A System to Predict the Percent Probability of Occurrence of a Road Accident and Its Severity Caused Due to Human Negligence

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Inspiration Behind the Idea

- In a study looking at critical reasons of car accidents, they found that 94% of car accidents are caused by drivers.
- Reasons for driver-caused crashes are commonly categorised into recognition errors, decision errors, and performance errors.
- Measures to reduce such human errors leads to increased road safety
- A warning signal for any careless behaviour while driving could be ignored by the driver
- A stern display of risk percentage and severity of an accident along with warning signals could psychologically have a deeper effect
- Drivers will be forced to correct themselves and adhere to road safety rules leading to reduction in the risk of road accidents.

Approach

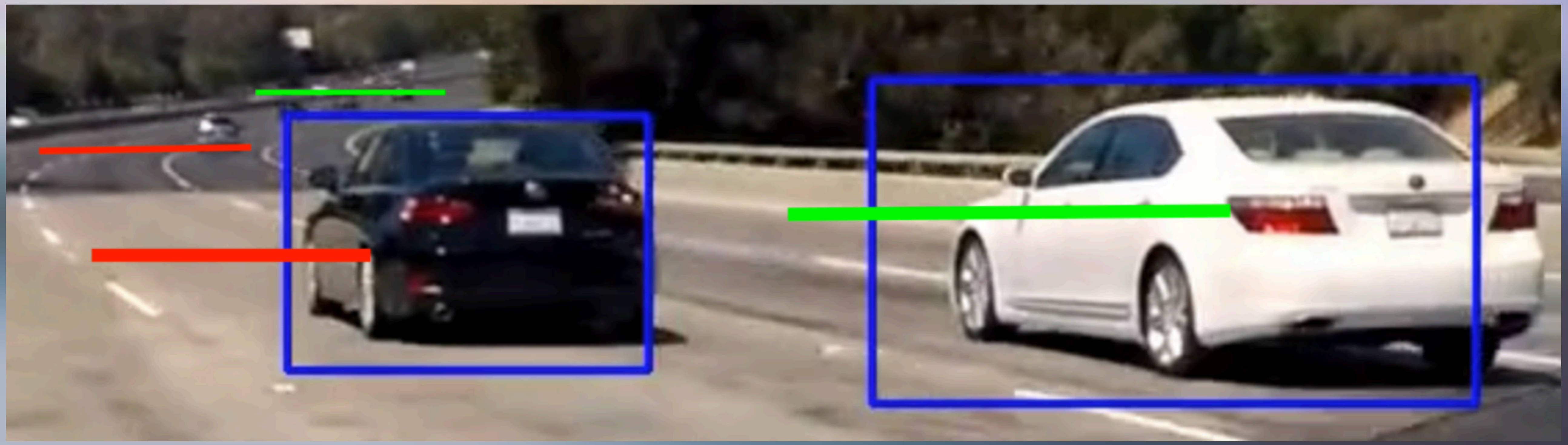
- The proposed system uses machine learning techniques
- This single system incorporates multiple uses cases
- These use cases include-
  i. speed, breaking traffic signal rules and tailgating detection
  ii. alcohol consumption detection
  iii. age, gender and mood detection
  iv. distraction classification
- Each of these use cases are implemented using machine learning and deep learning algorithms
- These detection models yield data for some features, while sensors installed in the vehicle provide data for others
- This data is fed into the final predicting model in the system, a MLP neural network that predicts the percent probability of occurrence of an accident and its severity

Speed, Breaking Traffic Signal Rule and Tailgating Detection

Detection of vehicles and traffic signal is implemented using YOLOv3 algorithm utilising a camera installed in the vehicle

