

Speed Control of DC Motor via Internet

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Abstract

The Internet has played an important role in our daily life. The foremost target of Internet has always been the communication. We can communicate in a fraction of second with a person who is sitting in the other part of the world. Today for better communication, e-mail and other facilities are available also, we can chat for hours with our friends who are live anywhere in the world. Such services of Internet which provide to establish a kind of global friendship where you can explore other cultures of different countries. The information is biggest advantage offered by internet ie, Internet is a virtual treasure of information. Now a days Internet achieve a drastic changes in communication as well as the industrial area. In recent years, Internet is also used for controlling the industrial machines like motors cranes and other devices which placed remotely. There are several methods available for controlling speed of DC motor depending on its industrial as well as the domestic applications. This paper includes three type methods for controlling the speed of DC motor by using an android phone. The methods are as follows; (i): Speed control of dc motor using SMS application, (ii): Speed control of dc motor by voice recognition via Bluetooth and (iii): Speed control of dc motor via Internet. Among the above method, the third one is the introduced system ie Speed control of DC motor Via Internet. In this system, the industrial machines like cranes, traction motors can be controlled remotely by just scrolling the widget in the android smart phone. This gives enough opportunities for physically challenged people to operate industrial machines more easily and safely. This system is simple, cost effective and digital. By using this system we can control any machine from anywhere on the world.

Keyword- Smart Phone, Internet, Traction Motors

I. INTRODUCTION

Today the Internet is the most powerful tool in the world. The Internet is a collection of various services and resources. However, like every single innovation in science and technology, Internet has its own advantages and disadvantages. Besides, information is the biggest advantage internet is offering. The Internet is a virtual treasure of information. Any kind of information on any topic is available on the Internet, and you can almost find any type of data on almost any kind of subject that you are looking for. There is a huge amount of information ranging from government law and services to market information, new ideas and technical support. It is very useful for students who usually have to gather information to do their homework. Entertainment is another popular reason explaining why many people prefer to surf the Internet. Downloading games and songs, visiting chat rooms or just surfing the web are some of the pleasures people have discovered. When people surf the web, there are numerous things that can be found. Music, hobbies, news and more can be found and shared on the Internet.

The Internet was mainly used for communication, data transmission in the later 2000 but recently it serves many purpose other than communication. They are communication between human and machine which is otherwise called human machine interaction. Today the power of internet is applied for doing many task like controlling a remotely placed server machine from anywhere in the globe. Smartphones had made a revolution in the world but the concepts that led to the invention of Smartphone was during 1970s. It was however not until 1992 when IBM came up with a phone which has personal digital assistant (PDA) features.

An automation system was developed for home using BT which saves lot of power but it will not setup connection all the time when essentially required. Another technique to assistant handicapped old aged people to control various home appliances but the BT connectivity was not all the time. Smart home and monitoring system has low cost and flexible monitoring system using micro web server technology but this technique can control devices only to certain extent. No work have done on controlling any power machine using android Smartphone through internet which can be very much useful in Industrial and in Traction applications. Here Android Smartphone can be used as a powerful tool to control these power machines. With the introduced system any power cranes as industrial machines, traction motors need not be operated with the gears and the operators need not be in the place where the task is done. This introduced system any power machine can be operated from anywhere in the globe, anytime just by scrolling (or) touching some of the widgets in the Smartphone application. The advantages of introduced system are cheap, reliable, robust (can be installed in all places), wide range of control, accuracy as it is controlled digitally.

II. SPEED CONTROL USING SMS APPLICATION

In this method, 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.

III. SPEED CONTROL OF MOTOR BY VOICE RECOGNITION

In this method, voice recognition is carried out by android mobiles in which internal voice recognition is used to pass voice commands to motor which is paired with Bluetooth Serial Modules which in turn the recognized voice as a string. ARDUINO receives the command voice output from the android mobile and there are certain predefined conditions in ARDUINO. If it satisfies the condition then it sends the signal to driver circuit. Driver circuit in turn converts output pulse signal from ARDUINO to electrical signal (voltage) required to drive the motor. DC motor is sensed by the speed sensor. The sensed output is given back to the android mobile via Bluetooth.

Voice is given to the android mobile. The mobile is used with an installed voice recognition application. This application has the feature of sending voice commands and also has the ability of receiving speed from the speed sensor. Voice command is given to android mobile application. This application sends the voice to the Bluetooth module interfaced with ARDUINO UNO. HC-05 is the Bluetooth module used here. Voice command is converted into industrial, scientific and medical (ISM) radio bands of about 2.4 GHz frequencies and transmitted to the microcontroller. It converts the given input signal to pulsating signal with the help of programming performed using ARDUINO software. The pulsating signal is converted into the driving signal using driver circuit. The driver circuit has IC L298. It operates two DC motors simultaneously up to 46V and 4A. The motor rotates as we given command through the android mobile. Speed is sensed by the IR sensor. It is a wireless sensor and it is directly connected to the ARDUINO UNO board. The speed of the motor can be displayed by android mobile via Bluetooth.

