

# Efficient Android Based Application for Required Movement of Robot

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**Abstract** - The goal of this paper is to serve as a prototype for such venture having set the paths to a wide range of new opportunities in the field of remote controlled robots interaction. The proposed work designed to develop a robotic vehicle that is controlled by a Bluetooth device. Bluetooth operation is achieved by any smart-phone/Tablet etc., with Android OS, upon a GUI (Graphical User Interface) based touch screen operation. It consists of a HC-06 Bluetooth module circuit and ATMEGA2560 microcontroller is used for the desired operation. At the transmitting end user send the command using android application, commands are sent to the receiver to control the movement of the robot either to move forward, backward and left or right etc. At the receiving end two motors are interfaced to the microcontroller where they are used for the movement of the vehicle. The android application device transmitter acts as a remote control. While the receiver end Bluetooth device is fed to the microcontroller to drive servo motors via motor driver IC for necessary work.

**Keywords** - *Atmega2560, Android OS, Bluetooth interface, Fire Bird V robot.*

## 1. Introduction

Robotics is the branch of technology that deals with the design, construction, operation and application of robots. The word “robot” was first introduced by the Czech writer, Karel Capek in a 1921 play R.U.R. Isaac Asimov a renowned science fiction writer came up with the word “Robots”. There are different types of mobile robots which can be divided into several categories consists of wheeled robot, crawling robot and legged robot. Robot has sufficient intelligence to cover the maximum area. Designing autonomous robot requires the integration of many sensors and actuators according to their task. Nowadays smart phones are becoming more powerful with advanced processors, larger storage capacities, richer entertainment function and more communication methods. Bluetooth is mainly used for data exchange; add new features to smart phones. Bluetooth technology, created by telecom vendor Ericsson in 1994, shows its advantage by integrating with smart phones. It has changed how people use digital device at home or office, and has transferred traditional wired digital devices into wireless devices. A host Bluetooth device is capable of communicating with up to seven

Bluetooth modules at same time through one link. Considering its normal working area of within eight meters, it is especially useful in home environment. Thank for Bluetooth technology and other similar techniques, with dramatic increase in Smartphone users, smart phones have gradually turned into an all-purpose portable device and provided people for their daily use. In recent years, an open-source platform Android has been widely used in smart phones. Android has complete software package consisting of an operating system, middleware layer and core applications. Different from other existing platform like iOS (iPhone OS), it comes with software development kit (SDK), which provides essential tools and Application. Using a Smartphone as the “brain” of a robot is already an active research field with several open opportunities and promising possibilities. In this paper we present a review of current robots controlled by mobile phone and discuss a closed loop control systems using audio channels of mobile devices, such as phones and tablet computers. In our work, move the robot upward, backward, left and right side by the android application such as Arduino Bluetooth RC Car.

## 2. Literature Survey

Aniket R. Yeole *et al.* Nowadays android smart phones are the most popular gadget. There are multiple applications on the internet that exploit inbuilt hardware in these mobile phones, such as Bluetooth, Wi-Fi and ZigBee technology to control other devices. With the development of modern technology and Android Smartphone, Bluetooth technology aims to exchange data wirelessly at a short distance using radio wave transmission comprising features to create ease, perception and controllability. In this paper we have designed a robot that can be controlled using an application running on an android phone [2].

Ratnesh Malik *et al.* A robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Many robots have been built for manufacturing purpose and can be found in factories around the world. Designing of the latest inverted ROBOT which can be controlling using an APP for android mobile. We are developing the remote buttons in the android app by which we can control the robot motion with them. And in which we use Bluetooth communication to interface controller and android. Controller can be interfaced to the Bluetooth module though UART protocol. According to commands received from android the robot motion can be controlled. The consistent output of a robotic system along with quality and repeatability are unmatched. Pick and Place robots can be reprogrammable and tooling can be interchanged to provide for multiple [3].

Arpit Sharma *et al.* The project is aimed to control a robot using an android application. Bluetooth devices interfacing are done with the control unit on the robot for receiving the signals transmitted by the android application. These signals are sending to the control unit which moves the robot as required. An 8051 series microcontroller is used as control device in this project.

