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RESEARCH ARTICLE

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BIDIRECTIONAL SPEED CONTROL OF DC MOTOR USING GSM

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ABSTRACT

Now a day's many industrial applications demand remote speed control and feedback monitoring of DC motors. Also speed control has to be accurate enough for many practical purposes. In present paper we employ GSM technology for sending control commands and monitoring speed. The desired speed control is achieved by using PWM technique.

A pulse width modulator (PWM) is a device that may be used as an efficient DC motor speed controller. This paper is a versatile device that can control DC devices which draw up to a few amps of current. This device has been used to control the speed of the DC motor. In this paper, the DC motor speed can be controlled by sending predefined messages to the modem. The modem is interfaced with the microcontroller via serial interface. The user has to send predefined messages to vary the speed and direction of the motor to the modem. When the modem receives data (SMS), it will intimate the same to the microcontroller. Now, the controller will read the modems received data by issuing certain AT commands. The controller performs the corresponding action in accordance with the message received from the modem. 16X2 LCD is connected at the controller section to display the speed level of the motor and the direction of rotation of motor.

Finally, this paper presents an easy method to control the speed of DC motor by sending SMS message from mobile phone. This system is designed to bring convenience to the user to control the motor speed from anywhere by using SMS application.

Keywords: DC Motor, speed control, PWM technique, H-Bridge, GSM technology

INTRODUCTION

This chapter will give reader a basic introduction about the idea of this paper generated. The chapter contains introduction, objective of the paper, problem statement, scopes of work, brief methodology.

In a modern industrial situation, DC motor is widely used which is due to 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. Motor application is not completed without a control system. The inventions of microprocessor and microcontroller make the control system become easier. This control system is basically controlling the switch, speed, and direction of motor. Control signal is generated by a switch that

is connected directly to the control circuit. In order to control and monitor the motor, user need to be at the place where the switch is located. DC motors have some control capabilities, which means that speed, torque and even direction of rotation can be changed at anytime to meet new condition.

DC motors also can provide a high starting torque at low speed and it is possible to obtain speed control over a wide range. So, the study of controlling DC motor is more practical significance. In this system, mobile phone is used as a control switch. By sending text message using short message service (SMS) which is a part of the Global System for Mobile Communications (GSM), control signal is sent wirelessly to the control circuit.

By implementing GSM module on the control circuit of motor, it can enable the user to send text message that contain command from any mobile phone to that GSM module.

The GSM module will receive the text command and send it to the microcontroller to be processed and converted into desired control signal. Controlling motor using SMS is really convenient and give mobility as the user is able to control and monitor the motor from anywhere as long as the places have coverage. Moreover, sending text message is considered very low cost and most of people have their own mobile phones and it already becomes one of the basic needs in life.

The overall process is done in such a way that, here we are using a GSM module.GSM (SMS) Controlled DC Motor is automatic control system which capable of receiving a set of command instructions in the form of Short message service and performs the necessary actions like Start , Stop and speed control. We will be using a dedicated modem/mobile at the receiver module i.e. with the robot itself and send the commands using SMS service as per the required actions. The mobile unit which is dedicated at the motor driver is interfaced with an intellectual device called Micro controller so that it takes the responsibility of reading the received commands in the form of SMS from the mobile unit and perform the corresponding predefined tasks such as motor start, stop, motor direction and speed control at different levels etc.

Here in this paper we are using GSM module for receiving SMS from the phone.

Introduction to GSM:

Global system for mobile communication (GSM) is a wide area wireless communications system that uses digital radio transmission to provide voice, data, and multimedia communication services. A GSM system coordinates the communication between a mobile telephones (mobile stations), base stations (cell sites), and switching systems. GSM is a global system for mobile communication GSM is an international digital cellular telecommunication. The GSM standard was released by ETSI (European Standard Telecommunication Standard) back in 1989. The first commercial services were launched in 1991 and after its early introduction in Europe; the standard went global in 1992. Since then, GSM has become the most widely adopted and fastest-growing digital cellular standard, and it is positioned to become the world's dominant cellular standard. Today's second-generation GSM networks deliver high quality and secure mobile voice and data services (such as SMS/ Text Messaging) with full roaming capabilities across the world.

