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SELF-DRIVING CAR WITH ARTIFICIAL INTELLIGENCE (AI) TECHNOLOGY

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ABSTRACT

The autonomous vehicle technology is highly developed and ready for commercial deployment. The self-driving car is a type of autonomous vehicle that can drive autonomously based on Artificial Intelligence (AI). It is based on the use of sensors, actuators, sophisticated algorithms, machine learning systems, and robust processors. The software that autonomous vehicles use to operate is executed by sensors and actuators. Artificial Intelligence (AI) is crucial in operating the autonomous car systems. The National Automotive Policy 2020 (NAP 2020) aims to grow Malaysia's automotive sector through research and development of new technologies, especially in the fields of Next-Generation Vehicles (NxGV), Industrial Revolution 4.0 (IR 4.0), and Mobility-as-a-Service (MaaS). In this paper, we will focus on the application of AI in autonomous car system. We will also discuss the development of autonomous vehicles.

Keywords: Artificial Intelligence, Self-Driving Car, Autonomous Cars, Tesla, Waymo

Introduction of application

Artificial Intelligence (Ai) Technology

Artificial intelligence (AI) is when machines, particularly computer systems, simulate human intelligence processes. Expert systems, natural language processing (NLP), speech recognition, and machine vision are a few examples of specific AI applications. (Burns et al., 2023)

In general, AI systems function by consuming vast quantities of labelled training data, searching the data for correlations and patterns, and then using these patterns to forecast future states. In this way, an image recognition software can learn to recognize and describe items in photographs by looking at millions of examples, much as a chatbot trained on examples of text chats can learn to make lifelike exchanges with people. (Burns et al., 2023).

Self-Driving Car

Autonomous automobiles, often known as self-driving cars, can operate with little to no input from the driver. (Towards AI Team, 2022). Autonomous automobile is a vehicle that can sense its surroundings and operate without human intervention. A human passenger is not necessary to operate the car at any time or to be inside the vehicle at any time. An autonomous vehicle may travel anywhere a typical

vehicle can go and can perform every task that a qualified human driver can. The ability to observe a completely autonomous vehicle in action has long been a goal of many people. The term "Self-driving car" has recently gained popularity in the technology sector as a result of developments in artificial intelligence and computational resources. (Towards AI Team, 2022).

Due to safety features like assisted parking and braking systems, many vehicles on the road today are classified as semi-autonomous, and a select number are equipped with the capacity to drive, steer, brake, and park themselves. Technology for autonomous vehicles depends on GPS capabilities as well as sophisticated sensing systems that can identify lane boundaries, signs, and unanticipated obstructions. (Gringer, 2018). Even while the technology isn't currently flawless, it's anticipated to become more common as it advances. In fact, some experts believe that by 2025, up to half of all vehicles leaving global manufacturing lines will be autonomous. In anticipation of the day when this technology is widespread, legislation governing the use of driverless vehicles is already in place in dozens of states. (Gringer, 2018).

Several advantages are anticipated from autonomous vehicles, but increased road safety is likely to be the most significant. Since cars cannot get intoxicated or under the influence like human drivers do, the incidence of accidents involving impaired driving is projected to significantly decrease. (Gringer, 2018). Additionally, self-driving cars don't grow tired and don't have to worry about getting diverted by passengers or phone messages. A computer is also unlikely to be involved in a collision as a result of road rage. According to a National Highway Traffic Safety Administration data from 2015, human error is to blame for 94% of all traffic accidents: Self-driving cars should make the roads considerably safer for everyone because they remove people from the equation. (Gringer, 2018).

History Of Self-Driving Car

Autonomous automobiles are those that are driven by without any human involvement, computer technologies. They are able to navigate and drive themselves on the roadways by detecting the effects on the environment. Their appearance is made to take up less space on the road to prevent traffic jams and lower the possibility of accidents. (Szikora & Madarasz, 2017).

In the 1920s, prototypes of the first autonomous cars were made, although they didn't resemble them today. (Szikora & Madarasz, 2017). Although the "driver" was supposedly absent, these vehicles heavily relied on particular outside inputs. Norman Bel Geddes developed the first self-driving car in GM's 1939 display. It was an electric vehicle that was propelled by electromagnetic fields formed by magnetized metal spikes buried in the road and controlled by radio. General Motors has brought this idea to life by 1958. Pick-up coils, sensors that could sense the current flowing via a wire buried in the

road, were incorporated into the car's front end. The steering wheel of the car could be moved left or right by manipulating the current (Gringer, 2018).

