Final_Deep Drowsiness Detection using Pytorch and yolov5.docx

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Deep Drowsiness Detection and Alerting System Using Pytorch and Yolov5

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ABSTRACT

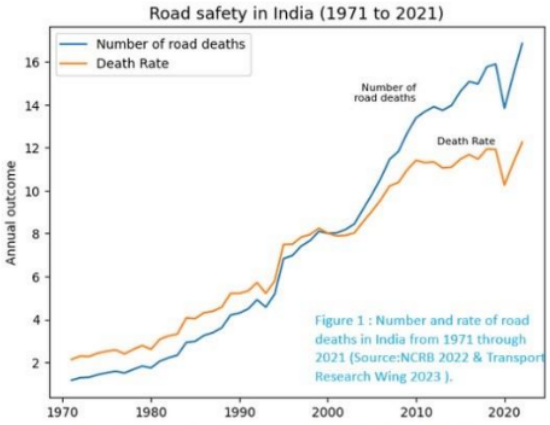
According to statistics published by the Ministry of Road Transport and Infrastructure, in 2021 there will be 153,972 road fatalities at an annual growth rate of 6 % which is 13.2 times greater than 1971's. With an AACGR of 4%, the death rate in 2021 is 5.3 times higher than that in 1971. [3] In 2022, a total of 4,61,312 traffic accidents, with 1,68,491 fatalities and 4,43,366 injuries, were reported by the U.S. and Union Territories police. [4]

The primary cause of death in developing nations such as India is accidents. [5] In India, traffic accidents are now the 13th most common cause of health-related deaths and disabilities throughout the past ten years (2009–2019). [3] At 23% of all road users liable for victim deaths (19% and 4%, respectively), pedestrians and cyclists are the second largest category. Bicyclists are among the road users who die most frequently—roughly 87% of all deaths. [3] In the hills and mountains, roads are very small, winding, single track or more dangerous. It may be difficult to control the corner if the vehicle is not in good condition, since the driver cannot see the vehicle or any obstacles on the other side of the bend. [5]

The future is predicted to see a decline in traffic accidents due to the latest advancements in intelligent transportation systems (ITS). [6] About 70% of fatal accidents are due to trucks and buses in both rural and urban regions. In contrast, in Western countries, there is a marked difference in traffic patterns between rural and urban areas. [3] [1] Slowdowns happen to drivers who don't work consistently because of quicker and slower times, especially when driving for extended periods of time. Right now, there is a significant chance of dying. Driving after intoxication might result in collisions. [2]

Among solutions aimed at saving lives, artificial intelligence is used in computer vision, especially neural networks (CNN), to improve systems to identify signs of drowsy driving or predict driver drowsiness and drowsiness. The idea is to examine the driver's live video frame by frame, look for head movement, and then check if they are awake or asleep. The system issues an alarm alert, sends a text message of warning, and sends the driver's GPS location to a list of contacts if the driver is drowsy for more than Ten seconds. The most important of these dilemmas is the state of head movement as an indicator of fatigue.

Keywords: Deep learning, Head motion, transfer learning, face detection, facial landmarks, OpenCV, convolutional neural network (CNN).



Persons killed in Trucks Accidents Classified by the type of impacting vehicles during 2022

