Automation of Cafeteria Services in COVID-19

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Abstract- SARs-CoV2 virus, COVID 19 has laid down restrictions on all human activities and continues to be a global threat. COVID has severely affected the food café, restaurants and their services. This paper aims to provide regular and automated services by the cafeterias even in the pandemic and in the future. The paper proposes an android OS based app for automation of café services. Automated café services will facilitate online pre-booking of food after the secure payment transaction and the use of robot services to deliver the food at the café table. The application has the advantage of low cost automation, cashless transaction, less human intervention, customer authentication using one-time password and abide to social distancing.

Keywords – Authentication, Bot, cafeteria, android app, OTP, payment gateway

I. INTRODUCTION

The government norms of social distancing and hygiene regulations during COVID-19 had locked every individual under a roof. All the commercial sectors are widely affected by the COVID-19. The restaurants and cafeterias are no exceptions and needs a solution to restart and regularize their services abiding by the government rules and regulations. This paper proposes an android based application and delivery robots to regularize the cafeteria services. Automation service facilitates pre-booking of food orders at the café to avoid the crowd and indirectly time spent by the customer at the café. The app customizes cafeteria services to provide online orders, cashless transaction, less human intervention, customer waiting time and also follow social distance as required by the pandemic. The customer can pre book orders and also reserve the table number by using a user-friendly interface. The order confirmation is given to the customer after successful payment transaction. The customer interface indicates the status of the food delivery like order placed, order shipping and order delivered. The café server places the food according to the order in the shelves of the robot and the respective table number are programmed. The robot ships the food to the customer. Authentic customer verification is carried out by a unique OTP code delivered to the customer on the registered number. After the customer verification the robot unlocks the food shelf and food is delivered to the customer. After food delivery to the customer, the robot directs itself towards the pantry of the café. The bot communicates using a Wi-Fi with the firebase-database which has all the data about the food order placed by the customer.

II. LITERATURE SURBEY

The literature shows use of wireless technologies like Bluetooth, Zig-Bee, and Wi-Fi for booking orders, guided robots for delivery of food and café table-based applications. Y. Pawse et al. [1], has used the robot to deliver the

food inside the railway compartment. The Bluetooth is used to communicate between pantry and the passenger, incase if internet service is not available inside the railway. The limitation of the paper is the area covered by the Bluetooth is restricted to 10 m. In Aman Jain et al. [2], author proposes a system using Zigbee defines WPAN technology for scalability feature to increase the number of users. The use of conveyor belt is done to deliver the food to the table. The conveyor belt has advantages of less human interaction and it does not have a chance to be misguided as the belt is fixed. The problem with the food delivery using conveyor belt arises if the canteen environment dynamically changes or the table arrangement needs to be changed which is normally done to attract the customers. In Yong Chai Tan et al. [3] the food delivery is done using a line follower robot. The robot follows the lines that are embedded into the ground of cafes and above that traces the robots runs. Ultrasound or cameras can be used over the robots to avoid wrong delivery and accidents. In this approach, the problem arises when the robots are misguided or steps outside the track, for which costly measures are required to replace the system. In Renjith Ravi et al. [4], the app to place the food orders is available at the café table. The limitation of this paper is that there is no authorization as the device sending the orders is fixed on the table. Also the customer is unable to pre-book the order before arrived to the café and the time between the booking and the serving time is wasted. In M. Asif et al. [5], proposes an autonomous robot which takes the order from the table. The problem with this approach arises when all the tables are occupied. So, the customer cannot pre-book the orders, which is not the case in android based application. Monik Shah et al. [6], provides a convenient way to deal with the online food ordering. It uses a web application to pre book the orders. In Albin Antony et al. [7] a combining approach of multiple robots is used for implementing restaurant automation but the disadvantage is that it needs synchronization between central station and mobile robots. In Kazi R Alam et al. [8] an overhead crane is used to deliver the food at the tables, this approach needs heavy load current as the motor moves from above and is not mobile. In Syed Viquar Ahmed et al. [9] they have used various wireless technologies like RFID, Zigbee and Wi-Fi together for a menu based ordering system using touch screen device on the order table, this all can be reduced to single technology using Wi-Fi as shown in this paper. In Raviprakash Shriwas et al. [10] a touch screen based ordering system is designed to decrease the cost, they have proposed the use of RF transceiver instead of zigbee but the problem arises for Non Line of sight communication. In Vo Nhu Thanh et al. [11] a double line sensor approach is used along with PID and PWM sensor for the robot to minimize the jerking of motors and stability.

