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Accident Precaution System For Vehicle In Motion Using Machine Learning

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Abstract - ***Nowadays speed and breaching traffic rules causes many accident. we can save many live if we provide accident information to emergency service and if we reach in time. heavy road traffic and increasing number of road accidents are major concern in current scenario rather than new vehicle have latest technology. Our survey on this topic is made to construct such a system which is efficient and reliable to detect danger while our vehicle in motion. In this paper, we try to overcome the problem by create system "Accident Precaution System For Vehicle In Motion Using Machine Learning" using Deep learning and machine learning algorithm such as Convolutional Neural Network (CNN), Artificial Neural Network (ANN), YOLO (you look only once).Using these algorithm we develop different model such as Driver Drowsiness, object detection, pothole detection and traffic sign detection for decrease the possibility of accident.***

Key Words: **Deep learning, Machine learning, Convolutional Neural Network (CNN), Artificial Neural Network (ANN), YOLO(you look only once),python, Computer Vision.**

1. INTRODUCTION

Automobile has provide a great benefits in our daily life. We use vehicle to reach destination on time. In 21st century it hard to imagine life without vehicle. There are various types of vehicle such as car, bus, truck etc. each used for different purpose, But every coin had two side that way increasing number of vehicle on road provide us benefits of fast transportation and decrease our travel time but it also cause disaster to us and may kill us through serious accident. Inappropriate driving and over speeding causes risk to involve in accident. Many efforts taken by various organization and government to decreases number of accident but still so many accident happen daily. We can save many life by provide emergency information about upcoming danger while driving. According Data of Ministry of Road Transport & Highways of India major reason for accident is Over Speeding, Distractions of Driver, Traffic Light Jumping, Non-adherence to lane driving and overtaking in a wrong manner.

As most of accident occurs because traffic rules properly not follow.so many drivers they actual not seen traffic light because there vehicle in motion so deep learning algorithm such as Convolutional Neural Network(CNN) which focus on particular region can help in fast image processing[1].

Some causes for accident is Driver fall in slip while driving, it happen mostly in night driving.it may cause serious crash so if we analyze driver face and detect facial feature in real time it will overcome the danger of an accident[3].

Another obstacles on Road also cause accident such as vehicle can crash with each other so vehicle can detect using technology such as R-CNN, CNN, Darknet for detect and analyze vehicle from surrounding in safe distance [9].

In this paper, we proposed systems that previously detect Road objects, Traffic sign and Driver Drowsiness using various Deep learning and machine learning technology with tensorflow and image processing. It will help in Autonomous vehicle creation and make driving safe and secure for Driver and passenger.

2. RELATED WORK

In Existing system, models are built for accident prevention such as Drowsiness Detection, road object detection and traffic sign detection for create pre-alarm system that help driver in his journey. These models are built separately and used dataset that is limited. As we built different models we see different work separately as follow:

Traffic sign detection

In paper[1] they built model on DFG dataset which had different types of traffic signs, some of which give warning, mandatory and prohibitive instructions on how and where to drive. To trained and built the model they used region-based neural network which focus on particular region for detect traffic sign. In paper to built traffic sign detection we had to done pre-image processing as mention in paper [2].In this they used Image enhancement technology for clear shapes using linear filtering algorithm.

Driver Drowsiness

In previous study [3] To monitor and warn the driver in real-time, the use of the kernelized correlation filters (KCF) algorithm is preferred based on system's evaluation. For real

time detection of driver face fatigue MC-KCF algorithm is helpful for highest accuracy for Drowsiness detection by tracking eyes fatigue. As mention in previous study in paper Drowsiness track by face fatigue condition, as model built for detect eye aspect ratio by tracking eyes blinking rate. Normally eyes blink two to three time a minute. For detect Drowsiness we must track face for few second then as per face condition detection result occurs.

In study in paper[3] we mark number of facial key points as per mark rather than detect upper and lower eyelids we detect eyebrows and whole eyes socket for track eyes fatigue.

According the study of paper[11] Behavioral measures like yawning, amount of eye closure, eye blinking etc. need to be consider, but normally activity like yawning is less so we can say it's not Drowsy. Normally amount of eyes closure is also 0.1s to 0.4s so eyes are blink 3 to 4 time a second. But when driver close to sleep amount of eyes closure is increases.

