Wireless DC Motor Control System using Radio Frequencies

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Abstract— The aim of this paper is to design an effective, efficient and low cost microcontroller based control unit that will be used to wirelessly control a DC motor using RF (radio frequencies) at distances ranging from 100 meters. The user should be able to wirelessly control the DC Motor. To achieve this, the digital circuit will be interfaced to a microcontroller 8051. An electronic technique called Pulse Width Modulation (PWM) is used to generate High and Low pulses (duty cycles) that vary and thus control the speed of the motor. The generation of this pulse is made possible by using a microcontroller (SST89E516RD) which in turn sets the speed ranges as per each cycle. H-Bridge was also used to achieve direction control (clockwise and counter clockwise direction) and an RF module, a small electronic circuit used to transmit, receive radio wave where transmitter transmits the signal while receiver receives the signals that have same range of frequencies. This paper is practical in the economic view and hence gives a reliable, durable, accurate and most efficient way of a DC motor control.

Key words: DC Motor Control, Radio Frequencies

I. INTRODUCTION

In a modern industrial situation, DC motor is widely used which is due to the low initial cost, excellent drive performance, low maintenance and the noise limit. As the electronic technology develops rapidly, its provide a wide scope of applications of high performance DC motor drives in areas such as rolling mills, electric vehicle tractions, electric trains, electric bicycles, guided vehicles, robotic manipulators, and home electrical appliances.

DC motors have some control capabilities, which means that speed, torque and even direction of rotation can be changed at any time to meet new condition. DC motors also can provide a high starting torque at low speed and it's possible to obtain speed control over a wide range. So, the study of controlling DC motor is more practical significance.

Aim of this paper is to control the speed and direction as well as position of the DC motor using wireless RF communication system. The wireless control of a DC Motor involves the design and implementation of a microcontroller based control unit to use RF (radio frequency) to wirelessly control a DC Motor. DC motors have played a vital role in the development of industrial power transmission systems. It was the first practical device to convert electrical power into mechanical power.

Inherently straight forward operating characteristics, flexible performance and high efficiency encouraged the wide spread use of DC motors in many types of industrial drive applications. With the advancement in the field of wireless communication technology has thus encouraged their use in other fields such as military drones, surveillance systems, toy cars among others.

In this paper 8051 Microcontroller Integrated Chip plays the main role. The program for this project is embedded in this Microcontroller Integrated Chip and interfaced to all the peripherals. The control program is inside the Micro controller IC to maintain the speed and direction of dc motor. Kiel compiler is used for the making of the code and hex file.

II. LITERATURE SURVEY

A. Classifications of control units

Electronic control units can be classified into two main categories:
Manual control units (systems) & Wireless control unit (system)

B. Manual control units (systems)

In this systems the control of our systems can be obtained in the following ways;

1) Engaging personnel to manually control the system at its location.
2) Having to manually operate the control unit, physically.

And thus it comes at a great expense such as time consuming and expensive since more personnel will be involved.

C. Wireless control units (systems)

This system uses the transfer of information between two or more points which are not directly connected through an electrical conductor. Controlling the different parameters of a DC motor such as direction (clockwise and counter clockwise) and speed control is made possible at a distance. Such as a few meters away. This technology includes:

D. Wireless Communication

Wireless communication is the transmission of information without using of electrical conductors. Distances involved is probably several meters such as in the television remote control or thousands kilo meters for radio communications. In general, wireless communication regarded as a branch of telecommunications. It covers wide range of fixed radio, portable two-ways radio and wireless networking.

Wireless operation allows services such as long distance communication which is impossible to implement with the use of wires. It usually used in telecommunication industries which is refer to telecommunication system that used some form of energy such as radio frequency (RF), laser light and visible light to convey information without need of wires. The information is transferred in short and long distance. Wireless communication depends on limited resources which is radio spectrum. Those that allowed higher frequencies to be used more efficient, the use of spectrum for wireless communication required the key complementary technologies that been developed and also more sophisticated. A systematic development standard is also required to get the most efficient of wireless communication.

