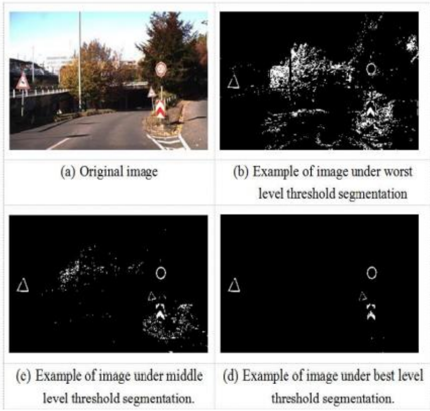


Figure 3 shows different thresholds that occur when we extract ROIs from an image taken in sunny weather based in RGB space. It is obvious that the levels of settings for threshold are hard to control; under different environmental conditions, the thresholds may be changed directly.

$r = R / (R+G+B)$ (1)

$g = G / (R+G+B)$ (2)

$b = B / (R+G+B)$ (3)

Where and are called chromaticity coordinates,

$r + g + b = 1$

The brightness of each pixel in an image equals the sum of the three RGB components. The use of normalized RGB parameters in a system can therefore reduce the impact on changes in brightness. However, the r, g and b of the normalized RGB model only eliminate components of the relative brightness in RGB. The colour saturation does not separate from the normalized model; thus, the model is still sensitive to changes in colour saturation. To separate the luminance and colour entirely, the colour segmentation process is then carried out on images that were initially converted to HSV (Hue or colour, Saturation and Value lightness) space; or with intensity, brightness, lightness, etc., instead of Value lightness, generating HIS, HSB, HSL and other spaces model

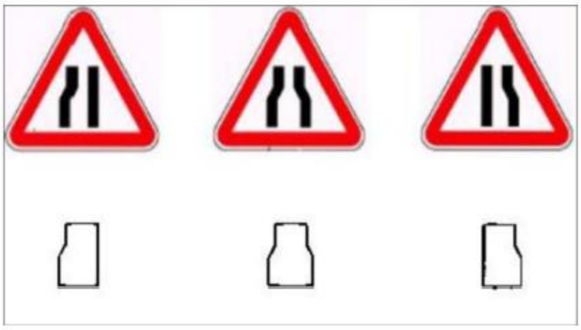
2. Recognition of traffic sign

After sign detection and their classification into classes, comes the recognition stage, where each ROI will be identified as a concrete sign. traffic-sign recognition is a technology by which a driver is able to recognize the traffic signs put on the road e.g., "speed limit" or "children" or "turn ahead". This is part of the features collectively called ADAS. The technology is being developed by many automotive suppliers, including Continental and

Delphi. Traffic signs recognition is a hard-multi-class problem. In practice, handling the entire gamut of pictograms is never considered in TSR. This would be impractical as the total number of signs is huge, they differ from country to country, and some of them are extremely rare.

Therefore, the common approach adopted is to focus on a relatively narrow category of the most relevant signs within one country. This reduces the complexity of the classification task and is hence more suitable for in-vehicle application. In addition, very traffic signs are not standardized in terms of colour, shape, and icons they contain. A good example is the directional sign that can vary according to size, shape, font, writing, and background colour of the plate. Regarding each class, although it is possible to see signs having similar pictograms, the outer contours of each pictogram are unique. The example of Figure 4 shows three different signs with similar pictograms, whose outer contours are enough to make them distinguishable

Figure 4: Similar pictograms with



distinguishable contours

The pictographic content of signs is what distinguishes each sign, within its class and it will be analysed for recognition purposes. Problems could arise for different signs that contain the same pictographic information – as the ones shown in Figure 5. However, this similarity only occurs for signs of different classes. And, since ROIs were previously classified into classes, the problem is easily by passed

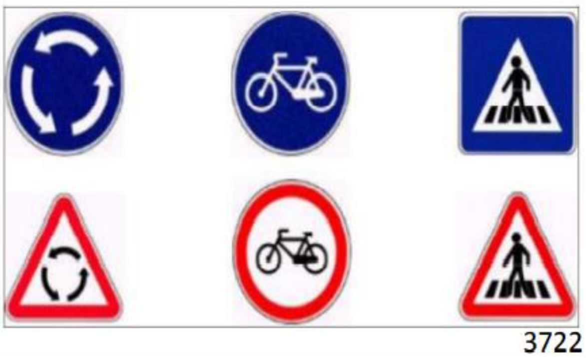


Figure 5: Signs with similar content

After pre-processing the image of traffic sign candidate is to be compared with templates in database to perform recognition process. This process is carried out as follow

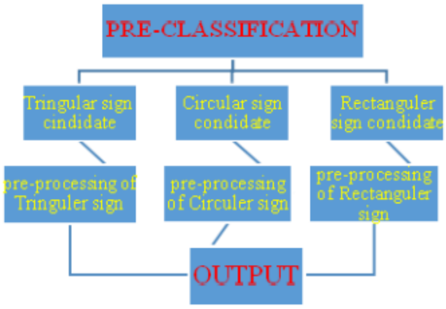


Figure 6: Simplified block diagram of recognition scheme

7. Traffic Signs Dataset

Before building the system, another principal element of any traffic sign detection and recognition system is the availability of a dataset. In order to train and test a detector for identifying an object based on different features and classifiers, we need to have access to a large number of samples of that object. During the past few years, a number of research groups have worked on creating traffic sign datasets for the task of detection, recognition, and tracking. Some of these datasets are publicly available for use by the research community. The following table introduces some of these datasets

BTSDB	Country of origin: Belgium Number of images: 7000
STSD	Country of origin: Sweden Number of images: more than 20000
Stereopolis	Country of origin: France Number of images: 847 Classes: 10
LISA	Country of origin: United States Number of images: 6000 Classes: 46

Table1: Publicly available traffic sign datasets

Dataset	Description
GTSRB	Country of origin: Germany Number of images: 50000 Classes: 43
GTSDB	Country of origin: Germany Number of images: 900
BTSCB	Country of origin: Belgium Number of images: 10000 Classes: 62

Table2: Traffic Sign Datasets

Among these datasets, the German Traffic Sign (GTS) dataset and the Belgium Traffic Sign (BTS) dataset are the two large and famous datasets that can be used for detection and recognition. The German Traffic Sign Recognition Benchmark (GTSRB) and Belgium Traffic Sign Classification Benchmark (BTSCB) can be used for the task of both detection and recognition.

