

GUI Controlled Arduino

Mrityunjaya D H¹, Naveen Kumar², Hemanth Kelagadi³

Student, Electronics and Communications Department, BVBCET, Hubli, India ^{1,2}

Professor, Electronics and Communications Department, BVBCET, Hubli, India ³

Abstract: With the advancement in science and technology, there has been an exponential increase in the demand in the field of wireless communication. The drawback of wired communication is high cost of materials which can be overcome by wireless communication. In this paper an idea of communication between GUI and Arduino board is presented. A high performance smart phone application is developed and integrated with the robot.

Keywords: Graphical User Interface, Bluetooth, Microcontroller, Wireless Application Protocol.

I. INTRODUCTION

The objective of the above said project is to establish communication between Graphical User Interface and Arduino board which is a driving force for the movement of bot. As discussed earlier the system may be called as an Embedded System which is a combination of software and hardware. GUI being software part where Microcontroller with Arduino acts as hardware. Both the parts have different modules which are discussed in later part of this paper. Voice recognition is an add-on to this system which will enable the user to communicate efficiently. This is a multidisciplinary project which involves the concepts of electronics and mechanical. The Reader is expected to have the knowledge of both the disciplines. Different modules used in this project are Bluetooth module, Arduino Board with Microcontroller, Graphical User Interface built by Java Code. Since we are using this system for a specific domain with certain range we are expected to follow some standard protocol for Bluetooth module.

Fig.1 stands in support for the fact that in recent days, the demand for the wireless communication is increasing exponentially with the time. The figure depicts the usage of different means of communications where telephones and wired broadband are wired type of communication and the rest are wireless. Examining the figure will give a picture of how the demand in different wireless communications has been increased within a short span i.e. in 6 years which indirectly supports the above said advantage in abstract.

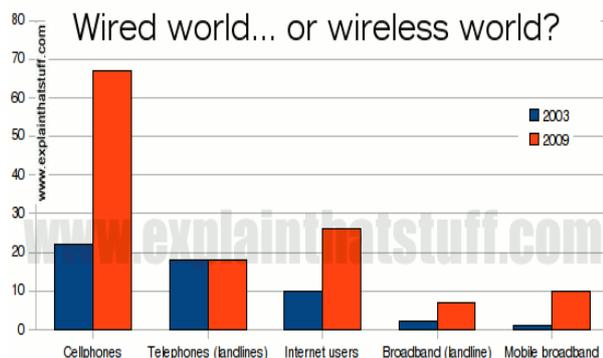


Fig.1. Demand for wireless communication

II. LITERATURE SURVEY

The Arduino platform is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino is open-source, which means hardware is reasonably priced and development software is free. An important feature of the Arduino is that you can create a control program on the host PC, download it to the Arduino and it will run automatically. Remove the USB cable connection to the PC and the program will still run from the top each time reset button is activated. Remove the battery and put the Arduino board in a closet for six months.

A. Motivation

Android is now becoming the best among all the mobile operating systems. Most of us have smart phones with Android Operating System. Hence we are trying to build an android application which can control the movement of a bot wirelessly using a Bluetooth module. Research is going on towards mobile controlled robots and concerns in the communication technology that connect mobile with robots.

B. Problem Statement

Analysing the needs of wireless communication and simplicity and effectiveness of Arduino board, we end up with a problem statement which says” Development of an GUI application to control movements of robot.”

III. PROPOSED IDEA

The principle behind the project is to establish wireless communication between Graphical User Interface and Arduino board. This can be accomplished by a Bluetooth device with certain range of communication. This range varies from module to module. This range is decided by different set of predefined protocols. In software part of the project we need to develop an android application using GUI programming in JAVA. On the other hand for the proper functioning of the hardware, we need to write C/C++ code for Arduino board. The Bluetooth module which provides a channel between the software and hardware. This protocol allows the user to access the control over the bot. Security options are to be added so as to be used by an authorized user. We begin the actual implementation by constructing the hardware.

Hardware part in our project is the bot with four wheels, base plate, and different holders to hold the bot in exact position. The dimensions of each hardware will be explained in the further part of this paper.

IV. CONCEPTUAL DESIGN

The concept behind this design is to combine both software and hardware. Software being the Graphical User Interface and Hardware is bot interfaced with Arduino. In software part we have developed an Android application. Arduino UNO R3, L293D driver and DC motor are to be added in hardware part. Below is the description of each module used.

A. Software Requirements

1] Graphical User Interface:

Typically users interact with computers via graphical user interfaces or GUIs. These interfaces provide the user with multiple windows on the screen and support touch on buttons, drag items around, pull down and select items from menus, select text fields in which to type responses, scroll through windows, and perform many other operations. GUI components (some-times called widgets) are items like buttons and menus that can be added to the user interface to provide a way for users to interact with a program. So far we have not been able to program using these components. We can draw geometric objects on a canvas and interact with programs using mouse actions. In this paper we have introduced techniques for programming a graphical user interface with Java programs.

