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AI GUIDED IOT SOLUTIONS FOR SELF-DRIVING ELECTRIC VEHICLES

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Abstract: The AI-Guided IoT Solutions for Self-Driving Electric Vehicles project combines AI-powered object and lane detection with IoT-based motor control to create an intelligent self-driving system for electric vehicles. Using a laptop camera and YOLO (You Only Look Once) integrated with OpenCV, the system detects objects, lanes, and special zones marked by RFID tags. Detected data is sent to an Arduino, which controls the vehicle's motors to stop for obstacles, change direction during lane deviations, and adjust speed automatically based on zone identification. This project offers a scalable and efficient solution for self-driving electric vehicles in diverse real-world scenarios.

1. INTRODUCTION

The rise of autonomous vehicles has highlighted the need for real-time object detection, lane tracking, and adaptive control mechanisms. Conventional self-driving systems are often resource-intensive, relying on high-end sensors and complex setups. This project addresses these challenges by integrating lightweight AI and IoT tools, providing cost-effective and reliable self-driving solutions for robotic electric vehicles.

Artificial intelligence (AI) uses data, computers and technology to simulate the human mind's problem-solving and decision-making abilities (Anjou, 2021). AI can be defined as "the study of agents that receive precepts from the environment and perform actions" (Harris, 2022). It is essentially the Endeavour of producing systems with human-like cognitive behavior such as the ability to reason, solve problem, discover meaning and perceive from past experience and act accordingly. Machine Learning and Deep Learning approaches are combined in AI (Copeland, 2022). Today, AI has numerous uses.AI has increasingly gained importance due to its ability to

address various problems in business. AI is making our daily lives more convenient and efficient. One of the growing applications of AI is in the field of automotive industry and self-driving cars are an excellent example of that. (Education, 2022).Self-driving vehicles, also known as autonomous or driverless cars, are cars or trucks which do not require human drivers to take control, for safely operating the vehicles. Such cars are composed of sensors in software to control, navigate and drive the vehicle. Self-driving cars are essentially built using artificial intelligence. In self-driving cars applications of AI can be deployed in conjunction with advanced technological innovations like GPS, radar, camera, cloud services and control signals. AI can further enhance users' experience by adding value features such as blind-spot monitoring, emergency braking and driver-assist steering (Dilmegani, 2022). The problems like poor road safety, lesser independence for the disabled, high costs, less productivity, traffic congestion, high travel time, environmental pollution associated with conventional cars can be prevented with self-driving cars (Benefits of Self-Driving Vehicles, 2018). Today the vehicles are not just machines they are intelligent, highly advanced, technological, and innovative machines. The main motivations behind research on autonomous vehicles (AV) are safe driving, increase in population and vehicles on the road, comfortable and stress free driving and effective use of available resources (Parekhet.al, 2022).

According to Battle et.al (2021) AI powered applications play a major role in designing AVs intelligent system especially in improving the safety standards (2021). The study also emphasized that in order to implement AI in practical complex environments, the autonomous system needs to be integrated with multiple advanced technologies like Internet of Things (IoT), cloud computing and block chain. Toilets AVs collect relevant data automatically. IoT sensors collect road traffic related data at various traffic signals and AI models use this data to take further decisions. AI powered Natural Language Processing (NLP) and speech recognition applications are used to understandthe text and speech instructions in AVs. Safari et al (2021) discuss the functioning of sensors in autonomous vehicles. Advanced neural networks are used to predict the malfunctioning of sensors such as faulty sensor prediction, identification, and isolation.

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Electric vehicles, or EVs, are becoming increasingly popular as an alternative to traditional gasoline-powered cars. EVs are powered by an electric motor that draws its power from batteries and other energy sources. The batteries are recharged by plugging the car into an electrical outlet. EVs are known for their low environmental impact, low running costs, and convenience. EVs are a great way to reduce emissions and save money. They don't emit any harmful gases or require regular oil changes like traditional cars. They are also quieter than gasoline-powered cars, making them a great choice for those living in urban areas [1]. Additionally, EVs are cheaper to operate than gasoline-powered cars, since they require no fuel costs. The cost savings come from reduced maintenance costs since there are fewer parts to maintain. EVs also offer convenience. Recharging an EV is much quicker than refueling a traditional car. Additionally, some EVs come with home charging systems, allowing drivers to recharge their vehicles overnight. This makes it easy to always have a full charge ready for the morning commute.

