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Driver Drowsiness Detection using Deep Learning Algorithms

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Abstract—This paper gives an overview of the research on applying deep learning algorithms to detect tired faces. Many car accidents and fatalities are caused by drowsy drivers around the world. The development of computing technology has made it possible to create intelligent face detection systems. Faces provide information that can be utilised to deduce sleepiness levels. We use deep learning to predict actual human behaviour during sleepiness episodes using face cues as a target.

Keywords—Drowsy face Detection, Facial Features, Deep learning, Human Behavior.

I. Introduction

Drowsiness affects mental attentiveness, reducing a person's capacity to perceive their environment on a fundamental level and increasing the risk of human error. According to figures from the police departments of India's states and union territories, 1,50,785 people were killed in road accidents in 2016 and 1,47,913 people were killed in 2017[1].

Drowsiness is thought to be responsible for between 10% and 20% of traffic accidents, resulting in both fatalities [2] and injuries [3], with the trucking industry accounting for 57 percent of fatal truck accidents [4],[5]. Drowsiness is responsible for 30% of all automobile accidents[6]. Drowsiness is responsible for 100000 road accidents in the United States each year, costing almost $12.000 million [7]. In Germany, one out of every four road accidents is caused by tiredness, whilst in England, drowsiness causes 20% of all traffic accidents [8], and in Australia, 1500 million dollars has been spent on fatalities caused by this problem [9].

Drowsiness, often known as sleepiness, is a biological state in which the body is transitioning from an awake to a sleeping state. A motorist may lose focus at this point and be unable to perform steps such as avoiding head-on crashes or braking in a timely manner. There are several telltale symptoms that a motorist is drowsy, including:

- Frequent yawning
- Inability to keep eyes open
- Head swivelling forward
- Changes in face colour owing to blood flow

II. Process For Drowsiness Detection

Using a camera, facial features such as eye state, head movement, blinking rate, and yawning can be retrieved to determine the behaviour patterns that are responsible for drowsiness detection. After extracting the countenance from the video feed, machine learning techniques such as Support Vector Machines (SVM), Convolutional Neural Networks (CNN), and Hidden Markov Models are used to determine the level of tiredness (HMM). These strategies are used to train models that will be used to predict drowsiness utilising characteristics and tagged outputs. Finding a huge dataset is the most difficult component of this approach. Because of the security and

confidentiality considerations that occur when posting datasets for educational and commercial use, this is frequently a unique challenge.

A. Machine Learning Approach

A supervised machine learning challenge is image classification. We establish a collection of target classes in this challenge and use labelled example images to train the model to recognise them. In picture categorization, the following are some of the most widely used machine learning algorithms:

1) *Logistic Regression*: When the dependent variable is dichotomous, a variant of binomial regression called logistic regression is used to estimate the parameters of a logistic model. It's used to handle data with two possible criterion and relationships.
2) *Decision Trees:* In a tree-structured method, a decision tree constructs classification models. According to a given parameter, images are separated into smaller and smaller subsets, and a decision tree is constructed gradually at the same time. The end result is a tree containing leaf nodes and decision nodes. The root node is the topmost decision node in the tree that corresponds to the best predictor. Both categorical and numerical data could be used with this technique.
3) *Random Forest Classifier*: Random Forest(RF) is an ensemble learning method for classification that constructs many decision trees during training and outputs individual tree classification predictions.

4) k-Nearest Neighbour: This is a supervised machine learning approach that uses labelled input data to develop a function that gives an appropriate output when presented with new unlabeled data. The KNN algorithm believes that objects that are similar are close together. In a dataset, it essentially produces a cluster of similar items, which can then be used to classify the photos

B. Deep Learning Approach

Deep learning algorithms work well with Image data-sets due to the use of Convolutional Neural Network(CNN) as opposed to that of Machine learning algorithms.

