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Review Paper on Self-Parking Chair

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Abstract: ***The Self-Parking Chair is an innovative automation system designed to improve convenience and space management in indoor environments such as offices, conference rooms, and smart homes. This project focuses on developing a chair that can automatically navigate and park itself in a designated location without human assistance. The system uses a combination of sensors, a microcontroller (such as Arduino), and image processing techniques like OpenCV to detect a predefined coloured tag or marker placed at the parking area. A camera mounted on the chair continuously captures real-time images, which are processed to identify the target location based on colour detection. The system then calculates the direction and distance required to reach the parking spot. Motor drivers control the movement of the chair, enabling it to avoid obstacles and adjust its path dynamically. Ultrasonic or infrared sensors are also used to enhance obstacle detection and ensure safe navigation.***

Keywords: Self-Parking System, Arduino, OpenCV, Computer Vision, Obstacle Detection, Autonomous Navigation.

I. INTRODUCTION

With the rapid advancement of technology, automation has become an integral part of modern life, aiming to improve efficiency, convenience, and user comfort. Smart systems are increasingly being integrated into everyday objects, transforming them into intelligent devices capable of performing tasks autonomously. One such innovation is the Self-Parking Chair, which combines robotics, embedded systems, and computer vision to create a smart seating solution. The concept of a self-parking chair is inspired by autonomous vehicles that can navigate and park without human intervention. In many environments such as offices, classrooms, and conference halls, arranging chairs manually can be time-consuming and inefficient. The Self-Parking Chair addresses this issue by enabling the chair to automatically move to a predefined parking location after use. This system typically utilizes a microcontroller such as Arduino, along with sensors and a camera module. Image processing techniques using OpenCV are employed to detect a specific-coloured marker that indicates the parking position. Additionally, ultrasonic or infrared sensors are used for obstacle detection to ensure safe navigation. Based on the processed data, the chair calculates its path and moves accordingly using motorized wheels. The main objective of this project is to develop an intelligent and autonomous system that reduces human effort while improving space management. It also demonstrates the practical application of emerging technologies such as computer vision and robotics in solving real-world problems. The Self-Parking Chair represents a step forward in the development of smart environments, where even simple objects can operate with minimal human intervention. The growing demand for smart infrastructure has encouraged the development of automated systems that enhance productivity and reduce dependency on manual labour. In shared spaces such as libraries, auditoriums, and co-working areas, maintaining proper arrangement of furniture is a recurring challenge. A self-parking chair system can play a significant role in maintaining cleanliness and order by automatically organizing itself after use, thereby reducing the workload on maintenance staff. Another important aspect of the self-parking chair is its ability to adapt to dynamic environments. Unlike static systems, the chair must operate in spaces where obstacles such as people, tables, or other chairs may frequently change position. This requires the system to make real-time decisions, demonstrating the importance of adaptive algorithms and responsive control mechanisms in modern automation solutions. Energy efficiency is also a key consideration in the design of such systems. The chair can be designed to operate on rechargeable batteries and optimized to consume minimal power during movement and standby modes. Incorporating energy-saving techniques not only increases the operational time but also makes the system more environmentally friendly and sustainable in the long run. User interaction and ease of operation are equally important in ensuring the success of the system. The self-parking feature can be activated through simple methods such as a button, remote control, or even mobile application integration. This enhances user experience by providing convenience and accessibility, making the technology practical for everyday use. Furthermore, the concept of a self-parking chair opens the door to future advancements in smart furniture. It can be extended to include features such as automatic alignment in rows, integration with IoT systems for centralized control, or even voice command functionality. These possibilities highlight the scalability of the project and its potential contribution to the development of intelligent and connected environment.

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Additionally, the system enhances safety by minimizing human effort in moving heavy furniture, reducing the risk of injury. It also promotes efficient space utilization, making environments more organized and user-friendly.

II. LITERATURE REVIEW

Several research works have been carried out in the field of automation and smart furniture systems, particularly focusing on self-parking mechanisms and autonomous navigation. In paper [1], the authors proposed a smart self-parking chair system that uses basic sensors and microcontroller-based control for navigation. The study emphasizes cost-effective implementation and demonstrates how automation can reduce manual effort in organizing indoor spaces. The system mainly relies on predefined paths and simple obstacle detection techniques. In paper [2], the researchers introduced an advanced approach by integrating computer vision techniques into the self-parking system. The use of image processing allows the system to identify target locations more accurately compared to traditional sensor-based methods. This paper highlights the importance of real-time data processing and improved decision-making capabilities, making the system more adaptable to dynamic environments.

