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POV

Advanced Driver-Assistance System (ADAS) for On-Road Driver Assessment: Automated Driver Profiling

Overview

Globally, transport vehicles (both personal and commercial) are one of the key building blocks of any developing economy. Ensuring safe driving conditions is imperative for any successful road traffic management plan. Most commercial and civilian drivers obtain their driver's license from a government authority. However, there is no foolproof method to assess a driver's on-road driving ability.

Using modern technology like the Advanced Driver-Assistance System (ADAS) [1] to create personalized driver profiles is a natural step towards creating an accurate and realistic record of drivers' profiles. Just like the vehicle pollution under control (PUC) checks at regular intervals, drivers of these vehicles would need to update their driving statistics obtained from the ADAS assessment periodically. The benefit of using this technology would be not needing to physically visit government agencies for the assessment. It would get tracked within the vehicle and stored centrally in a government database.

As per the official GOI website, a private driving license is valid for at least 20 years[2]. In India, a driver's ability to drive a vehicle is not evaluated unless he/she is on the road, making co-drivers and pedestrians vulnerable to a faulty system. Globally, surveys have been conducted to figure out ways to assess the driving quality of drivers across the world. As per the graphics below, India has a massive scope for improvement in erroneous driving patterns.

World's worst drivers

	1 Thailand	2 Peru	3 Lebanon	4 India	5 Malaysia	6 Argentina	7 United States	8 Turkey	9 Canada	10 Brazil
Traffic Index	174.4	220.4	185.3	203.9	168.4	175	152.2	189.8	140.1	173.3
Road Quality	4.4	3.2	2.6	4.5	5.3	3.6	5.5	5	5	3
Speed Limit(km/h)	120	100	100	120	110	130	137	140	120	120
Traffic Injury Deaths**	32	14	16	16	23	14	13	7	5	16
Blood alcohol Limit(g/ml)	0.05	0.05	0.05	0.03	0.08	0.05	0.08	0.05	0.08	0
Social Media Sentiment(%)	20.8	18	17.3	9.63	17.2	19.9	16.7	14.7	8.44	12.2
Total Score*	**2.17**	**2.28**	**2.28**	**2.34**	**2.36**	**2.4**	**2.5**	**2.56**	**2.61**	**2.65**

* Lower Total Score is better ** calculated per 1 Million of Population

Figure 1: Statistics on countries with the world's worst drivers Global Traffic Survey

Source: *World's worst drivers,* Team-BHP:
https://www.team-bhp.com/forum/attachments/indian-car-scene/2418695d1676361384-worlds-b

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Need for technological intervention in modern traffic management systems

Faulty driving is an often-neglected aspect of traffic management systems around the globe. The primary reason is the lack of a relevant and up-to-date data system to monitor the driving abilities of commercial and private drivers. As technology has evolved, we can now use advanced techniques such as ADAS to watch a driver's regular behavior and benchmark the same against safety standards. This data would be locally generated and then stored securely and centrally using cloud storage technologies in near real-time, enabling government agencies to:

- Flag extremely incompetent drivers and retrain them.
- Advise drivers around their problem areas and incentivize error correction, safe driving practices, etc.
- Analyze possible reasons behind bad driving across various parameters like region, profession, weather conditions, socio-economic conditions, etc.

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Advanced Driver-Assistance System (ADAS) for driver profiling and assessment

ADAS uses sensors and electronic data processing to detect deviance from standard safe driving techniques and practices. This solution uses cloud technologies and the internet to send recorded deviations to a centralized server supported on cloud storage in a government agency-maintained account. The government agency and the driver would jointly bear the cost of the solution.

