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Microcontroller Based Speed Control of DC Motor

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ABSTRACT

Direct current (DC) motor has already become an important drive configuration for many applications across a wide range of powers and speeds. The ease of control and excellent performance of the DC motors will ensure that the number of applications using them will continue grow in future. This paper is mainly concerned on DC motor speed control system by using microcontroller PIC 16F877A. The objective of developing this project is to control the speed of DC motor. The main advantage in using a DC motor is that the Speed-Torque relationship can be varied to almost any useful form. To achieve the speed control DAC is used which generates voltages gradually according to microcontroller digital pulses. These voltages vary the speed in the motor. This project can be used in automation field where it is needed to control the speed and direction of a dc motor.

Keywords: DC Motor, Microcontroller, Peripheral Interface Controller (PIC)

I. INTRODUCTION

Direct current (DC) motors have variable characteristics and are used extensively in variable-speed drives. DC motor can provide a high starting torque and it is also possible to obtain speed control over wide range. It is important to make a controller to control the speed of DC motor in desired speed. DC motor plays a significant role in modern industrial. These are several types of applications where the load on the DC motor varies over a speed range. These applications may demand high-speed control accuracy and good dynamic responses. DC motors are suitable for belt-driven applications and the applications where great amount of torque is required. In Train and automotive traction, fuel pump control, electronic steering control, engine control and electric vehicle control are good examples of these. In aerospace, there are a number of applications, like centrifuges, pumps, robotic arm controls, gyroscope controls and so on. For precise speed control of servo system, closed-loop control is normally used. The speed, which is sensed by optical sensing devices (e.g., LED & Photo diode), is compared with the reference speed to generate he error signal and to vary the armature voltage of the motor.

II. METHODOLOGY

Figure 1 shows the block diagram of DC motor speed control

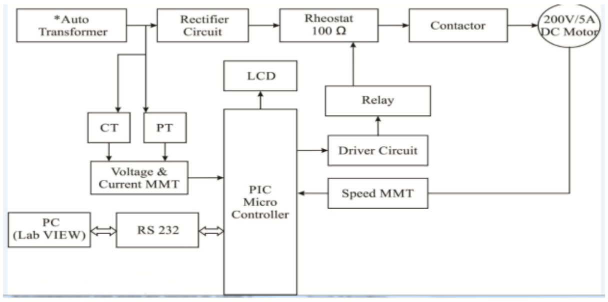

Figure 1. Block Diagram

As shown in the block diagram the major component used are Microcontroller, LCD, power supply, Current Measurement Unit, Voltage Measurement unit and DC motor. This assembly is connected to a computer using RS232 which works as a logic level converter. At the PC the frontend designed in Lab View will work as a Graphical User Interface.The front end displays the values of voltage, current and speed. There is a tab to set the speed of the motor as specified by the user. Once the speed is set, this signal will be transmitted to the microcontroller via RS232. The microcontroller will then checks the set speed provided by the user with current speed of the motor and then provide triggering PWM pulses to the MOSFETs which in turn controls the speed of the motor. To test the speed of the motor the proximity sensor which is a metal sensor is placed in front of circular metal blade connected with the shaft of the motor. To generate the fault an additional load is added to the motor which in turn will increase the current. Hence when Over current will occurs, the microcontroller will trip the motor.

III. SYSTEM DETAILS

The major component used are : Microcontroller, LCD, power supply, Current Measurement Unit, Voltage Measurement unit and DC motor.

A. **Microcontroller**

The Microcontrollers are destined to play an increasingly important role in revolutionizing various industries and influencing our day to day life more strongly than one can imagine. It is finding using diverse area, starting from simple children's toys to highly complex spacecraft. Because of its versatility and many advantages, the application domain has spread in all conceivable directions, making it ubiquitous. As a consequence, it has generate a great deal of interest and enthusiasm among students, teachers and practicing engineers.

A microcontroller is a complete microprocessor system built on a single IC. Microcontrollers were developed to meet a need for microprocessors to be put into low cost products.

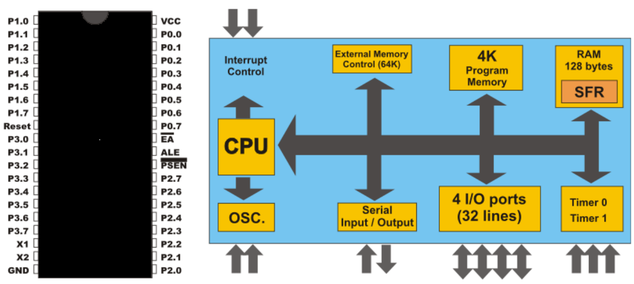

Figure 2. Block diagram of the micorocontroller

B. LCD

The Crystalonics dot –matrix (alphanumeric) liquid crystal displays are available in TN, STN types, with or without backlight. The use of C-MOS LCD controller and driver ICs result in low power consumption. These modules can be interfaced with a 4-bit or 8-bit micro processor /Micro controller.

