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Speed Synchronization of DC Motors by Using Microcontroller

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Abstract- **In this venture, another control approach for ongoing pace synchronization of numerous enlistment motors amid speed increasing speed and load changes is produced. The control technique is to settle speed following of every motor while synchronizing its movement with other motors' movements so differential speed blunders among various motors merge to zero. In industry many procedures required speed synchronization of more than one motors required all the while. Speed control of motor is imperative particularly in the fields including mechanical applications, apply autonomy, material factories, and so on. In all these application motor speed synchronization is animate in transport line driven by different motors. Sudden changes in load cause chasing and oscillatory conduct in DC machine. This conduct can be unsafe to the procedure. There are such a variety of strategies which is utilized for controlling the DC machines. Among all these strategy ace slave synchronization is a broadly utilized method. The ADC is accessible in microcontroller chip which make criticism circle. A driver circuit is utilized to drive the motor. In this strategy, the direction of motor's speed is accomplished by changing the voltage of the motor which is balanced by the obligation cycle of PWM.**

Keywords- **Microcontroller, ADC (Analog to Digital Converter), PWM (Pulse Width Modulation), Slave Synchronization.**

I. INTRODUCTION

1. 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:

- Non linearity in dc motor.
- Variable and unpredictable input.
- Noise propagation along a series of unit processes.
- Unknown parameters.
- 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. NEED OF SPEED SYNCHRONIZATION

The real issues in applying a customary control system in speed controller are the impacts of non-linearity in a DC motor. The non-direct qualities of a dc motor, for example, immersion in erosion could embarrass the execution of customary controller. In material industry, moving of dress ought to be synchronized with the speed of weaving axle to evade harm. Substantial load varieties cause chasing or oscillatory conduct in DC machine.

In the most recent couple of years has made it conceivable to apply cutting edge control innovation to control productive and solid operation of numerous applications, for example, the paper mills, journey, electric vehicles, materials factories, flour mills and mechanical technology. Huge numbers of these operations including electric motors and in this way there is a requirement for practical successful control techniques with advanced control of these motors. In customary procedures motors are synchronized through mechanical transmission framework comprising of a line shaft gears, pullers. So for variable load condition speed control is vital to accomplish a hearty framework. This venture displays the plan and usage of microcontroller based speed control of motors. For PWM era microcontroller is utilized.

1.Draw backs of using conveyor belt for speed synchronization. [Earlier Method] -The master slave [main motor] will be the hardest to start, stop and maintain smooth motion on the whole process. • All the motors should be connected in Parallel. • 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. • The design of master slave or follower motors in the system may be series, branch, or mixed. • 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.

2.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 savethe 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.

III. DESCRIPTION OF COMPONENTS

Following are the major components used from which Speed Synchronization system has been fabricated.

- Microcontroller.
- Regulator IC.
- Power Supply.
- Bridge Rectifier.
- Smoothening Capacitor.
- DC Motor.

1. Microcontroller

A microcontroller is a single chip that contains the processor (the CPU), non-volatile memory for the program (ROM or flash), volatile memory for input and output (RAM), a clock and an I/O control unit. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. The ATmega32 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16- bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry. In addition, the ATmega32 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes.

2. Regulator IC (78XX)

It is a three pin IC used as a voltage regulator. It converts unregulated DC current into regulated DC current. There are two types of voltage regulators 1.fixed voltage regulators (78xx, 79xx) 2.variable voltage regulators (LM317) in fixed voltage regulators there is another classification 1. +ve voltage regulators 2. -ve voltage regulators. Positive Voltage Regulators include 78xx voltage regulators. The most commonly used ones are 7805 and 7812. 7805 gives fixed 5V DC voltage if input voltage is in (7.5V, 20V).

3. Power Supply

Power supply is a reference to a source of electrical power. A device or system that supplies electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. Here in our application we need a 5v DC power supply for all electronics involved in the project and 12V supply for the DC motors. This requires step down transformer, rectifier, voltage regulator, and filter circuit for generation of 5v DC power.

4. Bridge Rectifier

A bridge rectifier makes use of four diodes in a bridge arrangement to achieve full wave rectification. This is a widely used configuration, both with individual diodes wired as shown and with single component bridges where the diode bridge is wired internally.

5. Smoothening Capacitor

The function of this capacitor is to lessen the variation in the rectified AC output voltage waveform from the bridge. One explanation of 'smoothing' is that the capacitor provides a low impedance path to the AC component of the output, reducing the AC voltage across, and AC current through, the resistive load.

In less technical terms, any drop in the output voltage and current of the bridge tends to be cancelled by loss of charge in the capacitor. This charge flows out as additional current through the load. Thus the change of load current and voltage is reduced relative to what would occur without the capacitor. Increases of voltage correspondingly store excess charge in the capacitor, thus moderating the change in output voltage / current.

6. DC Motor

DC Motor has two leads. It has bidirectional motion

6.1 If we apply +ve to one lead and ground to another motor will rotate in one direction, if we reverse the connection the motor will rotate in opposite direction.

