The Transporter

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## **Abstract**

Commute is a part of people’s daily routine which gets least attention. With the rapid increase in the number of cars on Indian roads, proper maintenance becomes a necessity. A car can give us a lot of data, but not information that a common man can understand. With this current boom in software-based service sector, other parts like transport and logistics are often forgotten. We propose an idea to overcome these challenges. Our idea is based on OBD (On-Board Diagnostics) scanner-cum-Bluetooth device which relays real-time sensor information including speed, acceleration, and fuel usage to a smartphone which in turn sends it to cloud services which analyse the data and suggest driving behavioural changes, predict and help diagnose faults, prevent impending breakdowns, analyse road conditions and predict the best route to save money and fuel, all with the power of different computing techniques and machine learning algorithms implemented on these data on the cloud. This can be implemented alongside with other fleet management systems already being used by the transport and logistics sector to improve their services. With large amount of data coming in through fleet management systems, there won’t be a shortage of data.

## **Background of the Problem being solved**

Is it possible to improve the daily commute of the people, and thereby reduce fuel consumption, traffic congestion, and pollution and increase the efficiency of existing systems? Or to monitor the performance of a car very closely and prevent a malfunction even before it happens? And even go on to pick the best route to a destination considering not just the traffic but also the road conditions?

These questions form the main background of our problem statement. Our daily commute remains to be a daily routine without much thought being given into it. We use our car daily without looking at the warnings and are tired of approaching the authorities for better roads. It’s time to optimize our route plan to choose the road in best condition. Even with the advent of many Fleet Management Systems, monitoring the health of each of its vehicles remains a challenge. Some existing systems provide parameters for vehicular health management, but monitoring and analysing these data requires knowledge and remains a challenge.

We propose our idea by keeping these problems in mind.

**Overview or Schematic of the Solution Proposed** image01.png

The above schematic represents the top level communication taking place between devices. OBDs read data from the vehicle and send them to smartphone from where it is sent to the cloud and processed using optimized machine learning algorithms. The results are sent back to the phone from which the user is informed about the processed information. In future through proprietary OBDs we communicate directly to the cloud without any smartphone with all the required devices integrated inside an OBD.

## **Prior Art**

* [Getting Data from OBD](https://en.wikipedia.org/wiki/OBD-II_PIDs) – This link shows that data can be procured from an OBD device
* MacQueen, J. B. (1967). *Some Methods for classification and Analysis of Multivariate Observations*. Proceedings of 5th Berkeley Symposium on Mathematical Statistics and Probability. University of California Press. pp. 281–297 (K-Means Clustering algorithm - [link](http://projecteuclid.org/download/pdf_1/euclid.bsmsp/1200512992))
* Cortes, C.; Vapnik, V. (1995). "Support-vector networks" - [link](http://link.springer.com/article/10.1007%252FBF00994018)
* [Speed Breaker Detection](https://www.iiitd.edu.in/~skkaul/Papers/nsdr12-final11.pdf) – This link gives an idea about detecting bumps on roads
* [EcoDrive](http://www.sigmobile.org/mobicom/2015/papers/p358-kangA.pdf) : A mobile sensing and control system for driving fuel efficiently
* Estimation of fuel consumption using in-vehicle parameters ([link](http://www.sersc.org/journals/IJUNESST/vol4_no4/3.pdf))
* In future we would like to implement these features by tapping information from the CAN port directly as this would help us extract more technical data from the ECU. This paper is focused on OBD vs CAN. It tells that OBD is cost effective than using CAN directly, but the amount of information we could tap is more by using CAN. *ICT in road vehicles - Reliable vehicle sensor information from OBD versus CAN* ([link](http://ieeexplore.ieee.org/xpl/login.jsp?tp=&arnumber=7223296&url=http%253A%252F%252Fieeexplore.ieee.org%252Fxpls%252Fabs_all.jsp%253Farnumber%253D7223296))
* A paper on Gear shifting- [Link](https://drive.google.com/open?id=0B7uyFMy9sqHvWF9jRW9ldDU4QVE)

## **Novelty of the Proposed Idea**

Many fleet management system and vehicle management services exist already, but our model differs from these existing services in the following ways:

* We use optimized machine learning algorithms to extract every possible information from the data we collect from OBD and smartphone
* Most of the apps directly use Google Maps™ to provide the best route, but we use a different concept. We fragment the best possible routes given by Google into a number of legs. We then try to detect the road condition using the data collected from the people who have travelled in that particular leg for the past hour. We generate a score based on the road condition. This score is multiplied with the road distance of each leg and finally they are summed up to give out a road score. The route which gives the least road score will be the best route for the current hour.
* Fault detection: We don’t just give out the error codes nor their descriptions but we try to narrow down the problem by matching the error codes and suggesting the user that the problem might be due to this specific part of the vehicle.
* We try to save every drop of fuel in all possible ways we could, by warning the users to slow down before a break to avoid unwanted acceleration, suggesting drivers to improve their driving behaviour by reading their driving patterns, telling them to shift the gear at the right time, giving suggestions to reduce the idle time and much more.
* Our service is built not only for individuals but also for fleet managers. Our service can combined with a fleet managing system to make maximum profit for owners and their employees. The above proposed ideas apply to each and every vehicle in the fleet.

**Proof of Concept Studies - Simulation**

The below given links shows the simulation of above mentioned concepts.

* Road Condition Detection and Speed Breaker Detection – [Link](https://drive.google.com/file/d/0B22DNqcurXEwSnVnUkU1ZDAzT3c/view?usp=sharing)
* Best Route calculation – [Link](https://drive.google.com/open?id=0BycMB_n4CcSTVmdHVzdpUW1acW8)
* Gear Shifting – [Link](https://drive.google.com/open?id=0BycMB_n4CcSTSl9Gc0VGZWtyQkk)

## **Value Proposition from the Conceptual Study**

We use Machine learning algorithms to detect the road conditions based on the data collected from people who used the road for the past hour. A normalized score is generated based on the road condition. The routes provided by Google Maps™ are evaluated using our algorithm which provides a normalized score for each of the routes. Using this score the user is assigned the best route. Gear shifting algorithm is employed by using the current gear, speed, engine rpm and throttle position obtained from the OBD. It tells the user to shift the gear at the right time and warns him in case of gear mismatch. A speed breaker detection algorithm based on Machine learning is used to detect speed breakers and warn users beforehand. The app studies driving behaviour of the driver and suggests things that can improve driving and at the same time increase fuel efficiency, decrease risk etc. We have a database of error codes which is collected from the internet. We use Natural Language Processing to narrow down the cause for a set of error codes and suggest the user to check the corresponding component. Messages can be broadcast to vehicles travelling on a particular route in case of any emergency. Shown below are some of the existing services:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Services currently in Market** | **Fleet Management** | **Individuals** | **OBD** | **GPS** | **Special Algorithms** | **Advantages** | **Disadvantages** |
| Fleetio | Yes | No | No | Yes | No | Only Shows Statistics of the Fleet. Ex Fuel Cost | Does not tell the user how to increase the efficiency |
| Automatic | No | Yes | Yes | Yes | No | Shows Statistics and at the same time Detects the impending errors in the vehicle | It does not show the best route and is only dependent on OBD values. |
| Transporter (Our Service) | Yes | Yes | Yes | Yes | Yes | --See Below-- | --See Below-- |

The main idea is to design a service that focuses on all vehicle users irrespective of whether they belong to an organization or an individual vehicle owner. Best routes are suggested depending upon real time traffic and road conditions that are collected from other users. Unwanted fuel wastage due to acceleration at the wrong time or due to sudden brakes is also minimised. Driving behaviour of the driver is studied and improvements to be made are suggested. Impending vehicle breakdowns are identified and suggested to the user, saving time and money. Additional fleet statistics is also provided to organizations.

## **Technical Risk Assessment**

Although OBD II Scanners are available widely in markets, there are many clones which are sold by reproducing the original microcontroller's code [ELM327]. These clones are sold at cheaper rates and they may not provide exact results for analysing and processing OBD information. This could lead to wrong output data, as these clones are often error-prone. The user must take care while buying products and making sure that it is genuine ([Source](http://en.m.wikipedia.org/wiki/ELM327))

Another potential problem that could arise from OBD Scanners which use Bluetooth interface for sending data to the smart-devices is that it could interfere with the vehicle's Bluetooth enabled entertainment systems (such as music players, phone calls synced to the Bluetooth of the device]. A solution for this problem is to use OBD Scanners with a Wi-Fi interface for connectivity. This could avoid interferences from the OBD and the vehicle's communication system.

