Design, Modelling and Fabrication of Advanced Robots

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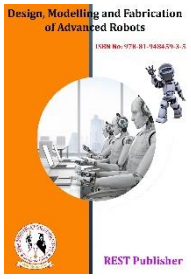

Design and Development of Automated Control of Restaurant Robot

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Abstract: *This paper presents a novel voice-controlled restaurant robot system designed to revolutionize the dining experience by seamlessly integrating advanced robotics and natural language processing technologies. The proposed system aims to enhance customer service, operational efficiency, and overall dining satisfaction by providing a user-friendly and interactive platform. .The restaurant robot is equipped with a comprehensive set of capabilities, including, voice recognition and manipulation. By leveraging voice control, users can interact with the robot using natural language commands, enabling seamless communication and intuitive control. This allows customers to effortlessly place orders The system's is comprises a mobile robotic platform, bluetooth modules, a cloud-based natural language processing, The voice control functionality is implemented through a sophisticated speech recognition system, enabling the robot to accurately understand and interpret user commands. .In addition to customer-facing interactions, the restaurant robot also assists restaurant staff in various tasks. Deliver food and beverages to tables, handle payment transactions, and perform routine cleaning tasks. By automating these processes, the system improves operational efficiency, reduces labor costs, and allows human staff to focus on higher value activities such as customer engagement and culinary expertise. .To evaluate the performance and usability of the voice-controlled restaurant robot, a series of experiments were conducted in a real-world restaurant environment. The results demonstrated the system's high recognition accuracy, robustness in noisy environments, and its ability to effectively handle a wide range of user requests. .The proposed voice-controlled restaurant robot presents a promising solution for transforming the dining experience. It combines the convenience of voice control with advanced robotics, enabling seamless and interactive interactions between customers, staff, and the robotic platform. The system's ability to enhance customer service, operational efficiency, and overall dining satisfaction positions it as a significant advancement in the hospitality industry.*

Keywords: *Autonomous vehicle, delivery vehicle, Path planning, Electrical speed controller*.

I. INTRODUCTION

The restaurant industry plays a vital role in the global economy, providing sustenance and entertainment to millions of people daily. However, the ever-increasing demands for efficiency, quality, and personalized experiences have compelled restaurant owners to explore innovative solutions to cater to evolving customer expectations. In this context, the integration of robotics and artificial intelligence (AI) technologies has emerged as a promising avenue to transform the way restaurants operate and engage with their patrons. This paper focuses on the development of a voice-controlled restaurant robot, which aims to revolutionize the customer experience by seamlessly integrating human-like interaction. By employing state-of-the-art voice recognition, natural language processing, and robotic capabilities, the proposed system empowers customers to interact with the robot in a natural and intuitive manner. The utilization of voice control as the primary mode of communication offers numerous advantages over traditional methods. It eliminates the need for physical menus and reduces the reliance on human staff for order placement. Moreover, by leveraging AI-driven algorithms, the robot is the further enhancing the overall dining experience. The development of the voice-controlled restaurant robot entails several core components, including speech recognition algorithms, language understanding models and robotic manipulators. These components work in harmony to process voice commands, interpret customer intent, and execute appropriate actions. This research aims to address several key challenges, such as robust speech

recognition in noisy restaurant environments, context-aware language understanding, efficient task execution, and human-robot interaction design. By overcoming these challenges, we envision a future where customers can effortlessly interact with restaurant robots and enjoy personalized services. The contributions of this paper extend beyond the technological advancements, as it also explores the potential implications and benefits of voice-controlled restaurant robots for various stakeholders. We examine the impact on customer satisfaction, staff workload, operational efficiency, and business profitability. Additionally, ethical considerations, privacy concerns, and social acceptance are critically analyzed to ensure the responsible deployment of this technology. In conclusion, the voice-controlled restaurant robot presented in this paper represents a significant step towards transforming the restaurant industry through intelligent automation. By harnessing the power of voice control, advanced AI technologies, and robotic capabilities, the proposed system aims to enhance customer experiences, optimize operational efficiency, and pave the way for a new era of dining.