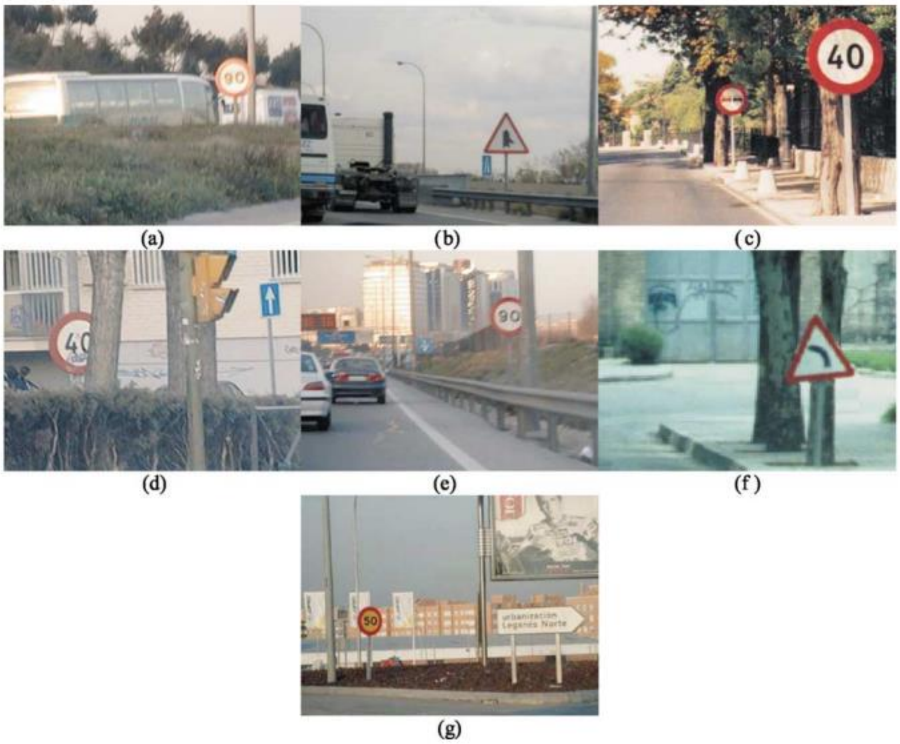


Fig 2 Traffic sign detection problems. (a) Reflections; (b) not controlled lighting; (c) shadows; (d, e) partial occlusions; (f) sign rotation; (g) shape deformation

2.3.2 FEATURES

Traffic sign recognition is a technology which allows us to recognize signs in real time, typically in videos, or sometimes just (off-line) in photos. It is used for Driver Assistance Systems (DAS), road surveys, or the management of road assets (to improve road safety).

2.4 CONCLUSION

In the article, an algorithm for the detection and recognition of traffic sign have been proposed, although the algorithm has been used for traffic signs it can be generalised to deal with other kinds of objects. The known difficulties that exist for object recognition in outdoor environments have been deal with. This way the system is immune to lighting changes, occlusions and object deformation being useful for Driver Support Systems. There are few previous works that deal with these last two problems. In addition to recognising the sign and as a novelty, the system provides information about its state

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION RESEARCH DESIGN

An Application of Intelligent Voice Assistant System based on natural language processing which can be used to send messages and even use the other application on the device was designed and developed using python on the platform of android.

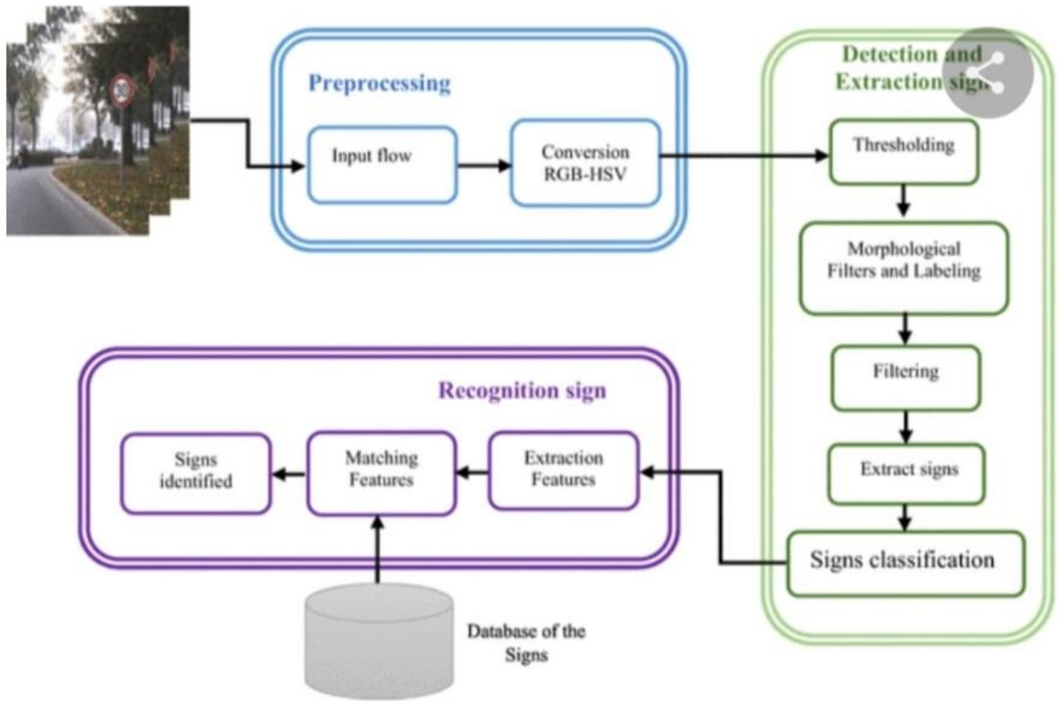
3.1.1 SYSTEM ARCHITECTURE

The overall system design consists of following phases:

