

CONTROL OF ELECTRIC MOTOR USING BLUETOOTH

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Abstract: Switching the control of an electric motor with help of a Bluetooth device has been carried out in the present work. Electric motor works on electricity whose supply is controlled by a mechanical switch. In the present work switch is replaced by electronically operated transistor which is further controlled by a smart phone with help of a Bluetooth device. The wireless control action is achieved by assembling the prototype device which includes Bluetooth module, microcontroller, transistor and electric motor. A simple self explanatory software program is written for controlling the on/off action of motor. Present work is helpful for the beginners as well as first year student of computer science.

Keywords : Bluetooth, Electric motor and microcontroller.

I. INTRODUCTION

Since the introduction to the phenomenon of wireless communication by Guglielmo Marconi and its implementation by Alexander Graham Bell, its scope is gradually expanding in various fields. Wireless means replacement of electric current carrying wire by the air medium through which the information is carried by radio waves. Wireless communication involves the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors [1,2]. Wireless communication has two broad types, namely radio communication and telecommunication. Radio communication is either short wave or medium wave type. It is a one way long range broadcast type and mainly used for transmission of radio and television signals. Telecommunication is two way unicast type communication and mainly used for transmission and reception of voice and text signal [3,4].

Wireless communication has many advantages and some of them are given below [5,6]:

- 1) The transmitted distance can be anywhere between a few meters (for example a television remote control) and thousands of kilometres (for example radio communication).
 - 2) Wireless communication can be used for cellular telephony, wireless access to internet, wireless home networking.
 - 3) Other examples includes GPS unit, car door openers, wireless computer mice, radio receiver, satellite television, broadcast television, cordless and cordless telephony.
- Nowadays digital telecommunication is widely used because of its requirement for communication between computing devices. The conversion of digital signal into

radio waves and vice versa is done by some communication devices which given in table 1.

TABLE I: TYPES OF WIRELESS DEVICES

Name of device	Type of modulation	Range	Use
Bluetooth	Line of sight 2.4Ghz.	10 m-100m	Controlling of some devices like computer mouse, speaker.
Zigbee	Frequency modulation.	1 km	Wireless sensor network.
GSM	Gaussian Phase Shift keying.	31 km-250 km	Mobile handset, controlling electric devices.

Among all communication devices Bluetooth is more common because its hardware do not involve modulation and demodulation circuits. It is a direct non-modulated communication.

Wireless communication requires authentication for the use of a particular radio frequency. For instance, satellite communication for television signal transmission requires authorization for broadcasting the signal. License need to be subscribed as well as renewed and generally the charges is collected from the subscribers. Almost all communication need authorisation and a specific radio frequency band are assigned to the authorised users. Wireless radio frequency is any of the electromagnetic radio frequencies that lies between 3khz-300Ghz. This frequency range is divided into bands and which are assigned to a particular subscriber. Table 2 shows the wireless radio frequency bands. 2.4 GHz frequency signal is freely available for experimental purpose and the same frequency is also used for Bluetooth communication.

There are many advantages of Bluetooth and some of them are given below:

1. No requirement of authentication.
2. Easy hardware implementation.
3. Low power and hence not hazardous.
4. No cost is applicable on it's usage i.e. transfer of data does not cost anything.
5. Bluetooth devices are easily available in market at lower cost.

Due to the above advantages, Bluetooth technology is used in all modern electronic devices like cell phone, laptop, television and peripheral devices like mouse, printer, and camera.

It is used by Engineering and science students for their final year project work because of its easy availability.

We have also used it the present work for switching the control of electric motor.

Software is discussed in section 3 and finally conclusions are presented in section 4.

