RECENT DISCOVERIES IN AI - EVOLUTION OF AUTONOMOUS VEHICLES

ASSIGNMENT – 3

IFT 598 – AI IN CYBER SECURITY

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Abstract:

Self-driving cars have been a concept for far longer than just Google's current development [1]. In fact, Futurama, a display at the 1939 New York World's Fair, is where the idea of an autonomous vehicle first appeared. The exhibit was designed by General Motors to showcase their vision for the future of the world in 20 years, which featured an automated highway system for self-driving automobiles. Even if a future full of driverless vehicles isn't yet a reality, many modern automobiles come equipped with them, including braking and parking assistance systems. Full-fledged autonomous cars are still being developed, with the aim of making driving a car safer and easier in the ensuing decades.

The idea of Autonomous vehicles is being developed for various purposes. These vehicles are being developed to make our daily commute easier, to reduce traffic congestion on the roads and even to help the environment. The autonomous vehicle industry is expected to grow from $3 billion in 2016 to $42 billion by 2025.

History of Autonomous Cars:

Norman Bel Geddes developed the first self-driving automobile at 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 included into the car's front end. The steering wheel of the car may be moved left or right by manipulating the current [2].

The idea of autonomous vehicles has been around for a while. The first patent was filed in the late 1800s, and there have been many attempts to create practical autonomous vehicles. But the idea didn't really start to gain traction until the 1990s when the Defense Advanced Research Projects Agency (DARPA) started a research program called "Highways of the Future" (HOT). This program was aimed at creating self-driving cars that could be used for military purposes. The program ran from 1991 to 1998 and it helped pave the way for Google's self-driving car project, which was launched in 2009. However, this project didn't gain much traction until 2012 when Google acquired an AI company, DeepMind Technologies - DeepMind's AI [3].

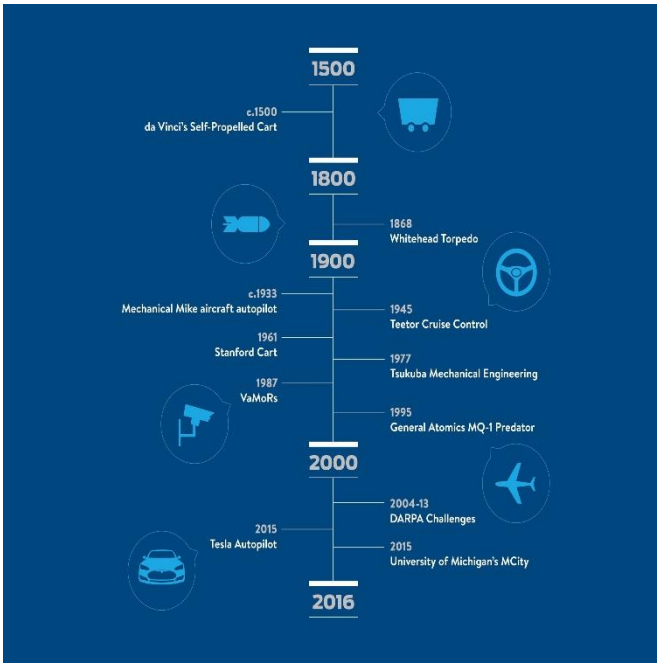

Fig -1: Journey of Autonomous Vehicles [4]

At present, many vehicles on the road today are regarded as semi-autonomous due to security features like assisted parking and braking systems, and a select number are equipped with the

capacity to drive, steer, brake, and park themselves. Using GPS and sophisticated sensory technologies, autonomous vehicles can recognize lane markings, traffic lights, and unforeseen obstructions. 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 new cars coming off assembly lines globally will be autonomous. In anticipation of the day when autonomous car technology would be widely used, many of states currently have laws governing its usage.

Software and Hardware Requirements:

A self-driving automobile is one that runs without a human driver having to steer or press a pedal. Although the technology is available, there are presently no completely autonomous self-driving vehicles on public roads. Tesla's vehicles, which in some circumstances can drive themselves but still require drivers to pay attention to the road, are the closest to being self-driving. The five levels of autonomy were established by the Society of Automotive Engineers (SAE) to categorize self-driving cars. The majority of automobiles on the road now are level 2 vehicles, while level 5 prototypes are already undergoing testing, and according to industry analysts, level 4 autonomous vehicles might be driving on public roads within the next ten years.

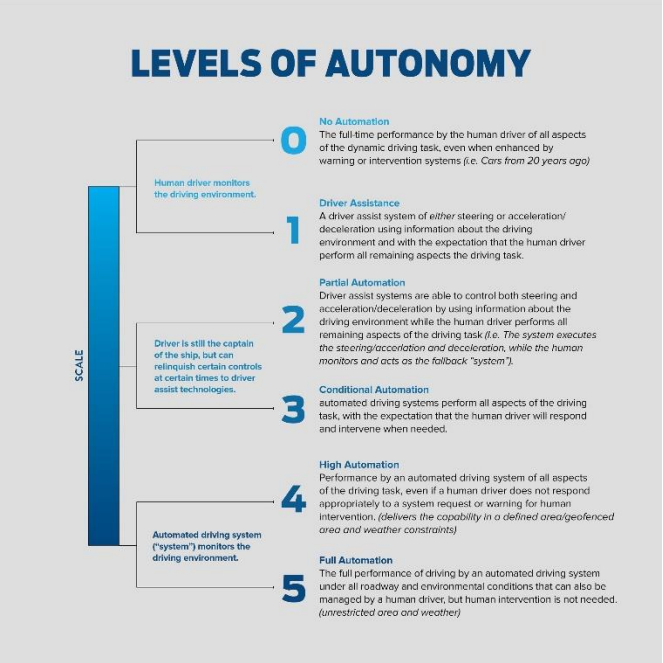

Fig-2 : Levels of Autonomy [5]

