ISSN 2395-695X (Print)
ISSN 2395-695X (Online)
International Journal of Advanced Research in Biology Engineering Science and Technology (IJARBEST)
Vol. 2, Issue 2, February 2016

SMART SERVER BOT USING ZIGBEE TRANSCIEVER

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ABSTRACT:

This paper approaches a smart server concept which is capable of replacing a server (servant) in a hotel. We use two concepts in order to localize the spot (customer table) by the serving bot. First concept, localization is based on the wheel displacement of the bot using proximity sensor. Second method is based on the received signal strength of the ZigBee. Additionally the order (menu/item) from the customer end is sent to the server (servant) end by wireless transmission. Here the wireless transmission is achieved by using ZigBee transceiver. The input (menu/item) in the customer node is given through a keypad matrix method. An LCD display is used for menu portrayal. In our work, arduino Uno which has ATMEGA 328 is used as a microcontroller. The model is tested under various circumstances and the experimental results are obtained as expected.

INDEX TERMS*:* ZigBee module, microcontroller (ATMEGA 328), LCD (liquid crystal diode), keypad, proximity sensor.

I. INTRODUCTION

Due to development of technologies the world is partially automated. In restaurant/ hotels personal digital assistance (PDA) has been used instead of taking orders using pen and paper by a server. PDA based food ordering has its own limitations such as need of training for attendants, need of attendants to operate, lack of attendants during peak hours. In multi touchable restaurant system the limitation is that the touch screens used are costly. To overcome the above limitations android applications were used. In android based system the food ordering is done wirelessly using technologies such as Bluetooth, Wi-Fi etc. But the android based system has its own limitations such as limited distance; system may not work efficiently/properly if smart phone /tablet suffer a defect. And also it may be a drawback if the end users (customers) are not able to use the smart phone devices. Countries such as Japan uses rotating conveyor belt system attached in a round table for delivering the ordered dishes to the customers in a sequential manner. But the above system is very costly and the orders from the customers are taken by conventional pen and paper method.

II. PROPOSED WORK

We proposed an idea, which is the integration of wireless food ordering system and automatic food serving bot system. Here ZigBee is used for wireless transmission of data from the customer end to the server end (chef node/room). In our project we use Zigbee because it is an open, global, packet based protocol designed to provide an easy to use architecture for security, reliability and low power applications. Zigbee can be used in the range of distance (10-100) meters. It has a bit rate of (20-250) kbps.

In this project we use a bit rate of 250 kbps. The frequency band of ZigBee transmission is (868MHz-2.4GHz). In our work we use a frequency of 2.4 GHz for transmission of data from customer node to server node and vice versa

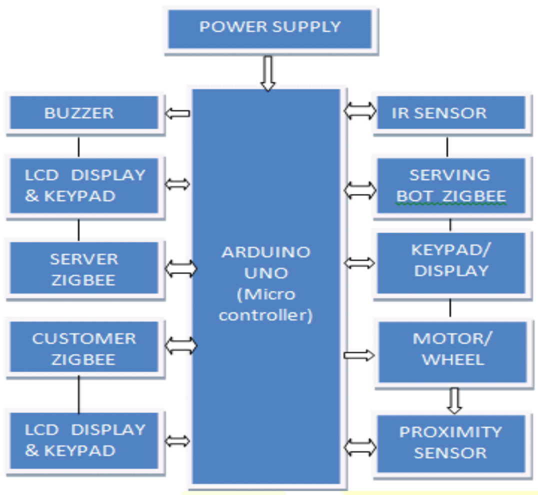

Fig.1. system block diagram

The ZigBee in the serving bot tracks the received signal strength of the customer end ZigBee for localization of the specified customer node for serving the ordered dishes/items. It also uses wheel displacement of the bot for localization of the specified customer node. The system block diagram of the smart server bot is shown in the above figure. Our project has three nodes (modules) that are connected wirelessly. The wireless data transmission is done between the ZigBee modules in each node. The customers place their order through the customer node available in their tables. The data entered is sent to the server node available at the kitchen through ZigBee communication. The chef places the ordered items in the serving bot and presses the key in the serving bot so that the bot reaches the destination. After serving the dishes to the customer table, the bot returns back to its original position when the customer press the enter key in the bot. The detailed description of each node is given below.

