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Drowse Plate: An ML based integrated framework for Number Plate Recognition and Drowsiness Detection in Indian traffic system

Sanjay Pandey[1], Vansh Chanchlani[2], Vatsal Mehta[3], Sanket Nakharekar[4], Nayan Agrawal[5]

[1] Asst.Prof., Dept. of I.T., Thadomal Shahani *Engineering College, Bandra (w), Mumbai 400050, India*
[2,3,4,5] *Student, Dept. of I.T., Thadomal Shahani Engineering College, Bandra (w), Mumbai 400050, India*

Abstract –
The Indian traffic system is notorious for its congested roads and rash driving, which often leads to accidents. In order to reduce the number of accidents, there is a need for an integrated framework that can simultaneously detect drowsy drivers and recognize number plates. In this paper, we propose an ML-based integrated framework called DrowsePlate that can perform both tasks. The proposed work is integration of image processing techniques, deep learning models, and computer vision algorithms to achieve high accuracy in both tasks. The results show that the proposed system can effectively detect drowsy drivers and recognize number plates in real-time.

Key Words: Indian traffic system, drowsy driving, number plate recognition, machine learning, integrated framework, image processing, deep learning models, computer vision algorithms, real-time detection..

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I. INTRODUCTION

An ML based integrated framework for number plate recognition and drowsiness detection in Indian traffic system is a system that utilizes machine learning (ML) algorithms to identify and recognize number plates of vehicles and to detect driver drowsiness. The system is designed to improve traffic safety on Indian roads by automating certain tasks and alerting drivers when they are showing signs of drowsiness.

The number plate recognition component of the system uses computer vision techniques to identify and read each and every alphanumeric characters written on number plate vehicle. In this process we have harnessed camera for image capturing & image processing techniques which helps in identifying unique character patterns written on vehicle number plate. Once the number plate is recognized, it can be used for various purposes, such as tracking vehicles or identifying traffic violations.

The drowsiness detection component of the system uses ML algorithms to analyze the behavior and movements of the driver to determine whether they are showing signs of drowsiness. This is done through the use of cameras and sensors that track the driver's eye movements, facial expressions, and body posture. The ML algorithms analyze this data and provide an alert if the driver is showing signs of drowsiness, allowing them to take appropriate action and avoid accidents.

Overall, the ML based integrated framework for number plate recognition and drowsiness detection in the Indian traffic system is a powerful tool that can help improve safety on Indian roads by automating certain tasks and providing alerts to drivers when they are showing signs of drowsiness**.**

II. LITERATURE REVIEW

Automatic number plate recognition (ANPR) has been an area of research for many years. Traditional methods for ANPR include feature extraction and matching techniques. However, in recent years, deep learning-based approaches have shown promising results for number plate recognition. Gupta et al. (2020) proposed a novel neural network-based approach for license plate recognition in Indian traffic conditions, which achieved high accuracy rates. Similarly, Singh et al. (2021) proposed a real-time license plate recognition system that uses deep learning and faster R-CNN (region-based convolutional neural network) to accurately detect and recognize number plates in Indian traffic conditions.[2]

Drowsiness detection is an important aspect of ensuring driver safety on the roads. There are several approaches to drowsiness detection, including image processing, deep learning, and support vector machines. Jalal and Islam (2019) provided a comprehensive review of different machine learning techniques that can be used for driver drowsiness detection. Sharma and Prasad (2017) proposed a real-time drowsiness detection system for drivers that uses a combination of facial feature extraction and machine learning algorithms to detect signs of drowsiness.[4]

The integration of number plate recognition and drowsiness detection has the potential to improve traffic safety significantly. Arumugam and Premkumar (2020) proposed a vehicle no plate recognition system based on deep learning which can accurately recognize number plates in Indian traffic conditions. The system also incorporates a drowsiness detection module that uses facial feature extraction and machine learning algorithms to detect signs of drowsiness in drivers.

Overall, the literature suggests that an ML based integrated framework for number plate recognition and drowsiness detection in Indian traffic system can significantly improve traffic safety.

Deep learning-based approaches have shown promising results for number plate recognition, while machine learning techniques can be used for drowsiness detection. The integration of these two systems can provide a more comprehensive approach to improving traffic safety.

