SELF DRIVING CARS DRIVERLESS /AUTOMATED TECHNOLOGY

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ABSTRACT

Self-driving cars have, in recent years, clearly become among the most actively discussed and researched topics. By all definitions, these systems, as a third robotic revolution, belong to the robotics field, despite the fact that people generally assign them to a specific domain of the automotive industry. Autonomous car/Driverless car can also be called as robotic car since it automatically operates by itself without the aid of any driver. This car senses environment such as traffic, weather, surface conditions, road infrastructure, adjacent cars, maps, sign boards etc with the help of cameras, radar, lidar, GPS and navigational paths. The advantages of autonomous cars over normal cars is such as fewer traffic collisions, increased reliability, increased safety, reduction of accidents, increased efficiency, secured human life etc. The main disadvantages of it, is the issues of cyber security, software malfunction, liability of damage and loss of driver related jobs. This paper gives the information on working of autonomous cars by explaining the working of various sensors used to control it.

INTRODUCTION

Autonomous cars create and maintain a map of their surroundings based on a variety of sensors situated in different parts of the vehicle. Radar sensors monitor the position of nearby vehicles. Video cameras detect traffic lights, read road signs, track other vehicles, and look for pedestrians. Lidar (light detection and ranging) sensors bounce pulses of light off the car's surroundings to measure distances, detect road edges, and identify lane markings. Ultrasonic sensors in the wheels detect curbs and other vehicles when parking. The vehicle uses positional information from the GPS and inertial navigation system to localize itself and sensor data to refine its position estimate as well as to build a three-dimensional image of its environment. Data from each sensor is filtered to remove noise and often fused with other data sources to augment the original image.

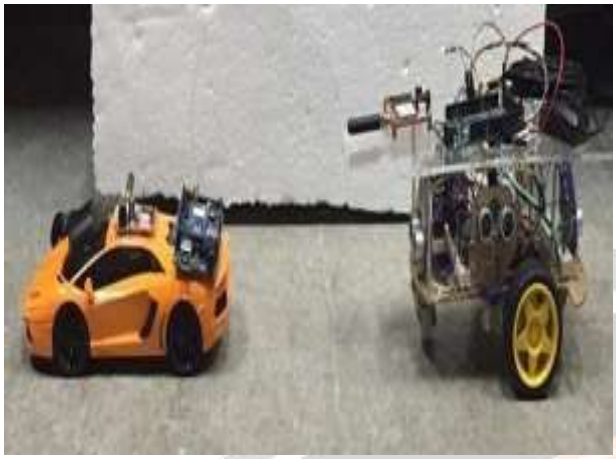
Sophisticated software then processes all this sensory input, plots a path, and sends instructions to the car's actuators, which control acceleration, braking, and steering. Hard-coded rules, obstacle avoidance algorithms, predictive modelling, and object recognition help the software follow traffic rules and navigate obstacles. This process of localization, mapping, obstacle avoidance and path planning is repeated multiple times each second on powerful on-board processors until the vehicle reaches its destination.

The next section focuses on the technical components of each process: mapping and localization, obstacle avoidance and path planning. Although car manufacturers use different sensor suites and algorithms depending on their unique cost and operational constraints, the processes across vehicles are similar. The descriptions below most closely mirror their implementation in state-of-the-art selfdriving military vehicles.

LITRATURE SURVEY

Fully autonomous vehicles have a huge potential to enhance mobility. However, the trust to accept these technologies is not yet here for many potential users and may need to be built-up over time. The survey poll results suggest there may be some hesitancy around one's reassure with full automation among the major population. Improved schooling methods with greater closely align and preferred studying strategies may additionally help. Ultimately leading to adoption of fully self-reliant cars.[1]
This is an advanced step for autonomous driving vehicles. With the help of this algorithm, vehicles can be set to automatically navigate to the destination location by continuously receiving the direction from another vehicle moving ahead to the same destination. The robotic vehicle routes itself with the guidance of another vehicle moving ahead to the same destination, therefore, deviations in time can occur. The goal of navigation process

