International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-8, June 2020

Wireless Two-Way Restaurant E-menu Food Ordering System with Robot Delivery

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Abstract: ***This paper presents the design and implementation of E-restaurant with Robot delivery. It considered as the possible solution for the automation of present food ordering process in restaurants and hotels. The proposed system mainly consists of customer, robotic and maintainer section. The customer can place an order through the tab provided on the table which has the food menu in the restaurant website. This placed order is displayed on the system (PC) at maintainer section. Customer section's website and maintainer section PC's is connected through message queue telemetry protocol (MQTT). Maintainer can dynamically update the e-menu available in website according to availability of food in the restaurant and its prices. Kitchen staff prepares the food and places on the robot's tray and corresponding table number is selected. The robot is designed using line follower mechanism where it follows the black path laid and it will detect the table using the infrared sensor by counting the number of black patches it encounters while moving on the black path. Once the food is taken by the customer, robot will go back to the maintainer section automatically and waits for another order to be placed. The proposed system removes the language barrier between customer and waiter while ordering and to fasten the food ordering and serving process. It reduces the labor cost for the restaurants and waiting time for the customers.***

Keywords: Waiter Robot, Line Following Robot, Ultra-sonic Sensor, IR Sensor, E-Menu.

I. INTRODUCTION

Two-way e-menu food ordering system is a technology that implements the whole process of food ordering in restaurant and hotels atomized by providing comfortable and easy services to the customers. The aim is to reduce the manpower in the restaurants and hotel and also to simplify the ordering process for both the customer and the restaurant. The tablet is placed in each table from which the customers can order the items directly. The ordered food is displayed in the maintainer section, from which maintainer can quickly go through the orders they are received and process all orders efficiently and effectively with minimal delays and confusion.

Revised Manuscript Received on June 30, 2020.
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Communication between customer and maintainer happen through the website with the help of communication network called message queue telemetry transport (MQTT). The kitchen staff prepares the food and places the food items on the robot's tray and press the corresponding switch sets the robot to move and serve the food. The system also consists of a web application where the user can order the food before reaching the restaurant or the hotel and the user can also check for the availability for the reservation of the table and can also reserve it [1].

II. RELATED WORK

In intelligent restaurant system, customer will place the order on the tablet which is placed in each table. In each tablet the welcome screen appears first followed by the menu screen to select the food. According to their requirement food can be added using user friendly web application, in parallel it also calculates the price of the ordered food. This order will be displayed in the maintainer section, corresponding food is prepared and placed on the waiter robot's tray and selection of the table is made by the maintainer. The waiter robot used in the intelligent restaurant uses the line follower phenomenon. It uses the two IR sensors installed in the bottom which is used for the line following and to keep the robot in the line.

The same two IR sensors are used for the table recognition. IR sensor are used as feedback element to keep the robot in the line according to place where the robot is moving whether it is on the black line or white line. According to this sensor input the Arduino will drive the gear motor through the motor driver as per the programmer instructed. The waiter robot also uses two Ultrasonic sensors, one is for obstacle detection and another one is used to detect whether the food is taken by the customer or not. The waiter robot starts moving towards the selected table and stops when it arrives at the respective table, then the robot waits till the food is taken by the customer. After the food is taken out, robot will come back to the maintainer section [2]. The most important part of the intelligent restaurant is web application. The tablet in each table has been launched with the website. This website allows the access to the menu. The website also consists of reservation page where the customers can check the availability of tables and reserve it.

III. PROPOSED DESIGN METHODOLOGY

Fig.1 shows the block diagram of the proposed system which consists of three sections namely customer section, maintainer section and robot which serves as the connection between customer and maintainer section.

A. Customer Section

In the customer section, a tablet is placed on each table. The customers can place an order through the tablet on the table. The tablet starts with the welcome screen followed by the menu bar to order.

Customer has to select the items from the menu as well as the quantities and prices are calculated simultaneously according to the order. For each and every table there should be a black patch attached to it so that the robot can get to know the arrival of the table by scanning the black patch [3].

