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AN EFFICIENT METHOD OF CONTROLLING A TWO-MOTOR DRIVEN ROBOTIC VEHICLE VIA ANDROID SMARTPHONE

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Abstract*-Nowadays, interfacing with robots has been developed among both professionals and amateurish electronics users. Considering open source tools (hardware and software) as a framework, many enormous projects are being developed at this time combining creative ideas, wireless technologies and an open thought for users to become an active part of the robust system. In this paper, we present an innovative robotic system with android smartphone. Smartphones are becoming each time more robust and equipped with several add-ons that are useful for the Robotic field. The purpose of this is to provide powerful computational android platforms with simpler robot's hardware architecture. We have developed an android app that controls a two-motor driven robotic vehicle. In the system design, we used Bluetooth module that builds upon our Bluetooth communication network with the robot. The proposed system can be used in human-robot interaction, robotic remote control and so on.*

Keywords: Robotic Vehicle, Android, MIT App Inventor 2, Bluetooth Communication.

1. INTRODUCTION

Very few new methods of interfacing with robots are starting to develop at recent times. Both professional and non-professional electronics users are involved in this sector. Due to the recent development of open source software and more recently open source hardware like Arduino, as well as the decreasing prices in the world of electronic tools, engineers find themselves in a situation where they can think of and carry out a vast range of project ideas. Mobile robot is presented with a situation or form depending on the area of application usage. Considering the open tools as a framework, a big project is being developed at this time combining innovative ideas, wireless technologies and an open philosophy for users to become an active part of the big system. This paper aims in designing a robot that can be operated using android mobile phone. The controlling of the robot is done wirelessly through android smartphone using the Bluetooth feature presented in it. The program developed by MIT App Inventor 2 which is an open source web application. Here in the project, the android smartphone is used as a remote control for operating the robot.

2. RELATED WORKS

A robot controlled by Bluetooth module HC-06 and 8051 microcontroller is existing [1]. Bluetooth module receives data from a smartphone that is fed as input to the controller and it acts accordingly on the DC motor of the robot. The robot can be made to move in all the four directions using the android phone. To achieve this task the controller is loaded with a program written using Embedded C. ATMEGA328 Microcontroller was replaced to control the robot in recent days [2]. Android phone controlled robot using Bluetooth analyses the motion technology to capture gestures through an android smartphone with an inbuilt accelerometer and Bluetooth module to control the kinetics of a robot was also shown [3]. The paper [4] depicts a robotic movement control through the smartphones. However, to monitor the status or make minor changes to the programming procedure of the robot, the user must obtain access to the pendant or terminal.

An android platform was introduced in this paper [5], an effort to eliminate this need. It showed the way to communicate with robots over a Bluetooth connection. In paper [6] the smartphone supports IFLYTEK voice input and handwritten input, so it is agile, convenient, and practical to be used and can ensure the reliability of the whole system, on the other hand, by using Wi-Fi wireless network, the communication between smartphone and robot can be realized, which makes it simple and convenient to control robot to sing and dance in accordance with the commands.

3. BLOCK DIAGRAM

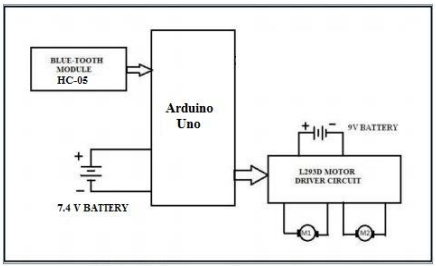

Figure 1: Block diagram of the whole system

It consists of the following blocks
• Arduino Uno
• Bluetooth module- HC-05
• DC motors
• Motor Driver H-Bridge
• Dc batteries

4. IMPLEMENTATION

The robot was made to move in all the four directions using the android phone. The circuit is built around Arduino board, Bluetooth module HC-05, motor driver L293D, DC motors M1 and M2, and a few common components. The circuit uses two batteries. First battery (7.4V) was used to power the Arduino board and the other (9V) was used to power the motors. The regulated 5V supply for the rest of the circuit was provided by the Arduino board itself. LED on the board indicates the presence of power supply. Motor Driver H-Bridge(L293D) was used to drive two motors which work on 9V DC batteries. Motor driver was interfaced to the Arduino. The data received by the Bluetooth module from android smartphone is fed as input to the controller. Interaction of all the module of the smartphone-controlled robot is shown in Figure 1.

5. CONTROL ARCHITECTURE

Typical common control architectures are shown below:

5.1 Arduino Uno R3

Arduino (shown in Figure 2) is an open-source physical computing platform based on a simple I/O board and a development environment that implements the processing / wiring language. It can be powered via the USB connection or with an external power supply.
Some specifications of this architecture are given below:

- ATmega328 microcontroller
- Input voltage - 7-12V
- 14 Digital I/O Pins (6 PWM outputs)
- 6 Analog Inputs
- 32k Flash Memory
- 16Mhz Clock Speed

Figure 2: Arduino Uno R3 [7].

5.2 Bluetooth Module HC-05

HC-05(shown in Figure 3) is a class-2 Bluetooth module with Serial Port Profile, which can configure as either master or slave. Specification of the module is:

- Bluetooth protocol: Bluetooth Specification V2.0+EDR
- Frequency: 2.4GHz ISM band
- Modulation: GFSK (Gaussian Frequency Shift Keying)
- Emission power: <4dBm, Class 2
- Sensitivity: <-84dBm at 0.1% BER
- Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps
- Security: Authentication and encryption
- Profiles: Bluetooth serial port
- Power supply: +3.3VDC 50mA
- Working temperature: -20 - +75Centigrade
- Dimension: 26.9mm x 13mm x 2.2 mm

Figure 3: Bluetooth Module HC-05 [8].