Paper [3] focuses on the implementation of autonomous navigation using embedded systems and sensor fusion. The authors combined multiple sensors to enhance obstacle detection and path planning. Their work shows that using a combination of technologies improves system reliability and reduces errors during movement, especially in cluttered environments.

In paper [4], the study explores the role of IoT and smart control systems in automated furniture. The system allows remote monitoring and control, making it more user-friendly and efficient. This approach demonstrates how connectivity and smart integration can enhance the functionality of self-parking systems beyond basic automation. Finally, paper [5] presents an intelligent self-parking chair system that integrates computer vision with motor control and sensor-based obstacle avoidance. The authors focus on improving accuracy and efficiency by using OpenCV for color detection and advanced algorithms for navigation. This work provides a strong foundation for developing more intelligent and autonomous systems.

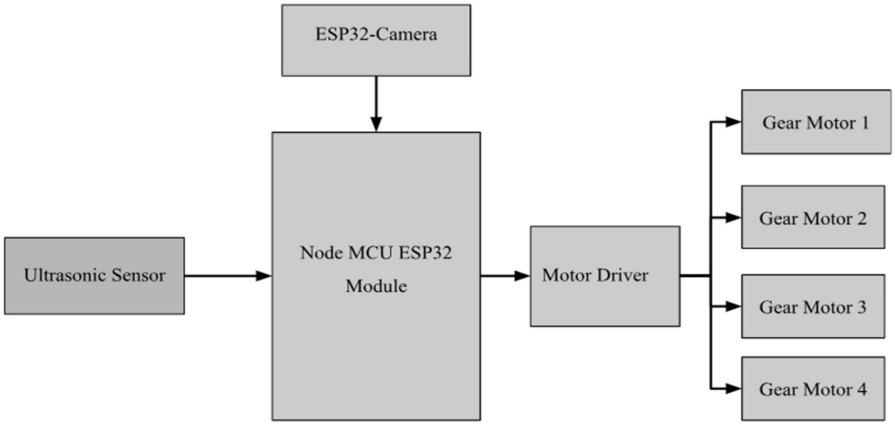
Overall, the reviewed literature indicates that self-parking chair systems are evolving from simple sensor-based models to more advanced, intelligent systems incorporating computer vision, IoT, and smart algorithms. These studies highlight the growing potential of automation in everyday applications and provide valuable insights for further development in this field.

III.OVERVIEW OF SELF-PARKING CHAIR

The Self-Parking Chair is an automated system designed to move and park itself without human assistance. It is built using a combination of hardware and software components that work together to achieve autonomous navigation. The main goal of this system is to reduce manual effort and improve the organization of indoor spaces.

The system operates by detecting a predefined parking location using a camera and image processing techniques. A coloured marker or tag is placed at the desired parking spot, which is recognized by the system using OpenCV. Based on the detected position of the marker, the chair determines the direction and movement required to reach the target location.

To ensure safe and smooth operation, the chair is equipped with motors and obstacle detection sensors. These components allow the chair to move in different directions while avoiding collisions with objects in its path. Once the chair reaches the designated location, it stops automatically, completing the parking process efficiently.



Block Diagram

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IV. AUTOMATION IN SELF-PARKING CHAIR

Automation plays a crucial role in the functioning of the self-parking chair by enabling it to perform tasks without human intervention. The system is designed to automatically detect, navigate, and park itself using integrated hardware and software components. This reduces the need for manual handling and enhances overall efficiency in managing indoor spaces.

