Calculating discount on premium for car driver using Rashness Index Calculator

Chirag Mandot[1], chirag_mandot2000@yahoo.com
Vinit Muchhala[1], vinitmuchhala@gmail.com
Disha Kanabar[1], dishakanabar08@gmail.com
Abhijit R. Joshi[1], abhijit.joshi@djsce.ac.in,
Stevina Dias[1], stevina.dias@djsce.ac.in
1 Information Technology, D.J.Sanghvi College of Engineering, Mumbai

Abstract— - Usage Based Insurance (UBI) project focuses on computation of car insurance policy based on the driving behavior. Under this system, the premium of the insurer is computed on the basis of the driving patterns which are calculated with various parameters ranging from miles driven, average speed, fuel efficiency, hard brakes and many such deciding factors. If the driver maintains car with desired speed, travels less distances then accordingly the premium value is discounted and hence benefits the user. Further, it convinces the insurer to avail the opportunity, drive safe and efficiently and therefore, serves a social purpose. The system is further aided with the Telematics system. Telematics helps to transmit data to the server and back to the device, and hence assists in the transfer of required data and making the system broad and fast-track. The GPS system enables route information and serves in figuring intricate details about driving patterns like road taken while travelling and speed on the particular kind of road. There are various challenges which are encountered like privacy intrusion, the electronic premium payment and proposing a system in different governance. Considering feasibility in such system which will be taken care of with alternatives like flexible agreement plans, standard and reliable payment option and acquainting users with the importance of the system. Usage Based Insurance is an integrated system where amalgamations of various technologies like different sensors for taking inputs, Net beans Studio using Java Swing for user interface, OBDII port collecting car inputs and Windows core i7 processor are combined and a sophisticated system for new generation drivers will be made and presented to the users.

Index Terms— Pay-as-you-drive, OBD II port, Usage Based Insurance, Driver Rashness, Dynamic Premium, Car Insurance, Value Added Services of Car, Global Positioning System

1. INTRODUCTION

Usage based insurance (UBI), also known as pay as you drive (PAYD) [1][7] and pay how you drive (PHYD) and mile-based auto insurance is a type of automobile insurance whereby the costs of motor insurance are dependent upon the type of vehicle used, measured against time, distance, behavior and place. This differs from traditional insurance, which attempts to differentiate and reward "safe" drivers, by giving lower premiums and/or a no-claims bonus. However, conventional differentiation reflects history rather than present patterns of behavior. This means that it may take a long time before safer (or more reckless) patterns of driving and changes in lifestyle feed through into premiums. We have to make the insurance policy where the premium will be determined dynamically and will make real time user experience.

The core research of improving the car services and providing better experience on the driver's end is conducted by large scale companies. The names include EMB America, Cognizant [8] and a few more and this task has also been undertaken by US Department of Transportation Federal Highway Administration. The features were to introduce a dynamic system, a better analysis of the driving behavior and provide with discounts on premium [9].

The project holds a wide scope for the coming generation as it makes the user experience more comfortable, processes data fast and gives relevant output on the screen.

2. OUR APPROACH

UBI project aims at providing a better and dynamic insurance policy as compared with the present static policy where the premium varies as per the driving behavior of the user. The project aims at making software which takes inputs from the car via On Board Diagnostic (OBD) port and the installed Global Positioning System (GPS) and accelerometer through Android cell phone. The OBD II sensor has been of great use for many purposes like car repairing, car monitoring and in a way to understand your car better [5]. The inputs derived from the devices includes the speed of the car, the fuel level of the car, the frequency and magnitude of braking of the car, the position of the car on the map, the road type, the time of driving, the duration of the drive and sharp turns.

Based on these inputs, a classification is done which decides what type of driver is it, whether it is a safe driver, a harsh driver or a moderate driver. After calculating the driver type the corresponding discounts are offered to the policy holder, maximum being the pre decided premium. We conducted various literature surveys to come up with conclusions on

varied aspect as the User Acceptance Ratio [2], Expenditure incurred on different parameters of car, Accidents based on distance and based on age of the driver, and the road type [3] [4]. We found that users are eager to accept the system which will fetch them a series of benefits. Further, the acceptance ratio got support from the other surveys like the actual expenditure will be reduced by the implementation of such a system. The accident rate will also come down if such kind of system is implemented. The literature survey depicts that the need of the system in India is large as per the accident ratio, the growing number of the car users and need of comfort driving experience. The survey took into account various drivers like personal car owner, taxi agencies, insurance agencies and the overall results were positive. The doubtful factors were the large scale implementation and distribution of the device. The literature survey was conducted by asking a questionnaire [6] with the priority or importance of each question mentioned besides it, which is as follows:

1. Prioritize the parameters regarding their importance, in descending order. (High priority)
2. Would you like to suggest any extra parameters? (High priority)
3. According to you, what is the feasibility of this project, keeping in mind that similar projects were a huge success in other countries when they were first unveiled?
4. What do you think about the teen driving program?
5. Would you consider sharing your location data with the device, an invasion of your privacy? Keeping in mind that, the location will only be transmitted to the insurance company in an event of a theft, otherwise it will just be used by the device for computational purposes and will not be transmitted to the insurance company under any other circumstances.
6. Would you rather take daily reports about your driving, like fuel efficiency, miles driven, average speed, time driven, etc. owing to the additional cost on your behalf, or rather take the monthly reports?(optional)
7. Considering all the features are you ready to pay extra cost for your insurance policy?

