JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

SMART VECHILE AUTOMATION ON INCULCATING PROXIMITY SENSORS

[1]Dr.E.S.Shamila,[2]Goruganti Rashmitha,[3]Haripriya J, [4]Koncha Venkata Vineela,5Meka Nandini

[1]Professor,[2,3,4,5]Final Year B.E. Students

[1,2,3,4,5] Department of Computer and Science and Engineering

[1,2,3,4,5] Jansons Institute of Technology, Karumathampatti,Coimbatore

Abstract: Exploring the forefront of electric vehicle (EV) technology, this study focuses on two critical aspects: optimizing charging efficiency and enhancing safety protocols to mitigate accidents, particularly those prevalent during nighttime conditions characterized by intense lighting. Our research introduces novel approaches to address these challenges. By leveraging wireless power transmission systems, EVs can charge on the move, reducing reliance on stationary charging stations and significantly diminishing charging time. Furthermore, we propose integrating advanced proximity sensors capable of detecting light sources, empowering EVs to dynamically adjust to environmental changes and proactively avoid potential hazards posed by bright lights. Additionally, we investigate the potential of automatic speed control systems, utilizing real-time road condition analysis facilitated by proximity sensors, to further fortify safety measures by adjusting vehicle speed accordingly. Despite existing limitations in proximity sensor availability and charging infrastructure distribution, we anticipate advancements in EV automation to overcome these barriers, ushering in a future where electric transportation is not only safer but also more efficient and sustainable. Our study envisions extending the utility of proximity sensors for speed control, providing greater flexibility and effectiveness in accident prevention strategies. By synergizing these approaches, EVs can not only bolster safety features but also streamline charging processes, ushering in a new era of efficient and automated electric vehicle systems that prioritize both safety and sustainability in our transportation networks.

IndexTerms–Electric vehicles, charging time, accident prevention, wireless power transmission, proximity sensors, light detection, automatic speed control, road conditions analysis, proximity sensors, charging station availability, automation, time efficiency.

I.INTRODUCTION

In the realm of technology, embedded systems stand as the cornerstone of innovation, blending hardware and software seamlessly to accomplish a myriad of functions. The evolution of embedded technology has ushered in an era of unparalleled knowledge and capability, revolutionizing industries and redefining possibilities. Central to this transformation is the fusion of diverse functionalities within embedded systems, driving the need for cohesive integration across departments and sources. The proposal outlined herein represents a pivotal advancement, poised to streamline operations, reduce reliance on manpower, and enhance efficiency through autonomous functionality. Embarking on this project marks our first stride toward achieving objectives, harnessing cutting-edge tech to infuse existing systems with innate intelligence. Embedded systems, with their intricate designs and sophisticated algorithms, have become the backbone of modern technological advancements. From consumer electronics to industrial automation, their pervasive presence has reshaped the landscape of innovation. The evolution of these systems has been marked by continuous refinement, enabling them to perform tasks with unprecedented precision and efficiency. As industries embrace the capabilities of embedded systems, the demand for seamless integration has become increasingly paramount. The convergence of hardware and software components requires meticulous planning and execution to ensure optimal performance. By leveraging the latest advancements in technology, organizations can unlock new opportunities for growth and development. One of the key drivers behind the adoption of embedded systems is their ability to enhance automation processes. By embedding intelligence directly into devices and machinery, organizations can achieve higher levels of autonomy and productivity. This shift towards autonomous functionality is reshaping traditional workflows and paving the way for more efficient operations. Furthermore, the interconnected nature of embedded systems has catalyzed collaboration across diverse domains. Departments once isolated are now working in tandem to harness the full potential of these systems. This interdisciplinary approach fosters innovation and accelerates the pace of technological advancement. In order to capitalize on these opportunities, organizations must invest in research and development to stay ahead of the curve. By continuously pushing the boundaries of what is possible, they can remain competitive in a rapidly evolving market. This commitment to innovation is essential for driving long-term success and sustainability. The proposal outlined herein represents a strategic investment in the future of embedded technology. By aligning our objectives with emerging trends and market demands, we can position ourselves as leaders in the field. Through collaboration and partnership, we can leverage collective expertise to overcome challenges and achieve our goals. In conclusion, embedded systems represent a cornerstone of technological innovation, driving progress across a wide range of industries. By embracing the transformative power of these systems, organizations can unlock new levels of efficiency, productivity, and competitiveness. The proposal outlined herein lays the foundation for a future where embedded technology is at the forefront of innovation, shaping the world in which we live and work.