The Japanese expanded on this concept in 1977 by utilizing a camera system that transmitted data to a computer so it could process pictures of the road. However, this car could only go at speeds of less than 20 mph. A decade later, the Germans made improvements with the VaMoRs, a camera-equipped car that could safely drive itself at 56 mph. The capability of self-driving cars to notice and respond to their surroundings has evolved along with technology (Gringer, 2018).

Despite the significant progress, the legally permitted automated vehicles on public roads in 2017 are not totally autonomous; each one requires a human driver to detect when it is required to regain control of the vehicle. (Szikora & Madarasz, 2017).

How Do Self- Driving Car Work

The software that autonomous cars use to operate is executed by sensors, actuators, sophisticated algorithms, machine learning systems, and robust processors. Based on a range of sensors placed in various places of the automobile, autonomous vehicles build and update a map of their environment. Radar sensors keep track of where neighboring vehicles are. Traffic light detection, road sign reading, vehicle tracking, and pedestrian detection are all performed by video cameras. Lidar (light detection and ranging) sensors use the reflection of light pulses from the environment around the automobile to calculate distances, find road boundaries, and recognize lane markers. When parking, the wheels' ultrasonic sensors pick up on curbs and other cars.

After processing all of this sensory data, sophisticated software designs a course and issues commands to the actuators in the automobile, which manage steering, braking, and acceleration. Predictive modelling, object identification, hard-coded rules, and obstacle avoidance algorithms aid the software in adhering to traffic regulations and avoiding obstructions.

The car's artificial intelligence software is integrated with all the sensors and receives data from Google Street View and cameras. The AI manages driving systems including steering and braking by simulating human perception and decision-making processes (Ondruš, et all., 2020). In order to be aware of things like landmarks, traffic signs, and lights in advance, the car's software consults Google Maps. There is an override feature that enables a person to take over driving the car. Information from nearby vehicles, particularly information about traffic congestion and safety hazards, may be useful to individual automobiles. Vehicles and roadside equipment serve as the communicative nodes in a peer-to-peer network in vehicular communication systems, passing information back and forth. (Ondruš, et all., 2020).

Usage Or Implementation Of The Application

Software of Artificial Intelligence (AI) is useful in the creation of self-driving car systems. (Lutkevich, 2019). It stimulates human intelligence which is processed by machines, especially computer systems. In order to create systems that can drive autonomously, developers of self-driving car combine massive amounts of data from image recognition systems with machine learning and neural networks. Machine Learning (ML) which is a type of artificial intelligence (AI) that allows software applications to predict more accurate outcomes without being specifically programmed to do so. Neural network is referred to a technique in AI that instructs computer to analyze data that inspired by human brain. It is type of machine learning process also known as deep learning algorithms. (Tyagi, 2020).

AI, machine learning, deep learning and neural technologies become widely used in autonomous car industry nowadays. With the presence of smartphone app and driverless car, people can direct use voice command to choose location. The car will navigate itself using GPS, camera, and multiple sensors technology involved which are radar and LiDAR. This helps them in path planning and a better understanding of their surroundings. (Bin Sulaiman, 2018).

Next, analysis data from machine vision cameras and sensors able to self-driving or autopilot. AI simulates human perceptual, decision-making processes and managing driving system including steering and breaking based on the ADAS. Firstly, LiDAR or (Light Detection and Ranging) sensors that enables AI system to operate quickly in response to changing evolving road conditions. The accuracy of LiDAR provides is its most important device in autonomous vehicles. It creates a 360 degree of the environment and location in 3D image by using laser, ultraviolet, visible or infrared light. It measures the distance between autonomous vehicle and nearby objects including people, tree, vehicles, roadblock and others. To add, it uses to scan mirror, multiple laser beams and other object space. It also used to estimate a storm and the rate of rainfall, for example, the systems can measure the raindrops in the atmosphere. (Ondruš, et all., 2020).

Furthermore, RADAR or Radio Detection and Ranging where it has similar function as LiDAR, and usually installed on the front and rear bumper of the car. (Gremillion, 2021). The difference its only it using electro-magnetic waves instead of laser. So, it can determine the mutual velocity of the object and the vehicle. (Ondruš, et all., 2020). Besides, the results of Lidar system and radar's detection of the environment are combined by central computer. For instance, oncoming vehicles, speeds, blind spot detection, lane change assistance and other are all will be detected by the radar system.