Speed detection

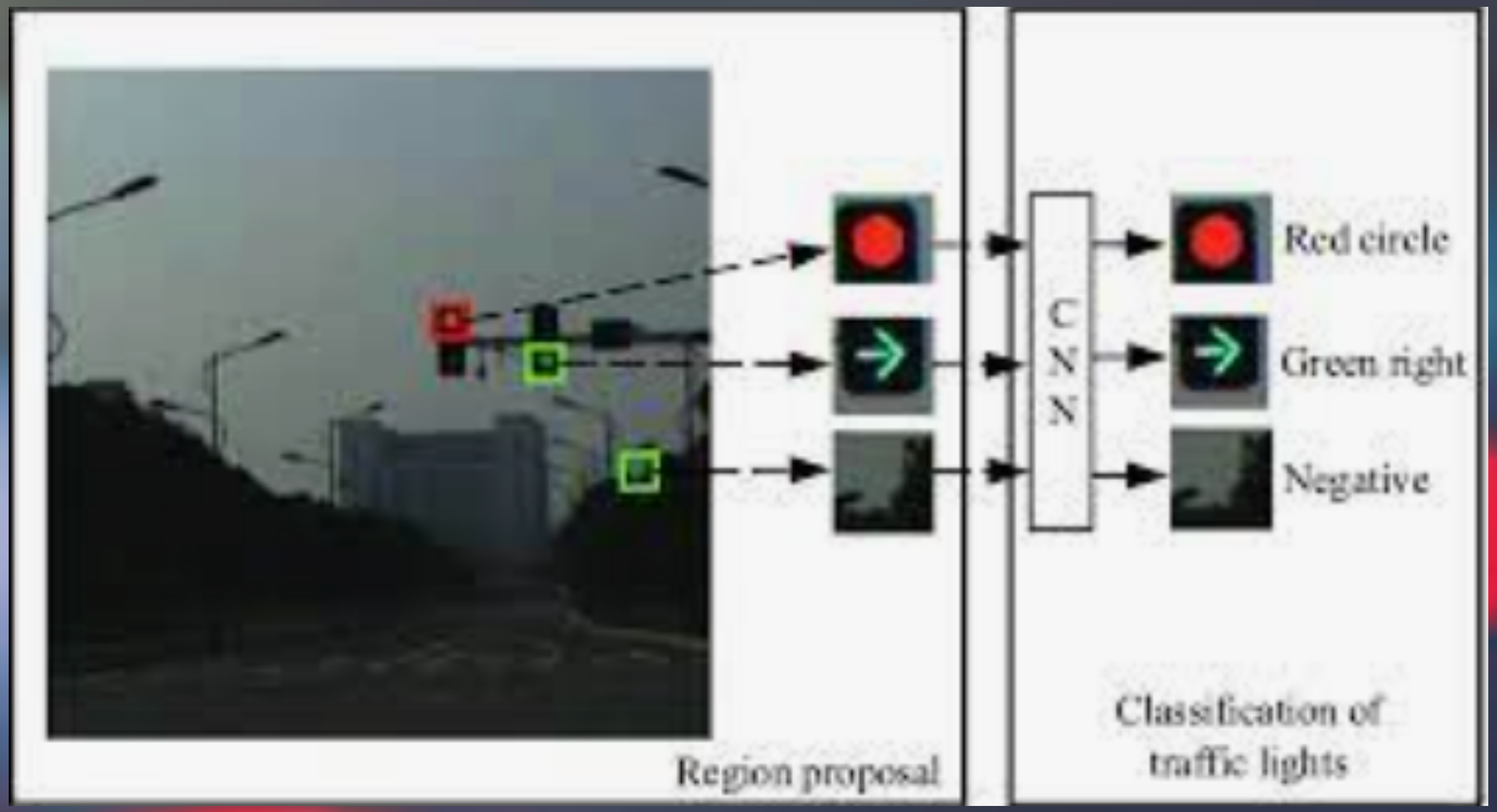
- Speed between two lines' method is implemented
- Distance covered and time taken is measured for a multiple vehicles in front
- Speed is computed for each vehicle using the formula speed=distance/time



