e-ISSN: 2349-9745
p-ISSN: 2393-8161
Scientific Journal Impact Factor (SJIF): 1.711
International Journal of Modern Trends in Engineering and Research
www.ijmter.com

SPEED SYNCHRONIZATION OF MASTER –SLAVE D.C. MOTORS USING MICROCONTROLLER, FOR TEXTILE APPLICATIONS

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Abstract— In textile industry many processes require speed synchronization of more than one motors involved in the process. Rolling of cloth should be synchronized with the speed of weaving spindle to avoid damage and motor speed synchronization is vital in conveyor belt driven by multiple motors. Abrupt load variations may cause hunting or oscillatory behavior in d. c. machines. This behavior can be detrimental to the process. The digitally controlled d. c. machines can have much aggravated phenomenon owing to poor sampling period selection. Traditionally processes are synchronized through mechanical transmission system consisting of a line shaft gears, pullers etc. Among the available software mechanisms master-slave synchronization is a widely used technique.

Multi-motor applications have become very attractive field in industrial applications replacing in traditional mechanical coupling. Many textile applications involved synchronized speed motors. For example wrapping of clothes should be synchronized with the speed of weaving spindle to avoid damage and Similarly in some cases the speed of long conveyor belt driven by multiple motors is need to be constant. In such types of applications master slave technique is used as a software mechanism to synchronize the speed of different motors to avoid damage.

Keywords- proportional (P), proportional integral (PI), proportional derivation integral (PID), adaptive, and fuzzy logic controller (FLCs).

I. INTRODUCTION

DC Motor speed control

Direct current (DC) motors have been widely used in many industrial applications such as electric vehicles, steel rolling mills, electric cranes, and robotic manipulators due to precise, wide, simple and Continuous control characteristics. The development of high performance motor drives is very important in Industrial as well as other purpose applications. Generally, a high performance motor drive system must have good dynamic speed and load regulating response. DC drives, because of their simplicity, ease of application, reliability and favorable cost have long been a backbone of industrial applications. DC drives are less complex with a single power conversion from AC to DC. DC drives are normally less expensive for more horsepower ratings. DC motors have a long tradition of use as adjustable speed machines and a wide range of options have evolved for this purpose. In these applications, the motor should be precisely controlled to give the desired performance traditionally rheostat armature control method was widely used for the speed control of low power dc motors. However the controllability, cheapness, higher efficiency, and higher current carrying capabilities of static power converters brought a major change in the performance of electrical drives. Many varieties of control schemes such as proportional (P), proportional integral (PI), proportional derivation integral (PID), adaptive, and fuzzy logic controller (FLCs), have been developed for speed control of dc motors.

Motor Control Constraints:

1. Non linearity in dc motor
2. Variable and unpredictable inputs

3. Noise propagation along a series of unit processes
4. Unknown parameters
5. Changes in load dynamics

Need of speed synchronization

Major problems in applying a conventional control algorithm in a speed controller are the effects of Non-linearity in a DC motor. The non-linear characteristics of a DC motor such as saturation and friction could degrade the performance of conventional controllers. Many advance model-based control methods such as variable-structure control and model reference adoptive control have been developed to reduce these effects. However, the performance of these methods depends on the accuracy of system models and parameters. Generally, an accurate non-linear model of an actual DC motor is difficult to find, and parameter values obtained from system identification may be only approximate values. Even the PID controllers require exact mathematical modeling.

In textile industry many processes require speed synchronization of more than one motors involved in the process. Rolling of cloth should be synchronized with the speed of weaving spindle to avoid damage and motor speed synchronization is vital in conveyor belt driven by multiple motors. Abrupt load variations may cause hunting or oscillatory behavior in d.c. machines. This behavior can be detrimental to the process. The digitally controlled d.c. machines can have much aggravated phenomenon owing to poor sampling period selection. Traditionally processes are synchronized through mechanical transmission system consisting of a line shaft gears, pullers etc. Among the available software mechanisms master-slave synchronization is a widely used technique.

Multi-motor applications have become very attractive field in industrial applications replacing in traditional mechanical coupling. Many textile applications involved synchronized speed motors. For e.g. wrapping of clothes should be synchronized with the speed of weaving spindle to avoid damage and Similarly in some cases the speed of long conveyor belt driven by multiple motors is need to be constant. In such types of applications master slave technique is used as a software mechanism to synchronize the speed of different motors to avoid damage. Although improved materials and manufacturing methods continue to refine electric machines, the fundamental issues relating to electromechanical energy conversion has been established for well over a century. In such a well established field it may come as a surprise that today there is more development activity than ever before. Many textile applications involve synchronized speed motors. For e.g. wrapping of clothes should be synchronized with the speed of weaving spindle to avoid damage and similarly in some cases the speed of long conveyor belt driven by multiple motors is need to be constant. In such types of applications master slave technique is used as a software mechanism to synchronize the speed of different motors to avoid damage.

