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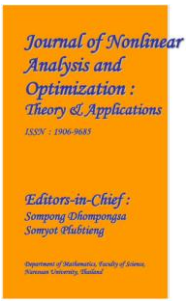

DEEP LEARNING TECHNIQUES TO REDUCE DMS COMPLEXITY FOR DRIVER OPTIMIZATION

[1]Sujana B, [2]Praveen Kumar Gajjella, [3]Shephali Singh, [4]Kurlapally Shivani
[1,2,3]Assistant Professor, [4]UG Student, [1,2,3,4]Department of Computer science and Engineering, Rishi MS Institute of Engineering and Technlogy for Women, Kukatpally, Hyderabad.

Abstract
The driver monitoring system (DMS), commonly referred to as the driver attention monitor, is crucial to the operation of the safety systems in vehicles. In DMS, the system recognises the driver's actions, such as driving when fatigued or failing to pay enough attention to prevent collisions. The technology alerts the driver to help prevent errors made while driving. DMS deployment requires a system that operates in real time with no delays. Due to the complexity of network implementation, the current DMS faces numerous implementation issues. We provide an optimization approach that makes use of camera pictures to track the activities of the driver in order to lessen the complexity of the DMS for real-time implementation. From the input camera images, we extract the driver's state information from the region of interest (ROI).
Keywords: Deep neural network (DNN), Key point Detection, 3D Transformation, camera calibration.

Introduction

Road accidents have significantly grown over the last few years, causing serious health problems and even fatalities [1]. Drivers are subject to a number of risk variables, which ultimately lead to collisions of various severity levels [3]. Professional drivers, weariness, large vehicle types, overloads, and topography have all been highlighted as risk factors. By offering technical solutions to these uncovered risk factors, accidents may be reduced to some extent. Technology improvements have led to a widespread use of many smart and intelligent strategies in the transportation sector [4]. These methods aid in distributing parking spaces, streamlining traffic, etc. These methods aid in lowering driver irritability, irresponsibility, etc. Various driver monitoring systems with a driver eye movement, behavior, fatigue etc focus are currently available. The basic idea behind the project "Drivers eye" is real time monitoring of the driver's eye and facial features using a camera. Then these images are processed to find the drivers behavioral conditions like distraction, drowsiness, fatigue etc. The signals from the vehicle parts like accelerator, brake, steering etc. are also recorded and both these data are simultaneously processed to find out whether the driver is distracted. If the driver is distracted, the alarm system which is placed inside the vehicle will warn the driver. This will help the driver to recover from distracted state to the normal driving state. The majority of driver distractions are caused due the usage of smartphone, social networking activities etc. while driving [7]. The proposed system can reduce the driver accidents that are caused due to such social activities. The proposed model uses Viola Jones Algorithm for Face analysis and combined with other machine learning algorithms for evaluation of both In-Vehicular and Face data evaluation. The open data datasets were used for training both In-Vehicular and Face Data.

Related Work

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Driver drowsiness is a genuine risk in transportation frameworks. It has been recognized as an immediate or contributing reason for street mishap. Drowsiness can truly slow response time, decline mindfulness and weaken a driver's judgment. It is inferred that driving while drowsy is like driving affected by liquor or medications. In existing system there is no proper way to observe driver drowsiness.

Proposed Method

The goals of this task are to build up a drowsiness recognition framework that can recognize drowsy or weariness in drivers. The system detects the driver's activities such as the state of being a driver sleepy or failure to give sufficient attention to avoid accidents. To reduce the driver mistakes while driving, the system warns the drivers.

Advantages

Reduce car accident
Security purpose of the driver

Architecture

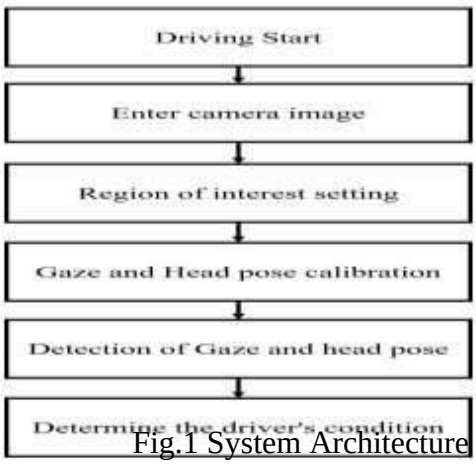

Fig.1 System Architecture

Proposed DMS Optimization

Algorithm: The proposed DMS optimization algorithm extracts driver head pose and gaze information from camera images and estimate the current driver state. The proposed system uses infrared (IR) cameras to capture the driver current state data and use this information to extract ROI information. From the ROI results, the driver gazes and head pose features are estimated to monitor the driver states. The proposed system consists of a deep neural network (DNN) for face detection, an algorithm for identifying ROI, eye detection algorithm and face detection algorithm.