2. LITERATURE SURVEY

Frauk seyitoglu Stanislav H Ivanov. This study aims to explore and understand the experience of travelers who have visited robotic restaurants worldwide. Due to the limited availability of such restaurants, a multiple case study method was chosen to gather comprehensive data. User-generated content, specifically qualitative case study techniques, were utilized. The data for this research were collected from reviews written by travelers between February 2013 and November 2019, with data collection taking place from November 18th to November 29th, 2019. The findings of the study identified seven main themes that constitute the components of the robotic restaurant experience: appeal to children, the robotic system itself, service quality, creating a memorable experience, attributes related to the restaurant's ambiance, attributes related to the food (economic value and gastronomic aspects), and deficiencies in various aspects (robotic system, service quality, ambiance, and food-related attributes). This study is the first of its kind to investigate the robotic restaurant experience from the perspective of travelers worldwide. Furthermore, it contributes to the broader research on restaurant experiences and presents a model outlining the components of the robotic restaurant experience. Kyung Hwa Seo ; jee Hye Lee Conor Mackl. Its developed to increasing presence of robots in the service industry, companies need to understand how to stay competitive in this new environment of artificial intelligence and service automation. However, there are limited studies that have examined consumer behavior towards robot restaurant visitors and its impact. This study addresses this gap by integrating trust, perceived risk, and satisfaction into the well-established Technology Acceptance Model (TAM) in the context of robot service restaurants. An online survey was conducted, involving 338 respondents and using scenarios to gather data. Structural equation modeling revealed that perceived usefulness (PU) directly impacts consumers' intention to revisit robot restaurants, while perceived ease of use (PEOU) has an indirect impact. Trust plays a significant role in increasing PU and PEOU towards service robots, while also reducing perceived risk and increasing satisfaction. Additionally, perceived risk decreases satisfaction and revisit intention. The findings of this study provide valuable insights for hospitality marketers, helping them understand how consumers accept robot service and the key drivers behind consumers' intention to revisit robot Akshay Agarwal ; Pradeep Gupta ; Faisal Iqbal ; Amit Kumar ; Abdullah Madani .This paper provides a review of a new technique that can successfully implement robots as waiters in restaurants. The technique involves the use of a coordinate follower robot, which is responsible for delivering the ordered meals to the respective customers. Additionally, the restaurant provides a Bluetooth connection that, when connected, displays a menu card on the customers' smartphone screens through a mobile application. This application allows customers to conveniently place their orders. Furthermore, the robot is guided to the customer who placed the order using RF (radio frequency) technology. By combining these elements, the restaurant aims to enhance the overall dining experience and streamline the serving process with the help of robotic waiters.

3. MATERIALS&METHODS

3.1 Frame Selection: The material for the Chassis or Body Frame used in this project is the acrylic sheet. acrylic is made by synthesizing methyl methacrylate. The properties of plastics are, relative Density (10^3 kg/m^3) = 1.19 The tensile elongation of acrylic is at most 15%, the tensile elongation of polycarbonate is up to 100%, temperature range of the material is 170-190°F and It soften between 210-220°F and melting is 300- 315°F. Its withstand temperatures down to -20°F without changes in properties.

3.2 Brushed DC motor: In order to control the restaurant robot, high quality, reliable rapid response are needed. If the motor have less accuracy it leads to the failure of the robot and can be dangerous for itself and also for the people. the motors are sufficiently powerful to be able to lift the entire robot and perform various movements. The motor have 300RPM and 30kg torque ,these type of high power metal gear motor are used to lift or carry or pull nearly 15 to 20 kg easily. Arduino UNO, its used to control the motor according to the code. Bluetooth

module(HC05) UART serial converter module, it can easily transfer data through UART wirelessly . Frequency: 2.4GHz ISM band. 24v lithium ion battery.

3.3. Lithium Battery:

1. Voltage: The lithium-ion battery has a nominal voltage of 24 volts. This voltage level is suitable for various

applications requiring a moderate power supply.

2. Capacity: The capacity of a lithium-ion battery is measured in ampere-hours (Ah) or milliampere-hours(mAh). A 24V lithium-ion battery may have a capacity ranging from a few hundred ampere-hours to several thousand, depending on the specific model and application.
3. Chemistry: Lithium-ion batteries use various chemistries, but commonly used ones include lithium ironphosphate (LiFePO4), lithium manganese oxide (LiMn2O4), and lithium nickel cobalt aluminum oxide (LiNiCoAlO2). The specific chemistry used affects the battery's performance, energy density, and safety.
4. Energy Density: Lithium-ion batteries offer a high energy density compared to other rechargeable battery chemistries. Energy density refers to the amount of energy stored in the battery per unit volume or weight. Higher energy density allows for more power in a smaller and lighter package.
5. Charging Time: The charging time of a lithium-ion battery depends on the charging method and the charger's specifications. Fast chargers can charge a lithium-ion battery to a significant percentage of its capacity within a relatively short time, while slower chargers may take several hours for a full charge.
6. Safety Features: Lithium-ion batteries incorporate various safety features to prevent overcharging, over discharging, and thermal runaway. These safety mechanisms include built-in protection circuits, temperature sensors, and pressure relief valves to ensure safe operation.
7. Weight and Size: Lithium-ion batteries are known for their compact size and lightweight compared to other battery chemistries with similar capacity. The weight and size of a 24V lithium-ion battery may vary depending on its capacity and design.
8. Applications: 24V lithium-ion batteries find applications in a wide range of industries and devices, including electric vehicles (EVs), hybrid electric vehicles (HEVs), energy storage systems (ESS), uninterruptible power supplies (UPS), portable power tools, and more.

