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A Machine Learning Based Driver Skill Assist System

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***ABSTRACT:** A driver's driving skill is a key factor for vehicle handling in risk situations. This paper presents an approach to sense the driving pattern on all likes of gear shifting, braking, speed control of the driver alongside the corresponding vehicle's response and is assessed based on pre-defined set of guidelines for an initial period called the "Test phase", of the driver. Then implementing the assessed results as either an increment or a decrement on a gradient scale ranging from 0 to 100, called "Score", the driver is put into either of the two categories "Good" or "Bad". If the driver falls into "Bad" he is instructed on his driving pattern thus providing the instructions about ways of improving his driving collectively called as "Improving phase". Likewise if the driver falls into "Good", the system remains in the "Test phase" until it encounters any change. Further, our system learns about the driver's pattern throughout and uses decision making algorithms to continuously decide the phases and the actions. Thus it improves the driving skill of any person producing more skilled drivers thereby averting accidents and reduces road rush severely.*

***Keywords:** Driver skill assist, machine learning, Markov Decision Process (MDP), Fuzzy algorithm.*

1. INTRODUCTION

Driving is a process that deals with the interaction of the driver with the vehicle amongst a driving environment [1]. The design, build and handling system of the vehicle are not the only prime consent for a good ride but the driver's ability to adapt dynamically to risk situations and prompt decision making are also highly important [2]. Vehicle control cannot be the same always as it has to deal with steering, acceleration, navigation, speed control, proximity with surrounding environment, comfort of the driver and more importantly the braking. These cannot be made as a routine because it takes dynamic approach to react promptly on every situation. Decision making is not a solution but it's a path to the solution but the worst part is some decisions can go wrong and be fatal. Thus the decisions have to be prompt, accurate, feasible and logically correct. Driver's make it possible but not all the time so we make our system to observe the driver in his initial driving and matches his pattern with the predefined set of criteria for proper driving and provides a clear and apt result on how to improve his driving and pin points his fault. This enables the driver to self-assess himself on all aspects of driving.

There is a closely related yet fundamentally different concept, called driving style. Driving style refers to the way a driver habitually drives a vehicle, with the choices of driving speed, headway distance/time, and habitual level of attentiveness and assertiveness. Depending on some qualitative factors driving can be classified into four broad styles as suggested by Taubman-Ben-Ari et al [7].

1. Reckless and careless
2. Anxious
3. Angry and hostile
4. Patient and careful.

These four categories of drivers are distinct in terms of all aspects of vehicle handling but will possess both good and bad habits of driving. Our system will strive to provide a mean pattern for all these drivers thus making the driving a standardised one.

2. POTENTIAL VALUE FOR SKILL ASSIST

There are several facts that prove this proposal to be needy and a creative solution to today's life. Life is completely bound with travel everyday and that makes the proposal to be even more likely to be a need of the hour.

Road rush:

It is a mental stress and agitation ranging from mild to severe during driving that is caused by high traffic, rash or improper driving of other vehicles, frequent honking, indulging in disharmony or conflicts, etc. This stress easily makes to do the same with other drivers and this picks up like a chain reaction. Road rush also results in several personal hazards. Road rush of a driver can lead to,

- Hypertension
- Indulging in conflicts verbally or physically
- Damages to vehicle
- Violation of traffic rules
- Most importantly, road accidents

The reason for this proposal,

Drivers are tested for their driving only once in their lifetime, for the license test [5] [6].

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Usually they are just trained to pass the test so that makes them lack proper driving. There is a saying that "Practice makes perfection", but only the proper practice makes to perfection so if a driver learns driving improperly then it will last with him forever. Even good drivers change into bad and reluctant drivers due to external factors. Thus a harmless self-assessment is needed for any driver to be perfect.

Now with perfect drivers through our proposal we get the following advantages,

- Good drivers make a good driving environment which in turn make travel peaceful.
- Skilled drivers averts major accidents.
- It highly reduces road rush, a problem that bothers almost everyone, everyday.
- There is always a system that is monitoring our driving which in turn gives more attention even in peak hours.
- User manual of every vehicle has proper guidelines for extracting good performance but nobody can remember or follow it every day at every instance but our proposal makes it possible by functioning as an assistant anytime.
- Harmless self-assessment for drivers encourages them to be on the "Good" side.
- Good results make the drivers feel good.

