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Design & Implementation of Smart Restaurant Menu Ordering & Delivery System Using Line Following Robot

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ABSTRACT

This paper describes the design and development of a waiter robot which is considered as a possible solution to restaurant automation. The robotics technology is replacing manual work at a fast pace throughout the world. In classical café, restaurants and hotels, the customers face a lot of problems due to congestion at peak hours, unavailability of waiters and due to manual order processing. These shortcomings can be handled by using a restaurant automation system where „Waiter Robots" are used for ordering food and beverages. The desired order is also transmitted on wireless network to the kitchen via menu bar. The menu bar is based on the LCD' and the IR sensor. The customer places the order using electronic menu bar. This order is sent to the kitchen and reception using communication network. The waiter robot then transfers food from the kitchen to thecustomer.

Keywords: Waiter Robot, restaurant automation, Line following, Menu bar

I. INTRODUCTION

Robots are used to serve humanity. The branch of robotics that plays such a vital role is called "social robotics" [1] . Social robots in today's scenario are now communicating with human, interacting and relating to society in all aspect and are capable of understanding social terms [2]. Due to the modernization in robotic technologies, many new designs and mechanisms are being implemented which are able to read human thoughts and understand actions. Such robots find vast applications in assistive robotics e.g. to help out injured, sick and elder people [3]. Theses robots are adaptive, i.e. they can be used in multi-mode as per scenario [4]. So far, the robots are those who learn from us, but that time will not be so far when the teacher will then be learner. There is an ever-rising trend in using robots in restaurants for automation [5]. These robots can welcome guests, take orders, serve food to customers [6]. Designing such robots can be effective to learn advance concepts in human-robot interaction, develop new models and protocols for communication as well as use new architectures for real time path planning, guidance, and control.The significant issue looked in eateries and inns is the nature of administration given by them particularly requesting of food. Generally, it used to consume most of the time for food ordering as waiter used to note down orders, then place it in kitchen and when the food was ready the waiter used to bring the food. It additionally elaborate conventional pen and paper strategy and the cycle was tedious. It additionally elaborate a ton of wastage of paper. Thus, we have planned the smart restaurant in which the orders will be set paperless utilizing Arduino UNO, TFT.

II. DESIGN OF ROBOTWAITER

The robotic technology takes the place of manual work. In manual café systems, one can witness a lot of problems. The robot waiter is an innovation and the concept can be used for restaurant automation in various fast foodchains.

The robot waiter works as a line following robot for which four sensors are used. The project has two important parts namely the Menu Bar and the Robot itself.

a. MENUBAR

The menu bar is based on the LCD, Keypad and IR sensor. The LCD is used to display the order of menu bar, while the Keypad is used to select the order. The customer places the order

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using electronic menu bar. The order is sent to the kitchen and reception using IR sensor. The IR sensor is used for the wireless communication.

The robot waiter will work on the phenomenon of line following, we have used four IR sensors; the two sensors in the center are used for line following and set the robot waiter on line, The other two sensors installed on sides are used for table counting, i.e. if the robot count one, it means that it has stopped on the first table, and if the robot count two, the robot has stopped on the second table for 20 seconds and so on. The command to stop at the table number is sent to the robot wirelessly from the kitchen using WLAN wireless transmitter. This is because the range of WLAN is higher as compared toIR sensor.

This Block diagram explains the working of our menu bar. It has a microcontroller which receives command and work according to need. Then, the desired order will be shown on a 16x2 LCD. The microcontroller will send order to kitchen and reception through IR sensor.

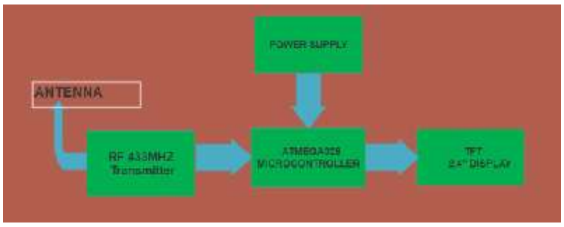

Figure 1. Block diagram of Transmitter

Figure 2.Menu Display

b. LCD Interface:

We interface the LCD with keypad so that the customer can see his order. The R/W (read/write) pin of the LCD is used to display messages. If the microcontroller sends „0" to the R/W pin then it is in "read mode" used to read charactersfrom the LCD. However, if the microcontroller sends „1" to that pin it isin "write mode". Since, the LCD is used to display the order which the customer wants, we only require write mode by displaying the order to customer when he is typing keys. The LCD has 16 columns and two rows and is monochrome display. The LCD used in menu bar is 16×2. We use only 4 pins of the LCD for data receiving. So, there is a variable resistor placed for the control of brightness of the LCD. This LCD has pins and schematic diagram are shown in Appendix-A (Figure 9).

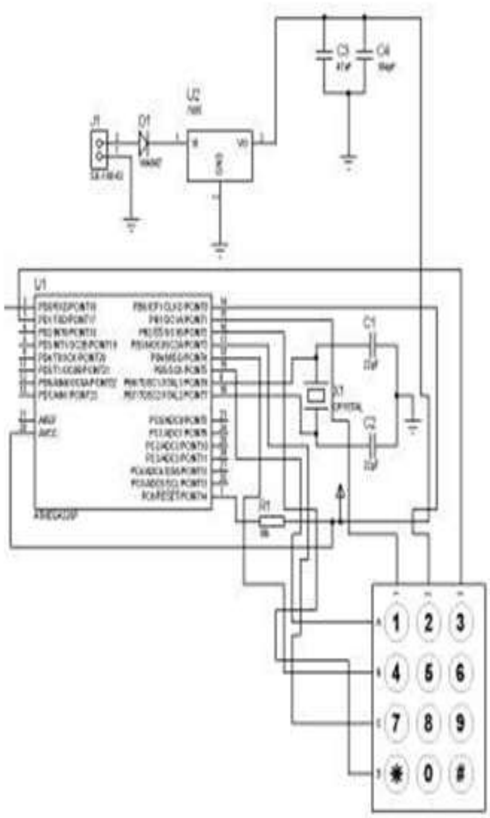

Figure 3. Schematic diagram of key-padinterface with Microcontroller

c. IR Sensor:

IR sensor used as a wireless communication device for the communication between the Reception, kitchen and Menu Bar. Ittransfersdatafromthetabletoreception & kitchen. The customer selects the order, the order transfer wirelessly via IR sensor to the kitchen.

