Report on AI in Autonomous Vehicles

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***Abstract*—**

I. Introduction

The technology in automobile industry has made some remarkable progress the last century. They have managed to make safe, reliable and affordable vehicles. The last couple of decades have seen significant advancements in computation and communication technologies, and consequentially autonomous vehicles (AV) are now becoming a reality [1]. Several prototypes exists today. Among others, Volvo have started implementing autonomous trucks that deliver goods [2].

A. Autonomous vehicles

1) What is it?: A definition of autonomous vehicle (AV) can be a vehicle which senses it's environment with little or no human input or interaction This means that the vehicle is capable of gathering information about the environment around it such as objects, temperature, position, velocity etc. And execute tasks or functions according to certain directives.

2) Why?: Humans are biological lifeforms which depends and reacts on, among other things but not limited to, sleep, food, stress, isolation, social interactions and other similar processes. Besides being complex lifeforms humans react differently to these processes choices taken, in certain situations, differ greatly.

Machines today are not dependent on such stimuli and therefor they can, theoretically, continue with tasks to an infinite amount of time. At mundane and repeated tasks such as arithmetic calculations or retaining huge amounts of data, machines and computers excel with unrivalled precision and accuracy. This makes them good candidates for making pure rational and logical decisions based on optimal outcomes of certain criteria.

Based on this assessment machines would take more optimal choices over time in comparison with the average human. And their choices would be easier to determine based on simulations and testing scenarios. This would make outcomes and outputs deterministic and easy to predict and consequentially present a good basis for development and optimization.

3) Terms:

II. Theory

A. Technology

A brief presentation on certain technologies implemented in todays land based vehicles. Both autonomous and nonautonomous.

1) Real Time Operating System: Cars today rely on numbers of sensors to acquire information about their surroundings. The velocity, GPS, proximity to obstacles, temperature etc. This sensors communicate to certain modules that is connected to a operating system (OS). This is often a specialized form of OS. A so called Real Time Operating System (RTOS) makes up the central core and processor of the car. Within, all decisions based on data form the sensors are made and functions executed. Some aspects of RTOS are presented here.

a) Hardt time RTOS: A deterministic RTOS. Meaning that the output of the RTOS should happen within a certain time or deadline. Used in mission critical systems like medical devices, fight control space shuttles etcetera.

b) Soft time RTOS: Not as deterministic as Hard Time, but deadline of tasks and processes should be met within certain limits. The RTOS performance will degrade if tasks are never done within deadline and would be useless. Examples here can be audio-visual-systems for entertainment, games and general purpose OS's like Windows, Ubuntu and iOS.

2) Camera: Cameras are indispensable for providing visual information and feedback to any system, in regards to its environment. In comparison to radar, LIDAR or similar sensors, cameras are affected by weather, dust and pollution.

3) RADAR: Radio Detection and Ranging (RADAR) can complement the camera and is resistant to both pollution, weather and similar. It emits electromagnetic waves which reflects on obstacles and back to the RADAR. Distance, velocity and position (relative to the RADAR) can then be calculated with great accuracy. There are different types of RADAR and the most used is Frequency-modulated continuous Wave (FMCW).

a) FMWC: Allows the detection of small objects with the use of the Doppler effect. Since the known transmitted frequency is known, stable and slow-moving objects can be filtered out of the receiving signal. This reduces interference and increases the signal to noise ratio.

4) LIDAR: Goes under many names. One of them is "Laser Imaging and Ranging". This method utilizes laser beams

and their reflection of of objects to measure distance. Also called ranging. The lidar's output would be point cloud data, which provides all the necessary information, to a software for detecting and determining where potential obstacles and objects are located in the environment.

5) GPS: A property of the United States Government. GPS is acronym for "Global Positioning System". It utilizes satellites for positioning. The system is freely available for anyone with a GPS receiver and has global coverage. Several other systems from other countries exists. As long as a GPS receiver has line of sight to four or more satellites, a pinpoint of position can happen with an accuracy of two meters or less.

B. Autonomy

The definition for autonomy would be the capacity to make informed and uncoerced decisions, based on some set of information. From a more metaphoric perspective, this would be that an entity, person or organization would be given self-governing capacity. This to make decisions not forced on it by a higher ranking entity, regime, person etc.

C. Machine learning

1) Deep learning:

D. Algorithms

1) Neural networks:

III. Various implementations of AI in AV's

A. Which algorithms are used?

What kind of algorithm used is dependent on computational ability and determined on what kind of technology implemented within the AV. Be it GPS, LIDAR or any similar technology.

IV. Discussion

A. Safety

B. Implementation

C. GDPR

V. Conclusion

References

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