1) *Convolutional Neural Network*: Convolutional Neural Network: CNN image classification takes a picture as input, analyses it, and then divides it into categories. CNN image classification takes a picture as input, analyses it, and then divides it into categories. The input image is seen by computers as an array of pixels, with the number of pixels varying depending on the image resolution. A grayscale image matrix is constructed based on the Image Resolution. Each image will go through a convolutional layer containing filters (kernels), pooling, and fully connected layers before being classified using the Softmax function with probabilistic values ranging from 0 to 1.
2) *YOLO:* The YOLO model takes a single sample of an image and then processes and modifies it using any pre-designed network. Following that, a feature map is created using numerous layers and a suitable activation function. To obtain a tensor, these completely connected layers and dimensional modifications are used.

III. DATASET

A. MRL Dataset

MRL Dataset: The MRL Eye Dataset is a massive collection of images of the human eye. This collection contains many infrared high and low resolution photos taken under various illumination situations with differing intensities and with various instruments. The dataset can be used to test a variety of features or trainable classifiers. The photos are separated into numerous categories to facilitate comparing algorithms easier, and they are also excellent for training and testing classifiers. [10]

B. Properties

The properties of this dataset are as follows:

- subject ID:
  In the dataset, we collected the data of 37 different persons (33 men and 4 women)
- image ID:
  The dataset consists of 84,898 images
- gender [0 - man, 1 - woman]:
  The dataset contains the information about gender for each image (man, woman)
- glasses [0 - no, 1 - yes]:
  The information if the eye image contains glasses is also provided for each image (with and without the glasses)
- eye state [0 - closed, 1 - open]:
  This property contains the information about two eye states (open, close)
- reflections [0 - none, 1 - small, 2 - big]: We annotated three reflection states based on the size of reflections (none, small, and big reflections)
- lighting conditions [0 - bad, 1 - good]: Each image has two states (bad, good) based on the amount of light during capturing the videos
- sensor ID [01 - RealSense, 02 - IDS, 03 - Aptina]: At this moment, the dataset contains the images captured by three

different sensors (Intel RealSense RS 300 sensor with 640 x 480 resolution, IDS Imaging sensor with 1280 x 1024 resolution, and Aptina sensor with 752 x 480 resolution)[10]

IV. Previous Work on Drowsiness Detection

Various methods for detecting a face and extracting information from a video feed have been employed in various studies.

Regrettably, the majority of these research employ different datasets, which may favour their own methods. The lack of standardised datasets that can be used as a benchmark is the reason for this.

As a result, comparing techniques based solely on reported accuracies is difficult. Machine learning algorithms for classifying different levels of drowsiness, as well as a review of measures that make up a driver drowsiness monitoring system, are presently reviewed.

A. Support Vector Machine (SVM):

SVM is a supervised machine learning technique that may be used for both classification and regression. It is however most commonly used in classification problems.

B. The Hidden Markov Model (HMM):

HMM is a type of model that provides a foundation for machine learning in the field of probabilistic models for linear sequenced problems. It gives a conceptual framework for creating complicated models by creating simple drawing of an intuitive picture.

TABLE I
Previous Work

Author	Year	Metric	Classifiers	Accuracy
L. Pauly and D.Sankar [11]	2015	Eye State	HOG and SVM	91.6
A. Punitha et al. [12]	2014	Eye State	SVM	93.5
Zhang et al. [13]	2015	Eye State	HMM	95.9
Y. Sun et al. [14]	2013	Eye Blink	SVM and HMM	90.9
K.Dwivedi et al.[15]	2014	Visual Features	CNN with softmax	78

V. Proposed System

The photos from the webcam would be fed into a Deep Learning model by the system. The strategy we'll use for this project could be as follows:

1) Take a picture from a camera as input.

2) Create a Region of Interest around the face in the image (ROI).

3) Take the ROI and extract multiple features to feed to the classifier.

4) To train and evaluate the model, the Deep Learning framework will classify the characteristics.

5) Calculate a score to see if the person is drowsy and display the Drowsiness Percentage.

Conclusion

For the objective of detecting driver drowsiness, numerous techniques that support behavioural methods and machine learning could be used. This paper reviewed the range of features and measurements used for classification and gave a survey of approaches to drowsiness detection using machine learning and deep learning techniques. We've also presented a deep learning-based drowsiness detection technique.

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