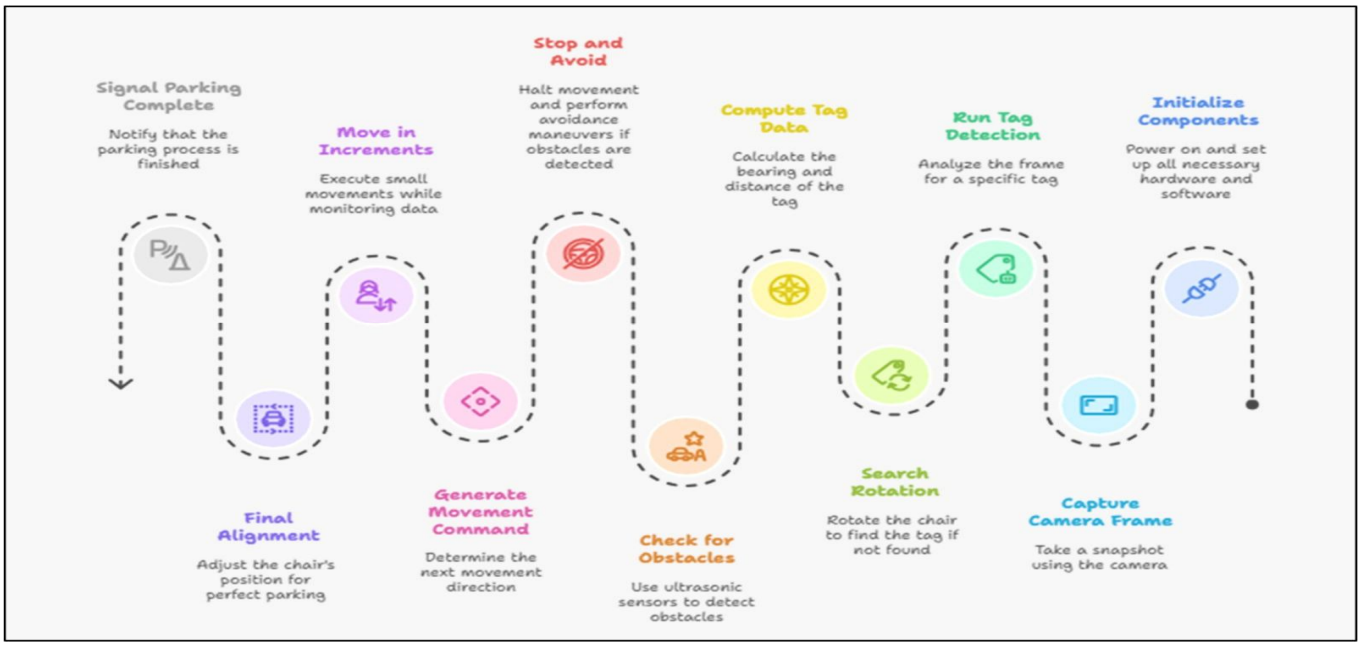
The automation process begins with data acquisition through sensors and a camera. The camera captures real-time images of the environment, while sensors continuously monitor the surroundings for obstacles. This data is processed by the microcontroller, which acts as the central unit for decision-making. The use of real-time data ensures that the system responds quickly and accurately to changes in the environment.

Control automation is achieved through programmed algorithms that guide the chair's movement. Based on the processed input, the system generates commands to control the motors, allowing the chair to move forward, backward, or turn as required. These automated control actions ensure precise navigation toward the designated parking location.

Another important aspect of automation is safety and reliability. Obstacle detection sensors help the system avoid collisions by automatically stopping or redirecting the chair when an object is detected in its path. This makes the system dependable and suitable for use in environments where human presence is frequent.

Furthermore, automation in the self-parking chair can be extended to include advanced features such as remote operation, scheduling, and integration with smart systems. These enhancements can improve user convenience and expand the functionality of the system, making it a part of modern smart environment.

The automation system also improves consistency in performance, as the chair follows predefined instructions and algorithms every time it operates. Unlike manual handling, which may vary from person to person, automated movement ensures uniform and accurate positioning of the chair at the designated parking spot. This consistency is especially useful in environments where proper arrangement is essential.



FLOW CHART

V. LIMITATIONS

The self-parking chair system has certain limitations that affect its overall performance and reliability. The accuracy of the system largely depends on proper lighting conditions, as poor or varying light can reduce the effectiveness of color detection using OpenCV. The system may also face difficulty in highly dynamic environments where obstacles frequently change position, leading to delays or incorrect navigation. Additionally, the reliance on predefined markers limits flexibility, as the chair can only park in locations with a specific coloured tag. Battery life and power consumption can also restrict continuous operation, while the processing speed of the microcontroller may limit real-time responsiveness. These factors highlight the need for further improvements to enhance the system's robustness and adaptability.

