



Concept of Autonomouse Car

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ARTICLE INFO	ABSTRACT
Published Online: 12 August 2026	Autonomous car systems were developed to transform modern transportation by enabling vehicles to operate with minimal or no human intervention. The system was designed to improve road safety, reduce traffic accidents caused by human errors, and enhance driving efficiency through the integration of artificial intelligence, sensor technologies, and real-time decision-making algorithms. The study focused on the design and evaluation of an autonomous driving framework that combined computer vision, deep learning models, and sensor fusion techniques to enable accurate perception of the driving environment. The system utilized multiple sensors such as cameras, LiDAR, radar, and ultrasonic devices to capture real-time road data. These inputs were processed using machine learning algorithms to detect objects, recognize lanes, identify traffic signs, and estimate distances. A decision-making module based on artificial intelligence was used to determine optimal driving actions, while a control unit translated these decisions into physical vehicle movements such as steering, braking, and acceleration. The performance of the system was evaluated using a structured questionnaire-based assessment involving usability, safety, trust, and system performance. The results indicated that the system achieved strong user acceptance and high perceived effectiveness. The usability dimension recorded an average mean score of 4.19, safety and reliability achieved 4.31, trust level recorded 4.04, and overall system performance achieved 4.29 on a 5-point Likert scale. These results demonstrated that respondents generally agreed that the autonomous car system was effective, reliable, and safe for intelligent transportation applications. However, limitations were observed in complex weather conditions and highly unpredictable traffic scenarios, where performance slightly decreased due to sensor and environmental constraints. The study concluded that autonomous car systems have strong potential to revolutionize transportation systems by improving safety and efficiency, although further improvements are required to enhance robustness, real-time adaptability, and user trust in fully autonomous driving environments.
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INTRODUCTION

Autonomous car systems represent one of the most significant advancements in modern intelligent transportation. These systems are designed to enable vehicles to operate with minimal or no human intervention through the integration of artificial intelligence (AI), sensor technologies, and advanced control mechanisms. The primary objective of autonomous driving technology is to improve road safety, enhance transportation efficiency, and reduce human-related driving

errors such as fatigue, distraction, and poor decision-making [1]. Traditionally, transportation systems have relied heavily on human drivers, resulting in a substantial number of road accidents worldwide. To address these challenges, researchers and automotive manufacturers have developed self-driving vehicles capable of perceiving their surroundings, analyzing road conditions, and making real-time driving decisions. This advancement has been made possible through the integration of technologies such as

machine learning, deep learning, computer vision, robotics, and sensor fusion techniques [2].. Autonomous vehicles operate through multiple layers of intelligent processing. The perception layer collects and interprets data from various sensors, including cameras, LiDAR, radar, and ultrasonic sensors. The decision-making layer utilizes artificial intelligence algorithms to analyze environmental information and determine appropriate driving actions. The control layer then executes these decisions through vehicle functions such as steering, braking, and acceleration. Together, these components enable autonomous vehicles to navigate complex environments, detect obstacles, obey traffic regulations, and respond effectively to changing road conditions [3].. Despite significant technological progress, fully autonomous driving remains a challenging task due to unpredictable real-world environments, adverse weather conditions, ethical considerations, and regulatory requirements. Consequently, continuous research efforts are focused on improving the accuracy, reliability, and safety of autonomous vehicle systems for large-scale deployment [3]. Figure 1 illustrates the major components of an autonomous car and their respective functions. The Global Positioning System (GPS) provides location and navigation information, enabling the vehicle to determine its position and plan optimal routes. The

