Centralised Speed Synchronization of DC Motor using Wireless Communication

Abhishek B[1], Yashaswini S [2], Lokesh Kumar[3], Sandhya M N[4]
Department of EEE,
Sri Krishna Institute Of Technology , Bengaluru,
Karnataka

***Abstract*— The main objective of the project is to control the speed and synchronization of DC motors using wireless module with higher efficiency and less maintenance. The speed control and synchronization of motors is an essential part of any industries, therefore it is an at most need to solve this problem. Multiple motors are working on load in an industry with one motor act as master and remaining two motor acting as slave, so synchronization becomes necessary. In this paper, the DC motors are used for synchronization because of their smooth operation, less noise & low torque. PWM technique used in our project to control the speed. Synchronization have been done through USART device using wireless module (WIR-1186v2).**

***Keywords*—DCmotor,PIC18F4520, PWM technique, Driver circuit, Wireless module, LCD, etc.**

INTRODUCTION

Traditionally conveyor belts, line shaft, pullers are used in order to synchronize multiple motor for doing particular works. But these techniques have many drawbacks such as the master slave [main motor] will be the hardest to start, stop and maintain smooth motion on the whole process. Maintenance is bit difficult as there are more mechanical parts in the system. This can be come over by using the wireless synchronization of multiple motors [1]. This project is designed to overcome all these problems. In this project, wireless technology is used to synchronize the motors without any differential error speed. Among all the motors one motor acts as transmitter and all other motor as receivers, therefore the speed set in the transmitter side of the motor, the same speed will be applied to all the receivers side of the motors [3]. This operation can be possible by using universal asynchronous receiver transmitter (UART) device. Generally the loads applied on the motors is variable, due to that the speed of the motor will affect and satisfactory operation will not achieve. For minimizing that problems, the speed control is necessary. PWM technique is used for controlling the speed of the motors [9].

For PWM generation PIC18F4520 is used. In this method, the regulation of motor's speed is achieved by changing the voltage of the motor which is adjusted by the duty cycle of PWM. Instead of using transformer and rectifier for giving supply, we used Adapter to give 12V supply to the DC motor. IC7805 is used to convert 12V into 5V supply. 12V DC motor is used for speed control and synchronization purpose. Driver circuit consists of BJT, MOSFET for interfacing between DC motor and

PIC, because direct dc motor can't connect to the PIC.

Manpower and time is saved in this arrangement. Satisfactry operation will obtain

SPEED CONTROL AND SYNCHRONIZATION

a. Initially, the 220v AC supply is fed to the adapter which converts 220 into 12v supply. After this 12v supply is given to the positive terminal of 12v dc motor. By using regulator IC7805, 12V is converted into fixed 5V DC supply and it is given to the PIC18F4520.

b. The required speed is entered using a switches (Sw1, Sw2, and Sw3) which is connect with the PIC. Where switch Sw1 is use to START/STOP the motor, switch Sw2 is use to increase the speed of motor and switch Sw3 is use to decrease the speed of the motor.

c. The DC motor is interfaced with the PIC through BJT and a MOSFET together forms a driver circuit and drive the motor.

d. PWM pulses are generated from PIC according to the required speed, the main or master motor is adjusted to that speed and transfer that particular speed through wireless module of transmitter to receiver and maintain that speed at slave motor.

e. Another two sets of receiver side of DC motors are run at that speed which run at the transmitter side. The speed at which the DC motor is running is show on the LCD display. This LCD is interfaced with OIC.

DRAWBACKS OF USING CONVEYOR BELT FOR SPEED SYNCHRONIZATION

a. The master slave [main motor] will be the hardest to start, stop and maintain smooth motion on the whole process.

b. All the motors should be connected in Parallel.

c. As there are moving elements like belts between the motors, we need to change then if it is not serviceable

and regular service in also required when they will get damage.

d. The design of master slave or follower motors in the system may be series, branch, or mixed.

e. Again the system and its product will determine what piece of equipment is directly synched or digitally rationed to each other piece of equipment.

