Design of Restaurant Service Robot for Contact less and Hygienic Eating Experience

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Abstract - *In today's world the use of robot is going on increasing. The robotics technology is replacing man work at a fast pace throughout the world. At restaurants and hotels, the customers face a lot of problems due to congestion at peak hours, unavailability of waiters due to manual order processing. These limitations can be overcome by our design RESTAURANT SERVICE ROBOT. It is used for ordering food and beverages. The customer needs to scan the QR code on a particular table. After scanning a mobile application will be opened on his/her smart phone from where he/she can order the food. As the orders will directly display in the kitchen, the cook will load the order on the robot & then the only task of the robot is to serve the food on particular table. Robots are able to carry out every work more effectively and efficiently than a man can do. We use the technique of line follower for the robot to move.*

Key Words: Congestion, Scanning, Line Follower, Restaurant, Rendering, Automatic, Sensors,

1. INTRODUCTION

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 Restaurant system delivers almost infinite flexibility in promoting meal and snack options. It uses technologies such as Arduino mega, RF module, database management & line following technique innovatively in a modern restaurant to enhance quality of services and to enrich customer's dining experience. A line following robot is designed using sensor operated motors to keep track the line path is predetermined for meal serving. Customer can pay the bill through cash or any mode of online payment.

In this paper we demonstrate the idea of automatic serving robot. In this paper we made a robot which provides proper service to customer at restaurant. Customer needs to scan

QR code present on the table, after scanning the code customer will counter a mobile application on their own mobile itself. There they can order the food. As the orders will directly display in the kitchen, the cook will load the order on the robot & then the only task of the robot is to serve the food on particular table.

2. LITERATURE REVIEW

Few of the research papers were studied and the following inferences were understood in accordance with restaurant service robot. Tzou Jyh-Hwa and Su Kuo L [1] gave an overview on generation of robots where they have explained about two generation of robots. In first generation there were usage of tape on floor, infrared sensors for obstacle detection, chain mechanism and motors to move dish forward. It implemented different layers for diffferent components used. They used large touch screen monitor for human - machine interface. In second generation robot they used laser positioning system and used wireless technology for ordering. Robot can take dishes and also order using touch screen on robot.

Mehran Pakdaman and M.Mehdi Sanatiyaan [2] gave us introduction about line follower and how they used Atmel's AVR microcontroller.

Kazi Muhamad Asan , Abdullah-Al Nahid and Abdullah Al Mamun [3] used sensors like LDR, LED and sensors resistance and voltage divider arrangement for algorithm. They made simple, low cost line following robot without using any microcontroller.

Tetsuya Kimuraa and Akkharaphong Eksiri [4] tried to develop robot for taking orders and delivering food to table. Their robot was inspired from competition ABU Robocon. They have used two different robots where one is used for ordering and another for serving food. They also used line following technique and sounds were given to it for greeting

human. Due to the humanoid shape of the robot people stopped robot for taking selfie and for this purpose they had emergency pause switch to stop robot.

Asif , M. Sabeel, Mujeeb-ur-Rahman, Z. H. Khan [5] used Bluetooth connection and WLAN and also used 2 different robots where one controlled manually and other automatic. Robot used atmega 328 microcontroller for its working and LCD for food menu.

Jinglin Zhang, Yongsheng Ou, Guolai Jiang and Yimin Zhou [6] they made restaurant service robot based on SLAM. They made it interesting by the usage of used depth cameras, sensors odometry and gyroscopes. The robot could build map by itself.

Karan Kaushal, Khushboo Yadav, Vidhu Vaibhav, Chakshu Sharma, Love Gupta, Tanu Tripathy [7] proposed idea of E-restaurant where they used robot for serving food. They proposed idea on how money expense on waiter can be reduced by using robots. They explained that this robot is able to serve for one or more order in one cycle. They had also used the idea of line follower and made local server and website (XAMPP).

Md. Kamruzzaman, Md. Tareq [8] proposed idea of robotic base waiter and used android app to give command. When the robot receives command, it brings food. They used the idea of rotary encoder technique for movement on small prototype model (8-inch robot).