for a robotic vehicle is to move the robot to a known destination in an unknown environment. The navigation planning is one of the vital aspects of autonomous systems. When the robotic vehicle actually starts to move towards the planned route it may find unknown obstacles from the existing location to the destined location, hence the robotic vehicle must avoid the obstacles and follow an optimal route to reach the destined position. The potential applications of this robotic vehicle are to use these types of autonomous vehicle on highways or heavy traffic roads. These types of autonomous vehicles can also be used when a driver travels to the new areas. It is an improved navigation system for autonomous vehicles. [2]



Autonomous vehicles have been subject to research and development for nearly a century. Vehicle to vehicle communication is in the near future. Cars will no longer he thought of as simple a transportation option, but rather a mobile entertainment centre equipped with WI-FI, television and a entertainment dedicated onboard computer. Autonomous car is a super computer with deterministic network on wheels. 5G will play significant role in autonomous vehicle. Upon addressing the mechanics of the driverless car as well as its benefit and potential issues, it is quite interesting to see how the world will actually look by the year 2040.Companies manufacturing them should take great care and control mechanisms for these vehicles [3]

In the near future, our professional ambition and conduct will increasingly be directed towards vehicles furnished with the state of the art and sophisticated equipment. Such systems are aimed to ease and facilitate the drive, yet, they might be the cause of complication upon professional investigation of the accident. Autonomous vehicles are still a developing technology. A large number of companies and researchers have speculated about future developments and the possible effects of the vehicles. The following section describes the various visions of vehicle producers regarding the future of autonomous vehicles: - By 2020, Google autonomous vehicle project head's goal is to have all outstanding problems with the autonomous vehicle resolved.

- By 2020, Volvo envisages having vehicles in which passengers would be immune from injuries.
- By 2020, Daimler and Ford, Mercedes-Benz, Audi, Nissan and BMW all expect to sell autonomous vehicles.
- By 2020, GM, Mercedes-Benz, Audi, Nissan, BMW, Renault, Tesla and Google all expect to sell vehicles that can drive themselves at least part of the time. (Level 3)

SAE level	Name	Narrative Definition	Execution of Steering and Acceleration/ Deceleration	*Monitoring* of Driving Environment	Fallback Performance of *Dynamic Driving Task*	System Capability *(Driving Modes)*
***Human driver* monitors the driving environment**						
0	**No Automation**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Driver Assistance**	the *driving mode*-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the dynamic driving task with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an automated driving system of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

- By 2024, Jaguar, Daimler and Ford expect to release an autonomous vehicle. Ford predicts it will have the first mass market autonomous vehicle, but released no target date.
- By 2025, most new GM vehicles will have automated driving functions as well as vehicle -to-vehicle communication technology.
- By 2035, Navigant Research forecasts that autonomous vehicles will gradually gain traction in the market over the coming two decades and by 2035, sales of autonomous vehicles will reach 95.4 million annually, representing 75% of all light-duty vehicle sales.
- By 2040, expert members of the Institute of Electrical and Electronics Engineers (IEEE) have estimated that up to 75% of all vehicles will be autonomous. (Kalašová et al., 2018)[4]

It can be a path changer as it will reduce the number of accidents that take place and in turn reduce wastage of time during transport in the future without any hindrances. This idea when implemented will be a boon to blind people as they cannot drive themselves at present.[5]