III. CUSTOMER NODE

This node will be available in each customer table and enables the customer to order their items. This node consists of a keypad, microcontroller, LCD display and a ZigBee module. The microcontroller is programmed in such a way that the items and its price are displayed in the LCD display.

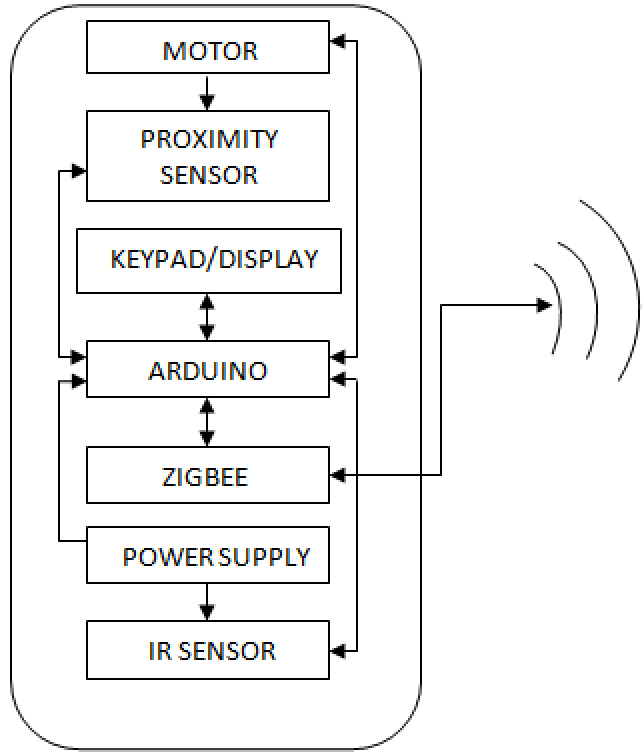

Fig.2. Customer node block

The customer can select the items and required quantity displayed in the LCD display through the keypad. The ordered items are sent to the server node after pressing the enter key in the keypad.

IV. SERVER NODE

This node will be available in the kitchen and displays the dishes ordered by the customer along with their table number. This node consists of LCD display, ZigBee module, keypad, microcontroller and buzzer. The LCD displays the ordered item and the quantity. When the data is received by the ZigBee in the server node module, the buzzer is turned on. The buzzer sound indicates that the new menu has been ordered by the customer.

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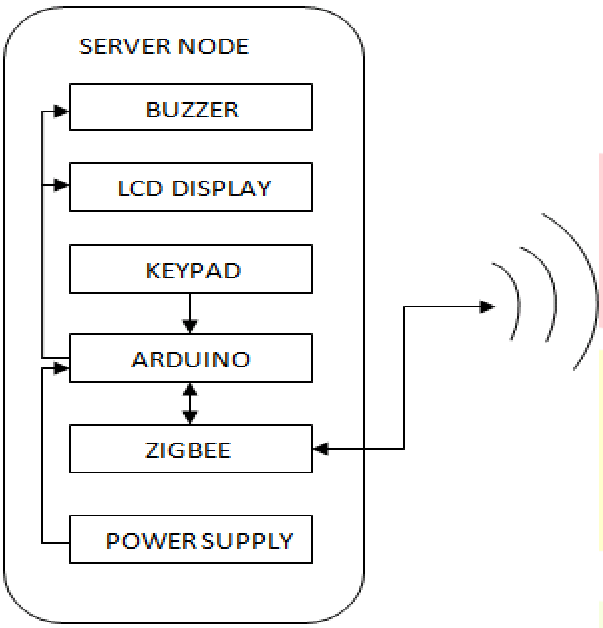

Fig.3. Server node block

SERVING BOT:

The serving bot is used to serve dishes ordered by the customer. This node consists of LCD display, ZigBee module, keypad, IR sensor, proximity sensor, motors and microcontroller.

