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Smart Restaurant System

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ABSTRACT: As the world is emerging towards new trends and technologies, there is a need to invent something that is more attractive and useful for the citizens. This project highlights the application of robotics in the food industry. In this new technological age, all jobs depend on a technology called automation. New research works are developed in the market instead of human workers being the fashion and new passion today. In this context, we develop the concept of the food serving robots (FSR) in this work. It required Arduino board and the Arduino IDE to build. This project is divided in to two parts, first one that consists of a digital menu made via MIT app inventor and Firebase database. Second segment is moveable robot that delivers the food to the customers table.

KEYWORDS: Android Application, IR Sensor, HC-05 Bluetooth Module, DC Motors, Arduino UNO Micro-controller.

I. INTRODUCTION

Restaurant is a place where people come, sit and eat meals that are cooked and served by the chef and the waiters respectively. In traditional restaurant system orders are taken by a waiter and they bring the food when it is ready. After eating the food customers will pay the bill. This system relies on large numbers of manpower to handle customer reservation, inquiry about them, ordering food, placing order on table, reminding dishes of customer. Therefore, to improve the service quality for customers effectively by using advanced technologies has received much attention in recent years. Intelligent Restaurant it's all about getting all of your different touch-points working together connected, sharing information, personalizing experiences and speeding processes.

In today's restaurant Digital multi-touch menu cards and other forms of digital facility are replacing old fashioned services like-waiters can take order from customer and serve them. Intelligent Robot system delivers almost infinite flexibility in promoting meal and snack options. Intelligent Robot system uses technologies innovatively in a modern restaurant such as LCD, RF module, database & line following Robot to enhance quality of services and to enrich customer's dining experience. In our project we have also created two mobile applications one for the customers and second one for the chef. When customers enter our shop they open the app and give out their order and this order is received at the chef side via internet using firebase database that stores orders. At the chef side there is a separate application to which is connected with the robot by using that application we can give order to the robot to go to specific table after placing the order in the robotic system.

II. PROBLEM STATEMENT

Creating a smart restaurant system involves integrating cutting-edge technologies such as an E-menu and an autonomous path-following waiter robot to revolutionize the dining experience. The E-menu, accessible via mobile devices, provides customers with a seamless interface to browse the menu, view dish details, and place orders effortlessly. Meanwhile, a robust backend order management system ensures real-time synchronization between the E-menu app and kitchen staff, enabling efficient order processing and tracking. The autonomous waiter robot, equipped with advanced sensors and communication capabilities, navigates the restaurant environment independently, delivering orders from the kitchen to designated tables. Integration of these components requires meticulous planning to establish seamless communication protocols and ensure efficient data flow. By prioritizing user experience and feedback, as well as providing comprehensive maintenance and support, the smart restaurant system aims to optimize operations, enhance customer satisfaction, and set new standards for dining establishments in the modern era.

III. RELATED WORK

“Automated System for Restaurant Services” Riga Technical University, Riga, Latvia published a paper in 2021 in which The authors proposed a smart restaurant system that can automate the ordering, payment, and kitchen processes using touchscreen devices, wireless networks, and data transmission technologies. The authors develop an application prototype that can reduce the service time by 52.76% compared to the manual service system. The authors suggest some possible ways to enhance the system, such as using robots, sensors, RFID, and IoT technologies to improve customer experience, inventory management, and food delivery.

Smart restaurant using waiter robot dept. of ECE, ksit (2023) published a paper. This research paper describes a smart restaurant system that uses an electronic menu and a waiter robot to improve the efficiency, convenience, and customer satisfaction of the restaurant. The system allows customers to browse and place orders using an LCD display with a 4X4 keypad, while the robot delivers food and drinks to tables. The system aims to reduce human contact and errors, but it also faces some limitations such as the cost of installation and maintenance, and the need for human staff to interact with customers.

Robots, Artificial Intelligence, and Service Automation in Restaurants(2019). The findings underscore the substantial advantages of robots, artificial intelligence, and service automation (RAISA) in restaurants. These technologies enhance efficiency, reduce labor costs, personalize customer experiences, and provide valuable data for decision-making. However, addressing cost constraints, technological limitations, and customer adoption challenges is essential for their successful implementation.