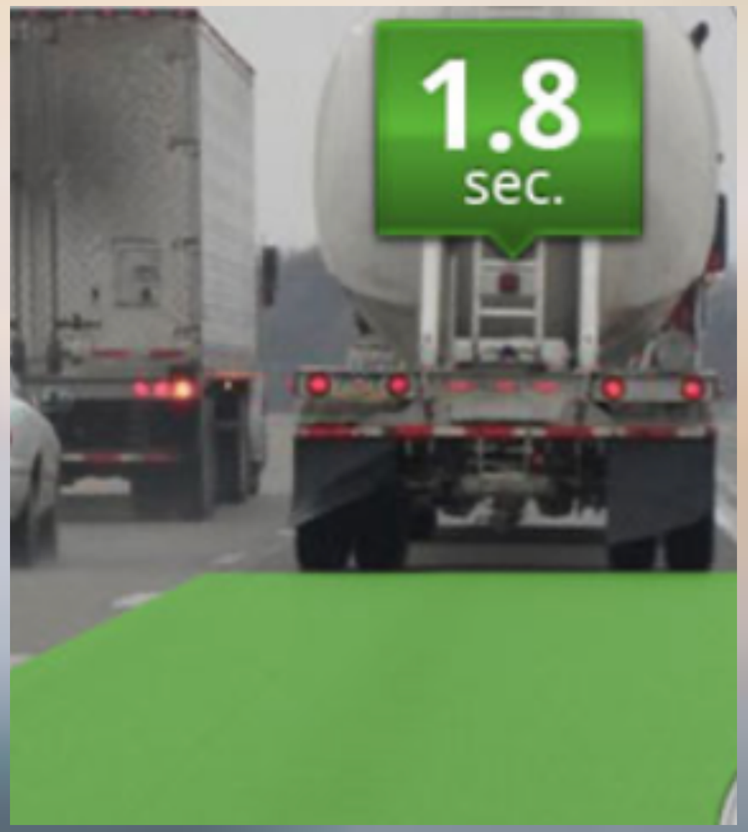
- Average of all the speeds is calculated to compute the speed limit for the road
- Speed of the vehicle is recorded using vehicle speed sensor (VSS)
- This speed is compared with computed speed limit
- The model returns a 'YES' for over-speeding or delaying, else returns a 'NO' along with the speed value