Based on the survey we can easily show the evolution of the system and the characteristics of the proposed in the Table 1.

TABLE 1
COMPARISON OF DIFFERENT EXISTING AND PROPOSED SYSTEM

	Traditional System	**Odometer Audit**	**Incentive based approach**	**GPS based PAYD**	**Proposed system**
Mobility based premium	Not possible	Possible	Possible	Possible	Possible
Infrastructure cost	None	Low	Medium	High	High
Privacy invasion	Low	Low	Medium	High	Flexible
Time of day risk assessment	Not possible	Not possible	Possible	Possible	Possible
Road based risk assessment	Not possible	Not possible	Not possible	Possible	Possible
Condition based risk assessment	Not possible	Not possible	Not possible	Not possible	Possible
Actuarially accurate	Inaccurate	Slightly better than classical insurance	Slightly better than odometer audit	Slightly better than incentive based	Better than existing system

Fig. 1 illustrates the basic model of UBI system. The proposed design takes real time input data which received from sensors and OBD port. The parameters which are obtained are specified. The system performs mathematical computations and stores and retrieves data from the databases. The final output generated consists of the premium charged on the user and to assist user with better driving experience various value added services are offered. Our implementation adapts with the situation in the country, provides features as per the city's requirements and runs along with its insurance requirements. We have included various value added services like monthly report for driver along with the ways to improve the driving pattern, automatic accident updates, speed suggestions as per the road type, and other features. The system depicted here gives the reader a complete idea of the concept, whereas in actuality few features have already been implemented by companies.

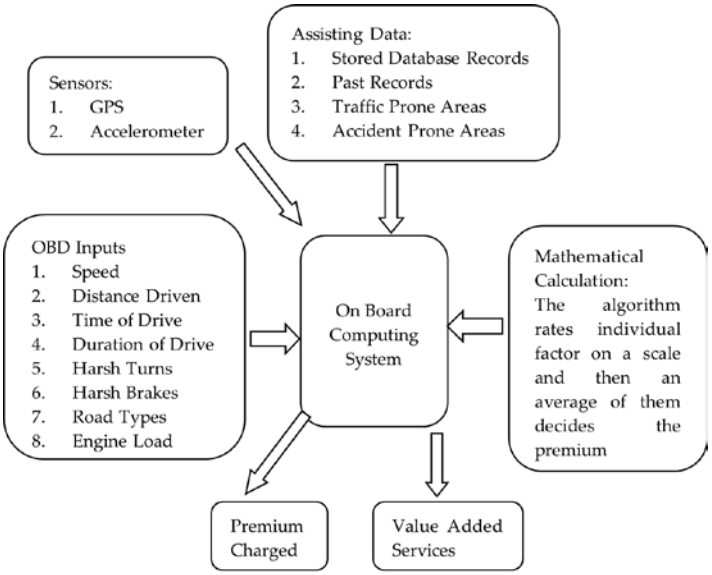

Fig. 1: Model of UBI System

3. WORKING OF THE SYSTEM

The working of the system is divided into different parts depending on its interfacing. For the time being the project is implemented on portable laptop and can be easily converted into any portable device. The various steps needs to perform to make system in working are as follows:

A. OBD - II Interfacing

The software used for interfacing is Net beans and the language used is Java.

B. User Interface

The user interface is the output which will be displayed to the user while he/she is driving. It will display all the relevant information and rating of the driving behavior. Figure 2 shows a screenshot of user interface.