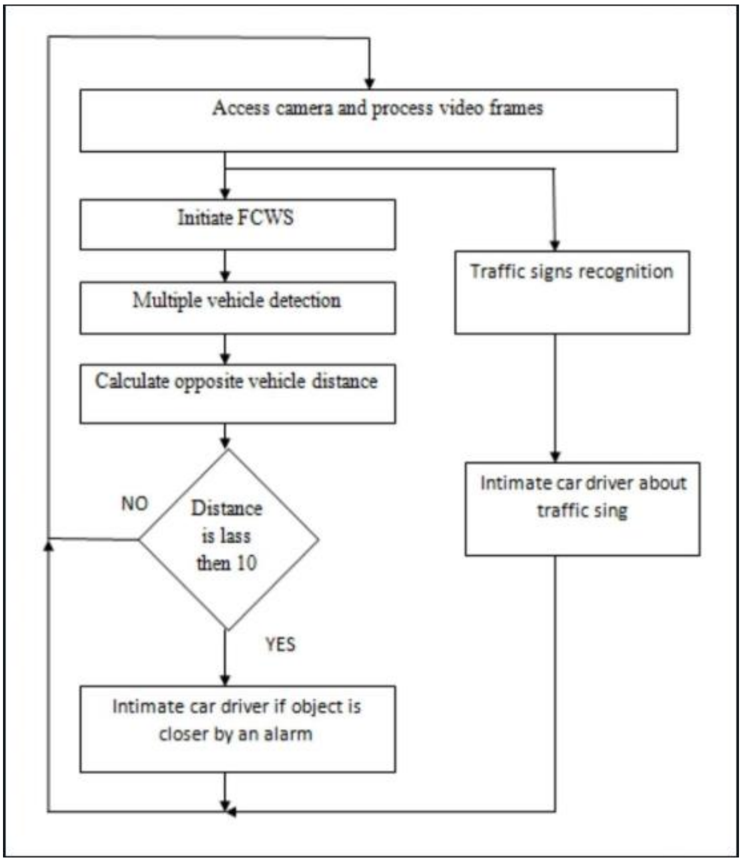
- Collection of images as captured by camera.
- Analysis and conversion of the image into system understanding language using machine learning.
- Storing and processing of the data image.
- Generation of image processing from the captured image is done.
- User at last able to detect the sign in hazy whether also given by automatic sign recognition system.
- Andrey et al. use a very similar approach involving colour segmentation and shape analysis. Histograms, however, are used as the shape classification method after connected regions are labelled. Actual sign recognition is done via template matching by using a weighted direct comparison of the interior portion of each shape to template.

BASIC FLOW CHART:

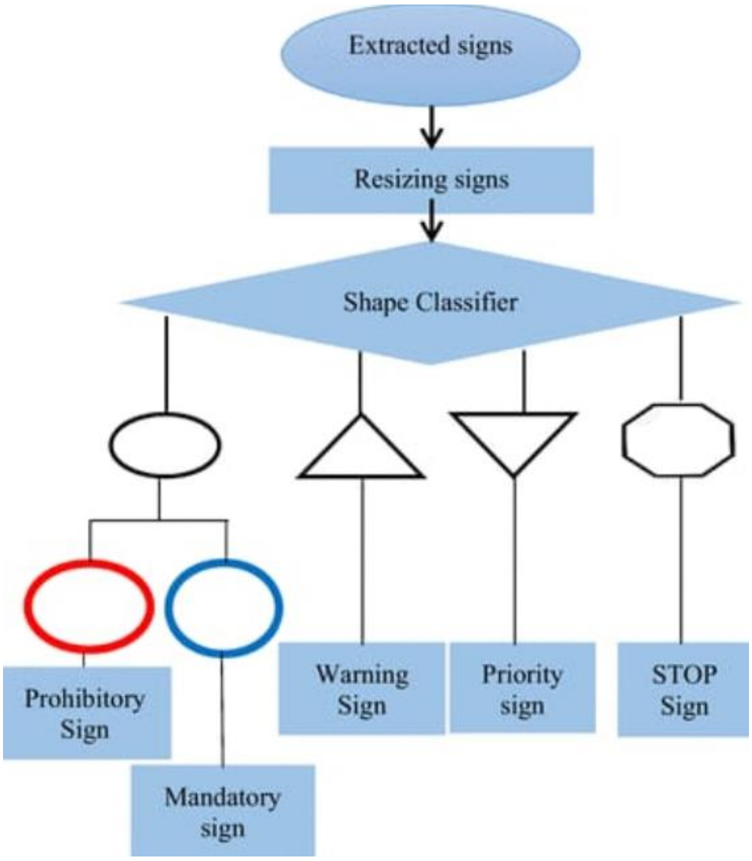
DFD LEVEL 0:



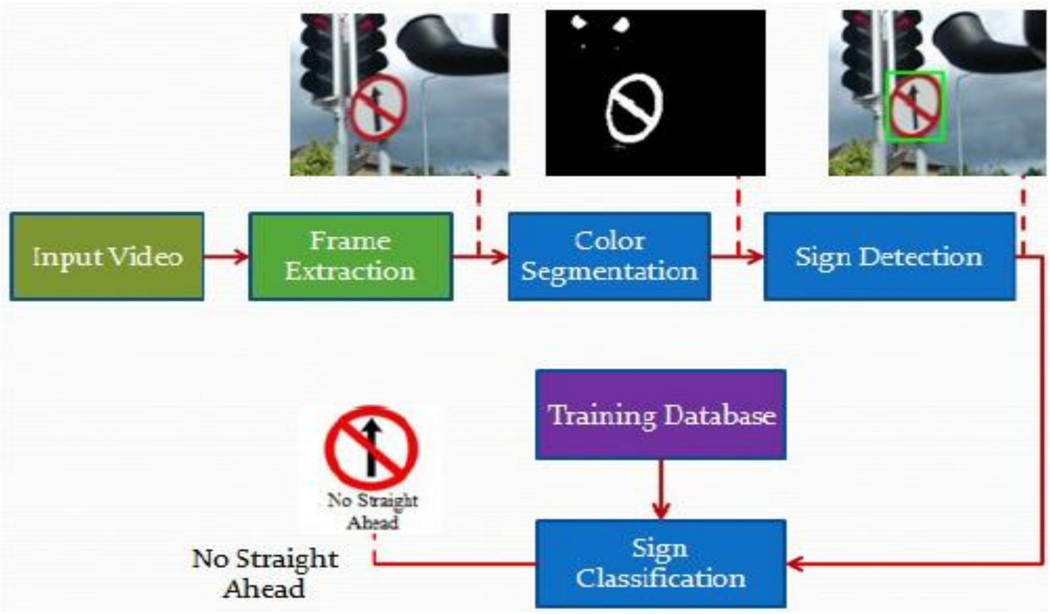
DFD LEVEL 1:

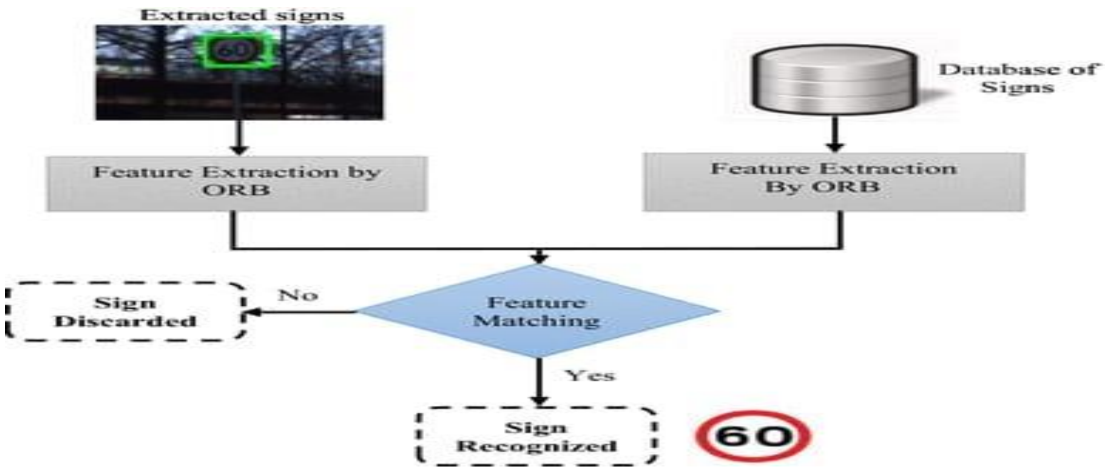


DFD LEVEL 2:



DFD LEVEL 3:





3.2 ADVANTAGES AND APPLICATIONS:

1. Nowadays it is difficult to find new models that do not include some form of driver assistance system. Manufacturers are investing in the development of safety equipment with the aim of reducing the number of accidents due to driver distraction as well as the severity of such accidents.