GSM Modem:

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. Like a GSM mobile phone, a GSM modem requires a SIM card from a wireless carrier in order to operate.

This GSM modem is interfaced to 8051 microcontroller using the level shifter MAX232.And the dc motor is interfaced to 8051 through L293D driver.

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. And finally all the components are interfaced with 8051 micro controller and programming is done to control the motor.

Bidirectional Speed Control Of DC Motor Using GSM:

The attractive feature of the dc motor is that it offers the wide range of speed control both above and below the rated speeds. This can be achieved in dc shunt motors by methods such as armature control method and field control method. This is one of the main applications in which dc motors are widely used in fine speed applications such as in rolling mills and in paper mills.

Speed control means intentional change of the drive speed to a value required for performing the specific work process. Speed control is a different concept from speed regulation where there is natural change in speed due change in load on the shaft. Speed control is either done manually by the operator or by means of some automatic control device. Here we are controlling the speed by using the wireless technology GSM (Global system for mobile communication).

DC Motor

A direct current (DC) motor converts DC electrical energy into mechanical energy. It produces a mechanical rotary action at the motor shaft where the shaft is physically coupled to a machine or other mechanical device to perform some type of work. DC motors are well suited for many industrial applications. For example, DC motors are used where accurate control of speed or position of the load is required and can be accelerate or decelerate quickly and smoothly. Plus, the direction easily reversed.

Generally, a simple two pole DC motor has six basic parts which are rotor or armature, axle, stator, field magnets and brushes. Figure is the illustration of DC motor and shows the parts of DC motor.

Speed of DC Motor:

We know, back EMF of a DC motor Eb is the induced emf due to rotation of the armature in magnetic field. Thus value of the Eb can be given by the EMF equation of a DC generator.

$$E_b = \frac{P\emptyset NZ}{60A}$$

(where, P = no. of poles, Ø=flux/pole, N=speed in rpm, Z = no. of armature conductors, A=parallel paths)

E_b Can also be given as,

$$E_b = V - i_a R_a$$

Thus from above equations,

$$N = E_b \frac{60A}{P\emptyset Z}$$

But, for a DC motor A, P and Z are constant

$$N \alpha K\frac{Eb}{\emptyset}$$

(where, K=constant)

Thus, it shows speed is directly proportional to back emf and inversely

proportional to the flux per pole.

H-Bridge Driver:

An H bridge is an electronic circuit that enables a voltage to be applied across a load in either direction. These circuits are often used in robotics and other applications to allow DC motors to run forwards and backward. The motor forms the cross-piece in the "H". Speed and direction are controlled as current flows through the motor in the direction which is determined by the position (On or Off) of the switches in the bridge.

These circuits are often used in robotics and other applications to allow DC motors to run forwards and backwards. H-bridge driver are constructed by combining a four switches. Thus by using PWM technique speed control is done and by using concept of HBRIDGE rotation of direction of DC motor is controlled. The whole process is controlled

by using micro controller.GSM technology is used to control the motor from anywhere. The following components are used in the present paper to overcome the above disadvantages.

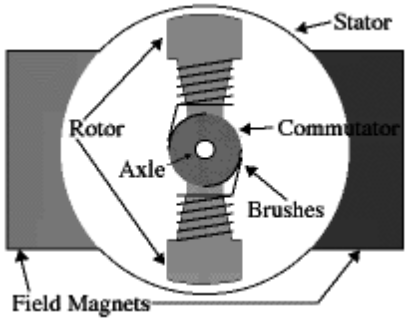
Microcontroller-GSM interfacing:

We started the paper by creating an interface between the microcontroller and the GSM modem. Since, it was the basic step of implementation; therefore it was placed first. Microcontrollers have a serial port (UART) that enables them to communicate to any device serially. Most GSM modems communicate with the computers through serial port. Since the very basic objective of the paper was to read SMS, this required an interface between the microcontroller and GSM modem. Embedded C code was written that made the controller able to feed proper AT command to the GSM phone serially. As stated earlier, reception of a new message is indicated by the mobile through AT+CMGL command; we communicated this command to the GSM phone and read its response. Further, processing was based on this response i.e. the controller reads the new message and concludes which interfaced device the user wants to switch.