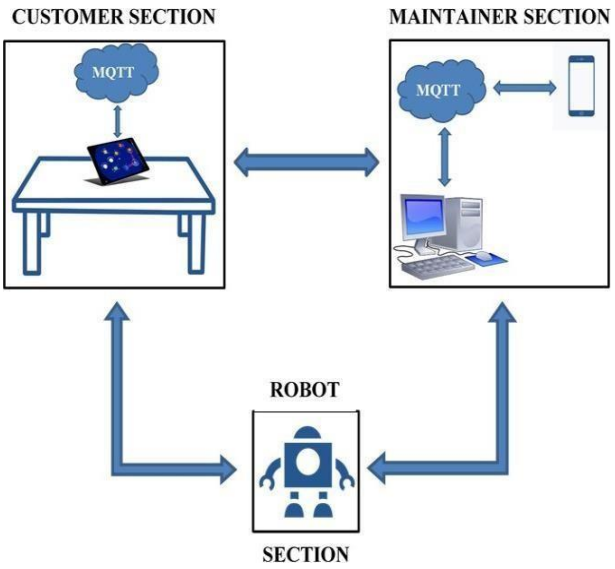

Fig.1 Block diagram of Wireless Two-Way E-menu Food Ordering System

The menu can be easily updated depending on the availability of the food. The menu is synchronized with database which is running in the restaurant's website. Upon synchronization the data is stored locally in the tablet so the customer need not wait until the menu downloads.

B. Robotic Section

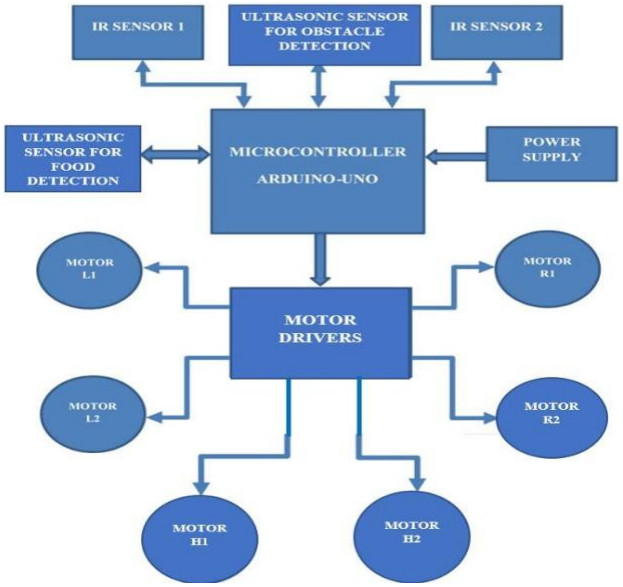

Fig.2 Block diagram of Line following robot

Fig.2 shows the block diagram of the line following robot which consists of two IR sensors which is used to measure the infrared light radiating from object and two ultrasonic sensor which is used to measure the distance of an object and food on tray respectively and four motors to move the robot which are driven by the two motor drivers and another pair of motor for the hand movement. These are interfaced with an Arduino microcontroller. Fig.3 shows the block diagram of base of the robot which consists of H-bridge motor drivers which drives the motors. Arduino microcontroller in the Fig.2 takes the input from the two-infrared sensor IR1 and IR2 whether the black path is in the middle, left or right. According to the input from the sensor the Arduino will take the decision whether to turn right or left based on whether path is present in left or right respectively. One Ultrasonic sensor is used to detect the presence of obstacle in-front of robot and based on the input from this sensor the Arduino make decision whether to move or not and another Ultrasonic sensor is used to detect the food on the tray. Motors are controlled through the motor driver by Arduino.