Robotic in Modern-Day Restaurants and its Impact on the Dining Experience. IMS Unison University, Dehradun India 248009 (2022) published a paper in which the authors studied the robotic restaurant experience in India, using online reviews as data. They found six factors influencing customer satisfaction: uniqueness, robotic experience, service quality, food quality, pricing, and ambiance.

They proposed a model for improving the dining experience and discussed the implications and limitations of their study.

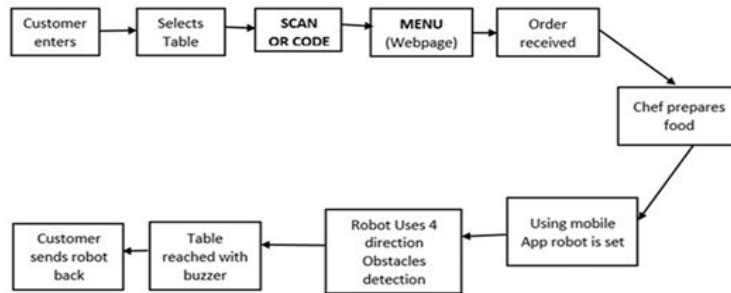
Restaurant Automation Technology for the Future.(2022) The findings underscore the substantial advantages of robots, artificial intelligence, and service automation (RAISA) in restaurants. These technologies enhance efficiency, reduce labor costs, personalize customer experiences, and provide valuable data for decision-making. However, addressing cost constraints, technological limitations, and customer adoption challenges is essential for their successful implementation.

Waiter Robot with Smart Ordering System(2022) The paper presents an autonomous waiter robot with Arduino, QR code tech, and sensors, navigating via infrared and ultrasonic sensors. A Wix-based website facilitates contactless ordering and reservations. The lightweight aluminum chassis supports the system. Successful integration showcases potential for restaurant automation. Future work includes refining functionality and aesthetics, emphasizing continuous improvement.

IV. PROPOSED SYSTEM(METHODOLOGY)

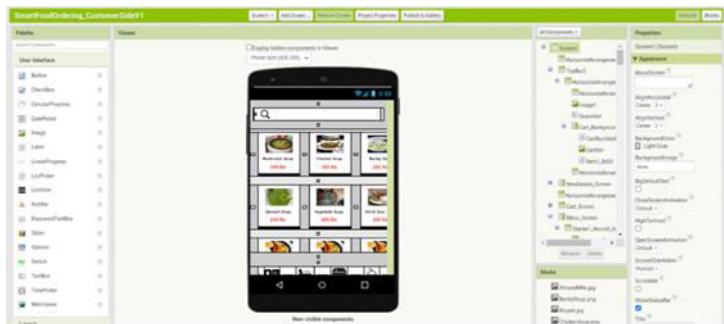
We propose a smart restaurant system designed to revolutionize the dining experience through the integration of mobile technology and robotics. Our system consists of an Android application for streamlined food ordering and an Arduino-based robot tasked with delivering orders from the kitchen to designated tables. The Android application serves as the primary interface for customers, providing them with a user-friendly platform to browse the menu, place orders, and make payments seamlessly. Meanwhile, the Arduino-based robot autonomously navigates predefined paths within the restaurant, equipped with sensors for obstacle detection and navigation to ensure safe and efficient order delivery. Through this integration, our proposed system aims to optimize restaurant operations, minimize wait times, and enhance customer satisfaction.

Our research paper will delve into the technical details of each component, the implementation process, and the potential impact of our system on the hospitality industry.



V. SOFTWARE AND HARDWARE INTERFACE

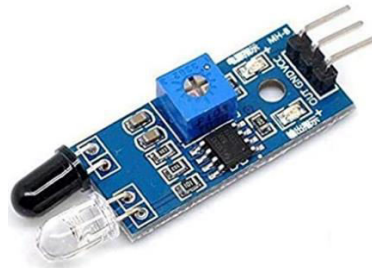
Android Application : In our smart restaurant system, the Android application serves as the primary interface for customers to explore the menu, place orders, and track their delivery. Developed using MIT App Inventor, the application provides a user-friendly experience, allowing customers to browse through various dishes, view descriptions, and customize their orders effortlessly. While payment processing is not facilitated directly within the app, customers can conveniently settle their bills through traditional payment methods upon dining completion. The Android application seamlessly integrates with the backend system, ensuring smooth communication between customers and the restaurant staff for efficient order processing and delivery.



