Real-time Behavior Analysis of an Inattentive Driver

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Abstract: Driver distraction is defined as an activity performed by a driver that diverts attention away from the driver's primary ones and that can be the leading cause of motor vehicle accidents. The driver is the most important participant in vehicle control including steering, throttling, braking, maneuvering, and other operations. These primary tasks must be accomplished safely for all traffic participants. This project proposes a driver distraction detection system that identifies various types of distractions through a camera observing the driver. Our goal is to build a high accuracy that captures the live movement of the driver and to distinguish whether the driver is driving safely or conducting a particular kind of distraction. Based on these activities, the system will classify them accordingly using proper Machine Learning techniques and instruct the driver about the distraction.

Index Terms- Distracted driver, Machine Learning, TensorFlow, caffe model.

1.Introduction:

Distracted driving is driving while doing another activity that takes your attention away from driving. Distracted driving can increase the chance of a motor vehicle crash. Anything that takes your attention away from driving can be a distraction. Sending a text message, talking on a cell phone, using a navigation system, and eating while driving is a few examples of distracted driving. Any of these distractions can endanger you, your passengers, and others on the road. There are three main types of distraction: Visual: taking your eyes off the road, Manual: taking your hands off the wheel, Cognitive: taking your mind off driving[1]. This issue has also been addressed by a WHO report, stating that 1.35 million people worldwide die in traffic accidents each year, that is nearly 3700 people are dying on the world's roads every day. "One of the most heart-breaking statistics in this report is that road traffic injury is the leading cause of death for people aged between 5 and 29 years". The report also shows that the total number of deaths increases from year to year and the most common cause behind these accidents is driver's distraction. The use of a mobile phone while driving is widespread among young drivers[3]. The National Institute of Statistics (INS) had reported 1951 deaths and 40211 injured in road accidents with distracted drivers. As vehicles gain intelligence and capabilities, new opportunities emerge where the vehicle can improve traffic safety by supervising a driver's performance, alertness, and driving intentions via a so-called Driver Monitoring System (DMS)[18]. Self-driving technology can create a safer driving environment by giving autonomous vehicles the capacity to learn from driving experiences and avoid

human errors. However, today driver monitoring systems are still essential to improve safety even for the latest autonomous vehicles. As per the report, there were a few self-driving car fatalities like Tesla autopilot's crash with the white truck Trailor in Williston, Florida in May 2016 and Uber's self-driving car with an emergency driver behind the wheel, hit and killed a pedestrian in Arizona in March 2018. In both of these fatalities, the driver could have avoided accidents, but the evidence shows he was distracted. This makes distracted driver detection an essential part of the car and can lead to the development of a new system. Detecting driver inattention is extremely important for additional prevention measures[1]. The amount of car accident reduction caused by distracted driving and the improvement of traffic safety using smart vehicles equipped with distracted driver's postures detectors have become the priority of many governments and car manufacturers.

Considering all of these we have proposed a system where the real-time distraction of the driver is captured through OpenCV It is a cross-platform library using which we can develop real-time computer vision applications. It mainly focuses on image processing, video capture, and analysis including features like face detection and object detection. An image is nothing but a standard NumPy array containing pixels of data points. More the number of pixels in an image, the better is its resolution. Pixels to be tiny blocks of information arranged in the form of a 2D grid, and the depth of a pixel refers to the colour information present in colour order to be processed by a computer, an image needs to be converted into a binary form, and dlib is the frontal face detector provided by dlib works using features extracted by Histogram of Oriented Gradients (HOG) which are then passed through an SVM. In the HOG feature descriptor, the distribution of the directions of gradients is used as a feature. Moreover, Dlib provides a more advanced CNN-based face detector. [16] the visual gestures such as turning towards left, right, up, and down are captured, along with his manual gestures such as drinking water, using a cell phone, face-makeup, etc. All these are captured and later by using a proper CNN model such as Caffe. Caffe is a framework of Deep Learning and it was made used for the implementation and to access the following things in an object detection system. Expression: Models and optimizations are defined as plaintext schemas in the Caffe model, unlike others that use codes for this purpose. Speed: for research and industry alike speed is crucial for state-of-the-art models and massive data [11]. Modularity: Flexibility and extension is majorly required for the new tasks and different settings. Openness: Common code, reference models, and reproducibility are the basic requirements of scientific and applied progress[14] these are done along with the help of python libraries such as TensorFlow and Keras TensorFlow is a Python library for fast numerical computing and is used to create large-scale neural networks with many layers. It is used to create Deep Learning models directly or by using wrapper libraries that simplify the process built on top of TensorFlow. TensorFlow is mainly used for problems such as Classification, Perception, Understanding, Discovering, Prediction and Creation[15]. The Keras is an open-source software library that provides a Python interface for artificial neural networks and is a more flexible way for defining models. It specifically allows you to define multiple inputs or output models as well as models that share layers. Keras acts as an interface for the TensorFlow library, these gestures are classified[17] and a proper alert is given to the driver with the help of python library such as pyttsx3 pyttsx3 is a text-to-speech

conversion library in Python. Unlike alternative libraries, it works offline and is compatible with both Python 2 and 3. An application invokes the pyttsx3.init() factory function to get a reference to a pyttsx3. Engine instance. is a very easy-to-use tool that converts the entered text into speech. The pyttsx3 module supports two voices first is female and the second is male which is provided by "sapi5" for windows. It supports three TTS engines: sapi*5* – SAPI5 on Windows, *less* – NSSpeechSynthesizer on Mac OS X, *espeak* – eSpeak on every other platform. Hence all these factors help us identify each gesture accurately and with suitable classification accidents can be reduced and thus we can ensure safe driving and several lives can be saved.

