AI WITH SELF-DRIVEN CARS: STUDYING THE SMART MANUFACTURING OF ROBOTS AND SENSORS FOR PREDICTION OF PROBLEMS AND IMPROVEMENT OF FUEL EFFICIENCY.

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ABSTRACT

This study examined the role of Artificial Intelligence (AI) in self-driven cars with emphasis on the smart manufacturing of robots and sensors for prediction of problems and improvement of fuel efficiency. The study explored how AI technologies, robotics, and sensor systems are integrated into autonomous vehicles to enhance intelligent decision-making, operational safety, predictive maintenance, and sustainable transportation. The paper highlighted the concept of artificial intelligence as a system capable of performing human-like intelligent tasks such as learning, reasoning, and decision-making. It also examined self-driven cars as autonomous systems that depend on sensors, machine learning, and robotics for navigation and environmental awareness. Furthermore, the study discussed the concepts of robots and sensors as critical components of smart manufacturing systems used in modern automotive industries. The study further investigated how smart manufacturing technologies improve the production and performance of robots and sensors through automation, Internet of Things (IoT), predictive analytics, and cyber-physical systems. The study concluded that the integration of AI, robotics, and smart sensors has transformed the development and operation of self-driven cars by improving safety, reliability, predictive maintenance, and environmental sustainability. It was recommended that governments, researchers, and automotive industries should invest more in AI-driven manufacturing technologies, advanced sensor systems, and predictive analytics to further enhance the performance and fuel efficiency of autonomous vehicles.

KEYWORDS: AI, Self-Driven, Cars, Manufacturing, Robots, Sensors, Fuel Efficiency.

INTRODUCTION

Artificial Intelligence (AI) has become a transformative force in the evolution of self-driven cars, fundamentally reshaping how vehicles are designed, manufactured, and operated. The term artificial intelligence is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience (Henry & Akpan, 2025).At the core of this innovation is the integration of intelligent algorithms with advanced robotic systems and sensor technologies, enabling autonomous vehicles to perceive their environment, make decisions, and act with minimal human intervention. Smart manufacturing plays a critical role in this ecosystem by leveraging AI-driven robotics to enhance precision, consistency, and efficiency in the production of vehicle components, particularly sensors such as LiDAR, radar, and cameras. Arisekola (2025) noted that by leveraging AI-driven predictive analytics, it is possible for retailers to forecast demand, optimize the levels of inventory and personalize the experiences of customers. These sensors serve as the “eyes and ears” of autonomous systems, continuously collecting real-time data that AI models process to ensure safe navigation and operational reliability (Zhang, Liu&Brown, 2023; Kumar & Lee, 2022).

Furthermore, the predictive capabilities of AI significantly improve the performance and durability of self-driven cars by enabling early detection of potential faults in both mechanical and electronic systems. Through machine learning techniques such as predictive maintenance and anomaly detection, AI systems can analyze patterns from sensor data to forecast failures before they occur, thereby reducing downtime and maintenance costs while enhancing safety (Smith & Rao, 2024). In smart manufacturing environments, this predictive intelligence is also applied during the production phase, where robotic systems can identify defects in real-time, optimize assembly processes, and ensure high-quality output. According to Akpan & Essien (2025) Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. This synergy between AI, and sensors not only improves vehicle reliability but also contributes to more sustainable production practices by minimizing waste and energy consumption.

In addition, AI-driven optimization plays a vital role in improving fuel efficiency in autonomous vehicles. By analyzing driving patterns, traffic conditions, and vehicle dynamics, AI systems can optimize route planning, acceleration, braking, and energy usage. Smart sensors continuously feed data into these systems, allowing real-time adjustments that reduce fuel consumption and emissions. Leveraging, moreover, intelligent manufacturing processes ensure that vehicle components are designed and assembled with maximum efficiency, contributing to lighter structures and better aerodynamic performance (Chen, Wang & Zhao, 2023). As a result, the integration of AI in self-driven cars extends beyond autonomy, encompassing smart production, predictive problem-solving, and energy efficiency, thereby positioning it as a cornerstone of next-generation transportation systems.

Concept of Artificial Intelligence

Artificial intelligence (AI) refers to the branch of computer science concerned with designing systems capable of performing tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making. As noted by Akpan & Henry (2025) Artificial intelligence (AI) is the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. Artificial intelligence is the study of how the human brain makes decisions, learns new things, and thinks through difficulties. A lot of companies in a lot of different areas are migrating to AI-based solutions to make things simpler and more precise (Adesemowo & Hameed, 2025), such as in sectors like healthcare, finance, and manufacturing, where AI can enhance efficiency and accuracy in operations.

