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Voice Assistant Based Food Serving Robot

Leena Patil[1], Nisha Bhute[2], Tisha Kunwar[3], Kareena Fulsunge[4], Leena Thakre[5], Snehal Khobragade [6]

[1,2,3,4,5,6]Department of Computer Science & Engineering Priyadarshini College of Engineering, Nagpur, India
[1]lhpatil10@gmail.com ; [2] nishabhute3932@gmail.com ; [3]tishakunwar1507@gmail.com;
[4]preetifulsunge27@gmail.com ;[5]leenathakare@gmail.com ;[6]snehaljkhobragade10@gmail.com

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Abstract

A voice assistant-based food serving robot uses voice commands to take orders, deliver food to tables, etc. Customers can speak their order to the robot, which then processes it through its integrated voice assistant. The robot uses sensors to navigate obstacles and deliver food efficiently. Restaurants are exploring robotic solutions designed to streamline operations and enhance the dining experience. These systems utilize voice recognition to allow customers to place orders conversationally, and automated delivery to bring meals to tables. By taking on routine tasks, these robots free up human staff to concentrate on higher-level customer interactions and culinary duties. Furthermore, the technology collects valuable data about customer choices and ordering trends, which can be leveraged to refine menus and improve service strategies

INTRODUCTION

Voice assistant technology is increasingly being integrated into food serving robots, transforming the way restaurants operate and enhancing customer experiences. This recognition technology to revolutionize the dining experience. By seamlessly assistants often offer proactive suggestions and recommendations based on your habits and preferences. For example, they can remind you of upcoming deadlines, suggest relevant documents or websites, or even provide personalized news updates. Desktop assistants can also integrate with other applications and services on your computer, allowing for seamless collaboration and enhanced productivity. They can interact with email clients, calendar apps, project management tools, and more, helping you stay organized and efficient. Overall, a desktop assistant aims to simplify your computer experience, save you time and effort, and make your tasks more enjoyable. With their intelligence, adaptability, and user-friendly interfaces, desktop assistants are becoming increasingly popular and are transforming the way we interact with our computers. Provide a novel and interactive dining experience for customers. Improve efficiency and reduce operational costs. Minimize human error in order taking and delivery. His project will investigate the design, development, and implementation of a prototype Voice Assistant-Based Food Serving Robot, evaluating its performance and analysing its potential impact on the future of the restaurant industry. Utilize advanced sensors and algorithms to navigate obstacles and deliver orders to the correct tables.

LITERATURE REVIEW

Leena Patil, et.al [1] describes a robotic waiter for restaurants. It is a computerized system designed to replace human waiters and serve food on tables. The robot uses various

components like Arduino UNO, ultrasonic sensors and servo motors to move and serve food. It can avoid obstacles using ultrasonic sensors and is controlled by an embedded circuit. The project also incorporates artificial intelligence algorithms.

Leena Patil, et.al [2] discusses the potential of the Internet of Things (IoT) in various fields, including smart cities, healthcare and smart living. It then focuses on the hotel industry and how IoT can improve guest satisfaction. The employment of robots in the hotel business is highlighted in the text, especially in Vietnam, where there is still a lack of widespread acceptance of waiter robots. The article describes the preliminary construction of a line following restaurant serving robot, in which robots are taught to approach particular tables using algorithms for image recognition.

Ata Jahangir Moshayedi, et.al [3] have discussed that a project focused on improving a food delivery robot called FOODIEBOT. The robot uses image processing and mobile app integration to deliver food in dining halls. The researchers tested the robot's performance on a variety of trajectories, including circular, elliptical, spiral and octagonal, after calibrating PID controllers for navigation. To determine the ideal PID controller values they employed optimization methods such as Beetle Antennae Search (BAS), Particle Swarm Optimization (PSO), Pelican Optimization Algorithm (POA) and Equilibrium Optimizer (EO). The result showed that BAS was the most efficient method while EO, POA and PSO excelled in different scenarios. The study highlights the importance of careful optimization and simulation in designing effective robotic systems. Chin Chen, et.al [5] has talked about the creation of a food service robot for fast-food establishments. The robot integrates cutting-edge advancements in navigation, mapping, and localization. It creates a PC-OGM by combining 2D occupancy grid maps and 3D point cloud maps, which improves the robot's location and enables it to adapt to complicated settings. To smoothly navigate tight aisles, the navigation feature makes use of an adaptive motion controller. Fast-food establishments examined the robot and provided input on its availability, dependability, and satisfaction. In light of COVID-19, this also takes into account how food service robots might assist eateries in maintaining food and surface hygiene.