Any miss or latency in updating the data in the centralized server would be flagged, and alerts would be sent to both the driver and the concerned government department officials. Police officers and traffic law enforcement officials would be trained on the operational aspects of checking driver profile data (based on driver license and vehicle registration number) and act based on established guidelines. For instance, they could impose fines on profile and ratings below a safety threshold and so on. Given below is a very high-level overview of the solution process flow:

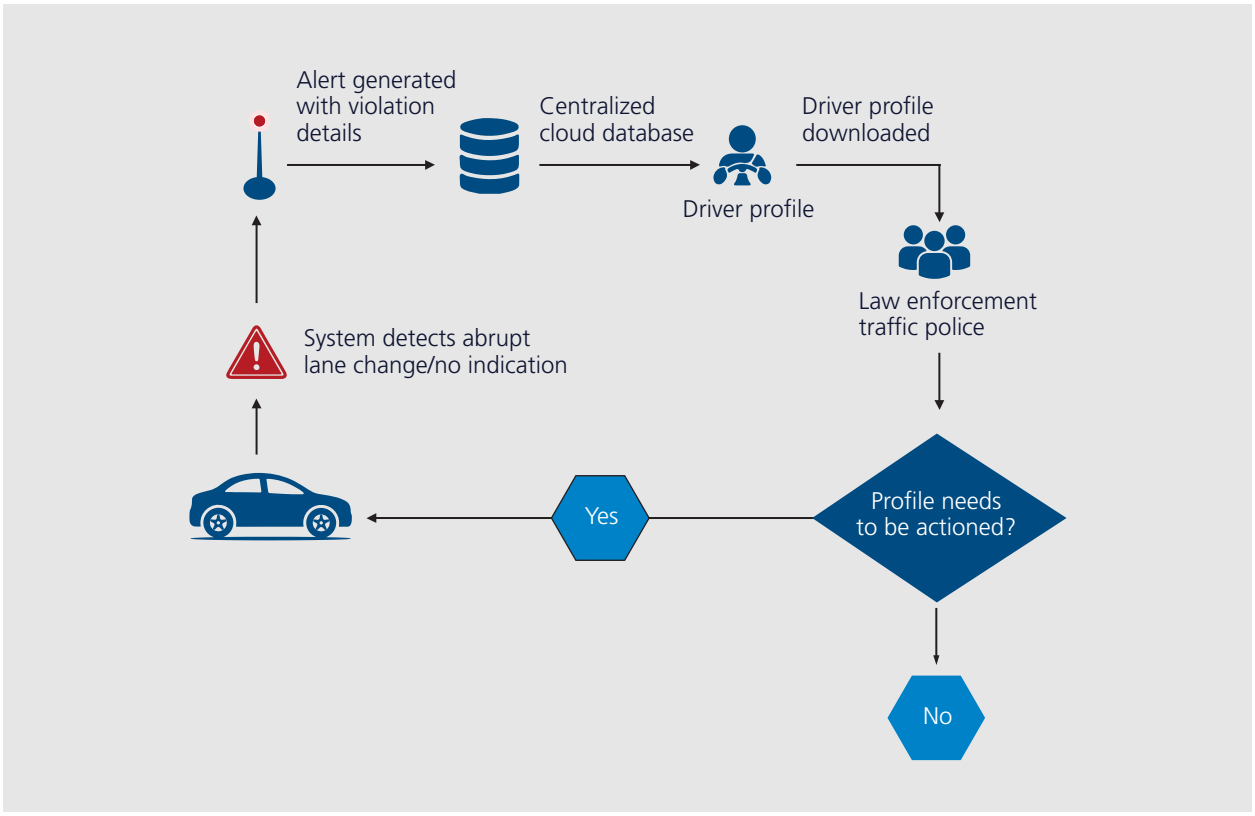

Figure 2: Process flow for ADAS

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Modern ADAS device installations on vehicles

A rich set of functionalities supported by the ADAS system will ensure that the driver profile maintained is a valuable resource for law enforcement. Instances of incidents that should trigger an alert to the centralized server can be:

- Cutting lanes abruptly or without the use of indicators (on highways or thoroughfares).
- Excessive honking in pedestrian zones.
- Zigzag driving on busy intersections or crowded city lanes.
- Overtaking other vehicles from the wrong side.
- Not maintaining proper braking distance from vehicles in front of them.
- Not being alerted to traffic signal changes, delayed response, drowsiness, etc.
- Driving on the wrong side of the road (common in some Indian cities).

