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An Emotion Recognition Based Assistant For Vehicles

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Abstract: Numerous studies have been conducted on automated vehicles. Additionally, considerable research has been done to increase vehicle safety. The majority of safety-related research done in this field uses hardware and electronic components. Lane keep assistance, parking assistance, and city break assistance are a few instances that can be given. Only a small number of software-related parts are utilized in current automobiles, nevertheless. The primary illustration for this is vehicle assistants. However, current vehicle aides can carry out commands and carry out some specified responsibilities for drivers or passengers. In some aspects, this might be able to lessen driver stickiness and increase driving enjoyment. In contrast to the current vehicle assistants, this proposed assistant represents a fresh method. It can detect drivers' emotions and adjust behavior accordingly. The major goal of this research is to reduce accidents that are caused by driver distraction. Additionally, this suggested helper may recognize emotional states in drivers, such as fatigue, grief, and anger, and act accordingly to keep them focused on the road.

Keyword : Convolutional Neural Networking(CNN) , Deep Learning , Machine Learning , Image Processing , Emotion Recognition , OpenCV-python , Sentiment Analysis , etc.

1. Introduction

Around 1.35 million people die in traffic accidents every year, and 3,700 people die on the world's roadways every day on average . The primary causes of these car accidents are the driver's reckless actions and fatigue. Leading automakers like BMW, Mercedes Benz, and Land Rover conduct extensive research to increase the safety of passengers in accidents. They described Lane Keep Assist, City Brake Assist, and Auto parking as examples. The majority of these studies can lessen the damage caused by an accident.

Figure 1 shows that driver distraction accounts for more than 20% of current accidents. Each year, there are more accidents caused by distracted driving. Fig. 2 illustrates how the annual increase in deaths was caused by that. According to the national highway traffic safety, driver distraction is a factor in roughly 100 000 police-reported crashes each year. According to a research by the AAA Foundation for highway safety, 328,000 drowsy and distracted driving accidents are reported worldwide every year. According to the same survey, 6400 of the 109 000 accidents that caused injuries were fatal . Therefore, a suitable solution is required to maintain the passengers' safety. The authors suggest an assistant based on emotion recognition to address this.

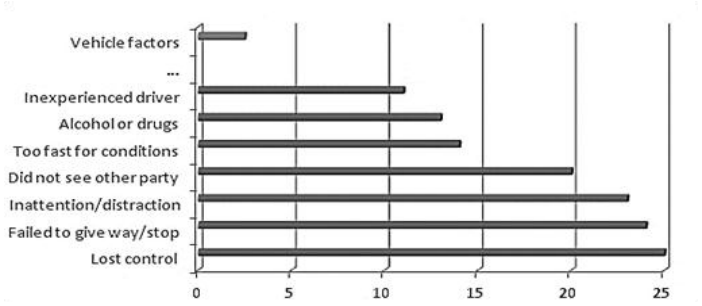

Fig 1: Reasons for accidents

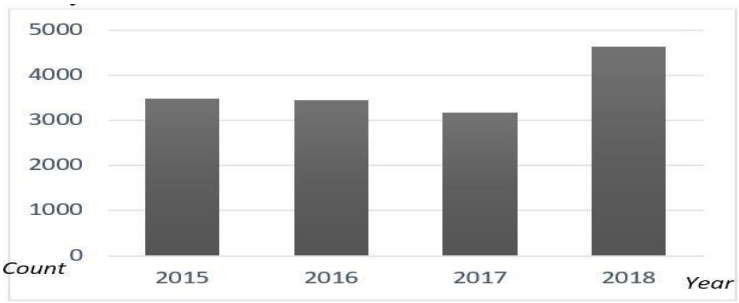

Fig 2: Number of accidents because of the driver distraction

This is typically brought on by driver distraction and a lack of focus on the road. Drowsiness, melancholy, anger, or excessive enjoyment could be the main causes of poor attention. Therefore, the majority of accidents may be prevented if there was a method to determine the driver's emotions. How to execute that in real time is the issue, though. It must be quite accurate and convey the warning to the driver in an appealing manner. In any other case, the technology can add to the driver's distraction.