IV. SPEED CONTROL OF DC MOTOR VIA INTERNET

The Android Smartphone can be used as a powerful tool to control these power machines. With the introduced method any power cranes as industrial machines, traction motors need not be operated with the gear and the operators need not be in the place where the task is done. In this method any power machine can be operated from anywhere in the globe, anytime just scrolling or touching some of widgets in the smartphone application. The advantage of this system are cheap, reliable, robust (can be installed in all places), wide range of control, accuracy as it is controlled digitally.

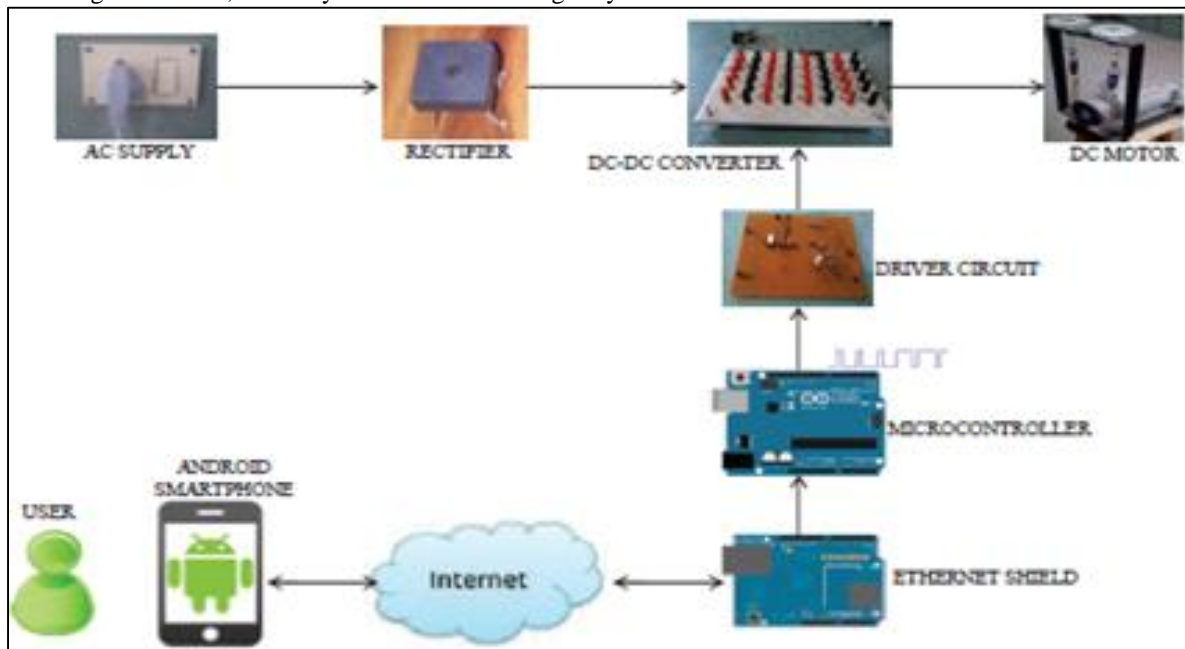


Fig. 1: Block diagram of the speed control of DC motor using android smartphone via internet

The introduced system consist of rectifier which converts the available 230V, 50Hz, single phase AC supply to pulsated DC supply and the filter capacitor smoothens the pulsated DC supply to pure DC. The pure DC is then fed to the DC/DC converter which converts fixed DC into Variable DC supply. The variable DC supply is connected to high power DC motor. The DC/DC converter has an Insulated Gate Bipolar Transistor [IGBT], diode, inductors and capacitor for smoothening current ripple and voltage ripple. The main component of DC/DC converter is the IGBT which is driven by the PWM pulses fed from the

Microcontroller. The developed android application will have a slider widget which is designed to have (0-255) i.e.8-bit digital values. The Smartphone and the Ethernet shield is interfaced by a authentication token and linked by a cloud server on the web when an user needs certain speed on the DC motor, the user needs to slide the widget and the slider has to be fixed in the position. The corresponding control data is sent to the Ethernet shield. The Ethernet shield is the internet provider to the ARDUINO UNO microcontroller. The control data sent by the user through internet will be received by the Ethernet shield and the shield transfers the control data to the ARDUINO UNO microcontroller. The microcontroller converts the control data into corresponding PWM pulses. The PWM pulse produced by the microcontroller will be in the order of 5V which will not drive the power IGBT. The 5V PWM signal is then boosted to 20V by IGBT driver circuit. The output PWM pulse from the driver circuit is then fed to the gate terminal of the IGBT. The main purpose of driver is for isolating the ARDUINO microcontroller from the power circuit.