This is not an exhaustive list, as ADAS is an evolving technology. ADAS has levels to indicate the maturity or sophistication of the system, with the highest level indicating a self-driven car.

Reliable connectivity between vehicle and centralized profile server

The next step of the solution involves a reliable connection between the centralized profile database and the ADAS system installed on the vehicle. There are several options to achieve this based on local viability and cost-effectiveness. Either an inbuilt wi-fi module using a mobile network provider or a hotspot or router within the vehicle can be used to provide internet connectivity to the profile database server or application.

Batch updates over designated third-party vendors who can sync the data over a secure network can also be an option where wi-fi or router connectivity is poor, especially in remote areas. This is a major challenge in rural and remote areas and can also be circumvented by use of a mobile application connected to the ADAS system over Bluetooth or mobile hotspot.

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Secure data storage on the profile database

Data stored for citizen drivers has a good chance of being tampered with as there are several implications of profile data for the driver. This requires that profile data is encrypted and secured from individual access. Only application-level access should be allowed to the authorized users of the system, such as traffic law enforcement designated officials, IT systems maintenance and admins, etc. Data access should be audited periodically and backed up for redundancy with appropriate disaster recovery mechanisms enabled.

Data privacy and authenticity

As this application deals with an individual's driving patterns, it is private information and might require user consent for use with certain third parties other than law enforcement. Individuals also need to provide their consent for being analyzed when they install the ADAS profiling tool on their vehicles. Given these implications, some of the more errant drivers may opt out of the system, thus defeating the purpose. Hence, an incentivization system is required, which will encourage such drivers to take the benefits of compliance with the tool. A government-backed system with a good private partnership should be used. For example, discounts on fuel prices can be given if driving records show a low-risk profile and so on. Such initiatives will ensure that drivers, particularly commercial drivers who might want to break the rules to reach destinations faster, will change their habits for the better.

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End-user application for law enforcement and other third parties

Any technology-enabled system will require extensive testing by end-users and feedback cycles before it can be rolled out to the public. As with most systems, there would be multiple iterations, and with the underlying technologies evolving rapidly, newer and better features will be available to the end user. The most cost-effective and intuitive design would be to build a mobile application that traffic police officials can log into and download the driver profiles using the vehicle number and the driver's license number. The application should have guardrails to check for valid vehicle and license details to avoid invoking the profile update application in such scenarios. For starters, the said application (traffic official login screen) could look like this:

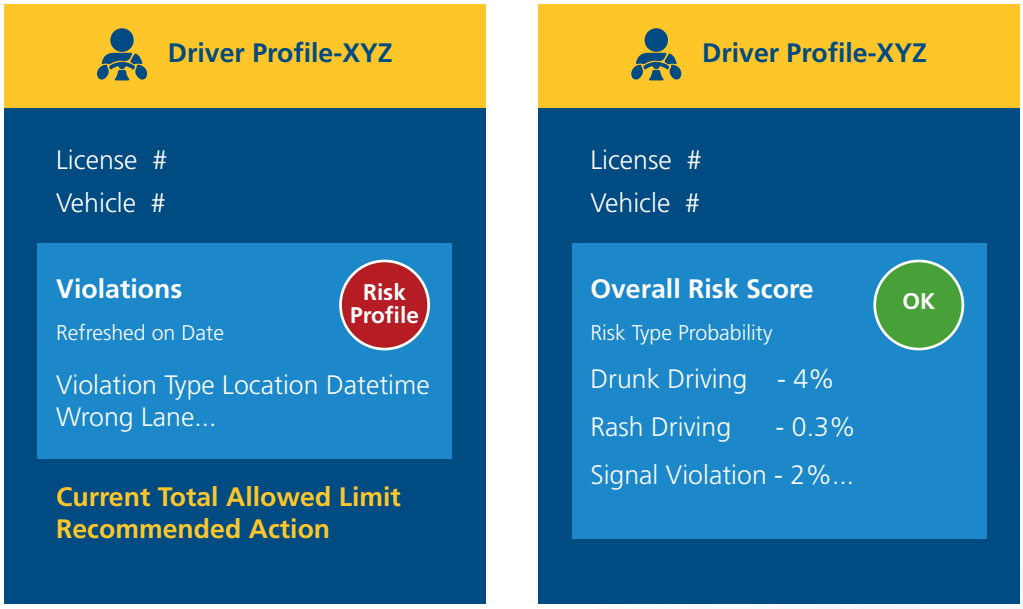

Figure 3: User application mock-up

Source: *What is a driving risk assessment?,* IRU: https://www.iru.org/what-driving-risk-assessment

Some third-party organizations that could make use of this data are as follows:

- Vehicle insurance companies.
- Background check agencies (rash driving could be a sign of poor temperament and other relevant factors).
- Medical insurance or health agencies (to determine psychological risk factors and other relevant factors).

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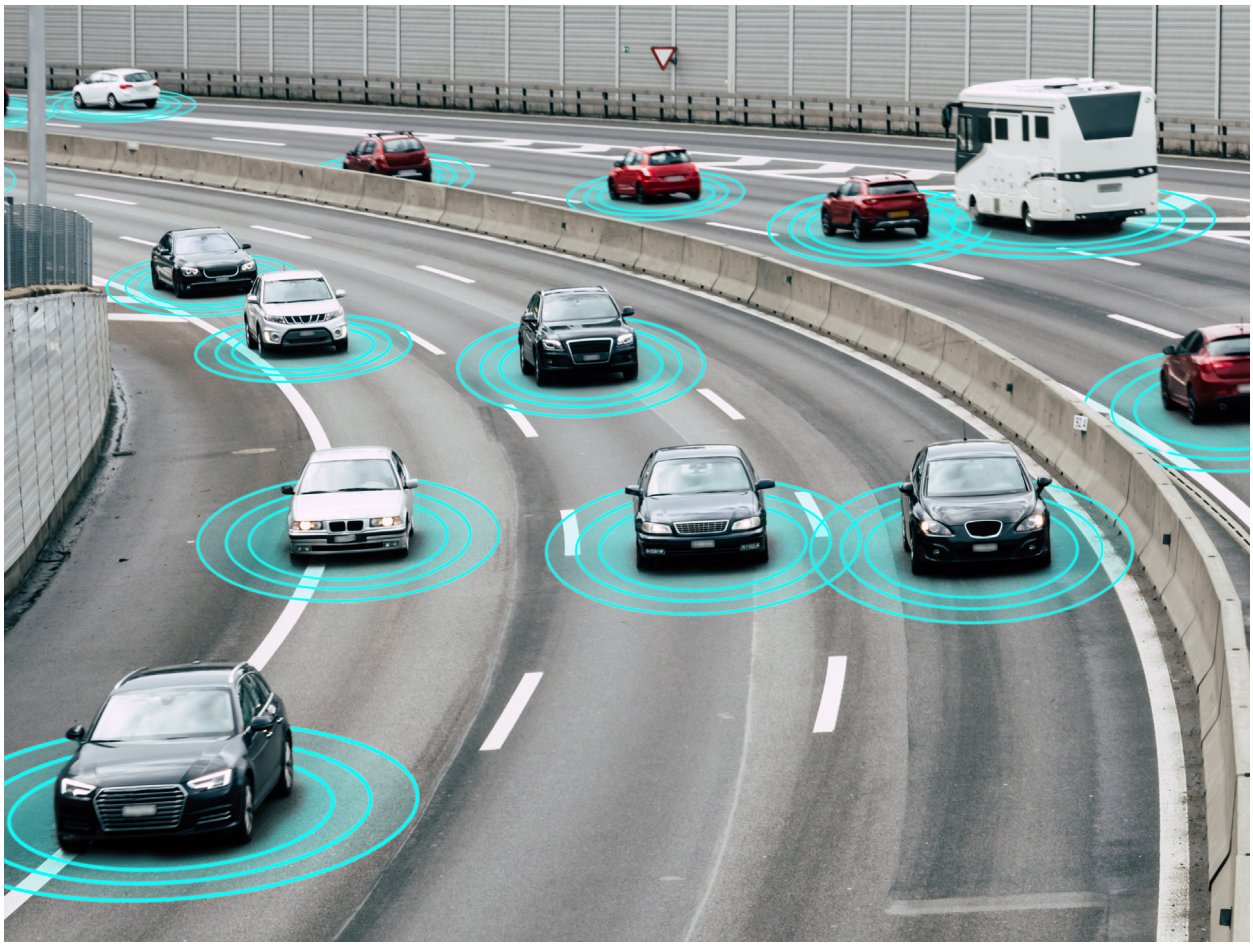
Using technology to reduce driver-induced road accidents

