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AutoDine: Revolutionizing Restaurants with IoT and Android

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ABSTRACT

The integration of IoT (Internet of Things) and Android platforms into smart dining robots marks a significant advancement over traditional dining systems, which typically depend on manual processes, limited automation, or basic interaction tools. The proposed system introduces real-time communication between robots, kitchen systems, and customers through IoT technology, while an Android-based mobile application offers a user-friendly interface for customizing menus and remotely controlling the system. This setup includes two main robots: an ordering robot and a serving robot. The ordering robot is responsible for collecting orders directly from table counters, sending the details to the receptionist, and forwarding the data to the kitchen via IoT connectivity. Meanwhile, the serving robot, operated via Bluetooth, delivers the prepared meals to the appropriate tables. This smart dining system utilizes interconnected sensors, cloud-based data processing, and an intuitive Android interface to support autonomous navigation, efficient order handling, and personalized customer service.

Keywords: Smart Dining System, Wi-Fi Module (ESP8266), LCD Display, Battery, Autonomous Navigation.

1. INTRODUCTION

The use of Internet of Things (IoT) and Android technology in restaurants changes how dining works. Traditional dining mostly depends on people doing tasks like taking orders, sending them to the kitchen, and serving food. This can lead to problems like slow service, mistakes, and uneven quality. The new IoT-Android smart dining robot system, on the other hand, makes the whole process automatic and faster. It helps reduce the need for human workers, speeds up service, and gives customers a better experience. By using IoT and Android, this system solves common problems that restaurants face, making things run more smoothly and keeping customers happier.

Fig. 1: Network communication embedded systems

The IoT Android-integrated smart dining robot is a system that uses robots to take orders and deliver food in restaurants. It connects the robots, kitchen, and customers through IoT technology to make everything work smoothly in real-time. This system helps reduce mistakes, speed up service, and offer personalized experiences for customers. It also allows restaurants to track orders and improve how they

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operate. Overall, it makes dining faster, easier, and more fun. The IoT-Android smart dining system has two main robots: the ordering robot and the serving robot. These robots work together to make dining easier and more automated. The system also uses sensors, cloud data, and an Android interface to help with communication, managing orders, and providing real-time updates.The ordering robot is the first robot customers interact with. It moves around the restaurant and takes orders from tables, counters, or the reception area. The robot uses sensors and communication tools to collect the order and send it directly to the kitchen. This reduces human error and makes sure the order is accurate.The ordering robot uses IoT technology to send the order to the kitchen right away, so the chefs can start preparing the food immediately.

2. LITERATURE SURVEY

Iyanda, et al. proposed the ESP32 acted as a web server, processing requests and communicating with an Arduino Mega to control the robot's actions. The system's performance was evaluated by testing accuracy, efficiency, and its ability to handle multilingual customer requests. Real-world scenarios were simulated, including order handling in multiple languages, obstacle avoidance, and food delivery. Feedback was gathered to assess performance and identify improvements. This work highlights the potential impact of multilingual restaurant serving robots in enhancing customer experiences, streamlining operations, and promoting cultural inclusivity in the restaurant industry**.[1]**

Srilekha, et al. adopted robotic systems for tasks like taking orders, delivering food, and processing bills to enhance the dining experience. This project focused on a smart delivery robot designed to efficiently deliver food. It addressed challenges in traditional restaurants, such as service inconsistency and human errors. The robot, equipped with an Arduino module and advanced algorithms, uses RFID for precise table identification and navigation. A Gaussian Regression model predicted the robot's distance traveled and error percentage to improve delivery accuracy. **[2]**

Sultana, et al. proposed an IoT-based automated order-handling system to enhance the dining experience in restaurants, particularly in developing countries. The system addressed challenges like operational inefficiency and customer satisfaction. It demonstrated significant potential in improving food order validity, quality, and privacy. By using advanced technology, it provided a sustainable solution for the dining sector, offering both economic and operational benefits in developing countries. **[3]**

Srinivasan, et al. experimented the integrating robot waiters and cloud-based systems to improve customer service. Robots, using cloud-enabled collaborative filtering, can personalize dining experiences by analyzing customer preferences and streamlining order suggestions. This technology has been shown to improve service efficiency, reduce wait times, and enhance customer satisfaction. For example, some Asian restaurants use robots to take orders and deliver food, while cloud systems help personalize the experience. While challenges like cost and customer acceptance remain, the combination of robotics and cloud computing continues to offer exciting possibilities for transforming the restaurant industry.**[4]**

