



## REVIEW PAPER ON SELF DRIVING CARS

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### Abstract-

The project entitled “Self-Driving Car” presents an autonomous self-driving car. Various companies have launched their new models for public use, few of which are Tesla, Mercedes, Rolls Royce, BMW, Waymo, Uber etc. The project started before 1980, first self-driving car appeared in 1980 by Carnegie Mellon University and ALV. With more than 100 million lines of code and hundreds of sensors, these connected vehicles (CVs) exposed a large attack surface, which could be remotely compromised and exploited by malicious attackers. Security and privacy are big concerns that deter the adoption of smart cars, which if not properly addressed will have grave implications with risk to human life and limb. In this review paper we focused on a company-wise review on the projects and their future work plans.

**Keywords-** Self- Driving Car, Autonomous Vehicle, IR Sensor, Trajectory, Motion Sensor

### 1. INTRODUCTION

The goal of any transportation vehicle is to take people from one location to another in any way possible via one or more than one particular locations. This is complicated by the overwhelming number of factors that impact what makes a form of transportation the most effective: speed, reliability, comfort, safety, flexibility, convenience, cost, and environmental impact to name a few. Automation is leading the world today, and with ‘things’ around sensing and acting on their own or with a remote user command, has given humans to have anything accessible with a finger touch. Data generated by these smart

devices unleash countless business opportunities and offer customer targeted services. Many technical advances that enable self-driving cars are of course due to software and algorithmic innovation. There have been incredible advances in machine learning that improve the ability to perceive the world, new tracking and planning algorithms allow for safer and smoother driving, and the software infrastructure to simulate and analyze vast amounts of data in data centers have all been key contributors towards making self-driving cars a reality. The automation level in self-driving car is shown in figure 1. In the zero phase the driver performs all tasks so there is Zero Automation. In the first phase driver assistance is needed, the vehicle is controlled by driver, but some driving assistant features may be included in the vehicle design. In the second case, instead, only the indication of the destination and the start of the system is required, without any other intervention by the driver, in all possible cases. In the third phase there is conditional automation, most of the companies trying to achieve that level of automation in other countries except USA in which driver is necessary for monitoring the environment. The fourth and fifth level of automation are very difficult to achieve. Consumers who want the flexibility and freedom of complete level 5 vehicles will have to wait longer. The major car manufacturers (Tesla, General Motors, Ford, Fiat-Chrysler, and Waymo, to name a few of the main ones) like to talk about autonomous vehicles as if they will be on sale in their showrooms in three or four years. In this paper we have focused on four companies and their work overview and their future plans.