In order to acquire vehicle statistics, the OBD Scanner is indispensable. Without it, the whole idea is rendered useless.  The scanners can be easily bought online via online vendors at a nominal price.

OBD Scanners, even though they extract a lot of data about the vehicle, lack the ability to obtain exact values from the CAN (Controller Area Network). The FMS standard CAN interface can be used as an alternative for OBDs.  They extract raw data in the form of voltages directly from the CAN. FMS CAN bus provides more accurate data and have faster refreshing rates. They can be used in large firms(like taxi-service firms, commercial entities, etc.) which need more precise statistics about their vehicles' performance such as fuel-levels, tachograph information, GPS integration, engine coolant temperatures, etc. FMS CAN bus could prove expensive and is designed for large industries, corporations, etc. For individual use, just an OBD Scanner will be sufficient.

The smart-device is the interface for receiving the data and displaying it to the user. It would have to retrieve data from cloud servers for processing the data. This could significantly drain the battery of the device. A suggestion is to the charge the device via the car's USB charger.

Some data are processed based on past information made available from other users' devices. This could lead to inaccurate results. It can be solved by filtering information from a very recent point of time. The best possible result can be obtained in this way.

Finally, for suggesting best routes, an active internet connection would be required as it is necessary for getting real-time data from the servers. Hence, without it, a part of the whole idea becomes useless.

**Commercial Feasibility Studies**

The cost and commercial feasibility studies are based on the primary IoT architecture:

**Devices:** ODB II scanner for the vehicle (preferably ARM based with Wi-Fi) – approximate cost: Rs.1400/-

**Network – Cellular data usage**: Usage ranges from 1MB to 3.5MB per day (on an average) and a maximum of 5MB. The cost is very minimal although not negligible.

**Cloud**: Data storage, analysis and processing - billing & subscription, security, authentication and authorization (Infrastructure as a service IaaS).

**Application:** App development for various platforms and its maintenance

The fixed costs are device cost and initial cost to set up the platform on the cloud. Variable cost include other overhead costs including subscription cost for using cloud services. When rolled out on a large scale, the costs can be cut down to a large extent. To manage enormous amount of data on the cloud when the number of users increase presents a challenge, which can be overcome by tie-ups with device vendors and online service providers.

The smartphone application is available free for a month on trial basis. After which an optimal amount is charged as annual subscription charge in order to meet the cost requirements of the cloud services and maintenance of the app and for the business to break even with the required profit.

Any surge in the number of users can be managed easily, for the cloud services are capable of handling several multiples of the current number of estimated users.

## **Plan for Incubation**

With the incubation grant, our first goal is to meet with industry experts to know more about OBD, the data that comes out of it and the information that can be derived out of the data. Help will also be sought for the implementation of machine learning algorithms for selecting the best algorithm and for optimisations. There are many OBD Bluetooth devices already present in the market. But many of them do not support Bluetooth LE™. Also, they have very slow scan rates. So, we will design our own OBD scanner for customers who expect more. It is best to include a GPS tracker into it so that less energy will be consumed from smartphone. Since the use of Bluetooth can hinder with in-car entertainment system, a Wi-Fi enabled OBD scanner will also be developed. The machine learning algorithms will be implemented on Microsoft Azure™ with heavy code optimisations. So, a license to use the service will also be bought.

Our business model will be two-forked: one for individual customers and another for Fleet Managers. Individuals are allowed to buy any OBD scanner either from market or our proprietary scanner. Fleets will be advised to buy our proprietary scanner. Fleets will be provided help to integrate our service into their existing fleet management systems. For individuals, our payment method will be subscription based. For fleets, the payment method can be negotiated.

In a minimum span of 10 – 12 months, we will be able to move from developing phase to marketing phase. For easy adoption of our idea, we plan to have tie-ups with car manufacturers and showroom owners to distribute our app along with an OBD device. We will pitch our product to existing fleets and based on their reviews, further necessary changes can be made.