Road object detection

As per study that previously done vehicle detection is challenging for human to calculate, this is where a machine learning had great benefits to automatically learn and improve over time tracking, classifying, and counting the number of vehicles passing by certain area [9].object detection is beneficiary in prevention of accident therefore fast detection of object is required for real-time object detection we used technology Yolo and its different version(v1,v2,v3,v5).

In the paper [9] we apply Deep learning based Yolo framework and perform task such as Collection of picture of interest, labeling and classify image, Train model and run code, it will draw rectangular shapes on object and give label to the object. Model specifies by this Provide accuracy 82%.

As per model are built separately and had low detection Accuracy in some model and some model built had low accuracy as they used dataset that had limited elements.

Pothole Detection

Major reason for accident is pothole not detected on time. As per paper[4] for accurately detect the pothole models are trained and tested with preprocessed dataset, including YOLO V3, SSD, HOG with SVM and Faster R-CNN. According to accuracy of Different models Yolo v3 provide highest accuracy.

In paper[7] study show that pothole detection system can be used for create report on road condition as system automatically detect potholes so its used for monitoring and make report whether road condition is good or bad. road surface monitoring, deep learning, convolutional neural network, k-nearest neighbor, global positioning system are technology helpful for create the system. still shape of pothole are different in different region and that causes hard to detect the poteholes.so there need to used dataset that provide accurate different sets of images of potholes.

3. PROPOSED SYSTEM

Aim of this project is previously detect obstacles on road that causes serious accidents and aware driver from incoming danger on road as early as possible. Road obstacles that causes most of the accident include Drivers Drowsiness, Traffic light jumping, Various object on road such as other vehicle is not detected, potholes. A causes that above mention is most common reason for road accident to happen. In our study we found that some model are built previously for solving this problem, but these model had many limitation such as Low accuracy, trained on limited data, Detection speed is slow. Previous system models are built separately that only address particular problem. For creating perfect accident precaution system we had to Built various models that provide fast detection and high accuracy.so we built the model such as Traffic sign detection, Driver Drowsiness, Road object detection and Pothole detection for detect all road sign and object, Driver Drowsiness come in drivers journey.so as per our study we had to consider these models:

Traffic sign detection

Nowadays we heard about automated vehicle technology in this for avoid accidents we had to consider traffic rule. For that traffic sign need to detect accurately. As most of traffic sign are placed in left or right side and that cover small portion of road its challenging to detect accurately. Detection and classification is dependents on shape and color of the traffic sign.so we used dataset that had various Indian traffic sign including Traffic signal ahead, speed limit, no entry, crosswalk, speed break, speed limit and many more. Dataset mostly had image data with their labels.

To achieve high accuracy with real-time monitoring and detection in this project we used CNN (convolution neural network) and R-CNN are used. CNN are mostly useful for real time detection as per paper[1].In this project Deep learning image processing and object detection used CNN with artificial neural network. convolutional neural network is very helpful in deal with high definition image data and also blur image to process image and make prediction.[2]convolutional neural network is work differently as they treats data as special. Instead of neurons being connected to every neuron in previous layer, they are instead only connected to neuron close to it and all have the same weight. The simplification in connections means the network upholds the spatial aspect of dataset.

Like normal neural network convolution neural network made up of multiple layer that is convolutional layer, pooling layer, ReLu layer, fully connected layer:

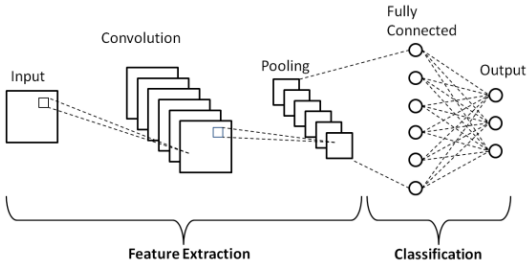

Fig-3.1: Convolutional neural network

Convolutional Layer: This is first layer of CNN architecture. this layer meanly deal with scanning image and get maximum input from image pixel.in this mathematical operation is perform between input image pixel and filter of size NxN, here n is size of filter. there are various filter such as Edge filter, colour filter, curve filter. when we slide or convolve filter over image the random value of filter join with image pixel value and give us new set of value which help us to identify image properties. After convolve it generated feature map that give use information about corner and edges of image. feature map give as output to other layer for extract more information about image and accurately detect the image.

Pooling Layer: This layer is reduce the sample size of feature map. this also make processing faster as it reduce number of parameter network need to process.it reduce samples size by decreasing connection between layer and independly used each feature map. output of this layer is pooled feature map. there are two method of doing this fist is max pooling which take maximum input of particular convolve feature and average pooling which simply calculate average of the elements in a predefined sized image section. pooling layer act as bridge between convolutional layer and fully connected layer.