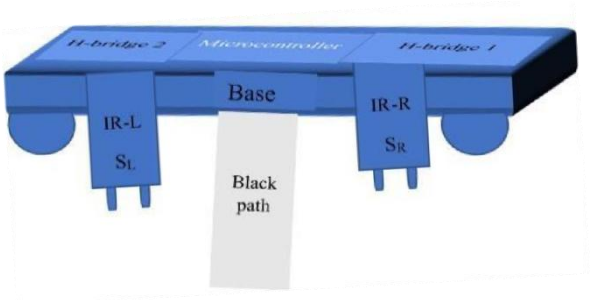

Fig.3 Block diagram of base of robot

The placement of sensors, Arduino and H-bridge (motor driver) is as shown in Fig.3. The IR sensor is placed in front of the robot base and Arduino is placed in-between the two motor driver.

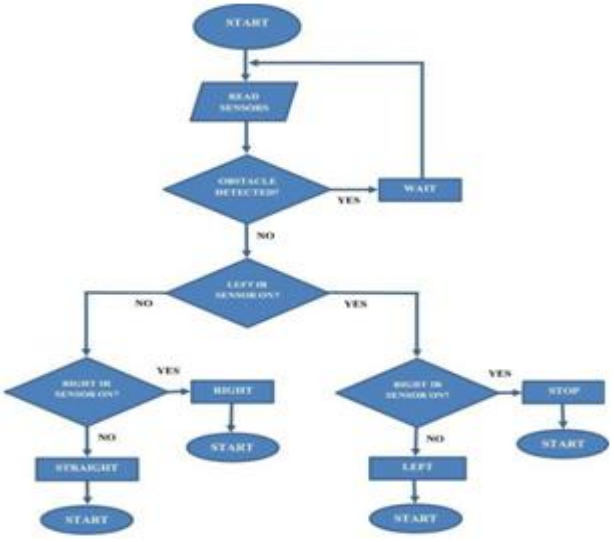

Fig.4 Circuit diagram of proposed system

The food is displayed in the kitchen and the food is prepared and placed on the robot then the corresponding table number is pressed and the robot goes to that table and delivers the food. Fig.4 shows the circuit of the waiter robot where two infrared sensor and two ultrasonic sensors are connected to the four digital pins respectively.

The motor drivers are connected to the output pin of the Arduino which controls the movement of motors, finally the switches are connected to the three input pins of Arduino [4].

C. Maintainer Section

Fig.5 shows the path followed by robot from maintainer section to customer section. Maintainer section consists of web application to display the order placed by the customer. This web application is connected to the maintainer section through message queue telemetry transport. Physically the maintainer section and customer section are connected with the help of a black path.

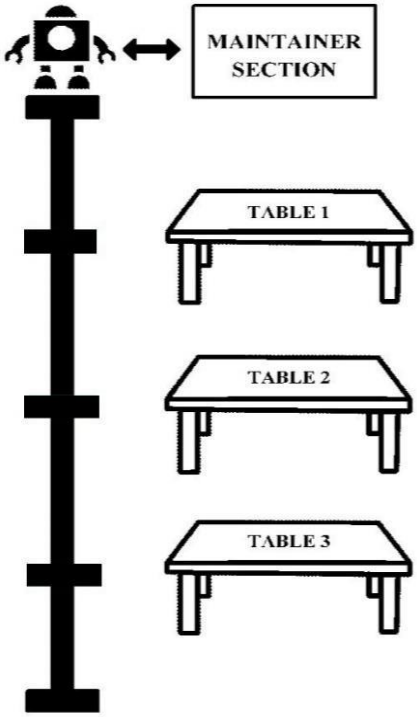

Fig.5 Path followed by robot from maintainer section to customer section.

The web application is used by the customer which is helpful for checking the availability of table, availability of particular food in given day and to reserve the table and order the food before reaching the restaurant so that waiting time is reduced. This website also consists of one tap location and this web application is connected with MQTT for accessing the data about the availability of items in restaurant [5].