S.No	State/UTs	1.Bicycles	2.Two Wheelers	3.Auto Rickshaws	4.Cars, Taxis, Van & LMV	5.Trucks/ Lorries	6.Buses	7.Other Non-Motorised Vehicles(Handcart etc.)	8. Others	Total
1	2	3	4	5	6	7	8	9	10	11
1	Andhra Pradesh	0	10	31	63	801	13	3	42	963
2	Arunachal Pradesh	0	0	0	0	33	0	0	0	33
3	Assam	19	46	21	75	76	28	13	16	294
4	Bihar	0	0	3	15	136	17	23	19	213
5	Chhattisgarh	0	13	1	1	132	8	0	37	192
6	Goa	0	0	0	0	3	0	0	0	3
7	Gujarat	0	0	0	27	406	141	0	71	645
8	Haryana	32	105	11	69	72	13	3	37	338
9	Himachal Pradesh	0	36	0	3	42	3	0	3	51
10	Jharkhand	1	93	3	33	124	20	6	10	291
11	Karnataka	0	261	16	162	298	28	4	34	793
12	Kerala	0	0	0	0	33	3	0	0	36
13	Madhya Pradesh	0	109	14	172	697	56	35	130	1,213
14	Maharashtra	0	2	1	39	619	36	0	120	808
15	Manipur	0	0	0	0	10	0	0	0	10
16	Meghalaya	0	1	0	2	8	0	0	0	11
17	Mizoram	0	1	0	0	15	0	0	4	20
18	Nagaland	0	0	0	2	12	0	0	0	13
19	Odisha	9	129	20	68	149	39	0	66	498
20	Punjab	0	0	0	2	36	22	0	7	67
21	Rajasthan	0	31	0	86	475	43	0	42	668
22	Sikkim	0	0	0	0	29	0	0	0	29
23	Tamil Nadu	2	49	1	28	234	16	0	6	332
24	Telangana	2	127	13	18	172	8	1	36	397
25	Tripura	0	0	0	1	11	1	0	3	16
26	Uttarakhand	0	0	0	0	9	1	0	2	12
27	Uttar Pradesh	65	566	139	370	527	223	139	194	2,223
28	West Bengal	0	259	1	69	99	13	12	85	451
29	A & N Islands	0	0	0	0	0	0	0	0	0
30	Chandigarh	0	0	0	0	0	0	0	0	0
31	D & N Haveli	0	0	0	0	1	0	0	0	1
32	Daman & Diu	NA	NA	NA	NA	NA	NA	NA	NA	NA
33	Delhi	0	0	0	0	6	0	0	1	7
34	Jammu & Kashmir	0	6	0	15	47	0	0	7	75
35	Ladakh	0	0	0	0	9	0	0	0	9
36	Lakshadweep	0	0	0	0	0	0	0	0	0
37	Puducherry	0	0	0	0	0	0	0	0	0
	Total	**129**	**1,893**	**284**	**1,353**	**6,943**	**744**	**250**	**1,020**	**10,564**

NA: Not Available; Note: Data of Daman & Diu is included in Dadra & Nagar Haveli from 2020 onwards

Source - morth.nic.in

LITERATURE SURVEY

A method to detect sleepiness in real time for drivers, taking account of their own characteristics, is proposed by this study. There are currently a lot of searches about how to detect tiredness while driving [9] [10] [11], as well as Intelligent Transport System (ITS),[5] [6]. The majority of them are focusing on the development of a system to

identify tiredness for all drivers and avoid these differences. For example, physiological approaches where some physiological response is monitored, like heart rate and deep learning in the framework of traditional methods. Yang Bin et al. proposed a camera-based definition of tiredness in June 2010 for the purpose of classifying driver fatigue while driving. They added that to gauge how fatigued a motorist is, their eyes could be examined in simulators or exams. This study assesses the efficacy of contemporary visual tracking-based vehicle tiredness detection systems. A categorization technique based on extensive data from ninety hours of real driving was used to assess these characteristics. According to the research, some drivers may benefit from eye strain reduction if their blinks are appropriately identified. Notwithstanding many advancements, issues with inadequate light persist, particularly for those who wear spectacles. [1]
Thus, the focus of Our System is Head Movement Analysis.