Therefore, neither the driver nor the passengers should be bothered by this driver's emotional basis warning system. It ought to be a desirable quality. This study suggests a driver's friend or companion who can monitor facial emotions and operate in accordance with the driver's mood in order to prevent this from happening. The vehicle's safety may increase as a result, and the drivers' focus will remain on the road. This will make driving more enjoyable. When selling the vehicle, using an assistant is a desirable marketing element as opposed to using a warning alarm.

2. Literature Review :

As mentioned above the driver distraction is one of the major reasons for present vehicle accidents. The chart in Fig.3 clearly describes the accident percentage for each reason.

To avoid driver distraction, various research projects have been conducted over the last few years. A facial emotional monitoring-based helper was suggested as the remedy in this study. For diverse conditions, there are numerous emotion monitoring systems developed. The entertainment center of the vehicle can be controlled by a variety of vehicle helpers that many car manufacturers have developed to accomplish specific functions.

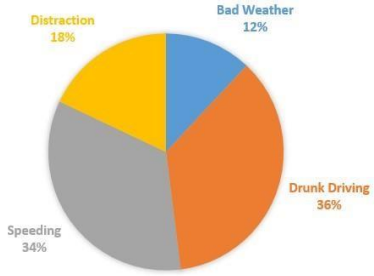

Fig 3: Reasons for accidents in the USA

The machine learning experiment carried out by Nitisha Raut from San Joes State University is one of the current leading research works when focusing on facial emotional interpretation. The researchers in this study employed support vector machines and feature extraction approaches. There aren't many studies on the emotional direction of drivers. Emotional Recognition for semi-autonomous vehicles, developed by four researchers for the IJIDeM, is one of the most intriguing of them. Here, their strategy was to accurately recognize nine various driver facial emotions, including rage, astonishment, etc. They employed techniques like K Nearest Neighbors and EEG for the execution, and ultimately achieved 97% present accuracy .

3. Methodology

The suggested method for enhancing passenger safety by identifying driver distractions is to use real-time face monitoring technologies to identify causes of driving attention and use intelligent assistants to react to each emotion of the driver. Data science is the key technology utilized here. There are three key data science components in the research's implementation process. One is used to detect the driver's sleepiness, one is used to detect other emotions, and one is for the assistance. The image-processing method utilizing OpenCV and dlib will be used for facial emotion recognition.

Here, the tiredness detection system will work by examining both the eye and the yawn. For the 68-point iBUG 300 data set, a pre-trained dlib model was employed.

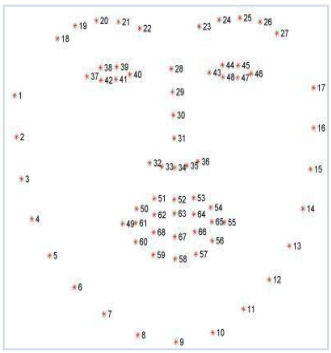

Fig 4: Facial Landmarks

The intelligent helper is the core idea behind this study. Here, the assistant needs to be trained to recognize every driver's facial expression. Data science was employed to instruct the research assistant in this case. Here, natural language processing will be used to teach the suggested assistant. Additionally, the data for the assistant (Responses and Requests) will be written in a JSON file, and the assistant will be trained using the Keras and NLTK libraries. After instructing the assistant here in the research prototype, the voice of the assistant will be obtained using the Google Text to Speech (GTTS) library. Additionally, pertinent Python libraries will be used to collect user requests.

The process of detecting drowsiness is depicted in Fig. 5's flow diagram. Two researchers conducted a study and discovered that a person yawns more than six times on average every 24 minutes [15]. These statistics can be seen in the graph in Fig. 6. The suggested system calculates the number of yawns per minute in order to identify tiredness, and if it is larger than two, it indicates that the driver is drowsy. Here, the authors determine that there are more than two yawns per minute because a person's yawn rate may increase when they are weary.