2. The aim of this technology is to help improve driver safety, especially when the driver is tired or unable to pay proper attention to the signs. Which driver hasn't known at some point what speed limit he should be driving at? This is because signage can vary from section to section on the same road, leading to confusion and even distraction.

3. The challenge now is to combine this signal detection system with other driver assistance systems in order to offer more safety and comfort to the driver, all with one ultimate goal in mind: to achieve fully automated driving and zero accidents on the roads.

4. The correct signage of infrastructures is vital for safety, as, in addition to regulating traffic, it informs the driver about the state of the road. For this reason, a system capable of automatically detecting and recognising road signs in real time from images captured from a moving vehicle is a major step forward for road safety.

CHAPTER-4
FINDINGS & ANALYSIS

4.1 INTRODUCTION

Traffic-sign recognition (TSR) is a technology by which a vehicle is able to recognize the traffic signs put on the road e.g., "speed limit" or "children" or "turn ahead". This is part of the features collectively called ADAS. The technology is being developed by a variety of automotive suppliers. It uses image processing techniques to detect the traffic signs. The detection methods can be generally divided into colour based, shape based and learning based method.

4.2 LANGUAGE USED

The language we used to develop this program is PYTHON.
Python is a general-purpose coding language—which means that, unlike HTML, CSS, and JavaScript, it can be used for other types of programming and software development besides web development. That includes back-end development, software development, data science and writing system scripts among other things. Python is easy to learn. Its syntax is easy and code is very readable. Python allows you to write programs in fewer lines of code than most of the programming languages. The popularity of Python is growing rapidly.

4.2.1 WHY WE CHOSE PYTHON?

- If you want your machine to run on your command like Jarvis did for Tony, yes, it is possible. It is possible using Python. Python offers a good major library so that we can use it for making a virtual assistant.
- Python is the most used language for AI with multiple libraries and huge support. Apart from being an open-source programming language, python is also one of the most versatile programming languages.
- Python is free and simple to learn. Its primary features are that it is high-level, dynamically typed and interpreted. This makes debugging of errors easy and encourages the rapid development of application prototypes, marking itself as the language to code with.

4.2.2 FEATURES OF PYTHON

- **GUI Programming Support:** Graphical User interfaces can be made using a module such as PyQt5, PyQt4, python, or Tk in python.
- **Free and Open Source:** Python language is freely available at the official website and you can download it from any given download link with Download Python keyword.

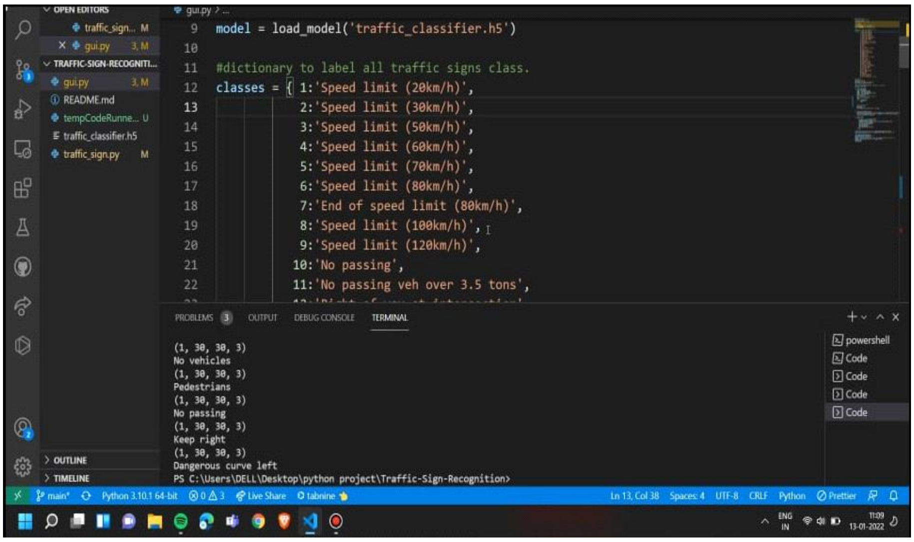
- **Object-Oriented Language:** One of the key features of python is Object-Oriented programming. Python supports object-oriented language and concepts of classes, objects encapsulation, etc.
- **High-Level Language:** Python is a high-level language. When we write programs in python, we do not need to remember the system architecture, nor do we need to manage the memory.
- **Extensible feature**: Python is an Extensible language. We can write us some Python code into C or C++ language and also we can compile that code in C/C++ language.
- **Python is Portable language:** Python language is also a portable language. For example, if we have python code for windows and if we want to run this code on other platforms such as Linux, Unix, and Mac then we do not need to change it, we can run this code on any platform.
- **Interpreted Language:** Python is an Interpreted Language because Python code is executed line by line at a time. like other languages C, C++, Java, etc. there is no need to compile python code this makes it easier to debug our code.
- **Large Standard Library:** Python has a large standard library which provides a rich set of module and functions so you do not have to write your own code for every single thing. There are many libraries present in python for such as regular expressions, unit-testing, web browsers, etc.

