

Investigation of DC Motor Control Strategies for Variable Speed and Direction Management

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Abstract. Motion control plays a vital role in industrial atomization. Application wise variety type of motors like DC, AC, stepper or servo are used. Because of easier control DC motors are very popular to the users, its application is oriented very useful for rotation and speed. As speed depends on voltage applied to the terminal, smoothly can be controlled down to zero and again accelerated opposite way without using power CKT and switching CKT. Hence, if voltage across motor terminal is varied, then speed can also be varied. One of the best controlling method for DC motor is armature voltage control method using PWM. Speed of the motors depends on the variation of the duty cycles. Direction control can be achieved by the same microcontroller using slight modifications in its programming language. Depending on the application speed range vary in DC motor. Analysis and design of any system in real time can be easily implemented by hardware technology also by smart software. A motor driver IC is interfaced to the microcontroller for receiving PWM signals and delivering desired output for speed control of a small DC motor. The combination provides smooth speed control in both clockwise as well as anticlockwise direction.

Keywords: DC motor, PWM signal, Proteus simulation, PIC 18F4550, speed and direction control.

Introduction

In both industries and domestic, the use of DC motor is very high. Domestic sense like mixer, zero machine, hair dryer, elevator similarly in industry point of view like traction and in elevator. These applications demand accuracy high-speed control, and good dynamic responses. Most of the home appliances, washers, dryers and compressors are good examples of speed control. In automotive, electronic steering control, engine control, fuel pump control, and electric vehicle control are good examples of these. In aerospace technology, there are a lot of applications, such as pumps, robotic arm controls, centrifuges, gyroscope controls and so on.

Depending on the application speed range varies in DC motor. Both industries and domestic, the use of DC motor is very high. Domestic sense like mixer, zero machine, hair dryer, elevator similarly in industry point of view like traction and in elevator. For practical application of view DC motor is very useful [1].

12v dc will generate by driving circuit without changing load, one can able to control the DC motor with desired speed. For this one can use PIC18F4550 microcontroller device which is also very low cost and best low-cost device for ECG measurement [2] and this also is used for data Acquisition process [3].

Whenever we think then programmable devices like embedded technology comes fast in mind. The embedded systems are nowadays very much popular and most of the product are developed with Microcontroller based embedded technology. The advantages of using the microcontroller is the reduction of the cost and also the use of extra hardware such as the use of timer RAM and ROM can be avoided. This technology is very fast thereby controlling of multiple parameters is possible; also, the parameters are field programmable by the user. Here we are using Programmable embedded microcontroller for PWM based speed control of DC motor. The scope of this project includes using MPLAB IDE to program microcontroller PIC 18F4550, build hardware for the system, and interface the hardware to computer by using RS232 serial port communication. DC motor, programming one can use assembly language [4].

Block Diagram

By use of digital technology, there has been interesting in DC motor control, either in terms of direction or in terms of speed. This will be perfect only when code is run on the actual hardware.

The principal of electromagnetism will play an important role when current will pass through DC motor. Axle, stator, commutator, rotor, field magnet and brushes are six parts of DC motor [5].

Basically, the motor speed depends on supply voltage, if supply will be one fourth then speed will be reduced to twenty-five percentage of the original speed. Figure 1 represents the basic block diagram of the purposed system.

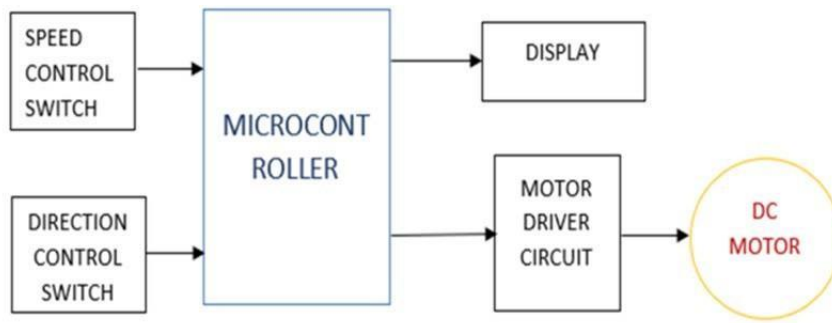


Figure 1. Block diagram of proposed system.

Hardware Implementation

Motor Basically it is used for encoding of amplitude of require signal and sometimes used as a carrier signal. Basically, it is used in AC/DC motors and control the power of various electrical devices. It is possible to control the average power delivered to load; DC voltage chopping can be possible with regular interval. Due to high and low pulse speed can be increased or decreased by the motor. As per the applications speed of the controller requirement is important. This requirement may demand the accuracy and good dynamic response. Desired speed makes able to change speed slower, faster, slower up, faster down

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all can possible. Here the basic pin diagrams of PIC18F4550 is shown in figure 2. Figure 3 indicates Motor driver circuit, which is a monolithic, high current, high voltage is designed to accept TTL logic.