3. PROPOSED SYSTEM

Our system works on three collective steps to provide proper assistance, they are,

1. Sense the driver's driving pattern,
2. Assess the pattern based on existing set of proper driving guidelines and
3. Produce the suggestion as a result.

Driving is sensed on four distinct parameters, they are

1. Braking,
2. Gear shifting,
3. Speed control,
4. Comfort of the passengers

3.1 Functioning algorithm of our proposal

- "Score" – a numeric value in a gradient scale ranging from 0 to 100 used to mark the driver's category and system's phase.
- "Bad" – a category bucket that denotes the driver's pattern to be improper. The "Score" of the driver should be 0 to 50 in order to fall in this bucket.
- "Good" – a category bucket that denotes the driver's pattern is proper. The "Score" of the driver should be 51 to 100 in order to fall in this bucket.
- "Positive" – means an increment in the "Score" as a result of good driving.
- "Negative" – means a decrement in the "Score" as a result of improper driving.
- "Test phase" – a phase activated if the driver is in "Good" bucket and it does not give any suggestions on driving yet gives complements for being good.
- "Improving phase" – a phase activated if the driver is in "Bad" bucket. It gives instructions to the driver on overcoming his fault by notifying beforehand the action to be taken at any instant.

A driver in the "Improving phase" remains in the "Bad" bucket until the simultaneously working "Test phase" detects proper driving from the driver. Proper driving would result in "Positive" thus an increment in the "Score". If the "Score" rises above 50 he will be moved to "Good" bucket and the "Improving phase" stops. Thus this is a continuous monitoring system for making the driver better. The functional algorithm is given in the figure 1.

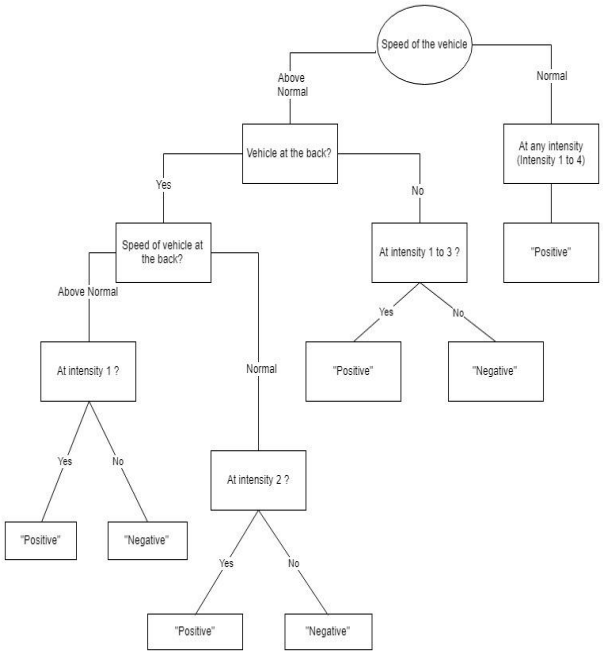

Figure 1: Functional algorithm of our system

3.2 Decision tree for assessment of braking process

The decision tree for braking process is given in the figure 2.

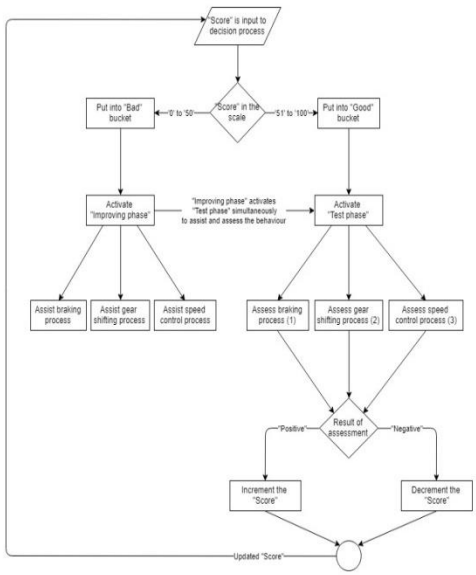

Figure 2: Decision tree for braking process

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3.3 Decision tree for assessment of gear shifting process

The figure 3 describes about the decision tree for gear shifting process.