In addition, Global Positioning System, (GPS) is technology that combines real-time geographic information from satellites including latitude, speed to help navigate and assist in driving. This software components used to record the road signs and directions from the location. It serves the basis for all

maps that vehicle uses while on the road. Besides, this system able maintains the car on its pathway with 30 centimeters accuracy. (Ondruš, et all., 2020). Then, the data detect by the sensors and camera is imported into the central computer. With the rise of camera also help to safety driver such as receive alert from the road maintenance.

In order to sense the environment around the car and then alert the driver or take action, AI processing algorithms requires ADAS (Advance Driver Assistance System) as combination in the sensor's technology of automobile. (Nazir, 2022). A car accident can be prevented by sending out warnings to other drivers or even by taking autonomous action. Thus, with the addition of multiple technology sensors may useful in AI system for existence of autonomous car.

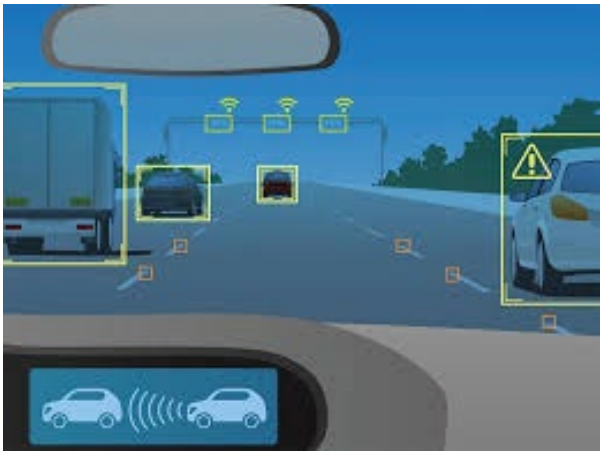

Figure 1: The View of Camera of The Alert Sign by Sensors.

Advantages Of Self-Driving Car

Self-driving car may almost be implemented globally and potentially outdo the classic and antique fuel-powered car due to its pioneer brand like Tesla has already spread its wing to its commercial and marketing. The development of self-driving cars or autonomous vehicles has developed at an unforeseen pace. There are bound to be many advantages that can be beneficial as the technology always seem to seek convenience in human lives.

One of the advantages that can be clearly seen is the reduce of car accident or car crashes. With the help of AI that can fully assist driver and reduce the human strain involved during driving, Self-driving car can ultimately reduce crashes occurred per year. According to government statistics, drivers' actions or mistakes cause 94 percent of collisions; self-driving cars can assist lower driver error (Coalition for Future Mobility, 2017). The artificial intelligences in self-driving car would help driver have more comfortable and safe driving especially in the long duration of driving. As the self-driving

car has an AI and full 360-degree sensor that works co-efficiently and possess a 360° field of view, which is twice as wide as that of humans, where horizontal field of view is only 180°. (Tenorio, 2021).

Accidents will be much decreased thanks to 360-degree vision and vehicles being connected to and in constant communication with one another. Accidents won't be completely eliminated at first, but they will still be significantly fewer than those brought on by human driving. A Google-trained autonomous vehicle crashed in the Mountain View region. The car, however, had been on the road for over 1.4 million kilometres before to the accident without any accidents. Most humans are unable to say the same. (International, 2021)

Other advantages of implementing self-driving car, is not having any waste resource or energy and have a more efficient travel toward desired destination. A more efficient style of travelling as the AI will assist the driver to analyze the best route of travel, estimate the appropriate speed according to the travel time ¸ and safe distance between the car especially during congested traffic. Although their speed is predicted to be slower in large cities, their traffic efficiency will be higher. The AI self-driving car Maintain a secure and constant spacing between vehicles to assist lessen the number of stop-and-go traffic jams.

Real-time communication would enable cars to move efficiently at predetermined distances from one another allowing all passengers in a fully automated car safely engage in more useful or enjoyable tasks like checking email or watching a movie. This self-driving function may be crucial for businessman or corporate worker that need to be in meeting in a moment notice, enabling them to attend the meeting without problem.

Self-driving cars provide a secure and dependable means of transportation for persons who are unable or prefer not to drive especially Blind people, for example, can be self-sufficient, and a self-driving technology could enable them to live the life they desire. It could also provide access for the elderly and the disabled as they are unable or have problem in driving the normal vehicle. Even those with vision or hearing impairments will be able to increase their independence toward other people because the car will be autonomous and operate with little to no human interaction.

Disadvantages Of Self-Driving Car

As human commit more toward self-driving technology and its future prospect, human tend to overlook the disadvantages that comes along with the self-driving technology. The classic fuel powered car may seem frivolous compare the self-driving technology but the technology itself poses some major disadvantages that may be crucial and have yet to have a proper and everlasting solution.