Firestore Backend : Firestore serves as the robust backend infrastructure responsible for facilitating real-time communication and data management. Leveraging Firestore's real-time database capabilities, orders placed by customers through the Android application are instantly transmitted to the kitchen staff for prompt processing. Additionally, Firestore Authentication ensures secure user authentication, safeguarding sensitive information and enhancing data privacy. Moreover, Firestore Cloud Messaging enables instant notifications, keeping customers informed about order status updates throughout the dining experience. With Firestore as the backbone of our backend system, we ensure scalability, reliability, and responsiveness, crucial for optimizing restaurant operations and enhancing customer satisfaction.

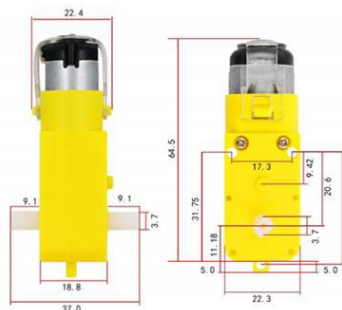
Communication : Communication between the customer-side application and Firestore, and subsequently the chef-side application, is integral for order processing. Customers utilize the application to place orders, which are then seamlessly transmitted to Firestore's real-time database. This database acts as a conduit, ensuring that orders are promptly relayed to the chef-side application for preparation. Through this streamlined communication, chefs receive real-time notifications of incoming orders, enabling efficient preparation and timely delivery of meals to customers.

Similarly, in the hardware-software interface, communication between the Android application and the Arduino-based robot is facilitated by a HC-05 Bluetooth module. Commands initiated by the application, such as specifying the destination table for order delivery, are wirelessly transmitted to the Arduino controller via the Bluetooth module. Upon receiving these commands, the Arduino controller orchestrates the robot's navigation, guiding it along predefined paths within the restaurant to the designated table. This seamless communication ensures effective coordination, enabling the robot to efficiently fulfill its role in delivering orders and enhancing the overall dining experience for customers.



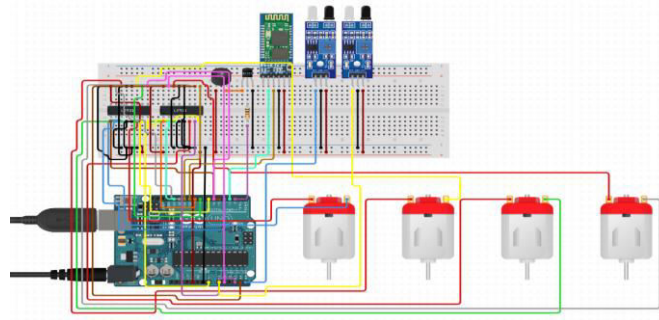
LM358 OP AMP : In our smart restaurant system project, the LM358 serves as a crucial component in signal processing for obstacle detection. Integrated with the IR sensors, the LM358 amplifies the signals received from the sensors, improving the accuracy of obstacle detection by the Arduino Mega controller. This amplified signal enables the system to effectively identify obstacles in the path of the food delivery robot, ensuring safe navigation within the restaurant environment. With its reliability and versatility, the LM358 enhances the overall performance and efficiency of our autonomous food delivery system, contributing to a seamless dining experience for restaurant patrons.

BO Motors : The BO (Brushed DC) motors are pivotal in our smart restaurant system, serving as the primary propulsion mechanism for the food delivery robot. These motors provide the necessary torque and rotational motion required for the robot's movement across the restaurant floor. Coupled with wheels, the BO motors enable smooth and precise navigation to designated tables for order delivery. Their compact size, affordability, and compatibility with motor driver modules make them an ideal choice for our project, ensuring reliable and efficient operation of the food delivery robot within the restaurant environment.