Internal clamp diodes are included and a separate supply for allowing the logic operation with a suitable switching application. After all circuits to be arranged properly, so one can tracking the copper layer just like in figure 4. PCB traces they may make or break the operation of electrical performance [6].

Figure 5 indicates the flow charts for speed and direction control and for this one has to assign the ports, variables and required connecting devices.

The main roll is the interrupt of delay, time, pulse and PWM module. PIC18F4550 microcontroller one can say the low cost and it is used to control advertising in LED system [7].

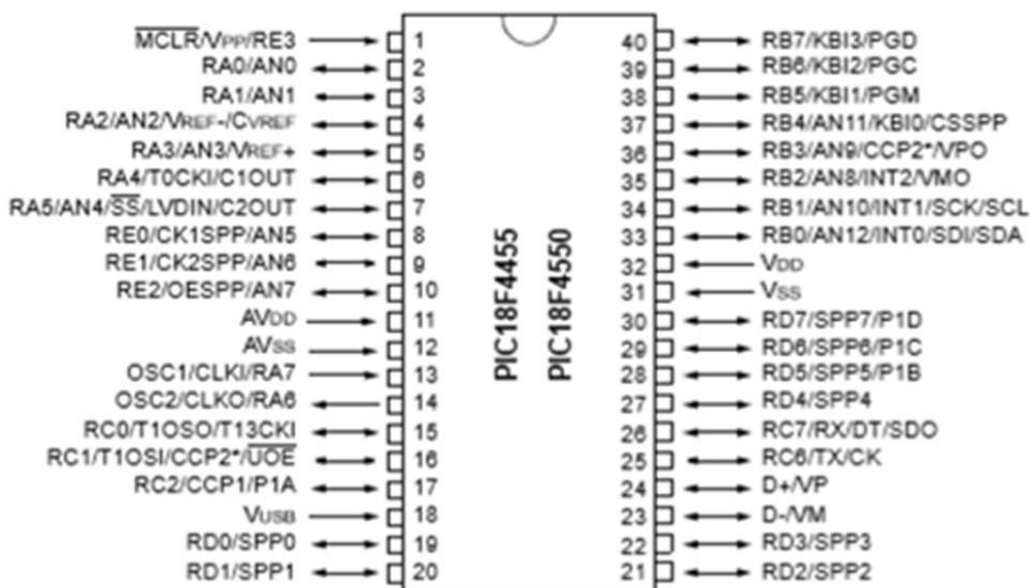


Figure 2. Pin diagram representation of PIC 18F4550.

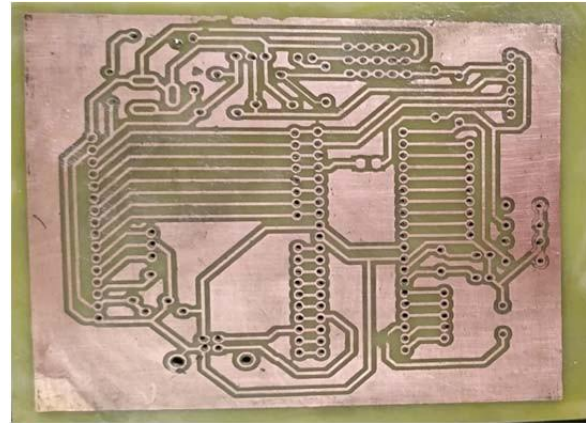
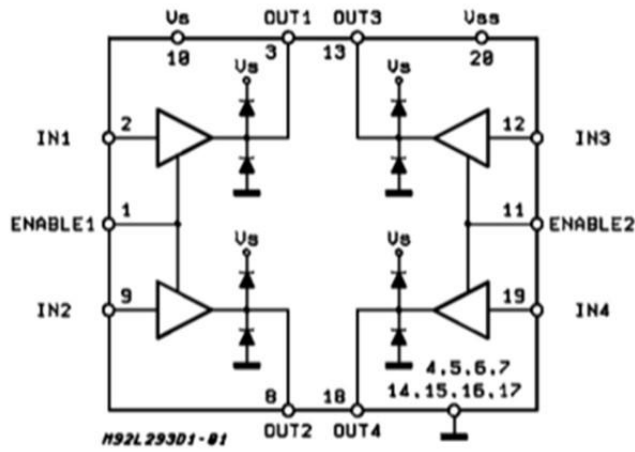


Figure 3. Representation of motor driver ckt copper layer.

Figure 4. Circuit is arranged on a PCB with block diagram.

C programming can be easily programmable in PIC 18F series easily. System setup and calculation can implement in a flexible software like proteus [9]. It is also known as Electronic Design Automation (EDA) software [10].