An obvious and significant disadvantage that the self-driving technology possess is the world-wide implementation, and it's not just talking about the self-driving technology having exist in some major country, but having the whole world sees self-driving technology as common like the nowadays fuel powered car. The constraint of having half self-driving vehicle and normal vehicle will affect the self-driving vehicle as they would need to have a wider range of analyzing and require more time to decide thus affecting the vehicle in real time driving. The constraint of having half self-driving vehicle and normal vehicle will affect the self-driving vehicle as they would need to have a wider range of analyzing and require more time to decide thus affecting the vehicle in real time driving. There is a significant difference between a few driverless automobiles on the road and an entire highway filled with them.

Moreover, the infrastructure for autonomous vehicles depends on 5G network coverage, which is still expensive. As a result, it might take governments a long time to invest in enough infrastructure to support autonomous vehicles at their best. While long-term societal cost savings from self-driving cars may be substantial, the initial cost of automated vehicles may be extremely high. The price ought to decrease as new technology develops. However, the initial entry hurdle can be too great for the average person. Thus, proving that the initial implementation of self-driving technology has much constraint and limitation.

Another major disadvantage of the self-driving technology is massive job losses especially those in the transportation or service sector. The human drivers who currently work as taxi and bus drivers will lose their jobs as they may completely rely on AI to operate the vehicles. With the advent of self-driving automobiles, those whose livelihood depends on driving may find their profession obsolete. Bus and taxi drivers, as well as those who work in the trucking industry, will all need to look for new jobs. Additionally, driverless automobiles would displace Uber and fast-food delivery drivers. For those who are not in those sectors may seem like it's not that big of a deal as they have not experienced it firsthand, but the future of the self-driving technology has many potential future prospects and in future the self-driving technology may be implement fully in other sector such as agriculture, flight service and may even be in the food and beverage industry. There may have already been some self-driving technology being implement already or in research and development stages but once the technology can be easily accessing the change will soon arrive.

Last but not least, the self-driving technology possess the ability of being hacked. Being constantly connected to the outside world can cause a cyber concern with data protection. Even the proper management of road networks may be harmed. A car that has been hacked could become exceedingly risky. The risk of a hacker taking over the vehicle and overriding controls exists even while someone is inside the car keeping an eye on things.

On the website HackerNoon, it is discussed how cybercriminals might remotely target a self-driving automobile and the cybersecurity threats it poses. There are deliberate attacks that target the safety-critical AI system functionalities in particular. Examples include painting the road to confuse the GPS or covering stop signs with stickers to obscure their visibility. Such changes may cause the AI algorithms to classify objects incorrectly, which could cause the self-driving car to act in a hazardous manner. (Harris, 2022). To have automated cars talk and coordinate with each other, they would have to use the identical network protocol, therefore it is crucial for the self-driving technology to have a hack proof technology to counter the hacking possibility.

Additional Content

Example Of Autonomous Cars

Tesla

Tesla is one of popular American multination automotive electric vehicle that invented by Elon Musk. This company is built on artificial intelligence technology and they train their algorithms for autonomous car. The latest AI systems that developed in cars are based on unsupervised machine learning. This one of the factors contributing to their success of making their cars fully autonomous. (Marr, 2021). There are several AI features in Tesla which are autopilot and AI integrated chips. Firstly, autopilot is developed using neural network which a part of Artificial Intelligence method. It detects the area around the car using radar, cameras and ultrasonic sensors. Driving is made safer and less stressful by presence of the sensors and cameras. This is because, drivers alert with their surroundings with the help of all the systems. Therefore, cars can autonomously steer, brake or accelerate in the lane because of autopilot.

Second, autonomy algorithm one of AI features that used in Tesla. Before train the neural network to predict such perfect performance, this company combining or gathering all data from the car's sensors across space and time. So, an algorithm can provide precise and large scale of information. The information interprets from images of the sensors that help users to plan their next moves and then make decision what to do. For instance, when the car should switch lanes or stay in the lanes. Therefore, Tesla has to gather data to train the algorithms and keep improved their AI system. (*AI | Tesla*, 2023).

Waymo

Waymo is one of the Google Self-Driving car projects which performed by American company, Google's firm. Waymo Driver using sensors and software to operate the safety rides. They are including three types of sensors which are Lidar, cameras and radar. The most powerful and important sensors that creates 3D image of its surrounding is Lidar. This sensor enabling driver to estimate the distance

and size of objects 360 degrees around it and more than 300 meters away. Moreover, camera act as vision system to capture sharper and detail image when facing challenging environments.

