Using LEGO NXT with Mobile Device Applications to Achieve Automatic System

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Abstract. Mobile apps have been popular in recent years. The mobile app combined with the automation system has become familiar this day. The paper presents the implementation of LEGO blocks, the panel NXT, and control (NXT 2.1 Programming) program. In addition, we also used the collocation of Zigbee wireless network protocols and VB (Visual basic) program, Bluetooth wireless transmission and mobile apps Android App. The principle of operation is the dining system by PID infrared light sensors which detect the black line and right along with the black line. Then confirm the meals and location table number and meals guests' mobile phone APP program by points through the RGB sensor. Reuse and flexible robotic arm to take dining tray, and correct dining of the guest's table number. After the last guests leave the table to go to the robot arm picks up run out utensils.

Keywords: FIG Control Program, PID light sensor, RGB sensor, Wireless internet protocol ZigBee, Visual Studio Program.

1. Introduction

The changing technology, modern science, and technology products have influenced our daily life, for example, robots are used to support our activities. The robots in recent years have become a very valuable research science and technology. For manufacturing side, the robot will help people to reduce the burden of a lot of human resources and continuously improve work efficiency. At present, most of the robot applications tend to medical, automotive, aviation, industrial and so on. In this research, the robot was implemented in the restaurant industry. The application of the robot is more creative and diversified.

Diet in life cannot be missing, the China ancients said:「people regard food as their prime want」, time is very precious to mankind, but also in order to reduce the cost of expenditure, so with the creative ideas, hoping for the busy modern society more favorable savings to the time, labor costs. The idea can be less manpower to achieve the desired purpose. The Guests just come to the restaurant and order the seat position to a receptionist and download mobile phone APP program. The android application program is not only for ordering the meal or calculating the price but also can be used by the guest to give a sign that the meal already delivered. After all ordering stage, the robot will deliver meals to the guest's table, as shown in Fig. 1, when to check out, as long as the table number, LCD will show the amount.
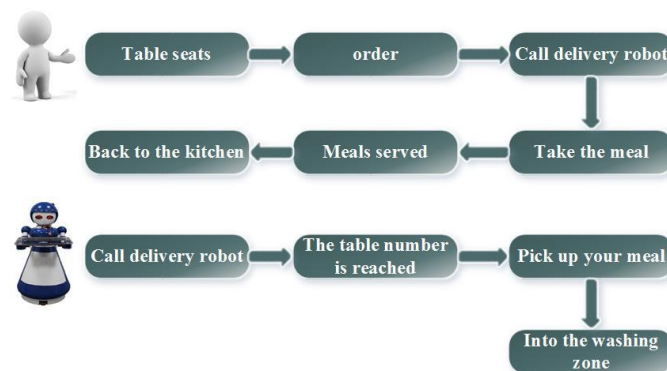

Fig. 1: Production flow chart

2. Research Methods And Procedures

The LEGO NXT-G map control program technology, wireless transmission controls a variety of sensors, mobile device applications was implemented in the restaurant industry. Simulate a restaurant-related scenario, planning meal dining route, customize the meal dining stop spot, set the mechanical parameters of the pawl taking the meal was the designed step. The ZigBee Wireless Network Protocol, VB(Visual Studio) program, Bluetooth wireless transmission, mobile phone APP(Android) supported this system. And finally, all system will be presented in a pictorial manner. [1]

2.1. System Flow

Assumed that there are 2 meals (A and B meals, respectively) and three tables for the seats (Ｔ1、Ｔ2、Ｔ3) in the restaurant. As well as the customer checkout counter the robot will clean up the table. There is a monitor at the kitchen and the counter.

The customer entered the dining room first and chose a table seat to sit down. And then use mobile phone APP program to select the meal and order. At this time, the phone APP program calls the robot.

Meals are taken from the kitchen and sent to the table where the guests are located by the robot. Then the robot will return to the original position waiting for the next customer's call.

When finished the meal, the guest use the APP program to call the dining car to clean up the plate, this article will be sent to the dining car to reach the guests call the table number to do the clean-up action. Picking up the plate was done by the improved multi Lego robot arm which can be accurate to clean up the meal plate to the dining car, after the dining car return to the washing area, it will back to the original position waiting for the next guest to call.

