

Controlling the Line Follower Delivery Robot with MIT APP Inventor

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Abstract

The Line follower robot is an autonomous robot that can detect and follow the line drawn on the floor using infrared sensor modules. Generally, the line follower robot detects a visible black line on the white surface. The delivery robot is an autonomous robot used for delivering items such as documents, foods, and the like. So, the line follower delivery robot is a robot that can deliver items and run on a path by detecting black line on white surface using infrared sensor. MIT App Inventor is a web service for creating mobile application for smartphones. It is easy for users who have little or have no previous programming experiences to create mobile applications using a visual block language. This paper presents controlling line follower delivery robot by using a smartphone. The researchers designed the line follower delivery robot and mobile application by using MIT App Inventor. The Bluetooth was used to connect between the smartphone and the microcontroller to control the line follower delivery robot. Manual and automatic control, speed performance of the robot's delivery and load capacity are described in this paper.

Keywords: Line follower robot, delivery robot, MIT App inventor

1. Introduction

Robots are electromechanical machines that have the ability to perform tasks or actions using electronics programming (Pakdaman & Sanaatiyan, 2009). The Line follower robot is an autonomous robot that detects and follows a visible line drawn on the floor. For the basic operation of the line follower robot, infrared sensors detect black color that has no reflection (Hasan & AI-Nahid, 2012; Transport Protocols, 2012; Engin & Engin, 2012; Binugroho & Pratama, 2015). Infrared sensors send data to a microcontroller to control speed and rotation direction of DC-motors of the robot. The follower robot can automatically go forward, turn left, turn right and stop by using input data from infrared sensors (Yun and Seo, 2015). The concept of the line follower robot is developed as a delivery robot (Engin & Engin, 2018). MIT App inventor is a tool to create mobile application for smartphones and tablets that are used by the Android operating system (Phung & Tran 2016).

An App Inventor project consists of a set of program blocks and components. Some components include visible items on the smartphone screen such as buttons, text boxes and images. Some components include non-visible items such as database, speech recognizers, GPS location sensors. MIT app Inventor is a web application designed with the use of a visual blocks-based programming framework instead of code programming. It

is relatively easy for users who have no experience about programming (Bati & Zonouz, 2015). This paper is divided into six parts. Part 1 presents an introduction. Part 2 describes a conceptual design of the line follower delivery robot. Part 3 gives information on control and hardware and Part 4 reports designing mobile application by MIT App Inventor for manual control and automatic control by using MIT App Inventor. Part 5 reports the experiment and its results on performance of the delivery robot on several paths. Increased weight was used in the experiment to test load capacity and speed. Part 6 concludes the experiment and results on performance of the delivery robot and recommends future research.

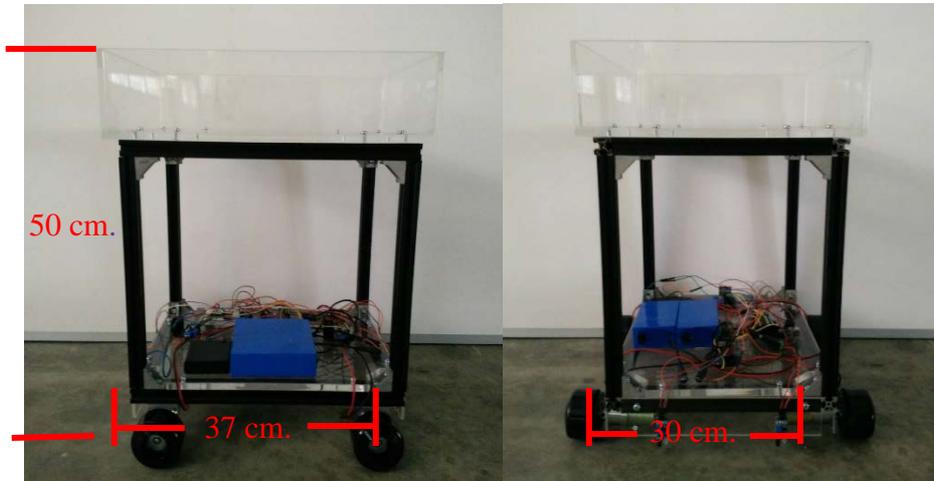
2. Conceptual Design of the Line Follower Delivery Robot

The design of the line follower delivery robot consists of four wheels and 2 layers. The first layer is designed to install a microcontroller, motor drivers, and a Bluetooth module. The second layer is designed to install a box to put items on as shown in Figure 1. The structure of the layers is made of acrylic. An aluminum profile is used to create a frame of the robot. Its total height is 50 centimeters, total length 37 centimeters and total width 30 centimeters. Figure 2 shows the size of the line follower delivery robot.

