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Predict vehicle health and driving characteristics using ML and Vehicle data analytics

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Abstract:-

Vehicles have been fitted with a variety of sensors in the last few decades that may offer helpful measurements and diagnostics for both the vehicle's state and the driver's behavior. Furthermore, the tremendous growth in people and goods transportation demands, along with the advancement of Information and Communication Technologies (ICT), is moving the transportation domain into a new, more intelligent and efficient era. The decrease of Emissions of co2 and the reduction of one's environmental footprint are undoubtedly critical for environmental conservation. In light of this, it is widely understood that driving behavior is closely related to a vehicle's fuel consumption and emissions.Given that modern cars are equipped with sensors that can gather a range of data, such as speed, acceleration, fuel consumption, direction, and so on, it is now more practical than ever to propose solutions that seek to not only monitor but also improve drivers' environmental behavior. Along with this, Path-hole detection is important to decrease accidents across the world. In this paper, we propose a way to implement path-hole detection.

The approach in this paper describes a comprehensive platform that combines well-known machine learning algorithms with sensor data to collect, store, process, analyze and correlate various data flows originating from vehicles.

Data from multiple vehicles is analyzed within a time span of a few days and processed using clustering algorithms to determine whether or not the driver's behavior is eco-friendly, followed by a comparative examination of supervised machine learning in the given labeled dataset.

Keywords:- Machine Learning, Vehicle safety, Automotive Vehicle Data.

Introduction:-

According to studies from National Road Safety Observatory (ONSV, 2020), 90% of Driver inattention accounts for 5 percent of road accidents, while car flaws account for another 5%, car defects and 5% due to the poor road condition.Understanding how drivers behave behind the wheel is one of the choices for supporting activities that address these issues. Using car data to better understand drivers is a topic that has gained traction in recent years, and in the face of the problems involved, identifying car use profiles have increasingly been a subject of worldwide research. With the rapid increase in the number of cars and the mercilessly congested Indian roads, for the residents of the country, road safety has become an extremely important concern. The majority of road accidents occur as a result of reckless and fast driving by automobiles, not for any other reason, driver fatigue, and, most importantly, the dreadful state of already congested roads, such as failure to respect or follow traffic laws, public and transportation vehicle overcrowding or overcapacity, poor vehicle upkeep, attitudes of the "right of the powerful" larger cars toward smaller cars, intoxicated driving, with unauthorized people encroaching on them. By using Machine learning and analytics of the vehicle data to prevent accident we mostly work on following things:

- The project focuses on creating a framework that will use machine learning algorithms and analytics of data to derive the vehicle health and characteristics of driving
- We are utilizing mobile sensor information along with OBD data to build Models for machine learning and data analytics. For the analytics part, data is collected from the OBD module from which we will select the suitable parameters to our applications.
- This feature will tell about performance of vehicle health at current state, about the driving surroundings like detecting the presence of potholes, speed breakers, lane detection, etc.
- Also determining the driving behavior of the driver, in terms of driving through the turn, proper gear shifting etc.
- We are proposing the machine learning and data analytics model framework that will give the result of these features and help the user have the benefit of the features at a lower rate.

Literature Review:-

We used journal publication on Machine Learning based real-time vehicle data analysis for safe driving modeling and path-hole detection using image processing in this research. The articles that we used were published in recent years, while some older articles that we referred to had technologies that are not used anymore or have lost their popularity. We studied the datasets, methodology and prepared our own datasets for the project.

Project Statement:-

Some of the major reasons for deduction of vehicle life and efficiency are path-holes, traffic, sharp turns and wrong driving habits of owners. As a result, Machine Learning models and algorithms, together with vehicle data, are utilized to improve overall vehicle health, efficiency, and detect and improve driving characteristics.

Software and Hardware:-

Python for data processing with the help of pandas and numpy library. Obd port for collecting data from the vehicle. OpenCV for image processing, Matplot library for graphical plotting and Keras for developing deep learning models.

Existing System:-

There are some applications which show the health of the vehicle but it does not show the ways to solve the problem causing the reduction of vehicle health.This systems are heavy to use for a single system and is not available for everyday users.

Methodology:-

The data of our vehicle and surroundings is collected with the help of OBD port and smartphone.The information is then pre-processed. The data is saved in csv format and passed to the algorithms. The data will then be processed and sent back to us.

Features:-

1. **Real-Time Pathole Detection :**

Purpose	Identify/Detect the road anomalies(Pothole. Speed Breakers)
Input	Acceleration values (smartphone) (in the axis normal to road surface)
Method	Find the negative and positive peaks in acceleration values for detecting the potholes and speed breakers respectively. Later confirm presence of anomaly with image processing method.
Output	Detected anomaly positions and their images
Application	By detecting the pothole, we can report location to respective authorities.

2. **Traffic Monitoring System :**

Purpose	Identify real time traffic to reduce traveling time
Input	Video Data, Vehicle speed, latitude and longitude
Method	1. Image Processing for object detection and keeping the count 2. Detection of traffic based on speed
Output	Detected traffic in any route
Application	Users will be able to see traffic in a specific path and choose another way if needed.

3. **Sharp turn monitoring:**

Purpose	Sharp turn monitoring to the quality of turn
Input	OBD data (Vehicle speed, accelerometer, gyroscope data)
Method	Identifying turn and then based speed behavior classify it as good or bad turn
Output	The sharp turn is plotted on the map and colored based on turn quality.