V. BUCK CONVERTER

In this introduced system, buck converter shown in Fig. 2. Is the heart of the system which converts fixed DC (230V) into variable DC (0-230V) by varying the duty ratio of the PWM signal. There are various types of DC/DC converter available the buck converter is chosen here because this application needs variable DC voltage of zero to the rated value. The operating mechanism of buck converter includes the current in an inductor controlled by two switches IGBT and diode. In ideal condition, all components are considered perfect that is the IGBT and diode will have zero voltage drop in ON state and zero current flow in OFF state. Practically all these conditions are not possible. The converter is operated with a switching frequency of 1kHz. The Output voltage of Buck Converter is V

$$V_0 = \delta V_s \delta = \frac{t_{on}}{T}$$

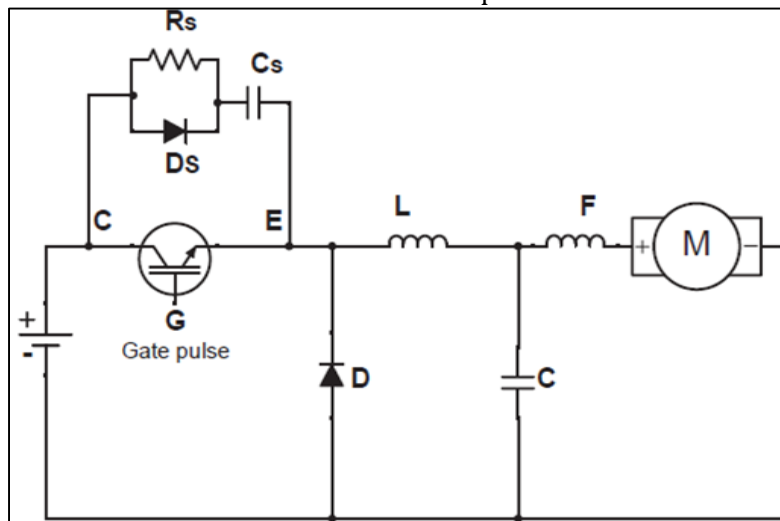


Fig. 2: The schematic representation of buck converter with snubber circuit fed to DC motor

VI. COMPONENTS USED

A. Snubber Circuit

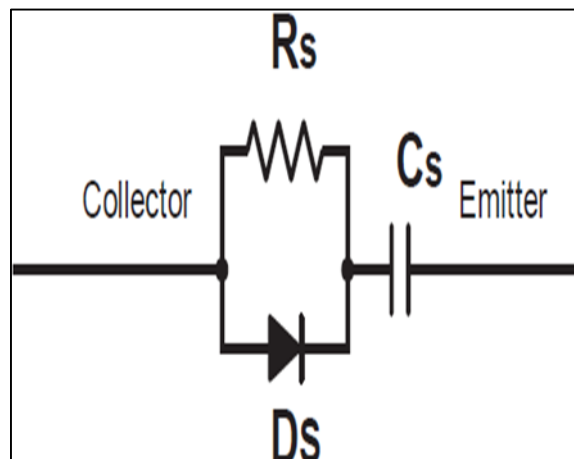


Fig. 3: Snubber circuit used across the IGBT for device protection to withstand under high voltage stress during switching

Snubber is the protective circuit shown in Fig. 3 used across the power switching device i.e. IGBT. In order to attain a good damping condition, snubber circuit is used to reduce the voltage stress across the switch. The values of Cs is chosen by considering the sum of output capacitance and reverse transfer capacitance. The snubber resistance Rs is chosen by ratio of output voltage to the current the initial voltage across Rs when current flow through it should be lesser than damped output voltage. The Cs is chosen to have 22 μ F, Rs is 220 and Ds is D1N4007.

B. Microcontroller

The ARDUINO UNO shown in Fig. 4 is a powerful n board microcontroller which can be used for many applications like robotics, automation, industrial machine control etc., the UNO has an on-board ATMEGA328 microcontroller which is operated at 5V. It has 14 digital I/O pins and 6 Analogue pins. The flash memory for this board is 23kB of which 0.5kB is used by the boot loader. The clock speed of the processor is 16MHz which is given by a Quartz crystal oscillator. The ATMEGA328 has 32kB of flash memory for storing the sketch. It also has SRAM of 2kB and 1kB of EEROM. Serial 1(TX) is used to transmit and receive 0(RX) receives TTL series data. UNO provides 8 bit PWM output by using analogue write () function. ARDUINO UNO is designed to provide many facilities for communicating with the computers, another ARDUINO and other on-board controllers. The software has a serial monitor which displays text data to be sent to or from the board. Any natural signal can be sensed by variety of sensors and the ARDUINO can process these analogue signal and gives us digital value of the signal for storage and analysis. It can also control lights, motor, sensors and other actuators.