A. DNN Algorithm for Face Detection

The proposed algorithm uses a DNN model for driver face detection and which follows a YOLO V2 model [1]. The DNN model uses 200,000 face data for training the model with a batch size of 10. The learning rate of the DNN model is $2 \times 10{-}5$ and an Adam optimizer is used for optimizing the model. Since in real time environment.

B. Driver ROI identification: The performance of the proposed system depends on the ROI identification. The following steps are used for the ROI identification.

1. Use a DNN face detection algorithm to detect all faces from input camera images.
2. If more than one face is detected, only the largest face is recognized as data and the rest are ignored.
3. Add the size of the face to a two-dimensional array with the same size as the image. In addition, position of the two-dimensional array is the center of the face rectangle.

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4. Repeat step 1 to step 3 for 5 minutes.
5. Apply a 2D filter of 50×50 with a value of 1 for step 3 results.
6. Locate the point that has the greatest value in the result value of step 5, increase the size by 1.9 times considering the driver's radius of action, and set the final ROI.

C. Eye Detection Algorithm: The proposed algorithm uses an eye detection algorithm which classifies the ROI results based on the driver state. The existing gaze detection algorithm classifies the input images based on the driver front view, collects learning data from driver front and dynamic views, training it, and estimates the driver's gaze information. However, the driver's state depends on the eye blinking and eye opening closing sizes. The eye blinking and eye opening-closing features are useful for identifying driver sleep conditions. Therefore, to add eye features, the proposed model uses GazeML algorithm [3] instead of conventional gaze detection approaches. The GazeML algorithm gives accurate results for driver front view data. However, in real situations, the driver looks at any direction and it is necessary to extract the gaze features for front and dynamic views. To improve the performance of gaze detection algorithm, our model uses new training data, which consists of images of driver's face in all direction.

D. Face Angle Detection Algorithm: The proposed model uses a face angle detection algorithm, which estimates the driver head pose information. The face angle detection algorithm estimates the head poses by using the 3D transformation of absolute and relative coordinates. Our proposed model uses 15 feature points and 15 hypothetical 3D coordinates to detect the driver's face angle.

Modules

Supervised Classification: The data has been divided into two parts i.e., training and testing data in the 70:30 ratios. Learning algorithms have been applied on the training data and based on the learning, predictions are made on the test data set.

Supervised Classification: The test dataset is 30% of the total data. Supervised learning algorithms have been applied on the test data and the output obtained is compared with the actual output.

Pandas: pandas are an open source, BSD-licensed library providing high-performance, easy-to-use data structures and data analysis tools for the Python programming language. **Numpy:** NumPy is a general-purpose array-processing package. It provides a high-performance multidimensional array object, and tools for working with these arrays. It is the fundamental package for scientific computing with Python.

MatPlotLib: matplotlib. Pyplot is a plotting library used for 2D graphics in python programming language. It can be used in python scripts, shell, web application servers and other graphical user interface toolkits

Scikitlearn: Scikit-learn is a free machine learning library for Python. It features various algorithms like support vector machine, random forests, and k-neighbors, and it also supports Python numerical and scientific libraries like NumPy and SciPy.

Experimental Results:

To evaluate the performance of our proposed algorithm, first we estimate the driver's ROI information.

```
from keras.models import Sequential
from keras.layers import Conv2D
from keras.layers import MaxPooling2D
from keras.layers import Flatten
from keras.layers import Dense
from keras.models import model_from_json
import numpy
import os
```

Fig.1 Importing related libraries for the model

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Fig.2. Estimating the driver head pose information by using face angle detection algorithm

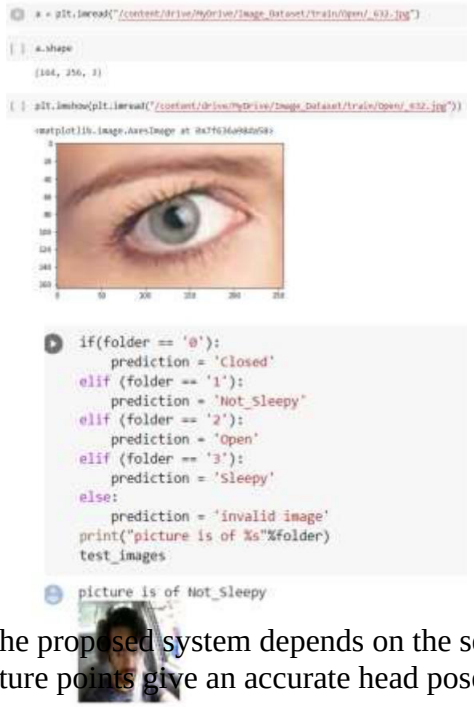

Fig.3. The performance of the proposed system depends on the selection of feature points and correct feature points give an accurate head pose estimation

