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Drowsy Driver Detection using Representation Learning and Face Detection Technique

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Abstract*: The advancement of computing technology over the years has provided assistance to drivers mainly in the form of intelligent vehicle systems. Driver fatigue is a significant factor in a large number of vehicle accidents. Thus, driver drowsiness detection has been considered a major potential area so as to prevent a huge number of sleep induced road accidents. The main aim of the project is to develop Drowsy Driver Detection System that allows for warning the driver of drowsiness or in attention to prevent traffic accidents. We propose a vision based intelligent algorithm to detect driver drowsiness. Previous approaches are generally based on blink rate, eye closure, yawning, eye brow shape and other hand engineered facial features. Our system proposes an algorithm for driver drowsiness detection using representation learning. A new perspective towards driver sleep detection is presented as features responsible for decision making are produced by leveraging multi-layer convolutional neural networks. The proposed algorithm makes use of features learnt using convolutional neural network so as to explicitly capture various latent facial features and the complex non-linear feature interactions. A softmax layer is used to classify the driver as drowsy or non-drowsy. This system is hence used for warning the driver of drowsiness or in attention to prevent traffic accidents. We present both qualitative and quantitative results to substantiate the claims made in the system.*

1. Introduction

Driver fatigue is a huge traffic safety problem and is widely believed to be one of the largest contributors to fatalities and severe injuries in traffic today, either as a direct cause of falling asleep at the wheel or as a contributing factor in lowering the attention and reaction time of a driver in critical situations [2]. Accidents with commercial heavy vehicles are not only dangerous but also very costly and the counteraction of driver fatigue is highly important for improvement of road safety.

There has been a very large increase in road accident due to drowsiness of driver while driving which leads to enormous fatal accidents. The driver lose his control when he falls sleep which leads to accident .This is because when the driver is not able to control his vehicle at very high speed on the road. This project can generate a model which can prevent such accidents. The main objective with this project has been to define a Fatigue Risk Management program for the commercial road transport area, following the recommendations from the DROWSI project. The work has focused on the development of concept solutions; tools and methods for fatigue risk management and how to work with driver fatigue on a strategic and tactical level [3]. Another part of the project has been focusing on enhancement techniques of a drowsiness detection system in terms of blink behaviour based indicators and increased robustness and availability of a lane position monitoring system by using additional sensor sources. Finally, a warning strategy in terms of vibrations in the steering wheel has been investigated and evaluated in a driving simulator experiment.

Objectives:

1. Attention to prevent traffic accidents.
2. A driver detection system for supporting and warning the driver when becoming drowsy.
3. Provide security for safe driving on road.

2. Literature Review

There are some significant previous studies about drowsiness detection and fatigue monitoring. Many computer vision based schemes have been developed for non-intrusive, real-time detection of driver sleep states with the help of various visual cues and observed facial features. An observed pattern of movement of eyes, head and changes in facial expressions are known to reflect the person's fatigue and vigilance levels. Eye closure, head movement, jaw drop, eyebrow shape and eyelid movement are examples of some features typical of high fatigue and drowsy state of a person. To make use of these visual cues, a remote camera is usually mounted on the dashboard of the vehicle which, with the help of various extracted facial features, analyses driver's physical conditions and classifies the current state as

drowsy/non drowsy. It has been concluded that computer vision techniques are non-intrusive, practically acceptable and hence are most promising for determining the driver's physical conditions and monitoring driver fatigue.

Y. Takei, Y. Furukawa Propose Autonomous systems designed to analyze driver exhaustion and detect driver drowsiness can be an integral part of the future intelligent vehicle so as to prevent accidents caused by sleep. A variety of techniques have been employed for vehicle driver fatigue and exhaustion detection. Driver operation and vehicle behaviour can be implemented by monitoring the steering wheel movement, accelerator or brake patterns, vehicle speed, lateral acceleration, and lateral displacement. These are non-intrusive ways of driver drowsiness detection, but are limited to the type of vehicle and driver conditions.