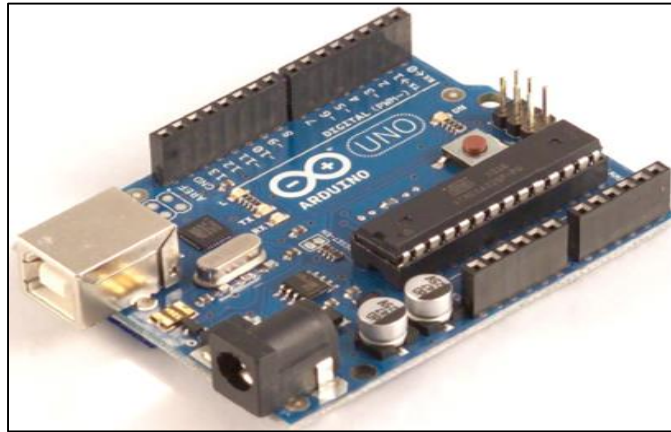


Fig. 4: ARDUINO UNO R3 Microcontroller with On-Board ATMEGA328 with USB connector, 8bit PWM output, 14 digital I/O,6 analogue pins

C. Ethernet Shield

The ARDUINO Ethernet shield shown in Fig. 5 connect any ARDUINO on-board microcontroller to the internet by just plugging the Ethernet module to RJ45 cable. The Ethernet shield is connected onto the ARDUINO UNO for the microcontroller to be linked to the internet. It works on the basis of wiznet W5100 Ethernet shield. The W5100 wiznet provides network (IP) stack which is capable of both TCP and UDP. It provides four simultaneous socket connections, predefined Ethernet library is available to write codes. The board has low output ripple and noise and also has short circuit and overload protections. It provides isolation up to 1500V. This board works on the operating voltage of 5V provided by the ARDUINO UNO. It can have connection speed up to 10 to 100Mbps.

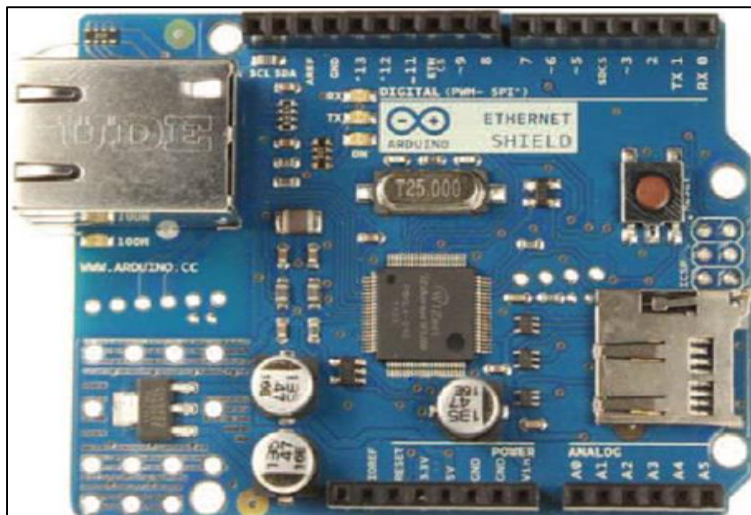


Fig. 5: Arduino Ethernet shield with W5100 wiznet to provide internet connection to the Arduino UNO Micro Controller

D. Smartphone Application

The android application is developed in an open source environment which has many control widgets as ON/OFF switch, slider, data reader etc., Each project file will have an authentication token that has to be linked it with the microcontroller through scripts when both Smartphone and controller gets an internet connection. It is linked by the authentication token which is configured in the android application as well as in the ARDUINO microcontroller through a web server on the cloud. The internet in the phone is configured to send control data by scrolling the slider in the android application. The slider is configured with 0 to 255 digital values. According to the value that is fixed by the user the data is sent to the Ethernet shield and the corresponding pulse with duty ratio is achieved. The received signal will drive the IGBT through driver circuit by which the speed of the machine can be controlled.

VII. CONCLUSION

The detailed explanation of three methods for speed controlling of DC are included in this paper. The speed control of DC motor can be done by SMS through android phone, voice recognition via Bluetooth and speed control via Internet. The speed of power DC motor is controlled for various values of duty ratio. To have visualization about speed, temperature and other parameters of the machine, the analogue value from the sensor can be fed into the microcontroller and it is processed through scripts and converted to digital data. The digital data can be sent to the Smartphone application and seen in the data reads widget by this user. This gives enough opportunities for physically challenged people to operate industrial machines more easily and safely. This system is simple, cost effective and digital. By using this system we can control any machine from anywhere on the world.

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