Maintenance is bit difficult as there are more mechanical parts in the system.

SOLUTION FOR OLD CONCEPT OF CONVEYOR BELT

There are so many other different techniques for the solution this problem. But those are not that reliable. In order to reduce man intervention and save the labor cost and time both we can use microcontroller to control, operate and synchronize this task. As compared to conveyor belt method is compatible as it involves hardware as well as software in this module. We can program microcontroller to control its speed and also can set the required speed through keypad to get our work done. Synchronization can done either wired or wirelessly. In this project we are using RF communication technology for wireless communication.

HARDWARE REQUIREMENTS

8051 series Microcontroller, Crystal, RF MODULE, LEDs, Resistors, Capacitors, Diodes, Transformer, Voltage Regulator, IR sensor, MOSFET, Keypad, Transistor, OPTO-isolator, BLDC fan.

SOFTWARE REQUIREMENTS

MPLAB & CCS C compiler. Language: Embedded C or Assembly.

BLOCK DIAGRAM

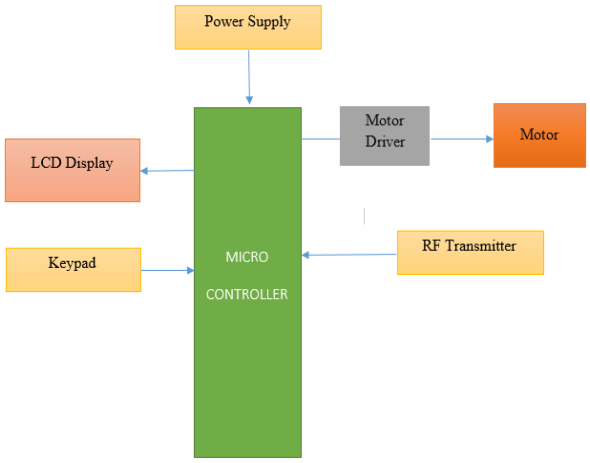


Fig 1. Block diagram of master motor

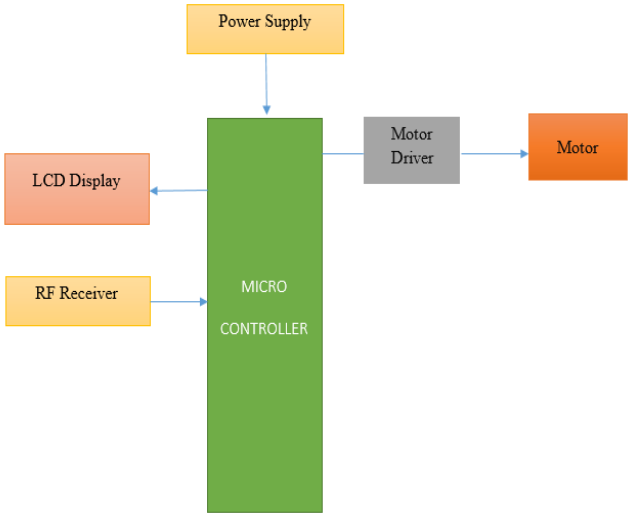


Fig 2. Block diagram of slave motor

The block diagram of transmitter and the receiver set of DC motors are shown above. The entire arrangement consists of a single transmitter circuit and two receiver circuits.

The block diagram of the receiver side which is exactly same as the transmitter block diagram the only difference is that the arrangement of switches is not present in the receiver side because the slave motors will going to operate at the speed which is set by the master motor and is done by the switches as we have discussed above. Thus, the switches are replaced by wireless module.

These block diagram consists of main parts such as power supply, PIC18F4520, LCD, DC motor, wireless module, driver circuit.

Wireless communication, or sometimes simply wireless, is the transfer of information or power between two or more points that are not connected by an electrical conductor.

The most common wireless technologies use radio waves. An RF module (radio frequency module) is a (usually) small electronic device used to transmit and/or receive radio signals between two devices. This wireless communication may be accomplished through radio frequency (RF) communication.

