# AUTONOMOUS NAVIGATION FOR DRIVERLESS CARS – A Survey

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***Abstract***

*In recent years, the spread of automobile technology has progressed, and autonomous driving has become an important issue. To provide safe, reliable and intelligent transportation systems, develop accurate positioning solutions considering various variables such as pedestrian behaviour, chance encounters with objects, road types and surroundings. is needed. Autonomous driving is expected to transform transportation by reducing current externalities, especially accidents and congestion. Over the years that automakers, scientists, and governments have been working on self-driving cars, significant progress has been made. The degree of research and development for autonomous vehicles in the fields of environment sensing, pedestrian identification, route planning, motion detection, and car security is examined in this paper. Our goal is to research and contrast the many potential technologies. Before cars are fully automated, these technologies must prove their correctness in their approach to solving these challenges in order to win the trust of the general public. In this article we have done literature survey on Autonomous navigation for driverless cars system which examines public perceptions of automobiles and public trust.*

**Keywords**
Artificial Intelligence, Autonomous driving, Self-driving cars, Path planning, Motion control, Vehicle cybersecurity, Pedestrian detection, Computer vision.

## INTRODUCTION

Vehicles were a subset of mechatronics, like the majority of common objects. However, the majority of them have evolved into new intelligent gadgets that need the internet to function thanks to the incredible development of embedded systems and IoT systems. Technology advancements have changed traditional vehicles into intelligent vehicles that are completely functional and provide more comfortable transportation. Modern technology's possibilities and advancements in automation serve as the foundation for intelligent cars. These intelligent cars are highly sought after as we advance, focusing on safety and improving daily living. These vehicles can detect their environment, stay connected to the internet, adhere to traffic regulations, navigate on their own, make split-second decisions, safeguard the safety of pedestrians and other passengers, park, etc.

Autonomous automobiles are among these machines. Currently, they are thought to be the most sophisticated kind of intelligent vehicle. The main driving forces behind the research and development of autonomous vehicles are the need for increased road safety, a growing population that adds more cars to the road, expanding infrastructure, the comfort of relying on machines for tasks like driving, and the need for resource and time management optimization. The population growth has had a negative impact on all of our resources, including our roads, infrastructure, parks, and petrol stations. Autonomous vehicles have developed and emerged as a result of outstanding scientific advancements in embedded and IoT systems, sensors and ad hoc networks, data collecting and analysis, wireless communication, and artificial intelligence.

## I. BACKGROUND

In GM's 1939 show, Norman Bel Geddes created the first self-driving automobile. It was an electric vehicle that was driven by radio-controlled magnetised metal spikes buried in the road and propelled by electromagnetic fields. By 1958, General Motors had made this concept a reality. The car's front end was equipped with pick-up coils, sensors that could detect the current flowing through a wire buried in the road. By adjusting the current, the car's steering wheel may be moved to the left or the right. By using a camera system that sent data to a computer so it could interpret images of the road, the Japanese developed on this idea in 1977. However, the maximum speed of this vehicle was less than 20 mph. German engineers made advancements ten years later with the VaMoRs, a camera-equipped vehicle that could safely travel 56 mph. As technology has evolved, so has self-driving cars' capacity to see and react to their surroundings.

Numerous teams developing autonomous vehicles were challenged in 2004 by the U.S. Defence Advanced Research Projects Administration (DARPA) to compete for a $1 million award. By 2015, it was anticipated that one-third of military vehicles would be self-driving. The initial batch of competitors failed badly, making it only a short distance before colliding. The Mojave Desert in California was being traversed by an odd flotilla of driverless cars and trucks without a scratch the next year. By 2007, the Urban Challenge had expanded those accomplishments to a fictitious urban setting. The foundation for self-driving had been created by European experts, but the United States was now a strong competitor. The disparity was caused by a number of things: better radar and laser sensors, as well as upgraded software for road-following and collision prevention. Also helpful was good mapping. Animals are better at analysing their environments than robots are, but a car that always "knows" what's around it can concentrate on variables that vary.

## II. PROBLEM STATEMENT

Autonomous vehicles, which were only a fantasy a few years ago, are rapidly approaching commercialization. Research on AVs is revealing the enormous implications that they might suggest for various professions as time passes and in tandem with technology advancements. Studies now underway set the groundwork for future research and highlight potential flaws that should be considered as technology and automobiles advance. Controversy arises in a dangerous situation since the AVs' behaviour will be dictated by pre-programmed ethical standards rather than on person moral or spontaneous impulses. This study, which focuses on passenger transportation, offers an overall view of the current state of the art for Autonomous vehicle that can aid academics in gaining a wider perspective.