"Driver Drowsiness Detection through HMM based Dynamic Modelling" is the title of an article that Eyosiyas et al. published in June 2014. They developed a novel method based on hidden Markov models and dynamic modelling to analyse the driver's facial expression (HMM). They tested the procedure on a driving simulator. The results of the experiment validated the effectiveness of the recommended approach. [1]

Visual examination of the head and eyes to keep an eye on the driver Kong G. et al. There has been discussion about it. To continuously monitor drivers, they offer head position (HP) and eye gaze analysis. Nowadays, the majority of techniques for identifying visual impairment during driving depend on head angle or the measurement of driving impact or fatigue level with closed eyelids. The suggested approach gathers crucial data about the unidentified driver by utilizing visual indicators like Head Position (HP), Pupil Activity (PA), and Eye Index (EI). Using a vector machine (SVM), video clips are categorized as driving scenarios with or without warning. [1]

Contributions:

1. We want to surpass the precision of earlier work in this effort.
2. Transparency in the research, as demonstrated by Head Movement's clarification of the key areas of the study
3. Create a model with a CONVOLUTIONAL NEURAL NETWORKS (CNN) accuracy of at least 90.
4. In order to handle the issue more effectively, we combined the facial aspect and the eye/mouth elements to accurately detect the driver's tiredness.

In this article, a model for Advanced Driving Assistance System (ADAS) is proposed. The system automatically detects driver fatigue based on visual information(Head movement) and intelligence, reducing accidents caused by driver fatigue and increasing traffic safety.

INTRODUCTION

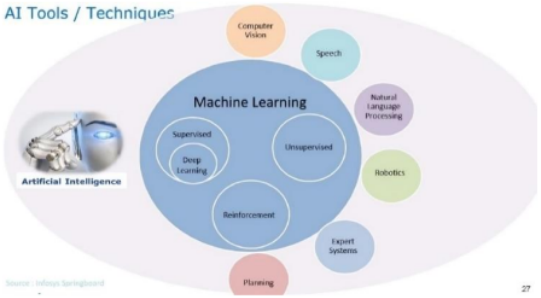
Numerous techniques have been put out to identify drowsiness and extract facial features, mouth features, eyes, and numerous other auxiliary features, including Viola Jones. [3] The approach for creating a precise, potent, and efficient sleepiness detection system for actual driving situations is presented in this part. We describe the algorithms in detail in this chapter. Next, we present the feature extraction section.

Unified Detection and Classification:

By approaching object detection as a regression problem that derives the bounding box coordinates and probabilities of each category directly from image pixels, we redefine object detection as a combined detection and classification function. This technique is quite straightforward and is also referred to as the combined search and distribution algorithm. It estimates numerous bounded boxes and their class relationships simultaneously using an integrated communication mechanism. Joint detection and classification, in contrast to conventional techniques, are trained on the complete image, which immediately enhances performance. These models outperform conventional search engines in terms of the models we develop.

Artificial Intelligence (AI) and Machine Learning(ML):

Artificial intelligence, or “AI,” is the ability of machines to mimic human intelligence, such as cognition, learning, listening, planning, and thinking.



Although introduced earlier, it boosted later due to:

1. Increased Data Volumes.
2. Advanced Algorithm.
3. Improvement in Computing Power and Storage has Propel the adoption and solve real-time problems using AI.

Aspects of Artificial Intelligence:

1. *Vision*

- Computer Vision
- Comprises of Image recognition and Machine Vision. It helps computers to understand images and Videos. It deals with Various Technique to acquiring, processing, and understanding the image from data.
- Example - Image Detection, Video Tracking, Object Detection, etc.

2. *Planning*

- Set of decision-making tasks performed by the machine to achieve a desired goal.
- Example-path planning of vacuum cleaner robot.

3. *Speech*

- It converts or simplify as humans' interaction with the machines, speech to text as well as text to speech. Example - Alexa, Siri

4. *Natural Language Processing (NLP)*

- Understand common dialect of humans. Text generation, Question answering, Content extraction, Machine translation.
- Example -Google Translate

5. *Robotics*

- Brings intelligent behaviour to the robot. Physical robot and software robot in the RPA (Robot processing automation). It processes unstructured data using multiple technique. Commonly called cognitive RPA.

6.*Expert System*

- It uses database of bodies of knowledge in respective field to make decision and provide advice.

7. *Machine Learning*

- It trains the system to learn underlying patterns in the data. Model aims to capture pattern and translate to learning model. Trained model can be used on new data. It Further Comprises of Unsupervised Learning, Supervised Learning and Deep Learning.
- It Plays a major role in achieving Artificial Intelligence.