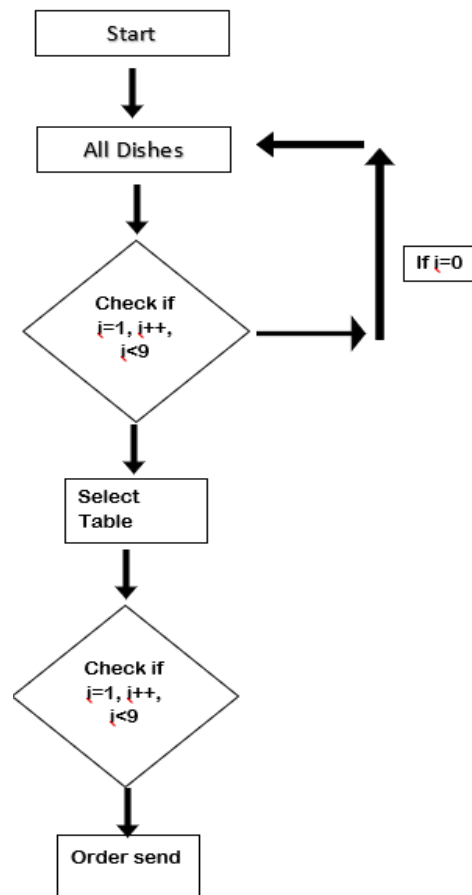


VI. SYSTEM ARCHITECTURE AND WORKING PROCEDURE

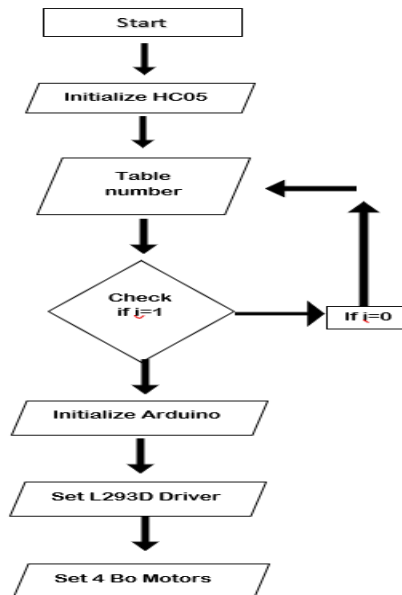
System Design : In our smart restaurant system project, the system design intricately blends hardware and software components to create an autonomous food delivery solution. The customer-facing Android application, crafted with MIT App Inventor and backed by Firebase, empowers patrons to effortlessly navigate the digital menu, place orders, and make payments. Meanwhile, Firebase ensures seamless communication between the application and the backend, expediting order processing and transmission to the chef-side application. On the hardware front, the Arduino Mega governs the food delivery robot's operation, integrating the HC-05 Bluetooth module for wireless communication, IR sensors for obstacle detection, and BO motors for precise movement control. This holistic design approach prioritizes reliability, efficiency, and user satisfaction, aiming to streamline restaurant operations and elevate the dining experience for patrons.



Digital Menu Flow Chart :



Arduino Software flow chart :



VII. HARDWARE WORKING DETAILS

Hardware details: - In this project we have used Arduino Uno for controlling purposes and 4 Bo Motors along with wheels for movement and also HC 05 for communication between mobile application and hardware. In this project we have also used IR sensor modules for detection of any obstacles.

Working: -

Digital Menu: - By using MIT app inventor & Firebase database we have created this digital menu which currently has 8 dishes, this number can be increased or decreased according to the restaurants. In our project we have developed 2 applications. 1 for chef and another for the customer. When customer selects the dish it then transferred via internet and stored on cloud Firebase data base and then transferred to the chef and then chef can start preparing the dish and after completing it, he can load all that to the robot and transfer it to the customer we have ordered.