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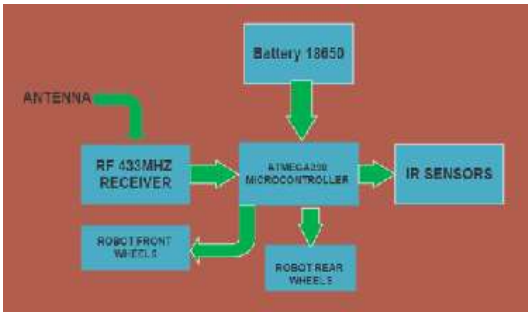


Figure 4. Block diagram of receiver

d. Voltage Regulator:

Voltage regulator provides the voltage levels according to our need as shown in Fig. 5. For this project, we require two regulators; First regulator can regulate +5V and other provides 3.3V. The +5V regulator used for the supply of a microcontroller and the second one with 3.3V regulated output is used for supply to the X-BEE module. For +5V regulator we use L298D and for 3.3V we used regulator.

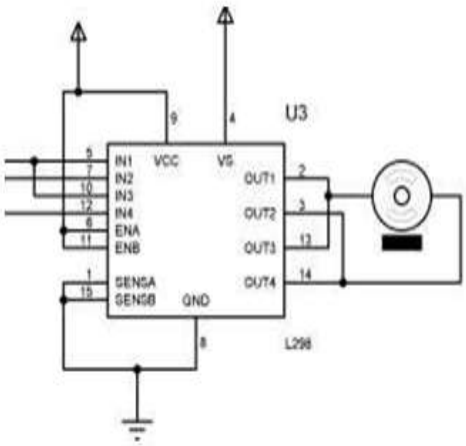


Figure 5. H-bridge Motor Driver

III. ROBOT CONTROL DESIGN

The main board block diagram of waiter robot is shown in Figure 4. When receptionist gives command through RF transmitter and main board, the robot receives that command through RF receiver and forwards it to the microcontroller (ATMEGA 328). Then, the microcontroller will drive motor through H-Bridge as per programmed instructions as shown in Fig. 5.

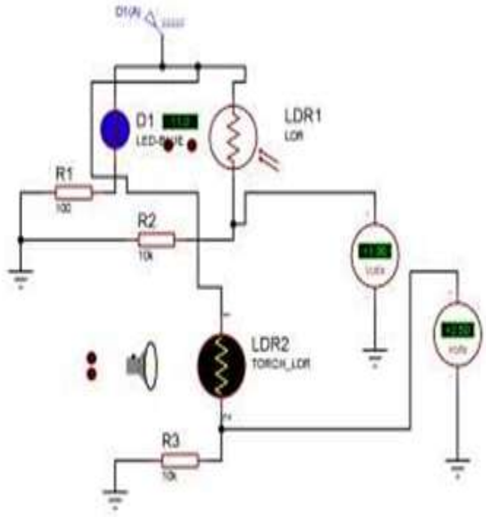


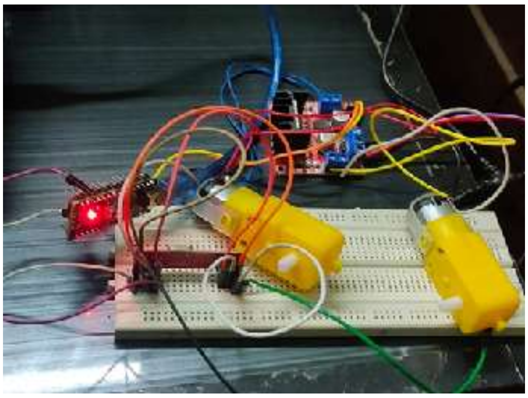
Figure 6. Line tracking sensor circuit

As seen in the block diagram of the robot, ATMEGA 328 microcontroller is managing all tasks for the motor driver as well as communication with the other sub-systems.

Fig. 6 shows the line tracking sensor circuit. The central two sensors are used for line-following and set the robot waiter on line. The two side-sensors are used for tables. If the robot counts one, it means it will stop on the first table, and if the robot counts two, the robot stops on the second table for 20 seconds. The command for table is sent to the robot via wireless link from the kitchen using wirelesstransceiver.

IV. RESULTS

The defined system was initially implemented on a smaller scale where a small robot was made and it was made to travel through different orientations of the restaurant and thus, improve the reliability of the traversal. The communication part of the system was also taken care of using IR sensor and the cash collection was made more reliable and secure. The implemented prototype of the system was tested for various constraints and loopholes but the result was quite satisfying. The robot is tested with five sample tables, and the accuracy is around 95%. The tray placing mechanism also gave astonishing results.



V. CONCLUSION

The robot waiter presented in this paper is apart of restaurant automation system. The system is found to perform well in a mock-up restaurant as demonstrated in the lab. Multiple customer tables are placed for stop-over, order placement and delivery from the kitchen. More experiments are being planned for improved performance and better human machine interface (HMI)design.

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