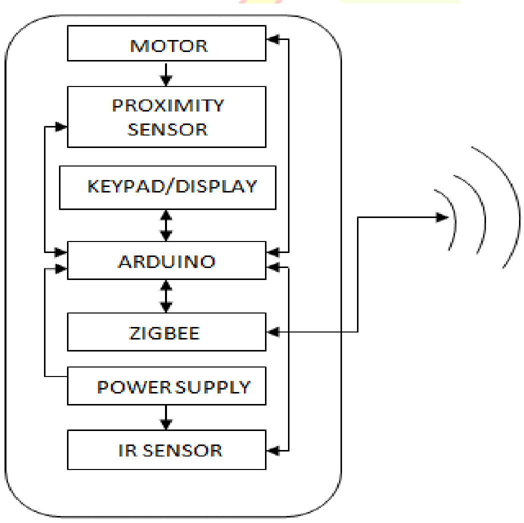

Fig.4. Serving Bot Module

The LCD display portrays the table number and it also displays the wheel count. Two 60 Rpm motors are used to drive the bot.

Initially, the chef places the dishes on the bot and sets the destination by pressing the table number on the keypad. The bot on receiving the command (destined table number) starts moving and reaches the customer table. The destination is reached exactly by the bot using its wheel displacement and received signal strength of the ZigBee. A piece of metal fixed in the wheel of the bot is detected by a proximity sensor, which is used to determine the number of rotations of the wheel. Thus the bot moves according to the wheel rotation and tracks the distance of the destined location as programmed.

VI. FUNCTION FLOW

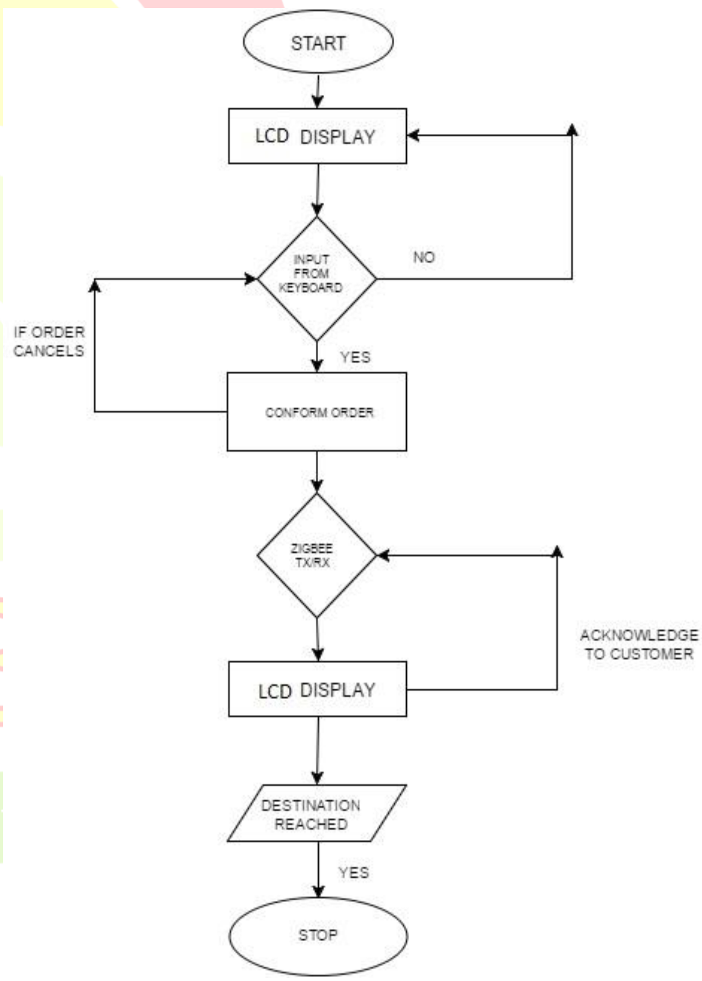

Fig.5. flow diagram

The flow chart of operation involved in the proposed system is shown in the above figure. The customer node LCD display portrays the available menu. As the customer chooses the item from the available menu and selects the quantity, the data is

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sent to the server located in the kitchen with an alert sound. After receiving the data, the server sends an acknowledgement to the destined customer table. The chef places the ordered items on the bot and presses the destined table number. Then the bot automatically moves to the destined customer table according to the instructions defined in the arduino program. The customer after taking the items from the bot presses the enter key so that the bot returns to its original position as programmed.

