Design and Development of Android Application based Wireless Toy Car

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ABSTRACT

This paper describes design and implementation of android application based bluetooth toy car. In this work android mobile platform is used for controlling toy car. Android application provides graphical user interface to the user. The toy car is composed of three DC motor with gear, bluetooth module, microcontroller unit, H-bridge and LCD display. Two motors are used for controlling speed and direction of toy car and one motor is used for general purpose. Bluetooth module accepts control signals from android mobile and sends data to the microcontroller unit. Microcontroller unit processes the received data and generates control signal for DC motor and LCD. Keil software is used for microcontroller programming and android application is developed with Eclipse and android SDK.

Keywords

Android Application, API, Bluetooth, H-Bridge, DC motor;

1. INTRODUCTION

Android is a Linux based open source development platform for creating mobile applications. In this project android v4.0 is used for creating application for directing toy car's motion. It provides a low level interface with hardware all enhanced for touch screen mobiles [9]. Android SDK is used to build android application, with related tools, plug-ins and documentation. Its development environment has libraries for using Bluetooth for peer to peer data transfer. Android bluetooth stack is known as bluez and supports RFCOMM. Android application accesses bluetooth utility of Android mobile through bluetooth APIs Android.bluetooth. With bluetooth APIs, application search for and connect to, other bluetooth device within range. By originating а communication link with bluetooth socket, data streams are transmitted and received between two devices [10]. Serial communication between bluetooth module and microcontroller is carried out by means of in built UART of microcontroller. Command is handled by microcontroller unit through software for controlling DC motor. IC chip known as H-Bridge is meant for bidirectional control of DC motor.

2. SYSTEM ARCHITECTURE

The block diagram of system is shown in figure 1. Microcontroller Atmel 89S52 is core control module of toy car which operates on 5V power supply. It is 8 bit microcontroller. AT89S52 is selected because it is very cheap, easily available and consumes less power. Main feature of AT89S52 are: - 8K bytes of in system programmable flash memory, 256 bytes of RAM, 32 I/O lines, three 16 bit timer J.S. Bhatia Centre for Development of Advanced Computing, Mohali, Punjab, India

/counter. Serial communication is carried out using inbuilt UART [8]. Microcontroller receives control signals from bluetooth module and processes them. It controls direction of DC motor according to command received and show command on LCD.

H- Bridge 1293d is a 16 pin IC used to control DC motor. The criteria for choosing L293d is that it consist of inbuilt diode which protects circuit from back EMF. L293d contains two H-bridge circuit. Operating voltage of L293d is between 4.5V to 36V .Output current is 600 mA. Here, 9v power supply is used. L293d is used for bidirectional control of two DC motors [11].

Various input and output of L293d:-

Input		output		
0	0	No DC motor rotation		
0	1	Clockwise direction		
1	0	Anticlockwise direction		
1	1	No DC motor rotation		

DC Motor with Gear is a device that translates electrical pulses into mechanical movement. DC motor consists of two leads positive and negative. When two leads are connected to voltage source motor moves in one direction and by changing polarities, DC motor moves in opposite direction. Speed of a DC motor is controlled by changing the applied voltage. There are various methods to change applied voltage. In this work applied voltage changes using PWM [8]. Average voltage that is supplied to DC motor is given by

 $V_{avge} = t_o / T * V_i$

Where V_{avge} =average voltage to DC motor t_o = time on of switches T = period of PWM V_i = input voltage t_o/T=duty cycle



Fig. 1: Block Diagram of System

Ratio of on time to off time is called duty cycle. Duty cycle defines motion of DC motor. AS t_o time is increases as compare to t_{off} , average speed of motor is increased and vice-versa. Specification of DC motor used:-

RPM=100, Weight=125 gm., Torque=1.2kgcm

No load current=60 mA, Load current=300 mA [11]

DC motor with gear is chose because its working life is greater than simple DC motor. As it is simple prototype so these specification are satisfactory.