The system aims to improve the safety of self-driving technology using new techniques. It is mainly about implementing a self-driving car that can make its own decisions accurately. The system is considered to be a prototype car that contains sensors and cameras to perceive the surrounding environment. The methodologies used in the system are lane detection using image filtering methods along with Hough transform feature extraction technique, anomalies detection using SVM classification algorithm with radial basis function, and distance measurement using disparity map. The result of lane detection is that the car moves accurately in its path according to the signals that are being sent to the motors from the road lane detection algorithm. For anomalies detection, the car is able to detect the road anomalies with an accuracy of 98.6%. Finally, for the results of the distance measurement, the car is able to make the right decisions either moving forward, slowing down, or stopping based on the disparity map algorithm output. The car was tested in an indoor and outdoor environment and its performance was very good. During the development process, we reached our goal which was to apply the idea on a small car prototype. So, we aim that our future work will consider applying this systemin a real car. [6]

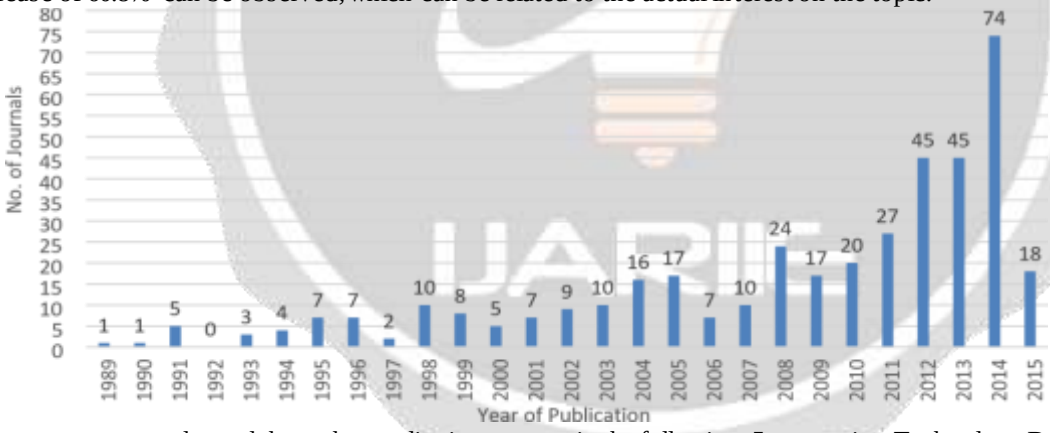
The automobile industry is ever-evolving with new technologies to increase the handling and efficiency of the car being invented and employed every year. The most anticipated and talked about topic – 'autonomous

vehicles will revolutionize the way people travel. With the advent of autonomous vehicles just around the corner, experts are evaluating the advantages/disadvantages and the impacts have been discussed thoroughly but surely the positive impacts of driverless concept are significant and cannot be disregarded. Also, the impacts turning positive or negative hugely depends upon the mindset of humans using it, thus regulations and rules are to be set for better results [31]. The obstacles are a cause of concern but can be improved with time and experience. Therefore, due to some challenges it would not be wise to discard the whole concept. The applications of autonomous vehicles are numerous which would certainly be very helpful for transportation industry as self-driving taxis and delivery trucks would reduce the manual labour a lot.[7]

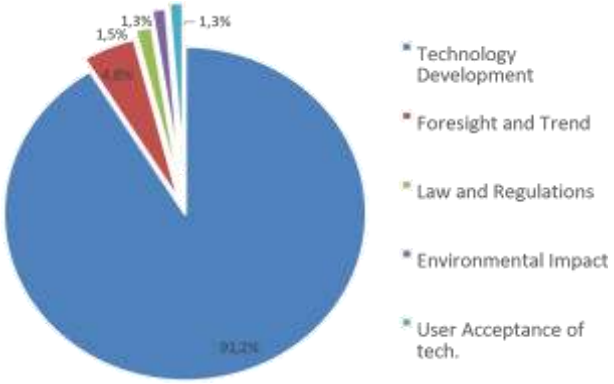
Though the idea of relying completely on technology for our safety and comfort is a new beginning for us and sometimes new things can be difficult to adjust to a proper and full implementation of our proposed system will not only ease the hard-working lives of our people, but also help the environment big time. With emerging and increasing expectations, awareness on the right use of this technology and its benefits must be presented. By proving the right and reasonable cost for the right technology, consumers will tend to accept the revolution more and eventually become a part of it. The proposed system was developed, with the help of Machine Learning and Image Processing, keeping in mind how it will benefit in reducing the increasing number of accidents and make the journey more convenient.[8]