II.RELATED WORK

The research work[16] provides a comprehensive review of wireless power transfer methods for electric vehicles (EVs), aiming to mitigate the environmental impact of internal combustion engine vehicles. It categorizes methods such as magnetic gear, capacitive, inductive, and resonant inductive power transfer, then delves into commonly used charger topologies. Finally, it explores future trends in wireless power chargers, emphasizing the promotion of safer, cleaner, and more efficient EVs to combat air pollution and global warming.

The paper may lack originality and depth in analysis, potentially presenting biased or outdated information, and it might fail to address conflicts of interest or provide practical implications.

The article[17] assesses the dosimetric impacts of an 85 kHz wireless power transfer (WPT) system for electric vehicles (EVs), considering various exposure scenarios. It investigates human exposure in front of the WPT system, with and without shielding, alignment and misalignment between transmitter and receiver, and with a metal plate mimicking the vehicle floor pan. The study determines minimum accessible distances to ensure compliance with international safety guidelines and investigates the maximum allowable transmitting power based on dosimetric findings.

The study might overlook potential long-term health effects of 85 kHz electromagnetic exposure and lacks comparative analysis with alternative charging methods, potentially limiting its comprehensive assessment.

The paper[18] discusses the collaborative efforts between KAIST and KU since 2018, focusing on joint research into a semi-dynamic wireless power transfer system for autonomous electric vehicles. This system includes a short (1.5m) power line for static charging and a longer (5m) power line for dynamic charging during vehicle stops. Through magnetic simulation, crucial system parameters are identified, leading to the development and testing of a prototype in the laboratory. Remarkably, the prototype achieves a maximum power efficiency of 90.8% for static charging and over 85% for dynamic charging.

The paper might lack detailed technical specifications of the wireless power transfer system and may not adequately address safety concerns associated with high-power wireless charging, potentially limiting its applicability and reliability.

The research article[19] introduces the composition and the power loss model of a wireless power transfer system. By the measured power loss parameters and experimental results, the optimal current control for the maximum power transfer efficiency is proposed.

The paper may lack experimental validation of the proposed segmentation method and could overlook potential efficiency losses or electromagnetic interference issues in high-power wireless transfer systems, raising concerns about its practical feasibility and reliability.

The article[20] develops the idea of wireless power transfer system for high power application. We proposed power supply system, power receiver system and it's integration. We assembly six supply and receiver pairs to obtain high power output using proposed resonance compensation. we verified proposed system by simulation and experiment. We were able to transfer 490kW over 11cm air gap. We discuss the practical applicability of this system and suggest directions

The paper might lack comprehensive comparison with existing segmentation methods and could overlook practical challenges such as alignment issues and energy loss, potentially limiting its applicability and robustness in real-world high-power applications.

The article[21] focuses on near-field wireless power transfer, exploring the potential of mixed coupling to enhance power density. While the fundamental principles of mixed coupling are understood, its implications for practical applications remain unclear. The study presents analytical solutions for a series topology of inductive and capacitive coupling, determining optimal loads and maximum achievable output power. Validation through SPICE simulations enhances confidence in the findings, offering valuable insight for evaluating mixed wireless power transfer systems

The paper may lack experimental validation of the proposed optimization techniques and could overlook practical constraints such as coil misalignment and efficiency losses, potentially limiting its real-world effectiveness in maximizing power transfer for mixed inductive and capacitive wireless systems.

III.PROPOSED WORK

Implementing wireless charging technology in vehicles and stations streamlines the charging process by eliminating physical connections, enhancing efficiency, and reducing maintenance needs. Additionally, a fully automatic refueling system minimizes human intervention, enhancing safety and operational efficiency. This transformative integration revolutionizes vehicle power and refueling, offering seamless charging experiences and safer refueling processes. By automating refueling, accidents and errors are reduced, ensuring smoother operations and user satisfaction. Overall, these advancements prioritize safety, convenience, and efficiency, marking a significant step in addressing manual refueling challenges. Wireless charging not only simplifies the charging process but also reduces wear and tear on physical connectors, leading to longer-lasting infrastructure. Moreover, it allows for more flexible charging locations, promoting accessibility and convenience for electric vehicle owners. The automated refueling system further enhances the user experience by optimizing refueling times and reducing queues at charging stations. With wireless charging and automated refueling, the transportation sector can significantly reduce its environmental footprint by encouraging the adoption of electric vehicles. This shift towards cleaner energy sources aligns with global efforts to combat climate change and improve air quality in urban areas. As technology continues to advance, we can expect further innovations in vehicle power and refueling systems, driving us towards a more sustainable and efficient future.