## III. LITERATURE *SURVEY*

***I Barabás1*, A Todoruţ1, N Cordoş1, A Molea1 [1]:*** The various levels of driving automation, potential environmental and traffic safety effects, the importance of rules and their current status, the moral implications of introducing these technologies, and future deployment scenarios have all been examined by the authors of this paper. The authors claim that there are many challenges that self-driving systems must overcome. A) They have to make judgments more quickly in a variety of situations, some of which may present moral dilemmas; B) They have a big chance to cut down on pollution by planning their routes and driving styles and interacting with other vehicles, infrastructure, and their surroundings. C)Fortunately, the level of self-driving technology and the regulations in existence now differ significantly. D) There are a variety of concerns about one's ability to make the right decision in the case of numerous different types of approaching accidents.

***James Andrew Bagnell, David Bradley, David Silver, Boris Sofman, and Anthony Stentz*** **[2]**: The authors of this paper cover the components of this robotics approach as well as how machine learning helps to improve performance by making system tweaks understandable to non-experts and resulting in significant time and effort savings in engineering. A number of learning techniques, such as classification and regression, self-supervised learning, imitation learning, online (no-regret) learning, and iterative learning control, were used to make this performance possible. The full range of subsystems on the Crusher platform are affected by the learning strategies in our method, including far-field monocular and stereo vision interpretation, height map analysis, local and global motion planning, motor control, and vehicle positioning.

***C. Fernandez, M. Gavil ´ an, D. F. Llorca, I. Parra, R. Quintero, A. G. Lorente, Lj. Vlacic ´, M. A. Sotelo*** [3]: A real-time free space identification system using a cheap camera and a moderately priced lidar sensor is provided in this study. The extrinsic link between the two sensors is established during the off-line calibration procedure. With a vertical resolution of 3.2 degrees and 4 horizontal layers, the lidar provides measurements. These observations are time-integrated based on the relative motion of the vehicle between subsequent laser scans. Spanish speed bumps are handled differently because they are commonly considered an obstacle. Due to the association between raised zebra crossings and speed bumps in Spain, speed bumps should have been painted with white stripes.

***Shun Niijima, Yoko Sasaki and Hiroshi Mizoguchia*** **[4]:** This study illustrates an electric wheelchair's ability to navigate autonomously in real-time in a large urban setting. For use in urban environments, careful self-pose localization and motion control selection are essential since electric wheelchairs move swiftly over sidewalks and in dynamic conditions on paved highways. Both a localization module based on a 3D map and a path planning module based on a navigation map are included in our solution. Because the large-scale 3D map uses a lot of memory, the embedded PC cannot process the map data. The large-scale navigation map's greater computing expense for path planning slows navigation.

***Margarita Martínez-Díaza*, Francesc Soriguera*** **[5]**: This research provides a summary of the current state of the art in the main autonomous driving domains. The authors analyse different approaches to autonomous traffic, summarise the most important findings reached so far, and suggest a framework for future study based on information gathered directly from top academic institutions working in the area and on a review of the literature.

***Yahya Zare Khafri, Ali*** **Jahanian [6]:** The automatic line tracking system for swiftly moving cars is suggested in this research. The operation of an autonomous vehicle navigation system utilising infrared sensors and intelligent lines has been demonstrated. They cleverly illustrate the state of the road using a tracking line and diagonal lines. The infrared sensors are aware of the car on the road ahead of them because they can read the tips that have been attached to the tracking lines. As a result, auto navigation operates more deftly. The proposed system's tracking lines incorporate additional information like turn points and intersections on actual roads in addition to the road course.

***Sehajbir Singh and Baljit Singh Saini* [7]:** This paper will go over recent developments and challenges in autonomous vehicles. Along with a brief history of autonomous vehicles, it offers a quick account of the history of the automobile in general. It also includes a list of advantages to using autonomous vehicle technology. The classification of vehicle automation has also been investigated, in addition to the fundamental sensor set and major technologies utilised in autonomous vehicles. Waymo, Cruise, and Argo AI, three key manufacturers, have all been carefully analysed in light of current advancements in the industry. The difficulties with development and implementation are covered in the third half of the essay, which goes deeper into the technical difficulties, along with potential remedies.

# IV. METHODOLOGY

The VANET (Vehicular Ad hoc Network) technology has recently made improvements to the applications and services it provides, such as crash notifications, earlier accident warnings, road construction, over-speeding, traffic signals, warnings about fog and the presence of black ice, and some services based on location. These developments have sparked the creation of linked vehicle technology as well as autonomous car technology by companies like Google and automakers like Tesla and Audi. Leading automakers like General Motors, Volvo, Nissan, Ford, BMW, Kia, Hyundai, Honda, Toyota, Mercedes-Benz, as well as General Motors, BMW, Kia, Hyundai, Nissan, and Volkswagen have also implemented features including accident warning, smart parking, and semi-automatic driving [7].

[6].PROPOSED NAVIGATION ALGORITHM: The mobile vehicle must have embedded software in order to operate properly and trace the line as smoothly as feasible. The algorithm's primary goal is to move the car along the line as smoothly as possible. In addition to the goal, the algorithm is also dependent on the hardware, such as the quantity of sensors, the kind of motors, the chassis, etc. The suggested algorithm is displayed .The following is an explanation of the algorithm in more depth.