E. Vural, M. Cetin, A. Ercil propose new techniques are based on machine learning algorithms to detect driver drowsiness levels. Authors creates Automatic classifiers for 30 facial actions from the Facial Action Coding system using machine learning on a separate database of spontaneous expressions to finally categorize driver drowsiness. Authors proposes a system that applies automated measurement of the face during actual drowsiness to discover new signals of drowsiness in facial expression and head motion. Authors demonstrates that the simultaneous use of multiple visual cues and their systematic combination yields a much more robust and accurate fatigue characterization than using a single visual cue by using a Bayesian network.

Scott Fisher, Jennifer Stein, describes current research towards new approaches for storytelling and context-and location specific character development. The result of this research is the Million Story Building (MSB) project, which has been designed and implemented by the Mobile and Environmental Media Lab in USC's Interactive Media Division. The new School of Cinematic Arts building provides the setting for ambient storytelling in which conversations between the building and its inhabitants introduce new ways of interacting with architectural spaces for storytelling.

3. Problem Statement

The main aim of the project is to develop Drowsy Driver Detection System that allows for warning the driver of drowsiness or in attention to prevent traffic accidents. We define driver eye segmentation technique for detecting drowsiness of driver. We propose a face detection algorithm to detect driver drowsiness using representation learning. If the detection of drowsiness is positive alarm is generated that is warning feedback system is triggered for driver.

4. Mathematical Model:

A. User Module:

- Set (Q)={q0,q1,q2,q3}
- Q0-user registration
- Q1-user login
- Q2-video input
- Q3-upload dataset

B. Face Detection:

- Set (D)={d0,d1,d2,d3,d4,d5}
- D0-Conversion of Video to Frame
- Frames Extraction
- D2-Resize Images
- D3-Performance Measure
- D4-Representation Learnings
- D5-Eye Detection

C. Drowsiness Detection:

- Set (T) = {d2,s0,s1,s2,s3,s4}
- s0= Performance Checking
- s1= Driver Nature Identification
- s2=Expressions Measure
- S3=Alarm Generation
- S4= Result

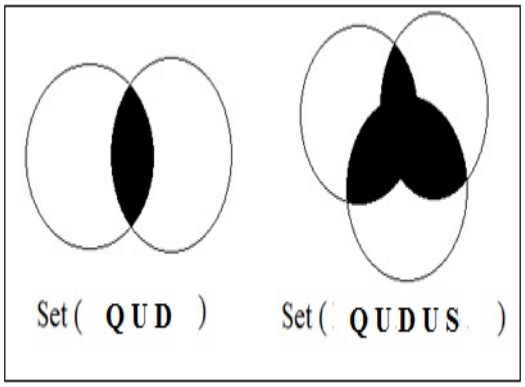

Figure 1. Union Of Set

5. Proposed Work

The primary purpose of the Drowsy Driver Detector is to develop a system that can reduce the number of accidents from sleep driving of vehicle. With our two monitoring steps, we can provide a more accurate detection. For the detecting stage, the eye blink sensor always monitor the eye blink moment. It continuously monitor eye blink. If the monitoring is over, the collected data will be transmitted to a database and face detection

algorithm is used to make a proper result and if the detection of drowsy is positive alarm is generated that is warning feedback system is triggered for driver.