3.1 BLOCKDIAGRAM

We utilize a microcontroller linked to a 2-Axis Robot and LCD display, along with a wireless transmitter, to transfer power between nodes. The vehicle's receiver module, integrated seamlessly, features an LED indicator showing battery charging status during communication. Due to cost constraints, power transmission is limited to 5-10 cm, yet vehicle control remains intuitive via keys, with LCD status monitoring for user convenience. This wireless setup optimizes charging and control, offering immediate feedback through LEDs, enhancing operational efficiency and user experience.

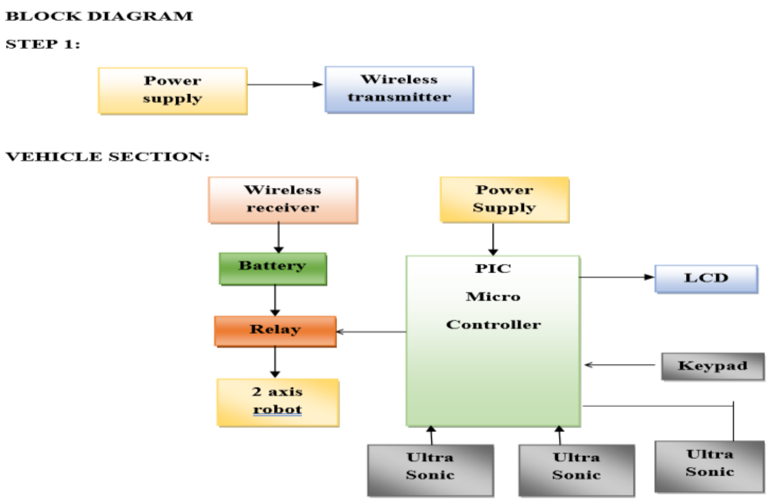

Figure 1: Block Diagram

PIC Micro Controller: A PC controller is a peripheral device designed for gaming, offering tactile control and precision in gameplay interactions. It commonly interfaces with a computer through USB or Bluetooth connectivity, ensuring smooth and seamless gaming experiences. With responsive buttons and joysticks, it allows precise input for navigating virtual environments and executing actions. The ergonomic design enhances comfort during extended gaming sessions, reducing strain and fatigue. Wireless connectivity options provide freedom of movement without the hassle of cables, enhancing user convenience. Some controllers feature motion-sensing capabilities, enabling gesture-based controls for immersive gameplay. Vibration feedback mechanisms enhance realism by providing tactile feedback during gameplay actions. Compatibility with popular gaming platforms like Steam and Epic Games Store ensures broad accessibility for gamers. Customizable features such as button mappings and sensitivity settings cater to individual preferences. Durability and reliability are key characteristics, ensuring longevity even under intense gaming usage. Integration with gaming software simplifies setup and optimization for new titles. Cross-platform support allows for seamless transition between PC and console gaming experiences. Ergonomic designs prioritize user comfort, with grips and contours designed for extended use. Advanced features like touch-sensitive pads and gyroscopic sensors expand control options and gameplay possibilities. Collaboration with game developers ensures optimized performance for popular titles. Community-driven customization options, including third-party mods and software, enhance functionality and user experience. Compatibility with virtual reality (VR) systems extends immersion in VR gaming experiences. Accessibility features such as remappable buttons accommodate diverse user needs, including those with disabilities. Multiplatform support extends compatibility to gaming consoles, providing versatility for gamers with multiple devices. Responsive analog sticks enable precise movement control, essential for competitive gaming. Customizable trigger sensitivity caters to various playstyles, from casual to professional gamers. Enhanced grip surfaces improve handling and control during intense gaming sessions. Integration with cloud gaming services enables streaming of PC games to a variety of devices. Continued innovation drives the evolution of controller design and technology, offering new features and capabilities to enhance the gaming experience.