C. **Power supply**

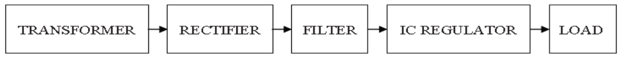

Figure 3. Block diagram of Power supply

The ac voltage, typically 220V rms, is connected to a transformer, which steps that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also remains the same dc value even if the input dc voltage varies. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

D. Current Measurement Unit

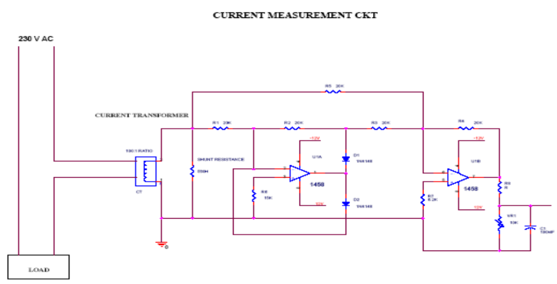

Figure 4. Current Measurement unit

This circuit is designed to monitor the supply current. The supply current that has to monitor is step down by the current transformer. The step down current is converted by the voltage with the help of shunt resistor. Then the converted voltage is rectified by the precision rectifier. The precision rectifier is a configuration obtained with an operational amplifier in order to have a circuit behaving like an ideal diode or rectifier.

The full wave rectifier is the combination of half wave precision rectifier and summing amplifier. When the input voltage is negative, there is a negative voltage on the diode, too, so it works like an open circuit, there is no current in the load and the output voltage is zero. When the input is positive, it is amplified by the operational amplifier and it turns the diode on. There is current in the load and, because of the feedback, the output voltage is equal to the input.

E. Voltage Measurement unit

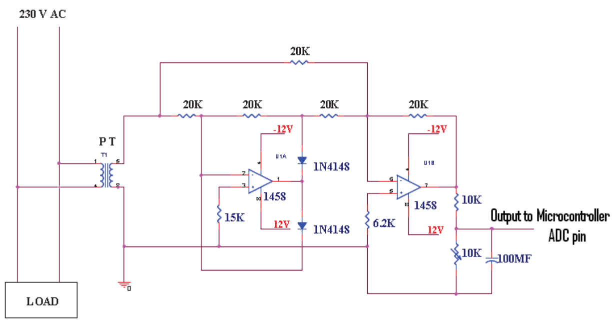

Figure 5. VoltageMeasurement unit

This circuit is designed to monitor the supply voltage. The supply voltage that has to monitor is step down by the potential transformer. Usually we are using the 0-6v potential transformer. The step down voltage is rectified by the precision rectifier. The precision rectifier is a configuration obtained with an operational amplifier in order to have a circuit behaving like an ideal diode or rectifier.

The full wave rectifier is the combination of half wave precision rectifer and summing amplifier. When the input voltage is negative, there is a negative voltage on the diode, too, so it works like an open circuit, there is no current in the load and the output voltage is zero. When the input is positive, it is amplified by the operational amplifier and it turns the diode on. There is current in the load and, because of the feedback, the output voltage is equal to the input.

F. Speed Measurement Unit

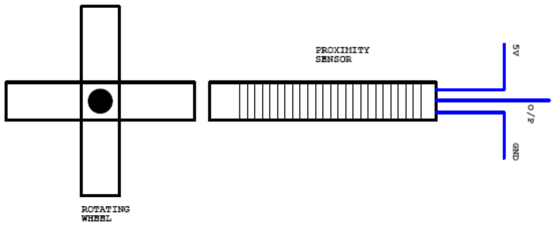

Figure 6. Proximity sensor:

Inductive proximity sensors are widely used in various applications to detect metal devices. They can be used in various environments (industry, workshop, lift shaft...) and need high reliability.

Inductive proximity sensors generate an electromagnetic field and detect the eddy current losses induced when the metal target enters the field. The field is generated by a coil, wrapped round a ferrite core, which is used by a transistorized circuit to produce oscillations. The target, while entering the electromagnetic field produced by the coil, will decrease the oscillations due to eddy currents developed in the target. If the target approaches the sensor within the so-called "sensing range", the oscillations cannot be produced anymore: the detector circuit generates then an output signal controlling a relay or a switch.

The wheel type metal rod is fixed in the motor shaft. The proximity sensor is placed near the shaft. When the shaft is rotating, the metal rod is crossed the proximity sensors sequentially. So the sensor gives the pulse to the microcontroller. Now the microcontroller counts the pulse. By using this pulse count we can find revolution per minute which is equal to speed of the microcontroller.

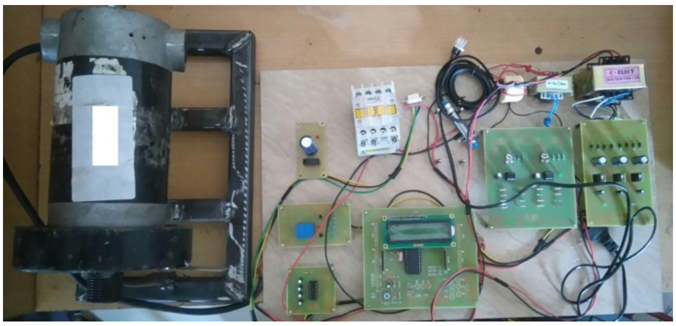

Figure 7. Hardware Implementation

IV. CONCLUSION

Thus we have been able to develop a microcontroller based hardware implementation which is able to monitor the speed of the DC motor. In addition to monitoring the speed of the motor it is also possible to measure the voltage and current. The voltage and current are displayed on LCD and if any fault occurs such as over voltage, over current and under voltage then the motor will be tripped. The system will thus allow to monitor the speed of the motor and will also protect the motor in case of any fault and will prevent the motor from getting damaged.

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