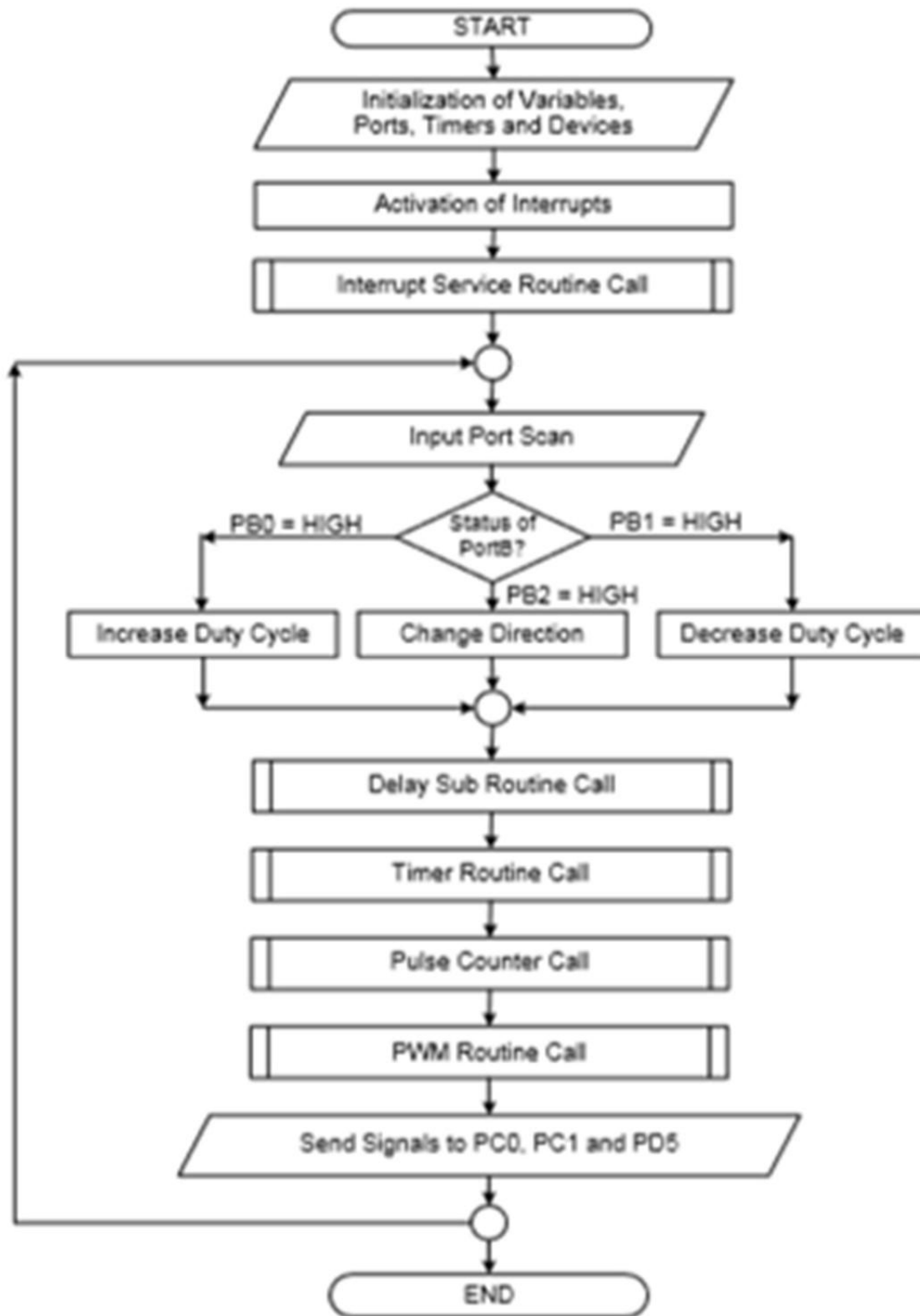


Figure 5. Flow chart of proposed system.

Basically, switches in H-bridge mainly controlled the speed and direction of DC motor. L293D IC is high current half H-drives [11]. A voltage of 4.5 v to 36 v and provide bidirectional drive current up to 600 mA. Hardware implementation is shown in figure 6 and figure 7 and indicates the software proteus simulation analysis on DC motor speed and direction control.