Ultra Sonic: The compact ultrasonic sensor module employs ultrasonic waves to detect objects, utilizing a single piezoelectric disc for both transmission and reception. This module operates on the principle of echo detection, where ultrasonic pulses are emitted and the reflected signals are analyzed to determine object distance. Its compact design makes it suitable for various applications, including distance measurement, obstacle detection, and presence sensing. The piezoelectric disc converts electrical energy into ultrasonic waves and vice versa, enabling bidirectional functionality within a single component. By measuring the time taken for ultrasonic pulses to travel to the target and back, the sensor calculates object distance with high accuracy. The module typically includes control circuitry for signal generation, timing, and signal processing, ensuring reliable performance. Ultrasonic sensors offer advantages such as non-contact operation, immunity to environmental factors like dust and light, and high detection sensitivity. They find widespread use in robotics, automotive systems, industrial automation, and smart devices. Integration with microcontrollers allows for easy interfacing and integration into electronic systems. Ultrasonic sensors can detect objects regardless of color, transparency, or surface characteristics, making them versatile in various environments. Their compact size and low power consumption make them suitable for battery-operated devices and portable applications. Some ultrasonic sensor modules feature adjustable sensitivity and range settings, allowing for customization based on specific requirements. The module's simple interface and easy installation facilitate rapid deployment in diverse projects. Ultrasonic sensors can detect multiple objects simultaneously within their detection range, enabling efficient object tracking and monitoring. Advanced signal processing techniques enhance sensor performance in noisy environments or under challenging conditions. Real-time data acquisition and processing enable dynamic adaptation to changing environments and object configurations. Integration with wireless communication protocols enables remote monitoring and control of ultrasonic sensor networks. Continuous innovation in ultrasonic sensor technology drives improvements in range, accuracy, and reliability. Ultrasonic sensors complement other sensing technologies such as infrared and laser sensors, offering complementary capabilities for comprehensive sensing solutions. The reliability and robustness of ultrasonic sensors make them suitable for demanding industrial applications with stringent performance requirements. Calibration and configuration options allow users to optimize sensor performance for specific applications and environments. Ultrasonic sensor modules are available in various form factors and designs to suit different mounting and installation requirements. Some modules feature waterproof or ruggedized enclosures for operation in harsh environments or outdoor applications. The versatility and reliability of ultrasonic sensors make them a preferred choice for a wide range of applications across industries.

Relay: A power relay module serves as an electrical switch controlled by an electromagnet. When energized, the electromagnet attracts an armature, causing a mechanical switch to open or close. These modules are crucial components in various electrical systems, allowing for remote or automated control of power circuits. They provide isolation between control signals and high-power loads, enhancing safety and reliability. Power relay modules come in various configurations, including single-pole single-throw (SPST), single-pole double-throw (SPDT), and double-pole double-throw (DPDT), to accommodate different switching requirements. They are commonly used in industrial automation, home automation, automotive applications, and electronic equipment. Relay modules can handle high currents and voltages, making them suitable for controlling motors, heaters, lights, and other heavy-duty loads. Their compact and modular design facilitates easy installation and maintenance in electrical systems. Some relay modules feature built-in protection circuits to safeguard against overcurrent, overvoltage, and other electrical faults. Integration with microcontrollers and other control systems enables programmable operation and intelligent automation capabilities. Relay modules provide reliable switching performance over a wide range of operating conditions, ensuring consistent operation in diverse environments. Advances in relay technology continue to improve efficiency, reliability, and lifespan, meeting the evolving needs of modern applications.

LCD: A liquid-crystal display (LCD) is a flat panel electronic visual display technology that utilizes the light-modulating properties of liquid crystals. These displays are commonly found in devices such as televisions, computer monitors, and smartphones. LCDs consist of layers of liquid crystals sandwiched between two transparent electrodes, which align to control the passage of light. They offer sharp image quality and consume relatively low power compared to other display technologies. LCDs are capable of displaying images and videos with vibrant colors and high resolution. The liquid crystals can be manipulated electronically to change the orientation of polarized light, resulting in varying levels of transparency. LCDs are versatile and can be made in various sizes, from small screens in handheld devices to large displays in televisions and public signage. They are widely used due to their thin profile, lightweight, and flexibility in design. LCD technology has evolved over the years, with advancements such as LED backlighting and IPS panels improving brightness, contrast, and viewing angles. These displays are known for their durability and long lifespan, making them suitable for continuous use in a wide range of applications. Integration with touchscreen technology has expanded the functionality of LCDs, enabling interactive user interfaces in devices like smartphones and tablets. LCDs are a popular choice for indoor displays due to their excellent visibility under controlled lighting conditions. They offer superior color reproduction and image clarity compared to older display technologies like cathode ray tubes (CRTs). The widespread adoption of LCDs has led to their dominance in the consumer electronics market, displacing older display technologies in most applications. Ongoing research and development aim to further improve the performance and efficiency of LCD technology, ensuring its continued relevance in the future.