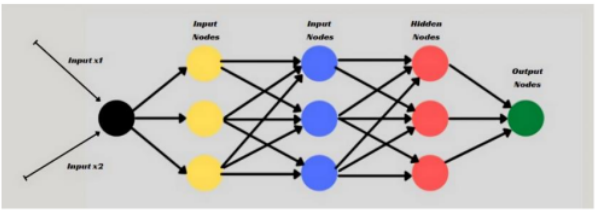
Deep Learning

The field of machine learning has long been preoccupied with creating models that recognize patterns in inputs and data. It did, however, require extensive knowledge of statistical computation, techniques, and data, all of which were not easily available. But during the last 20 years, a lot has changed.
Through statistical modelling and programming, robust, highly accurate machine learning models can be produced.

Deep learning is an automated procedure that extracts valuable patterns from data using neural networks and optimization. Many technologies, such as Pytorch and TensorFlow, make it possible to build complex models faster than ever before. These libraries are powered by widely accessible data and a neural network computing architecture that leverages GPU-based parallel processing in a massively parallel fashion.

In addition to compute hardware, many efficient initialization and computation strategies facilitate learning. [2]

Artificial Neural Network (ANN) is inspired by the attain to simulate the biological Neural System.
-It consists of:
1. Interconnected nodes analogous to human/biological neurons.
-Nodes mimic the neuron just as it receives input processes it and transmits it to other Nodes.
-It can ingest large amount of Data and processes it through Layers
-It can produce more accurate results than traditional ML algo in Input-Output Mapping.



Facial recognition, picture classification, speech recognition, text-to-speech generation, self-driving vehicles, recommendation systems, games, and machine translation, a great deal of progress has been accomplished

with deep learning. We will concentrate on the key deep learning architectures in this chapter, which have enabled these advancements.

Convolutional Neural Network (CNN)

Convolutions are used by CNN to find higher-order features in the data. [2] Convolution is a mathematical procedure that determines how similar or how much(degree) two functions overlap.

Representation of an Image
In an image, unstructured data is represented by pixels. The computer interprets a picture as an array or range of integers. It shows an image with a pixel resolution and a colour depth that shows how many bits make up each pixel: The width and height of an image given in pixels.

The loaded CNN input data is sent to the input layer for processing. The RGB channel, width, and height of the image data are sent to the input layer. [12]

Convolution of an Image
When a portion of an image and the filter are comparable, there will be the greatest amount of overlap and convolution. As it is recorded, similarity is measured. A feature map is a record of comparable features.
The image's feature convolutes, and the feature map stores the feature similarity.

CNNs can be used to align neurons in a three-dimensional structure based on factors such as length, height, and depth. The RGB channels, width pixels, and height pixels of the image can then be represented by these characteristics. To put it briefly, CNNs take an input image and transform it using multiple interconnected layers to get a set of class probabilities. Every CNN design has a few common layers. [10]

Learnable Filters
Learnable filters are used by convolution neural networks. Similar to ANN, where we start with random weights and learn the optimal weight through training, we randomly select such filters and then use training to learn the necessary filter.

Padding
This appears each time we apply a filter and examine the image for similarity. The size of the final image decreases steadily.

We want to retain the image at its original size in order to retrieve some low-level information.

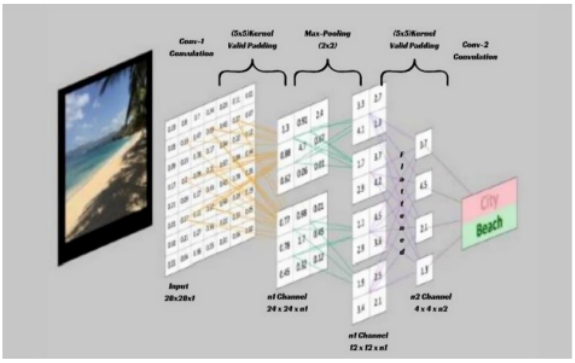
An extra pixel is added to the image by padding before the convention at the border. One pixel around the original image with a value of zero implies that the new pixel has zero value if zero padding equals one.