Sukhdeep Kaur Bhatia *et al.* Today human-machine interaction is moving away from mouse and pen and is becoming much more pervasive and much more compatible with the physical world. With each day passing the gap between the human and the machines is being reduced with the introduction of new technologies to ease the standard of living. The purpose of this project is to design and implement a Vacuum Robot. Vacuum Cleaner Robot is designed to make cleaning process become easier rather than by using manual vacuum. The main objective of this project is to design and implement a

vacuum robot prototype by using Arduino Uno, Motor Shield L298n and to achieve the goal of this project, knowledge about the sensor, controlled motor circuit and compatible software need to be determined. Vacuum Robot will have several criteria that are user-friendly, organized and efficient, which meets human needs.

M. P. Mahajan *et al.* A robot is usually an electro-mechanical machine that is guided by computer and electronic programming. Many robots have been built for manufacturing purpose and can be found in factories around the world. Designing of the latest inverted ROBOT which can be controlling using an APP for android mobile. And in which we use Bluetooth communication to interface Arduino UNO and android. Arduino can be interfaced to the Bluetooth module though UART protocol. According to commands received from android the robot motion can be controlled. The consistent output of a robotic system along with quality and repeatability are unmatched. These robots can be reprogrammable and can be interchanged to provide multiple applications.

## 3. System Architecture

The purpose of our research is to provide simpler robot's hardware architecture but with powerful computational platforms so that robot's designer can focus on their research and tests instead of Bluetooth connection infrastructure. This simple architecture is also useful for educational robotics, because students can build their own robots with low cost and use them as platform for experiments in several courses.

### A. BLOCK DIAGRAM

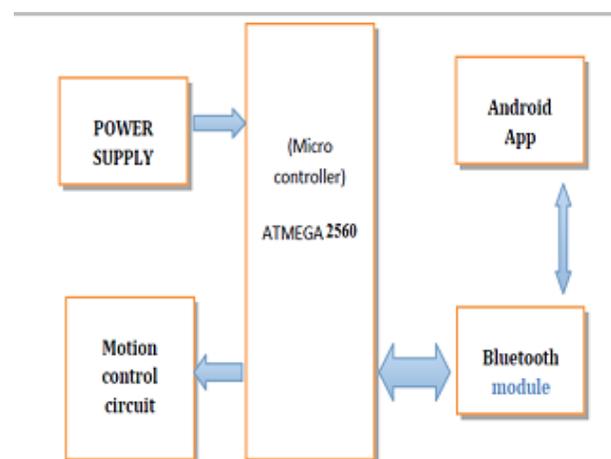


Figure 1.1: Block Diagram of System

The above block diagram shows the overall co-ordination of the system. A robot can be controlled using Bluetooth module HC-06 and ATMEGA2560 microcontroller with android Smartphone device. The controlling devices of the whole system are a microcontroller. Bluetooth module, DC motors are interfaced to the microcontroller. The data receive by the Bluetooth module from android smart phone is fed input to the controller. The controller acts accordingly on the DC motor of the robot. The robot can move to move in all the four directions using the android phone. The direction of the robot is indicators using LED indicators of the Robot system. In achieving the task the controller is loaded with program written using Embedded C.

#### 4. Hardware Description

##### A. ATMEGA2560 CONTROLLER

The Fire Bird V robot is the 5th in the Fire Bird series of robots. First two versions of the robots were designed for the Embedded Real-Time Systems Lab, Department of Computer Science and Engineering, IIT Bombay. These platforms were made commercially available from the version 3 onwards. All the Fire Bird V series robots share the same main board and other accessories. Different family of microcontrollers can be added by simply changing top microcontroller adapter board. Fire Bird V supports ATMEGA2560 (AVR), P89V51RD2 (8051) and LPC2148 (ARM7) microcontroller adapter boards. This modularity in changing the microcontroller adapter boards makes Fire Bird V robots very versatile. You can also add your own custom designed microcontroller adapter board. Features of ATMEGA2560 are [8] [9]-