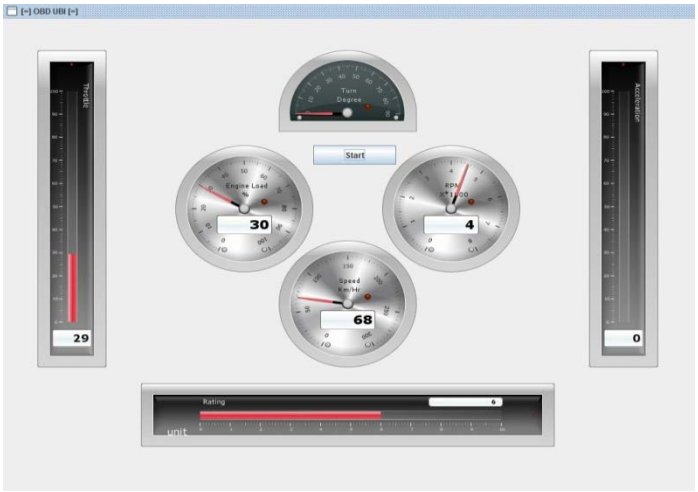

Fig. 2: Screenshot of User Interface

The user Interface displays all the information and the user rating. The simplicity of the display helps in faster and efficient retrieval of the data. The speed column displays the speed of the car in km/hr. The distance driven shows the distance the car has driven till now, the location gives the current position of the car. Here, the location is 'Khar' but in the calculation the current road type is taken into account. The number of hard brakes reduces the efficiency of the driver, here the number being 21 times. The time gives the start and the end position of the car. Therefore as of now the car has been driven 12 hours and hence it's bad for the driver to continue to drive for so much distance. The fuel efficiency shows how much the car is deviating from the average car fuel efficiency. Here it is +2 which is good. After the calculation the driver rating is displayed which is 8/10.

C. Database Optimization

As the car generates data every quarter of the second, we extract data every second and insert it into MS-Access database. After 1 minute all the generated data is used to calculate the driver rating and inserted into another database and the current data is deleted. Similarly the same process is carried out every hour and then for the whole day. This way all the information is generalized and conclusion is drawn and the extra data is deleted to conserve memory.

D. Android GPS and Accelerometer Interface

The sensors such as GPS and Accelerometer have been implemented using an Android phone in the initial state. For the large scale implementation the sensors will be replaced with actual independent GPS and Accelerometer sensors.

E. Algorithm (Rashness Index Calculator)

The algorithm decides the type of driver. The classification of some of the parameters is as follows which are based on the series of test runs conducted by us in the car.

Speed

At every second we will take Speed of the car (which will vary according to rainy, winter and sunny season)

Average speed of car as per road type (a → 60km/hr-city free road, b→ 35-40km/hr-busy road and c→80km/hr-highways)

Speed Rating=10 for above condition

=8 if a= 60-70, b=40-50, c=80-100

=7 if a=70-80, b=50-60, c=100-110

=6 if a=80-100, b=60-80, c=110-130

=5 if 100 and above, b=80 and above and c= 130 and above

Distance Driven

In city

If DD 30-40 DD Rating=9

If DD 40-50 DD Rating=8

If DD 50-60 DD Rating=7

If DD 60-70 DD Rating=6

If DD 70-80 DD Rating=5

On Highway

If DD 80-100 DD Rating=9

If DD 100-200 DD Rating=8

If DD 200-300 DD Rating=7

If DD 300-500 DD Rating=6

If DD 500-700 DD Rating=5

Harsh Turns

The turn will be harsh if the angle is above 45 degree and speed is above 25 km/hr.

Therefore,

Harsh turns per drive,

If Harsh Turns = 5 or less; Harsh Turns Rating=9,

If Harsh Turns = 8; Harsh Turns Rating= 8,

If Harsh Turns = 10; Harsh Turns Rating=7,

If Harsh Turns =12-15; Harsh Turns Rating= 6,

If Harsh Turns =15; and above Harsh Turns Rating=5

Harsh Brakes

The braking will be harsh if the acceleration will be above 6 m/s^2.

Therefore,

Harsh Brakes per drive,

If Harsh Brakes = 7 or less; Harsh Brakes Rating=9,

If Harsh Brakes = 10; Harsh Brakes Rating= 8,

If Harsh Brakes = 12; Harsh Brakes Rating=7,

If Harsh Brakes =14-17; Harsh Brakes Rating= 6,

If Harsh Brakes =17; and above Harsh Brakes Rating=5

RPM (Revolution per Minute)

If RPM < 1000, RPM Rating=10;

If RPM = 2000, RPM Rating=9;

If RPM = 3000, RPM Rating=8;

If RPM = 4000, RPM Rating=7;

If RPM = 5000, RPM Rating=6;

If RPM = 6000, RPM Rating=5;

Throttle

If Throttle = 5-18, Throttle Rating=10;

If Throttle = 19-33, Throttle Rating=9;

If Throttle = 34-47, Throttle Rating=8;

If Throttle = 48-61, Throttle Rating=7;

If Throttle = 62-66 Throttle Rating=6;

If Throttle = 67-84, Throttle Rating=5;

Engine Load

The average engine load is 40%. The car can sustain engine load till 60-65 percent while driving and hence rating will be 10 for this case. Therefore based on test runs,

If the engine load > 65 and < 70, EL Rating= 9,

If the engine load > 70 and < 75, EL Rating= 8,

If the engine load > 75 and < 80, EL Rating= 7,

If the engine load > 80 and < 85, EL Rating= 6

Hence the basic algorithm is explained.