3.4. Aurdino Uno:

Arduino uno is the popular microcontroller board based on the ATmega328P microcontroller

1.Microcontroller: The Arduino Uno is built around the ATmega328P microcontroller, which operates at 5 volts. It has 32KB of flash memory for storing the program code, 2KB of SRAM for storing variables, and 1KB of EEPROM for non-volatile storage.

2.Digital and Analog I/O: The board has 14 digital input/output pins (of which 6 can be used as PWM outputs) and 6 analog input pins. These pins can be used to connect and control various sensors, actuators, and other electronic components.

3.The USB connection can provide power and also allow you to upload programs to the board. Alternatively, you can power it using a 9V battery or a wall adapter connected to the power jack

4.Programming: Arduino Uno uses the Arduino programming language, which is based on a simplified version of C++. The Arduino IDE (Integrated Development Environment) is used to write, compile, and upload programs to the board.

3.5.0 4 channel relay: A relay is an electromagnetic switch that uses an electromagnet to control the opening and closing of one or multiple switch contacts. It is commonly used to control high-power or high-voltage devices using low-power control signals. A 4-channel relay has four independent channels, which means it can control up to four separate circuits or devices. Each channel typically consists of a relay coil and a set of normally open (NO) and normally closed (NC) contacts. The control signals for a relay are usually low-power signals, such as digital signals from microcontrollers, Arduino boards, or other electronic devices.

3.5.1 Bluetooth Module (Hc-05):

The HC-05 module is based on Bluetooth version 2.0 + EDR (Enhanced Data Rate), which allows for faster data transmission compared to older versions The module has a communication range of approximately 10 meters (33 feet) in an open space. The actual range may vary depending on environmental factors and obstacles, The HC-05 module typically operates at 3.3V, but it can also handle a voltage range from 3.6V to 6V. The HC-05 module is compatible with a wide range of devices, including microcontrollers (such as Arduino boards), PCs, smartphones, and other Bluetooth-enabled devices.

3.5.2 Controller App:

We are using AMR Voice app, There are several type of voice controller server or app ,which is used to control the movement or locomotion of robot via Bluetooth by voice control , C++ code are uploaded to the UNO board. Code are build and upload by Arduino IDE

4. 4.0 DESIGN OF RESTAURANT ROBOT

FIGURE 1. Design of Restaurant Robot

4. CIRCUIT DIAGRAM

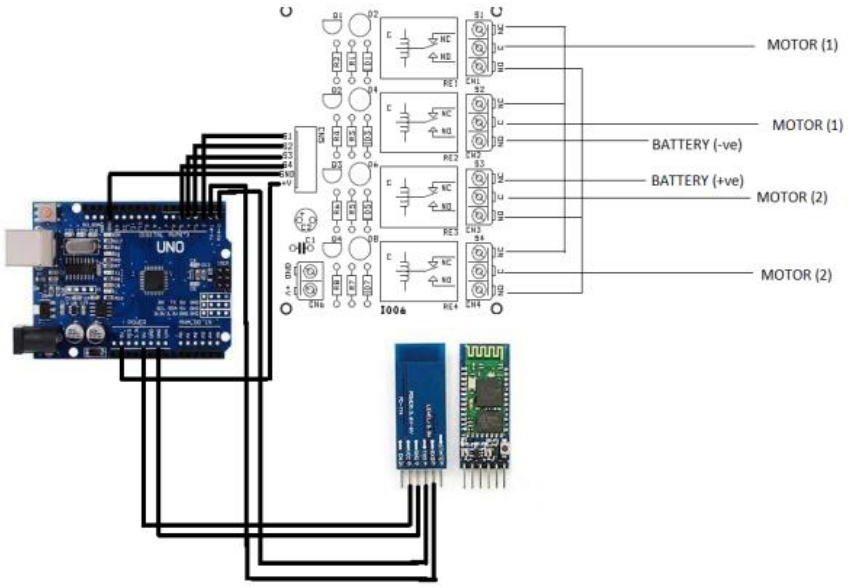

FIGURE 2. Circuit Diagram

Design Calculation
Mass of the Components
Material used =Acrylic Material
Motor Specifications
Motor Type =DC s
Motor Torque = 30kg
RPM = 300 5

5. CONCLUSION

The implementation of voice control technology in restaurant robots has revolutionized the hospitality industry, offering numerous benefits and enhancing the overall dining experience. This innovative solution has successfully

addressed various challenges faced by traditional restaurant operations, such as improving efficiency, reducing errors, and providing a personalized and interactive service.

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