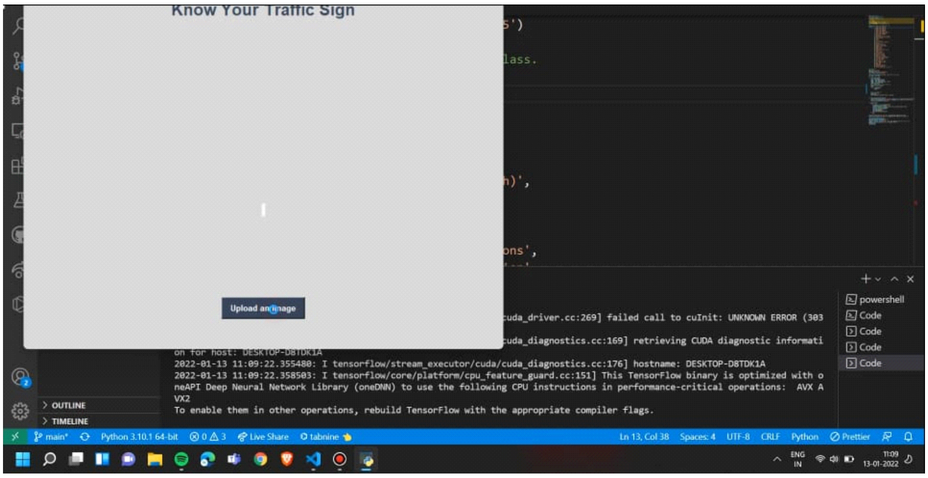
4.3 FEATURES

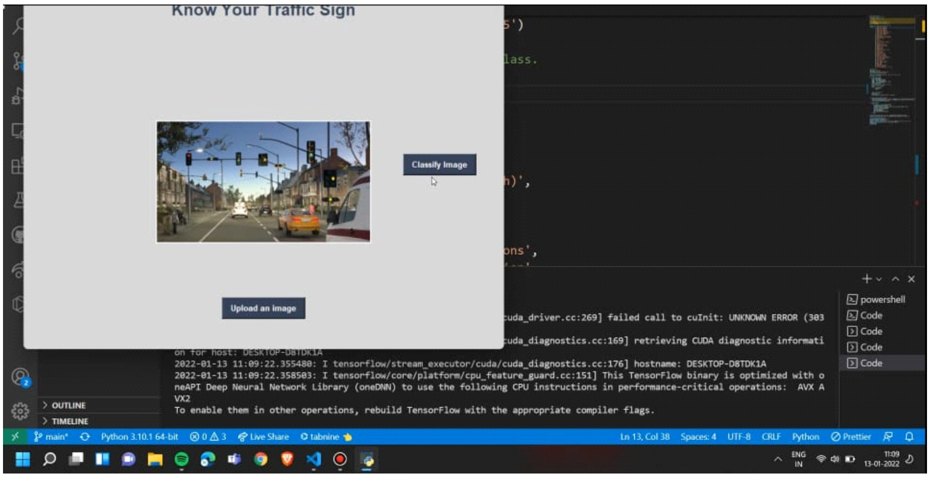
- Library Functions of python:

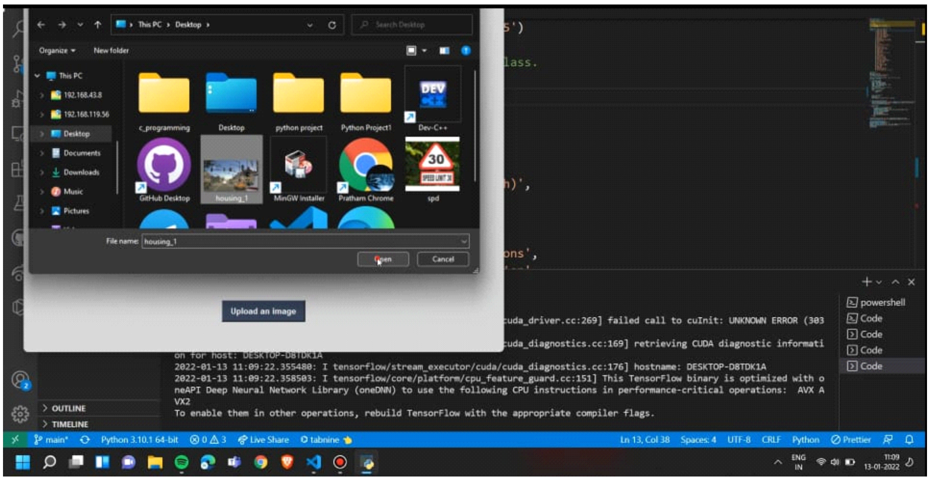
  Python has a large standard library which provides a rich set of module and functions so you do not have to write your own code for every single thing.

GRAPHICAL USER INTERFACE OF OUR PROJECT:

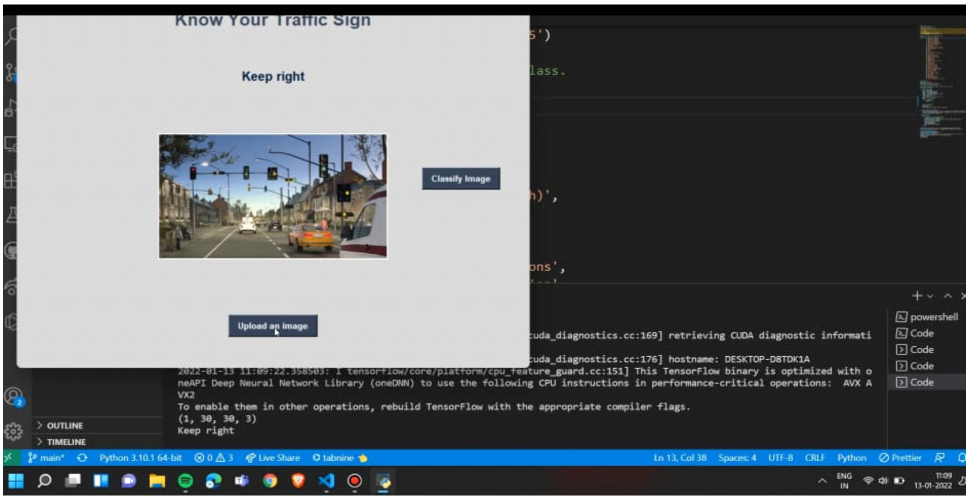




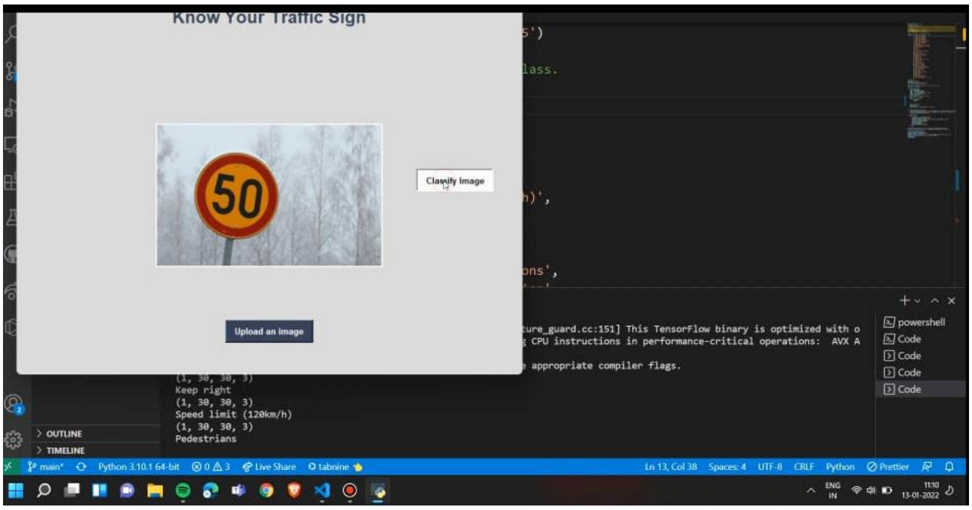




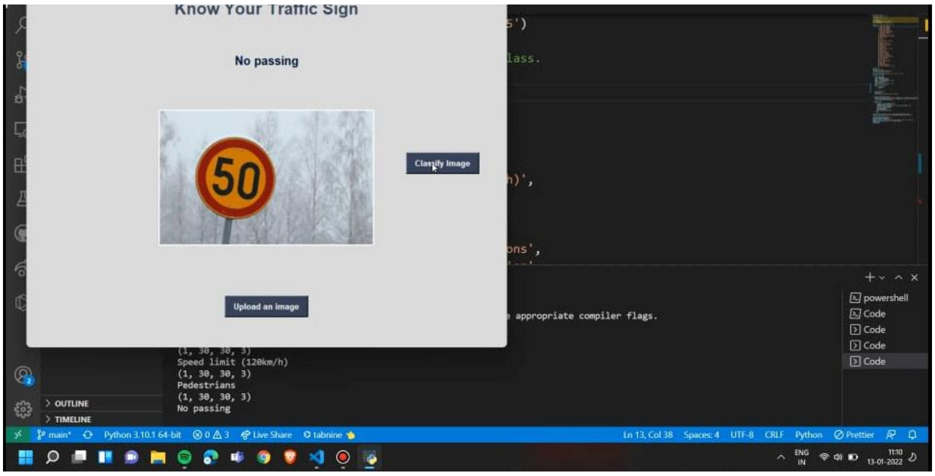
File name: housing_1
Open
Cancel
Upload an image

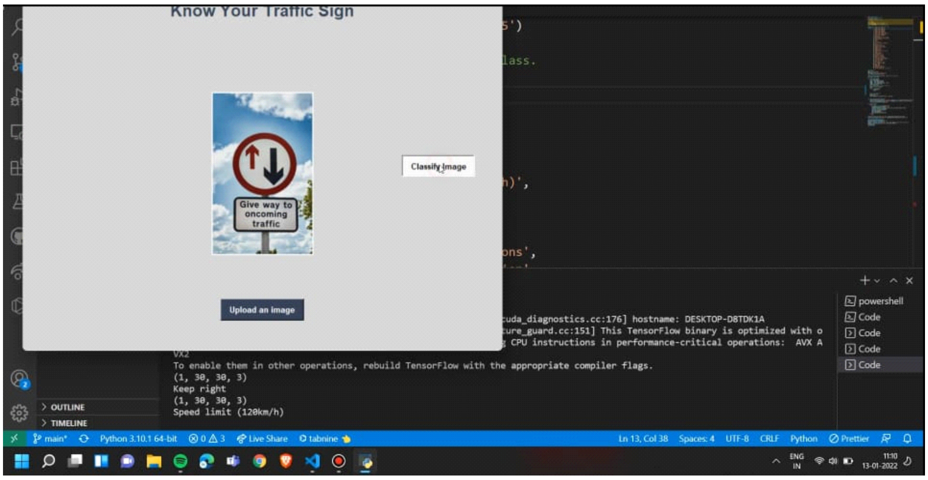


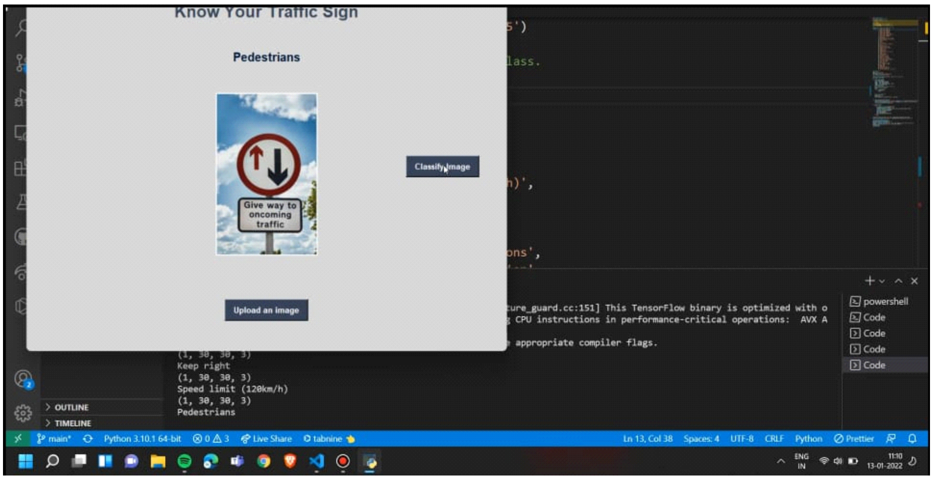
Know Your Traffic Sign
Keep right
Classify Image
Upload an image