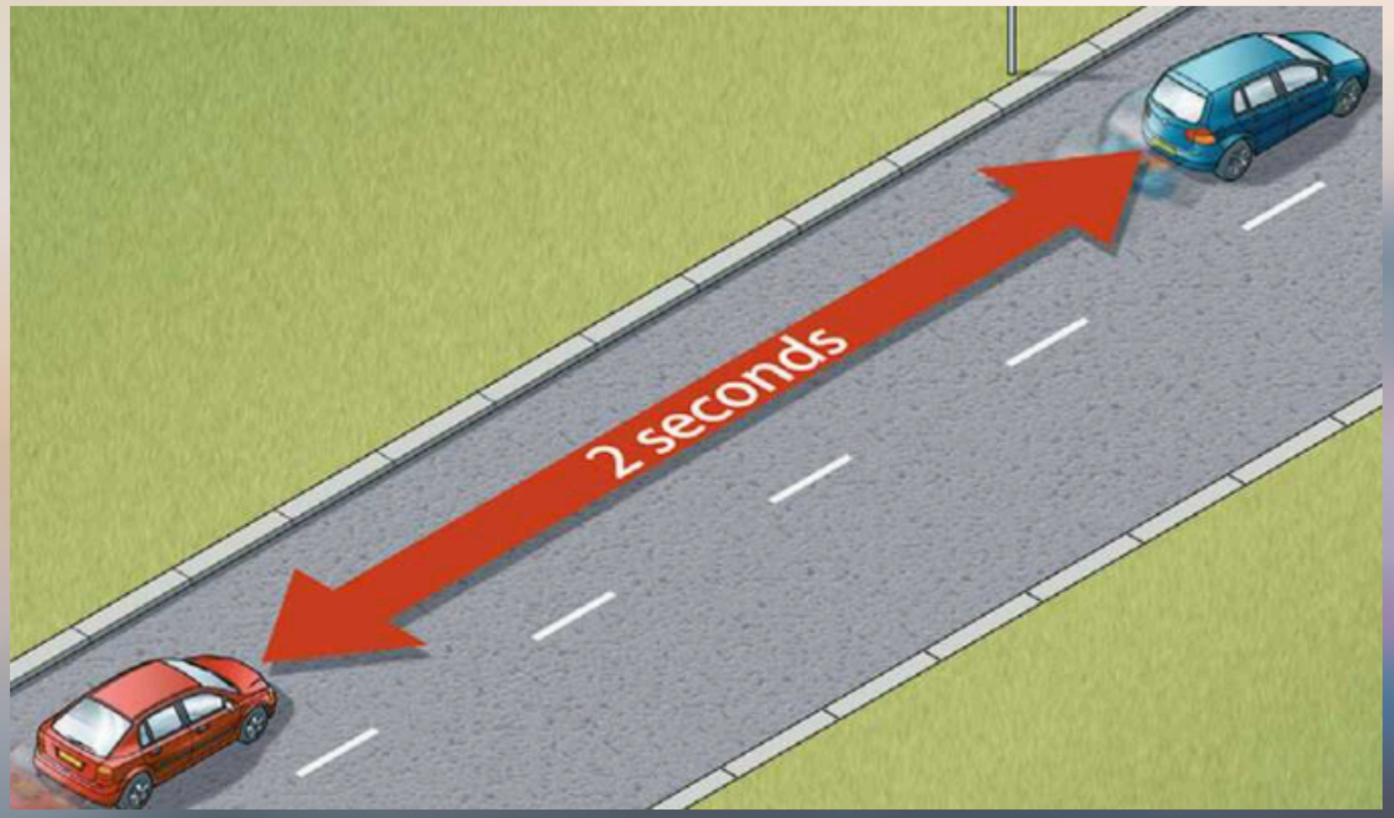
Breaking Traffic Signal Rules Detection

- Using a CNN classification model, the detected traffic signal is classified as ‘GO’ or ‘STOP’
- The classification is done based on the colour detected, ‘GO’ for green, else ‘STOP’
- The model returns a ‘YES' if the speed measured by VSS is 0 when the classification is ‘GO,' or if the sensors detect a speed when the classification is ‘STOP.’ A 'NO' will be returned in all other cases.



