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Application of Robot for Stewardship

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Abstract: This project aims at designing a low cost, efficient autonomous robot with a smart ordering system. Index Terms: Arduino, Motor, QR Code, Restaurant Website, Waiter Robot. The proposed robot combines advanced sensor technologies, and a robust control system to achieve accurate and reliable line-following capabilities. The integration of various sensor enables the robot to recognize and interpret intricate line patterns, facilitating seamless navigation through diverse environments. The key features of the delivery robot include a multiple IR sensor for real-time line detection, a sophisticated control algorithm for precise motor adjustments, and a clever programming that enhances performance over time. The robot's ability to follow lines with precision allows it to navigate complex routes, including indoor facilities, outdoor spaces, and public areas, making it versatile for various delivery scenarios.

Keywords: Sensors, Audino, Battery, Wheels, Motors,

I. INTRODUCTION

Robots have emerged as transformative entities, revolutionizing various aspects of human life and industries. Defined by their ability to carry out tasks autonomously or semi- autonomously, robots have evolved from mere mechanical devices to sophisticated systems driven by Artificial Intelligence (AI) and advanced sensor technologies. The history of robotics traces back to ancient times, where early automatons were created for entertainment and curiosity. However, the contemporary era has witnessed a paradigm shift in the capabilities and applications of robots. Modern robots are designed to perform a diverse range of tasks, from mundane and repetitive activities to complex and intricate operations that require precision and adaptability.

One of the defining characteristics of robots is their ability to sense and respond to their environment. Sensors, including cameras, lidar, and various other technologies, enable robots to perceive and interpret their surroundings. The integration of AI algorithms empowers robots to learn from experience, make decisions, and adapt to changing conditions, marking a departure from rigid, pre-programmed behaviour. The applications of robots are widespread, spanning industries such as manufacturing, healthcare, agriculture, and logistics. In manufacturing, robots have revolutionized production lines, enhancing efficiency and precision. In healthcare, they assist in surgeries, rehabilitation, and patient care. Agricultural robots contribute to precision farming, optimizing crop yields. Meanwhile, autonomous delivery robots are reshaping the landscape of logistics. As robots continue to evolve, ethical considerations and societal impacts become increasingly important. Discussions around the ethical use of AI in robots, potential job displacement, and the need for regulatory frameworks are integral to shaping a future where robots contribute positively to human well-being. In this dynamic landscape, the exploration of robots encompasses not only their technological advancements but also their profound implications for society. The journey of robots from mechanical curiosities to intelligent, adaptive systems reflects humanity's ongoing quest for innovation and efficiency.

II. LITERATURE SURVEY

Haixia Zeng et al., [1] Proposed design of an efficient and intelligent food delivery robot, which can receive background instructions, choose the route, deliver the food, and automatically returns back to the start. Used a radio frequency module to locate the target, an infrared module to navigate, an ultrasonic sensor for obstacle avoiding, a WI-FI module for serial communication, and MSP430 was used as a control unit.

Shruti et al., [2] is designed in such a way that it takes orders as well as serves food at minimal human assistance. RPA is used by the system to perform tasks instinctively. Customer has to press a button on each table to summon the serve robot. Ultrasonic sensors help in detecting obstacles if present in the robot's path, an

OLED screen is used to display the menu and the customer is provided with a remote to input their order easily.

Anjali et al., [3] presents an Autonomous Robot for delivering the orders in restaurants. The whole system is controlled by Raspberry Pi. Number of switches connected as inputs equals table numbers in restaurants. The robot is given a predefined path using unique identification of the table. In case of an obstacle encounter, an ultrasonic sensor is used. Raspberry Pi processes the input from switches and ultrasonic sensors and sends the data to motor drivers connected to two DC motors and one stepper motor.

Zeashan H. Khan et al., [4] proposes the design and development of a waiter robot which is considered as a possible solution to restaurant automation. The desired order is transmitted on wireless network to the kitchen via menu bar. The menu bar is based on the LCD, Keypad and the Bluetooth module. It works on the concept of line following using four IR sensors, where two sensors are used for line following and the remaining two are placed at the side for the count of tables. The customer places the order using an electronic menu bar. This order is sent to the kitchen and reception using a communication network. Bluetooth module (HC-06) is used with a baud rate of 9600 bps. The waiter robot then transfers the food from the kitchen to the customer.