Guo-Shing Huang [9] used RC Eberhart's particle swarm optimization for path planning for their idea of robot. Matlab software was used for multiple robots.

Neelima Mishraa , Dr. Dinesh Goyalb , Dr. Ashish Dutt Sharmac [10] shows how restaurants c service can be make more efficient. They suggest we can add gyro to balance tray and also highlighted on different aspects or parameters of restaurant robot. Like serving, ordering, balancing and communication.

3. DESIGN AND DEVELOPMENT

The entire robot is designed in such a way that it is compatible so that it can move freely in the restaurant. The electronic parts include sensors, speakers, buzzer, battery and motors. The mechanical design is also suitable for placing the food in a safe manner from germs. Pockets for spoons and forks are separately designed in the robot. The food shelves are neatly protected with glasses so that it does not spill with an emergency button given for any problematic situations.

3.1. Mechanical Design

Considering the situations and demand of contact less delivery the design has been made. Unlike regular humanoid restaurant robot this design is unique and serves better for

the purpose. It has more space for the food and also can accommodate well and is handy. Industrial aluminum is chosen for the chassis because it has the strength to carry the load and the finish of it will be an added advantage. In order to bear the weight, it has 23-inch diameter base with a height of 7 inch.

The base has 2 wheels connected to the motor and 2 ball-caster wheels to assist the movement. IR sensor is placed in front of the front caster wheel. The batteries and electronic components are placed at the bottom of a 7 inch height base and it has 4 ultrasonic sensors on 4 sides.

Keeping the customer seating height in mind the robot was designed to be around 3.5ft height so that the customer can access the dishes easily and without getting up from his place. The speakers are placed in such a way that it gives a good look for the robot. The robot has 2 racks for food with a glass door so that food remains untouched by germs, dust, etc while it's travelling from kitchen to table. At the bottom the robot can accommodate spoons and forks, etc in a special tray and also has bottle holders on both sides of the tray.

It has an emergency switch on the top so that it can be easily accessible when there is a problem. All 3 indication LED's are placed at the front of top so that it can be easily visible. The charging slots are provided at the back and at a suitable height to plug in automatically. The keypad is placed at the back of food rack to make is easy for operation after loading food. This design is made in such a way that it is easy to manufacture. The robot is easily accessible for the kitchen counter to load food. The design makes it easy to clean and sanitize in case of food spills or during general maintenance. Depending on the necessity the tray can be used for multiple purposes. According to the restaurant owner need he can use speakers for entertainment purpose.

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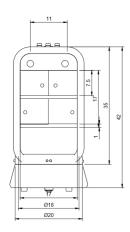
Fig -1: Dimensions of the proposed robot

Fig -2: Front view, Side view and Back view Design of Robot

Fig -3: View of Restaurant Service Robot

Fig -4: View of the Robot at a restaurant

3.2 Electrical Design and Components

Line Follower: A line follower robot is used to follow the complete path within the restaurant. It has line sensors on it. Whenever the robot starts it sense for black color. When sensor senses black color the robot will move forward on that line. Whenever the value of the sensor changes it is a time to take decision for robot to turn left or right.

Obstacle detect and avoidance: Ultrasonic sensor are used in the robot so that they will calculate the distance between the robot and the object or any person standing on the path(obstacle) and after a particular distance as per the code the robot will stop i.e. it will detect the obstacle and for avoiding it, it will stop and for the advancement a piezo buzzer is placed which will start when there is something in the path so if there is any person then he/she will move aside and if there is any object someone will move that aside.

Keypad: The input keypad placed on the back side of the robot is used by only chef. The inputs given via keypad will direct to the respective table. Without increasing the complications, the keypad is used so that the chef can directly input the table number so that the robot can directly recognize the pre-defined path and go there.

Indicator LED's: Indicator LED's are use for the indication of the particular tasks. Red LED will glow when the robot is power on, green one will glow when the robot is in working condition, and the orange one will glow when the robot is loaded that is when it is going to serve.