Feature Map set
The degree to which the filter and the image are comparable. An image may possess several unique qualities. We must learn every one of them in order to accurately recognize the image.
Therefore, we implement many learnable filters. Each is an expert at identifying a single feature. And a feature map is produced by each filter. Thus, we have a set for the feature map.
.

Pooling
CNN uses a variety of filters. There are a lot of feature maps in it. This generates a lot of data. During training, processing such data will demand a significant amount of time and hardware resources. Hence, "pooling" is used to lower the dimensionality of the data. In order to maximize the feature extraction from the input, windows slide rather than overlap as in a traditional window arrangement. The term for it is sub-sampling.
.

Full conventional neural network
The selected CNN output is a multidimensional matrix of data. However, neural networks do not accept 1D vectors as input.
By lighting the matrix into vectors, this problem is resolved.
Overfitting is a common problem in neural networks. Random dropout is used to alleviate this issue; this helps the model become more widely applicable by removing the model's reliance on individual notes.

Dropout
One way to overcome overfitting is to sporadically drop a few weights or filters throughout each pass. This makes sure the filter can function even when some characteristics are marked off and does not become overly specialized in identifying features.



PROPOSED SYSTEM
Deep learning can be used in the context of an accident prevention system to analyse different kinds of data gathered from cameras, sensors, and other sources in order

to identify possible dangers and anticipate accidents before they occur.
A camera that searches a video stream for faces will be deployed as part of the suggested system. It is proposed to use YOLOv5, a popular object recognition system, for object identification. YOLOv5 can recognize items from pictures, videos, and live cameras. Before producing a version, this approach is pre-trained with all photos, giving each one a unique and elegant call. All photos are divided into layers by this set of criteria, from which capabilities are extracted and the model's weight is increased.

Every time we submit an image, it will be processed with a weight version that has previously undergone training to ensure the best possible image label accuracy. Here, we train the model using an existing COCO (Common Object in Context) dataset. Pytorch is our choice because of its comprehensive feature set, support for GPU acceleration, and ability to quickly build neural networks and gain effective training. Among the essential building elements and model building parameters that Pytorch provides to finish the computation of neural network models from input to output are fully connected layers and nonlinear activation functions.[8] We choose NumPy due to its ability to manage enormous, multi-dimensional arrays and matrices of numerical data, as well as its applications in image representation, array manipulation, and other convolutional neural network practicalities.

We selected OpenCV because it eliminates the need for computer vision programs to be completely written, making it easy for developers and non-mathematicians to design them. The library contains over 2,500 algorithms that users can employ to perform tasks like face and object identification. [1]

Its working is as follows:

1. *Data exploration:*
The process of looking over and comprehending the data that is available for a particular project or problem is known as data exploration. It entails going through the data and searching for trends, connections, and revelations that might direct further research or help with making decisions. This entails choosing the COCO dataset to be used for both the YOLOv5 model's training and assessment. [7] It contains multiple architectural prediction models.

2. *Data Processing:*
In the object detection pipeline, data processing is the stage where unprocessed data is changed and made ready for use in object detection model training and testing. In the context of YOLOv5, common data processing operations include data loading, cleaning, augmentation, normalization, batching, and splitting.

3. *Building a model:*

Python 3.8:

The most recent feature release of Python 3 is Python 3.8, which replaces the older bugfix release of Python 3.7, 3.7.5.

There are several processes involved in creating an object detection model using YOLOv5, including data preparation, model construction, and training.