Rajule, et al. developed Intelligent Restaurant to improve service by addressing common mistakes made by wait staff during busy times. By placing QR codes on dining tables, customers can directly place their orders, reducing errors and enhancing the dining experience. A smart restaurant system integrates a database that not only improves service quality but also analyzes customer reviews and predicts daily order trends. This technology helps restaurants optimize inventory management and better understand customer sentiment**.[5]**

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Ramadevi, et al. designed a "Wireless Communication-Based Menu Ordering System" enhances the dining experience by integrating technology with restaurant services. Using Arduino Uno, Bluetooth, an LCD display, a 4x4 keypad, and a buzzer, the system allows customers to browse and order from the menu via a mobile app. Once connected, customers can view item details and place orders, which are sent directly to the chef for real-time updates. This system streamlines the kitchen's workflow, reduces order processing times, and offers greater convenience for diners**.[6]**

Qaisar, et al. introduced a cost-effective IoT-based waiter robot designed to improve customer service and restaurant efficiency. Equipped with an RPLidar sensor and encoded DC motors for navigation, the robot can carry heavier loads and navigate to specific tables.Using the Robot Operating System (ROS) and herbal lidar maps, it autonomously plans paths and successfully reaches target tables. Initial tests confirm its ability to navigate and perform tasks, showcasing a promising step forward in service robotics for the hospitality industry**.[7]**

Moshayedi, et al. developed the FOODIEBOT, an advanced food delivery robot using image processing, mobile apps, and web interfaces for efficient navigation in dining halls. PID controller calibration and MATLAB simulations were used to optimize its movement across various paths. The Beetle Antennae Search (BAS) method proved most efficient, outperforming others in execution time, while Particle Swarm Optimization (PSO) achieved the highest speeds on certain paths. The study confirms the effectiveness of optimization methods and the accuracy of simulations in improving the robot's performance.**[8].**

3. PROPOSED SYSTEM

The IoT Android Integrated Smart Dining Robot is an automated system designed to enhance food service in restaurants and homes. It uses an Arduino Uno as the main controller, with Bluetooth for wireless communication via an Android app. Equipped with infrared sensors for navigation, an LCD display for menu interactions, and a keypad for manual input, the robot efficiently delivers food with minimal human intervention. IoT integration enables real-time monitoring, improving service speed and efficiency, making it a smart solution for modern dining automation.

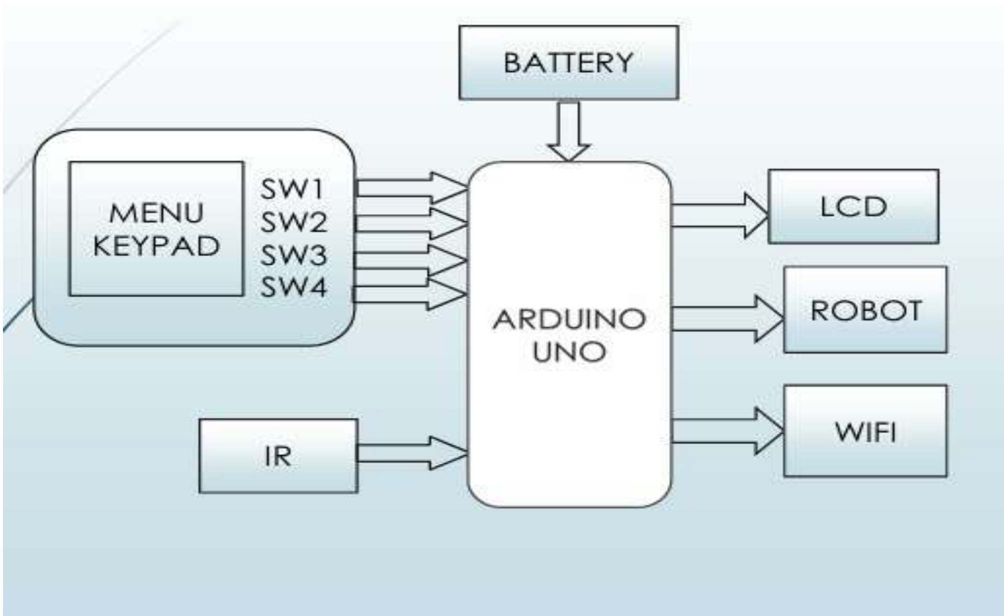

Fig. 2: Block diagram of Transmitting section

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Based on the block diagram, the IoT Android-integrated smart dining robot operates using an Arduino Uno as the main controller. A battery powers the system, while Bluetooth enables communication with an Android device for remote operation. The robot receives commands from the Android app via Bluetooth, which the Arduino processes to control its movement and functions. The system may include additional components such as an LCD for displaying information, a keypad for menu selection, and infrared sensors for navigation and obstacle detection. This setup enhances automation in dining services by allowing users to interact with and control the robot seamlessly.