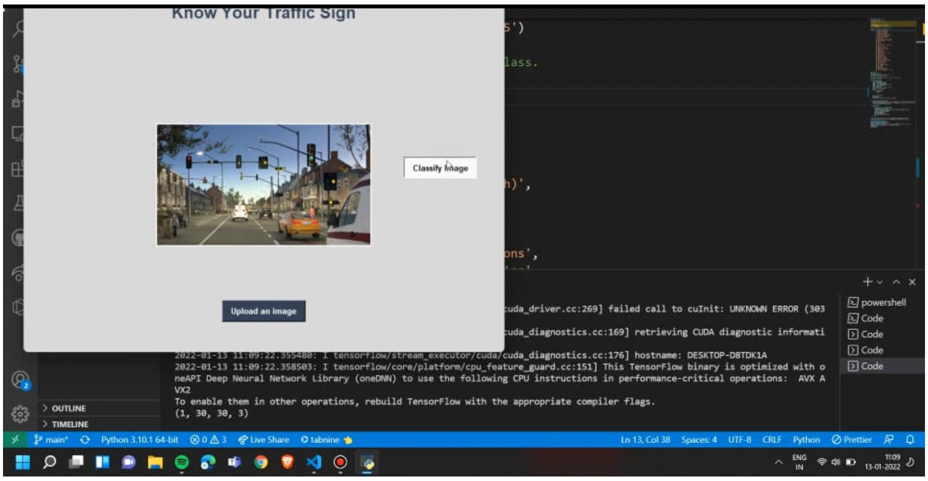


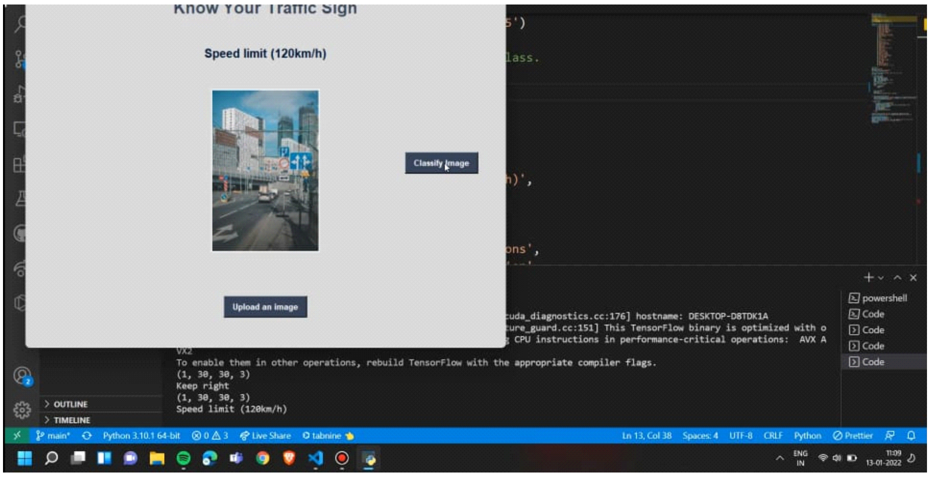
Know Your Traffic Sign
Classify Image
Upload an image
Keep right
Speed limit (120km/h)
Pedestrians


Know Your Traffic Sign
No passing
50
Classify Image
Upload an image
appropriate compiler flags.
Speed limit (120km/h)
(1, 30, 30, 3)
Pedestrians
(1, 30, 30, 3)
No passing
OUTLINE
TIMELINE
powershell
Code
Code
Code
Code


Know Your Traffic Sign
Give way to oncoming traffic
Classify Image
Upload an image
To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.
(1, 30, 30, 3)
Keep right
(1, 30, 30, 3)
Speed limit (120km/h)
OUTLINE
TIMELINE
powershell
Code
Code
Code
Code


Know Your Traffic Sign
Pedestrians
Give way to oncoming traffic
Classify Image
Upload an image
Keep right
(1, 30, 30, 3)
Speed limit (120km/h)
(1, 30, 30, 3)
Pedestrians
OUTLINE
TIMELINE
powershell
Code
Code
Code
Code





4.4 MODULES IMPORTED IN OUR PROJECT

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import cv2
import tensor flow as tf
from PIL import Image
import os
from sklearn.model_selection import train_test_split
from keras.utils import to_categorical
from keras.models import Sequential, load_model
from keras.layers import Conv2D, MaxPool2D, Dense, Flatten, Dropout
import tqdm
import warnings
```

CHAPTER-5

CONCLUSIONS

5.1 SUMMARY OF FINDINGS

The proposed system consists of the following steps Traffic signs can be analysed using forward-facing cameras in many modern cars, vehicles and trucks. One of the basic use cases of a traffic-sign recognition system is for speed limits. Most of the GPS data would procure speed information, but additional speed limit traffic signs can also be used to extract information and display it in the dashboard of the car to alert the driver about the road sign. This is an advanced driver-assistance feature available in most high-end cars, mainly in European vehicles.

Modern traffic-sign recognition systems are being developed using convolutional neural networks, mainly driven by the requirements of autonomous vehicles and self-driving cars. In these scenarios, the detection system needs to identify a variety of traffic signs and not just speed limits. This is where the Vienna Convention on Road Signs and Signals comes to help. A convolutional neural network can be trained to take in these predefined traffic signs and 'learn' using Deep Learning techniques.

5.2 RESULT AND CONCLUSION

This study proposed an automatic traffic sign detection, classification and recognition system. The detection of traffic signs, assumes a crucial role in any traffic sign recognition application. In fact, a sign that is not correctly detected cannot be classified and recognized to inform the driver. In detection step, the distinctive features of traffic signs shall be considered. Since, traffic signs are regulated to be in specific colour and shape; it is convenient to use those features to decide the candidates. Additionally, in recent years, several feature extraction techniques are preferred to get more distinctive features those cannot be observed directly, like colour or shape. Therefore, the detection algorithms can be studied under “Colour Analysis

There are dominant colours used on traffic signs which are red, blue, green, orange, brown, yellow and white. These colours can be set with certain thresholds and their inter-relationships can be used to localize traffic sign. On captured images of real-world scenes, it is not always possible to obtain required coloured regions by applying thresholds directly to RGB colour space, because of the changing illumination of the environment. Therefore, this uncontrollable factor shall be separated from colour information. For this purpose, preferred approach is to work on different colour spaces. The most common examples of different colour spaces are: RGB, HSI/HSV, YUV, YCbCr, CIE Lab, etc. This thesis explained the RGB and HSI colour space which HSI (Hue, Saturation and Intensity) space is used to segment red coloured regions on the image. In this colour map, hue component of a pixel stands for the colour information. On the other hand, saturation refers to the dominance of hue in the colour. In other words, saturation describes the pureness of the colour. The last component, intensity, is the illumination factor separated from colour information. where the used

Hue and Saturation components are normalized to 255. The most commonly used space in image processing is RGB colour space; this space is based on human eye recognition. The RGB model assigns a range of intensity values from 0 to 255 for each pixel of RGB components in images. However, intensity values can be mixed in different ratios, showing up to 16,777,216 (256 _ 256 _ 256) colours on the screen.

The classification module takes the detected ROIs and classifies them into one of the considered classes: danger, information, obligation or prohibition, or as a non-sign. In addition, Yield, Wrong Way and STOP signs are recognized as special cases. Also, this study identified three shapes (triangular, circular, rectangular (square)) of signs, which Triangular and squared shapes are identified by finding the corners of each ROI, using the Harris corner detection algorithm. The

5.3 FUTURE RESEARCH

- The traffic signs focus on reduction of the traffic load on existing road network through various travel demand management measures.
- Traffic signs should remove the encroachments, congestion and improve the traffic signal, road condition and geometrics features at intersections.
- The traffic signs should be as a guidance or speaker on a road network.
- Traffic sign reduce the traffic congestion along the road and also provide facilities for the road users.
- Road signs notify road users of regulations and provide warning and guidance needed for safe, uniform and efficient operation.
- The purpose of road signs is to promote road safety and efficiency by providing for the orderly movement of all road users on all roads in both urban and non-urban.

APPENDIX

GUI.PY