Table II: Radio frequency band allocated by FCC

Name	Abbreviation	Frequency Range	Application
Extremely Low frequency	ELF	3-30Hz	Submarine Communication.
Very Low frequency	VLF	3-30 KHz	Communication with submarines near the surface.
Super Low Frequency	SLF	30-300Hz	Communication with submarine
Ultra Low Frequency	ULF	300Hz-3kHz	Communication with submarine
Low frequency	LF	30-300KHz	Navigation , long wave AM broadcasting RFID
Medium Frequency	MF	300KHz-3MHz	Medium Wave AM broadcast
High Frequency	HF	3-30MHz	Short Wave AM broadcast
Very High Frequency	VHF	30MHz-300MHz	FM, Television Broadcast.
Ultra High Frequency	UHF	300MHz-3GHz	Cellular Communication, Bluetooth, ZigBee , GPS, Wi-Fi.
Super High Frequency	SHF	3GHz-30GHz	Radar , satellite.
Extreme High Frequency	EHF	30GHz-300GHz	Remote sensing
Tremendously High Frequency	THF	300GHz-3000GHz	Ultra Sound

II. Experimental work

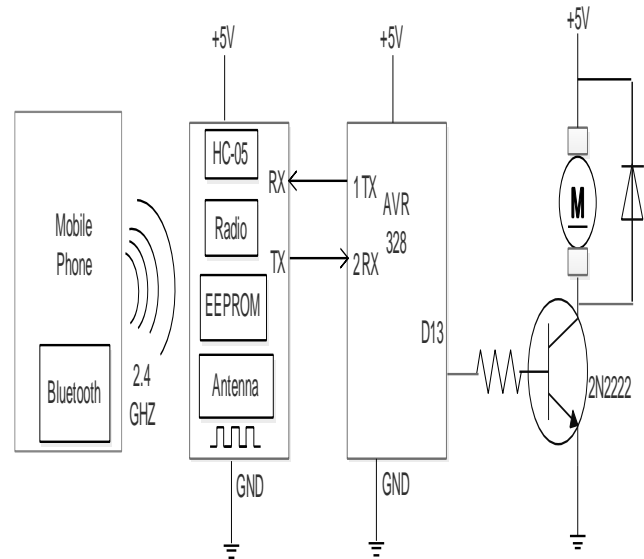


Figure 1: Schematic diagram of switching control of electric motor.

Figure 1 shows the Bluetooth devices for motor control. Electric motor operates on electricity and switching action is control by switching ON/OFF by electricity to the motor. For example electric fan can be manually switch on and off by use of on/off switch. Motor can be controlled by following 2 electronic methods.

1. SPST relay : Relay is electronically operator switch and its contact are closed or open by controlling the current passing through the coil. Relay's are generally used for AC motors
2. Transistor, as shown in Figure 1, can be used as switch in self bias mode. It is suitable for switching of DC motor.

Now a days, Thyristor is commonly used as solid state relay, for the control of on/off and speed of AC or DC motor control. Figure 1 shows control of DC motor using NPN transistor. The motor is connected between supply voltage and collector terminal of transistor. The switching action of transistor and hence the motor is done by the execution of program.