VII. RSSI ALGORITHM

The Received signal strength indicator features are pre-stored in a database and are retrieved with comparison to spot the user's position. Using RSSI, the blind node continuously sends the requests to its nearby reference nodes and receives responses from those reference nodes. The method, which can locate a mobile object by using three reference nodes without pre-determined database, is named as Real Time Tracking. The Real time tracking System can convert the RSSI value to a corresponding distance by using appropriate formulas. Trilateration method is used to determine the position of an object based on signal range measurements from at least three reference nodes at known location. Trilateration requires at least three reference nodes with coordinates (x_i, y_i) and d_p^i is the distance between the blind node and the fixed reference nodes. The targeted position/spot *P (Xp, Yp)* can be obtained by MMSE. The difference between actual and estimated distance is defined by formula where *I* is a reference position and *p* is a mobile object. A blind node refers to a moving object (serving bot) and the reference node is a fixed node that responds its RSSI in order to spot the blind node. In our work, the blind node as well as the reference node is ZigBee modules.

$$d_p^i = \sqrt{(x_i - x_p)^2 + (y_i - y_p)^2}$$

The proposed algorithm for closer tracking (CTA) was designed in order to enhance robotic applications. This tracking is carried out by the following four steps.

Step1:

[Build Neighbour List]

The blind node (the mobile object) periodically receives RSSI from its neighbour nodes by broadcasting its requests. The neighbour nodes will be recorded by comparing their RSSIs with the pre-defined threshold values. That means, if the RSSI of the neighbour is within the *threshold* at *distance d*, the neighbour will be stored into the *Closer List.*

Step2:

[Tracks the desired node]

As the zigbee stack is configured with its own table number, the blind node (bot) tracks the RSSI value of the specific zigbee as programmed. This tracking starts as soon as the server presses the table number in the serving bot.

Step3:

[Approximately Closer Approach]

The ZigBee in the bot keeps tracking the RSSI value of the destined ZigBee placed on the table. And its compares the RSSI value with the destined zigbee's RSSI value. The bot keeps moving until the threshold value of the customer node (destined table) is reached. As both the receiving RSSI value and its threshold value is equal then the bot has reached the exact position as expected.

VIII. RESULT

The smart server bot prototype is shown in the below figures.

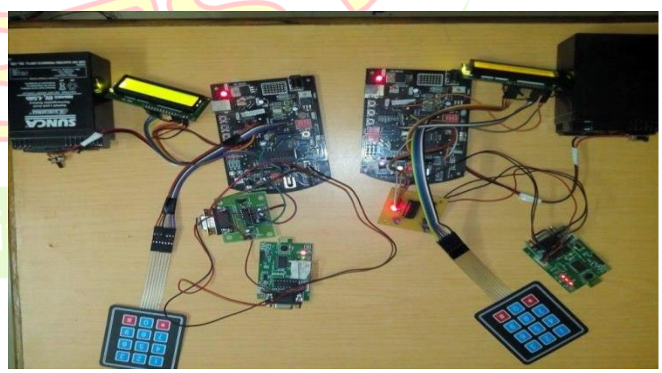

Fig.6. customer nodes

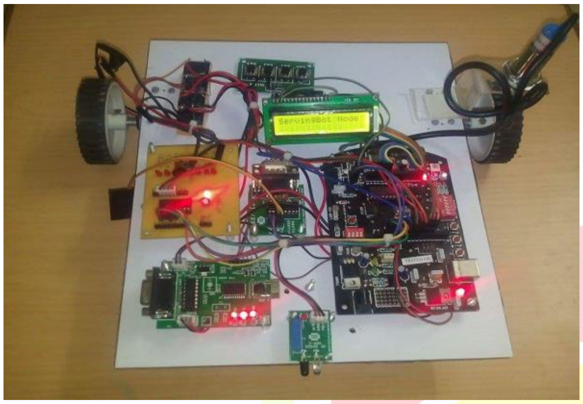

Fig.7. Serving bot

Fig.8. customer node display

The below LCD display is the portrayal of menu in the customer table.

IX. CONCLUSION

Efforts have been made to design this system which will overcome the drawbacks of the above mentioned systems. The system has been tested for two customer tables. As a result of testing, the data are transmitted from customer end module to the server end module and the spot is localized by the serving bot as expected.

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