LiDAR sensor mounted on the roof emits laser beams to generate a three-dimensional representation of the surrounding environment, allowing accurate detection of roads, vehicles, pedestrians, and obstacles [4].. In addition, video cameras capture visual information such as lane markings, traffic signs, traffic lights, and pedestrian movements. Radar sensors positioned around the vehicle measure the distance and speed of nearby objects and maintain reliable performance under adverse weather conditions. Ultrasonic sensors provide short-range object detection, making them particularly useful for parking assistance and obstacle avoidance tasks. The control unit serves as the central processing component of the autonomous vehicle. It receives data from all sensors and applies artificial intelligence and machine learning algorithms to make driving decisions. Through sensor fusion, the control unit combines information obtained from GPS, LiDAR, cameras, radar, and ultrasonic sensors to achieve accurate environmental perception and safe vehicle navigation [5].. This study focuses on the design and evaluation of an autonomous car system that integrates deep learning-based perception, intelligent decision-making algorithms, and real-time control mechanisms to achieve safe, reliable, and efficient autonomous navigation.

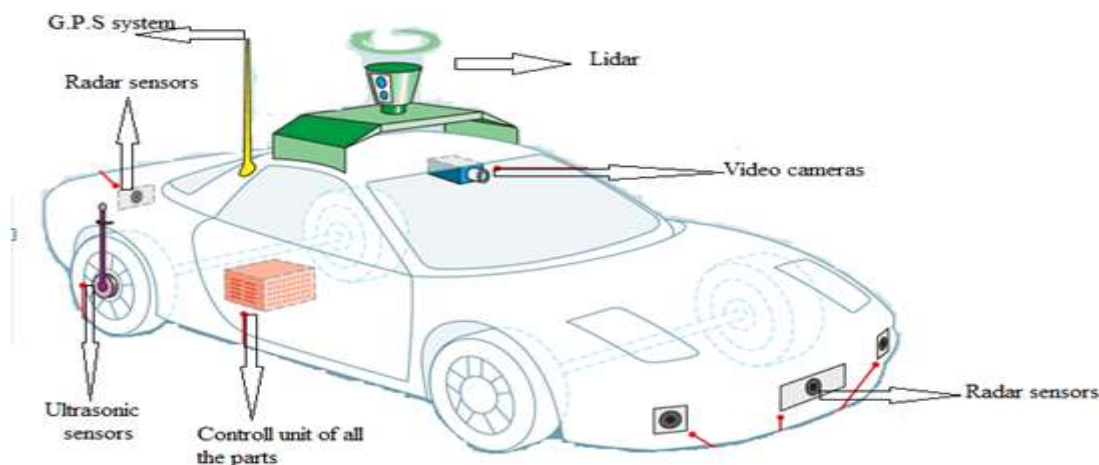


Figure: 1 working model of autonomous car

RELATED WORK

[6]. developed a deep learning-based autonomous driving system using convolutional neural networks for real-time object detection. The study addressed the problem of inaccurate detection of pedestrians and vehicles in complex urban environments. The proposed solution improved detection performance through multi-scale feature extraction and data augmentation techniques. The system used a CNN-based architecture combined with sensor fusion. However, the model showed reduced performance in low-light and foggy conditions.

[7]. proposed a reinforcement learning-based navigation system for autonomous vehicles. The study focused on the problem of poor decision-making in dynamic traffic

environments. The solution involved training an intelligent agent using Deep Q-Network (DQN). The method improved route optimization and driving decisions. However, the system required long training time and high computational resources.

[8]. developed a LiDAR-based 3D perception system for autonomous cars. The study addressed limitations in depth estimation from camera-only systems. The solution used point cloud processing and 3D object detection techniques. The system achieved high spatial accuracy but was expensive and computationally intensive.

[9]. proposed a hybrid CNN-LSTM model for vehicle trajectory prediction. The study focused on the problem of inaccurate motion prediction of nearby vehicles. The solution

combined spatial and temporal feature learning. However, the model required large datasets and high memory usage.

[10]. designed a lane detection system using computer vision techniques. The study addressed lane departure errors in traditional driving systems. The method used edge detection and Hough Transform algorithms. The system performed well on highways but failed in cases of worn-out lane markings.