4.*Training a model:*

Develop a Drowsiness Detector, or a personalized YOLO model. This includes gathering data (pictures) and labelling the photos with the intended output. Say, Awake or Drowsy, for instance. To uniquely identify the labelled image, we utilize the uuid (Unique Identifier) that PyTorch has built in. By repeating the labels and gathering images (data) for certain labels (shown in Fig. 7), we make use of this information. Next, we use a package named labelImg to label them.
We collect images as pre-defined datasets with the use of real-time camera rendering, precisely as trained models are used in supervised learning.
The following values are indicated in order by the tagged images in the YOLO annotation format: class number, width, height, and the coordinates of the x and y centres.
After setting up our training data and creating pre-defined dataset batches (shown in Fig. 5) and their correlograms (shown in Fig. 6), we may forecast a more accurate model with the aid of epochs.

Fig. 5 Figure

Feature Extraction in from supplied data, deep learning models are able to automatically identify significant details. These details could include things like the distance between obstacles, the speed of other automobiles, and the design of road signs and lines in order to prevent accidents. In essence, these models are adept at identifying events surrounding a car and determining whether anything dangerous is occurring.

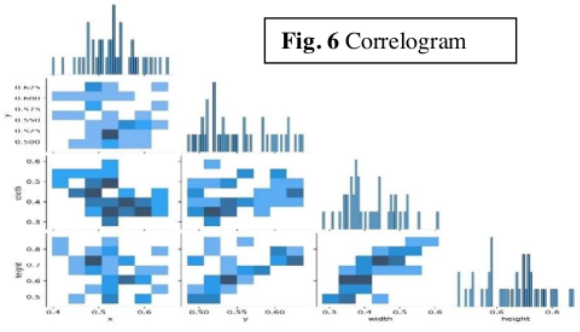


Fig. 6 Correlogram

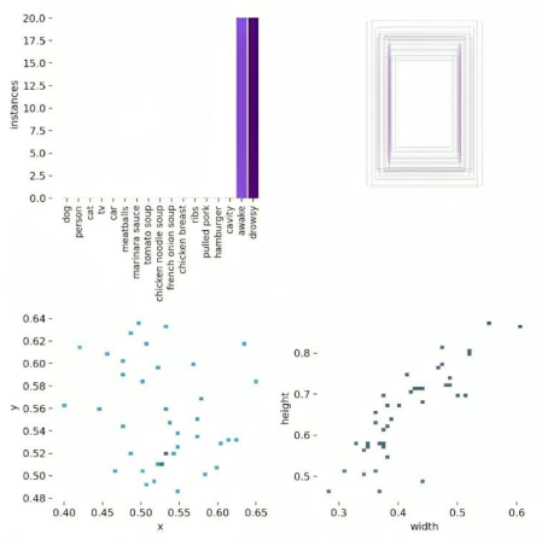


Fig. 7 Labels Graphs

5.Alerting and Prevention

Implementation of Markov chain Process:
A stochastic process in which the future state is only dependent on the current state and not on the preceding series of events is known as a Markov chain process. Put another way, you don't need to know the whole story of how you got there to forecast the next state if you know the current one. [1]

Consider being on a game board, for example, where various spaces correspond to various states. To travel from one space to another, you roll a die. Every time you relocate, the only space that matters is the one you're in right now—not how you got there.

Let us now imagine that you are monitoring sensor data, such as temperature or motion detection. Instead of storing every sensor reading from the past, you may utilize a similar concept to anticipate sensor readings in the future based on the present one.

Assigning probabilities to every potential state transition allows you to make predictions. For every state, these odds sum up to one. You may therefore determine the probability that you will end up in any other state after being in a particular state.

This method allows you to define thresholds under specific circumstances. For instance, an alert may sound if a sensor reading exceeds a predetermined threshold. In this manner, anomalies or odd patterns in your data might be found.

Additionally, to further enhance these forecasts, researchers are investigating more sophisticated methods such as deep learning. These techniques may be more accurate in identifying patterns and abnormalities because they make use of sophisticated algorithms to learn from vast volumes of data. [1]

We may improve our real-time object detection system for driver drowsiness's capacity to anticipate and react to shifts in the driver's attention by using a Markov chain method. This can make a big difference in preventing accidents and guaranteeing the security of both drivers and passengers.[6]

1.*Integration of Markov Chain Process*:

- Define states in the Markov chain corresponding to different levels of drowsiness (e.g., Alert, Slightly Drowsy, Moderately Drowsy, Very Drowsy).
- Estimate transition probabilities between these states based on historical data or domain knowledge.
- Update the Markov chain's state by incorporating real-time predictions from the sleepiness detection model.
- Put alerting logic into action depending on preset thresholds and the Markov chain's current state.

