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Arduino-Based Robot Car for Returning Food Orders

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Abstract: This paper describes several Bluetooth innovative features, mobile and robot components, and to control a robot using a mobile phone through a wireless connection. To manage the motions of the car in small restaurants and minimize face-to-face interaction between customers and diners. This project also focused on creating and controlling remote control cars utilizing Arduino UNO, Bluetooth and smartphones. The purpose of this paper is to design the robot car that will deliver back orders to kitchens in restaurants in the range of 20 meters to 30 meters by implementing a smartphone as a medium to control the movement of the car by designing an Android Remote Control Bluetooth car application using MIT App Inventor Bluetooth connection. The connection range of the Bluetooth is recorded and tabulated so that the optimum distance reached by the Bluetooth car and the average speed of the Bluetooth car can be obtained by taking the average of the trials. The result is then plotted using Microsoft Excel to analyze the performance pattern of the graph obtained. From the collected data, the maximum distance reached by the Bluetooth to be controlled is 29.45 meters with 25.35 seconds taken to reach the distance. The average distance and average speed of the Bluetooth car are calculated using a mathematical method which are 28.48 meters and 1.16 m/s respectively. In conclusion, this RC Bluetooth car is practically safe and applicable to be used in a small restaurant since the Bluetooth coverage range is reachable and the speed of the car is considered as the normal speed with no load.

Keywords: Wireless, Android, Bluetooth, Arduino UNO

1. Introduction

"Social robotics" is the branch of robotics that plays such an important role [1]. In the current situation, social robots can converse with humans, engage and engage with all aspects of society, and understand social terminology [2]. Many novel designs and processes are being introduced as a result of advances in robotic technology that can read the human mind and interpret actions. Assistive robotics, for example, uses these types of robots to help injured, sick, and elderly people [3]. Several systems have been created in order to apply the usage of robots in real life. For example, the one created in [4]

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necessitates the use of many types of sensors such as infrared sensors, ultrasonic sensors, and gyroscope accelerometers to avoid obstacles and serve food securely.

There has been a lot of study done on service robots and their possible use in restaurant automation. A line follower service robot is equipped with sensors that detect the black line and identify impediments [5]. This is a single robot system in which the robot serves the customer after the table switch is activated. The orders are sent by an RF transceiver, and the robot is ordered once the meal is ready. IoT (Internet of Things)-based product in which various types of equipment were connected to communicate with each other based on programming, avoiding human errors within expectations and demands [6].

This paper highlights a Bluetooth-controlled robotic car that runs an Android application. The primary aim of this approach is to use an Android application to operate a car. Arduino UNO (ATMEGA 328P) and a Bluetooth module (HC-06) are primarily used in this project. It is compulsory to install the Bluetooth module to the system so that a mobile application may simply operate it. The project's goal is to design a robot that can be controlled by an Android smartphone. The Android smartphone in this project serves as a remote control to operate the robot.

2. Materials and Methods

The following hardware used in this project included Microcontroller Arduino UNO, Bluetooth Module HC-06 and motor driver L298N. This project used its own apps which is designed using MIT App Inventor and to create the interface of the apps and also the arrangement of the control buttons accordingly in manner. MIT App Inventor not required any specific coding to start building any apps compared to Android Developer software.

The system block diagram is shown in Figure 1. The required voltage to operate the Arduino UNO is 6V until 20V maximum and in this project, the minimum voltage required is 7.4V needed for the system to operate. The DC power supply is used to send electrical signals to the microcontroller and the Bluetooth module HC-06. The Bluetooth module receives the signal sent by an Android smartphone which used in this project is VIVO Y12 and the microcontroller interprets the instruction to be sent again to the Bluetooth module. The movement and operation of the motor depend on the command received from the Android smartphone and send the signal to the motor driver L298N to operate the DC motor.

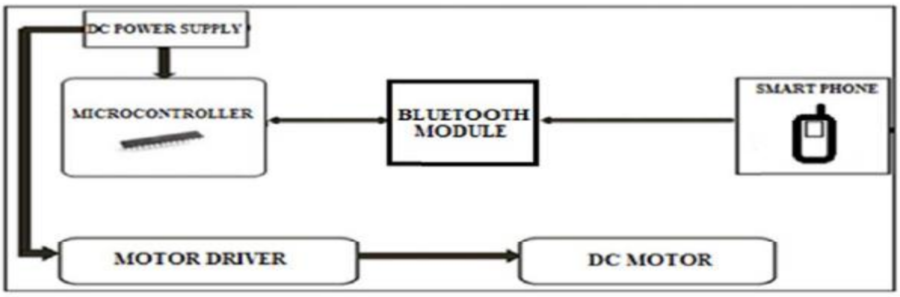

Figure 1: Block diagram of the system

Figure 2 shows the process flow of the system. The project starts with the user opening a Bluetooth connection to connect with the HC-06 Bluetooth module. The pin ‘1234’ is entered which is provided by the manufacturer to enable the connection with the smartphone. The designed app is downloaded and installed on the user’s phone and opened. The interface of the apps will show the Bluetooth logo which the user needs to click on and pair with the device. The code is transferred into the Arduino UNO by uploading it from the laptop. After the uploading process, the user can use the apps to control the movement of the Bluetooth car.