2.2. LEGO NXT Host

Bonding parts can be selected in according to the needs of different parts to assemble blocks, but mainly used in Technic building blocks. Also in the power parts include a variety of length of the transmission shaft, gear and pulleys, can be used with the motor. The NXT main unit is included in the electronics and the electric motor. There are a variety of sensors, like touch, light, sound, ultrasound, angle, color, gyro, magnetic force, vector, acceleration, temperature and photographic lens as shown in Fig. 2 and Table. 1 [2]

Table 1: NXT host connection

Fig.2: NXT host

Port A	Drive the left wheel motor
Port B	Drive the right wheel motor
Port C	Control the paw
Port 1	NXTLineLeader sensor
Port 2	RGB 2, the right side of the body (Ｔ1)～(Ｔ3)
Port 3	RGB 1, the left side of the body (A, B meal)

2.3. PID Control Parameters

The proportion of unit P, integral unit I and differential unit D composition is the PID Method that was used in this system. Through the Kp, Ki and Kd three parameters set, basically, it is mainly applied to linearity, and the dynamic characteristic without change the time, the PID controller is a feedback loop component [3]. The input value can be adjusted according to the historical data and the occurrence rate of error to make the system more accurate and stable. The other can be used to control any variable that can be measured and can be manipulated, for example, control temperature, flow, speed and so on. [4]

The constant Kp is the corrected current error, Ki is the error value for correcting the past average and Kd is the prediction correction error [5]. Setpoint：45；Power：90；Ｂx3÷4, measured 1 results are too sensitive, turn the flow does not flow along the results of the line 2 correction, Smooth turn (the current value of the best tour), As shown in Fig. 3.
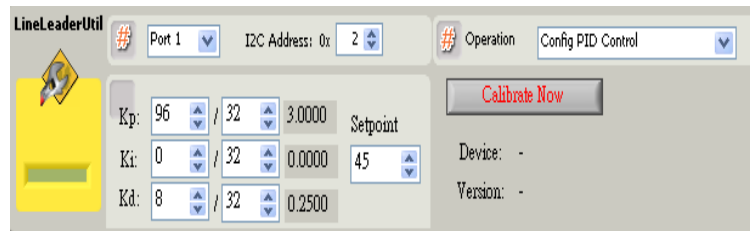
Fig. 3: Control the measured value

2.4. ZigBee Wireless Transmission

Zigbee Wireless Transmission is an open IEEE 802.15.4 protocol which has a low power consumption, low transmission rate (250kbps), short distance (Usually about 50-100m, depending on the power consumption of different, can be raised to 300m) and simple structure of the technology. ZigBee supports master-slave or point-to-point operation. 255 devices can be connected at the same time with high scalability. ZigBee mainly used in home automation, environmental safety, and control, as well as personal medical care and other functions, has gradually become the industry's common short-range wireless communication technology. [6]

This system used ZigBeeCC2530 type. The circuit used in the receiver (Kit) and the sender (Tag), the main function is to order meal amount. If no one at the table, do not need supplements, this information spread to our receiving end.

2.5. APP Mobile Phone Program

First, the customer came into the restaurant using the table drawer mobile phone APP program to choose the favorite meal, at this point the phone APP program will call dining car. The dining car will move to the kitchen to take meals and determine the guest's table number after the dining car will automatically return to the set of the origin waiting for the next guest's call. When the guest finished their the meal, and then use the phone call dining car to clean up the plate. The dining car will accurately arrive at the table number of the table which the guest calls. After that, the dining car again set the origin, waiting for the next guest to call. According to the different table number, mobile phone APP pattern into the screen will not follow the same as shown in Fig. 4.

Fig. 4: Mobile phone APP interface and APP pattern

2.6. RGB Color Control

A, B dining body on the left side of the RGB 1 (Port 3) to detect the value after the implementation of color blocks to take meal action, T1~T3 right side of the body for the RGB 2 (Port2) detection site color, the start meal delivery action, RGB2 (Port2) to detect the site color, began to clean up the meal, As shown in Table. 2. [7]

Table 2: RGB and facility correspondence table

NXT-G / APP	The table number corresponds to the name	RGB1 (On the left) pick up	RGB2 (On the right) Send and pack	RGB1 (On the left) Stop point of washing
The first table	T1A	R	R	B
	T1B	G	R	B
The second table	T2A	R	G	B
	T2B	G	G	B
The third table	T3A	R	B	B
	T3B	G	B	B