Tailgating Detection

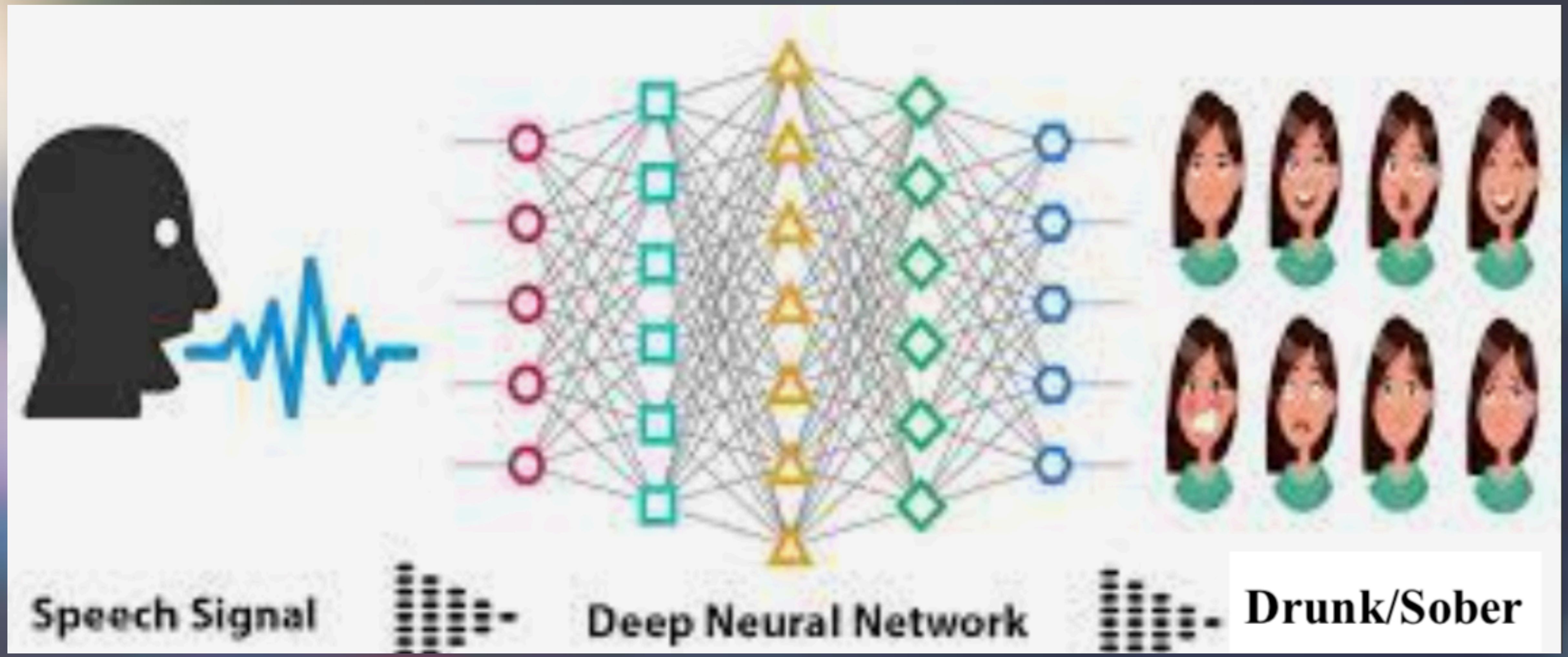




- **The ‘2 second thumb rule’ is implemented**
- **The vehicle right in front is detected and the distance between is calculated**
- **Using the speed computed by speed detection model, time is calculated using the formula *time=distance/speed***
- **If time computed is less than 2 seconds, a ‘YES’ is returned by the model, else a ‘NO’ for tailgating**

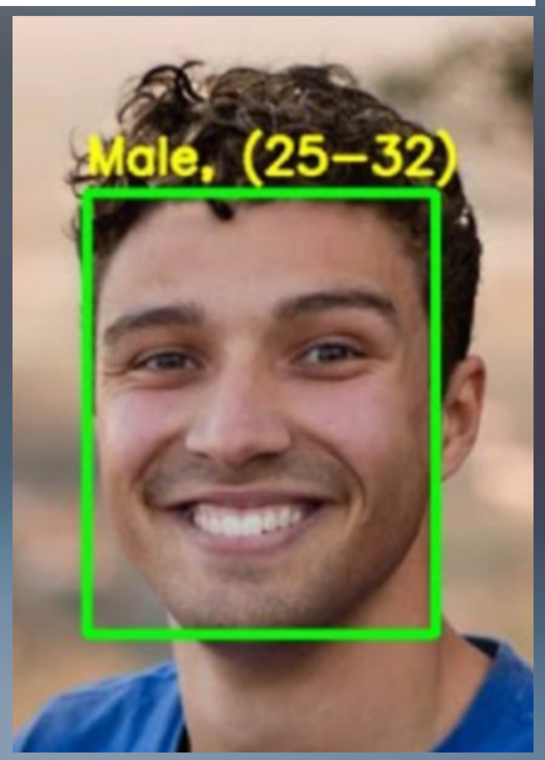
Alcohol Consumption Detection

- Intoxication is detected using the voice sample of the driver.
- The voice of the driver is given as an audio input to the model
- A convolutional auto encoder is used as an audio classifier
- It classifies the model into ‘DRUNK’ or ‘SOBER’



Age, Gender, Drowsiness and Mood Detection

Face detection is implemented using a MTCNN model and the detected face image is fed as input to 4 deep CNN classifiers through camera installed in the vehicle



- **CNN classifier is trained to classify the detected face image into an age group**
- **Similarly, the second CNN classifier is trained to classify the image based on gender**
- **The third classifier classifies the image into categories like surprise, happy, disgust, anger, sadness, fear and contempt**
- **The fourth classifier classifies the image as 'DROWSY' or 'AWAKE'.**

Distraction Detector

- A deep CNN model is implemented to recognise the drivers actions through a camera installed in the vehicle
- A neural classifier is used to classify the detected image into various distraction categories
- These categories include safe driving, texting-right, talking on the phone-right, texting-left, talking on the phone-left, operating the radio, drinking, reaching behind, hair and makeup and talking to passenger
- The model returns the output category

Final Predicting Model

- The final model is a multi-output model that can predict both a numeric (accident risk percent probability) and class label(accident severity) value fro the same input
- It is implemented using a MLP neural network
- The output of all the above mentioned models are fed as input to this model
- Along with this, data from sensors installed in the vehicles also provide inputs to the model
- Using the values provided by the above mentioned models and sensors, the model predicts the percent probability of occurrence of an accident and its severity

Feasibility

- The idea is moderately to highly feasible
- High availability of the hardware components required
- State-of-the-art Deep Learning models are made better every day
- Although DL is computationally expensive and can lead to unsustainability, a lot of research is being made in the domain for improving the training process as well as making them sustainable
- There is a constant development in hardware required for training deep learning models
- Once the training is done, running the model takes only seconds

Impact and Outcomes

- Road safety measures are followed
- Reduction in human negligence during driving
- Accident rate reduction
- Casualty reduction
- Improved safety

Thank You

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