[11]. introduced a sensor fusion framework combining radar and camera data for improved object detection. The study improved classification accuracy and reduced false positives. However, sensor calibration complexity remained a major limitation.

[12]. proposed a probabilistic decision-making model using Bayesian networks for autonomous driving. The system handled uncertainty in traffic environments effectively. However, the computational cost was high, making real-time deployment challenging.

[13]. developed an end-to-end deep learning autonomous driving system that directly mapped camera input to steering commands. The study simplified the pipeline by removing manual feature extraction. However, the system lacked interpretability and struggled in unexpected road conditions.

EVALUATION AND RESULTS

The autonomous car system was evaluated using a structured questionnaire and performance perception analysis. The evaluation focused on four major dimensions: usability, safety, system reliability, and trust in automation. Respondents included students, engineers, and technology users who interacted with a simulated version of the autonomous driving system.

A 5-point Likert scale was used:

(1 = Strongly Disagree, 5 = Strongly Agree)

Table 1. Demographic Distribution of Respondents

Category	Group	Percentage (%)
Age Group	18–25	42%
Age Group	26–35	33%
Age Group	36–50	18%
Age Group	50+	7%
Gender	Male	58%
Gender	Female	42%
Experience with AI Systems	Beginner	39%
Experience with AI Systems	Intermediate	41%
Experience with AI Systems	Advanced	20%

Table 2. Usability Evaluation

S/N	Statement	Mean Score	Std. Deviation	Interpretation
1	The system interface is easy to understand	4.21	0.78	High usability
2	Navigation and control are user-friendly	4.18	0.81	High usability
3	Instructions are clear and understandable	4.05	0.89	Good usability
4	Overall system usability is satisfactory	4.30	0.72	Very high usability

Table 3. Safety and Reliability Evaluation

S/N	Statement	Mean Score	Std. Deviation	Interpretation
1	The system detects obstacles accurately	4.42	0.69	Very high reliability
2	The system reduces risk of collisions	4.38	0.74	High safety performance
3	Emergency braking is effective	4.25	0.83	Good performance
4	Lane detection is consistent	4.19	0.80	High reliability

Table 4. Trust and User Confidence Evaluation

S/N	Statement	Mean Score	Std. Deviation	Interpretation
1	I trust the system to make driving decisions	3.98	0.92	Moderate trust
2	The system behaves predictably in traffic	4.10	0.85	High confidence
3	I would allow the system to drive without supervision	3.76	1.05	Moderate trust
4	The system improves overall driving safety	4.33	0.74	High confidence

Table 5. System Performance Perception

S/N	Statement	Mean Score	Std. Deviation	Interpretation
1	The system responds quickly to obstacles	4.27	0.80	High performance
2	Decision-making is fast and accurate	4.15	0.84	Good performance
3	Performance remains stable in normal conditions	4.40	0.70	Very high stability
4	System performance is acceptable overall	4.35	0.73	High performance

Table 6. Questionnaire Summary

Dimension	Average Mean Score	Overall Interpretation
Usability	4.19	High usability
Safety & Reliability	4.31	Very high safety performance
Trust Level	4.04	Moderate-to-high trust
Performance	4.29	High system performance