Figure 1: The Line Follower Delivery Robot



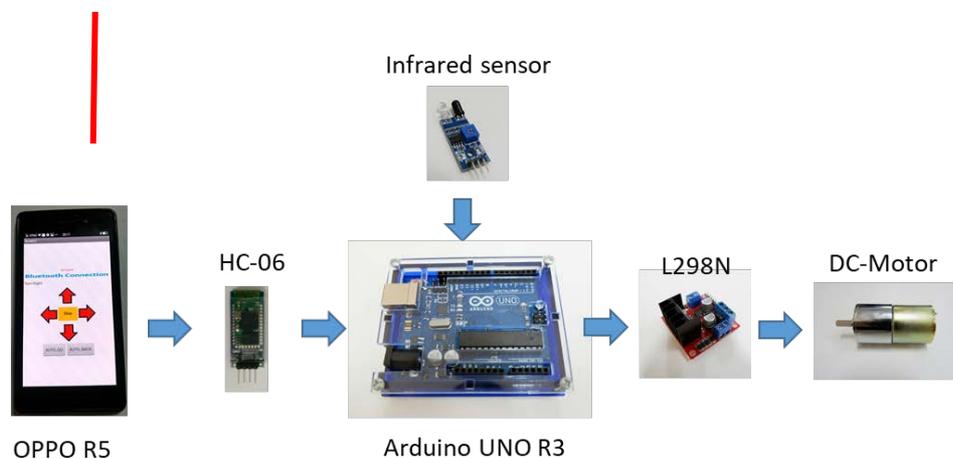
Figure 2: Size of the Line Follower Delivery Robot



3. Control hardware and actuators

The control system consists of the Arduino UNO controller board. A total of 4 motors are of 12V DC-Motor. A total of 2 motor drivers are of L298N. Each L298N motor driver controls speed and rotation direction of 2 DC-Motors. The input sensors are a 4-infrared-sensor module. A 2-Infrared-sensor module is attached on the front side. A 2-Infrared-sensor module is attached on the back side. The Infrared Sensor Module is used to detect line for turning left or right. Bluetooth used in this research is HC-06. The smartphone used in this research is the OPPO R5. For basic control, OPPO R5 sends signal to the HC-06 Bluetooth device connected with Arduino UNO controller board; the Arduino UNO controller board sends data to the motor driver L298N to control DC motors. Infrared sensors are connected with the Arduino UNO controller board as input data for automatic control. Figure 3 shows basic concept control of this research.

Figure 3: Basic Control of Research

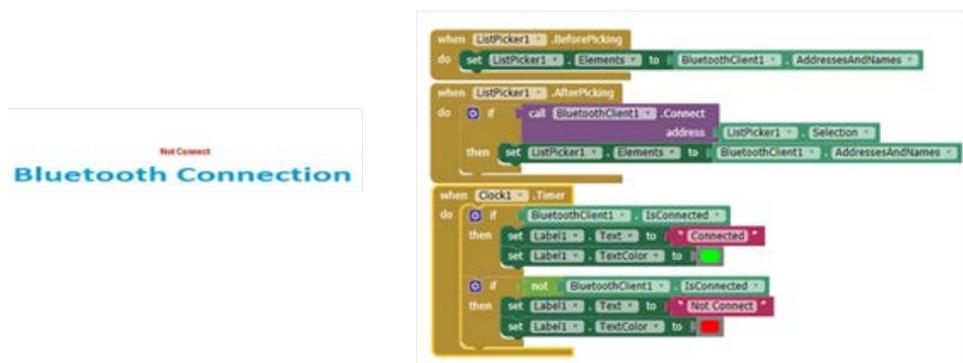


4. MIT App Inventor

The researchers designed mobile application using MIT App inventor to install on the Smartphone. The researchers designed mobile application in 3 parts.

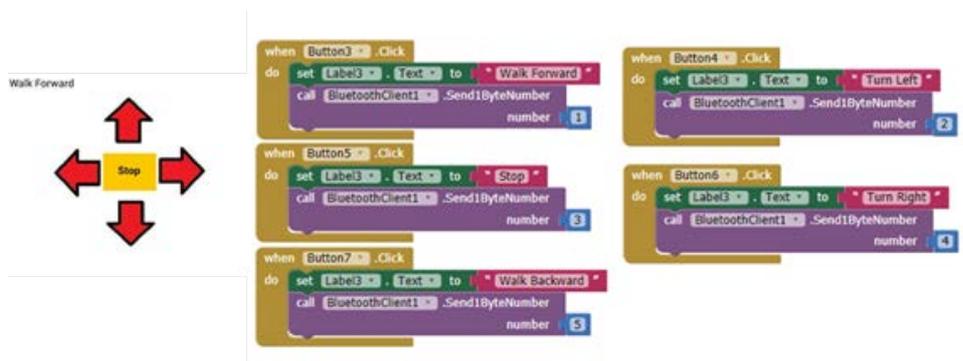
Part 1: Bluetooth connection active and Bluetooth connection status are designed in this part. If the smartphone is connected to the Bluetooth device, the status will show a green color text “Connected.” But if the smartphone is not connected to the Bluetooth device, the status will show a red color text “Not connected.” Figure 4 shows the component and blocks for Bluetooth connection with the MIT app inventor.