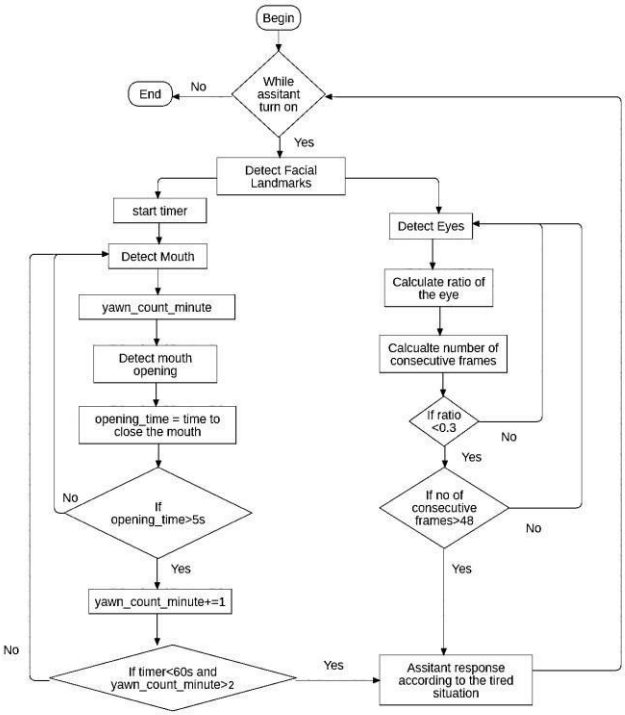

Fig 5: The flow of the drowsiness detection component

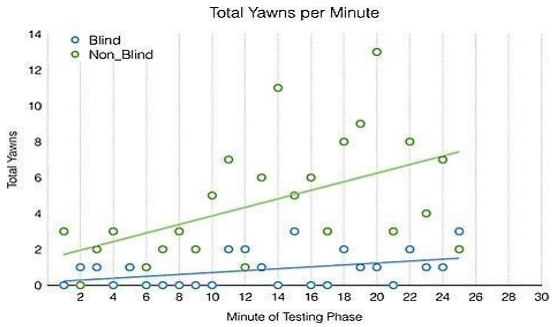

Fig 6: Number of yawns according to age

The research was implemented using the aforementioned libraries and packages. This section provides a fairly detailed description of the implementation's overall flow. Furthermore, it made it very clear how this research differed from those conducted by competitors

4. Modeling And Analysis

Two data sets were employed in the research's implementation. There were pre-trained dlib models to recognize the face landmarks for the diagnosis of tiredness. due to the fact that the facial landmarks model outlined in the previous section was used. Drowsiness detection has become more accurate since utilizing this pre-trained model.

Here, it examines the eye's aspect ratio and yawns to assess the driver's level of fatigue. The unique feature of this device for detecting tiredness is that it counts the number of yawns each minute. When compared to competing techniques, this process makes drowsiness detection effective.

However, a set of 35887 photos from an image data set was employed in this study to identify different emotions. As a result, it receives 60% of the implementation budget for training and the remaining 40% for model testing. Using Keras, a deep neural network model is used to train the emotion recognition model. The assessments show that the emotion recognition model has a training accuracy of more than 80% and a present validation accuracy of 62%.

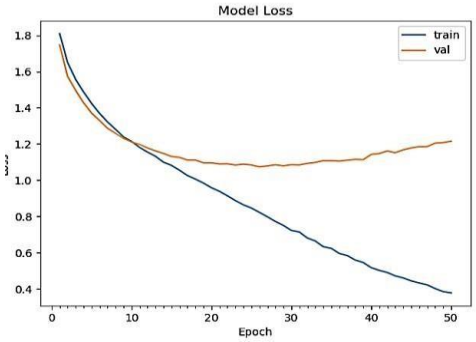

Fig 7: Emotion recognition model loss

The validation and training loss of the emotion recognition model are shown in Fig. 7. Here, it is clear that very little overfitting or underfitting occurred during the training of this model. As a result, this model can foretell the emotions on any given face.