ANALYSIS OF RESEARCH OVER TIME

Through this method, good insight can be gained on the origin and development of a research field over time (Dahlander & Gann, 2010). As shown in Figure we can observe the development of self-driving cars research throughout the last decades, demonstrating at the same time a continuous increase of the interest on the topic as well as important milestones that can also influence the topic development and research such as in this case the DARPA Grand Challenges in the beginning of 2004 and end of 2005 or the Urban Challenge in the end of 2007 (DARPA, 2015), that were relatively important events in the field. Furthermore, from 2013 to 2014 a rapid increase of 60.8% can be observed, which can be related to the actual interest on the topic.



All papers were catalogued through a qualitative process in the following 5 categories; Technology Development, Foresight and Trend, Law and
Regulations, Environmental Impact, and User Acceptance of Technology.



CONCLUSION

This paper discusses basic chronology leading to the development of autonomous cars. Autonomous vehicles developed from the basic robotic cars to much efficient and practical vision guided vehicles. The development of Mercedes- Benz vision guided autonomous van by Ernst Dickmanns and his team gave a paradigm shift to the approach followed in autonomous cars. Also, contemporary developments in autonomous cars reflect the vivid future autonomous cars behold. Official future predictions about autonomous cars point out that most automobile companies will launch cars with semi and fully autonomous features by 2020. Most cars are expected to be fully autonomous by 2035, according to official predictions as cited earlier. This paper reviewed the historical antecedents, contemporary advancements and developments, and predictable future of semi and fully autonomous cars for public us.

Sixty-five years of automotive baby steps

FUTURE SCOPE

Research has shown that the number of U.S. deaths resulting from road accidents could be reduced by more than 90% by the year 2050 because of self-driving cars. However, this is not the only effect driverless cars will have on our future. The transition from self-driving cars with varying levels of autonomy to fully autonomous vehicles is yet to be made. However, modern AI technologies and machine learning development are making rapid leaps forward in this direction, and that is what's driving the industry forward. Top automotive brands such as General Motors, Ford, and Tesla are in the final stages of testing their driverless vehicles which means we are on the verge of seeing a revolutionary change in the way we commute.

In the near future, AVs will be an indispensable part of modern transport systems. Furthermore, in light of such rapid changes in intelligent transportation systems, the education system must without question, align itself with these emerging technologies. Traffic engineering schools must reform their curricula to ensure that they cover more diverse subjects including communication technologies, software development, electrical engineering, and environmental and energy sustainability

Table: Most cited publications in the Autonomous Driving field

Author Name	Title of the Paper	Year	Source	Cited
P.A. Ioannou, C.C. Chien,	Autonomous intelligent cruise control	1993	IEEE Transactions on vehicular technology	330
U. Franke, D. Gavrila, et ál	Autonomous driving goes downtown	1998	IEEE Intelligent systems and their applications	311
M. Bertozzi A. Broggi, A. Fascioli,	Vision-based intelligent vehicles: State of the art and perspectives	2000	Robotics and Autonomous Systems	364
P. Hidas	Modelling lane changing and merging in microscopic traffic simulation.	2002	Transportation Research: Part C	230
T.-H.S Li, C. Shih-Jie et ál.	Implementation of HumanLike Driving Skills by Autonomous Fuzzy Behavior Control on an FPGA-Based CarLike Mobile Robot.	2003	EEE Transactions on Industrial Electronics.	155
W. Wijesoma, K.R.S. Kodagoda, et ál.	Road-Boundary Detection and Tracking Using Ladar Sensing.	2004	IEEE Transactions on Robotics & Automation.	163
C. Urmson C. Baker et ál.	Autonomous driving in urban environments: Boss and the Urban Challenge	2008	Journal of Field Robotics	557
J. Leonard, J. How, et ál.	A Perception-Driven Autonomous Urban Vehicle	2008	Journal of Field Robotics	201
Y. Kuwata, S. Karaman, et ál.	Real-Time Motion Planning With Applications to Autonomous Urban Driving	2009	IEEE Transactions on control systems technology	164
K. Konolige, J. Bowman et ál.	View-based Maps.	2010	International Journal of Robotics Research	157