The author uses the android application and line following robot equipped with IR sensors to overcome most of the limitation existing in the automation of café services as studied in the literature. The author provide online ordering, pre-booking, cashless transaction, less human interaction, authorized user delivery, social distancing and time management between the order placed and delivered.

III. SYSTEM DESIGN

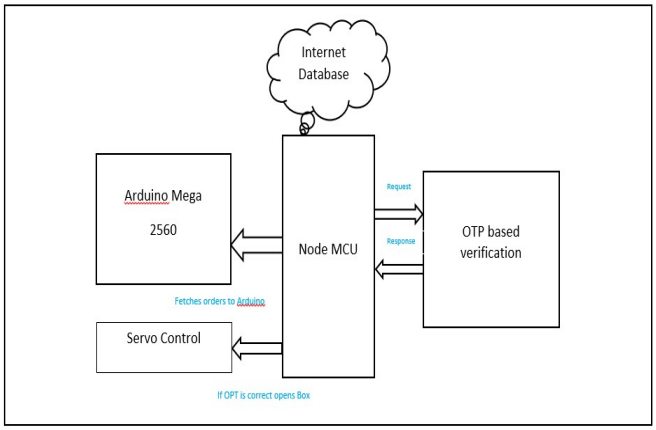

Fig 1. Design of café automation services

The café automation services and the hardware flow of the technology used is shown in fig 1. The robot receives the food orders from the node MCU. Node MCU microcontroller is used for connecting the robot to internet. The line follower robot is used for the food delivery from the pantry to the customer. The robot is mounted with OLED display on it which displays customer information destination table no, and battery percentage left for the robot that is required by the server. The customers can place the food order using the app by selection of food and number of units from the app. The cost is displayed at the customer end and after the successful payment transaction by the customer 'order placed' status is displayed on the app at the customer end. The orders from the customers are

displayed at the pantry. Once the food order is ready in the pantry, the food is placed in the robot shelves. The shelf is locked and then the shelf can only be unlocked by a secret key. Secret key is the six-digit key provided by the application only to the user for customer authentication. The line follower robot is programmed for respective destination table. After the robot starts its destination table journey, the 'order placed' status at the customer end is switched to the 'shipping'. The table detection is done using IR sensors after table detection the food delivery process begins. At the destination table the customer authentication is carried out using six-digit key. Using keypad and OLED display the customer enters the secret key and the shelf unlocks. The countdown timer is provided on the shelf for the customer to take the food. After food is taken out, the signal is sent to the server to indicate that the food is delivered to the customer. If the delivery is successful the response is positive, otherwise negative response is sent to the server. As an indication of successful food delivery to the customer 'thank you' message is displayed on the robot display and again is directed towards the pantry for its next order. The status at the server end is displayed as 'shipped'.

IV. HARDWARE DISCUSSIONS

The line follower bot used for delivery is designed to move in the forward direction along a guide-line on its own and stop at a delivery location. To implement this we need to have synchronization between the IR modules and Arduino Mega and we have used Ultrasonic Sensor for Obstacle avoidance. Arduino Mega is the microcontroller used in this paper. The IR setup for table detection has a technique where it has a different kind of mark on every table so that the robot can differentiate between the path and the tables. To detect a table this paper proposes a technique where 2 extra IR sensors are used. The main aspect of the robot is that it should have internet connectivity all the time. There is no need of high bandwidth in this paper as the data is very small. The orders are saved in firebase database and these are fetched to arduino using node MCU. Like every order maintenance in this automated delivery system the orders are given 3 states and only controlled by the server as mentioned before. 1) Placed, 2) Shipping and 3) Shipped.