ReLu: Relu is stand for rectified Linear Unit. Purpose of this layer is introduce non linearity in neural network model during the convolution operation. its most popular activation layer using after convolutional operation. Relu is operation with applied after each convolution operation it convert all negative value to zero. which help to achieve non-linearity. It computes the function $f(\kappa)=\max(0,\kappa)$. activation is simply threshold at zero when value is negative it convert it into zero.

Fully Connected Layer: FC layer is nothing but dense network of neuron and connection between every two neuron. we use fully connected layer to classify image to particular categories after we have extracted feature from image using convolutional layer and max pooling layer.

FC layer are dense network of neurons. this layer is applied after convolutional and max pooling layer its purpose is to classify the output. FC layer is representation between input and output.it is final layer of architecture.

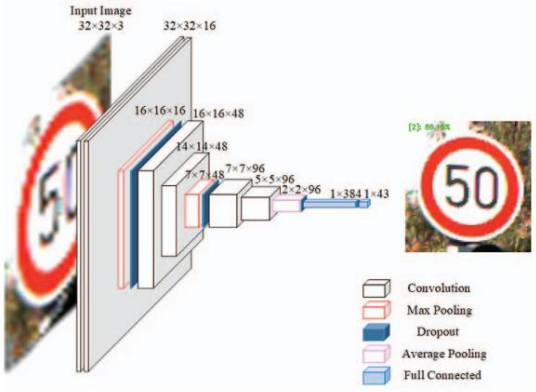

Fig-3.2:Traffic sign detection using CNN

Above **fig-3.2** show working of different layer of convolution neural network as show in figure high definition traffic sign speed limit 50 detect clearly and go through various CNN layers.

Drivers Drowsiness Detection

As face is important aspect of our body it will used for detection of Drowsiness of Drivers Based on eyes closing time and fatigue detection.as number of vehicle increases per day.[11]Big vehicles like bus, trucks, transport vehicle whose drive at night, so prolonged drive duration and bad working condition Driver fatigue is major reason for accident. In this project detection of Drowsiness sign is based on eyes aspect ratio eyes aspect ratio is amount of duration of eyes blinking 2 to 3 time a second is normal. If eyes aspect ratio is increases suppose 2 to 3 second eyes are not open then it will detect the drowsiness.

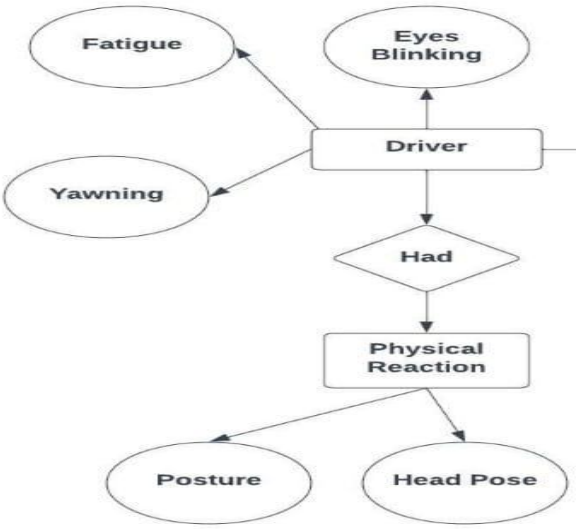

Fig-3.3:Driver Drowsiness System

In fig.3 it's a Driver Drowsiness system in this Driver start driving camera captures its facial expression it will analyze yawning, fatigue, eyes blinking and based on physical reaction like posture and head pose it will detect Drowsy and Buzzer Alarm.

Road Object Detection

while driving vehicle may crash with other vehicle or other object on road such as cycle person create obstacle for driver. In this project we create Road object detection model that detect road object with high accuracy. we used opencv and Deep neural network to detect object while driver is driving. Opencv used for analyze all features of computer vision and draw rectangle shape around object.

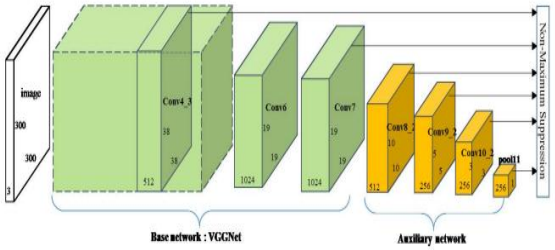

Fig-3.4: SSD network architecture: Base network (VGGNet)

SSD is based on CNN it used to detect object and VGGNet used for image classification.