Figure 4: Components and Blocks for Bluetooth Connection



Part 2: Five buttons for manual control direction are used with the line follower delivery robot. The researchers designed 5 buttons that include walk forward, turn left, turn right, walk backward and stop. Figure 5 shows the component and blocks controlling the direction of the line follower delivery robot with the MIT app inventor. Figure 5 shows the component and blocks for manual control.

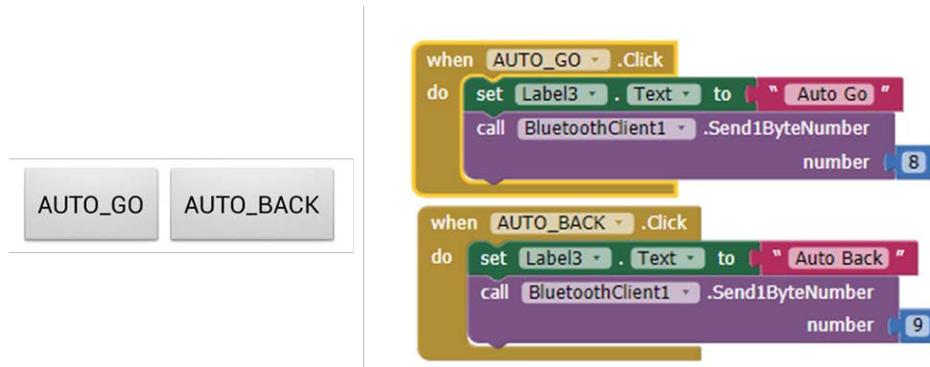
Figure 5: Components and Blocks for Manual Control



Part 3: Two buttons for automatic control are used with the line follower delivery robot. The line follower delivery robot uses a 4-Infrared-sensor module for line tracking.

AUTO_GO button is designed for “go forward.” The line follower delivery robot uses a 2-front-side-infrared-sensor module for line tracking. AUTO_BACK button is designed for “go backward.” A 2-back-side-infrared sensor is used for line tracking for “go backward.” Figure 6 shows the component and blocks controlling direction of the line follower delivery robot with MIT app inventor.

Figure 6: Components and Blocks for Automatic Control



5. Experiment and Results

This part shows the performance of the line follower delivery robot. Automatic control is used in this experiment. The researchers designed 2 paths. Each path has a length of 8 m. Details of the paths are presented below.

Path 1 Straight line path. The line follower delivery robot runs from the *start* point to the *finish* point. Figure 7 shows path 1 as a straight line path.

Path 2 Straight line and curve line path. The researcher designed this path to analyze performance of the robot when turning right or left. Figure 8 shows path 2 as a straight line and curve line path.

Figure 7: Path 1 Straight Line Path



Figure 8: Path 2 Straight and Curve Line Path



As shown, load capacity is increased in the speed test. Details of the results are presented in Table 1 and Table 2. Table 1 shows the results of path 1 straight line path and Table 2 shows the result of path 2 straight line and curve line path.

Table 1: Result of Straight Line Path

Load Capacity(kg)	Time(s)
0	27.54
1	28.06
2	28.49
3	28.86
4	29.44

Table 2: Result of Straight and Curve Line Path

Load Capacity(kg)	Time(s)
0	36.12
1	37.60
2	40.24
3	43.57

6. Conclusion and Future Research

The researchers designed the line follower delivery robot to deliver items. The maximum load for the straight line path is 4 kg and the maximum load for the straight and curve line path is 3 kg. Moreover, the researchers designed mobile application to control the line follower delivery robot. Smartphone and Bluetooth technology facilitates robot control. As for future research, the researchers have considered the use of Internet of things (IOT) technology for robot control (Tan & Wang, 2010).

7. The Authors

Supaphon Kamon and Sommart Thongkom are working in Department of Mechanical Engineering, Bangkokthonburi University, Bangkok, Thailand. Both researchers have keen interest in line follower robot research and robotic applications.

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