3. NXT-G Program Design

This section is mainly to allow dining cars to determine their own meals seats and tables, using the map-control program in the host car with RGB sensors, wireless transmission protocol, Bluetooth to complete, the overall program of the system are shown in Fig. 5.
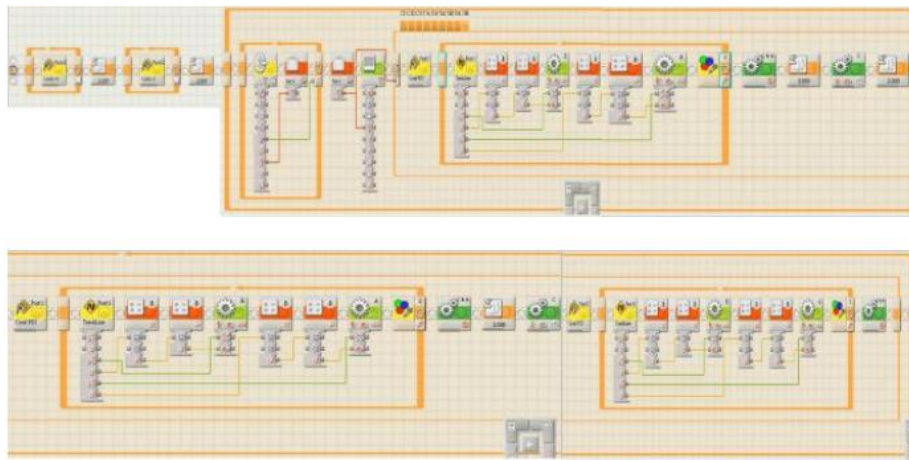
Fig. 5: NXT-G map control master program

3.1. Calibration

This article is in accordance with the dining car we set up the black line walking, so it is necessary to let the dining car can follow the black line, patrol track forward must let the dining car know he is going to take part of the black line. Therefore, we need to correct, the dining car patrol program.

3.2. Bluetooth

When the calibration is complete, it will begin to enter the system's total map control program infinite loop, to wait for Bluetooth to receive the signal, to send food car can receive Bluetooth signals also need to write programs to control[8], the loop Text1 has logical judgment, numerical operation, non-logical non-operational options, we are in the dining car system is the choice of non-logical non-computing this one, there are two Text1 tiles, in the loop is written action, in the loop is read outside the action, writing means that the received message is temporarily stored in Text1, judgment is correct after reading the Text1 message.

3.3. The Tag Number

And then the control signal whether there is in the label set by the program, and perform actions, Because each table with the changes in the order there are many, so it needs to be numbered, set the first table of the A meal, our tag number is set to T1A, the second table B meal, set to T2B, the third table presses to clean up the plate; for the T3C ... and so on, so the system set the number of total T1A, T1B, CT1, T2A, T2B, CT2, T3A, T3B, CT3, so the Bluetooth signal received by the system does not set the number, then there will be no action.

Bluetooth received the signal and the label corresponds to the words, this article will be the implementation of the dining car in the label of the action, each set of labels contains three groups of tracing systems. There are trajectories to go to the kitchen, to achieve the number of guests' table meal delivery

trajectory, to return to the original point of the standby trajectory, CT1, CT2, CT3. These three groups of labels only two groups of trajectory. One of the groups is directly to the guest's table number to clean up the tableware. The second group will return to the washing area (the original point) to do on standby. The trajectory control program section is the same. The difference is only between the RGB color block judgment and the motor set value.

4. Research Result And Conclusion

As shown in Figure. 6 can be seen in this paper, automatic dining car system simulation of the site, the most important are the host of the dining car. The Automated dining car is running around the wheel of one. The Line Leader sensor allows the delivery car to follow the black line and to let the dining car know where to stop the RGB sensor. Finally, let the left and right wheels and claw rotation motor angle sensor shown in Fig. 6.

Fig. 6: The entity of the dining car and site simulation

There are a number of restaurants within countries already in around the world. One after another began to use the RFID point meal to run their own restaurant. But most of the restaurant is still the traditional hand-paper way to order meals. This system is more suitable for use in larger restaurants or with more people in the peak meal time because the above two conditions need to spend more manpower and time to serve the guests. However, as it often overlooked the needs of some guests.

In future, The NXT automatic delivery dining car system with RFID Internet of things environment will commonly use in the restaurants. We will order the part of the meal in the phone app. In this system, we can tell the counter through the mobile phone APP number of customers in the current table, also know what kind of meal points, the number, this will not only enhance the restaurant operating efficiency and service quality but also through the system to achieve rapidly. Besides, this system also increases the creativity and reduces the cost of the restaurant. The system of mobility, portability for the restaurant brings great convenience.

5. References

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