Pothole Detection

As pothole are major reason for accident so this is our priority to detect pothole at run time.to achieve this goal we proposed system that used computer vision. Computer vision with deep learning model help us in fast detection of pothole while vehicle in motion. major problem for pothole detection is pothole not in particular shape for that we used CNN-CUDA model that help us fast detection and harnessing power of GPU and increases computing power to perform pothole detection in real time and draw circle around pothole.it required so much work of graphical unit NVIDIA cuda Toolkit help us to accelerate GPU-accelerated applications which provide good GPU utilization.

By combining all models we can create perfect accident precaution system while vehicle in motion.

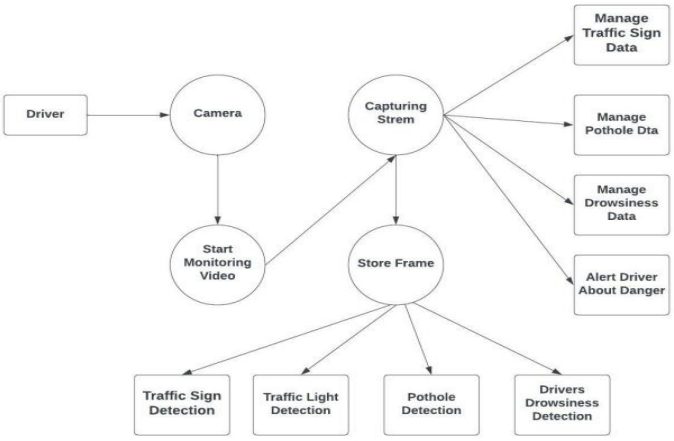

Fig-3.5:Architectural diagram for Accident precaution system while vehicle in motion

As driver start vehicle its start capturing images based on pretrained models and analyze the footage and based on that detect potholes, Traffic sign, Driver drowsiness and various road objects.

4. METHDOLOGY

This project main concern with built system that detect object and prevent accident while vehicle in motion. to solve this problem methodological approach for study are as following:

Dataset Collection and model building:

To build model for Road object detection The dataset is collected from Kaggle Repository and was split into training and testing data after its analysis.to build perfect road object detection model which help in prevention of accident we used dataset that include various traffic sign images with two hundreds categories and more than seven thousand images, car which had more than two thousand images, motorcycle which had more than 3000 images, person's dataset had

more than 1000 images. combine dataset is train and test for model building which had 13,874 images. we build model using CNN and train the dataset using this architecture. To make model predicted accurate result we first perform some operation on our dataset to make data understandable by our trained model.

Road object detection model Training and testing:

model training and testing:

To train the model we used model.fit() function it work well after successfully trained and test model. using 35 batch size we get 94% accuracy on trained model and get stability using 15 epoch as per each epoch it get more stable.

epochs=15

M1 = model.fit(X_train1, y_train1, batch_size=32, epochs=15, validation_data=(X_test2, y_test2))

we trained model on 13874 sample and validate on 3500 sample after testing the model we get following accuracy chart-1:

Accuracy show how accuracy of training data and testing data increases per epochs.

Loss graph show error will decreases as per epochs. initially at training data error is high it goes down same in testing data error decreases almost goes to zero.

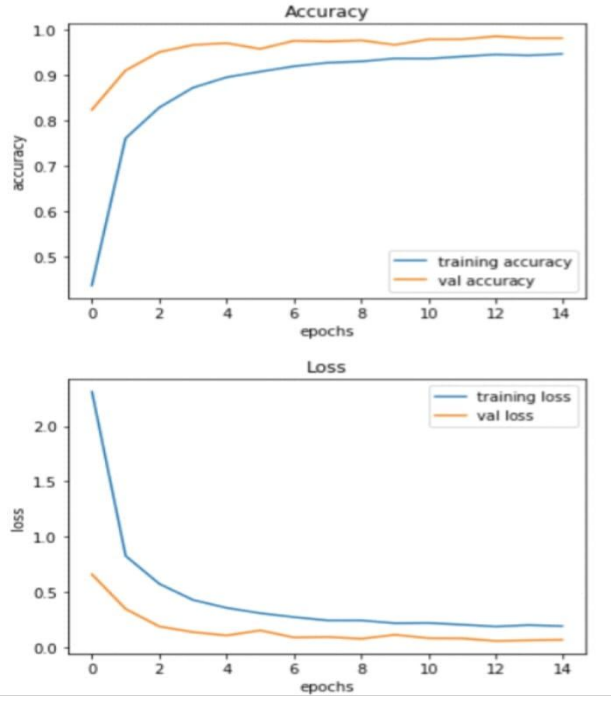

Chart-1: Accuracy and loss chart of trained and testing data

Performance of model:

As we test the model on real time video that detect various road object such as person, motorcycle, car and traffic sign. After testing the model following is result of model performance:

Table-1: Model performance table

OBJECT	BEFORE DETECTION	AFTER DETECTION	ACCURACY_SCORE
Person	0	6	0.90
Motorcycle	0	4	0.80
car	0	3	0.75
Traffic sign	0	1	0.83

Accuracy score in table 1 is increases as object is near to camera and getting decreses after object is far away from camera.

CNN is deep learning architecture which help us fast road object detection and recognition. CNN model get input from camera that compare input data with various images in dataset. It scan input and input goes through various layers of CNN and generate clear image of road object by applying filter such as color filter, edge filter and curve filter. As most traffic sign are

place on left or right side of road so input image is blur but using CNN clear image of is provide to train model and it predicted sign accurately.

To build this we used python and various libraries in python such as opencv, keras, matplotlib, numpy which help us to detection model with high detection accuracy. After training and testing Accuracy of model is 94%.

Main work of Driver Drowsiness detection system model is detect fatigue, Drowsiness of driver accurately and quickly and alert driver who sit on driver sit. Model play important role in implemented the system. For develop model for Driver Drowsiness detection following are model and sub model need to build:

i] Frame Acquisition: In this process image of driver face is capture via webcam camera it used for capturing live video of driver eyes in all visible condition.

ii] Facial landmark detection: Facial landmark detector mainly used for face condition detection we use dlib face detector and dlib python library for draw box around face.

iii] Eye Localization and tracking: This check eyes condition whether eye is open or close.

iv] Measuring EAR: measuring eye aspect ratio(EAR) is most important task in drowsiness detection. when eyes are open then EAR is constant and when eyes blink then then EAR immediately reduce to zero.

v] Monitoring of EAR for blinks detection: using continuous video capture we monitoring EAR for Drowsiness, fatigue detection by continuously detect using eyes using webcam camera.

vi] Estimation of fatigue periods between blinking: It is calculate eyes blinking time.

vii] Audio Visual warning on fatigue detection: When model detect fatigue it sound buzzer to alert driver.

Drowsiness model training and testing:

We used SVM to test the data in SVM algorithm we create model based on Eye Aspect Ratio. EAR calculate blinking of eyes. result of drivers fatigue is calculated by SVM classifier. Following are test case of Drowsiness model training.

Table-2: Testing of Drowsiness

Test cases	Eyes Detected	Eyes closure	result
Case 1	No	No	No result
Case 2	Yes	No	No result
Case 3	Yes	Yes	Voice alert

After training the model on SVM classifier we test it using CNN model for fast detection. Performance of model after testing show in following table:

Table-3: Performace of Model

I/P	Drowsiness Detection	Accuracy
Sample 1	Not Detected	0
Sample 2	Detected	94 %
Sample 3	Detected	96 %

As per each sample its improve its accuracy.to calculate alert following formula is used :

Drowsiness Detection Accuracy=total no. of times alert cames as eyes close/(no. of alert not come as eyes is close+ no. of alert is cames as eyes is close).

So, Detection accuracy is 96%.

As we used python for trained this model we used computer vision concept for draw circle around eyes and continuously capturing driver face. another python library such as pygame used for playing buzzer sound and dlib used for detect the face landmark.

To make perfect accident precaution system we build pothole detection model. In this model we detect potholes of any size in real time scenario.to accurately detect pothole we used dataset that had various images of pothole of many size.to build model we perform following steps:

i] Data collection: collect the data from various source such as kaggle and real pothole image from road.

ii] Clean the dataset: In this we remove some image and only used the data that help in accurate detection.

iii] Build model: To model building we used YOLO v4(You only look once) architecture that help us in fast detection of pothole while vehicle in motion. we used YOLO v4 which is CNN based real time object detection. we used YOLOv4-tiny weight with fixed resolution image. Later we modify YOLOv4-tiny weight for train model on multi-resolution. carry out final training process.

iv]Test model: test model on real time input and also with video it gives accuracy 94%.