Meanwhile, radar complements both lidar and cameras with ability to estimate speed of object and direction. This very useful in challenging weather such as fog, rain and snow. The popular modal that uses fully autonomous cars is Jaguar I-PACE. Therefore, with the help of AI and machine learning, Waymo Driver uses all information to determine safe route and enable to respond in any traffic condition. The ability to record driving data which is used enhance its performance over time. (Lutkevich, 2019).

Challenges In Autonomous Cars

Weather and Traffic Conditions

Firstly, challenges in lidar and radar of the autonomous cars to sensing the environment conditions. Such as during bad weather, unexpected encounters and traffic conditions. The laser light emitted from the lidar system can be interrupted by snow, fog and heavy rain. The lenses become low visibility and the vision system of the car difficult to identify image such as road signs and marking. Moreover, challenge in the tunnel will disturb the sensors and cameras because of lighting. Because the lighting inside and outside of tunnels is very contrast, the self-driving car face particular difficulties when navigating. In addition, GPS has limits regarding position accuracy and requires a clear view to be effective. Moreover, challenge in the tunnel of the road with interface of GPS such as constructing project that cause complex decision by the system. (Newton, 2022).

Localization

Secondly, automotive industry face challenging in localization because companies need to customized according to the customers experience. Company must take into various linguistic, demographic factors and others while designed the artificial intelligence for automotive applications. For instance, there are design and develop things such as style guides and voice personas by collaboration with linguist partner. This good idea to optimize across many languages. Thus, every automotive company keep analysis and improved AI software for different languages, cultures and country. (*Five Challenges of Artificial Intelligence for Automotive Applications*, 2020).

Security Concern

In addition, automotive industry that works with technology, sensitive information and important software definitely requires proper security. This one of challenges in cybersecurity to ensure the data handled correctly. So, they need additional security for save all the important data of the company. for instance, company face challenges to protect the self-driving cars by machine learning. Most companies look for data partners who provide solutions including secure data access, private cloud deployment

and others. (Causevic, 2017). When developing extensive AI project, the high security standard is crucial in this industry. Therefore, they need competition with other company in order to meet partners who want provide this type of security.

Self-Driving Technology Research in Malaysia

Malaysia aims to lead international development in engineering, manufacturing, and technology. In order to achieve this, the National Automotive Policy 2020 (NAP 2020) aims to grow Malaysia's automotive sector through research and development of new technologies, especially in the fields of Next-Generation Vehicles (NxGV), Industrial Revolution 4.0 (IR 4.0), and Mobility-as-a-Service (MaaS). (Amirul, 2021). Since 2019, the autonomous vehicle test bed (AVTB) has been conducting tests to see how well different technologies work with the local environment and infrastructure while analysing autonomous vehicles and creating NxGV parts and components. The Cyberjaya MyAV Testing Route is a forward-thinking initiative to support the AVTB in a bigger way, possibly increasing local technical innovation in the NxGV space. (Jerrica, 2020).

In September 2016, a level 3 automated self-driving Proton Perdana was developed by REKA, a Malaysian R&D tech company. As part of the 5G Malaysia demonstration in April 2020, Celcom displayed a self-driving Proton Exora using the autonomous system created by MooVita and Ericsson, accelerating the development of autonomous car technology. (Gill, 2019).

Figure 2: The Self-Driving Prototype of The Proton Perdana

Figure 3: The Self -Driving Prototype of The Proton Exora

A local startup, Kommu aims to achieve an autonomous self-driving technology, the startup turns existing car into a level 2 of the 6 level of automation driving by the Society of Automotive Engineers (SAE). (Dayangku, 2022). Although, Kommu being a level 2 advanced driver assistance system, it still requires driver attention. The product, KommuAssist include feature such as auto lane centering, auto gas and brake, auto lane change with the ability to integrate with a vehicle's blind spot monitoring function, active safety features like a pre-collision warning, lane departure warning, and auto emergency braking.

Figure 4: The Advance Driver Assistance System (ADAS) Of the Kommuassist

Figure 5: The Product of The Kommu Company

Conclusion

In conclusion, semi- and fully autonomous vehicle technology is highly developed and ready for commercial deployment. Street mapping, accident avoidance, and navigation have all advanced significantly thanks to major automobile manufacturers and software providers (West, 2016). Governments' regulatory practices have the power to either hasten or hinder the transition to autonomous vehicles. All nations considering autonomous vehicles should place a high priority on addressing pertinent issues and ensuring that regulatory guidelines are clear.

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