Fig. 2: Bluetooth connection with PC

Bluetooth module is used for wireless communication between Toy car and Android Application. Bluetooth module used is Robokits Bluetooth module [RKI -1545]. It is selected because it is compatible with 3.3V to 5V so there is no need of separate power supply. Bluetooth module's main features are: - working frequency is 2.4 GHz, V2.0 compliant, baud rate is 9600bps-115200bps, supports serial port profile and supports master and slave mode [11]. In this project it is used as slave mode. In slave mode it receives control signals from Android mobile and advancing command to microcontroller. It uses RS232 standard to communicate with microcontroller. Before using Bluetooth module, it has to be configured. AT commands are used to set control parameter of Bluetooth module. HyperTerminal software is used for this serial communication. Figure 2 is showing Bluetooth connection with PC.

Table 1.Bluetooth module parameters

Name	Baud	Parity	Stop	Data	Pass
	rate	bits	bits	bits	key
Pankaj	9600 bps	0	1	8	0000

LCD used is 16*2 LCD module. It is available in 16 pin package with back light and contrast adjustment function. Power supply is provided using two non-rechargeable 6f22 9V batteries. A voltage regulator 7805 is used to regulate 9V into 5V.

3. ANDROID APPLICATION

Android is an open source mobile application development platform where as Windows mobile and Apple's iPhone applications are built on proprietary operating systems that prioritize native application [10]. Android applications are easy to develop and distribute. These days' low cost android mobiles are available in market. These services are inspiring developer to develop application for android.GUI of application is shown in Figure 3.It comprises of five buttons for all directions and one for stop.



Fig. 3: GUI of application

When user clicks on menu button of mobile, four options are displayed on screen. Before bluetooth socket is establishing for communication, the local bluetooth adapter must pair with remote bluetooth device and before pairing, devices need to discover each other. For this Select connect device option. Bluetooth adapter of mobile starts scanning for device as shown in Figure 4.



Fig.4: Mobile bluetooth scanning for devices



Fig. 5: Showing bluetooth devices are connected

After scanning Android Application sends pass code of bluetooth module which is "0000". A RFCOMM channel is

established between Android mobile Bluetooth and Bluetooth module. Application is connected to Bluetooth of toy car is shown in Figure 5. RFCOMM supports RS232 serial communication.

4. DC MOTOR DRIVING METHODOLOGY

Figure 6 shows the DC motor driving methodology. This program controls speed and direction of DC Motor according to received command from Bluetooth module. Firstly bluetooth module is powered up. LCD displays CDAC Mohali. If any control signal is send by android mobile, bluetooth module takes control signal and forward control signal to microcontroller unit. Microcontroller unit equates control signal with predefined value existing in controller program. After equating, it takes conclusion in which direction DC motor will move. Commands are send in the form of 8 bit data stream. Table 2 is showing command in the form of 8 bit data.



Fig. 6: Flow diagram of software

Table 2. Showing commands in the form of 8 bits data

Serial no.	Command	Data bits
1.	Left	00000001
2.	Right	00000010
3.	Forward	00000011
4.	Backward	00000100
5.	Stop	00000000

5. RESULTS

This paper present a smart toy car motion based on android application, AT89S52 microcontroller and wireless tools. The Toy car is positioned on ground where moving features are tested. By clicking on direction buttons corresponding to four directions, toy car moves rapidly. GUI of application consists of five buttons. Four buttons designed for all directions forward, backward, left, right and one to stop car. The system made full use of internal properties of AT89S52, reduced hardware size and cost.

6. FUTURE SCOPE

The car model used in this project is very simple prototype and need to be further developed. Some features can be added to this prototype such as voice recognition sensor, obstacle sensor, gas sensor and ultrasonic sensor etc so that it can be used in various applications. Application developed for this project has one way communication. So it can be further developed for two way communication so that toy car can also send data or various sensors output to android mobile.

7. REFERENCES

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