Key Pad: A Push Button is a switch that operates on the "Push-to-make" mechanism, typically in an off or normally open state. When pressed, it completes the circuit, allowing current to flow through. These switches are essential components in electronic devices, machinery, and control systems. Push buttons are made of plastic or metal, offering durability and reliability. They come in various sizes, shapes, and colors to suit different applications and aesthetic preferences. The simple mechanism of push buttons makes them easy to use and understand. They are commonly used for functions such as power on/off, start/stop, and mode selection. Push buttons are versatile and can be integrated into control panels, handheld devices, and industrial equipment. Their compact design allows for space-efficient installation in tight spaces. Some push buttons feature illuminated indicators for enhanced visibility in low-light conditions. The momentary action of push buttons ensures that the circuit is only activated while the button is pressed, providing precise control. Push buttons are designed to withstand frequent use and harsh operating environments. They are often used in conjunction with other control elements such as switches, relays, and sensors. Advances in push button technology have led to the development of sealed and waterproof versions for outdoor and industrial applications. Push buttons play a crucial role in safety-critical systems, providing emergency stop and reset functionalities. They are a fundamental part of human-machine interfaces, allowing users to interact with electronic devices and equipment. The versatility and reliability of push buttons make them indispensable in various industries, including automotive, aerospace, and consumer electronics.

2- Axis Robot: A 2-axis robot is an essential component of smart vehicle automation systems, especially when incorporating proximity sensors. These robots feature two degrees of freedom, enabling precise movement along two axes for efficient operation. Proximity sensors play a crucial role in smart vehicle automation by detecting nearby objects or obstacles in real-time. When integrated with 2-axis robots, proximity sensors provide critical input for navigation, collision avoidance, and object detection. By accurately sensing the proximity of surrounding objects, these sensors enable the robot to make intelligent decisions and adjust its trajectory accordingly. In smart vehicle automation, 2-axis robots equipped with proximity sensors can perform tasks such as parking assistance, obstacle avoidance, and autonomous navigation. The combination of 2-axis robots and proximity sensors enhances safety, efficiency, and reliability in smart vehicle applications. These systems can detect obstacles in the robot's path and take evasive action to avoid collisions, reducing the risk of accidents and damage to vehicles and property. Proximity sensors can detect objects at close range, allowing 2-axis robots to maneuver safely in confined spaces and crowded environments. Integration of proximity sensors with 2-axis robots enables seamless interaction with the surrounding environment, making them ideal for applications in smart transportation, logistics, and manufacturing. The use of proximity sensors in conjunction with 2-axis robots enhances automation capabilities, reducing the need for human intervention and improving overall system efficiency. Advanced algorithms and control systems enable precise coordination between the robot's movements and the feedback from proximity sensors, ensuring smooth and accurate operation. By leveraging proximity sensors, 2-axis robots can adapt to dynamic environments and changing conditions, making them versatile and adaptable solutions for smart vehicle automation. The integration of proximity sensors with 2-axis robots opens up new possibilities for intelligent automation in various industries, paving the way for safer, more efficient, and more autonomous vehicles and systems.

Battery: In smart vehicle automation, batteries play a crucial role in powering onboard systems, including those incorporating proximity sensors. These sensors detect objects in the vehicle's vicinity, aiding in navigation, collision avoidance, and parking assistance. Batteries provide the necessary electrical energy to operate proximity sensors continuously, ensuring uninterrupted functionality. Smart vehicle automation relies on efficient energy management to maximize battery life while supporting sensor operations. Proximity sensors help optimize energy usage by activating systems only when necessary, conserving battery power. Advanced battery technologies, such as lithium-ion, offer high energy density and rechargeability, ideal for powering smart vehicle systems. Integration of proximity sensors with battery management systems allows for real-time monitoring and optimization of power consumption. Reliable battery performance is essential for the safe and efficient operation of smart vehicles, ensuring continuous sensor functionality for enhanced safety and convenience. Optimizing the synergy between batteries and proximity sensors is key to unlocking the full potential of smart vehicle automation, enabling seamless and reliable operation in various driving scenarios.