REFERENCES

[1] Mr. Mukul Dongre ,**A Review Paper on Autonomous Cars- Future of Mobility** ,Journal of Instrumentation and movation Sciences e-ISSN: 2456-9860

[2] Memon, Muzamil Ahmed, Shahzeb Ali, Azam Rafique Memon, Wajiha Shah **Self-Driving and Driver Relaxing Vehicle** National ICT R&D. ©2016

[3] Megha M1, Namratha shetty T G2, Pavan Kumar E3 **WORKING OF AUTONOMOUS VEHICLES** International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 06 Issue: 12 | Dec 2019

[4] Ján Ondruša,*, Eduard Kollab, Peter Vertaľb and Željko **Šarićc How Do Autonomous Cars Work?** University of Zilina, Faculty of Operation and Economics of Transport and Communications, Department of road and Transportation Research Procedia 44 (2020) 226–233

[5] Uvais Karni 1, S.Shreyas Ramachandran 2, K.Sivaraman 3, A.K.Veeraraghavan 4 **Development Of Autonomous Downscaled Model Car Using Neural Networks And Machine Learning Conference Paper** · December 2018

[6] Mahmoud Fathya,_, Nada Ashrafa, Omar Ismaila, Sarah Fouada, Lobna Shaheena, Alaa Hamdy **Design and implementation of self-driving car** , The 17th International Conference on Mobile Systems and Pervasive Computing (MobiSPC) August 9-12, 2020, Leuven, Belgium

[7] Mohsin Raza **Autonomous Vehicles: Levels, Technologies, Impacts and Concerns** International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 16 (2018) pp. 1271012714

[8] Dr. Sharmila S. Gaikwad, Uzma Kazi ,Richa Koli ,Samiksha Mhad eshwar **Model of Autonomous Car** International Journal of Engineering Research & Technology (IJERT)

[9] C. Urmsonet al., **"Autonomous driving in urban environments: Boss and the Urban Challenge,"** J. Field Robot., vol.25, no. 8, pp. 425-466, Aug. 2008

[10] S. Bunzel, **"AUTOSAR The standardized software architecture,"** Informatik-Spektrum, vol. 34, no. l, pp. 79-83, 2011

[11] Hillary Abraham, Chaiwoo Lee, Samantha Brady, Craig Fitzgerald, Bruce Mehler, Bryan Reimer, & Joseph F. Coughlin **Autonomous Vehicles, Trust, and Driving Alternatives: A survey of consumer preferences**

[12] Juan Rosenzweig, Michael Bartl **"A Review and Analysis of Literature on Autonomous Driving"** THE MAKING-OF INNOVATION, E-JOURNAL makingofinnovation.com, OCTOBER 2015

[13] M. Frutiger and C. Kim**, "Digital Autopilot Test Platform with Reference Design and Implementation of a 2-Axis Autopilot for Small Airplanes,"** Departament of Electrical and, pp. 1– 24, 2003.

[14] D. Helbing, **"Traffic and related self-driven many-particle systems,"** Reviews of Modern Physics, vol. 73, no. 4, pp. 1067–1141, dec 2001.

[15] P. ˇSvec, A. Thakur, E. Raboin, B. C. Shah, and S. K. Gupta, **"Target following with motion prediction for unmanned surface vehicle operating in cluttered environments,"** Autonomous Robots, vol. 36, no. 4, pp. 383–405, apr 2013