5.3 Motor Driver H-BridgeL298N

The L298N (shown in Figure 4) is an integrated monolithic circuit in 15-lead PowerSO20 packages. It is a high voltage, high current dual full-bridge driver designed to accept standard TTL logic levels and drive inductive loads such as relays, solenoids, DC and stepping motors.
Key features:

- Operating supply voltage up to 46V
- Total dc current up to 4A
- Low saturation voltage
- Over temperature protection
- Logical "0" input voltage up to 1.5 V (high noise immunity)

Figure 4: Motor Driver H-Bridge L298N [9].

6. PROGRAMMING SECTION

This system has two programming section. One is for Arduino and another is for android application.

6.1 Arduino IDE

For Arduino programming, open-source Arduino software (IDE) is used (Figure 5).

Figure 5: Arduino software (IDE)

6.2 MIT App Inventor 2

MIT App Inventor 2 is a blocks-based programming language that allows creating simple apps for android phones. It is an open-source web application originally provided by Google. Figure 6 shows the programming environment of the MIT App Inventor 2.

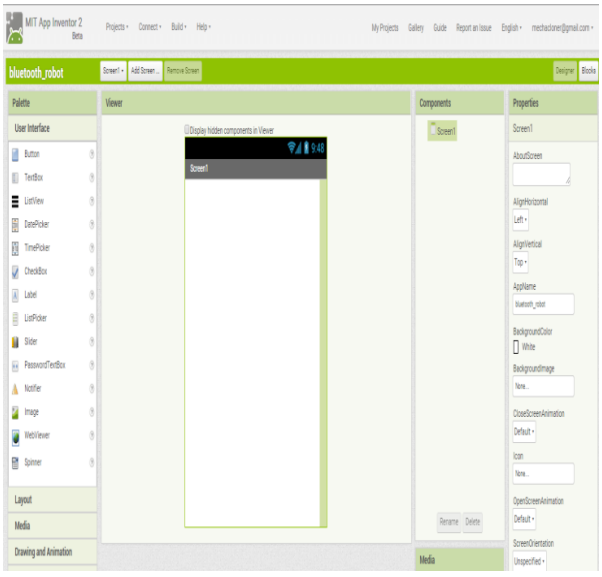

Figure 6: MIT App Inventor 2 programming environment [10].

7. ANDROID APPLICATION AND ROBOT STRUCTURE

The application made by the MIT App Inventor 2 is shown in Fig.7. At first, it should be connected with the Bluetooth module HC-05 which was interfacing to Arduino attached with the final robotic structure illustrates in Fig.8. When the Bluetooth module connected with the android, the communication between robot and android phone was started. If the user of the android application presses any directional or functional key, the robot will be directed and follow that command.

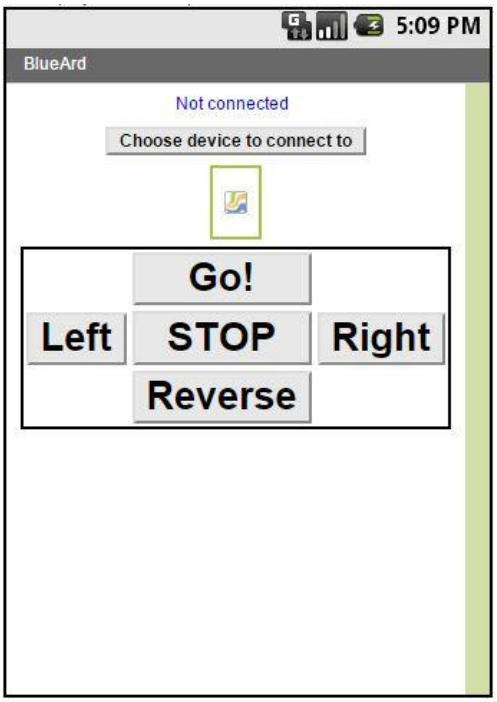

Figure 7: Android application

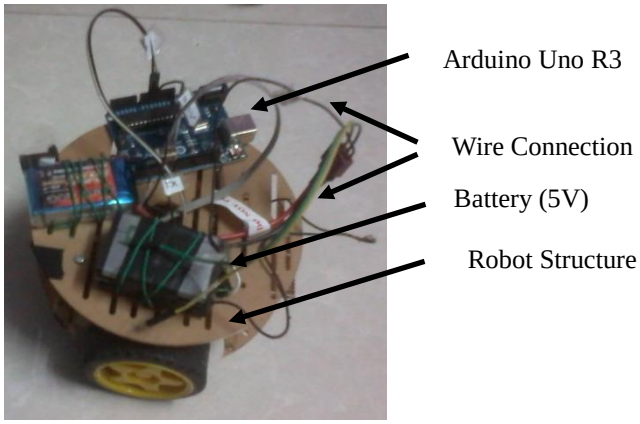

Figure 8: Android phone controlled Robot

8. CONCLUSION

In recent days, more than 60 percent people use smartphones and most of the smartphones are now android operated. The android operating system is user-friendly and it is easy to develop software for this. In this paper, an android application was developed to control a mobile robot. Although this research is still in an early stage of

development, it has already proved to succeed in several of its goals. It will facilitate the industry to control the robot using the mobile device and provide opportunities for alternative communication service providers use existing mobile devices. This system can further be developed by enhancing the performance and by adding more features. The system may be improved by adding features like gas sensor, thermal image sensing, connecting robotic arms and so on.

9. REFERENCES

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