6.2 If we keep both leads open or both leads ground it will not rotate (but some inertia will be there).

6.3 If we apply +ve voltage to both leads then braking will occurs.

IV. 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, RS422, 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.

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V. BLOCK DIAGRAM

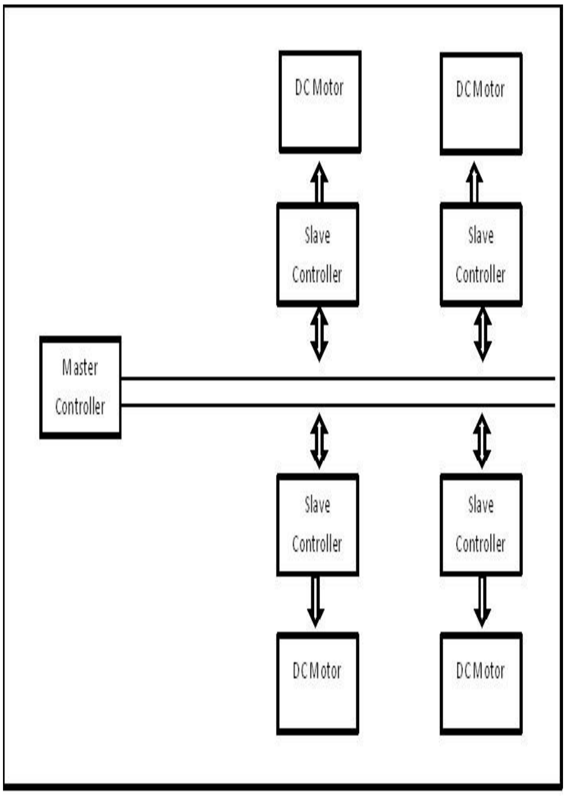

Figure1: Synchronized Motor Controller

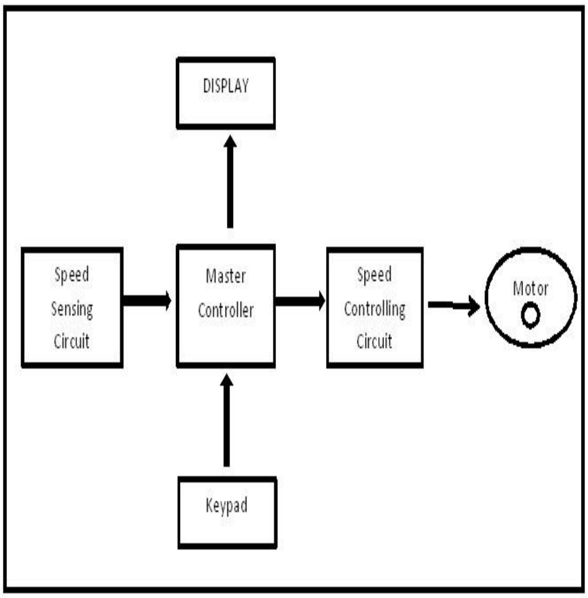

Figure2: Master System

VI. RESULT

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

VII. 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. 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. The manual speed entry flexibility provides us easy calibration of the system to compare the different operation. Hence this technique of synchronization can be used in textile, paper and other prominent industries.

APPENDIX

Table 1 Specification of Microcontroller

Microcontroller	ATmega32
Operating Voltage	4.5-5.5V
Input Voltage	5V
Digital I/O Pins	32
DC Current per I/O Pin	40mA

Flash Memory	32KB (ATmega32) of which 0.5KB used by boot loader
SRAM	2 KB (ATmega32)
EEPROM	1 KB (ATmega32)
Clock Speed	16 MHz
Length	6.86mm
Width	5.34mm
Weight	25 gram
Data Retain	20 years
PWM Channels	4
ADC	10 bit
Single-ended Channels	8

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REFERENCES

[1]. Perez-Pinal, Nunez, C., Alvarez, R., Cervantes, I., “Comparison of Multi- Motor Synchronization Techniques Industrial Electronics Society”, 30th Annual Onference of IEEE Volume: 2, Pp 1670 – 1675, Vol. 2 23, May 2005’

[2]. Ashab Mirza, Dr. Sarfraz Hussian, “D.C. Motor Speed Synchronization in Non Linear Process by Selective State Feedback & Integral Control”, Pakistan Navy Engg. College, National University of Sciences & Technology (Nust), Jauhar, 13th April 2001.

[3]. K. Boudjit, “Real-Time Digital Control Using Dsp Of A Multiple Motors System”, Journal Of Electrical Systems Special Issue No. 01, 2009.

[4]. Fang He, Weiming Tong, Qiang Wang, “Synchronization Control Strategy of Multi-Motor System Based On Profibus Network”. Vol; 1, Pp 3029 – 3034, 08 October 2007.

[5]. Bhim Singh, Sanjeev Singh, State of the art on permanent magnet brushless DC motor drivers.Journal of Power Electronics, 9 (1) (2009), pp. 3–17 .

[6]. B. K. Lee,M. Ehsani, Advanced BLDC motor drive for low cost and high performance propulsion system in electric and hybrid vehicles, IEEE electric machines and drives conference .2001,pp.246-251.

[7]. Ling Xu; Dept. of Autom. Control, Henan Mech. & Electr. Eng.Coll. Xinxiang, China; Gang Liu; Chao-wei Duan.

[8]. Kang Huaguang. Foundation of electronic technology – digital department. High Education Press, 2001.

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