Final Premium

After getting all the rating we will calculate the driver rating daily basis. Suppose the premium is 500 Rs, if the rating is 5, then the user will have to pay the whole sum

If rating is 6 then 5% discount

If rating is 7 then 10% discount

If rating is 8 then 15% discount

If rating is 9 then 20% discount

If rating is 10 then 25% discount

Hence the algorithm is explained.

F. Implementation

First a connection to the OBD II device was made through serial communication, then communication with accelerometer was established through java socket connection. The following components were integrated together:

OBD II connection: The OBD II device operates over Bluetooth. It creates Serial Connection over Bluetooth Link so communication with the OBD II can be done serially, in this case "COM11". OBD II device responds to specific commands. This command is the combination of mode and PID. The mode underlines the type of data that is requested. For example, Live Data, Freeze Frames and the PID are unique ID given to an attribute, namely, Speed and Engine Load. Table 2 shows OBD PIDs.

TABLE 2
OBD PIDS

Mode (Hex)	PID (Hex)	Data Bytes Returned	Description	Min Value	Max Value	Units	Formula
01	04	1	Calculated engine load value	0	100	%	A*100/255
01	0C	1	Engine RPM	0	16383.75	rpm	((A*256)+B)/4
01	0D	1	Vehicle Speed	0	255	Km/h	A
01	11	1	Throttle Position	0	100	%	A*100/255
01	1F	1	Run time since engine start	0	65535	sec	(A*256)+B
01	31	1	Distance Travelled since codes cleared	0	65535	Km	(A*256)+B

The OBD II returns hexadecimal values. These values are required to convert into decimal values.

Accelerometer Connection (android phone): For getting accelerometer values from the android phone, '.apk' application file had to be created that passed accelerometer values when requested. The connection between the android phone and laptop was done through Socket Connection. Android phone was used to create a hotspot, and then the laptop was connected to the same network to enable the socket connection.

The UBI system took the readings from both sources, aggregated the data for 60 seconds and then updated this data into the database.

4. BASIC FEATURES OF UBI SYSTEM

1. Dynamic and Real Time System: Dynamic system refers to a system which changes and adapts according to the use and hence comes up with smarter policies and inputs for the user. For example, in this system if the user wants to switch from a lower risk plan to a higher risk plan, i.e., if the usage of the car changes from less distance traveling to high distance travel, then need for a high risk coverage plan arises, so this concept enables easy switch in mid of the plan.
   Real time System which provides all the important aspects like mileage of the car, speed, fuel usage, idle time and many other important parameters. The attractive feature which it provides is the user interface with a graphical and animated pattern of the car usage and thus aids the user with the overall driving pattern.
2. Traffic Zones: This feature provides the user with the traffic congestion data, i.e., it provides user with the major traffic-hit areas and the time at which the area is unsuitable for driving. Along with the traffic data, accident prone areas will also be notified to the user.
3. Monthly Usage Report: This report provides the user with various parameters which will help the user to keep an account of the pattern and the behavior of driving. The basic parameters which will be provided are distance driven, mileage, time of driving, fuel efficiency comparison, speed, hard brakes and cornering, alternate routes (if needed), harsh acceleration, driving in traffic and accident zones, and driving in adverse weather conditions [10].
4. Lost/ Stolen: This feature aids the user with unauthorized access to the location of the car once the user files a complaint of the car being stolen.
5. Real Time reporting of damage: This feature aids the real time accident time, intensity and hence provides the insurance company with the necessary data for further proceedings. Furthermore, this system can detect the failure caused because of internal machine failure, which is not included in the traditional policy. False claims can be detected and hence will be beneficial.
6. Value Added Services: This being the exciting and important feature which provides many value added services which will be implemented in the system according to the user needs and change in the technology. Hence, this feature allows the flexible system which is appreciable to any changes needed. The above mentioned features fall into this category but because of the necessity of the system they are mentioned explicitly [7]. Few of the value added services are listed below:
   a) Assistance in driving to increase mileage
   b) Adjust driving speed as per the road type
   c) Accident zone indication
   d) Indicate adjustment in speed as per the weather conditions
   e) Teen driving program
   f) Traffic alerts
   g) Hospital alert in case of accident
   h) Car clubs
   i) Predict accident intensity

5. CONCLUSION AND FUTURE WORK

The UBI project aims at creating an application which will give a different edge in the driving world and promote safe driving. With taking inputs from OBD port, GPS and Accelerometer sensors various other sensors can be implemented to make the device more general and adaptable according to the scenario. Further, neural network can be implemented to make the system intelligent and think on its own if the same situation arises again and again.

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