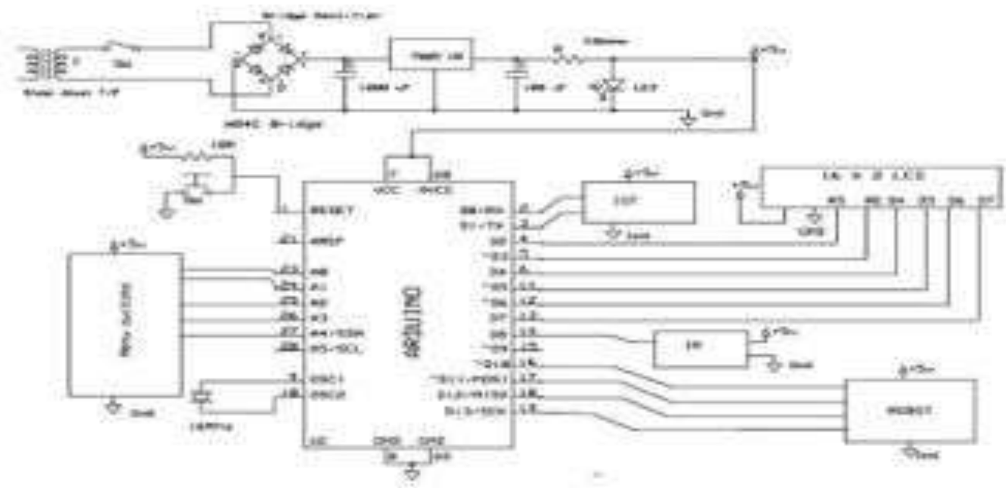

Fig. 3: SCHEMATIC DIAGRAM

The power supply section of the circuit begins with a step-down transformer that reduces the AC voltage to a lower level suitable for the system. This reduced AC voltage is then converted into DC using a bridge rectifier. To smooth out fluctuations in the voltage, capacitors rated at 1000µF are used. A 7805 voltage regulator is employed to ensure a stable 5V DC supply for the entire circuit. At the heart of the system is a microcontroller, typically an Arduino, which acts as the central controller. It receives input from various sensors and processes this data accordingly. A 16 MHz clock crystal is connected to the Arduino to provide stable and accurate timing for its operations. For input, an Infrared (IR) sensor is used to detect obstacles or identify specific markers, which is essential for navigation in many robotic applications. The system also includes an IoT module, likely a Wi-Fi (such as ESP8266) or Bluetooth (such as HC-05) module, which allows for wireless communication and remote monitoring or control. In the output section, a 16x2 LCD display is included to show relevant information, such as the robot's current status or order details, providing a user-friendly interface for monitoring system activity.

4. RESULTS AND DISCUSSION

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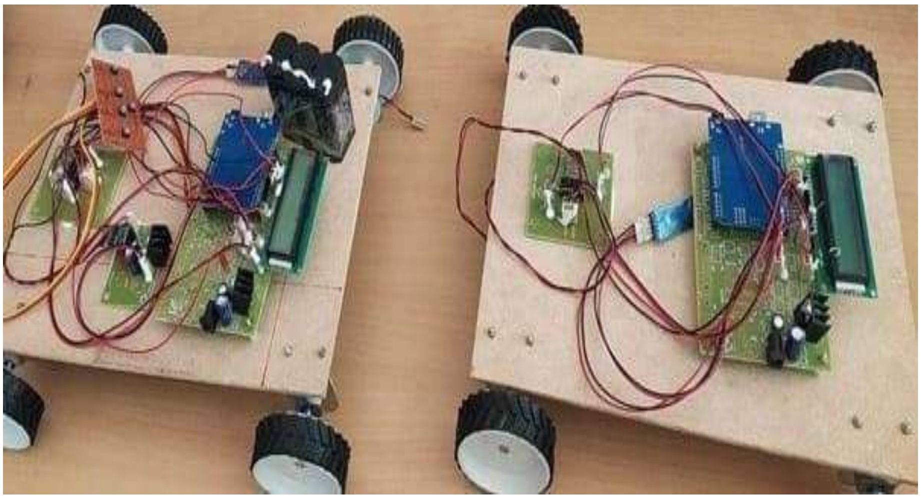

Fig. 4: The figure shows the final view of our project consisting the both ordering robot and serving robot.