III. METHODOLOGY

3.1 Proposed System

The camera captures driver's face and the vehicle's number plate. The drowsiness detection algorithm processes the images to detect signs of drowsiness. In our proposed recognition system we extracted alphanumeric plate number from the captured image of plate number. If drowsiness is detected, the alert system is triggered, and an alert is displayed to the driver.

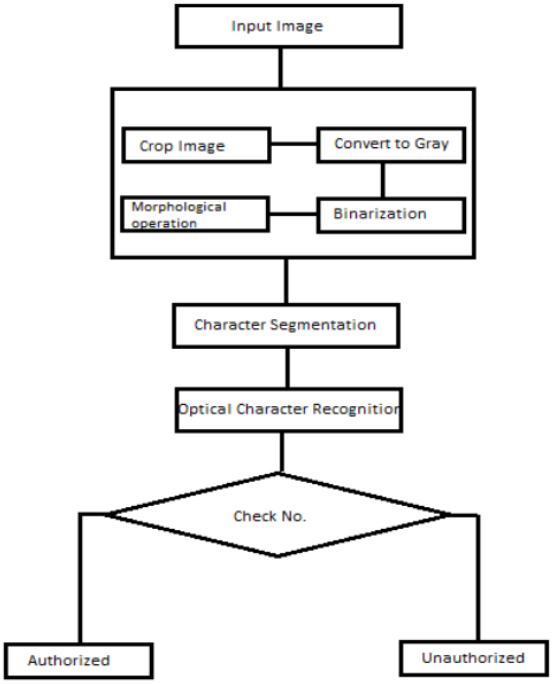

Fig -1: Block Diagram including all essential parts of the number plate detection system.

3.2. System Architecture

The main steps of proposed system are RGB to grey scale conversion, Noise Reduction and Edge Detection, Character Segmentation, Optical Character Recognition, search and sort algorithm. The main python libraries used are OpenCV, Tesseract, Glob, Sys, OS , Kera's, Pillow. The next sections will explain the detailed explanation of each method and steps used in well-defined systems.

I. Image pre-processing

A. **Noise Reduction**

The main motive of Gaussian filtering/ Gaussian smoothing is to reduce noise.

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{\frac{-(x^2+y^2)}{2\sigma^2}}$$

Fig -2.1: Gaussian Filtering

The input image is made to convolve with this 2-D 'G' matrix to obtain a smoothened image.

B. **RGB to Grayscale Conversion**

To decrease the image's dimensionality while maintaining the crucial details required for precise detection, RGB to grayscale conversion might be performed. This simplification boosts number plate identification accuracy and the computational efficiency of subsequent image processing methods.

C. **Edge Detection using Sobel Method**

Edge detection using the Sobel method is an image processing technique that can be used to extract edges or boundaries from an input image. The Sobel method involves applying a 3x3 kernel to each and every pixel in captured image to calculate gradient magnitude for images. The kernel is designed to highlight the changes in pixel intensity in the horizontal and vertical directions, which are indicative of edges or boundaries.

Run filter over image

$$\frac{\partial \boldsymbol{f}}{\partial x} = \boldsymbol{S}_x \otimes \boldsymbol{f} \qquad \frac{\partial \boldsymbol{f}}{\partial y} = \boldsymbol{S}_y \otimes \boldsymbol{f}$$

Image gradient

$$\nabla \boldsymbol{f} = \left[\frac{\partial \boldsymbol{f}}{\partial x}, \frac{\partial \boldsymbol{f}}{\partial y}\right]$$

Fig -2.2: Sobel Edge Detection

II. Optical Character Recognition

OCR is a technique for recognizing printed or handwritten text characters from digital images. It involves preprocessing the image to enhance the text, segmenting the text into individual characters, and then using pattern recognition algorithms to recognize the characters. OCR is commonly used in applications such as digitizing books and documents.

A. **Character Segmentation-**

Character segmentation is the process of dividing an image containing multiple characters into separate images of individual characters. It is an important step in many applications of optical character recognition (OCR), as it allows the individual characters to be recognized and processed independently.

