Assignment 1: Recent Advances in AI Essay

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Artificial intelligence is the ability of a computer to perform tasks that resemble human learning and decision-making (Cheprasov, A., 2023). Autonomous vehicles, also known as self-driving cars, utilize driver assistance technologies to eliminate the need for a human operator. The development of these vehicles spans decades, with engineers like Ernst Dickmanns and institutions like Carnegie Mellon University laying the groundwork in the mid-20th century. DARPA, or the Defense Advanced Research Projects Agency, accelerated this technology through their Grand Challenges, which sparked advancements in sensor systems and computer algorithms crucial for autonomous driving (Anderson et al., 2014). Partnerships between automobile manufacturers and educational institutions have paved the way for initiatives such as Google's Driverless Car program. These partnerships have pushed this technology from theory to reality.

The idea of autonomous vehicles has been driven by several reasons and for various societal benefits. Most car accidents result from human error and impaired driving. Driving under the influence, lack of sleep, distractions from passengers, medical events, and other human-related issues are far too common. The Alliance for Automotive Innovation highlights many potential benefits on its website. According to the alliance, driver-assist technologies like blind spot monitoring and lane departure warnings enhance road safety. Reducing accidents and impaired driving decreases congestion caused by stop-and-go traffic from road incidents. This improvement leads to environmental benefits, as less idling reduces greenhouse gas emissions and fuel consumption. Additionally, these vehicles boost productivity by allowing people to focus on things such as work, rest, reading, or taking phone calls instead of driving. Autonomous vehicles also offer significant advantages to individuals with disabilities who may not be able to drive themselves, as the car can handle the driving for them (Alliance for Automotive Innovation, 2024).

Automation in cars ranges across several levels starting at level 0, which is entirely manual driving with no autonomous features, to level 5 which refers to vehicles that can operate entirely on their own without any driver present (Cole, R., 2024). At level 1, the driver is operating the vehicle, but with assistance from one automatic feature at a time, such as cruise control or lane centering assistance. Level 2 still requires the human to be in full operation of the vehicle, but there is assistance from at least two automated features such as auto braking and steering or auto acceleration. At stage 3, the vehicle can operate autonomously, but the human must monitor conditions and take control if the vehicle alerts them to do so, or if there is any cause to intervene. Autonomous vehicles at stage 4 are like the self-driving Tesla or Waymo. At level 4, the vehicles can operate without assistance or attention from a driver and are officially driverless in certain environments. Level 5 autonomous vehicles do not currently exist. Level 5 would be vehicles that require zero assistance or input from a human being.

Self-driving cars must accomplish three tasks to effectively replace a human driver: perceive, think, and act. These functions are facilitated by an array of advanced technologies, including cameras, computers, and controllers (Menke, T., 2017). For both humans and autonomous vehicles, the process involves perceiving the environment, processing information taken in from the environment, and then determining the appropriate actions to execute. These steps work cyclically to enable the vehicle's movement.

Perception involves the ability to see, hear, or become aware of something through the senses. While operating a vehicle, humans rely on their eyes and ears for perception. In contrast, a self-driving vehicle uses cameras, LIDAR sensors, and radar for perception. Cameras provide 360-degree vision and are effective at identifying shapes and colors in the environment. As mentioned by Menke, LIDAR (Light Detection and Ranging) sensors emit invisible laser beams that rotate continuously to detect the location of people and objects around the car. These sensors send invisible light pulses in all directions and measure the travel time and location of the reflected light to determine the shape and position of nearby objects (Menke, T., 2017). Conventional radars complement these sensors by detecting moving objects.

Computing can be understood as the process of determining or making sense of information. While driving, humans use their brains to interpret and respond to various situations, such as deciding when to use a blinker, honk the horn, slow down, speed up, or react to traffic signs. Similarly, a self-driving vehicle relies on a computer to perform such tasks. Using GPS, the computer initially outlines a general route to the destination. As the car perceives its environment, data from cameras, LIDAR sensors, and radars are sent to the computer, which manages the vehicle's decision-making (Menke, T., 2017). These perception tools pinpoint the car's exact location and identify nearby objects, enabling the vehicle to navigate busy streets, change lanes, stop at traffic lights, yield to pedestrians, and otherwise respond appropriately and safely to its surroundings.

Control can be defined as supervising the operation of something. Humans use their hands and feet to control a vehicle's movement through the steering wheel, brake, and gas pedals. Self-driving cars, on the other hand, use control electronics to manage the vehicle. Once the computer identifies the surrounding objects and their distances, it makes a decision and executes it. This process employs machine learning techniques similar to those used in speech and facial recognition (Menke, T., 2017). The vehicles are programmed with algorithms that allow them to learn from past actions and make inferences for handling new, similar situations (Menke, T., 2017). After the car's computer determines the appropriate action, it sends electronic commands to the controllers that maneuver features such as the steering wheel and brakes.

According to the Insurance Institute of Highway Safety, as of May 2024, states are still developing legal frameworks for self-driving vehicles. State laws and provisions regarding the type of driving automation allowed on public roads vary. Some states permit only testing, while others allow deployment, often limited to commercial purposes. For instance, Michigan's regulations on driving automation depend on the vehicle type. Requirements for an autonomous vehicle operator to be licensed or present in the vehicle also differ. In Colorado, no license or presence is required by law, whereas most states mandate a licensed operator. Several states have not yet addressed the licensing requirement, while others specify it based on the vehicle or level of automation. Liability insurance requirements also differ by state. As you can see, as the use of autonomous vehicles expands, states are continuously creating, modifying, and implementing laws to govern their use.

The rapid increase of autonomous vehicles will introduce moral issues that impact both present and future scenarios. One significant area of concern lies in economics. As autonomous vehicles become more prevalent, the demand for taxi drivers and drivers for companies like Uber and Lyft will diminish. This could profoundly affect individuals who rely on such jobs for their livelihoods or those who lack the experience to transition into alternative employment opportunities if their role as a driver becomes obsolete due to fully autonomous vehicles. While the need for engineers proficient in the software and hardware required for these vehicles will rise, these positions demand specialized education and training, making them less accessible to job seekers. This shift from low-skilled labor to highly specialized engineering roles could present a moral dilemma. Individuals who lose their jobs as drivers may lack the necessary skills or experience to pursue newly created roles associated with autonomous vehicles.

Another moral implication, as articulated by Rachel Wallace at the University of Michigan, involves the possibility that owners of autonomous vehicles may deploy their cars to drive aimlessly without passengers to avoid parking fees. This practice raises ethical concerns as it contributes to unnecessary traffic congestion, results in financial losses associated with parking fees, and adds to environmental pollution (Wallace, R., 2017).

The increase in the use of autonomous vehicles will positively impact the elderly population. These cars will allow this population to maintain independence and access essential services without relying on others for transportation. This will increase the quality of life and social inclusion for the elderly and others with limited mobility (Harper et al., 2016). These vehicles may have positive impacts on equity in other ways as well. Autonomous vehicles are better suited for carpooling and car-sharing as companies do not need to hire and pay drivers. Low-income individuals who do not live near public transportation may be able to benefit from community-based transportation services in the form of self-driving ride-share vehicles (Cao et al., 2021).

The rise of autonomous vehicles signifies a significant advancement in transportation and promises safer roads and increased efficiency. However, the adoption of these vehicles brings moral dilemmas, particularly concerning employment and ethical usage. As states continue to develop legal frameworks, it’s crucial to address these concerns proactively to ensure equitable opportunities and responsible deployment. By navigating these challenges carefully, we can maximize the benefits of autonomous vehicles while minimizing their societal impacts.

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