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On Board Diagnostic System

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Abstract**—** Automobile manufacturing industry is an everdeveloping industry driven to satisfy consumer's needs focusing on key factors like performance, comfort, luxury, eco-friendliness and most importantly driver and passenger safety. Driver profiling in modern times is a decisive and convenient method ensuing driver and passenger safety. This project offers a knowledge base outline to the consumer for On-Board Diagnostics (OBD) and Driver Profiling. On-Board Diagnostics assists the user in car maintenance by enlisting Diagnostic Trouble Codes (DTC) from the car's Engine Control Unit (ECU) using an Android application. The second aspect of this project, i.e. to profile the driver's behaviour is proposed in two different approaches, offering mathematical, visual and analytical analysis of consumer's driving behaviour. A simple, immediate and cost-effective approach to profile driver behaviours using GPS co-ordinates is accessible on the same Android application proposed for On-Board diagnostics. An alternate detailed, novel approach to profile driver behaviour is based on car engine parameters such as Engine speed/rpm, Vehicular Speed, Engine load & Throttle valve; is modeled using Data Analytics & unsupervised Machine Learning techniques. Key Words: On-Board Diagnostics (OBD), Diagnostic Trouble Codes (DTC), Driver behaviour Profiling, Risk Score, K-means clustering, Elbow method, Machine Learning, Data Analytics.

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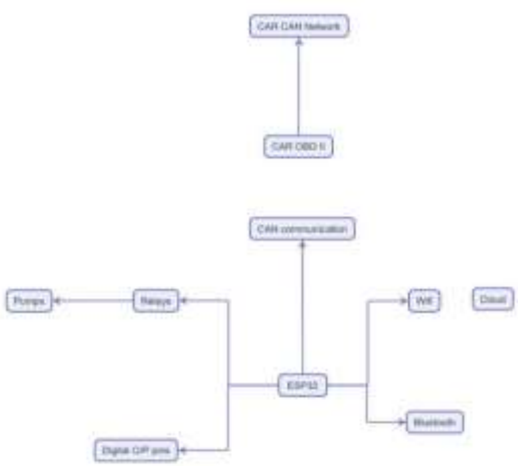
Introduction

Car diagnostics is carried out by various leading car manufacturers like Toyota, Hyundai, Maruti Suzuki and Renault for their customers at their respective service centers[2]. The fault codes help service technicians to understand the condition of the various parts of the Engine using their On-Board diagnostics tool[3]. Our project provides a tool to the user to individually track and monitor the condition of the vehicle's ECU using an Android app[3]. Driver profiling is an essential modern commodity useful in categorizing an individual based on their driving behaviour[4]. Driver safety is one of the most critical but under looked aspect in India[5]. Indian roads are considered to be one of the most dangerous roads around the world and a lot of lives are lost due to negligent driving[2]. Out of all the vehicle accidents, 78% of these accidents occur due to driver's negligence like distraction, rash driving and over speeding[1]. Driver profiling measures an individual's attitude towards driving, it provides excellent insights into the risk posed by drivers[4]. Driving behaviour data is based on on-board sensors installed by car manufacturers to monitor speeds, accelerators, harsh deceleration, abrupt lane change, travel time etc[1]. Our project provides a tool to the user to interpret the risk in the user's driving behaviour resulting in an accident[2].

Figures



Detail description

SYSTEM MODULES

A basic OBD system consists of a central system, a network of sensors, a connection point and indicators, creating a complete monitoring system with standardized access and readability. The OBD system consists of the following components:

- **ECU:**The central part of the OBD system is the Electronic Control Unit, or ECU. The ECU collects input from various sensors throughout the vehicle. The ECU then uses this data to either control parts of the vehicle, like fuel injectors, or monitor for issues.

- **Sensors:**There are sensors throughout vehicles covering every area from the engine and chassis to the electronic system itself. Each one of these systems sends codes to the ECU, specifying the source and the parameters of the signal. The ECU then "reads" and interprets this signal.

- **DTC:** If a sensor sends information to the ECU that falls outside of the normal range, the ECU saves the information as a code called a Diagnostic Trouble Code, or DTC. The DTC code essentially is a list of letters and numbers, which indicate the source and nature of the problem. DTC codes are usually standardized but may be manufacturer-specific. When a DTC is saved, the ECU sends a signal to your indicator light to state that a problem has been found. The DTC can also be pulled by linking a sensor to the connector for the OBD system.

- **MIL:**When the ECU collects a DTC code, it sends a signal to the vehicle dashboard to turn on the appropriate indicator lights. These lights, known formally as Malfunction Indicator Lights or MILs, provide an early warning system for vehicle malfunctions. Generally speaking, if the light turns on and stays on, the problem is minor. If the light flashes, the problem is urgent.