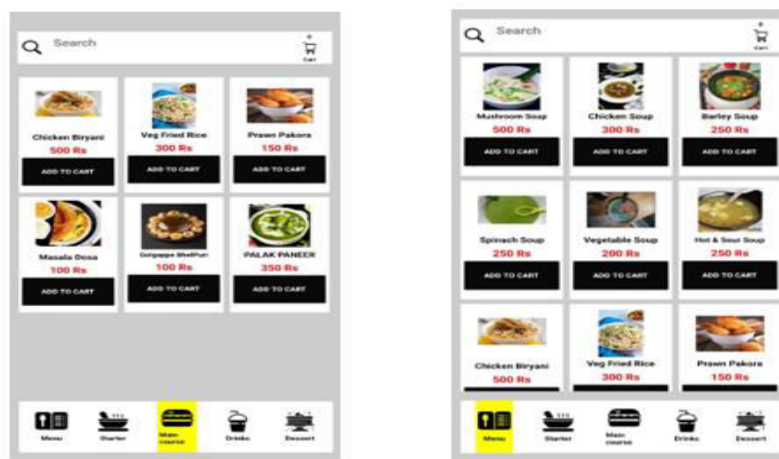


Fig . Customer Side Application

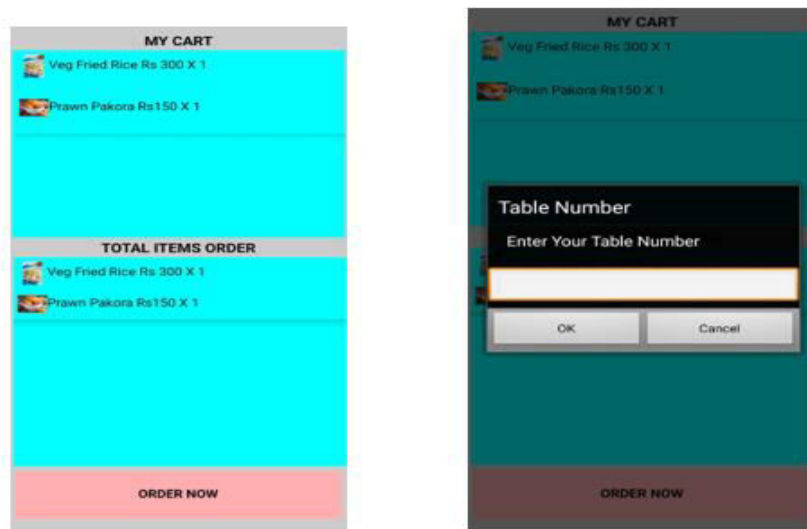


Fig. Chef side application

Robot :- Now starts the important elements of our project i.e automatic food distribution in hotels. In this part when the chef prepares a dish and gives a command for that specific table i.e. (Table 1, Table 2, Table 3). The robot automatically starts moving and reaches its Destination table gives and alert using buzzer which is available and when customers take their orders from the robot they have a switch which will give command to robot to return at the chef's stop. And this process continues for all tables. In this project we have only implemented 3 tables we can have n number of tables and destinations.

In this process of delivering the food at the customers table if there is any obstacles available then the robot will stop give alert via buzzer and wait for clearance. The front and back IR modules are responsible for all kind of obstacles detection.



Fig. Food Delivery robot

VIII. CONCLUSION AND FUTURE WORK

Our smart restaurant system project represents a successful integration of innovative technologies to enhance the dining experience for customers and optimize restaurant operations. Through the development of a customer-facing Android application and an autonomous food delivery robot, we have created a seamless platform for browsing menus, placing orders, and delivering meals. The robust communication between the application and the backend, coupled with efficient obstacle detection and navigation capabilities of the robot, ensures smooth and reliable operation within the restaurant environment. This project demonstrates the potential of technology to revolutionize the hospitality industry, offering a glimpse into the future of automated service and customer interaction.

Future Work:

Moving forward, there are several avenues for further development and enhancement of our smart restaurant system. One potential area of focus is the refinement of the user interface and functionality of the Android application, incorporating features such as personalized recommendations, order tracking, and loyalty programs to enhance customer engagement and satisfaction. Additionally, improvements to the obstacle detection system of the food delivery robot could be explored, utilizing advanced sensor technologies or machine learning algorithms to enhance accuracy and responsiveness. Furthermore, scalability and adaptability to different restaurant environments could be addressed, allowing for seamless integration of the system into a variety of dining establishments. Overall, future work on our smart restaurant system project aims to continue pushing the boundaries of innovation in hospitality technology, ultimately delivering a superior dining experience for customers and streamlining restaurant operations.

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