II. LITERATURE SURVEY

Multi-motor synchronization techniques

Multi-motor applications has become very attractive field in industrial applications replacing the traditional mechanical coupling .Applications can be found in paper machines, offset printing, textiles, differential rives, to name some examples. Multi-motor techniques are used where matched speed during acceleration, deceleration and changes in load requires "truly" speed and angle synchronization between at least two axes. Several synchronization techniques has been developed in order to fulfill those necessities, in this work the master-slave, cross coupling technique, bi-axial cross-coupled control method, electronic (virtual) line-shafting and the relative coupling strategy are compared for different industrial applications. Practical results in a two 1.5 kW induction machine test ring are presented, showing advantages and limitation of those techniques during different load conditions. The work reported in this paper makes use of a V/Hz motor control scheme, but conclusions drawn can be applied to any motor control technique. Parallel research is ongoing; results are reported on future publications. [1]

Motors Speed Asynchronization in Nonlinear Process by Selective State Feedback & Integral DC-Motor Controller

In textile industry many processes require speed synchronization (or asynchronization) of more than motors involved in the process. Rolling of cloth should be synchronized with the speed of weaving spindle to avoid damage and similarly motors-speed synchronization is vital in a conveyor-belt driven by multiple motors. Abrupt load (or power-supply) variations may cause hunting or oscillatory behavior in dc machines. This behavior can be detrimental to the process. The digitally controlled dc machines(or motors) can have much aggravated phenomena owing to poor sampling period selection applications require higher performance, reliability, variable speed due to its ease of controllability.

Microcontroller based speed control system consist of electronic component, microcontroller and the LCD. In this paper, implementation of the ATmega8L microcontroller for speed control of DC motor fed by a DC chopper has been investigated. The chopper is driven by a high frequency PWM signal. Controlling the PWM duty cycle is equivalent to controlling the motor terminal voltage, which in turn adjusts directly the motor speed. This work is a practical one and high feasibility according to economic point of view and accuracy. In this work d, envelopment of hardware and software of the close loop dc motor speed control system have been explained and illustrated. The desired objective is to achieve a system with the constant speed at any load condition. That means motor will run at a fixed speed instead of varying with amount. [2]

Real-Time Digital Control Using DSP of a Multiple Motor System

Multiple Motors System - A method for achieving the co-ordination and synchronization of multiple motors on line using DSP is described. The co-ordination and synchronization control of motion of multiple motors is a challenging problem, since the synchronization of each individual motor can be influenced by many factors. This paper presents the concept and implementation of a scheme that uses a real time control approach to realize drive synchronization of the multiple motors. Anew Master-Slave configuration is developed. Imperfect synchronization can be corrected on-line using DSP. Also, this paper shows the advantages of using DSP controllers for such applications. Finally experimental and simulation results are provided to validate the performance. [3]

PWM Based Automatic Closed Loop Speed Control of DC Motor

Many industries like textile industries, automation industries, paper mills etc, conveyer belts are often used. These conveyer belts are used to transfer the raw material or the produced material from one place to another. For a feasible operation, the conveyer belt must run at exact speed at all locations. This means motors should run at a synchronized speed.

This project demonstrates a prototype to achieve synchronization of multiple motors such that the motors can run exactly at the same speed, as desired by the user. The speed is set for the master motor at the desired rate. Here a RF communication method is used to transmit this speed to the other slave motors, so that those motors can run at the same speed. For each motor, a speed sensing unit is attached to sense the speed. The speed controls of the motors are achieved by each microcontroller connected with a MOSFET. [4]