Wireless communication starts with a message that swapped into electronic signals by a device called transmitter.

This system are involving either one-way of transmission or two-way transmission. The principles technologies involved in wireless communications are infrared (IR), Bluetooth and Radio Frequency (RF).

E. Radio Frequency Technology (RF Technology)

Radio Frequency is a mode of communication for wireless technologies such as cordless phone, radar and television broadcast. Nowadays, the use of RF technology as one part of the daily routine is rampant. RF waves invisible to the human eyes due to slower frequencies than those of visible light.

Radio Frequency is referring to oscillations in electromagnetic radiation or electrical circuit that normally used in wireless communication. The frequency of a wave is determined by its oscillations or cycles per second where one cycle is equal to one hertz (Hz).

F. Radio Frequency Module (RF Module)

RF module is a small electronic circuit that used to transmit, receive or transceiver radio wave on one of a number of carrier frequencies. The main components of a RF communication are the transmitter and receiver. Transmitter used to transmit signal while receiver function to receive RF signal from transmitter that have same range of frequencies. Table 1 shows the RF range, specification and also its applications.

Type of Frequencies	Frequency Range	Distance of Operation	Applications
Low Frequency	30-300KHz	1km-10km	AM Broadcasting Navigational Beacons.
Medium Frequency	300-3MHz	100m-1km	Navigational Beacons, AM Broadcasting Maritime and Aviation Communication.
High Frequency	3-30MHz	10m-100m	Shortwave, Amateur Radio, Citizens' Band Ratio
Very High Frequency	30-0.3GHz	1m-10m	FM Broadcasting Television., Aviation, GPR
Ultra High Frequency	300-3GHz	10cm- 100cm	Broadcasting Television, Mobile telephones, Cordless Telephones, Wireless Networking, Remote Keyless Entry for Automobiles
Super High Frequency	3-30GHz	1cm-10cm	Wireless Networking, Satellite links, Microwave links, Satellite Television, Door openers.
Extreme High Frequency	30-300GHz	1 mm-10mm	Microwave Data links, Radio Astronomy, Remote Sensing Advanced Weapons Systems

Table 1: RF Specifications and Applications

G. Pulse Width Modulation (PWM)

The new method, which extensively used in motor controller, is pulse width modulation (PWM). PWM switching technique is a best method to control the speed of DC motor compare to another method. The duty cycle can be varied to get the variable output voltage. The concept of this system is same like DC-DC converter which is the output voltage depends on their duty cycle.

Digital-to-analog conversion is not necessary because PWM itself is a signal that remains digital all the way from processor to control the overall system. By keeping the signal digital, noise effects are minimized unless there is a change from logic 1 to logic 0, which will make noise affect the digital signal.

The Pulse-Width-Modulation (PWM) in microcontroller is used to control duty cycle of DC motor drive. PWM is an entirely different approach to controlling the speed of a DC motor. Power is supplied to the motor in square wave of constant voltage but varying pulse-width or duty cycle. Duty cycle refers to the percentage of one cycle during which duty cycle of a continuous train of pulses. Since the frequency is held constant while the on-off time is varied, the duty cycle of PWM is determined by the pulse width. Thus the power increases duty cycle in PWM.

The expression of duty cycle is determined by:

$$\% \text{ Duty Cycle} = \text{ton}/T \times 100\ \%$$

III. DESIGN OF PROPOSED SYSTEM

A. General Overview

- The objective of this project is to control wireless dc motor control system using through RF.
- The push button is used for single bit parallel data generate. And this data gives to the Encoder IC.
- The Encoder IC is used for covert parallel single bit data into 8 bit serial data. And this data gives to RF transmitter.
- The RF transmitter is used for wireless data transmit one medium another medium.
- The RF receiver receive transmitter data and gives to Decoder IC.
- The Decoder IC is used for 8 bit serial data into single bit data. And this data gives to Microcontroller.
- The operation of the microcontroller is creating the PWM. Here we are using embedded controller built around the 8051 family (SST89E516RD) for the control according to the data pattern produced at the input port of the micro controller, the appropriate selected action will be taken.
- The logic is produced by the program written in Embedded C language. The software program is written, by using the KEIL micro vision environment.
- The program written is then Converted in HEX code after simulation and burned on to microcontroller using FLASH micro vision.
- The microcontroller control signal gives to H-Bridge motor driver IC.
- The H-Bridge motor driver IC is used for revers or forward direction purpose.
- The LCD used for represent of microcontroller instruction on the display.