3.2 WORKING PRINCIPLE

In this work, we leverage a microcontroller interfaced with a 2-Axis Robot and LCD display, coupled with a wireless transmitter to facilitate power transmission between nodes. The receiver module is seamlessly integrated into the vehicle section, with an LED indicator illuminating to denote battery charging status during communication between transmitter and receiver. Due to cost considerations, the transfer distance is constrained to 5-10 cm, limiting the effective range. Vehicle control is orchestrated through keys, with comprehensive status monitoring displayed on the LCD screen for user convenience. To achieve wireless power transmission, a transmitter-receiver pair is utilized, wherein the transmitter dispatches power to the embedded receiver module within the vehicle. Visual feedback, courtesy of an LED on the receiver, furnishes users with immediate insight into battery charging status throughout the communication process. This setup optimizes vehicle charging procedures and control mechanisms, thereby enhancing operational efficiency and user experience alike. By integrating wireless technology, the system circumvents physical constraints, enabling more adaptable charging configurations. The inclusion of LED feedback ensures users remain well-informed about the ongoing charging process, promoting transparency and ease of use. As wireless power transfer technology continues to evolve, future iterations may transcend current distance limitations, further refining electric vehicle charging solutions. The incorporation of microcontrollers and LCD displays empowers real-time monitoring and control, bolstering system functionality and reliability in tandem.

IV.RESULTS AND DISCUSSION

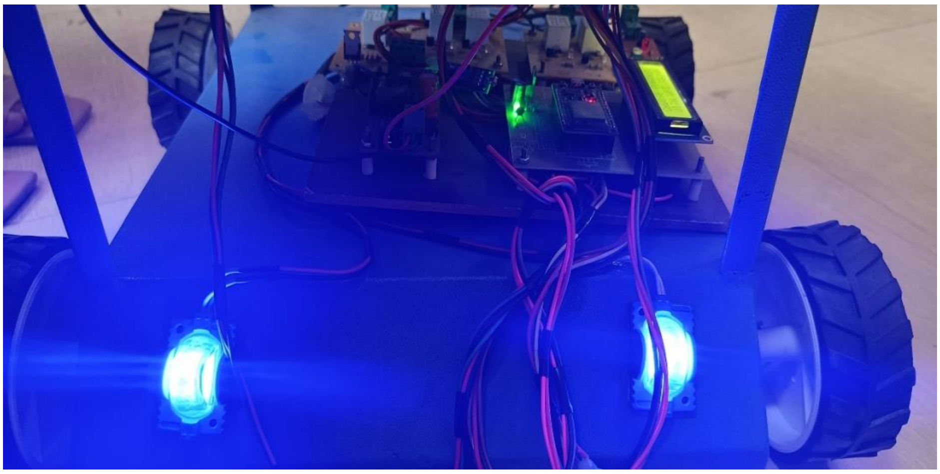

Figure 2: Beam Light

The beam lights of our vehicle are designed to dynamically adjust their brightness in response to changes in the brightness of the headlights of the opposite vehicle. This adaptive feature enhances safety on the road by ensuring optimal visibility while minimizing glare for other drivers. Such technology reflects advancements in automotive engineering aimed at improving driving conditions and reducing the risk of accidents. By seamlessly synchronizing with surrounding traffic, these adaptive beam lights contribute to a smoother and more secure driving experience.

Figure 3: Display

The LCD display provides visual feedback and information regarding the vehicle's surroundings, allowing drivers to stay informed and aware of their environment at all times. This real-time feedback enhances situational awareness and enables drivers to make informed decisions while navigating challenging road conditions.