Automatic charger: For recharging the robot automatically a fixed socket is placed at the robot's ready position. When the robot is at ideal condition, the charging points on robot will exactly overlap the points at the charger, so when it is at ideal condition it will be continue charging which will reduce the fear of discharging of robot in between the performance.
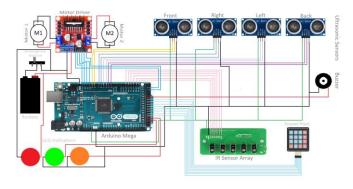

Fig -5: Electric Circuit of the Robot

3.3 User Interface and Experience

The user interface (UI) has been designed keeping the robot-human appeal technology in mind and to ensure comfortable and appealing interaction between the two. The interface is dynamic in response to the feedback given by the customers. The User Interface includes the menu of the restaurant the customers select the options and clicks on confirm order. The order details are then saved into the database and

displayed in the kitchen server computer. The order is then prepared and served by the robots.

The UI is an app which is developed using Android studio , the database used is ROOM Database, The App is divided into different activities including the main page where all the menu categories is displayed , each category opens into a new activity .

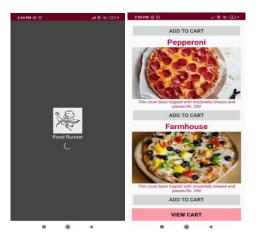The future scope for this app will be to add a QR code so that whenever the customer scans the code, the app will get open. This will reduce the cost in our product.
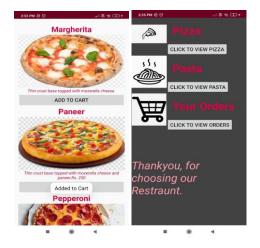

Fig -6: Front and the order page of the App

Fig -7: Order page and cart of the App

Fig -8: Payment page of the App

4. Working

The robot is used to serve food from the kitchen, to the table. The robot uses line following technique with the help of Infra-red sensors for navigation. In case of obstacles in the way the ultrasonic sensors in the robot will detect them and stops the robot. A keypad is integrated in the robot to know which table to serve.

The food will be ordered through an app, on each table there will be a QR code that could be scanned which will redirect them to the app store. After the food is ordered, the order will be directly sent to the kitchen screen with the table number.

The robot is first placed near the kitchen (on the line). When the food is ready, the chef can place the items inside the robot and click the table number on the keypad for delivery. The robot will start making its way to the table following the line. In case of obstacles in the path, the ultrasonic sensors will detect them and stop the robot from moving. And also, when it detects the obstacle a piezo buzzer will alert the person to move or move the obstacle. The directions for the table are already coded in the robot for smooth running.

Three LEDs are used in the robot for detecting fault in the robot if a problem occurs. The red led is turned on if the robot has power. The green led is turned on if the robot has started working. The orange led is turned on if the robot is handling an order (or) is on movement.
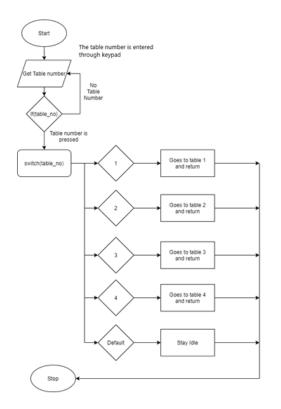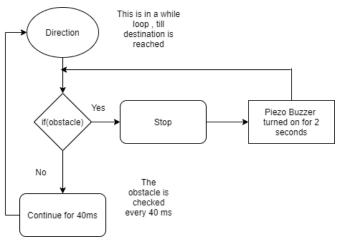
Fig -9: Flowchart for basic ideology

Fig -10: Flowchart of Obstacle Clearance

5. CONCLUSION

Lately in this technology world, people have started accepting robots as a part of their lives because it not only makes getting work easier but also the amount of time required is less .The efficiency and productivity of the robot is also more. Though there are many robots available all over country , cost has become a major factor to customers but our design of restaurant robot is cost efficient since we have used the concept of line follower to make the robot move. The design used is very compact and comfortable and can be used in any restaurant. Our design has ensured the utmost safety factor for the robot while serving food.

Restaurant is a place where family and friends come to have a fun time and to make their visit more enjoyable and memorable, robots are a different way to serve food for the people. Our food application, also makes ordering and payment easy with just a few clicks on the button. Our robot is a very useful solution to all types of restaurants and in future it can be enhanced more.

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