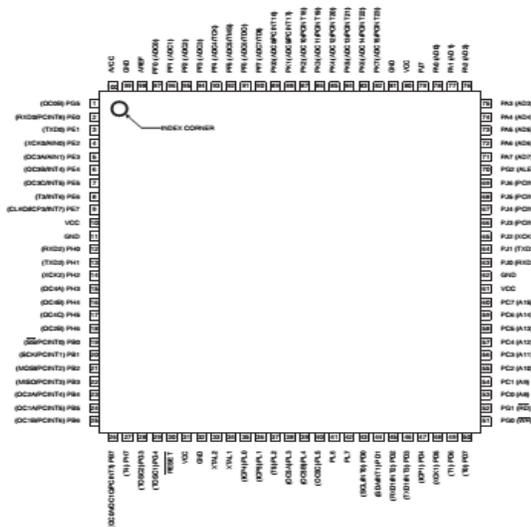


Figure 1.2: Pin configuration of ATMEGA2560

- 32x8 General Purpose Working Registers
- Most Single Clock Cycle Execution
- On-Chip 2-cycle Multiplier
- In-System Programming by On-chip Boot Program
- Programming Lock for Software Security

Ultra-Low Power Consumption

##### B. HC-06 Bluetooth Module

HC-06 is a drop-in replacement for wired serial connection. This can be used as serial port replacement to establish connection between PC and MCU (Microcontroller). This is a Slave Mode only Bluetooth device. This module can be configured for baud rates 1200 to 115200 bps.[4]



Figure 1.3: HC-06 module. [4]

##### C. SMART PHONE

A smart phone Android operated robot. Now here is a simple to control your robot/robot car using Bluetooth module HC-06 and 89c2051 microcontroller with your android Smartphone device. The controlling devices of the whole system are a microcontroller. Bluetooth module, DC motors are interfaced to the microcontroller. The data receive by the Bluetooth module from android smart phone is fed as input to the controller. The controller acts accordingly on the DC motor of the robot. The robot in this paper can be made to move in all the four directions using the android phone. The direction of the robot is indicators using LED indicators of the Robot system. In achieving the task the controller is loaded with program written using Embedded 'C' Languages.

## 5. Software Description

### A. ANDROID APPLICATION

The Mobile application consists of 7 buttons viz. Right, Left, Forward, Reverse, Stop, Buzzer on, buzzer off. The above screen consists of an overlook of the app. Right now all the 5 buttons are disabled until the Bluetooth is connected The above screen consists of an overlook of the app. Right now all the 5 buttons are disabled until the Bluetooth is connected. Now since the Bluetooth of the mobile is connected to another Bluetooth Module, the status shown is Connected [3].

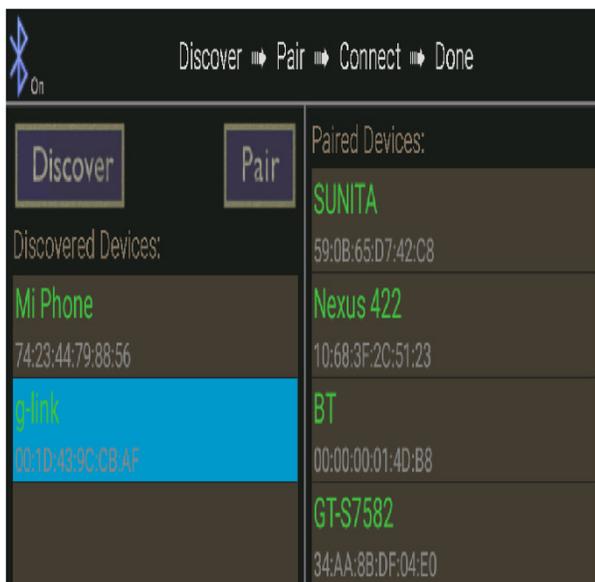


Figure 3.11: Bluetooth connection

### B. ANDROID STUDIO

Android Studio is the official IDE for Android development, and includes everything you need to develop Android apps in a single download. Download Android Studio here and get started by reading Meet Android Studio. Periodic updates are pushed to Android Studio without requiring you to update your Android. To manually check for updates, select Help , Check for update (on Mac, select Android Studio, Check for updates).[1][3]

### C. AVR STUDIO

There are number of IDEs (Integrated Development Environment) available for the AVR microcontrollers. There are free IDEs which are based on AVR GCC like

AVR Studio from ATMEL and WIN AVR and proprietary IDEs like ICC AVR, Code vision AVR, IAR and KEIL etc. IDEs like ICC AVR and code vision AVR are very simple to use because of their GUI based code generator which gives generated code. We have used AVR Studio from ATMEL which is feature rich free to IDE for the robot. In this manual we are going to focus on the AVR studio from the ATMEL.