Hardware Implementation

Introduction:

The main aim of the dc motor speed control using PWM is after power on the power supply generates +5v dc ,+12v dc ,the logic section works on +5v dc and the motor and motor driven sections are working on +12v dc .the explanations of the power supply is given in the power supply module. After power on the micro controller generates oscillations at the rate of 11.059- 12Mhz.Frequency sine wave i.e. internally converted into square wave with the help of internal oscillator. The oscillator section is given bellowing the oscillator module. The reset logic generates the reset signal are applied at the RxD pin of the micro controller. The exploitation of the reset logic is given below. After reset he micro controller starts executing program on the memory location program area 0000H initially the micro controller initializes the LCD display connected to the port0, port2.7, port2.6, port2.5. Sub sequentially the microcontroller displays the “set speed” i.e. required Speed to rotate the information must be feeded through 3 switches connected to the port1; the 3 switches are meant for increment decrement, set. After set speed is entered the micro controller drives the motor via motor driver tip122 transistor connected to the port if the port pin is 1 the transistor enters in to the saturation region then the motor start rotating at the rate of specified speed the speed is decided by the duty cycle. initially we are rotating at the rate of 50% Duty Cycle i.e. 50% on time and 50% off time .The rotation of the motor is detected by the an optical encoder that includes u-shaped OCTO-coupler and sensor with holes the OCTO-coupler generates a square wave corresponding to the number of ports located on the disk and motor speed.



Parts of DC Motor

The very basic construction of a dc motor contains a current carrying armature
which is connected to the supply end through commutator segments and brushes and placed within the north south poles of a permanent or an electro-magnet as shown in the diagram below.

Now to go into the details of the operating principle of DC motor, it is important that we have a clear understanding of Fleming’s left hand rule to determine the direction of force acting on the armature conductors of dc motor. Fleming’s left hand rule says that if we extend the index finger, middle finger and thumb of our left hand in such a way that the current carrying conductor is placed in a magnetic field (represented by the index finger) is perpendicular to the direction of current(represented by the middle finger), then the conductor experiences a force in the direction (represented by the thumb) mutually perpendicular to both the direction of field and the current in the conductor. Every DC motor has six basic parts -- axle, rotor (a.k.a., armature), stator, commutator, field magnets and brushes. In most common DC motors (and all

that beamers will see), the external magnetic field is produced by high-strength permanent magnets. The stator is the stationary part of the motor -- this includes the motor casing, as well as two or more permanent magnet pole pieces. The rotor(together with the axle and attached commutator) rotate with respect to the stator. The rotor consists of windings (generally on a core), the windings being electrically connected to the commutator. The geometry of the brushes, commutator contacts, and rotor windings are such that when power is applied, the polarities of the energized winding and the stator magnets are misaligned, and the rotor will rotate until it is almost aligned with the stator's field magnets. As the rotor reaches alignment, the brushes move to the next commutator contacts, and energize the next winding. Given our example two-pole motor, the rotation reverses the direction of current through the rotor winding, leading to a "flip" of the rotor's magnetic field, driving it to continue rotating. Here in this paper we are using geared 12v dc motor and the specifications are,

- Length: 80mm
- Torque: 1.5 kg.cm
- Shatt Diameter: 6mm
- Weight: 130.00g
- Speed :100 RPM
- Voltage : 12V

Microcontroller:

Micro controller is a true computer on a chip. Microprocessors are intended to be general-purpose digital computers whereas micro controllers are intended to be special purpose digital controllers. Generally microprocessors contain a CPU, memory addressing units and interrupt handling circuits. Micro controllers have these features as well as timers, parallel and serial I/O and internal RAM and ROM. Like the microprocessor, a microcontroller is a general-purpose device, but one that is meant to read data, and control its environmental based on those calculations. The contrast between a micro controller and a microprocessor is best exemplified by the fact that microprocessors have many operational codes for moving data from external memory to CPU; microcontrollers may have one or two. Microprocessors may have one or two types of bit-handling instructions; micro controllers will have many. The microprocessor is concerned with the rapid movement of code and data from external addresses to the chip; the microcontroller is concerned with rapid movements of bits within the chip. The microcontroller can function as a computer with the addition of no external digital parts; the microprocessor must have many additional parts to be operational. Generally 4-bit microcontrollers are intended for use in large volumes as true 1-chipcomputers.