IoT is revolutionizing the way we interact with the world around us. It's no surprise that the automotive industry has embraced this technology with open arms, and the rise ofelectricvehicles (EVs) has been no exception. Thanks to the increased connectivity that IoT provides, EV manufacturers can offer a more efficient and convenient driving experience. In the past, EVs were limited to a single vehicle and were largely unable to interact with other vehicles on the road. This meant that drivers had to manually charge their EVs, and if they needed to use a public charging station, they had to manually locate one and plug in. With the introduction of IoT, however, EVs now can communicate with each other and with the surrounding environment. This means that drivers can now locate the closest charging station with the help of GPS, and they can even set up charging schedules and receive notifications when their EVs are fully charged

Autonomous vehicles (AVs) and associated technologies have rapidly gained the attention of the research community. AV utilizes sensorial technologies such as computer vision, odometer, GPS, laser lights, sensors, and a mapping system to navigate. see technologies can be used to determine environments and locations and recognize the suitable routes amid obstacles and signage [1, 2]. AVs are supposed to minimize vehicle accidents, enhance the flow of traffic and immovability, reduce the

utilization of fuel, be free from driving, and facilitate business operation and transportation [3–6]. Despite the massive potential advantages, there are many unsolved safety, security, legal and regulatory, social, Hindawi Mobile Information Systems Volume 2022, Article ID 7632892, 36 pages https://doi.org/10.1155/2022/7632892 ethical, and technology issues [7–10]. In the AV system, it is expected to solve all the problems to avoid failure. In this survey, design, hardware, AI-based, and safety issues and current solutions of autonomous vehicles are discussed. Furthermore, scope of improvement in these solutions is provided as directions for AV research community. Intelligent software and tools are required for efficient design and development of AVs. □ese tools are used during path planning, object detection, perception, act, operational testing, and risk assessment phases.

2. LITERATURE SURVEY

Automation (IA) in automobiles combines robotic process automation and artificial intelligence, allowing digital transformation in autonomous vehicles. IA can completely replace humans with automation with better safety and intelligent movement of vehicles. □is work surveys those recent methodologies and their comparative analysis, which use artificial in- diligence, machine learning, and IoT in autonomous vehicles. With the shift from manual to automation, there is a need to understand risk mitigation technologies. □us, this work surveys the safety standards and challenges associated with autonomous vehicles in context of object detection, cyber security, and V2X privacy. Additionally, the conceptual autonomous technology risks and benefits are listed to study the consideration of artificial intelligence as an essential factor in handling futuristic vehicles. Researchers and organizations are innovating efficient tools and frameworks for autonomous vehicles. In this survey, in-depth analysis of design techniques of intelligent tools and frameworks for AI and IoT-based autonomous vehicles was conducted. Furthermore, autonomous electric vehicle functionality is also covered with its applications. □e real-life applications of au- tonomous truck, bus, car, shuttle, helicopter, rover, and underground vehicles in various countries and organizations are elaborated. Furthermore, the applications of autonomous vehicles in the supply chain management and manufacturing industry are included in this survey. □e advancements in autonomous vehicles technology using

machine learning, deep learning, reinforcement learning, statistical techniques, and IoT are presented with comparative analysis. □e important future directions are offered in order to indicate areas of potential study that may be carried out in order to enhance autonomous cars in the future.

The Internet of Things (IoT) is a technology that is rapidly gaining popularity and has been embraced by many industries, including electric vehicles (EVs). IoT is enabling EV manufacturers to create connected cars with innovative features, such as remote diagnostics and location-based services, and to improve the customer experience. Furthermore, IoT technologies are enabling the integration of EVs into smart grids and the development of predictive maintenance systems. This article will discuss the potential of IoT in EVs, focusing on the advantages and challenges associated with its implementation. The main advantage of using IoT in EVs is the ability to monitor and analyze data in real-time. By connecting the vehicle to the cloud, manufacturers can collect and analyze data from various sensors, such as speed, location, and performance metrics. This data can then be used to improve the performance of the car, detect and diagnose malfunctions, and optimize the driving experience. Additionally, IoT-enabled EV technologies can be used to create a more efficient, safe, and sustainable energy grid, as well as to reduce energy consumption and carbon emissions. Another advantage of using IoT in EVs is the ability to provide customers with a personalized experience. With IoT, manufacturers can collect data about the customer's driving habits and preferences, and use this data to tailor the vehicle's settings and features to their specific needs. Finally, there is the challenge of ensuring that the data collected is accurate and reliable. In conclusion, IoT has the potential to revolutionize the way EVs are designed, operated, and maintained, providing significant benefits to both manufacturers and customers.