4. **Fuel Consumption monitoring**

Purpose	To monitor the engine load variation, fuel consumption during the drive.
Input	Engine load, Fuel mass consumption, KPL, vehicle speed
Method	Monitoring the fuel mass consumption with engine load variation, keeping track of average fuel consumption of the drive on a routine route.
Output	Average fuel consumption values of the drive during the drive, to monitor fuel consumption performance over the days.

Libraries:-

Numpy

- In Python we have lists that serve the purpose of arrays, but they are slow to process.
- NumPy aims to make array objects 50 times faster than regular Python lists.
- NumPy arrays are stored at one continuous place in memory unlike lists, so processes can access and manipulate them very efficiently.This is known as locality of reference in computer science.

Pandas

- Pandas is a widely used open-source Python tool for data science, data analysis, and machine learning.
- It is built on top of Numpy and provides support for multi-dimensional arrays.
- Pandas, as one of the most widely used data-wrangling tools, is compatible with a wide range of other Python data science modules.

OpenCV

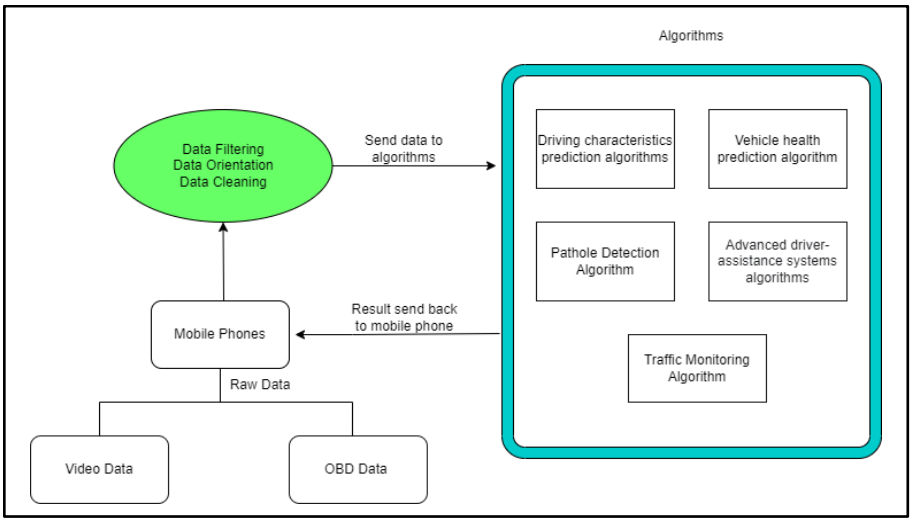
- OpenCV is a comprehensive open-source library for computer vision, machine learning, and image processing.
- OpenCV can process images and videos to identify objects, faces, or even the handwriting of a human.
- OpenCV is a completely free programme.
- In our case, for the detection of pathoholes and for detection of objects like cars, motorcycles, peoples to analyze traffic, OpenCV library plays a very important role.

CV2

- OpenCV has a function to read video, which is cv2.
- cv2. The imread() method opens a file and loads an image from it.
- This function produces an empty matrix if the picture can't be read (due to a missing file, insufficient permissions, or an unsupported or incorrect format).

System Design:-

Data Flow Diagram:-



Implementation:-

Data Gathering

We are collecting raw data from two sources. The first one is using the OBD port of the car to collect vehicle acceleration data and the second is a smartphone which is used to collect the video data for image processing.

Data Collection & Storage

The data that is collected for the OBD port is saved in csv format in various categories for cleaning and preprocessing. The data that is collected from smartphones is stored locally and is separated frame by frame in order to pass it for image processing and training.There are errors, omissions, and discrepancies in the raw data. It necessitates modifications following a thorough examination of the completed questionnaires.

Data Analysis and Processing

Data Preprocessing could be a technique that's accustomed to convert the {raw knowledge|data|information} into a clean data set. To put it another way, anytime data is received from several sources, it is acquired in a raw format that makes analysis impossible. We are utilizing mobile sensor information along with OBD data to build ML and analytics model. For the analytics part, data is collected from the OBD module from which we will select the suitable parameters for our applications. The data that has been filtered is passed to the modules to train them.

Data Display

After passing the data to our modules the resulting numbers will be displayed on the smartphone.

Result:-

The algorithms that we use to process the data collected from the ports and smartphone gives us accurate location of path-holes, the location of traffic, it shows us the severity of turns and what speed to maintain for safe turning, and it gives us the characteristics of the driver for better vehicle efficiency.

Future Work:-

- The model used in the project will be trained as it will be used more in future. The more it gets trained, the better results we may obtain, so as to be more accurate.
- This feature can be used as a regular side gear in vehicles in future so as to avoid heavy traffic but primarily potholes.
- This may give users correct indications about the pothole or similar kind of anomalies on road; the user can slow down or drive carefully according to the instructions received from the model.
- The research based

Conclusion:-

This project focuses on providing users with useful data to improve their driving characteristics and eventually the health of their vehicle. It also detects the potholes on the road, the traffic, and sharp turns. The above features are plotted on the map for user's help. The detection of the above features depend on the real time data as more historical data is obtained, the system's accuracy improves.

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