Typical applications consist of appliances and toys. Eight bit micro controllers represent a transition zone between the dedicated, high volume, 4-bit micro controllers and the high performance, 16 and 32-bit units. Eight bit micro controllers are very useful word size for small computing tasks. 16-bit controllers have also been designed to take the advantage of high level programming languages in the expectation that very little assembly language programming will be done when employing these controllers in sophisticated applications. 32 bit controllers are also used in high speed control and signal processing applications.

GSM Modem:

A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages.

GSM Modem

This GSM modem is a highly flexible plug and play quad band GSM modem for direct and easy

integration to RS232. Supports features like voices, data, SMS, GPRS and integrated TCP/IP stack.

* Insert SIM card: Press the yellow pin to remove the tray from the SIM card
holder. After properly fixing the SIM card in the tray, insert the tray in the slot
provided.

* Connect RS232 cable: (cable provided for RS232 communication) Default
baud rate is 9600 with 8-N-1, no hardware shaking. If we need hardware handshaking the pins 7,8 can be taken for signaling.

* Pin 2 is RS232 level TX out

* Pin3 is RS232 level RX in

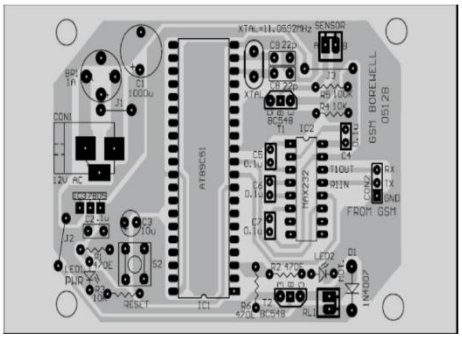
* Pin 5 is ground

* Pin 7 RTS in (shorted to pin 8 in cable for no hardware handshaking)

*Pin 8 CTS out (shorted to pin 7 in cable for no hardware handshaking)

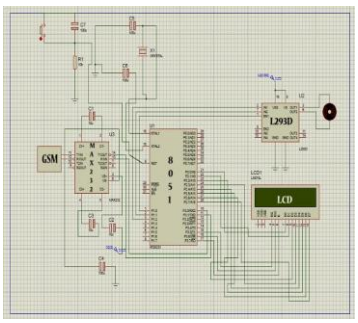
After the modem registers the network, Led will blink in step of 3 seconds. At this stage
we can start using our modem for our modem for our application.

Component Layout:

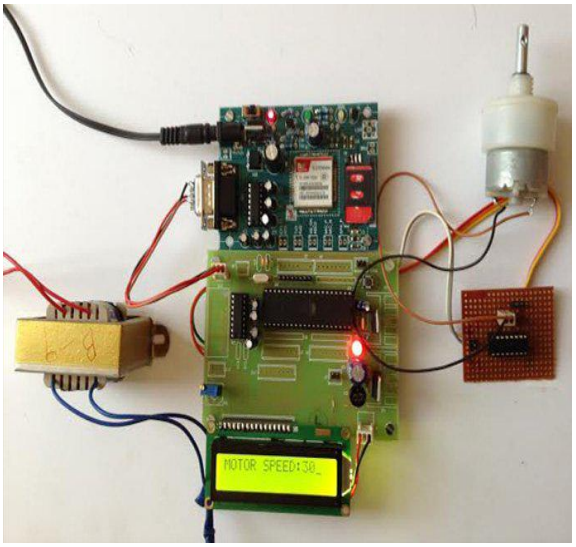


Component Layout

Schematic Diagram:



Results And Conclusion:



Paper Overview

Result

Our paper deals with the speed and direction control of DC motor by using Microcontroller 8051, LCD displays and LED's.. When we send SMS from the mobile phone it is received by the GSM modem and based on the AT commands and the program in the micro controller the data is received and the output is generated. This signal is sent to the microcontroller which decodes the signal and performs the
corresponding action for the respected output. At the same time Microcontroller sends the signals to LCD monitor which displays the set speed and direction of DC motor. Here we have used 16×2 LCD which
has 16 bit length and 8 bit characters. We have used L293D driver for voltage amplification and H-Bridge circuit. Depending up on the outputs of the microcontroller, speed and direction of rotation of DC motor is controlled as per our requirement. Now 8051 will perform its operation in accordance with our code and switches on the DC motor as per our use. We can operate the entire system by just sending an SMS from the mobile phone from anywhere and can the control the DC motor as per our requirement. So our paper "BIDIRECTIONAL SPEED CONTROL OF DC MOTOR USING GSM" has designed successfully and the output for different speeds is obtained.