Java provides two libraries to assist in the programming of GUI interfaces: AWT-Abstract Windowing Toolkit and Swing-intended to replace AWT which is the Java original windowing toolkit. In this paper we focus on Swing. However, many aspects of GUI programming still depend on AWT classes, so we will use classes from both of these libraries as well as libraries providing support for event handling.

B. Hardware Requirements

1] Bluetooth Module- HC 05:

Bluetooth is a wireless technology in a short-range communications system that aims to replace cables connecting portable. Bluetooth has many features like robustness, low power, and low cost. Bluetooth technology was designed firstly to support simple wireless networking devices, including cell phones, wireless headset, wireless mice, and PDAs. It is worth to mention that Bluetooth cover short distances. Bluetooth devices generally communicate at less than 1 Mbps [14]. Bluetooth requires a low cost transceiver chip to be included in devices. The maximum range for Bluetooth is 10 meters and this is one of Bluetooth drawbacks and this limitations caused by its high frequency.

The module used is HC-05.HC-05 embedded Bluetooth serial communication module (can be short for module) has two work modes: order response work mode and automatic connection work mode. And there are three work roles (Master, Slave and Loopback) at the automatic connection work mode.



Fig.2 Bluetooth Module (HC-05)

Fig.2 shows a typical Bluetooth module used in our project. When the module is at the automatic connection work mode, it will follow the default way set lastly to transmit the data automatically. When the module is at the order-response work mode, user can send the AT command to the module to set the control parameters and sent control order. The work mode of the module can be switched by controlling the module PIN (PIO11) input level [7].

2] Arduino UNO R3:

The Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. Fig.3 shows the top view of an Arduino UNO R3 board [8]. It contains everything needed to support the microcontroller; it can be connected to a computer with a USB cable or can be powered with a AC-to-DC adapter or battery to get started.. You can tinker with your UNO without worrying too much about doing something wrong.



Fig.3 Arduino UNO R3

"Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.

3] L293-D Driver:

L293D is a dual H-bridge motor driver integrated circuit (IC). Fig.4 shows the pin configuration of the driver. Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors. L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse

direction. Since the current signal coming from Arduino board is too low (in terms of mV) we make use of driver circuit which can act as amplifier.

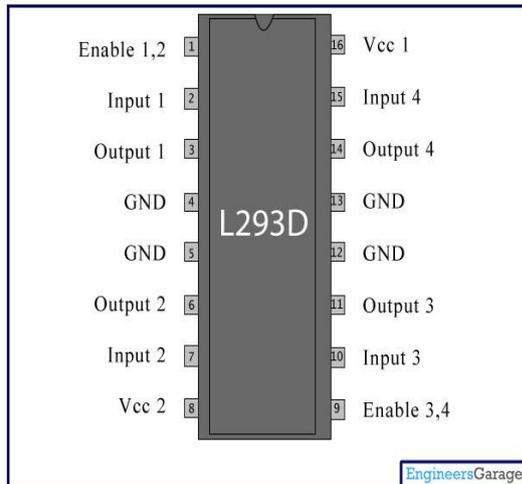


Fig.4 L293-D driver pin Configuration

4] DC motor:

DC motors are electric motors that are powered by direct current (DC), such as from a battery or DC power supply. Their commutation can be brushed or brushless. The speed of a brushed DC motor can be controlled by changing the voltage alone. By contrast, an AC motor is powered by alternating current (AC) which is defined by both a voltage and a frequency. Consequently, motors that are powered by AC require a change in frequency to change speed, involving more complex and costly speed control. This makes DC motors better suited for equipment ranging from 12V DC systems in automobiles to conveyor motors, both which require fine speed control for a range of speeds above and below the rated speeds [9].

V. DETAILED DESIGN

In this section we are trying to explain the block level specifications and engineering design approach to achieve end results.

A. Block Diagram

From the source there are two ways the inputs can be given: Touch keypad and Human voice. Either of the input signals can be sent to the microcontroller present in Arduino board through Bluetooth module which controls the movements of bot.

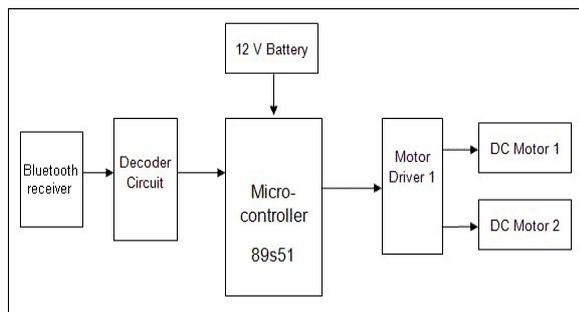


Fig.5 Block Diagram

In case of voice as input, before the transmission of commands the voice is converted into string format and sent. Fig.5 explains the block diagram of our project.

B. Engineering Design approach

Engineering design is an effective way to solve any kind of engineering problems. Engineering design problems are "Open Ended and Ill-structured". Hence we make use of this approach to solve this problem.