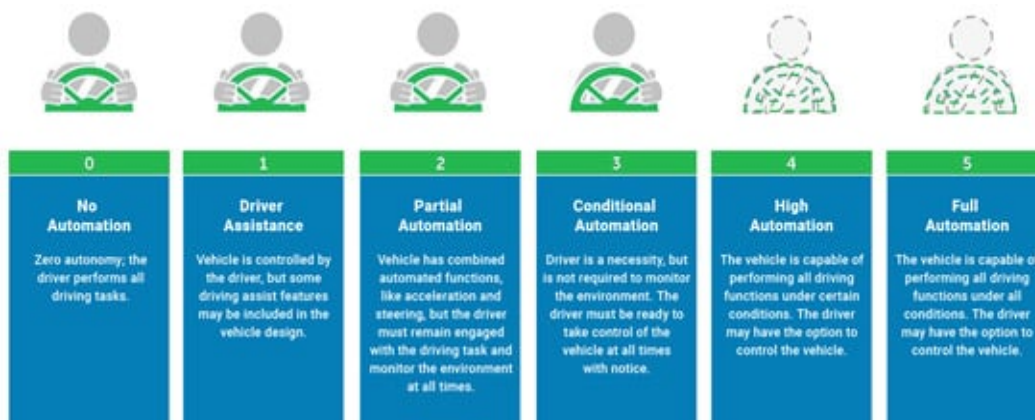


Figure 1

## 2. Tesla: -

With the mission to accelerate the world's transition to sustainable energy, Tesla founded in 2003 has now become one of the most empowering and leading companies of its kind in the market. With a definitive drive to create sustainable and variable speed motors; Tesla has changed the course of electric cars in the whole world. Inspirations from the late 19th century such as Thomas Edison or Nikolai Tesla state how a stationary source can be turned to a moving source in minimal effort using Copper coils, permanent magnets, and electric brushes. Easy to construct, reliable and with a brilliant alternating-current induction motor; Tesla started its journey with Elon Musk as it is head of operations and furthermore, CEO.

[1] The utility bills on a Tesla depend on two factors, namely: usage of the source and peak demand time for the grid building. Instead of using Locked Rotor Amps, or LRA (An old fashioned, traditional motor which spikes power use at startup is used to overcome the inertia of the rotor.); Tesla switched it is working to a VFD motor. The HVAC equipment was optimized with a great view of variable speed motors, thus maintaining the temperature indoors as well as outdoors. Utilizing 66% less energy translates into huge investment funds consistently. Variable speed engines are ideal for drafted frameworks. Taking into consideration further customization of those spaces such as the warmth and coolness inside your business building, it proves to be the best solution out there. Like an old inefficient vehicle, that obsolete HVAC framework that you depend upon might be eating up money better spent on different parts of your business activity.

[2] Martin Eberhard and Marc Tarpenning stated how “zero-emissions” can be confused or rephrased as “emissions-elsewhere”. This was made as a legit use case because the electric cars saving emissions needs to be charged by electricity (causing emission itself). They investigated Tesla Roadster how the lithium-ion-base of this car has helped it become an extraordinary investment for the near future. The Tesla Roadster only requires 110 watt-hours (0.40 mega-joules) of electricity from the battery to go on for a kilometer, or 2.53 km/MJ [3].

## 3. Mercedes

The Mercedes is more focused on luxury and comfort, so they are more focused towards Level 4 and 5 automations. The big news is the introduction of the Drive Pilot and intelligent parking technologies, new Level 3 and Level 4 self-driving systems that pave the road to the automaker's autonomous future. To ensure drivers remain ready to resume control, Mercedes uses an infrared camera that monitors the driver's face and eyelids to detect sleeping, observes the driver's position in the seat, and otherwise identifies and responds to any circumstance that might prevent a driver from retaking control of the vehicle. They have designed and tested car on various functionalities such as,

[9]3D Position and Motion for Every Pixel (Scene Flow): -

Computing the three-dimensional motion of a scene is a fundamental task in computer vision that has been approached in a wide variety of ways. If the scene is rigid and the cameras are calibrated, the three-dimensional scene structure and relative motion can be computed (up to a

scale factor) from a single monocular video sequence using structure-from-motion.

Three-dimensional scene flow is a fundamental property of dynamic scenes. It can be used as a prediction mechanism to build more robust stereo algorithms, and for various scene interpretation and rendering tasks.

[10] Generating Virtual Pedestrians: -

Benefit of the pedestrian generation module is that the pedestrian generation module guarantees that the virtual pedestrians it generates behave realistically (as measured against real-world accident reports) and conform to both manufacturer testing standards and international testing standards. This is because the path specification and the behavior specification are generated by the pedestrian generation module using digital data that describes accident reports, industry testing standards and manufacturer testing standards. No other existing solution, whether based on automatic or manual generation of virtual pedestrians, can provide a similar guarantee of both realism and conformance with both industry and manufacturer testing standards.

[11] Pedestrian Path Prediction by Trajectory Matching: -

They used these points:-

- Use higher order model; match learned trajectory “snippets” (segment of fixed length).
- QRLCS (Hermes et al. IV’09) metric computes similarity after alignment (translation/rotation). Use of additional motion features.
- Path prediction by extrapolation of matched trajectory snippets (non-param. regression).
- Use of particle filter representation.