Output Graph:

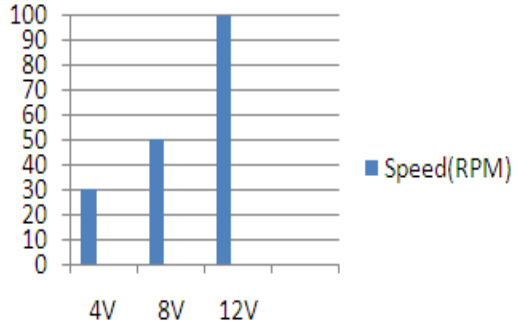


Table Representing The Control Commands :

Commands	Speed(RPM)	Direction
@1	30	FORWARD
@2	30	REVERSE
@3	50	FORWARD
@4	50	REVERSE
@5	100	FORWARD
@6	100	REVERSE

Conclusion:

* The paper "BIDIRECTIONAL SPEED CONTROL OF DC MOTOR USING GSM" has been successfully programmed using KEIL & PROTEUS software and the output is tested for various required speeds on DC motor. In the previous papers speed is controlled in forward direction. But, in this paper speed is controlled in both(forward and reverse) the directions.

Future Improvement:

- In this paper messages are sent through GSM network and Control the speed
- and direction of DC motor by utilizing AT (ATTENTION) commands. The same principle can be applied to display the message on electronics display board appliances at a distant location.
- Robots can be controlled in a similar fashion by sending the commands to the
- robots. These commands are read by using AT commands and appropriate action is taken. This can be used for spy robots at distant locations, utilized by the military to monitor movement of enemy troops.
- Currently farmers have to manually put on or off pumps, drippers etc by using electric switches. Using the principle of AT commands we put on off these appliances remotely.

References:

[1]. The 8051Microcontroller by Kenneth J. Ayala
[2]. The 8051 Microcontroller and Embedded Systems by Muhammad Ali Mazidi.
[3]. Principles and Applications of GSM by Vijay Garg.
[4]. LCD interfacing, the microcontroller and embedded systems by Muhammad Ali
[5]. Mazidi, Janice GillispieMazidi, Rolin D. Mckinlay Douglas V. Hall, Microprocessors and Interfacing, Revised Second Edition
[6]. Driving DC Motors by G. MAIOCCHI, DC Motors and drives by BL. THERAJA Pulse Width Modulated Power supplies by VALTER QUERCIOLI.
[7]. Micro processor Architecture, Programming & Applications by Ramesh S.Gaonkar
[8]. Wireless Speed and Direction Control of Dc Motor by Using Radio Frequency Technology By Ankesh N.Nichati, Sheikh KadirAliz, YogeshD.Solankez,AmithM.dodke.
[9]. Speed Control of Dc Motor Using Four-Quadrant Chopper and Bipolar ControlStrategy ByCiprianAfanasov, Mihai Rata, Leon Mandici.
[10]. PWM direct transmission through RF for motor speed and direction controlling By Syed Ahsan Ali
[11]. Touch Screen And Accelerometer Based Wireless Motor Speed And Direction
[12]. Controlling System Using Arduino By M.Pragna, K.S.Roy, Mahaboob Ali.
[13]. Controlling DC Motor using Microcontroller (PIC16F72) with PWMByShrutiShrivastava, JageshwarRawat, AmitAgrawal.
[14]. Thyristor Based Speed Control Techniques of DC Motor: A Comparative Analysis ByRohit Gupta, RuchikaLamba, SubhransuPadhee.
[15]. CPLD Based Speed Controller of a DC Motor Operated through Cell phone ByManas Kumar Parai, DebajyotiMisra, Banasree Das.
[16]. Speed Control of PMDC Motor Using LM3524 PWM IC by Dipti K. Shah, Prof. B.T.deshmukh.