2.Related works:

Many works that have been developed have shown promising results. Earlier real-time image-based driver distraction detection was a popular topic in the machine learning and computer vision field, and many models and algorithms are proposed and analyzed by researchers. Two main topics that researchers focus on are image pre-processing techniques and classifying model selection. As for image pre-processing, HaqQ et al. proposed that conducting feature extraction instead of directly conducting image flattening might improve prediction accuracy. Another approach where a model included the model of normal driving, a subsystem for measuring the errors from the secondary tasks, and a module for total distraction evaluation, this proposed approach does not use additional devices, such as cameras and neuro scan systems due to which accuracy problem arose. As for the classifying model, one main approach is to use convolutional neural work (CNN)-based models. Liu et al. proposed a convolutional TwoStream network with multi-facial feature fusion to detect distraction activities by combining static and dynamic features. Eraqi et al. proposed a model based on an ensemble of convolutional neural networks and show that a weighted ensemble of classifiers using a genetic algorithm yields better accuracy. It is revealed that CNN-based models generally report high accuracy. Already in 2006, Toyota started to use a near-infrared camera installed on the top of the steering wheel column to monitor drivers. In 2009, Saab, which was bought by another arXiv:1907.08009v1 [cs.CV] 18 Jul 2019 company in 2012, had integrated the Saab Driver Attention Warning System in their vehicles to detect inattention and drowsy driving using two miniature infrared cameras. Lately, we have seen the emergence of additional systems. FaceLAB is a commercial system of Seeing Machines, which uses a passive pair of stereo cameras mounted on the car dashboard to monitor drivers and has been used in several systems. However, stereo-based systems are expensive to be installed in cars and they require periodic re-calibration because vibrations cause the system calibration to drift over time. Today, there are many companies and start-ups producing driver monitoring systems. Most of these recent technologies apply deep learning to understand driver's attention and alertness.

3.Literature review:

Title of the paper and year	Methodology	Merits	Demerits
Driver Behaviour Analysis via TwoStream Deep Convolutional Neural Network. 11 March 2020	A driver behavior analysis system using one spatial stream ConvNet to extract the spatial features and one temporal stream ConvNet to capture the driver's motion information.	Proposed system can increase the accuracy rate by nearly 30% because 2-D ConvNet is used.	There isn't a proper alarm to a driver, where the driver can be notified.
Distracted Driver Detection with Deep Convolutional Neural Network. Nov 2019	This study proceeds to focus on the detection of distracted drivers via visual data and by using some machine learning algorithms.	Pretrained on the Image net dataset can be fine-tuned to classify distracted driver images with good accuracy.	There is a scope to involve an automated architecture search for CNN instead of relying on the predefined architectures.
Real-Time Distracted Drivers Detection Using Deep Learning. May 2019	The system is a CNN based system that detects and identifies the cause of distraction based of image classification.	The weight initialization was done by using ImageNet pre-trained model and for the new layers random normal distribution was used.	Since weighted initialization is used, so there might be a case where proper accuracy is not obtained.
Machine Learning Techniques for Distracted Driver Detection. 2019	5 different models were considered for classification such as, Linear SVM, SoftMax, Naïve Bayes, Decision Tree, Two-layer Neural Network.	Successfully implemented a Two-layer Neural Network model that has great performance on the task and gives an evaluation accuracy of 92.24%.	These self-implemented models could be applied for more sophisticated weight initialization method like Xavier Initialization or KaiMing Initialization.
Real-Time Driver State Monitoring Using a CNN Based Spatiotemporal Approach. 18 Jul 2019	Temporal information is retrieved by concatenating the extracted features from each selected frame.	Experiments conducted on the publicly available dataset show that the approach (99.10%) outperforms the state-of-the art techniques (96.31%).	Since it is not possible to monitor drivers with an RGB camera during night scenario, intend to do analysis with infrared and depth data for real world

4.Conclusion:

This proposed system helped us to demonstrated that deep learning models that are trained and with fine-tuning help us to classify distracted drivers with good accuracy. A robust vision-based system is built that recognizes distracted driving postures by making use of OpenCV and dlib along with the help of Machine

Learning framework such as TensorFlow, PyTorch, and sci-kit-learn to analyze the real-time behavior of the driver, classify each of the gestures, and later on to provide a suitable sound warning. As an extension of this work, the system can be included with a GSM module, that can be used to send a message or call the responsible person whenever there is a high risk of distraction. Thus, all this factor helps us to have a hassle-free driving and prevents road accidents.

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