For example:

1. Transitioning from Alert to Slightly Drowsy may trigger a mild alert (e.g., visual, or auditory warning).
2. Transitioning from Slightly Drowsy to Moderately Drowsy may trigger a stronger alert (e.g., vibrating seat or loud alarm).
3. Transitioning from Moderately Drowsy to Very Drowsy may trigger emergency measures (e.g., autonomous vehicle intervention or contacting emergency services).

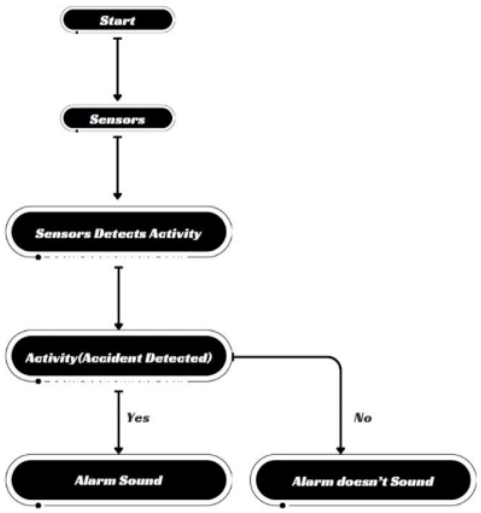
2. *Feedback Loop*:

- Continuously evaluate the effectiveness of the alerting system based on user feedback and system performance.

- Refine the Markov chain model and alerting logic based on the observed outcomes and improvements needed.
  Deployment Process: Using examples of both accidents and non-accidents, the neural network modifies its connections to learn new information.
  Deployment: Based on the estimated chance of accidents, the system can be utilized in real time to alert drivers or take preventive measures once it has been trained.

Evaluation and Improvement: Next, we'll examine the system's performance using several metrics, such as accuracy and efficiency. If it's not performing up to par, we can make necessary adjustments to the neural network or gather additional varied data. The neural network accident prevention system makes road safety safer for all users and lowers the annual number of accidents by using lessons from past events to forecast and avoid future ones.

Synergy: In accident prevention systems, IoT and neural networks work together to create a potent synergy. Neural networks improve the accuracy and efficiency of data analysis to efficiently detect and prevent accidents, while IoT supplies the raw data required for analysis. The basic diagrammatic depiction of our concept using an IOT and neural network is shown below:



PROJECT DESCRIPTION

The incremental model is used to build the framework. The framework's basic model is first built, and after each level of testing, it is further refined in this manner. Different levels of capacity were added to the basic undertaking framework. At a later incremental level, it might have improved and innovative execution support.

CONCLUSION

The study's findings highlight the critical need for swift action to prevent traffic accidents, especially in areas like India where the death toll from these incidents is still rising. Over the past ten years, there have been significant advancements in the sleepiness detection field thanks to innovations in IoT, sensor miniaturization, and artificial intelligence. This article provides a comprehensive and up-to-date review of the driver sleepiness detection technologies implemented over the previous ten years. It has described the four fundamental techniques utilized in developing DDD systems based on the type of sleepiness indicating parameters used. These four categories include image-based, bio-based, vehicle-based, and hybrid-based systems. Innovations in deep learning, namely in convolutional neural networks (CNN), combined with emerging technologies like Markov processes and head scanning, the proposed system has a good chance of reducing the dangers of drowsy driving.