Zainab Khyioon Abdalrdha, et.al [6] has discussed that a waiter robot system for restaurant automation. The robot uses black line tracking to navigate and deliver orders. Customers place orders through a tablet on their table. The robot then picks up the order from the cashier and delivers it to the customer. The system is designed to reduce crowding and manual order processing, especially during the COVID-19 pandemic.

METHODOLOGY

The design and development of food serving robots involve a multidisciplinary approach that combines robotics, artificial intelligence, and user experience design. The food and beverage sector is increasingly adopting robotic systems to optimize operational efficiency, decrease personnel expenditures, and elevate consumer contentment. The subsequent outline details the primary structural elements involved in the creation and implementation of these automated food service devices.

Conceptualization and Planning:

- *Market research*: analyze current trends in the food service industry, customer needs, and existing robotic solutions.
- *Define objectives:* establish the primary functions of the robot, such as order taking, food delivery, and customer interaction.
- *Target audience*: identify the target market, including restaurants, cafes, and other food establishments.

Hardware Development:

- *Chassis Design*: Create a robust and mobile chassis that can navigate through crowded dining areas. Considerations include size, weight, and stability.
- *Sensors and Navigation:*

LiDAR: For mapping the environment and obstacle detection.

Ultrasonic Sensors: To avoid collisions and navigate tight spaces.

Cameras: For visual recognition of tables, customers, and obstacles.

Actuators and Motors: Select appropriate motors for movement and robotic arms for serving food.

Consider using stepper motors for precise control.

Power Supply: Design an efficient power system, including rechargeable batteries that allow for extended operation.

Software Development

- *Control System*: Develop a control system that integrates hardware components and manages navigation, obstacle avoidance, and task execution.

- *Voice Recognition*: Implement natural language processing (NLP) capabilities to allow customers to place orders and interact with the robot.
- *User Interface:* Design a user-friendly interface for both customers and restaurant staff, possibly including touchscreens for order confirmation.
- *Integration with Restaurant Management Systems:* Ensure the robot can communicate with existing systems for order processing and inventory management.

Prototyping and Testing

- *Build a Prototype*: Create a working model of the robot to test its functionality and design.
- *Field Testing*: Conduct tests in real restaurant environments to evaluate performance, navigation, and customer interaction.
- *Iterative Design*: Use feedback from testing to refine the design, addressing any technical issues or user experience concerns.

IMPLEMENTATION

A. **Hardware:** Use a voice recognition module (e.g., EasyVR, or similar) that can be programmed to recognize specific keywords or short phrases. These modules typically output a digital code or trigger an event when a recognized keyword is spoken. Crucially, they do the voice processing onboard, so you don't need a separate processing unit for NLP.

B. **Predefined Commands:** Define a limited set of commands like "Table One," "Table Two," "Bring Water," "Bring Food," "Return Home," etc. These will be the keywords the module is trained to recognize.

C. **Microcontroller and Robot Control:**

- *Microcontroller:* Use a microcontroller (e.g., Arduino, ESP32, Raspberry Pi Pico) to act as the brain of the system. It will receive the output from the voice recognition module and control the robot's movements.
- *Motor Control:* Connect motor drivers to the microcontroller to control the robot's wheels or tracks.
- *Navigation:* For basic navigation, you can use line following (a black line on a light surface or vice-versa) or simple pre-programmed paths. More advanced navigation (obstacle avoidance, mapping) would complicate the project considerably and might involve sensors like ultrasonic or infrared, but are not strictly necessary for a simple implementation.

D. **IoT Connectivity (Optional but Recommended):** Wi-Fi Module (e.g., ESP8266, built into ESP32): Use a Wi-Fi module to connect the robot to your local network. This allows you to monitor the robot's status, send commands remotely (if needed), and potentially integrate with other systems (e.g., a kitchen order system). However, the voice control itself will happen locally.