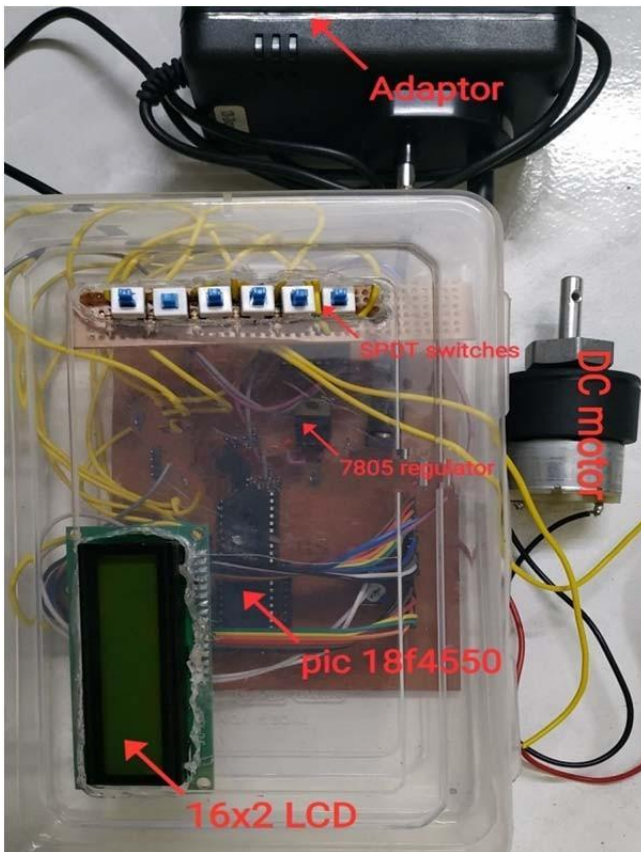


Figure 6. Hardware implementation.

Proteus Analysis

Due to low maintenance, good drive performance as well as low initiatory amount makes the dc motor more use in industry. DC motor has more features and utilized widely. PWM is also very common method and through PWM control of a DC motor used to drive the conveyor belt.

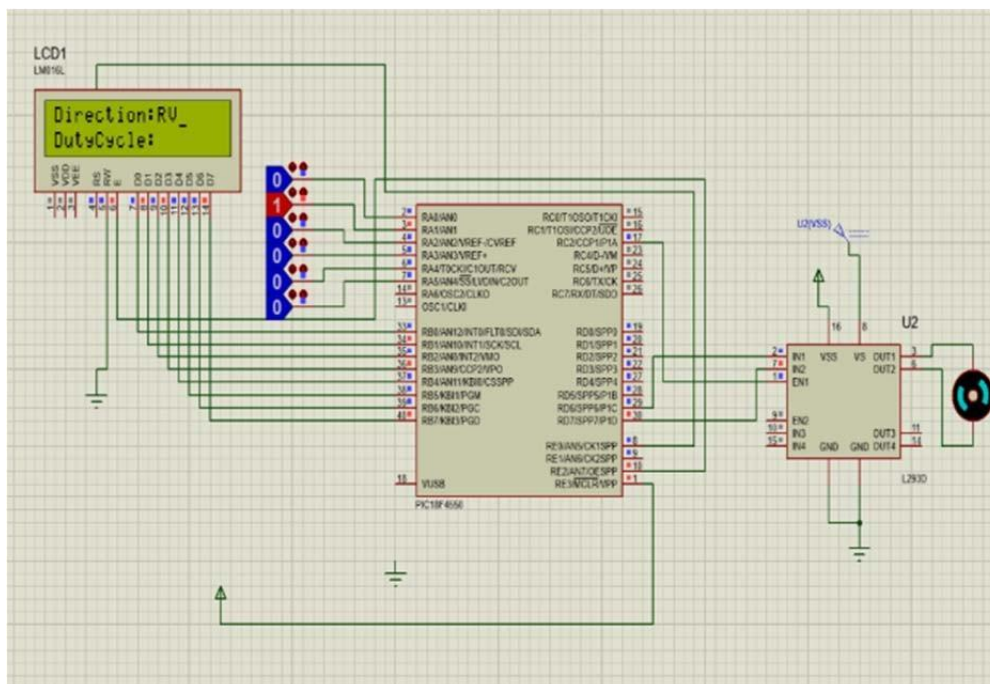


Figure 7. Analysis of control through simulation.

Depending on the programming of microcontroller the control on DC motor is faster and precise on its performance on operation. PWM signal can be changed due to changing in its duty cycle. That duty cycle can be control by H-bridge transistor.

Particularly, revolution per minute of DC motor changes as per controlled and one can make the programmed like increasing or decreasing the time interval. As a result, the motor rotation is maximum or minimum based on the duty cycle.

Conclusion

Continuous demand in electronics, instrumentation and electrical, this research idea gives a concise idea about design the low-cost technology for the control of speed and direction control. Pulse width modulation can switch the motor supply on and off very quickly. User can easily control can changes in speed and direction by reprogramming in microcontroller.

There may be chance of electric shock for conventional switching system. Both speed and direction control can easily be used in industrial as an automation system. So, the future direction is for mobile based or touch screen-based control the whole scenario so that it is free from danger and safer control can possible. For reliable and remarkable performance, future researcher can easily expand this work by implementing a mobile app application. Otherwise researcher can think of voice based controlled as a use of wireless network.

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