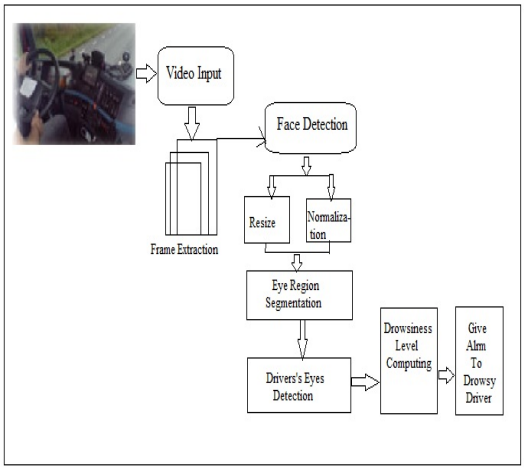

Figure 2. System Architecture

The proposed method aims to classify frames in videos based on special facial features learnt via convolutional neural network. Firstly, frames are extracted from the video. These frames are fed to a features based face detectors. The detected faces are cropped and resized to 48* 48 square images. These cropped images are normalized by subtracting each pixel by the mean followed by division with its standard deviation. Normalized images of 80 percent subjects are further fed to a multi-layer convolutional neural network. The outputs of the hidden layer are considered as extracted features. On the basis of these features, the softmax layer classifier was trained, the rest twenty percent of the images extracted earlier are tested on the trained classifier.

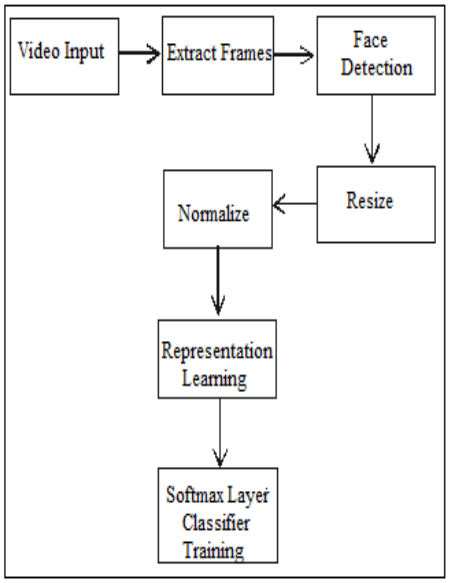

Figure 3. Algorithm Face Detection

The Proposed system consist of following techniques:

Detection System Blink Indicator Evaluation:

The results from the blink indicator development and analysis could not be concluded to increase the performance, as a single indicator, compared to other indicators developed within DROWSI. However, the development and evaluation of blink indicators are highly dependent on the hardware and software used in the camera sensor. As sensor techniques improves indicators based on blink behaviour, as proposed in this project, might have great potential for increasing the robustness of drowsiness detection systems both as single indicators and in fusion with others.

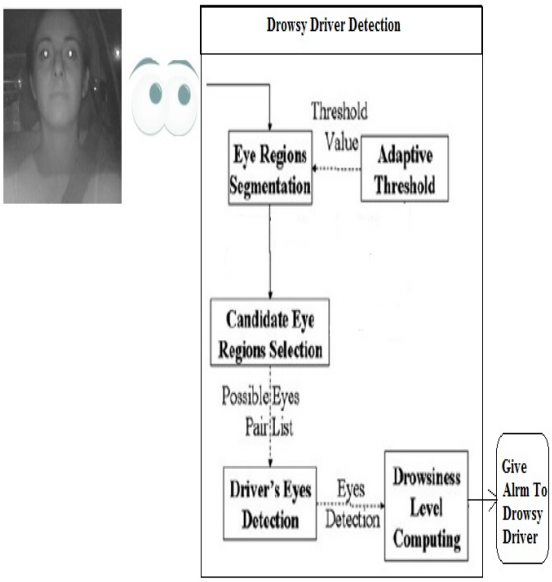

Figure 4. Eye Segmentation

Warning Strategy For Drivers that has Fallen Asleep :

The results of the study showed no major differences in effects between the different types of vibrations. All three vibrations woke up the driver in time for him/her to make correction in order to stay in the lane but the results indicated also that very soon the driver will be back to the same critical situations as before the vibrations was sent. Thus the results from the study show that the different initiative tested here is only useful for a very short time.

6. Conclusion

The analysis and design of driver drowsiness detection and alert system is presented. The proposed

system is used to avoid various road accidents caused by drowsy driving. And also this system used for security purpose of a driver to caution the driver if any fire accident. This system involves avoiding accident to unconsciousness through camera by checking eye blink. Here one eye blink sensor is fixed in vehicle where if driver lose his consciousness, then it alerts the driver through buzzer to prevent vehicle from accident. A complete study on road safety is going to be the next boom for the automobile industry for it to flourish and survive every human from the risk.

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