The details of the order are only fetched when pantry changes the state of the order from Placed to Shipping after he/she has prepared the order. After that node MCU sends data to arduino and arduino extracts the necessary data and changes the destination table and starts moving. Next important part of hardware assembly of this robot is about user confidentiality and food security from theft. The use of shelf with a servo lock is used to protect intervention of any unauthorized access. So OLED display and Keypad is needed to have OTP based authorization which will be generated by the application only when order is shipping. A servo motor opens the shelf when correct OTP has entered through user. After successful authentication he /she can close the shelf in limited time or press the key from Keypad.

V. INTEGRATION AND IMPLEMENTATION

Hardware Integration

The figure (2) shows the block diagram of the paper. The main components are the Arduino microcontroller and ESP8266 based node MCU internet connectivity provider. Node MCU is the key to the paper as it connects the robot to the firebase and other internet services through Wi-Fi. The arduino and the Node are connected through serial COMM port. All the other sensing and control components are connected directly to the arduino.

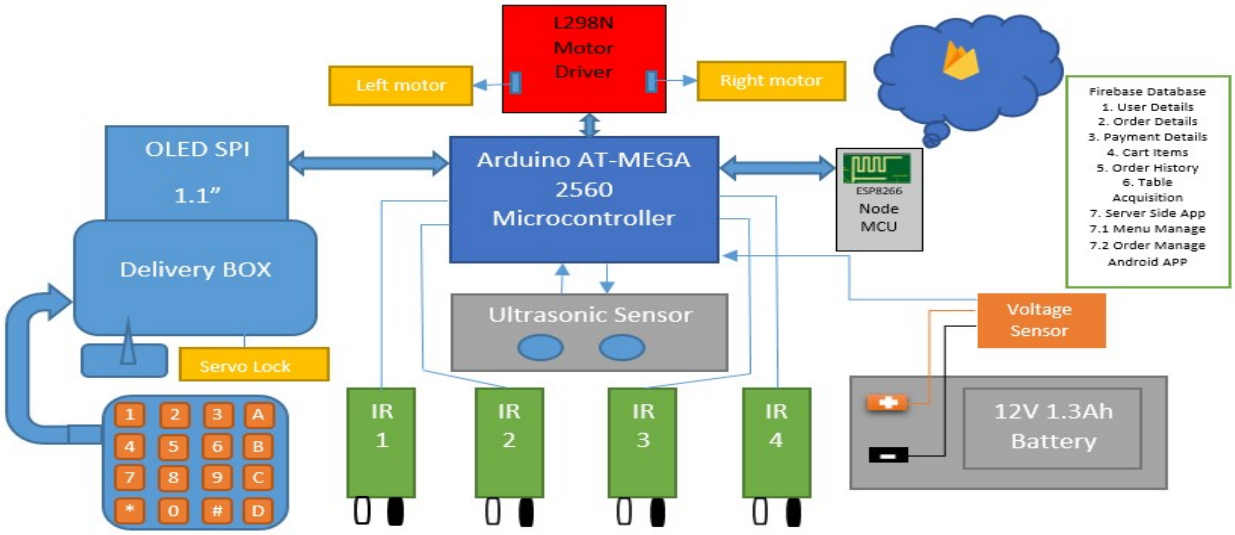

Fig (2): Hardware block Diagram

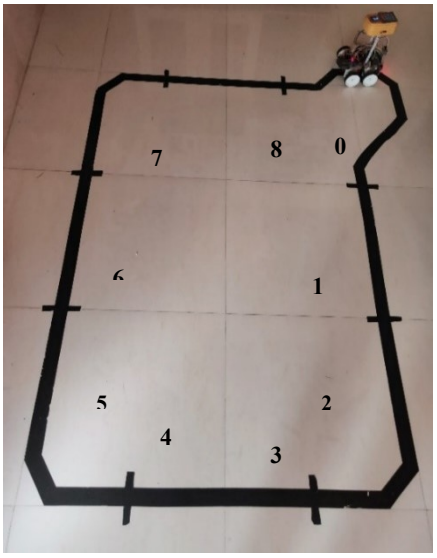

Fig (3): Actual Path

Fig (4): Delivery Shelf Assembly

1. Line Follower and Obstacle detector

From the fig (3), it can clearly be seen that there are total of 9 tables are inscribed on the white tiles. First table 0 is the default table which is at canteen counter so that service provider can put the food inside the bot and sterilize it. And other 8 bookable tables are from 1-8.The “+” mark on the path means that is the table.