Engineering Design approach involves different steps. Initially we listed different types of design attributes required for our project. We categorized these attributes into Objectives, Functions, Means and Constraints. Then we designed a tree of objectives. From the tree and pair wise comparison chart we found that the product must be user friendly. After this we found multiple solutions to achieve the goal. By analysing the attributes and using different processes used in Engineering design we arrived at a best suited solution which was developing an Android application to control the movements of bot interfaced with Arduino. Then we developed black box and glass box to understand how we can implement the above said project effectively and efficiently.

C. Tools used

To meet both software and hardware requirements we have made use of different software tools. Those are Android SDK, JAVA development Kit, and ADT plug-ins.

1] Android SDK:

The Android SDK includes a variety of tools that help you develop mobile applications for the Android platform. The tools are classified into two groups: SDK tools and platform tools. SDK tools are platform independent and are required no matter which Android platform you are developing on. Platform tools are customized to support the features of the latest Android platform.

2] Eclipse:

Eclipse is one of the most fully featured, free, Java IDE's available. Eclipse is also very easy to use, with a minimal learning curve. This makes Eclipse a very attractive IDE for solid, open Java development [4].

3] JAVA Development kit:

The JDK is a development environment for building applications, applets, and components using the Java programming language [2]. The JDK includes tools useful for developing and testing programs written in the Java programming language and running on Java platform [1].

D. Steps to install Eclipse

1. Download the latest JDK (Java distribution) from: www.oracle.com [3].
2. Download the Eclipse IDE (e.g. Galileo) from: www.eclipse.org/downloads/
3. Install the Android SDK starter package from: <http://developer.android.com/sdk/index.html>
4. In Eclipse, install the ADT plug-in <http://developer.android.com/sdk/eclipse-adt.html>
5. Instructions on setting up the SDK and development Environment can be found on: <http://developer.android.com/sdk/installing.html>.

VI. RESULTS

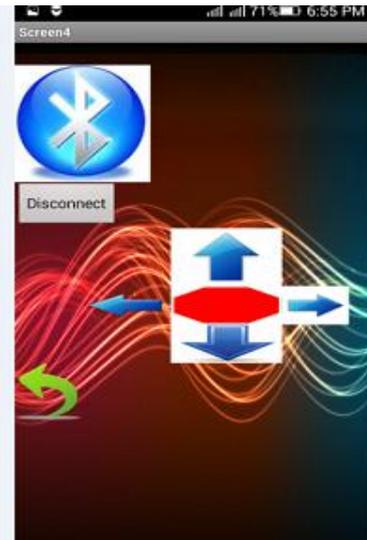


Fig.6 Screen 1



Fig.7 Screen 2



Fig.8 Prototype

In this section we have provided the results we got after interfacing and combining software and hardware. Fig.6 and Fig.7 are the screen shots of the Android application that we have built and Fig.8 is the picture of prototype of the project.

VII.CONCLUSION

In this experiment we have integrated a high performance Smartphone application with robotics and utilized the Bluetooth technology as a fast, secure and reliable connection between them. By this project it is found that it is possible to control any hardware via the same hierarchy that is mentioned. It allows opening a door, switching on a car and activating any machine. In future it is possible to add GPS adapter to the robot to make it able to identify the actual position of the robot, and also add voice command instead of keypad. Even we can use such types of bot in military applications to track the position of the enemy.

A. Future Scopes

1) New wireless technology is enabling automobile manufacturers to integrate gesture recognition features in their cars to let drivers manage the control systems of the car. For example, an approaching hand can activate the in-car infotainment system, or tilting your head can switch on the turning indicator.

2) Surgeons of the future might use a system that recognizes hand gestures as commands to control a robotic scrub nurse or tell a computer to display medical images of the patient during an operation which might help to reduce the length of surgeries and the potential for infection.

3) We can design a wireless robot which can sense hand gesture by using wireless technologies. It can be used in military applications as a robotic vehicle which can be handled by a soldier to avoid casualties.

REFERENCES

- [1] J.F. Dimarzio, Android: A Developers Guide, McGraw Hill, 3 ed., 2006.
- [2] Nikhil Jadhav, Android Application Development Guide, 2004
- [3] <http://www.oracle.com/>. [Online].
- [4] www.eclipse.org/downloads/. [Online].
- [5] <http://developer.android.com/sdk/index.html>. [Online].
- [6] <http://developer.android.com/sdk/eclipse-adt.html>. [Online].
- [7] Bradley Mitchell, Bluetooth, accessed on January 15, 2010
- [8] Bruno siciliano et al, Robotics Modeling, planning and control, August 2008.
- [9] <http://www.webopedia.com/term/r/robotics.html> accessed on January 15, 2010.
- [10] Bruno siciliano et al, Robotics Modeling, planning and control, August 2008.
- [11] Sonera Medialab, Symbian Application Development, January 2003.
- [12] M. Tasker et al, Professional Symbian Programming.
- [13] Symbian corporation website, www.symbian.com.
- [14] www.bluetooth.com/bluetooth/technology/works How Bluetooth Technology Works, accessed on January 15, 2010.