B. **Optical Character Recognition-**

Using the TensorFlow and Keras libraries, we train a CNN. 35 levels of instruction (10 for numbers and 25 for letters excluding the letter "O"). Tracing each character's shape in the image is the counter technique. It operates by spotting edges in the image and then tracing the contour of every connected component to establish the character boundaries.

III. Morphological Transformation and Placing Counters

Morphological transformations involve applying mathematical operations, such as erosion and dilation, to an image to extract useful information or enhance specific features. For example, in the case of DrowsePlate, morphological transformations can be used to extract each and every character from the captured image or enhance the driver's facial features for drowsiness detection.

Placing contours involves identifying and outlining the regions of interest in an image using contour detection techniques. In the case of DrowsePlate, placing contours can be used to identify the number plate region or the driver's facial features.

By applying morphological transformations and placing contours, DrowsePlate can accurately detect and extract the regions of interest in the input image, which is crucial for the subsequent recognition phase of the system. These techniques also help to reduce the noise and improve the overall quality of the input image, resulting in more accurate and reliable results.

IV. Python Libraries Used

A. **OpenCV i.e. Open source computer vision**

One of the very useful and popular library of python is Open Source Computer Vision which is mainly used for image processing works. In number plate recognition, OpenCV can be used for preprocessing the input images, extracting features from the number plates, and performing operations such as edge detection, thresholding, and contour detection.

B. **Tesseract**

Tesseract is an optical character recognition (OCR) engine that can be used for recognizing characters from images. Tesseract can be used to extract each and every alphanumeric character of the number plate image and recognize each and every characters present on it.

C. **Glob, Sys and OS**

This library can be used for searching files with a specific pattern or extension in a directory. In number plate recognition, Glob can be used to find the input images of number plates in a specific folder or directory.

Sys and OS provide system-level functions and operations, such as reading and writing files, accessing directories, and running system commands.

D. **Keras**

Keras is a popular deep learning library that can be used to create and train neural networks. In number plate recognition, Keras can be used to develop a deep learning model for recognizing number plates from images.

E. **Pillow**

Pillow is a Python Imaging Library that can be used for image processing tasks such as cropping, resizing, and rotating images. In number plate recognition, Pillow can be used for pre-processing

the input images, such as resizing the image to a specific size or cropping the image to remove any unnecessary elements.

F. **Pygame**

Pygame library can be used in drowsiness detection to play an alarm sound when the user's eyes are closed for a prolonged time. In the given code, Pygame is used to load an audio file 'alarm.wav' and initialize the mixer module.

3.3. System Implementation

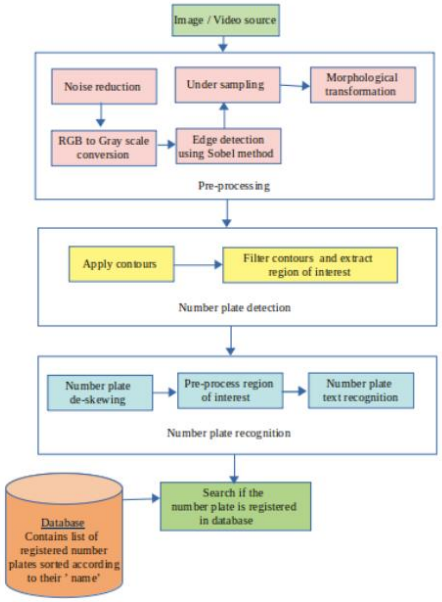

Fig -3: Flow Diagram of Number Plate Recognition

3.4. Implementation Steps

I. Detection Phase

A. Contours are produced using the contour tracing algorithm. A line of equal intensity points running along a boundary is known as a contour. Detecting contours in OpenCV is like detecting a white item against a black backdrop, hence inversion operation must be used during the adaptive gaussian thresholding stage.

B. Contours are used for small regions, particularly for cutting edges and noise outliers. Although the human eye can quickly recognize that such contours are unnecessary, a programmer must take this into account.

C. Each contour was initially given bounding boxes. The minimum contour area, width, and height for each contour were then considered.