Step 1: The initial status of the automobile on the tracking line is described in this stage. The starting position of the car is presumably on the line.

Step 2: In each loop of this algorithm's infinite loop, the fundamental navigation algorithm is run.

Stage 2-1: The sensors to the left and right of the car are initially inspected in this step. If these sensors identify a deviance from the algorithm's intended path, the vehicle will stop, and this is done by reducing its speed until it is at a standstill..

Steps 2-3: In this step, four extra sensors are added in addition to the four navigation sensors so that the vehicles are aware of any traffic laws.

For instance, if the outputs from these sensors display the pattern 1010101, it might mean that the vehicle should slow down in order to maintain control as it approaches a junction. That vehicle can more accurately follow the road because of this movement. Applying different patterns to turns, high-traffic areas, prohibited overtaking, traffic congestion, etc. can notify the car.

Step 2-4: The vehicle will continue to follow until it returns to the main path based on the most recently active sensor if none of the sensors are on the line during this phase (for example, when the speed is high and we are approaching a steep turn, it may happen).

**Line Tracking Navigation Algorithm**

```
Step 1:    Read start position
Step 2:    WHILE(TRUE)
Step 2-1:    IF (Side sensors are activated)
                Stop of the car
             END IF
Step 2-2:    IF (The line tracker sensors are activated)
                IF (Control sensors are not activated)
                   Track line
Step 2-3:       ELSE
                   Reduce speed
                   Track line
                END IF
             END IF
Step 2-4:    IF (The Line tracker sensor is not active)
                Read the previous active sensor
             END IF
           END WHILE
```

Fig 1. *Proposed vehicle navigation algorithm Khafri, Y.Z. and Jahanian, A., 2012. Improved Line Tracking System for Autonomous Navigation of High-Speed Vehicle. IAES International Journal of Robotics and Automation*

[4] EXPERIMENTAL SETUP: The automated navigation experiment took place on a pedestrian roadway with brick paving. In the experiment, the final location was chosen at random and approached after navigation. Candidates for destinations are represented by the numbers in circles in Figure 2. The positions of the destinations on the 2D navigation map are depicted in the figure. We manually adjusted the electric wheelchair's state when it hit impediments or stopped driving in an unpaved area before restarting autonomous navigation. Restarts were recorded as autonomous navigational aids. Since the proposed system does not yet have a traffic light recognition feature, it is important to note that there were some obligatory manual procedures at crosswalks that were not counted among the assists.

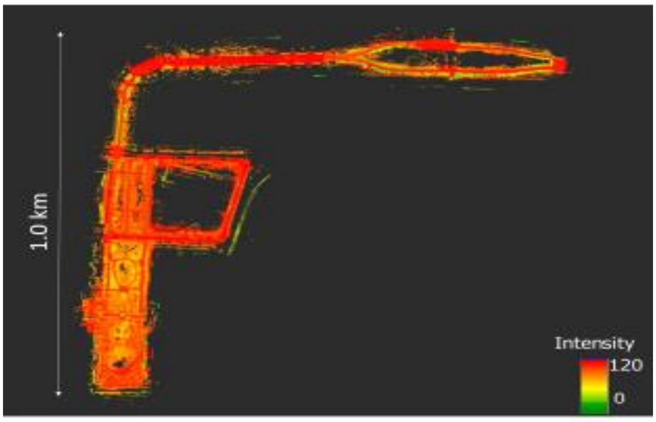


*Fig 2.a Navigation pre-processing results – Data collection route; Shun Niijima et al. (2019): Real-time autonomous navigation of an electric wheelchair inlarge-scale urban area with 3D map, Advanced Robotics*


Fig 2.b 3D point cloud map; *Shun Niijima et al. (2019): Real-time autonomous navigation of an electric wheelchair inlarge-scale urban area with 3D map, Advanced Robotics.*

## V. CONCLUSION

Even while the technology for fully autonomous vehicles has improved dramatically, it will still be a while before the general public can buy one. It may not be possible to give an exact year at this time. According to some predictions, fully autonomous vehicles may be widely used by 2035. Technology is always changing, but we still need to be ready to use it. Overcoming the aforementioned challenges is also necessary for the technology to develop smoothly. This research aims to provide a comprehensive knowledge of the autonomous vehicle technology industry.

The essential lesson to be learnt here is that these technological breakthroughs are inevitable and that we should prepare ourselves for how to handle them rather than dread them, even if automation and autonomous automobiles will have many societal implications. Although they have been able to slow it down, as was the case with the introduction of the automated elevator, humans have never been able to stop technological advancement, and they will not be able to stop change indefinitely. Our best course of action is to learn to use AI and automation as the tools that they are because there is little that can be done to stop them. Finally, we have presented literature survey data on Autonomous navigation for driverless cars system which examines public perceptions of automobiles and public trust.

## VI. ACKNOWLEDGEMENT

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