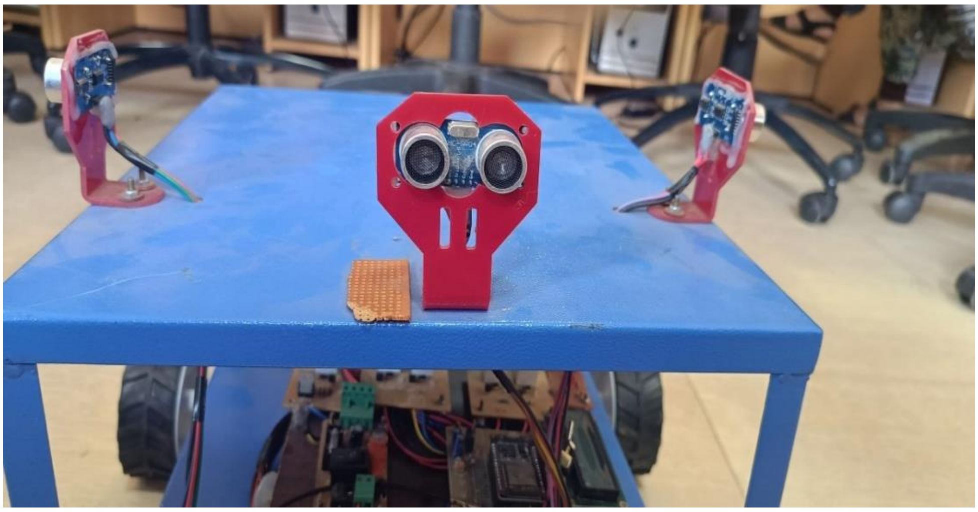

Figure 4: Proximity Sensor

Ultrasonic sensors are utilized in proximity sensors to determine the distance between our vehicle and neighboring vehicles, covering a 180-degree range. These sensors play a crucial role in ensuring safe driving by providing real-time data on the proximity of surrounding vehicles. By employing ultrasonic technology, our vehicle can accurately gauge distances and adjust its position or speed accordingly, enhancing overall road safety.

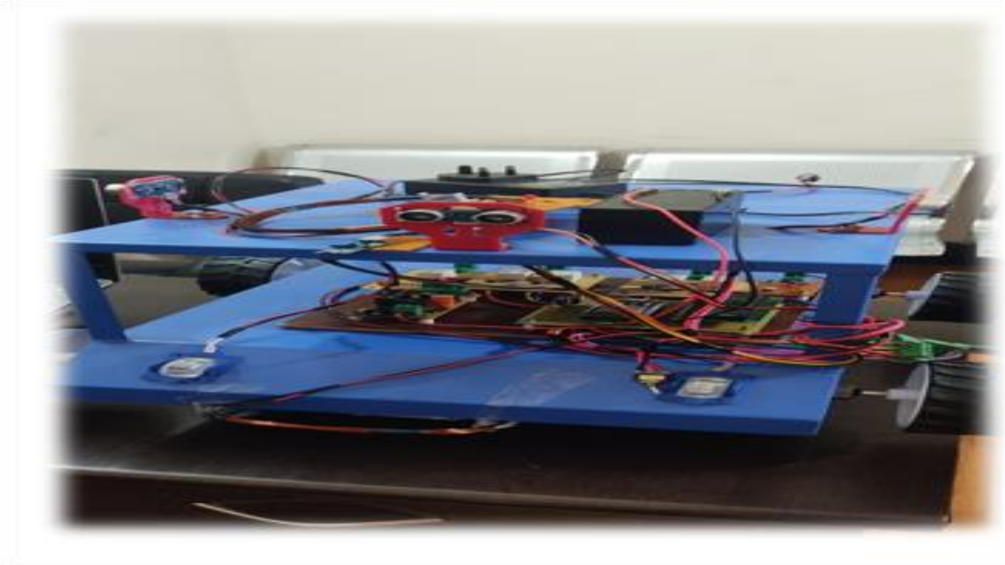

Figure 5: Working Model

The result of the above work implementation leads to the reduce in accidents during night times and ensure the safety of people to the fullest. The results of automating the vehicles ensure the road safety than the manual driving as there is no chance for the lack of concentration during drives. Due to the less human interventions throughout the driving process it reduces the stress and provides the peaceful and safe environment to enjoy the drive.

V.CONCLUSION

Our IoT-driven smart vehicle platform prioritizes accident mitigation, focusing on preempting collisions through technology integration. Sensors play a pivotal role, enhancing our ability to anticipate and respond to potential hazards, thereby reducing collision risks. By leveraging sensors, our system can detect obstacles and dynamically adjust vehicle behavior to avoid accidents. This proactive approach to safety significantly enhances the overall driving experience and minimizes the likelihood of collisions. Through continuous monitoring and real-time data analysis, our platform ensures swift and effective responses to changing road conditions. Ultimately, the integration of IoT and sensor technology empowers our smart vehicles to navigate roads with heightened safety and efficiency.