Additionally, AI can be seen as a revolutionary technological advancement that combines algorithms and massive datasets to increase productivity and accuracy in a variety of fields, including industry, healthcare, and education. AI improves logistics planning, inventory control, and forecasting accuracy in supply chain management (Umofia & Uwana, 2026).Artificial intelligence (AI) is the study of how the human brain makes decisions, learns new things, and thinks through difficulties (Akpan & Clark, 2024).

Furthermore, artificial intelligence (AI) focuses on learning from experience and adapting to new inputs by simulating human intelligence processes through technology, particularly computer systems. As noted by Ghosh and Singh (2020), AI includes the use of bio-inspired algorithms and machine learning models that enable systems to perform complex tasks such as prediction, classification, and automation across multiple sectors. In addition, artificial intelligence refers to the research and programming of computers to carry out intelligence tasks that require human intervention (Udo-Okon & Akpan, 2024).

Moreover, the concept of AI also incorporates ethical, social, and philosophical considerations, particularly regarding trust, autonomy, and decision-making.AI-powered systems now perform complex tasks such as medical diagnoses, financial predictions, and even creative writing, reducing human effort and enhancing productivity (Kingsley & James2025).

Concept of Self-Driven Car

Self-driving cars, or autonomous vehicles (AVs), are automobiles that use sensors, cameras, radar, and AI software to navigate and operate without human intervention. They aim to improve safety, reduce congestion, and increase mobility for the elderly and disabled by detecting environments and making real-time driving decisions. Autonomous vehicles, sometimes referred to as self-driven cars, are automobiles that can sense their surroundings and function without human intervention. According to Anderson and Kalra (2019), autonomous vehicle technology integrates multiple systems such as sensors, control algorithms, and computing power to enable safe and efficient navigation.

Artificial intelligence is a major factor in the decision-making processes of self-driving cars. AI is also essential for making data-driven decisions (Umuofia & Okorie, 2026). As noted by Abduljabbar, Dia, Liyanage, & Bagloee (2019), machine learning algorithms help autonomous vehicles analyze traffic situations and make safe driving decisions. These systems continuously improve through data collection and real-world testing.

Concept of Robots

Robots are programmable machines designed to perform tasks autonomously or semi-autonomously by sensing, processing information, and acting upon their environment. The concept of robots has evolved significantly with advancements in artificial intelligence (AI), machine learning, and sensor technologies, transforming robots from simple mechanical devices into intelligent systems capable of complex decision-making. Modern robots integrate hardware (actuators, sensors, control systems) with software algorithms that enable perception, reasoning, and action.

Autonomy, or a robot's capacity to carry out activities without constant human supervision, is a key component of the idea of robots. Contemporary research highlights that autonomy is achieved through the combination of perception systems (such as cameras, LiDAR, and radar), data processing units, and control mechanisms that allow robots to adapt to dynamic environments (Siciliano & Khatib, 2020). Another essential component is programmability, which allows robots to be reprogrammed to carry out various activities, making them adaptable to a variety of industries, including manufacturing, healthcare, transportation, and agriculture.

Robots are further distinguished by their contact with the physical world, employing actuators to carry out movements and sensors to collect data. Recent studies emphasize the growing importance of human-robot interaction (HRI), where robots are designed to collaborate safely and efficiently with humans in shared environments (Ajoudani, 2021). As a result, collaborative robots, or cobots, have been developed and are now commonly utilized in industrial and service applications.

Furthermore, by enabling learning, adaptation, and decision-making capabilities, the incorporation of artificial intelligence has completely changed the notion of robotics. AI-driven robots can analyze large datasets, recognize patterns, and improve performance over time (Yang, 2022). This change signifies the shift from conventional automation to intelligent robotics systems that can function in unpredictable and unstructured conditions.

Concept of Sensor

A sensor is a device that detects, measures, and responds to physical inputs from the environment (such as light, heat, motion, moisture, or pressure) and converts them into electrical signals. Acting as a bridge between the physical and digital worlds, sensors enable computers and automation systems to monitor and control processes in real-time. A sensor is an apparatus that recognizes and reacts to environmental physical, chemical, or biological inputs and transforms them into quantifiable signals. According to Fraden (2019), a sensor functions as a transducer that transforms one form of energy into another, typically into electrical signals that can be processed and analyzed.

Modern technology relies heavily on sensors, particularly in fields like automation, healthcare, transportation, and environmental monitoring. Ibokette, Thompson, Okon (2023), noted that Modern technology in communication has no doubt helped to serve as a means of connecting people and as a medium of interaction in the social world and educational arena. The AI-based system, however, is automated and possesses improved performance; it still requires human assistance and monitoring at certain stages (Habeed, Adesemowo, & Babatunde 2025). As noted by Kumar (2020), explain that sensors are essential components in smart systems, enabling real-time data collection and decision-making processes. These systems rely on accurate and reliable sensor data to function effectively.