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VI. CONCLUSION

The self-parking chair project successfully demonstrates the application of automation, robotics, and computer vision in creating an intelligent system capable of navigating and parking without human assistance. By integrating components such as a microcontroller, sensors, motors, and a camera with OpenCV, the system achieves autonomous movement and accurate positioning. The project highlights how everyday objects can be enhanced with smart features to improve convenience and efficiency.

Despite achieving the desired functionality, there is significant scope for improvement. The system can be enhanced by improving image processing techniques to perform reliably under different lighting conditions and complex environments. The addition of advanced sensors and faster processors can further increase accuracy, response time, and overall performance of the chair.

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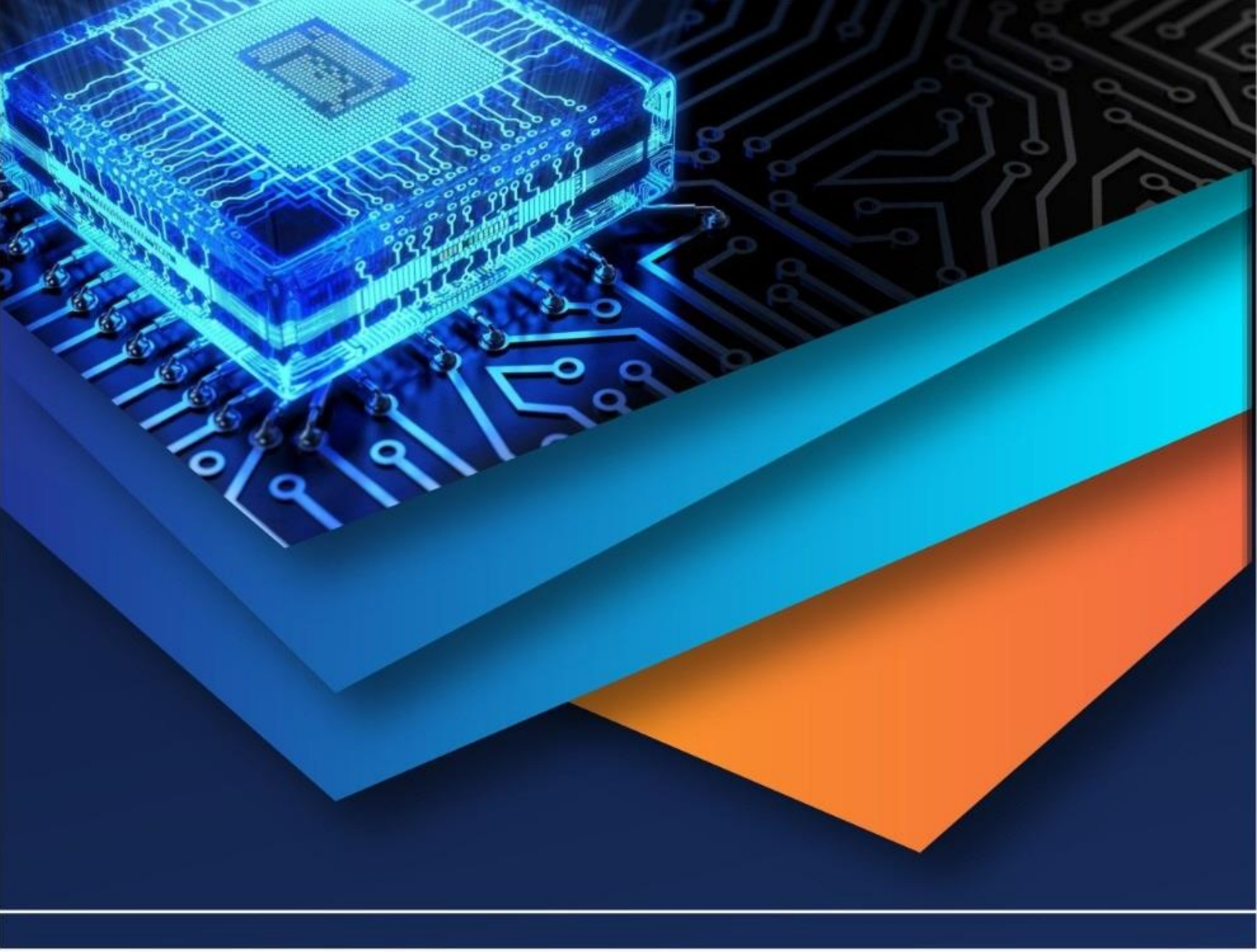

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