```
import tkinter as tk
from tkinter import filedialog
from tkinter import *
from PIL import ImageTk, Image

import numpy
#load the trained model to classify sign
from keras.models import load_model
model = load_model('traffic_classifier.h5')

#dictionary to label all traffic signs class.
classes = { 1:'Speed limit (20km/h)',
            2:'Speed limit (30km/h)',
            3:'Speed limit (50km/h)',
            4:'Speed limit (60km/h)',
            5:'Speed limit (70km/h)',
            6:'Speed limit (80km/h)',
            7:'End of speed limit (80km/h)',
            8:'Speed limit (100km/h)',
            9:'Speed limit (120km/h)',
           10:'No passing',
           11:'No passing veh over 3.5 tons',
           12:'Right-of-way at intersection',
           13:'Priority road',
           14:'Yield',
```

15:'Stop',

16:'No vehicles',

17:'Veh > 3.5 tons prohibited',

18:'No entry',

19:'General caution',

20:'Dangerous curve left',

21:'Dangerous curve right',

22:'Double curve',

23:'Bumpy road',

24:'Slippery road',

25:'Road narrows on the right',

26:'Road work',

27:'Traffic signals',

28:'Pedestrians',

29:'Children crossing',

30:'Bicycles crossing',

31:'Beware of ice/snow',

32:'Wild animals crossing',

33:'End speed + passing limits',

34:'Turn right ahead',

35:'Turn left ahead',

36:'Ahead only',

37:'Go straight or right',

38:'Go straight or left',

39:'Keep right',

40:'Keep left',

41:'Roundabout mandatory',

42:'End of no passing',

43:'End no passing veh > 3.5 tons' }

```
#initialise GUI
top=tk.Tk()
top.geometry('800x600')
top.title('Traffic sign classification')
top.configure(background='#CDCDCD')

label=Label(top,background='#CDCDCD', font=('arial',15,'bold'))
sign_image = Label(top)

def classify(file_path):
    global label_packed
    image = Image.open(file_path)
    image = image.resize((30,30))
    image = numpy.expand_dims(image, axis=0)
    image = numpy.array(image)
    print(image.shape)
    #pred = model.predict_classes([image])[0]
    p=model.predict([image])[0]
    ind=0
    for i in range(len(p)):
        if p[ind]<p[i]:
            ind=i



    #sign = classes[pred+1]
    sign=classes[ind]
    print(sign)
    label.configure(foreground='#011638', text=sign)
```

```
def show_classify_button(file_path):
    classify_b=Button(top,text="Classify Image",command=lambda:
classify(file_path),padx=10,pady=5)
    classify_b.configure(background='#364156',
foreground='white',font=('arial',10,'bold'))
    classify_b.place(relx=0.79,rely=0.46)

def upload_image():
    try:
        file_path=filedialog.askopenfilename()
        uploaded=Image.open(file_path)
        uploaded.thumbnail(((top.winfo_width()/2.25),(top.winfo_height()/2.25)))
        im=ImageTk.PhotoImage(uploaded)
        sign_image.configure(image=im)
        sign_image.image=im
        label.configure(text='')
        show_classify_button(file_path)
    except:
        pass

upload=Button(top,text="Upload an
image",command=upload_image,padx=10,pady=5)
upload.configure(background='#364156', foreground='white',font=('arial',10,'bold'))

upload.pack(side=BOTTOM,pady=50)
sign_image.pack(side=BOTTOM,expand=True)
label.pack(side=BOTTOM,expand=True)
```

```
heading = Label(top, text="Know Your Traffic Sign",pady=20, font=('arial',20,'bold'))
heading.configure(background='#CDCDCD',foreground='#364156')
heading.pack()
top.mainloop()
```

TRAFFIC_SIGN.PY

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import cv2
import tensorflow as tf
from PIL import Image
import os
from sklearn.model_selection import train_test_split
from tensorflow.keras.utils import to_categorical
from keras.models import Sequential, load_model
from keras.layers import Conv2D, MaxPool2D, Dense, Flatten, Dropout

data = []
labels = []
classes = 43
cur_path = os.getcwd()


for i in range(classes):
    path = os.path.join(cur_path,'train',str(i))
    images = os.listdir(path)
```

```
    for a in images:
        try:
            image = Image.open(path + '\\'+ a)
            image = image.resize((30,30))
            image = np.array(image)
            #sim = Image.fromarray(image)
            data.append(image)
            labels.append(i)
        except:
            print("Error loading image")



data = np.array(data)
labels = np.array(labels)

print(data.shape, labels.shape)
#Splitting training and testing dataset
X_train, X_test, y_train, y_test = train_test_split(data, labels, test_size=0.2,
random_state=42)

print(X_train.shape, X_test.shape, y_train.shape, y_test.shape)

#Converting the labels into one hot encoding
y_train = to_categorical(y_train, 43)
y_test = to_categorical(y_test, 43)

#Building the model
model = Sequential()
```

```
model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu',
input_shape=X_train.shape[1:]))
model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu'))
model.add(MaxPool2D(pool_size=(2, 2)))
model.add(Dropout(rate=0.25))
model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
model.add(MaxPool2D(pool_size=(2, 2)))
model.add(Dropout(rate=0.25))
model.add(Flatten())
model.add(Dense(256, activation='relu'))
model.add(Dropout(rate=0.5))
model.add(Dense(43, activation='softmax'))

#Compilation of the model
model.compile(loss='categorical_crossentropy', optimizer='adam',
metrics=['accuracy'])

epochs = 15
history = model.fit(X_train, y_train, batch_size=32, epochs=epochs,
validation_data=(X_test, y_test))
model.save("my_model.h5")

#plotting graphs for accuracy
plt.figure(0)
plt.plot(history.history['accuracy'], label='training accuracy')
plt.plot(history.history['val_accuracy'], label='val accuracy')
plt.title('Accuracy')
plt.xlabel('epochs')
```

```
plt.ylabel('accuracy')
plt.legend()
plt.show()

plt.figure(1)
plt.plot(history.history['loss'], label='training loss')
plt.plot(history.history['val_loss'], label='val loss')
plt.title('Loss')
plt.xlabel('epochs')
plt.ylabel('loss')
plt.legend()
plt.show()

#testing accuracy on test dataset
from sklearn.metrics import accuracy_score

y_test = pd.read_csv('Test.csv')

labels = y_test["ClassId"].values
imgs = y_test["Path"].values

data=[]

for img in imgs:
    image = Image.open(img)
    image = image.resize((30,30))
    data.append(np.array(image))

X_test=np.array(data)
```

```
pred = model.predict_classes(X_test)

#Accuracy with the test data
from sklearn.metrics import accuracy_score
print(accuracy_score(labels, pred))
```

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