[12]The company’s new S-Class takes self-driving car to new level, if the driver does not resume manual operation of the vehicle, Drive Pilot assumes he or she is suffering a medical emergency and activates the Automatic Emergency Stop Assist system. This technology, part of the standard Driver Assistance Package in all global markets, brings the S-Class to a stop, activates the hazard flashers, and initiates an emergency call to summon help. Michael Hafner, director of driver assistance systems and active safety for Mercedes-Benz, emphasizes that Drive Pilot is

not the same as General Motors’ Super Cruise or Tesla’s Autopilot.

Mercedes S-Class is giving many extra features on customer demand, such as necessary lidar, digital HD map technology, a more precise positioning system than a typical GPS, a rear window camera and external microphones for detecting the sirens of emergency vehicles.

#### 4. Waymo: -

Waymo self-driving car is the talk of the town, Waymo is owned by Google, the present co-CEOs are Tekedra Mawakana and Dmitri Dolgov. Google’s self-driving car project, now known as Waymo, has been performing supervised autonomous driving, in which the vehicle systems control all aspects of the driving task with Google engineers supervising and re-taking vehicle control, if necessary, on public roads since 2009, beginning with a fleet of modified Toyota Prius cars. [13]In 2012, Google switched to a fleet of modified Lexus RX450h SUVs and shifted testing from freeways to more urban roads, mostly in Mountain View, Calif. Waymo’s self-driving cars contain many sensors. The dome on the center of the vehicle roof integrates laser and camera systems that provide a 360° view around the vehicle. They also integrate sensors on the vehicle periphery, ensuring that we can see objects both near and far.[14]Waymo self-driving cars also heavily use compute accelerators to offload some of the most compute-intensive tasks. Accelerator selection is a delicate balance between ease of programming, performance, power, and cost. GPUs, FPGAs, and custom ASICs are all attractive options. Waymo uses LIDAR as the primary input for object detection. Waymo have integrated high performance computer into their cars. The computer takes real time decision that are all required to fully automate our car- process incoming sensor data, detect and classify objects, track, and predict their behaviors, plan where the vehicle should move next, etc. A tremendous amount of compute is required to perform these tasks, and especially with the increasing use of deep nets, there is very clear correlation between quality of results and the amount of compute that can be applied to a problem.

Figure 2 shows how just the CPU portion of our compute system has increased performance

over vehicle generations.[15] For example, compared to our initial freeway-only implementation, our latest generation self-driving car provides a 10x boost in CPU performance. Part of this performance increase is needed to drive fully autonomously (i.e., without a driver needed at the wheel) on complex city streets, and part is needed for a smoother and more robust driving experience.