It uses WIN AVR open source C compiler at the back end. It has many attractive features like built-in In-Circuit Emulator and AVR instruction set simulator. After writing and compiling the program it gives .hex le. This .hex le needs to be loaded on the robot using In System Programmer (ISP). AVR Studio was created by Atmel in order to help developers to create applications for AVR microcontrollers using C/C++ programming languages.

This piece of software comes with a large number of tutorials, which allow the users to get familiar with the application. The program stands as a complete pack for programmers that use C++ and other programming languages. It provides the users with access to the tools for writing, building and debugging their codes. The menu of this application is easy-to-use and oers access to powerful tools for both beginners and experienced developers, making it easy for the users to nd their way through C/C++ programming.

Some of the key features are: cycle correct simulator with advanced debugging functionality, rich SDK that enables tight integration of customer plug-ins and compatibility with many Microsoft Visual Studio plug-ins. Also the tool provides a split window button that allows the users to work on more than one project at a time.

All in all AVR Studio is a complete tool for programmers which develop, test and debug C/C++ applications.[8][9]

## 6. Performance Analysis

A robot can successfully move in all four directions. It was found that given robot moving in all four directions, with an average accuracy of 77.78 percentages. The equation for calculating the accuracy is given below.

$$Accuracy = \sum_{i=0}^n \frac{Number\ of\ Success\ Signal\ Receive\ And\ Required\ Movement}{No\ of\ Test\ Cases}$$

Table 1: Accuracy values for system

| Environment      | Command                    | Signal Receive | Required Movement | Accuracy |
|------------------|----------------------------|----------------|-------------------|----------|
| Well-lit         | Turn smooth left forward   | Yes            | No                | 50%      |
| Dimly-lit        | Forward                    | Yes            | Yes               | 100%     |
| Well-lit         | Turn smooth right forward  | Yes            | No                | 50%      |
| Dimly-lit        | Turn left                  | Yes            | Yes               | 100%     |
| Well-lit         | Stop                       | Yes            | Yes               | 100%     |
| Dimly-lit        | Turn right                 | Yes            | Yes               | 100%     |
| Well-lit         | Turn smooth left backward  | Yes            | No                | 50%      |
| Dimly-lit        | Backward                   | Yes            | Yes               | 100%     |
| Well-lit         | Turn smooth right backward | Yes            | No                | 50%      |
| Average Accuracy |                            |                |                   | 77.78%   |

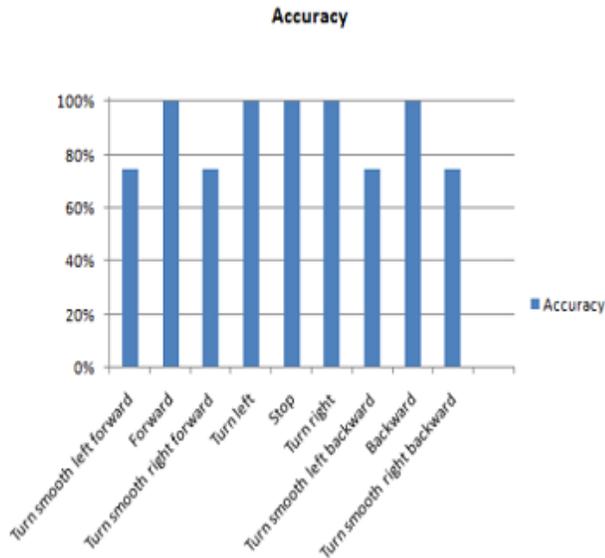


Figure 1.4: Accuracy of system

## 7. Conclusions

Thus a process monitoring of robot is capable of handling itself by its camouflage capability with 77.78 %. It can be used for various operation including remote and military areas. With the advancement of mobile network the connection can be made faster, easier and user friendly. It comes as a revolutionary model for the society which can be helpful in saving a lot of lives during natural disasters or even a national threat.

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