E. **Food Serving Mechanism:**
Tray/Platform: Design a suitable tray or platform on the robot to carry the food.

F. **System Integration:**
Communication: The voice recognition module communicates with the microcontroller. The microcontroller controls the motors and (optionally) communicates with the IoT network.

FUTURE SCOPE

The future of voice assistant-based food serving robots is incredibly exciting, with the potential to revolutionize the restaurant industry and customer experience. Here's a breakdown of the key areas of future development:

Enhanced Customer Experience:

- *Personalized Service:* Imagine a robot that remembers your dietary restrictions, past orders, and even your preferred table. Voice assistants can analyse this data to offer personalized recommendations and create a truly tailored dining experience.
- *Seamless Ordering:* Ordering food will become as easy as having a conversation. You'll be able to say, "I'd like the Pad Thai with extra spice," and the robot will relay the order to the kitchen, ensuring accuracy and efficiency.
- *Interactive Engagement:* Robots can be programmed to engage with customers in a friendly and informative way. They can answer questions about the menu, explain dishes, and even tell jokes, adding a touch of personality to the dining experience.
- *Multilingual Support:* Voice assistants can be programmed to understand and respond in multiple languages, making restaurants more accessible to international customers and tourists.

Increased Efficiency and Productivity:

- *Automated Operations:* Robots can take over repetitive tasks like delivering food, clearing tables, and refilling drinks, allowing human staff to focus on more complex tasks and customer interaction.
- *Optimized Workflow:* By integrating with restaurant management systems, robots can optimize their routes and tasks, ensuring that food is delivered quickly and efficiently, and tables are cleared promptly.
- *Reduced Errors:* By utilizing speech recognition systems, order accuracy is significantly improved, minimizing discrepancies between customer requests and delivered items. This precision directly contributes to enhanced consumer contentment and a decrease in discarded food products.
- *24/7 Availability:* These automated systems offer uninterrupted operation, enabling food service establishments to maintain service availability throughout all hours, thereby accommodating patrons regardless of the time

Improved Hygiene and Safety:

- *Contactless Service:* Robots minimize physical contact between staff and customers, reducing the spread of germs and promoting hygiene. This is especially important in a postpandemic world where customers are more conscious of cleanliness.
- *Precise Handling:* Robots can be programmed to handle food items with care, ensuring that dishes are presented in an appealing and safe manner.
- *Real-time Monitoring:* Robots can be equipped with sensors to monitor food temperature and storage conditions, ensuring food safety and preventing spoilage.

Cost Savings and Revenue Generation:

- *Reduced Labor Costs:* By automating tasks that would otherwise require human staff, robots can help restaurants reduce labor costs, which can be a significant expense.
- *Increased Table Turnover:* Efficient service and quick table clearing can increase table turnover rates, allowing restaurants to serve more customers and generate more revenue.
- *New Revenue Streams:* Restaurants can offer unique experiences like robot-assisted dining or personalized recommendations, attracting new customers and generating additional revenue.

Future Innovations:

- *AI-Powered Personalization:* Advanced AI algorithms can Analyze customer data to recommendations and even anticipate their needs. Imagine a robot that suggests a new dish based on your past orders and dietary preferences.
- *Emotional Intelligence:* Robots can be equipped with emotional intelligence to understand and respond to customer emotions, creating a more empathetic and engaging experience.
- *Integration with smart homes:* Customers can place orders through their smart home devices, and robots can deliver food directly to their homes, blurring the lines between restaurant and home dining.
- *Robotic Chefs:* Robots can be programmed to prepare dishes with precision and consistency, ensuring high-quality food and reducing the workload on human chefs.

RESULT

Fig. 1 Voice Assistant Food Serving Robot

Conclusions

Voice-assistant-controlled food serving robots hold considerable promise for revolutionizing the food service industry. By integrating voice commands, these robots can streamline operations, reduce human error, and improve efficiency in restaurants, hospitals, and other food service environments. In conclusion, while challenges remain, voice-assistant based food serving robots offer a compelling vision for the future of food service. Their ability to enhance efficiency, improve hygiene, and provide personalized service makes them a valuable asset for businesses seeking to innovate and optimize their operations.

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