The frequency of traffic accidents, which are caused by things like insufficient road infrastructure and driver weariness, emphasizes the significance of early intervention. Thanks to the rollout of 5G connectivity, deep learning will have access to a multitude of functions, enabling the creation of extremely accurate on-chip alternatives. In order to enable the IoV network to warn sleepy drivers, vehicles should function as network members. With its focus on instantaneous sleep detection and warning, the suggested system has the ability to prevent road accidents and save lives.

The system's core elements—data investigation, model construction, and deployment—are painstakingly engineered to guarantee precision and effectiveness in identifying driver fatigue. The system illustrates a strong framework that can analyse complicated data streams and react quickly to potential threats by utilizing OpenCV, PyTorch, and YOLOv5.

The system gains intelligence by the integration of a Markov chain method, which allows it to adjust dynamically to variations in driver attention. This flexible strategy guarantees prompt action to avert mishaps and improves the system's predictive powers.

In the future, the system's performance and efficacy will be maximized by ongoing assessment and improvement. Through the integration of IoT and neural networks, the suggested solution has the potential to transform accident prevention strategies and usher in a new era of safety in transportation.

To sum up, the system that has been suggested is a big step towards solving the urgent problem of traffic accidents. It provides a complete solution that blends state-of-the-art technology with proactive intervention tactics. With

additional work and deployment, the device might potentially save a great deal of lives and increase everyone's safety on the roadways. However, additional research and practical testing are still needed to ensure its effectiveness in various scenarios. We can develop a system that helps prevent accidents, saving lives and enhancing everyone's safety on our roadways with additional testing and upgrades.

Contributions [2]:
Numerous findings have also been obtained from the study, most notably:
Use algorithms that are tailored to the topic under study and analyse it.
1. Obtain data and figures regarding the quantity and reasons behind road accidents in Algeria from the National Gendarmerie and security services.
2. A variety of algorithms were used to process the database; these were then compared with one another to determine which algorithm was best for the study. Several metrics were used to categorize the most crucial accuracy.
3. A convolutional neural network model with 91% accuracy in real-time classification has been developed.
4. dedication to spending the necessary time researching, analyzing, and presenting the issue that the supervisor and the relevant party have submitted by the deadline

FUTURE ENHANCEMENT

Further improvement Subsequent investigations could focus on the utilization of external factors, such weather, mechanical data, vehicle statuses, sleeping habits, etc., to gauge fatigue. The problem of driver fatigue seriously jeopardizes highway safety, and it is especially problematic for commercial vehicle drivers. This serious safety issue is exacerbated by long work hours, round-the-clock operations, high annual miles, exposure to dangerous environmental conditions, and intense work schedules. Monitoring the driver's level of exhaustion and concentration, providing feedback on his condition, and ensuring that the necessary action is performed are crucial steps in the preventive measures that must be taken to fix this issue. At the moment, the camera cannot be used to adjust its zoom or orientation. As you labour in the future, your eyes will grow larger.

1.Enhanced model accuracy: The medium-performance and cost-cars are strengthened through the direct use of the model's design in classifying cases.
2. Generalization of the study, depending on other characteristics of the face, such as the position of the eyebrows. Total facial expressions. Etc.
3. The formation of a model supported by electronic elements to provide additional information in order to increase the accuracy of decisions.
4. Use other deep learning methods like RNN (Recurrent Neural Network) and try them together to get high results.

RNN recurrent neural networks differ from CNN serial artificial neural networks mostly in their use for processing cyclic data such as audio, video and text, whereas CNN networks rely on spatial data such as images and graphs.

CNN is better at handling three-dimensional digital images and signals, finding spatial relationships in images, and it also relies on detailed levels to extract important landmarks and features from the input data.

In contrast, RNNs rely on memory oriented to memorize and use previous information in current processing and deal better with structural and sequential data such as speaking, translation, audio signals and text data. Which can give us better results, especially in the studied phenomenon of detecting driver drowsiness. It analyses the entire situation of a driver and gives us an accurate prediction and decision of the actual situation.

When combined, the two models have diverse applications, but they can be leveraged to benefit from each other's advantages in various domains of artificial intelligence, like voice and picture recognition in autonomous driving robots. [2]

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