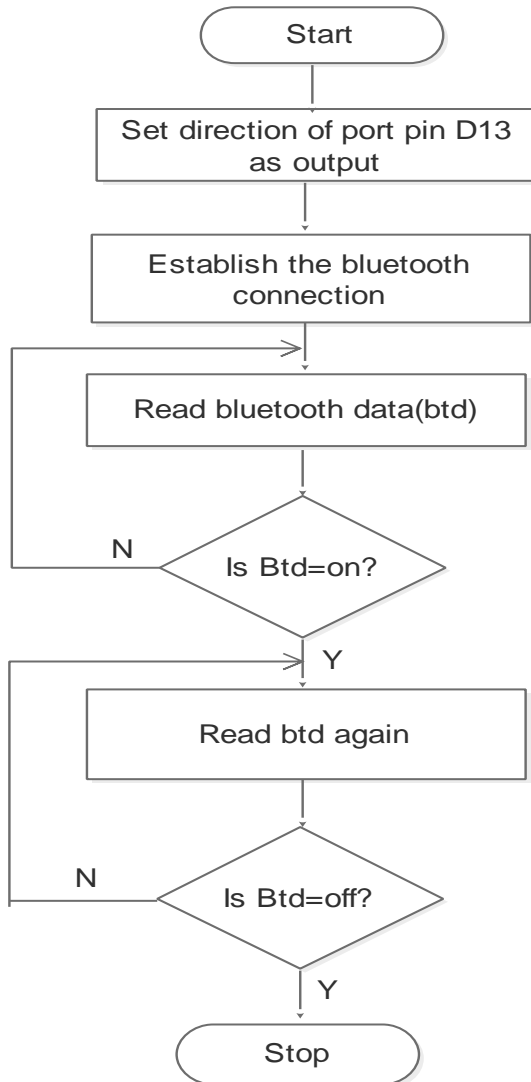


Figure. 2 : Flowchart for ON/OFF of motor

```

Char sb = 0;
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600); //Sets the baud for serial data
  transmission
  pinMode(13, OUTPUT); //Sets digital pin 13 as output
  pin
}
void loop() {
  // put your main code here, to run repeatedly:
  if(Serial.available() > 0) // Send data only when you
  receive data:
  {
    sb = Serial.read(); //Read the incoming sb & store
    into sb
    Serial.print(sb); //Print Value inside sb in Serial
    monitor
  }
}
  
```

```

Serial.print("\n");
if(sb == '1') // Checks whether value of sb is
equal to 1
  digitalWrite(13, HIGH); //If value is 1 then LED
turns ON
else if(sb == '0') // Checks whether value of sb is
equal to 0
  digitalWrite(13, LOW); //If value is 0 then LED
turns OFF
}
}
  
```

Figure.3: Source code for ON/OFF of motor

Bluetooth is a protocol for wireless communication, which should be considered while writing in the source code [7]. The pins are used for the Bluetooth connection i.e Rx and Tx and baud rate are required for programming. The sequence of step in writing the program are shown in the Figure 2 and the corresponding source code is depicted in Figure 3. Program is simple which uses very few variables for instance, variable SB is used to hold the data for serial monitor. The standard statement of arduino[8] are used for establishing the Bluetooth connections , reading character send by the smart phone, comparing its value and finally controlling the on/off action of the motor. The source code is edited and compiled in the open source software arduino nightly which is available from developer's website. The complied program is burned into the flash memory of ATMEGA 328p microcontroller of arduino NANO board .

Programming is done using arduino language, which is open source programming language [8]. Its structure is similar to C language with a difference that it has a mandatory function setup and loop. Whereas C language requires minimum one function that is main(). Setup is function generally used for declaration of variables, mode of pins and for linear programming. A repetitive portion of program is generally written in the loop function which is an infinite loop. In the program given in Figure 3, the baud rate for serial communication is defined using statement Serial.begin(9600). The mode of GPIO pin 13 is set as output by use of statement pinMode(13, OUTPUT). Loop section begins with conditional block if statement 'if(Serial.available() > 0)', which is required for checking of the availability of Bluetooth connectivity, and if available then accept the data in sb variable, compare its value for HIGH/LOW state, send the data to transistor using statement digitalWrite(13, HIGH). Since this code is in loop section it works infinitely and its execution can be interrupted either by using reset key or switching off its power supply.

III. CONCLUSION

Present work deals with elementary study of Bluetooth, arduino, mobile app and DC motor. A simple program is written in arduino language and successfully executed on the arduino nano development board. The main purpose of

present study to learn the basic of modern technology of embedded system which is generally necessary for beginners in the field of electronics.

IV. FUTURE SCOPE

The work done can be extended for the two purposes: one for changing the direction of robotic vehicle using two motors, and the second to change the speed of motor using PWM technology. The work can be extended to the further higher level where many motors are used for the construction of robot arm and robotic vehicle.

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