IV. IMPLEMENTATION OF ALGORITHM

The flow chart of the working robot and its sensor is shown in the Fig.6. The waiter robot consists of two Ultrasonic sensor and two IR sensor. One Ultrasonic sensor is used to check whether any obstacle is in front of the robot while moving in the path and another one for the detection of the food on tray. If there is any obstacle it waits until the obstacle moves out of the path. IR sensor is used to keep track of the robot moving in the black path, if any one of the IR sensors is misaligned according to the sensor input the micro-controller will turn the robot left, right, stop or move in straight path. If there is any glitch or the button to be pressed by maintainer malfunction then the robot will not move forward [6].

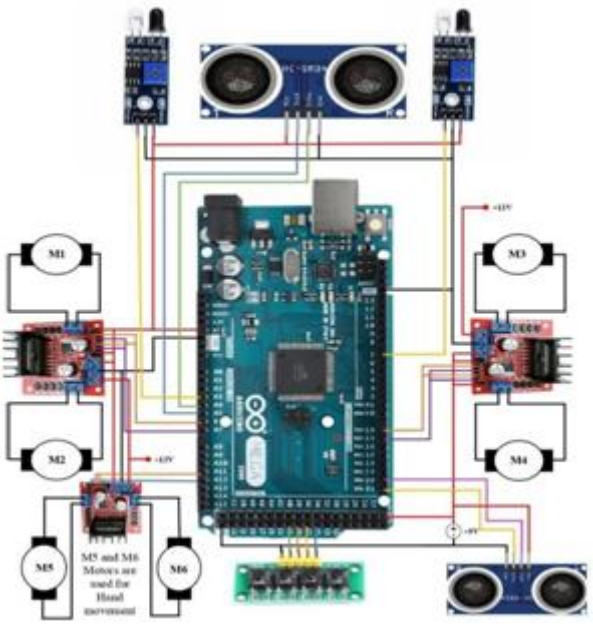

Fig.6 Flow chart of line following robot movement

V. RESULTS AND DISCUSSION

Wireless two-way restaurant E-menu food ordering system uses web application for food ordering in the customer section. In the robot section once, the food is placed on the robot as shown in the Fig.7, the respective button is pressed and the robot will go to that table. This robot can carry up to 1.2kg of food from maintainer section to customer section. Once the robot reaches the table, the customer has to take the food from robot as shown in Fig.8(a) and Fig.8(b). Once the food is taken from the tray by customer, robot will go back to the maintainer section.

Table.1 shows the analysis of power consumption of different motors based on RPM (Rotations per minute) for 11.1V 5200mAh Lipo battery. The selection of motors is based on speed and power consumption. 30 RPM DC motor is best suitable for the operation by considering the aspects shown in the table.

Fig.9(a),9(b),9(c),9(d) shows the snapshots of web application; Website: www.sitkitchen.weebly.com

Table.1 Analysis of power consumption of different motors

RPM	Power consumption	Duration of Battery	Remarks
10	19W	180 mins	Low speed
30	58W	60 mins	Perfect suitable
60	115W	30 mins	High power consumption

Fig.7 Front view of waiter robot

Fig.8(a) Fig.8(b)
Side view of robot carrying food (a) above table level, (b) to the table level