2. Delivery Shelf Details and Features

The delivery shelf assembly for the robot is mounted and elevated above the robot chassis. A servo motor is used to lock the shelf so that no one can interfere with the food from the start to the end of delivery process until the user unlocks it with the keypad and OLED. The purpose of OLED module is to display interaction messages to the user and the server and displays the state of the robot so that we can see the process going inside. It is also used to enter passkey to unlock the shelf. And Keypad is the means where we can press keys which are seen on OLED screen.

3. Hardware Assembly of the Bot

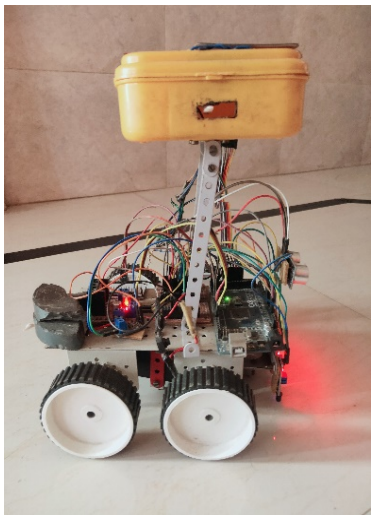

Fig (5): Hardware Assembly of the Bot

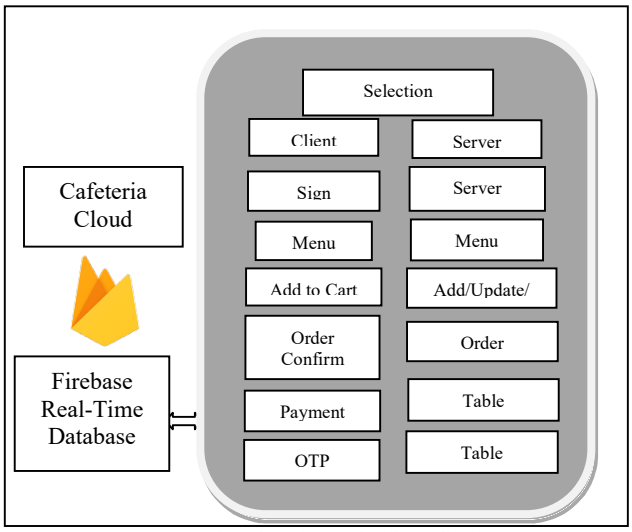

Fig (6): Flowchart for Android Application

Overall working with main Arduino functions

The process starts with the order booking on the application, the app has two sides the client side and the server side. The client side can book the orders from the app which are stored in the database. As discussed earlier an order has 3 states viz. Placed, Shipping and Shipped. When the order is placed on the app the default state of the order is placed. The time and table for the delivery is selected by the customers. When the allocated time comes the server side updates the orders to Shipping. Until then robot does the waiting on the default table. As soon as the food is ready at the server table the servo unlocks the shelf so that the food can be inserted.