Heena Sheikh et al., [5] Today, technology is being used to make improvements in every domain. Due to rapid development of technology, in the field of work the robots have replaced human labor and solved many related problems. Young people choose to enjoy a variety of food outside which led to emergence of new ideas in the food service industry. Nowadays the demand for intelligent food delivery systems is increasing at a rapid rate. This idea is leading towards the improvement of the cost and efficiency of the food delivery system. This project aims at designing a low cost, efficient autonomous robot with a smart ordering system.

Endrowednes et al., [6] proposes an autonomous intelligent line follower robot controlled by a microcontroller. The robot is designed to serve 4 designated rooms usings RF remote and seven sensors are used to trace the line mapped. Main system consists of an actuator as the main motor, destination room button, line reader sensor, alarm and ultrasonic system.

III. OBJECTIVES AND METHODOLOGY

3.1 OBJECTIVES

The Main Objectives of This Fabrication of Stewardship Robot

- **Efficient Service Delivery: Objective:** To enhance the efficiency of food and beverage service in hospitality settings by utilizing waiter robots. Rationale: Improve order accuracy, minimize wait times, and optimize the overall dining experience for customers.
- **Operational Cost Reduction: Objective:** To reduce operational costs associated with human waitstaff by implementing cost-effective and reliable waiter robot solutions. Rationale: Increase profitability through labour cost savings and improved resource utilization.
- **Enhanced Customer Experience: Objective**: To provide a unique and memorable dining experience for customers through the use of waiter robots. Rationale: Differentiate the establishment by offering innovative and entertaining services, attracting and retaining customers.
- **Adaptability and Flexibility: Objective:** To develop waiter robots that are adaptable to different restaurant layouts, cuisines, and service requirements. Rationale: Ensure the versatility of the waiter robots in addressing diverse operational needs within the hospitality industry.
- **Integration with Existing Systems: Objective**: To seamlessly integrate waiter robots with existing restaurant management systems, POS systems, and kitchen operations. Rationale: Streamline communication and coordination between robots and other components of the restaurant infrastructure.
- **User-Friendly Interaction: Objective:** To design intuitive interfaces and interactive features that enable easy communication between waiter robots and customers. Rationale: Enhance user acceptance and create a positive and engaging customer interaction.
- **Safety and Reliability: Objective**: To prioritize the safety of customers and staff by implementing robust safety features and reliability in the operation of waiter robots. Rationale: Mitigate potential risks and ensure the seamless and secure functioning of the robotic systems.

- **Scalability and Cost-Effectiveness:** Objective: To design waiter robots that are scalable for deployment in establishments of varying sizes while maintaining cost-effectiveness. Rationale: Facilitate the adoption of the technology by restaurants with diverse operational scales.

3.2 Methodology

Methodology for Developing Waiter Robot**:**

i. **Needs Assessment**: Identify the specific needs and requirements of the hospitality industry, considering factors such as restaurant type, size, and customer expectations.

ii. **Market Research:** Conduct a thorough analysis of existing waiter robot technologies, competitor solutions, and market trends to identify opportunities for innovation.

iii. **Technology Selection:** Choose appropriate technologies, including sensors, actuators, navigation systems, and communication protocols, based on the identified requirements and market research.

iv. **Prototyping and Testing:** Develop prototypes of the waiter robot, incorporating the selected technologies, and conduct rigorous testing in controlled environments to assess functionality and reliability.

v. **Human-Robot Interaction Design:** Collaborate with user experience (UX) designers to create a user-friendly interface for customers and staff, ensuring seamless interaction with the waiter robot.

vi. **Safety Features Integration**: Implement safety features such as obstacle detection, emergency stop mechanisms, and fail-safes to ensure the safety of customers and staff during robot operation.

vii. **Integration with Restaurant Systems:** Develop software interfaces for seamless integration with existing restaurant management systems, POS systems, and kitchen operations.

viii. **Scalability Considerations:** Design the waiter robot with scalability in mind, allowing for customization based on the size and requirements of different hospitality establishments.

ix. **User Training and Support:** Develop training programs for restaurant staff to effectively work with the waiter robots and provide ongoing technical support and maintenance services.

This combined set of objectives and methodologies aims to develop a waiter robot that not only meets the technical requirements of the hospitality industry but also aligns with the evolving needs and expectations of customers and restaurant operators.