As we develop pothole detection for real time input its required significant amount of processing power of GPU. for that we used CUDA-dnn (Compute Unified Device Architecture-deep neural network) which is created by NVIDIA for provide better GPU utilization and perform Graphical operation faster. We used python programming with various python library such as cv2 for image processing, time library for time in code for object, os library used for access functionality of operating system and it's provide interaction between user and os.

Result of performance of model after training and testing:

Table-4: pothole model performance

Potholes	Initially	After detection	Accuracy
crack	0	2	98 %
Low severity	0	3	95 %
High severity	0	4	99 %

As per above **Table-4** there are various shape of pothole such as crack, low severity, high severity.it will detect pothole on real time scenario with 14.77 fps.it will detect all pothole in its range in real time.it happen because of cnn and yolo v4 working to train and test the data . As testing model had accuracy 97%.

As per our study we build various model using machine learning and deep learning algorithm for create perfect accident Precaution system. we used SVM for Drowsiness detection for compare eyes aspect ratio of previous and current face condition that check blinking of eyes this model gives accuracy is 96%.Model of road object detection had accuracy 94%.Pothile using yolo v4 had Accuracy 97%.

Table-5: Model performance of all model

Model	Algorithm	Accuracy
Drowsiness	SVM	96%
Road object detection	CNN	94%
Pothole detection	Yolo	97%

As per **Table-5** our system had accuracy 95%.

So it will prevent 95% of Accident.

5. RESULT

We implemented various model using various python libraries: Numpy,Cv2,Matplotlib,dlib,pandas,tensorflow pygame.

Following are drowsiness model:

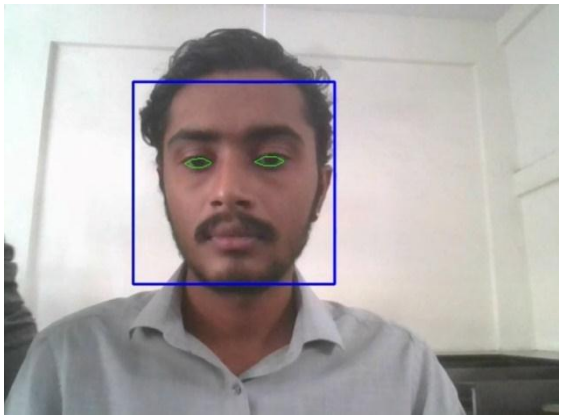

Fig-5.1:Before Detected

After capturing Drowsiness sign it detect Drowsiness and Draw square box around image with "You are drowsy" message.

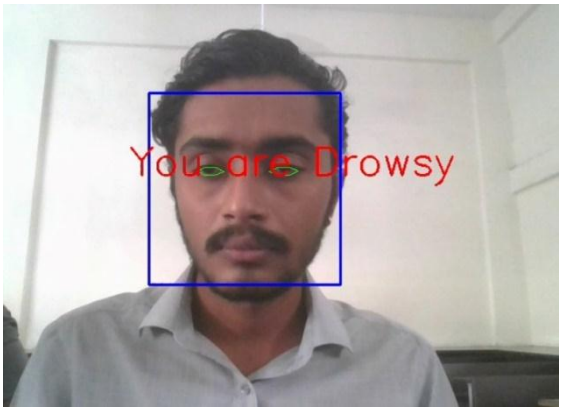

Fig-5.2:After Detected

Road object Detection Model Detected various object like car, cycle, Traffic sign and other object:

Fig-5.3:Before Road object Detection

Above figure is show image before road object detection.

Now after detection various road object such as car, person, traffic sign, motorcycle will detected by accuracy score show in Table-1.

Fig-5.4: After road object detection

After detection of object it will show overall accuracy 94%.

Pothole Detection Model detect potholes present in road from any shape and draw square box surrounding potholes. Model had 97% accuracy of detection.

Fig-5.5:Pothole Detection

As per our study we build various model to make driving secure, such as object detection, pothole detection and Drowsiness detection as per there performance and accuracy we can say this system will provide 95% of security to driver.

6. CONCLUSION

From this project we conclude that "Accident precaution system for vehicle in motion" on account of Machine learning is proposed, which mainly aims at recognizing signs and object and help prevents accidents resulting in safety for the driver and pedestrians. By using image pre-processing, sign and object detection, recognition and classification, this method can effectively detect and identify signs and objects and prevent accidents. It used latest technology with machine learning for classification and deep learning for object detection with help of Yolo, Tensorflow, Python, CNN,R-CNN algorithms.

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