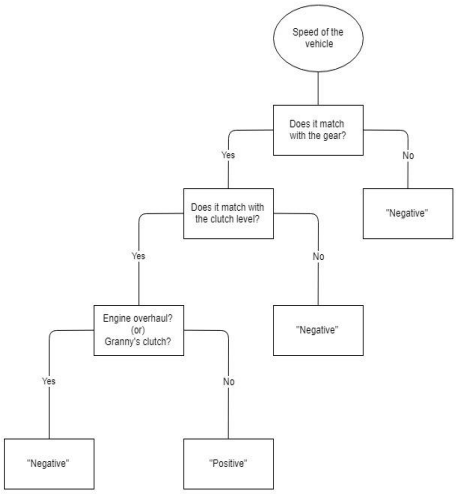

Figure 3: Decsion Tree for Gear shifiting Process

3.4 Decision tree for assessment of speed control process

Using Machine Learning with respective sensors for every parameter the sensing process takes place inside and outside the vehicle. The data is fed in a Hadoop database and fetched onto the decision making algorithm on Python using layers. In the function for decision making,

1. Proper driving pattern
2. Wrong driving pattern
3. Change wrong driving pattern

These are already defined for the decision making to work on the sensed data and match with these and finally produce the output. Based on the continuous results drivers are categorised into any one of the categories. The decision tree for speed control process is given in the figure 4.

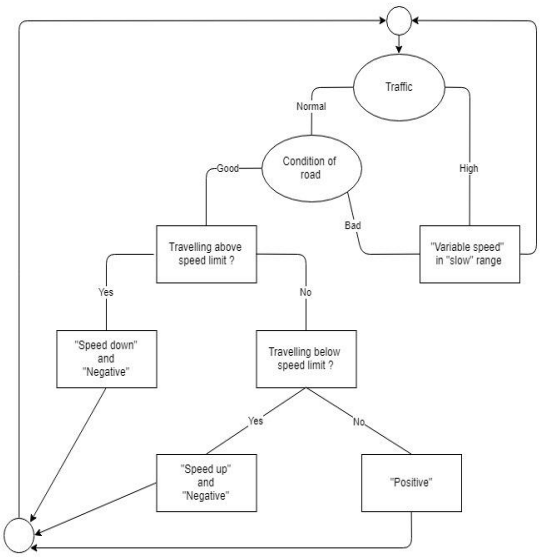

Figure 4: Decision Tree for Speed Control Process

The data that is matched with the predefined data is analysed using the combination of three machine learning algorithms, namely,

1. Markov Decision Process(MDP)
2. Fuzzy algorithm

Use of MDP enables the partially driver controlled and partially random action of the driver into a logical result that is fed to the Fuzzy algorithm for obtaining an analog output as a result. After segregating the driver into any of the category our system suggests the driver to overcome his mistakes and improve his skill set and proper driving.

4. EXPECTED RESULTS

The outcome of this paper aims at self assessing the drivers to improve their skills to relate themselves on the emerging busy and hectic driving style. Every driver is learning to drive the vehicle but not learning to drive it properly. There are many do's and dont's suggested by the vehicle manufacturer for the better performance and maintenance of the vehicle but in reality no driver can remember it in their daily routine. Instead this idea emerges as an assistant that notifies the driver of his mistakes at that moment, then the driver can easily change it and in a long run it becomes a habit. Thus we have produced good quality drivers in turn a good and safe riding environment.

5. CONCLUSION

It's not about the situation but the way of handling the situation matters the most. Hence a way of training the drivers to skill up to handle any kind of worse situation can bring about a good impact in the driving environment. And in the good situations a better maintenance and in turn a better performance is extracted from the vehicles. Further, the proposed idea is aimed at total implementation by us in near future.

6. FUTURE ENHANCEMENTS

Using Regression algorithms and the data set of the driver's skill in a certain road we can predict the performance of the driver on his inexperienced road. It helps in security forces and rapid response services. Our assist can be given with the data relating to the road condition and its traffic rate for more efficiently adapted corrections for that road. With the collection and interference of the data set from many drivers we can suggest a regular pattern that every single driver can adapt thereby we can bring the change not only in one driver but in the whole driving environment everywhere.

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