B. Concept of HT12E

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in inter facing RF circuits. The chosen pair of encoder/decoder should have same number of addresses and data format.

Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits. By using these

address pins we can provide 8 bit security code for data transmission and multiple receivers may be addressed using the same transmitter.

HT12E is able to operate in a wide voltage range from 2.4V to 12V and has a built in oscillator which requires only a small external resistor. Its power consumption is very low, standby current is 0.1µA at 5V VDD and has high immunity against noise. It is available in 18 pin DIP (Dual Inline Package) and 20 pin SOP (Small Outline Package).

C. Block Diagram of Receiver & Control side

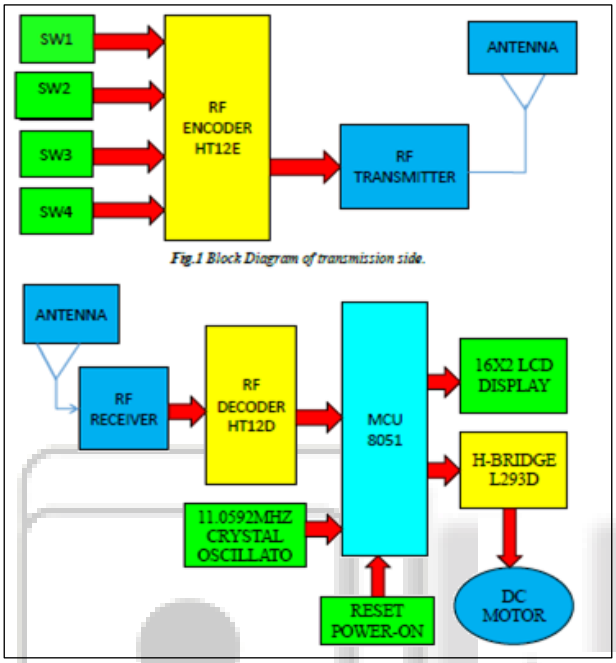

Fig.1 Block Diagram of transmission side.

D. RF Module (Transmitter & Receiver)

In generally, the wireless systems designer has two overriding constraints: it must operate over a certain distance and transfer a certain amount of information within a data rate. The RF modules are very small in dimension and have a wide operating voltage range i.e. 3V to 12V.

Basically the RF modules are 433 MHz RF transmitter and receiver modules. The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. In this RF system, the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as Amplitude Shift Keying (ASK). This RF Module Comprises Of An RF Transmitter And An RF Receiver. The Transmitter/Receiver (Tx/Rx) Pair Operates At A Frequency Of 434 Mhz. An RF Transmitter Receives Serial Data And Transmits It Wirelessly Through RF Through Its Antenna Connected At Pin4. The Transmission Occurs At The Rate Of 1Kbps - 10Kbps.The Transmitted Data Is Received By An RF Receiver Operating At The Same Frequency As That Of The Transmitter.

IV. Conclusion

By doing this paper we can say that motor control through remote device is possible by coding in mat lab. Electrical load can control forward and reverse direction, ON/OFF and also control the speed of dc motor through remote. According to click event on remote, the electrical equipment is being controlled.

My paper can be implementing in robotic arm controls, industry home appliances, centrifuges pumps where remote based controlling required.

V. Acknowledgment

Any accomplishment requires the effort, inspiration and encouragement of many people and this project is no different. I have been instrumental in giving me the ideological input for completing the project. This propelled us to put in harder efforts without which this project would not have seen the light of the day.

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