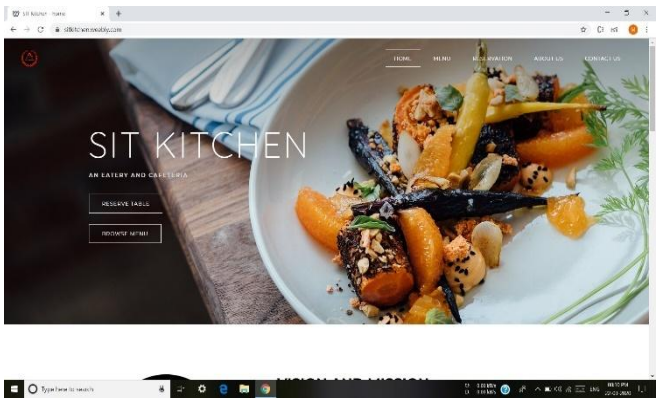

Fig 9(a): Home page

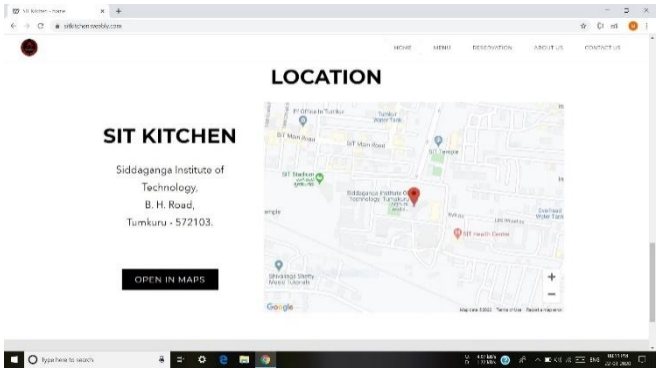

Fig 9(b): One tap location

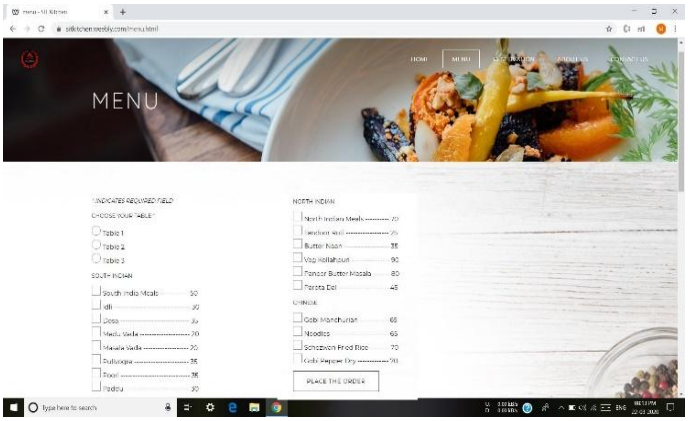

Fig 9(c): Menu page

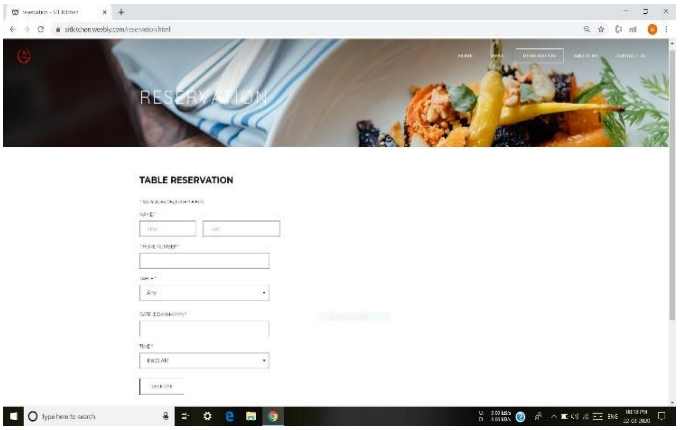

Fig 9(d): Table reservation page

VI. CONCLUSION

The proposed e-menu food ordering system with robot delivery is found to be the automation for regular food ordering process. Robot waiter was designed and implemented using Arduino Mega microcontroller, it takes the decision according to input form the sensors and switches as programmed and move accordingly. The robot runs for one hour uninterruptedly as tested. Hotel website displays the e-menu, corresponding prices and owner details. This method cuts the language barrier between the waiter and the customer while food ordering. Web application used in this system also helpful for the customer to know the availability of table, food on a particular day or time. This system enables the dynamic update and removal of a particular item from the menu and also enables the reservation of table before reaching the restaurant using web application. It is possible to place order before arriving at the restaurant and also provides one-tap location finder. Web application helps the maintainer to execute the placed order systematically without any confession and ease of billing.

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