Comparative Study:

The clouds of 3-D points from the sensor are captured and 2-D projects are analyzed based on head movements and also extracted for further analysis [16]. In order to detect drowsiness, an ingenuity method which combines the methods comprising of both computer vision as well as physiological bio-signals can be systematically employed. PCA model is employed initially to detect the face region; the eye region is determined by employing GA based on face segment. The changes in the signal waveform from active awake state to drowsy state can be systematically analyzed using Photo Plethysmo graphy (PPG) [17].

The main idea and contribution of the proposed work is the central focus on facial expressions based driving fatigue detection system in which a deep learning based feature extraction using LOP is used for facial expression recognition. There are three conventional methods available for facial recognition namely appearance-based methods, Geometric-based methods, and neural network based methods. The foremost classic method for observing face recognition is face geometry. The human face is represented and characterized by an optimal set of facial landmark points in Geometrical feature based approaches. The location and shape of facial components are determined by the angle and distances between those facial points. To classify the input face, the feature vectors that suitably represent the face are fed as input to the classifier. In order to accurately locate the landmark points on face, facial point detectors have to be found which is difficult task. The features are unanimously extracted from the relative pixel gray values as given in the face image in case of appearance-based methods. The pixel intensity is determined by the intensity of light emitted from the image. Some of the conventional appearance-based methods which do not include facial points information are Principal Component Analysis (PCA) including Eigen face, Local Binary Pattern (LBP), Linear Discriminate Analysis

(LDA), Local Gabor Binary Patterns (LGBP) and multi-orientation multi-resolution Gabor wavelets. The features which are extracted from the above methods are given as input to the neural network, which then tries to identify the input image. This is evaluated based on the analysis of the descriptive features, which are obtained from geometric and appearance based methods, Classifiers such as Artificial Neural Networks (ANNs), Support Vector Machines, (SVMs), K-Nearest Neighbors (KNNs), Hidden Markov Models (HMMs), which classifies the input image into one of the expressions. In recent years, the methods like Deep Learning have gained prominence and are considered as a promising technique to perform facial expression recognition.

Archana Shirsat et al. [18] has enumerated a novel FER using an efficient LBP for feature extraction and employed with Artificial Neural Network (ANN) for classification. The illumination variant based local binary pattern tries to detect the features using very simple mathematical computation. Some of the extracted features from the given LBP methodology were comprehensively fed into ANN for further classification. Three feature extraction methods were used by Reza Azmi [19]:

Gabor filters, LBP and local Gabor binary pattern (LGBP). The KNN classifier, coupled with calculation for the vector distance measure is utilized as a classifier. The LGBP due to its more powerful and effectiveness tends to show high accuracy based on different occlusion conditions on FER. Banu, Simona et al. [20] designed a model for detection of overall face, with detailed features of eyes and mouth, which makes use of the Haar feature functions and is applied with Bezier curves, which are used to extract features for geometrically different facial parts. Two layer Neural Networks method with K-means algorithm is used for pre-classification. Facial expression based recognition method using Hidden Markov Model was proposed by Jun Wang et al. [21].

Jun Wang et al. has proposed a deep CNN for identifying and recognizing a deeper feature representation of facial expression as part of the process of facial expression recognition system, which is mainly used in order to gain automatic recognition. These methods achieve high recognition rate, but the drawback is that needs additional improvement in terms of accuracy and sensible quality. Though these works achieve salient performance on facial expression recognition, an effective automatic driver warning system is proposed by extracting the facial features using LOP-CNN for facial expression recognition.

Conclusion

For the ADAS driver monitoring system, we suggested a DMS optimization algorithm in this study. The suggested model tracks the conditions of the driver's state using information on the driver's head attitude and eye position. The results of the experiment demonstrate that the suggested solution provides adequate ADAS performance, and the model decreases system complexity without causing any delay issues. But in the future, we must create a system that recognizes driver behaviors like using a cell phone, smoking, and eating.

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