Figure 4 displays the final setup of the project, which includes both the ordering robot and the serving robot. The ordering robot interacts with users to take their requests, while the serving robot is responsible for delivering items to designated locations. Both robots are integrated into a coordinated system for efficient operation. The figure highlights the complete assembly and functionality of the project.

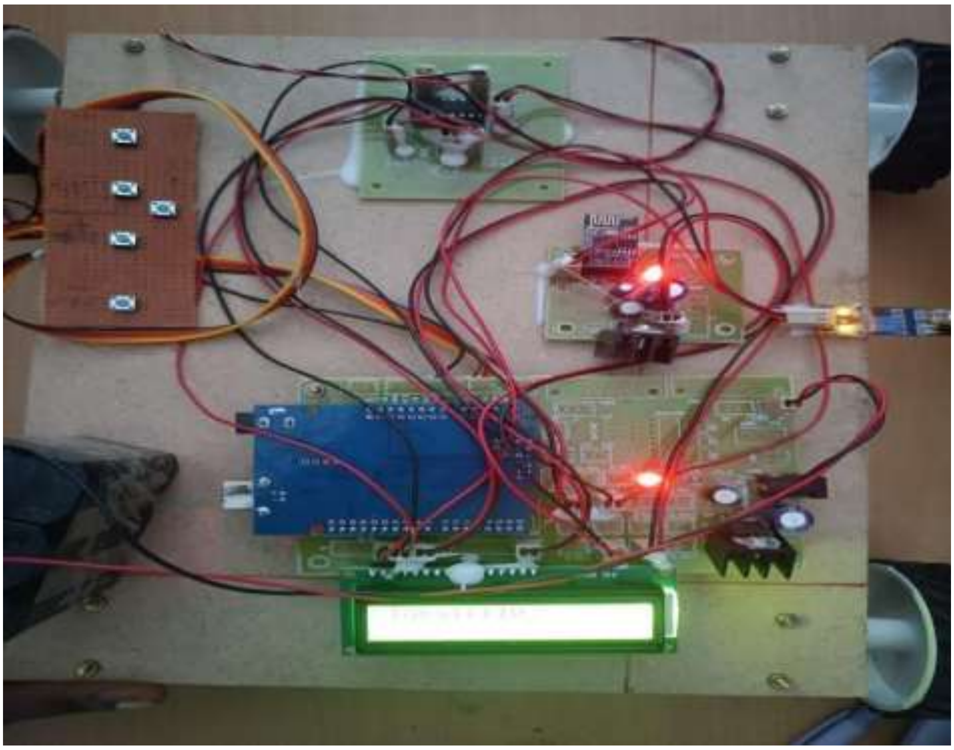

Fig. 5: The ordering section that displays the total amount for ordered items in 16*2 LCD display.

Figure 5 illustrates the ordering section of the project, where a 16x2 LCD display is used to show the total amount for the items ordered. This section allows users to view the cost of their selected items in

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real-time. It forms an essential part of the user interface, enhancing the ordering experience by providing clear and immediate feedback.

Fig. 6: The ordered items displayed in TCP Telnet Terminal by using wifi module.

Figure 6 shows the ordered items being displayed in the TCP Telnet Terminal through the use of a Wi-Fi module. This feature enables wireless communication between the ordering system and a remote device. The use of the TCP Telnet Terminal allows real-time monitoring of orders, enhancing efficiency and remote accessibility. It demonstrates the IoT capability integrated into the project.

5. CONCLUSION

The integration of IoT and Android platforms in the smart dining robots marks a significant advancement in modernizing the dining experience. Unlike traditional systems, which rely on manual labor or limited automation, this system enhances efficiency and customer interaction. By connecting the ordering robot, serving robot, and kitchen systems through IoT, real-time communication is achieved, ensuring smooth order processing and timely deliveries. The Android platform allows for easy menu customization and remote control, offering a user- friendly experience for both customers and staff. With two distinct robots – one for taking orders and the other for serving – the system operates seamlessly to improve both customer service and operational efficiency. The use of interconnected sensors, cloud-based data analytics, and Bluetooth-controlled navigation makes the system adaptable, autonomous, and responsive to real-time needs. In conclusion, the IoT-Android smart dining robot system transforms the traditional dining model, providing a more streamlined, personalized, and efficient dining experience that benefits both customers and restaurant operations.

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