D. This caused many of the redundant contours to be filtered out, which brought us closer to finding the number plate.

II. Recognition Phase

A. The amount of rotation necessary to align an image vertically and horizontally is called a skew. Skew is measured in degrees.

B. DE skewing is the process of removing a skew by rotating an image in the opposite direction by the same amount as its skew. The text runs across the page because of this, aligned both horizontally and vertically. In our project, ratio and rotation is used to complete this step. As with the number "zero," it is possible for two or more contours to completely encircle one another.

C. The inner contour may completely enclose the outer contour if it is picked up during the contouring process. As a result, during the recognition process, both contours might be recognized as separate characters.

III. Validation Phase

A. Register all the vehicles in the dataset and store them in a database after removing other special characters. To make the final stage of searching more efficient, we are performing sorting operations on the detected texts. This is done using a quick sort algorithm.

B. Obtain the new vehicle’s registration number and check if it is present in the database using Binary search method. It takes O(log(n)) time complexity, which when compared with linear search is much better, especially when the array size gets larger.

IV. Drowsiness Phase

A. In order to detect a person’s eye , whether it is open or closed we have harnessed computer vision techniques & deep learning methos and also to alert them when they are feeling sleepy. It starts by importing the necessary libraries such as OpenCV, Keras, NumPy, and Pygame, and then loads the pre-trained models using the Haar Cascade Classifier for face and eye detection.

B. Program then accesses the computer's camera to capture a live video stream, which is processed in real-time to detect the presence of a face and eyes. If both eyes are closed, the program increments a score, and if this score exceeds a threshold, an alarm is raised. The Pygame library generates an alarm sound and increases the thickness of a red rectangle around the video frame to indicate that the person is drowsy.

IV. RESULTS AND DISCUSSION

Fig -4.1: Result Showing Vehicle

The search database maps the car number plate, and the permitted vehicle number is output to pass.

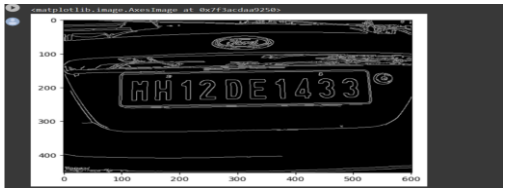

Fig -4.2: Noise Reduction and Edge Detection

Smoothing of image: A bilateral filter is a nonlinear image processing filter used for smoothing images while preserving edges.

Fig -4.3: Mask Application

Sobel Edge Detection: Detects the edges in an input image using the Sobel edge detection algorithm.

Fig. 4.4 Placing Counters

A fundamental problem in computer vision, contour detection is utilised in a variety of processes, such as object detection, shape recognition, and image segmentation.

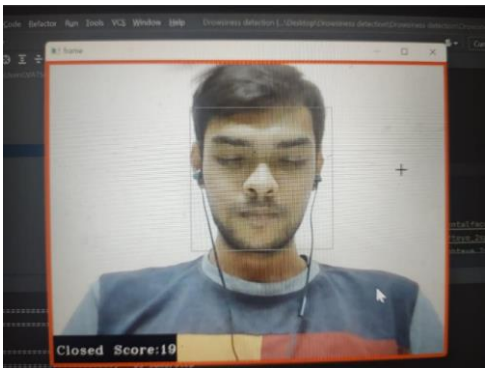

Fig. 4.4 Drowsiness Eyes Closed

As we can see in Fig No 4.4 the eyes of the person is closed and if score count greater than 15 is detected then alert is shown.

V. CONCLUSIONS

DrowsePlate is an innovative and integrated framework that combines machine learning-based techniques for number plate recognition and drowsiness detection in the Indian traffic system. This framework offers several benefits, including increased safety on the roads and improved traffic management.

By using machine learning algorithms, DrowsePlate can accurately recognize number plates in real-time, which can help law enforcement agencies to track down offenders and reduce crime rates. Additionally, the drowsiness detection feature of the framework can alert drivers when they are becoming drowsy, reducing the risk of accidents caused by driver fatigue.

Overall, DrowsePlate is a promising solution for improving road safety in India. With further development and implementation, it has the potential to significantly reduce the number of road accidents and fatalities in the country.

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