III. PROPOSED WORK

Block Diagrams

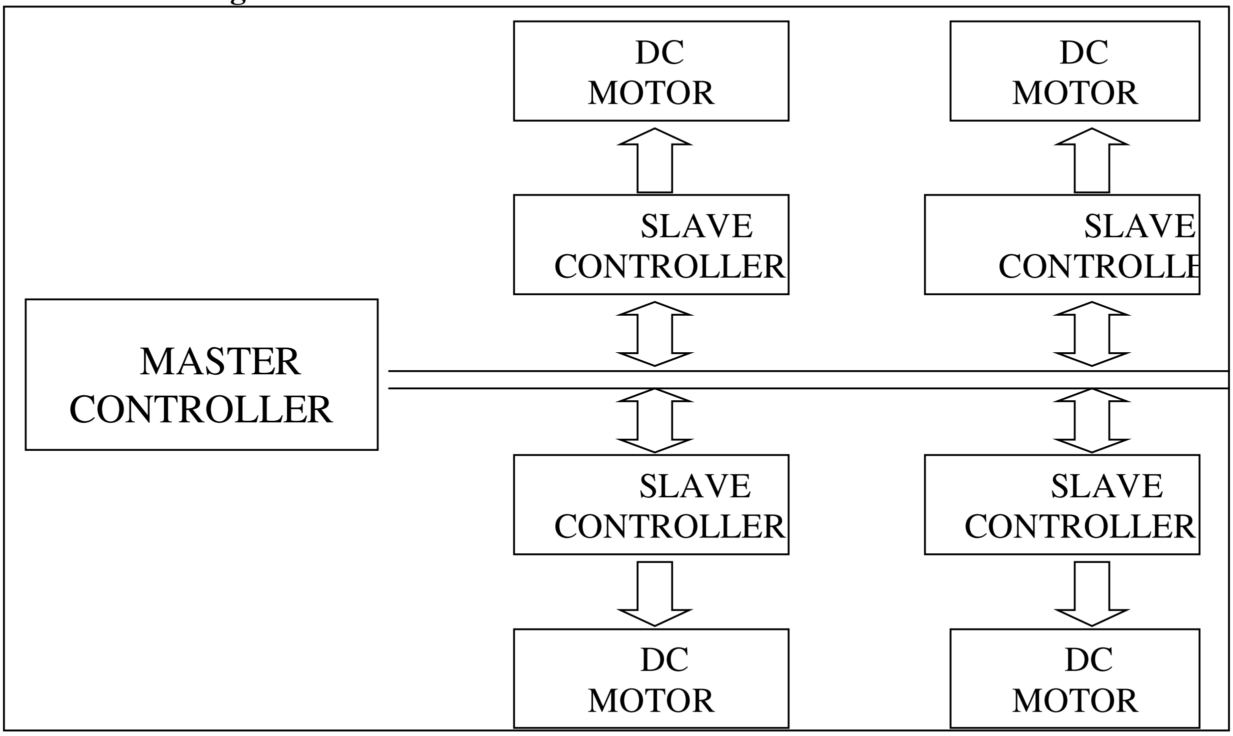

Figure1: synchronized Motor Controller

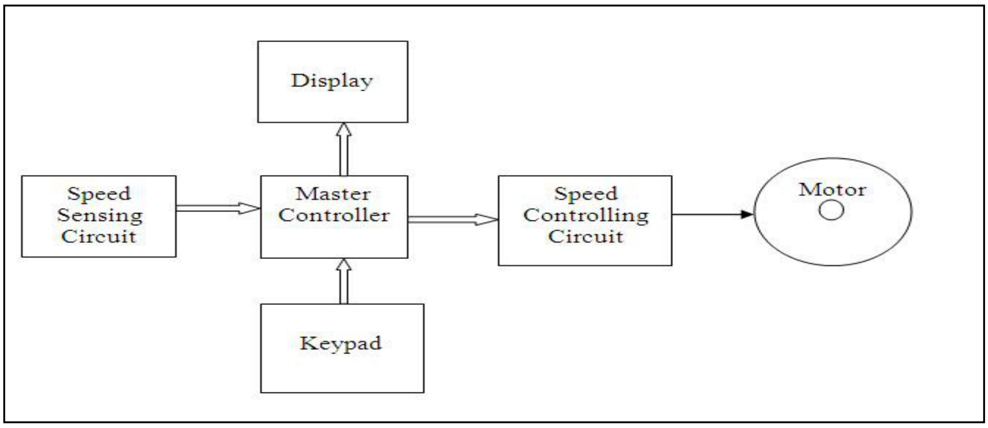

Figure2: Master System

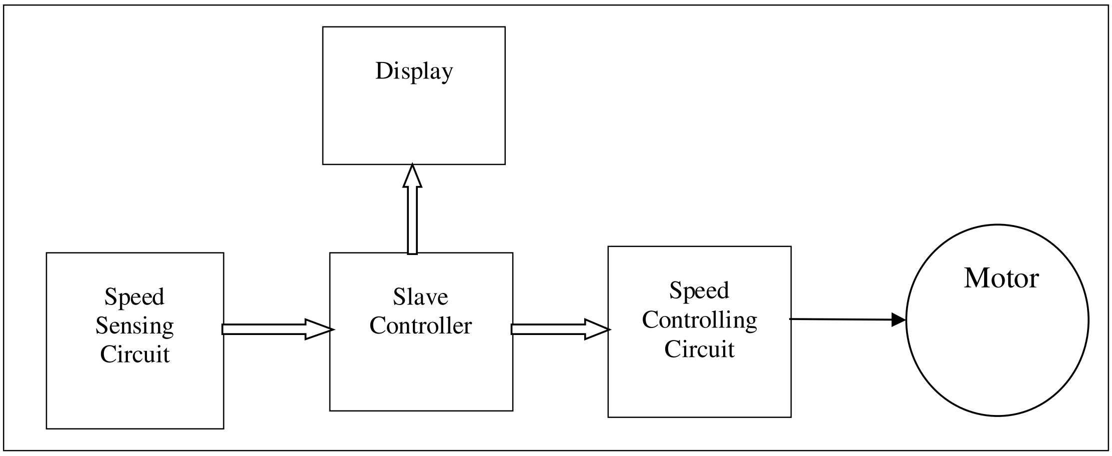

Figure3: Slave system

System Description

Proposed work in this project is based on synchronization between two motors. The synchronization is done by using microcontroller. Master controller will set the required speed and it will communicate with two slaves. Speed sensing is done by proximity detector or magnetic sensors and speed controlling is done by using either SCR control or IGBT. There will be separate control for each.

A UART is usually an individual (or part of) integrated circuit used for serial communication over a computer or peripheral device serial port .UART are now commonly included in microcontrollers. UART takes bytes of data and transmits the individual bits in a sequential fashion. At the destination second UART reassemble the bits into complete bytes. Each UART contain a shift register which is the fundamental method of conversion.

The UART usually does directly generate or received the external signals used between different items of equipments. Separate interface devices are used to convert the logical level signals of the UART to and from the external signal levels. Standards for voltage signally are RS-232, RS-422, and RS-485 etc. When data from master controller will be given to slave microcontroller then that will be taken by the microcontroller as set point of the speed. Hence when system will be started then the slave microcontroller will try to achieve the required speed. Here the speed can be measured with the help of either proximity sensor or IR sensor or any other. The purpose to measure the speed is to give the system feedback about the speed so that the required speed can be achieved by controlling the firing angle i.e. by PWM technique either with the help of SCR or IGBT or any other device. Similarly for second slave Microcontroller. The aim can be achieved. The keypad entry flexibility provides us easy calibration of the system to synchronize the different operation while installing and testing the system.