Now the delivery starts and counter is incremented after every table. As soon as it reaches the destination table it stops there and asks for the OTP which can be found in orders and if the state is shipping we can see the OTP in app. There are 3 chances to enter the OTP, if it is entered correctly then the Servo unlocks the shelf and let the customer take the food from the shelf and customer has to close it after the successful order completion within the stipulated time given. After that the robot sends the data to the database that the order is “Shipped” and if the OTP is not entered correctly then it changes the state of the order to “Placed” again so that the server can check what went wrong and restarts the process after sending the data to the database. Either false or true the robot comes back to the server table so that it can start the next order.

Software Design

The Android SDK (Software Development kit) is used to develop applications for the Android Platform. It supports Gradle based build support, template based wizards to create common Android designs, rich layout editor with drag-drop UI components, support for Google’s Cloud platform, virtual device (Emulator) for debugging and testing. Fig (6) shows the design flow of placing an order on the application

The flowchart in fig (6) shows associated components like the Firebase database that serves as the store house of the application. The application flowchart shows the client side and the server side. The client-side application is used to pre-book the food orders and the server-side application is used to manage the orders and control them. The customer needs to register for the first time and sign in for repetitive use. Customer can simply add the food items to the cart where he/she can verify the order and place the order on particular table at particular time. At the cart user needs to enter the table and time slot for the order. Another advantage of online pre-booking food orders is the cashless payment offered. User can select the online payment mode and safely pay for the order. The paper proposes PayTM SDK based API, by which the application gives the information of the order and the payment to PayTM.

The PayTM does the secure transaction. Server side application manages the menu and orders by tracking the order. Working and application screens for every aspect of management and ordering food is shown later in implementation. Server application also manages the table availability for the customers.

Software Implementation

The application takes in the details of the user through a registration form and takes the user to a detail form wherein the user must fill all the relevant details. A personalized home page is available for each user, wherein the Cart has all items selected by that specific user. Next step are to select a table and time slot from alert dialog view after successful selection it takes the user to the transaction begin page we he/she can press the start transaction button and initiate the payment through PayTM wallet or net banking or cards. The server side has several other features like order updates to the customers after they have placed their orders like shipping, shipped, etc. It can change the state of order by long clicking on any order. Other features of the server side application are updating the menu items, categories, food items, etc.

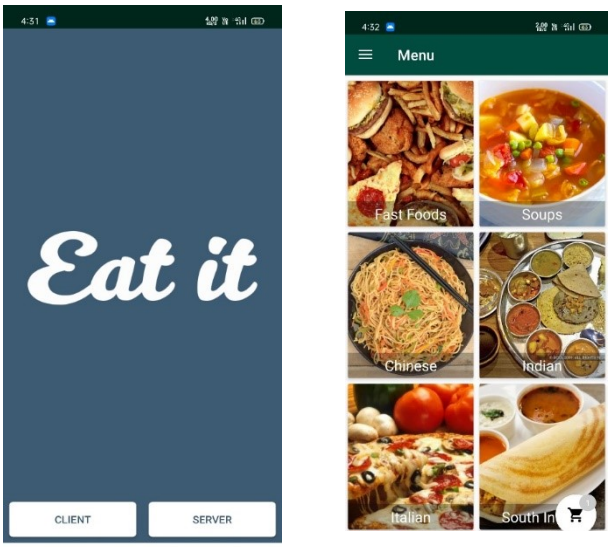

Fig (7): Software application

VI. CONCLUSION

Covid-19 has stopped various social activities and locked most of us in our homes. But the lifecycle cannot be stopped after that. The trust of the food industry relies on the health and hygiene of the customers. After implementing an automated cafeteria delivery robot and after regular sanitizing the robot the cafes can have that kind of trust on the services and the industry. The paper simplifies the process of ordering and delivery of the food in the cafes. The paper proposes a time saving approach of food delivery and it prevents the transmission of infection to a great extent. This project is an attempt to bring an advancement in the field of food industry by automating the system through bot and android application. Furthermore, the adoption of the paradigm opens a wide area of applications like safety assurance, smart infrastructure, and digital payment method with less risk of contracting infections. The design and selection of components for the prototype includes bare minimum hardware for implementation thus making it cost effective and efficient.

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