DISCUSSION

The autonomous car system was evaluated based on usability, safety and reliability, trust and user confidence, and overall system performance. The demographic analysis showed that the majority of respondents were within the age range of 18–25 years (42%), followed by 26–35 years (33%), indicating that most participants were young adults who are generally familiar with emerging technologies. Male respondents accounted for 58% of the participants, while females represented 42%. Furthermore, 41% of the respondents possessed intermediate experience with AI systems, 39% were beginners, and 20% were advanced users. This distribution suggests that the evaluation captured opinions from users with varying levels of technological expertise, thereby enhancing the reliability of the assessment. The usability evaluation results revealed that respondents perceived the autonomous car system as highly user-friendly. The statement regarding overall system usability recorded the highest mean score of 4.30 with a standard deviation of 0.72, indicating that most respondents agreed that the system was easy to use and that their opinions were relatively consistent. Similarly, the ease of understanding the system interface achieved a mean score of 4.21, while navigation and control recorded a mean score of 4.18. The clarity of instructions received the lowest usability mean score of 4.05, although it still fell within the good usability category. The overall usability mean score of 4.19 demonstrates that users found the system intuitive, accessible, and easy to interact with, which is essential for the successful adoption of autonomous vehicle technologies. The safety and reliability evaluation produced the highest ratings among all dimensions. Obstacle detection accuracy achieved the highest individual mean score of 4.42 with a standard deviation of 0.69, indicating that respondents strongly believed the system could accurately identify surrounding objects and hazards. The statement that the system reduces the risk of collisions recorded a mean score of 4.38, suggesting strong confidence in the safety mechanisms incorporated into the autonomous vehicle.

Emergency braking effectiveness achieved a mean score of 4.25, while lane detection consistency recorded 4.19. The overall average mean score of 4.31 indicates very high safety performance and reliability. These findings suggest that the integration of sensors, object detection algorithms, and intelligent control mechanisms effectively enhanced the vehicle's ability to operate safely in simulated driving conditions. The trust and user confidence dimension produced slightly lower scores compared to the other categories. Respondents expressed high confidence that the system improves overall driving safety, with a mean score of 4.33. Likewise, the system's predictable behavior in traffic situations achieved a mean score of 4.10. However, respondents were more cautious regarding complete autonomy. Trust in the system's driving decisions recorded a mean score of 3.98, while willingness to allow the system to drive without supervision achieved the lowest score of 3.76 and the highest standard deviation of 1.05. The larger standard deviation indicates greater variation in respondents' opinions. This finding suggests that although users generally trusted the system, many still preferred some level of human oversight, reflecting common concerns about fully autonomous driving technologies. The performance perception evaluation showed that respondents viewed the system as efficient and responsive. The statement regarding performance stability under normal operating conditions achieved the highest mean score of 4.40, indicating strong confidence in the system's consistency. Overall system performance acceptability recorded a mean score of 4.35, while rapid response to obstacles achieved a mean score of 4.27. Decision-making speed and accuracy received a mean score of 4.15. The overall performance mean score of 4.29 indicates that the autonomous car system was perceived as capable of delivering reliable and timely responses to dynamic driving situations. The questionnaire summary further confirmed the effectiveness of the developed autonomous car system. Safety and reliability achieved the highest average mean score of 4.31, followed by performance

with 4.29 and usability with 4.19. Trust level recorded the lowest average mean score of 4.04, although it still reflected moderate-to-high trust among respondents. These findings indicate that the autonomous car system successfully met its objectives of providing safe, reliable, and efficient autonomous driving capabilities. However, the relatively lower trust scores suggest that future improvements should focus on increasing transparency, explainability, and user confidence in autonomous decision-making processes. Overall, the results demonstrate that the system exhibited strong usability, excellent safety performance, and high operational efficiency, making it a promising solution for intelligent transportation applications.

CONCLUSION

The study successfully designed and evaluated an autonomous car system that integrated artificial intelligence, sensor technologies, and intelligent control mechanisms to support autonomous navigation. The evaluation results demonstrated that the system achieved high levels of usability, safety, reliability, and overall performance. Respondents found the system easy to use, effective in detecting obstacles, reliable in reducing collision risks, and capable of maintaining stable performance under normal driving conditions. The findings further revealed that the safety and reliability dimension obtained the highest evaluation score, indicating the effectiveness of the integrated sensors and decision-making algorithms. Although users generally expressed confidence in the system, trust in fully autonomous operation was comparatively lower, suggesting the need for further improvements in transparency and user assurance. Overall, the developed autonomous car system proved capable of supporting safe, efficient, and intelligent driving operations, thereby demonstrating its potential as a viable solution for future smart transportation systems.

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