The convergence of Artificial Intelligence (AI) and Internet of Things (IoT) technologies has transformed the field of sustainable transportation planning, notably in the context of Electric Vehicles (EVs). The Problems in all the Existing models are not having proper coordination of optimizing the elements of EV functioning. This research proposes a novel strategy to improving sustainable transportation planning by utilizing AI and IoT. AI-powered algorithms analyze real-time data

from IoT sensors installed in EVs and the surrounding environment. These adaptive control algorithms are designed to solve issues including range anxiety, charging infrastructure optimization and energy efficiency. Predictive analytics, route optimization, energy management, and grid interface are all part of the proposed system. Energy management algorithms alter EV settings dynamically to maximize efficiency while taking into account real-time traffic conditions thereby increasing the range extension is upto 2.5% and the total energy efficiency is improved up to 92%. Furthermore, bidirectional connection allowed by IoT devices facilitates the integration of EVs into the energy grid. EVs may engage intelligently in Vehicle-to-Grid (V2G) interactions, providing grid services such as energy delivery during peak demand periods and grid stability

3. EXISTING SYSTEM

The development of Self-Driving cars has had two main approaches, the vehicle as an individual object, allowing it to perceive the environment and react to it, and seeing it as part of an autonomous system (smart city) where the environment is responsible for identifying all components and providing timely activation. Internet of Things technologies can drastically improve the capabilities of the autonomous vehicle to better understand its environment with the interconnection of the surrounding elements. The findings from the development of the Internet of Things in autonomous cars are more intelligent mobility with higher levels of safety (for passengers and pedestrians), efficiency (allowing drivers to avoid traffic congestion and facilitating their search for parking), and sustainability (through reduced fuel consumption.). This article reviews advances on the Internet of Things and how it has changed the industry. Aspects in the development of intelligent cities result from implementing the Internet of Things

Current self-driving technologies depend on expensive hardware and infrastructure, making them inaccessible for small-scale or educational implementations. Furthermore, existing systems often struggle to adapt to dynamically changing environments, such as lane deviations or special road zones. There is a need for a system that is affordable, adaptive, and capable of real-time decision-making for self-driving electric vehicles

4. PROPOSED SYSTEM

Autonomous vehicles, also known as self-driving cars, are cars equipped with advanced technologies that allow them to navigate and operate without direct human intervention. These vehicles use sensors,

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cameras and artificial intelligence to sense their surroundings, make decisions and control their movements. The proposed system of this project is shown in Fig 1.

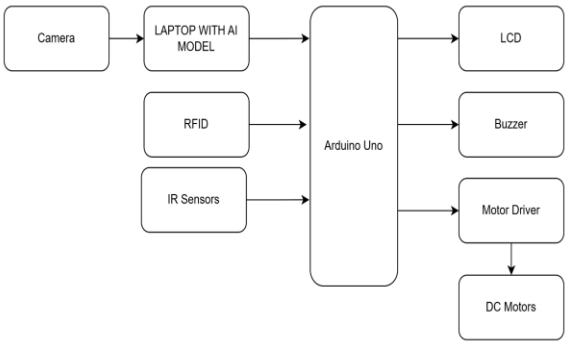


Fig 1 Block Diagram

Working Flow Steps

Working Steps:

Object and Lane Detection:

A laptop camera captures real-time video.

YOLO, integrated with OpenCV, processes the video feed to detect objects (e.g., vehicles, pedestrians) and lane markings.

Data Transmission to Arduino:

Detected objects and lane information are sent to Arduino via serial communication.

The Arduino uses this data to control the vehicle's motors.

Vehicle Motor Control:

The robotic vehicle stops when objects are detected.

It changes direction if a lane crossing is detected.

Special Zone Detection with RFID:

RFID modules detect tags corresponding to zones like schools, U-turns, and speed-restricted areas.

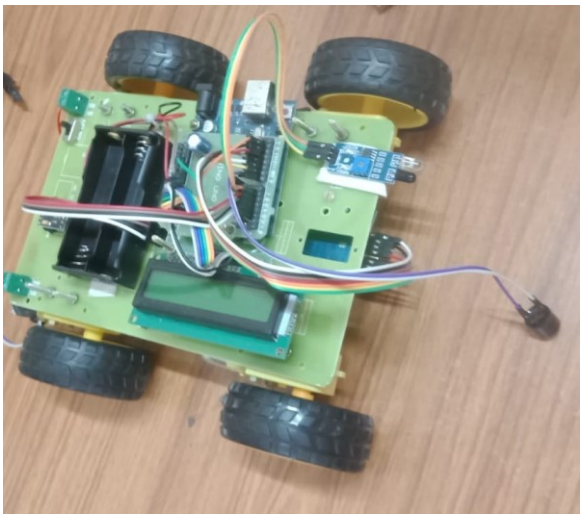
The Arduino adjusts the vehicle's speed and behavior based on the zone type.

Feedback Mechanisms:

Alerts and status updates are displayed on an LCD for monitoring.

A buzzer signals critical conditions like sudden lane changes or obstacles

5. RESULT



6. CONCLUSION

The system effectively detects objects and lanes, adjusts the vehicle's speed and direction in response to RFID-detected zones, and provides real-time feedback through an LCD and buzzer. It demonstrates robust functionality in simulated road scenarios.

The *AI-Guided IoT Solutions for Self-Driving Electric Vehicles* project combines

AI, IoT, and robotics to offer a practical, scalable solution for autonomous vehicle development. Its integration of YOLO and RFID technology provides real-time insights and precise control, paving the way for future advancements in smart transportation systems.

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