VI.REFERENCES

1. Zhang, L., Zhang, Y., Zhang, X., & Yang, L. 2022. Vehicle trajectory prediction with LSTM neural network based on ultrasonic proximity sensors, Journal of Advanced Transportation, ,5549594.
2. Jiang, W., Zuo, Z., Lu, C., & Lu, K. 2021. Research on Smart Vehicle Obstacle Avoidance System Based on Ultrasonic Proximity Sensor, IEEE International Conference on High Voltage Engineering and Application (ICHVE).
3. Karunaratne, S., & Jayasekara, B. 2021. Design and development of a smart vehicle collision avoidance system using ultrasonic proximity sensors. .IEEE 11th International Conference on Humanoid, Nanotechnology, Information Technology, Communication and Control, Environment and Management (HNICEM).
4. Iqbal, M. A., Khan, W. A., & Rehman, S. 2020. Design and development of a smart vehicle parking system using ultrasonic proximity sensors, 5th International Conference on Intelligent Technologies and Applications (INTAP).
5. Yang, J., Wu, W., Zeng, F., Zhang, L., & Zhao, X. 2020. A smart vehicle system for environment perception and driver assistance based on ultrasonic sensors. IEEE Access, 8, 23952-23963.

6. Ren, J., Wu, W., & Liu, Y. 2019. Design of a smart vehicle parking system based on ultrasonic sensor and infrared sensor. International Conference on Intelligent Transportation, Big Data & Smart City (ICITBS).

7. Pradhan, P. M., Gautam, K., & Dhungel, P. 2019. Design and implementation of a smart vehicle parking system using ultrasonic sensors. . International Conference on Electrical, Electronics and Civil Engineering (ICEECE).

8. Soares, T. P., Ferreira, B. B., Ribeiro, A. L., & Soares, F. S. 2019. Implementation of a smart vehicle parking system using ultrasonic sensors and Arduino. .IEEE International Instrumentation and Measurement Technology Conference (I2MTC).

9. Chang, K. C., Chen, J. L., Tsai, M. J., & Huang, J. J. 2018. Design and implementation of a smart vehicle parking system using ultrasonic sensors. International Conference on Applied System Innovation (ICASI).

10. Lai, J. Y., Chiang, M. F., Huang, C. H., & Lin, C. C..2018.. Smart vehicle parking system using ultrasonic sensors and fuzzy inference systems, International Conference on Advanced Robotics and Intelligent Systems (ARIS).

11. Musa, A., Dandjouma, S. M., & Umar, A. 2018. Development of a smart vehicle parking system using ultrasonic sensors. 15th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON).

12. Tian, Z., Guo, W., & Qin, L. 2017. Design of a smart vehicle parking system based on ultrasonic sensors, 12th IEEE Conference on Industrial Electronics and Applications (ICIEA).

13. Liu, Y., Wang, Y., & Zhang, Y. 2017. Design and implementation of a smart vehicle parking system using ultrasonic sensors. IEEE 2nd Advanced Information Technology, Electronic and Automation Control Conference (IAEAC).

14. Yu, Z., Peng, Y., & Wang, Y. .2016. Design of a smart vehicle parking system based on ultrasonic sensors, International Conference on Information and Communication Technology Convergence (ICTC).

15. Zhang, J., & Cao, Q. 2016. Development of a smart vehicle parking system using ultrasonic sensors, 12th World Congress on Intelligent Control and Automation (WCICA).

16. Sandesh Patel, Shekhar Yadav, and Nitesh Tiwari. 2023. A Comprehensive Review of Wireless Electric Vehicle Charger".

17. Sangwook Park. 2017. Evaluation of electromagnetic exposure during 85 khz wireless power transfer for electric vehicle.

18. Chung Hee Lee., Guhuo Jung. 2020. Wireless power transfer system for an autonomous electric vehicle. IEEE Wireless Power Transfer Conference (WPTC).

19. Juegue Shin., Seungyong Shin. 2012. Optimal current control of a wireless power transfer system for high power efficiency. Electrical Systems for Aircraft, Railway and Ship Propulsion

20. Juegue Shin., Seungyong Shin. 2013. Wireless power transfer system for high power application and a method of segmentation. IEEE Wireless Power Transfer Conference (WPTC).

21. Benn Minnaert., Nobby Stevens. 2019. Maximizing the power transfer for a mixed inductive and capacitive wireless power transfer system. IEEE Wireless Power Transfer Conference (WPTC).