Existing Solutions

Existing autonomous vehicle sense their surrounding objects through sensors such as Lidar (Light detection and ranging), GPS, Ultra sonic sensors, Cameras and radars [1]. These sensing inputs capable of controlling automated steering, breaking and acceleration according to dynamic surrounding objects movements [1]. With the enhancement of navigation and routing system, all of these technologies enable the vehicle to make their decision within the environment with limited or even no human inputs. According to this way the driver task slightly shifted from human driver to car itself [2].

Implementing autonomous vehicle may have benefits such as reduce vehicle accident, minimize traffic collisions by elimination of human driver errors for instance distraction, drunk driving, aggressive, sleepiness, inattention. As well as reliability and accuracy can be achieved to an optimum level by shifting human driver to a system.

In 2013 National Highway Traffic Safety Administration (NHTA) initiated a policy statement classification system defined by five level of autonomy from zero to five. And then collaboration with NHTA and Society of Automotive Engineers (SAE) define six levels of automation for automobile industry. Six level of autonomy standards that automakers need to achieve on their way to building no-steering-wheel self-driving vehicles [3] [4] [5].

Levels of Autonomy

**Level 0: No automation**

Driver is fully controlled the vehicle including acceleration, breaking, steering all the time. If the vehicle assist with warning tones, safety invention systems or emergency breaking system it can be still viewed as level zero category. ***Examples:***A 1967 Porsche 911, a 2018 Kia Rio [6].

**Level 1: Driver Assistance**

Hands on the wheel concept. In certain condition car has ability to take control over the steering wheel or the pedals. But not both at the same time. At level 1 driver still needs to be aware on the road conditions. **Examples**: Adaptive cruise control, Park assist [7].

**Level 2: Partial Automation**

Autonomous system has ability to control over vehicle up to certain level such as steer, accelerate and break in special circumstance. Driver involvements are responding to traffic signals, changing lanes and driver has to keep hands on the wheel. System will match vehicle speed to the speed of the traffic ahead and monitor the bends in the road in an optimum way. **Example**: Audi Traffic Jam Assist [8], Cadillac Super Cruise [9], Mercedes-Benz Driver Assistance System, Tesla Autopilot, Volvo Pilot Assist [6].

**Level 3: Conditional Automation**

The vehicle is capable of monitoring the environment rather than the driver and control driver task. But the human driver should available to take back control when the automated system requests. Audi achieved new A8 is the first production car to claim level 3 autonomy. The Audi AI traffic jam pilot can take control through highway at the speed below 59 Kmph. Since the driver is not paying attention on the road and if the traffic speed is above than 59Kmph, then the driver will be called for take control over the vehicle. This is also the difference in between level 3 and 4 [10] [11].

**Level 4: High Automation**

According to SAE terms and conditions this category car capable of handling most dynamic driving task on its own. Driver can hands off, eyes off and mind off from the vehicle controlling part. But this level still requires driver intervention from time to time during poor weather conditions. This type of vehicle still have a steering wheel pedal when driver wants to take control over the vehicle. For now Waymo operates within 100 miles radios of Chandler, Arizona and a suburb of Phoenix and this car operate without a driver behind the wheel [12] [13]. **Example:** Google Waymo.

**Level 5: Full Automation**

This level of autonomous car doesn’t require driver intervention at all. All the critical situations can be handled by itself. So that there is no need of pedals, brakes or a steering wheel. Google have developed level 5 driverless car named “Koala” and it’s still on experimental level. This vehicle has no steering or pedals. It consists with cameras, sensors and roof mounted LIDAR system which project environment objects. But due to the inaccuracy and reliability issues this project has been shut down by google [14]. Volvo has plans to launch their first self-driver car in 2021 under Driver Me project. Currently they are testing their prototypes on the streets of Gothenburg, Sweden [15].

Today the highest level production level of autonomous vehicles available to us is Level 3 which is not fully autonomy. So no autonomy vehicle currently exists at fully autonomous level. Audi AI can take place over some points but under certain condition Audi system requires driver intervention.

**Pros (According to Motor traffic management system)**

1. There is no platform dependency.

Separate IoT device will be used to get vehicle location and position on the road. So that this system can be installed to any vehicle with minimum effort.

1. This system capture user behavioral patterns and math with past records in order to provide high level of autonomous driver functionality.
2. All vehicles are connected to central server. So that it’s possible to maintain the region wise traffic condition.
3. Vehicle can be controlled not only from Autonomous vehicle technology, but also connected vehicle technology. So that accuracy and reliability is high.
4. System is capable of taking immediate action when law breach arise and proof records are available at any time.
5. Law cost. This system doesn’t require high budget to install. Installation and maintenance process are simple.
6. Authority parties can track each vehicle in real time without damaging their privacy.

**Cons**

1. Inaccuracy of GPS at certain locations and higher speed.
2. Map projection is tricky part with real world objects.
3. Another methodology is needed to detect pedestrians and cyclist.

System only operate through GPS and there is no way of locating pedestrians and cyclist and road barriers and etc.

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