- **DLC:**

All of the data and DTC codes collected by the ECU can be accessed via the Diagnostic Link Connector or DLC. The DLC port is the point of access for vehicles with OBD systems and is often found beneath the dashboard on the driver's side of the vehicle, though it may be located elsewhere in commercial vehicles. Current vehicles are made with a standard OBDII system so that any scan tool with a type 2 cable can connect to the type 2 connector.

History of OBD

1. OBD-I

The first OBD systems were proprietary in nature, so they differed between manufacturers. Prior to 1990, the codes, systems and information gathered by each OBD system varied widely from manufacturer to manufacturer. While these systems proved useful, they were unnecessarily complex for technicians to work with — technicians had to purchase a new tool and cable for every vehicle make or had to invest in a scanner that had an array of adapter cables for multiple vehicle makes. Due to the proprietary nature of these systems, users were often forced to go to dealership technicians to diagnose issues.

The push to standardize OBD systems didn't start until the California Air Resources Board mandated OBD capability in all cars in 1991. The board didn't issue any standards for these OBDs, however, causing increased difficulties for vehicle manufacturers and users. When the OBD-II standard was implemented in 1994 in response to this need, all previous forms of OBDs were retroactively classified as OBD-I systems.

2. OBD-II

In 1994, the California Air Resources Board issued OBD-II as a set of standards for OBD systems for all vehicles sold in California. This mandate was officially implemented in the 1996 model year and has been in use ever since. The Society of Automotive Engineers and the International Standardization Organization, known as the SAE and ISO, respectively, also issued standards for how digital information should be exchanged between ECUs and a diagnostic scan tool. The EPA further expanded the use of OBD-II following the passage of the Clean Air Act — as of 2001, 33 states and local areas require regular vehicle inspections to ensure that they meet emission standards, and OBD-II systems are a key part of these inspections.

The OBD-II standards are characterized by several requirements, including the following:

- **OBD-II Connector:** Modern OBD systems use standardized DLCs called Type 2 Connectors. This allows technicians to use the same cable, a Type 2 Cable, to access the digital communications stored in the OBD system through a port. The location of this port is not standard, but it is usually located under the dashboard on the driver's side of the vehicle.
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- **System Monitoring:** The EPA requires that OBD systems monitor problems that affect vehicle emissions. Many systems look into other metrics that are not included in this scope as a way to make it easier to find and fix vehicle issues, but the minimum requirement is set.

With this set of standards in place, technicians can service a wider variety of vehicles quickly and easily without the need for manufacturer-specific tools

Conclusion

An efficient PHMS is developed to monitor the up to date status of the patient irrespective of the presence of the doctor. The system collects information like temperature, blood pressure and pulse rate of the patient and updates the same to the doctor. The system is evaluated experimentally and collected the sample data of ten patients to verify the status of patients. The doctor can monitor the progress of patients' health now and then to advise them about their health.

This project describes about On-Board Diagnostics and Driver Profiling to the user. The project proposes the use Fig- 10: Visual Interpretation of Driving Profiling Fig- 11: Driver Score obtained through Analytical Analysis of an Android application to fetch and display the Diagnostics Trouble Codes (DTC) from the car Engine Control Unit (ECU) and thereby facilitates self-car maintenance. The proposed android application processes hexadecimal data of the DTC stored in the car ECU and presents them in a user-readable manner to the user. The proposed android application is also capable of providing a simple, immediate and cost-effective profile of the driver's behaviour. This proposed method is by means of tracking GPS co-ordinates of the moving car resulting in a Driver Score. The Driver Score defined as the probability risk of the driving behaviour leading to an accident for the observed trip for this approach. This project also proposes an alternate, detailed and novel approach to profile the driver visually and analytically using Machine Learning and Data Analytics techniques. The proposed driving behaviour analysis method utilizes OBD interface to collect a number of critical driving operation data, i.e., vehicle speed, engine speed (RPM), throttle position, and calculated engine load. The driver behaviour is profiled visually using K-means clustering algorithm along with the Elbow method to engine speed and vehicular speed. The visualization assists the user to interpret bad driving behaviours. The driver's behaviour is profiled analytically by setting thresholds to engine speeds, throttle valve and engine load resulting in a Driver Score. The Driver Score is defined as the percentile of bad driving behaviours over the observed period. The results from all the proposed approaches assist the user in On-Board Diagnostics & Driver Profiling.

Applications:

Maintenance: This application helps an individual to maintain their automobile on a regular basis and to be independent of a mechanic. The vehicle owner can understand minor glitches in the vehicle and can thus avoid frequent visits to a mechanic for petty issues saving both money and time. With basic knowledge to troubleshoot minor issues, the user can themselves patch it up preventing unnecessary expenditure. » Driver profiling: This application helps in measuring the number of acceleration, braking and turning events conducted by a driver, as well as the severity of the events and the distance travelled, Results are achieved through the collection of data from the vehicle, which allows us to build a detailed picture of which drivers need to improve their performance.

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