The software that autonomous cars need to operate is executed by sensors, actuators, sophisticated algorithms, machine learning systems, and robust processors. Based on a range of sensors placed

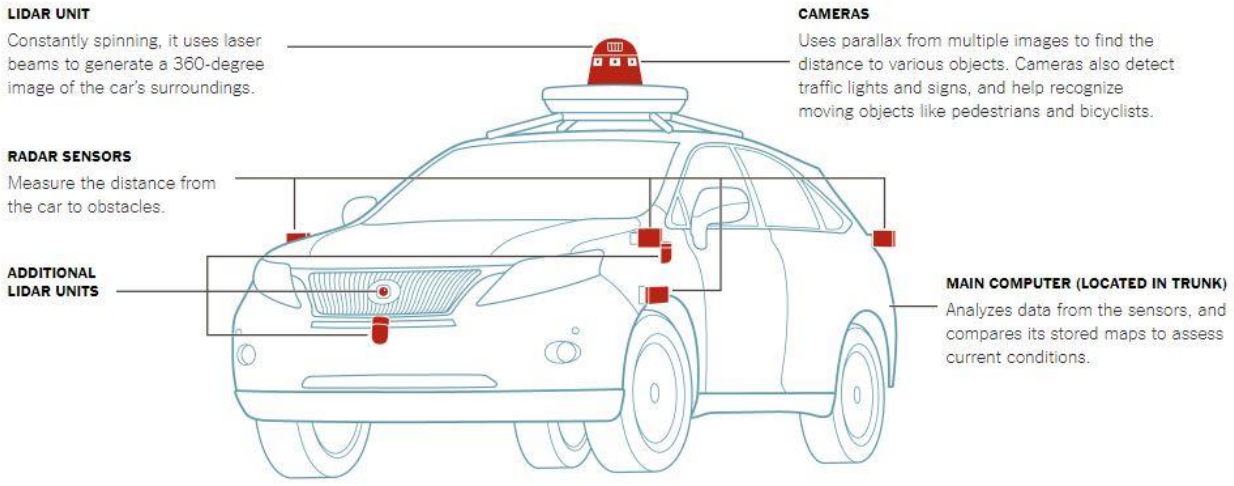

Fig-3 : Autonomous vehicle hardware & Software configuration [6]

in various places of the automobile, autonomous vehicles build and update a map of their environment. Radar sensors keep track of where neighboring cars 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 obstacles and other cars.

SLAM is a powerful computer vision and machine learning framework that can be used to map an environment. SLAM stands for Simultaneous Localization and Mapping. It's a technique that allows you to create maps of an environment while simultaneously keeping track of the robot's location within that environment. SLAM is used in many robotics applications, such as autonomous cars, robotic vacuum cleaners, and warehouse robots. When the autonomous vehicle generates data from its surrounding environment and feeds it to the intelligent agent, who then makes judgments and enables the autonomous vehicle to undertake specified actions in that same area, a repeated loop known as Perception Action Cycle is generated.

ADAS stands for Advanced Driver Assistance Systems. It is a system that can be found in cars that helps drivers to avoid accidents. The ADAS system typically consists of sensors and cameras that work together to monitor the car's surroundings and provide information to the drivers about what is happening on the road.

Legislations:

Autonomous vehicles, commonly referred to as self-driving automobiles, have the power to completely change how—and how safely—people go from point A to point B. Federal, state, and municipal governments are researching, discussing, and addressing the potential advantages and difficulties of this impending transportation revolution as the technology advances.

In 2015, there were more than 35,000 highway deaths on American roads, with driver error accounting for 95% of all car accidents. Autonomous vehicle proponents contend that they could eliminate human error from the driving equation and avoid the majority of collisions. Additionally, they view the creation of autonomous cars as having potential economic benefits for their state.

The National Highway Traffic Safety Administration (NHTSA) demonstrates its commitment to saving lives on our nation's roads and highways through its approach to the safe development, testing, and deployment of new and advanced vehicle technologies with enormous potential for improving safety and mobility for all Americans.

The National Highway Traffic Safety Administration (NHTSA) endorses the Safe System Approach, a data-driven, comprehensive, and equitable approach to highway safety that completely incorporates the demands of all users. Vehicle safety technologies, as part of this strategy, provide unique prospects to decrease traffic deaths, injuries, and harm [7].

Challenges:

Autonomous vehicles must learn to recognize a wide range of items in their route, from branches and garbage to animals and humans. Tunnels that interfere with the Global Positioning System (GPS), building projects that necessitate lane changes, and difficult judgments, such as where to stop to allow emergency vehicles to pass, are all obstacles on the road.

The systems must make rapid judgments on when to slow down, swerve, or maintain regular acceleration. This is an ongoing difficulty for engineers, and there have been instances of self-driving cars pausing and swerving excessively when objects on or near the highways are identified.

This issue was highlighted in a deadly accident involving an Uber autonomous vehicle in March 2018. According to the business, the vehicle's algorithms detected a pedestrian but judged it a false positive and did not swerve to avoid hitting her.

With crashes comes the issue of responsibility, and policymakers have yet to establish who is responsible when an autonomous vehicle is involved in an accident. There are also substantial fears that the software used to drive self-driving vehicles may be hacked, and automakers are striving to solve cybersecurity problems[8].

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