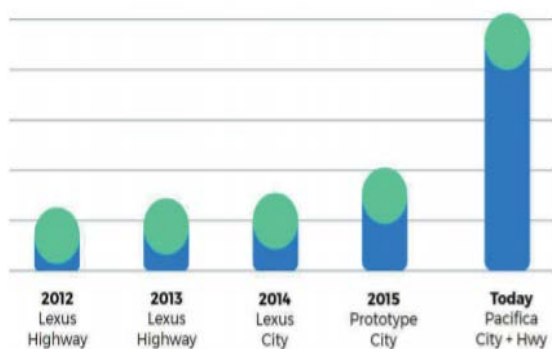


Figure 2

## 5. BMW:

Bayerische Motoren Werke AG, regularly referred to as BMW, is a German worldwide company which produces extravagance vehicles and bikes. [16] The organization was established in 1916 as a producer of airplane motors, which it delivered from 1917 until 1918 and again from 1933 to 1945. A place for vision: the BMW Group. The auto business is confronting the greatest changes in its more than 100-years presence. In the end of this decade, the principal electric vehicle will enter the mass market that can contend on item highlights, solace and cost with the interior ignition motors. Individuals keep moving in metropolitan regions. The necessities toward future portability increment. A few nations effectively chose to lean toward electric vehicles before traditional vehicles.[17] Benefits will move to other markets or fragments. Officeholders should adjust their present procedures to keep their portion of the overall industry in future and partake in future benefit pools of the car business. BMW and Tesla have distinctive key ways to deal with the impending changes in the business. BMW, as numerous other OEMs know about future difficulties and troublesome powers and have substantially more assets to oversee required interest in R&D than more modest new businesses.[18] Nonetheless, problematic powers come from lower usefulness and

minimal expense items that are typically directed by prevailing firms in an industry. This examination breaks down these two auto organizations by utilizing the regular procedure examination devices. To begin with, the company's outer climate is broke down by utilizing the PESTEL investigation, portraying applicable patterns that influence the essential choice of the two organizations.[19] An industry outline with future projection is given.

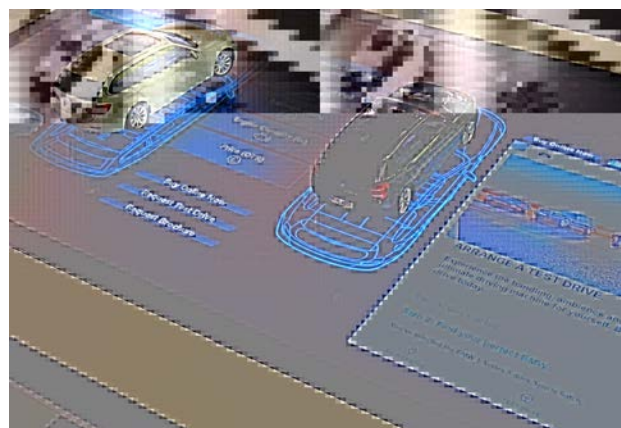


Fig: BMW deploys touch screen object recognition

Furthermore, the inner examination is performed. SWOT examination and the VRIO system structure the premise to characterize the qualities, shortcomings, special resources and capacities of BMW and Tesla. The accompanying section sums up the outcomes and key discoveries from this examination. The end part gives a general conversation of the main discoveries arising out of the examination with respect to the business activities and the current plans of action of the two vehicle producers. Moreover, significant ramifications for the adoption and change are talked about.

Two auto industry exchange associations, Automakers Alliance furthermore, Global Automakers, and their individuals, which incorporate many major players like Ford, GM, BMW Group, Toyota, Volvo, and that's just the beginning, have focused on an industry-wide arrangement of protection principles.[20] They have focused on standards, for example, "straightforwardness," "decision," "information minimization," and "access" with respect to certain client information.84 "Straightforwardness" implies that the "collect[ion], us[age], or shar[ing] of Geolocation Data, Biometrics, or Driver

Behavior Information" should be unmistakably unveiled to consumers[21]. "Decision" is given to customers by requiring "positive assent" if those sorts of information are utilized for promoting or imparted to unaffiliated outsiders. – Many clever thoughts have been carried out in freshest arrangement of idea vehicles by vehicle makers.

- (a) BMW's ConnectedDrive incorporates BMW Assist, BMW Online and driver help frameworks, supporting path change cautioning and stopping collaborator (Hoch et al., 2007).
- (b) BMW focuses on 20% of its vehicles to be electric by 2023. The supervisor likewise repeated his call to accelerate the development of charging framework.
- (c) "15,000 private and around 1,300 public charging focuses would need to be placed into activity consistently starting today. Lamentably, we are far from that", he told the paper.

### Conclusion:

By using the information in this study, it can be said that with the advancement in technology, the advancement in smart cars is inevitable. Various companies like BMW, Tesla, Waymo and Mercedes are making prominent progress in this upcoming field. As discussed above, it is safe to say that we might be entering the world of flying cars and hyperloop cars in the near future!

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