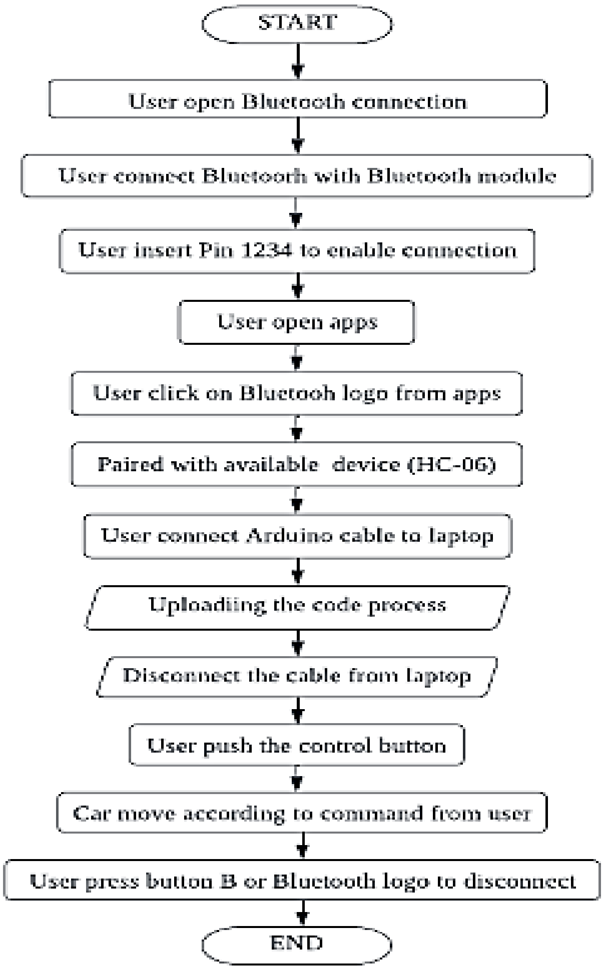

Figure 2: Process flow of the system

Figure 3 shows the designed control button of the apps using MIT App Inventor. The app interface is divided into three parts are left part which included the control of the movement of the car forward, backward, left or right. On the right part is the button to stop the movement of the car instantly while in the middle part is the Bluetooth logo which the user can click to make a connection with the connected device. It also displayed the available device when clicked. In building the app, the Bluetooth client is necessary to be included to connect the device to other devices using Bluetooth. This component uses the Serial Port Profile for communication. It also included an activity starter which is the component that can launch an activity using the StartActivity method.

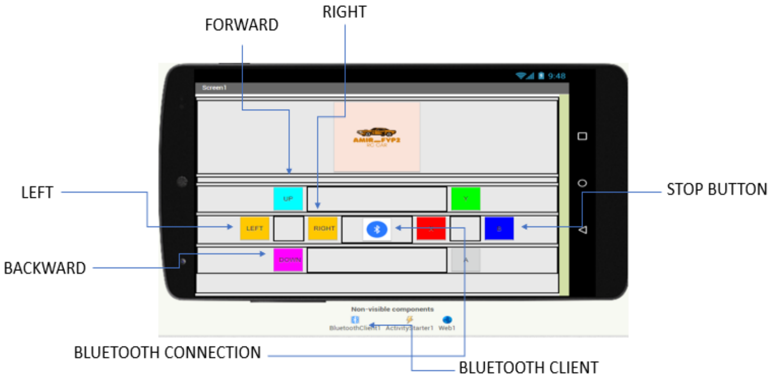

Figure 3: Process flow of the system

In this paper, the distance reachable by the car is measured using Apps from a smartphone while the speed and the average speed of the RC Bluetooth car are calculated using the equation as stated. The measurement is repeated for five times to ensure the accuracy of the distance. The measuring process is needed in order to know the reachable distance for the car to be controlled. At the same time, the speed and the average speed also can be obtained using Eq. 1 and Eq. 2 [9] to know the average weight of food that the car can carry. The weight of the car is estimated in the range of 350 grams to 400 grams which is able to carry one plate of Nasi Lemak (187 grams) and a glass of water. The area of the Bluetooth car measured is 40.96 m^2 which is wide enough to carry a set of foods with a drink. According to the measured data, it is found that the maximum distance the Bluetooth RC car can reach is 29.45 meters and the optimum distance achieved is 94.9% accuracy to the standard distance which is 30 meters and the average weight of food it can carry is legit.