Driver Circuit

Driver circuit consists of BJT and MOSFET which is essential for driving DC motor. BJT (bipolar junction transistor) is current driven while Power MOSFETs, with their insulated gates, are voltage driven. A basic knowledge of the principles of driving the gates of these devices will allow the designer to speed up or slow down the switching speeds according to the requirements of the application. Power MOSFETs can
be used to control the movement of DC motors directly by using pulse-width modulation (PWM) type controllers. As a DC motor offers high starting torque and which is also proportional to the armature current, MOSFET switches

along with a PWM can be used as a very good speed controller that would provide smooth and quiet motor operation. NPN type BJT is used here which is made from silicon semiconductor material. If the transistor's base emitter is open (Ib=0) the device is in off state.

Pluse Width Modulator (Pwm)

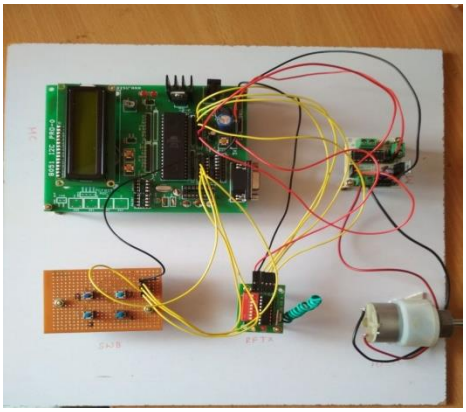
Pulse-width modulation (PWM) or duty-cycle variation methods are commonly used in speed control of DC motors. The duty cycle is defined as the percentage of digital 'high' to digital 'low' plus digital 'high' pulse-width during a PWM period. The average DC voltage value for 0% duty cycle is zero; with 25% duty cycle the average value is 1.25V (25% of 5V). With 50% duty cycle the average value is 2.5V, and if the duty cycle is 75%, the average voltage is 3.75V and so on. The maximum duty cycle can be 100%, which is equivalent to a DC waveform. Thus by varying the pulse-width, we can vary the average voltage across a DC motor and hence its speed.

WORKING OF PROJECT

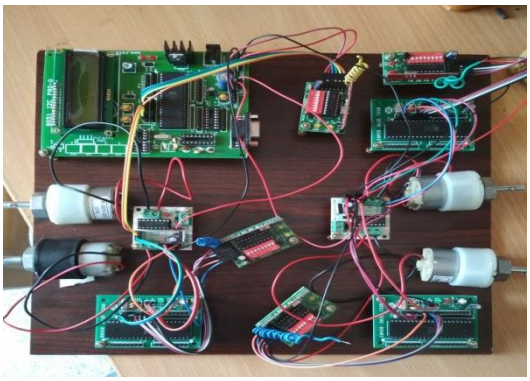
a. The Speed of the motor is sensed by an IR pair and is displayed on LCD and is also fed to the MC.
b. The required speed is entered using a keypad which is interfaced with MC.
c. The motor is interfaced to the MC through opto-coupler and a MOSFETwhich drives the motor.
d. PWM pulses are generated from MC according to the entered speed and the motor is adjusted to that speed and maintained at that speed.

HARDWARE COMPONENT

MASTER



SLAVE



APPLICATIONS

a. Excellent response to starting and stopping and reversing of motor.
b. Speed remains constant for any type of load.
c. They are constructed in wider gap therefore mechanically more stable.
d. Efficiency is more.

REFRENCES

[1]. MOTOR SELECTION for BELT-CONVEYOR DRIVES by Garry E. Paulson, P. Eng.
[2]. http://www.bonfiglioli.com/en/industrial/applications/conveyors/
[3]. Unique Conveyor Problems and Solutions :-Fenner Dunlop
[4]. The Use of PIC Microcontrollers in Multiple DC Motors Control Applications By Dr. Steve C. Hsiung
[5]. Wireless Digital Control and Synchronization of Master-Slave Multiple Motors Using Microcontroller PratikshaShingade, AratiDalavi, PriyankaShipate, Megha Barge
[6]. http://www.controldesign.com