This is how the system uses visual processing to identify the driver's other emotions and determine their tiredness.

The most intriguing and difficult aspect of this study was how the helper was trained using a dataset as well. Here, a

JSON file contained sample questions submitted by the user to the assistant and the assistant's responses. There are three attributes in this JSON file. Class name, Request, and Response are what they are. All of the information used to teach the assistant had been categorized based on these three criteria. The model was then trained using Keras and NLTK as indicated in the preceding section.

The assistant's voice was then added using the gtts (Google Text to Speech) package. Additionally, commands from users were recorded using speech recognition and added to the model. If the assistant determines that the driver is asleep after reviewing the results, it will say "Seems You Are Tired... How can I help?" The user can then give the assistant commands to perform specific tasks. The user of the prototype device can play music and conduct online searches for anything they like. The assistant will react in the same way as other emotions do. However, the researchers contend that the helper won't always respond when one is upset or furious. Considering that it can cause a disruption to the driver and other passengers. As a result, the system tracks the number of times each feeling, aside from sleepiness, is evaluated.

The assistant in this study proposal can also make recommendations to the driver for each mood. As an illustration, the assistant must advise the driver to take a break when they are fatigued, etc. The application's prototype here manages three data science components. Therefore, ensure that the software works efficiently and that any used threads are effective.

This is how the application of this research is carried out. Here, it discusses the implementation's end outcome and the precision of each data science component. The assistant can currently only execute a few tasks because this program was only implemented as a prototype. However, the assistant's primary goal was effective in being accomplished.

5. Discussion

There are various causes of driver distraction. They are drowsiness, rage, and melancholy. This study suggests a face tracking system as a result to identify driver distraction. Furthermore, writers deploy an intelligent assistant here to alert the motorist about their distraction. It is the research's most alluring and difficult element. This assistant alerts the motorist to the risk in a pleasant way. The major goal of adding a warning system helper is to prevent the warning system from disturbing other passengers. It might be possible to reduce the stickiness of both passengers and drivers, it was further noted.

The research's prototype is being implemented depending on the tiredness, melancholy, rage, and sadness of the drivers. The duties that the helper can complete for each emotion are very occasionally. Additionally, the assistant for each emotion's driver made some recommendations in this study.

The author needs to be aware of legal and societal considerations when the research is being developed. The majority of the time, the research's target audience was more concerned with privacy. Some of the drivers were reluctant to allow these kinds of technologies to monitor their actions. Furthermore, there needs to be a means to turn the system off when the driver and passengers are not interested.

However, utilizing facial emotions and an innovative approach, this research was able to identify the driver's preoccupation and issue warnings to the driver. The summary of the results and the future development of the application are covered in the next part.

6. Conclusion

This study was conducted to reduce crashes caused by driver distraction. This study focuses on two key elements in order to accomplish that goal. They are:

a). Emotions Recognition of the driver

b). Intelligent Assistant based warning system,

These two parts function together in a chain. The assistant will start and react in accordance with each emotion defined by the system when it detects a driver distraction-related feeling. This will be able to reduce the amount of accidents that occur while a motorist is distracted. There were certain restrictions in the research's implementation method. Those are

- The voice of the assistant was used in this study with GTTS. If the computer is merely linked to the internet, then this works.
- The use of mobile devices for distraction by drivers is another serious issue. However, that will not be identified in this study.
- A local machine was used to implement this application prototype. Consequently, it takes some time to run the software.
- The prototype helper in this case is only capable of a small number of duties, besides reacting to emotions.
- Therefore, the limitations of this study are as previously stated. The discussion regarding this project's future improvement will follow.
- This research's execution time is a little bit high because it was implemented on a local machine. It will be able to install onto a cloud to prevent that.
- It's important to recognize cell phone use while driving.
- The GTTS library was used for the help voice in this instance. It can, however, use a brand-new assistance.

Therefore, this is how this research was conducted and how it will be improved in the future.

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