IV. WORKING PRINCIPLE

A waiter robot typically operates in a restaurant or hospitality setting, assisting with tasks such as delivering food and drinks to customers, clearing tables, and navigating through the dining area the robot model as Shown in Fig. 1. Here's an overview of how a waiter robot might work:

1. **Navigation System:** The robot is equipped with sensors, cameras, or other navigation technology to autonomously move around the restaurant without colliding with obstacles or customers. This navigation system may utilize techniques such as Simultaneous Localization and Mapping (SLAM) to create a map of the environment and localize the robot within itShown in The Fig. 2.
2. **Order Processing:** When a customer places an order, whether through a digital interface or by interacting with a human waiter, the order details are transmitted to the kitchen or bar. The kitchen staff prepare the food or drinks as usual, and the robot receives notification of the completed order.
3. **Food and Drink Delivery:** Once the order is ready, the kitchen staff place the items onto the robot's tray or designated compartments. The robot then navigates to the appropriate table using its mapping and navigation system. It may use sensors to detect obstacles and avoid collisions along the way.
4. **Interaction with Customers:** Upon reaching the designated table, the robot stops and announces its arrival with a greeting or notification to the customers. Some waiter robots may have interactive displays or voice capabilities to communicate with customers, confirm the order, and provide basic information about the items being served.
5. **Table Service:** The robot carefully delivers the food or drinks to the customers, using sensors and actuators to ensure smooth and precise movement. It may also assist with setting down plates and glasses on the table.
6. **Clearing Tables:** After the customers have finished their meal, the robot returns to the table to collect empty plates, glasses, and other items. It then navigates back to the kitchen or designated area for dish collection.
7. **Maintenance and Charging:** Periodically, the robot may require maintenance, such as cleaning or battery replacement. Some waiter robots are equipped with docking stations where they can autonomously recharge their batteries when not in use.

Overall, the working of a waiter robot involves a combination of advanced robotics, navigation technology, and human-computer interaction to provide efficient and seamless service in a restaurant or hospitality environment. The Completed Project Model as Shown Fig.3.

V. FIGURES

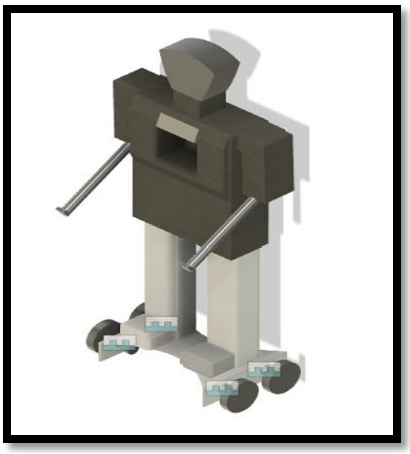

Fig. 1 3DModel of Robot

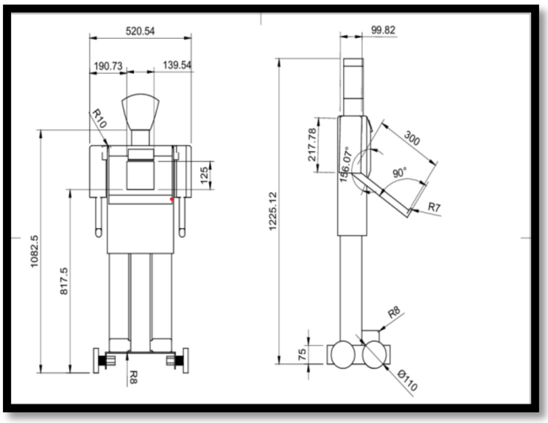

Fig. 2 CAD Model of Robot

Fig.3 Assembly of Robot

VI. CONCLUSION AND FUTURE SCOPE

6.1 Conclusion

In the exploration of the waiter robot project, several critical insights emerge, shaping its potential impact on restaurant operations. The choice of employing four motors, each boasting a torque rating of 16 kg/cm, underscores a deliberate engineering decision aimed at ensuring the robot's robust performance in fulfilling its designated roles within restaurant settings. This configuration promises a balance of power and control necessary for manoeuvring through dynamic and often crowded environments characteristic of dining establishments. Yet, while the motor setup provides a strong foundation, the precise load-carrying capacity of the robot remains contingent upon a multitude of factors, including its mechanical design, weight distribution, and wheel configuration. These intricacies highlight the need for meticulous planning and testing to optimize the robot's capabilities, particularly in tasks requiring the dragging of loads. Understanding the interplay between these variables is paramount in fine-tuning the robot's performance to meet the demands of real-world scenarios effectively.

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