Data is not useful unless it is real-time and contextual. In my view, based on practical driving experiences around India and the US, traffic violations are habitual offences and not accidents. Drivers who break traffic rules are often negligent of the risks their actions pose to fellow drivers and pedestrians, and they tend to do so repeatedly and without remorse. Lax traffic rule imposition and a general non-consequential mindset are to blame unless the driver is a marked criminal. However, implicating drivers for violating safety rules that did not directly lead to unwanted consequences such as crashes, fatalities, damage to property, etc. is not possible in most countries worldwide. After all, being able to freely drive and move around is a fundamental right.

Hence, the only choice is to present drivers with hard, recorded facts about their driving practices and make them aware of their faults. Using technology to make a fair, unbiased judgement is an appropriate answer to this problem. Driver-induced road accidents are truly a significant problem as referenced here[3] in this blog.



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Use cases for ADAS

The ADAS solution applies to the public at large and hence has socio-political implications. As with most large-scale system implementations, challenges are expected and will need to be addressed via multiple forums like print, media, conferences, and user engagement camps. This solution can have the following use cases:

- Supply a ready-to-use driver assessment system which can be used by law enforcement to isolate errant drivers.
- Help in user engagement by building awareness around faulty driving practices which would have become widespread habits.
- Create a deterrent to bad driving by having a transparent system of penalization.
- Potential gamification:
    a. Good driver profiles can be incentivized by free fuel, free vehicle wash / service or waiver of toll charges, etc. Errant drivers will also have the choice to improve their scores and get incentivized or have part of their fines waived if they comply within a specified timespan.
    b. Risk profile can be used by insurance agencies and third-party OEM manufactures to offer various discounts / riders based on the specific risk profile report (as in Figure 3 above).
    c. Finally, driver errors extracted from the profile database could be a reliable source of analytical insights for car manufacturers to install new safety features or as feedback into the ADAS systems. This could be a possible revenue source for law enforcement by selling this aggregated data (anonymized for privacy) to external agencies.

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Futuristic driving and error avoidance using ADAS

Safe roads are a concern for every citizen and government agency. However, drivers must practice safety before it becomes a habit. In many cases, we err in judgment and take shortcuts that sometimes endanger the lives of others and even ourselves. Using technology as a friend, we can make safety a habit by being more aware of our driving practices, as they affect the lives of others too. My call to action is for drivers to introspect and strive to be more thoughtful of driving best practices and avoid costly errors with the insights provided by using ADAS. As an extension to the theory, I hope we take the same awareness to the pedestrians as well. Happy driving!

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Abhishek Ghosh is a Senior Specialist at LTIMindtree with 16+ years of data technology experience across data warehousing, migration, cloud, and ML. His experience spans a multitude of roles such as developer, lead, architect, SME, and project manager. His current role combines Data Engineering and Data Science applications on the cloud or in hybrid setups (cloud + on-premises). He consults with clients on their overall data governance and modernization strategies and implements them with a long-term view.

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