IV. EXPERIMENTAL RESULTS

PWM Generation

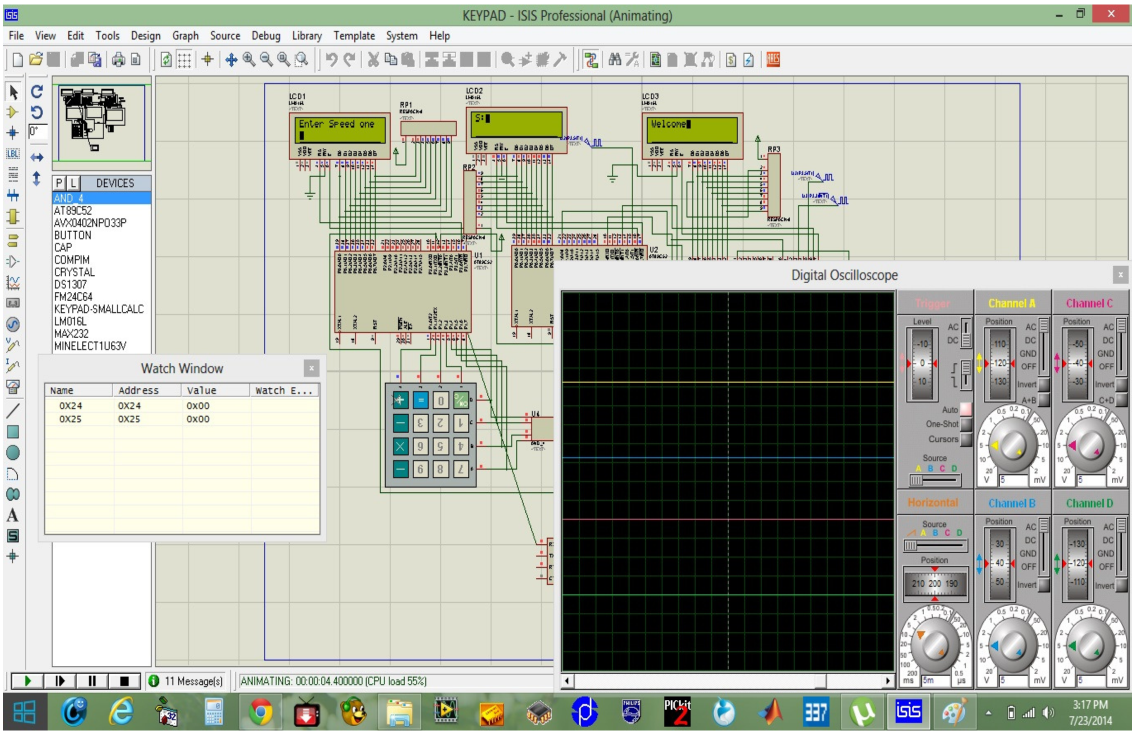

Figure4: Master-Slave Configuration

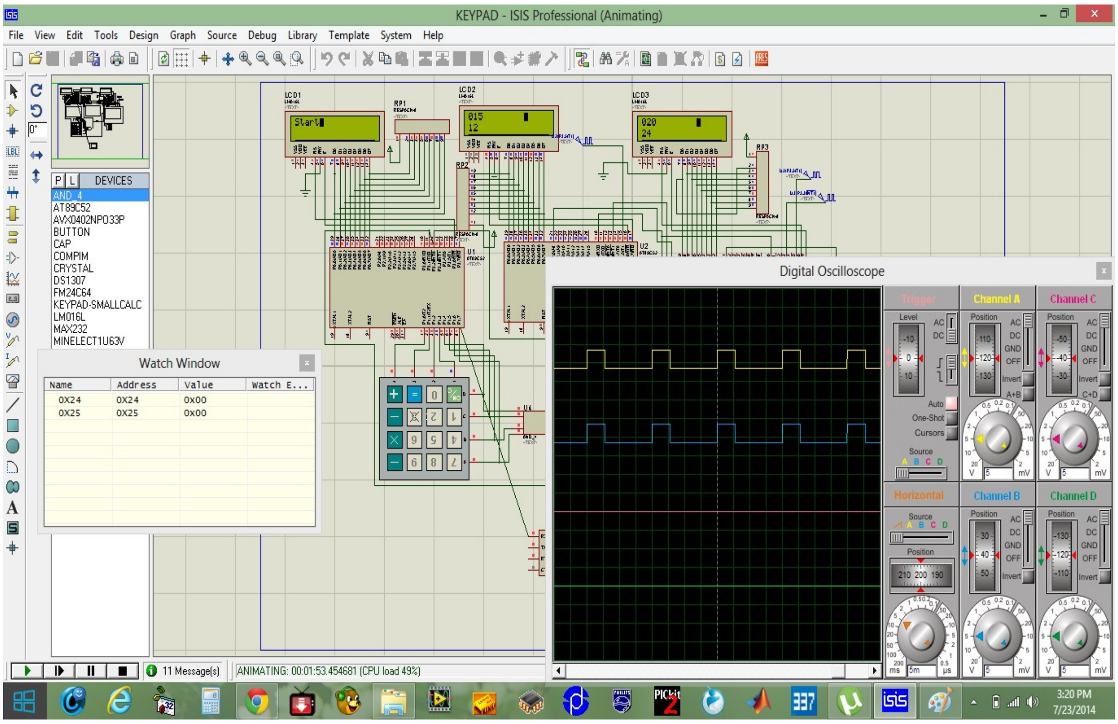

Figure5: Master-Slave Configuration

SR. NO.	Set Speed (RPS)		Expected Speed (RPM)		Actual Speed (RPM)	
	(Slave 1)	(Slave 2)	(Slave1)	(Slave2)	(Slave1)	(Slave2)
1	37	40	2220	2400	2206	2410
2	38	42	2280	2520	2238	2642
3	40	37	2400	2220	2400	2224
4	42	38	2520	2280	2610	2247

Table1: Speed Table

V. CONCLUSION AND FUTURE SCOPE

CONCLUSION

By using this technique speed of two D.C. motors can be synchronized easily by adjusting set point. Master controller sets the required speed and communicates with two slaves. Speed sensing is done by proximity sensor.

When data from master controller is given to slave controller then that is taken as set point of the speed hence when system is started the slave micro controller is trying to achieve the required speed. The purpose to measure speed is to give the system feedback about speed so that required speed can be achieved by controlling firing angle that is PWM technique with the help of solid state relay(SSR).

The keypad entry flexibility provides us easy calibration of the system to compare the different operation. Hence this technique of synchronization can be used in textile industries.

FUTURE SCOPE

- This system can be implemented by using DSP.
- This system can be implemented by wireless technique.
- This system can be implemented by using PIC microcontroller.

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