Temperature, pressure, motion, and chemical sensors are just a few of the several kinds of sensors. As emphasized by Yang and Li (2021), each type of sensor is designed to measure specific parameters and operates based on different principles such as resistance change, capacitance variation, or optical detection.

Smart Manufacturing of Robots and Sensors

The integration of cutting-edge digital technology into production systems to effectively design, manufacture, and optimize robotic systems and sensing devices is known as "smart manufacturing of robots and sensors." It is a fundamental part of Industry 4.0, which prioritizes intelligent decision-making, automation, and real-time data interchange in manufacturing settings. In order to improve efficiency, flexibility, and quality in the manufacturing of robots and sensors, smart manufacturing makes use of technologies like artificial intelligence (AI), the Internet of Things (IoT), big data analytics, and cyber-physical systems, (Zhang., 2022).

The utilization of interconnected systems, where machines, robots, and sensors communicate with one another via IoT networks, is a crucial component of smart manufacturing. Real-time manufacturing process monitoring and control are made possible by this link. To optimize operations and avoid equipment failure, for example, sensors integrated into production lines gather data on temperature, pressure, vibration, and performance, which is then analyzed. According to Lee. (2020), smart manufacturing systems improve efficiency by enabling predictive maintenance and reducing downtime through continuous data analysis.

Automation and robotics integration is another crucial component. Robots are both active players in the manufacturing process and products of smart manufacturing. Intelligent sensors enable sophisticated robotic systems to execute intricate tasks like material handling, assembly, and inspection with extreme accuracy. These robots make manufacturing systems more adaptable and responsive by using sensor data to adjust to changing conditions. As noted by Kusiak (2021), the combination of robotics and data-driven manufacturing leads to higher productivity and improved product quality.

Effect of Mart Manufacturing of Robots and Sensors on Problem Solving

Through the integration of robots and sensor technology, the fast development of smart manufacturing—often referred to as "mart manufacturing" in specific places but more widely known as "smart manufacturing"—has had a tremendous impact on industry problem-solving procedures. These systems improve decision-making, operational efficiency, and adaptability in complex production contexts by combining automation, real-time data collecting, and artificial intelligence.

Robots' capacity to perform high-precision, repetitive operations with little assistance from humans is one of their most prominent effects in smart manufacturing. Machine learning algorithms enable industrial robots to recognize trends, spot irregularities, and modify their behavior accordingly. By facilitating predictive maintenance and cutting downtime, this skill enhances problem-solving. For instance, collaborative robots (cobots) can work alongside humans, assisting in tasks that require both flexibility and accuracy, thereby enhancing human problem-solving capacity rather than replacing it (Bogue, 2021).

On the other hand, sensors play a crucial role in collecting data and monitoring the environment. IoT-enabled devices and other advanced sensors continuously collect data on vibration, temperature, pressure, and machine performance. This real-time data enables early fault detection and aids well-informed decision-making. Because of these benefits, issues can be found and fixed before they become serious failures. According to Zhang (2022), sensor-driven analytics significantly improve fault diagnosis and system optimization in manufacturing systems.

Robots and sensors work together to produce a cyber-physical system in which digital technologies are used to precisely monitor and control physical processes. Through the use of digital twins, modeling, and simulation, this networked environment improves problem-solving. Digital twin technology, for example, allows manufacturers to replicate physical systems virtually, test different scenarios, and identify optimal solutions without disrupting actual operations (Tao, 2021). This reduces trial-and-error approaches and leads to more efficient and accurate solutions.

Additionally, decentralized decision-making is supported by smart manufacturing systems. Intelligent machines may make decisions on their own using sensor data and preset algorithms rather than depending just on human operators. This improves system resilience and speeds up reaction times. However, it also introduces challenges such as cybersecurity risks and the need for skilled personnel to manage and interpret complex data systems (Javaid, 2020).

CONCLUSION

In conclusion, the integration of artificial intelligence in self-driven cars represents a significant advancement in modern transportation, driven by the synergy between smart manufacturing, robotics, and sensor technologies. These innovations enable vehicles not only to operate autonomously but also to predict potential faults, optimize performance, and enhance overall safety. Through intelligent production systems, manufacturers can achieve higher precision and efficiency, ensuring that critical components such as sensors are reliable and effective. At the same time, AI-powered predictive systems reduce maintenance challenges by identifying issues before they escalate, contributing to longer vehicle lifespan and improved user confidence.

RECOMMENDATION

- Engineers and policymakers should prioritize AI-based optimization techniques that improve fuel efficiency and reduce emissions.
- Automotive developers should integrate robust predictive analytics systems into self-driving vehicles to continuously monitor performance and detect faults early.
- Governments, automotive companies, and research institutions should allocate more resources to improving AI algorithms and sensor accuracy.

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