$$speed = \frac{distance\ (m)}{time\ (s)} \quad Eq.1$$

$$average\ speed = \frac{\Delta\ distance(m)}{\Delta\ time(s)} \quad Eq.2$$

3. Results and Discussion

In this paper, there are two main components that contribute to the whole system to function. The main coding of the movements of the car which is programmed using Arduino IDE software and also MIT app inventor is used for designing the apps and the control buttons. Figure 4 shows the measured distance for 28.56 meters and 27.82 meters based on the tabulated data record. The results obtained throughout this study are also analyzed and explained in this section. The speed of the RC Bluetooth car is obtained and measured using a mathematical approach such as in Eq. 1 and Eq. 2 by measuring the distance reached by the car and the time taken to reach the distance. The data obtained is tabulated in the table and the graph is plotted in the Microsoft Excel. The data is analyzed to observed the performance of the project.

(a) **(b)**

Figure 4: (a) Coding of the movement; (b) Design of control buttons

Table 1 shows the measurement data of distance, time and speed of the car. The analysis is necessary to know the average speed of the car in order to return food orders in a restaurant. From Table 1, it is found that the maximum distance that the Bluetooth RC car can reach is 29.45 meters, which is almost exactly the actual distance, which is 30 meters. The optimum distance was achieved with an accuracy of 94.9% of the standard distance. The time it takes the car to reach the distance is increased linearly with increasing distance. The speed of the car can be analyzed as an uneven pattern due to the surface condition tested is on the road.

Table 1: Measurement data of distance, time and speed of the car

Number of trials	Distance (m)	Time (s)	Speed (m/s)
1	27.82	23.74	1.17
2	27.91	23.91	1.17
3	28.56	24.56	1.16
4	28.66	24.65	1.16
5	29.45	25.35	1.16

The graph of the data collected is plotted as shown in Figure 5. It can be observed that the speed of the car is 1.17 m/s between 23.74 and 23.91 seconds before gradually decreasing to 1.16 m/s between 24.56 and 25.35 seconds. The decrease in speed happened because the charge capacity of the DC power source is diminishing with time. The distance versus time graph compares the standard distance that the RC car can reach and the tested distance by obtaining the average distance reading five times. The transmission distance of the automobile also indicates that the distance of the car controlled in range is less than 30 meters.

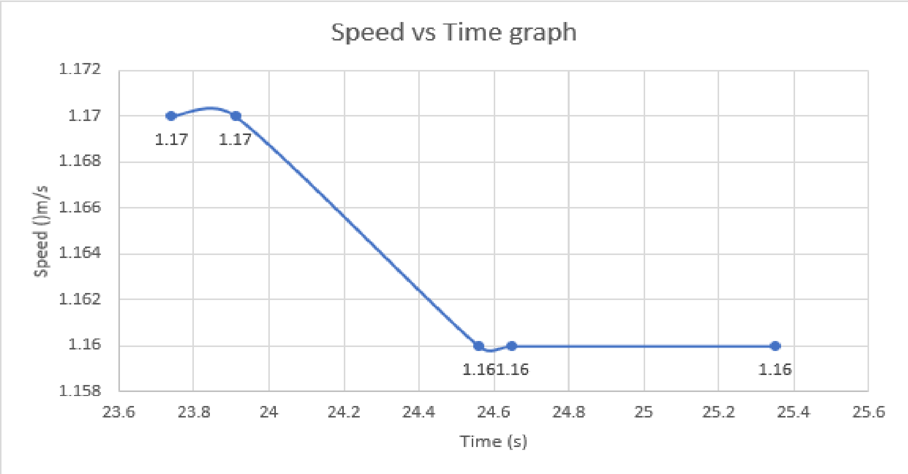

Figure 5: Graph representation for the Speed over Time

4. Conclusion

Overall, in this project, the RC Bluetooth car is successfully constructed and the designed control apps are also functioning in terms of communication between devices. Based on the analysis showed in in the data and the graph shows that this project is capable to implement in small restaurants. As the RC Bluetooth car is tested with no load and the obtained measured average speed is slowed down noticeably due to the power consumption and the condition of the tested area is not smooth. Even though the optimum distance measured is near to the standard distance, the project still can be improved by collecting more data to ensure the potential of the project in order to produce high accuracy of the data.

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