ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 4, April 2018

Speed Synchronization of Multiple Motors in Industries

M. Karthigeyan[1], K. Namashivayam[2], B. Sunil Shaajan[3], S. Sivasami[4], Dr.M.Subba[5]

UG Scholar, Department of Instrumentation and Control Engineering, Sri Manakula Vinayagar Engineering College, Puducherri[1,2,3,4]

Professor, Department of Instrumentation and Control Engineering, Sri Manakula Vinayagar Engineering College, Puducherri[5]

Abstract: In various industries speed synchronisation of the motor plays a major role. Mainly, in textile industries the differential speed error leads to much consumption of power. The aim of this project is synchronization of multiple motors using wireless technology. In textile mills where multiple motors work simultaneously on a conveyor belt to draw clothes, it is essential that all the motors there should run at same speed, so that balanced tension is achieved to avoid clothes getting damaged. In this work motors are wirelessly synchronized to reduce the differential speed error among multiple motors. One motor acts as transmitter and the rest as receivers. Brush Less Direct Current Motors (BLDC) used operate on the basis of Pulse Width Modulation (PWM) control. The pulse width output from the microcontroller would be automatically adjusted to maintain the DC power to the motor such that the entered speed percentage matches the running Rotation Per Minute. The above operation is carried out by using electronic speed controller for driving the BLDC motor duly interfaced from the microcontroller.

Keywords: Speed synchronization, Microcontroller , BLDC motor, electronic speed controller.

I. INTRODUCTION

There are distinctive sorts of motors utilized as a part of ventures, preparing mills and so forth. The fundamental issue is to keep up the distinctive speed (RPM) of various motors i.e. control over the speed for each motor. To overcome the problem of control over speed for different motors we designed a single controller which can vary the different motor's speed at a time from one place. It decreased the use of different controllers to control the speed for different motors. In this project the speed (RPM) of motor which has a variable power supply. The aim is to provide a constant flow of water at output side of motor whether the flow of water at input has increased or decreased. Pumping of motor is controlled using motor speed controller, accordingly to the change in flow which in turn increases or decreases the motor speed. There is a facility of relay used to switch off the motor when the water flow goes below the minimum level to prevent from burning/damage. 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. In the last few years has made it possible to apply modern control technology to control efficient and reliable operation of many applications such as the paper mills, cruise, electric vehicles, textiles mills, flour mills and robotics. Many of these operations including electric motors and therefore there is a need for feasible effective control strategies with digital control of these motors. For motors speed control, closed-loop PWM technique is widely used and most efficient. In this technique, the regulation of motor's speed is achieved by changing the voltage of motor which is adjusted by the duty cycle of PWM. The Pulse Width Modulation (PWM) duty cycle is generated using timer of microcontroller by varying pulses of input voltage for the on and off duration which causes the PWM voltage control with high accuracy. The development of high motor drive is very important in order to have high dynamic response.

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 4, April 2018

II. LITERATURE SURVEY

Mohamed S. Zaky [1] says that PI controller gains are the adjustable parameters and depending on the speed error that will be updated online. PI controller gives a high degree of accuracy in the presence of external disturbance. PI controllers is not simultaneously meeting good step reference tracking and also not provide good load torque rejection as well as it gives slow response large overshoots and oscillations.

Xiaoyuan Zhu [2] implemented integrated motor transmission power train system in which driving motor and multi-gearbox is directly connected. Controller Area Network (CAN) is used in that system with random delays in both feedback and forward channel and the speed synchronization is done and motor speed is control. The drawback is that transient performance of control system is reduce with significant overshot and produce vibrations in the power train system. The steady state speed synchronization error is very high and cannot be stabilized because of random oscillations.

Ganiyu, R. A [3] proposed that the motor speed control system requires a closed loop real time system where a very high optical encoder is connected to motor shaft and provide a feedback signal through micro controller. Microcontroller is acts as a proportional controller. At very high gain causes the speed response of the control loop becomes steady state oscillations and increase in gain causes speed up the motor and be damaged.

Prof. R.V. Katre [4] discussed that in textile industry many processes required speed synchronization of more than one motors involved in the process. Speed control of motor is very important especially in the fields including industrial applications, robotics, textile mills, etc.

In all these application motor speed synchronization is invigorate in conveyor belt driven by multiple motors. Sudden changes in load cause hunting and oscillatory behaviour in DC machine. This behaviour can be harmful to the process. There are so many methods which is used for controlling the DC machines. The synchronization is done by using microcontroller which acts as the master slave and control the speed whose speed is followed by the other motors which all have to be synchronized.

Ankur Shukla [5] says that multiple motor set up has vast application in industries. The application can be in textile mills, paper mills and robotics. In these all application the synchronization is must between the motors to perform certain task. Speed synchronization is very essential in these all operation to avoid damage to the product. The synchronization is done by using microcontroller chip which controls the master slave whose speed is followed by the other motors which all have to be synchronized.

III. PROPOSED SYSTEM

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 labour cost and time both 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. The microcontroller can be programmed to control its speed and also can set the required speed through potentiometer to get our work done. Synchronization has been done here using wireless method. RF communication technology has been used here for wireless communication. Motors are synchronized with the master slave method. The motor speed is transmitted using the RF Module from the transmitter and using PWM Technique the speed is received in the receiver side and the motors will run at synchronized speed.

A. System Architecture

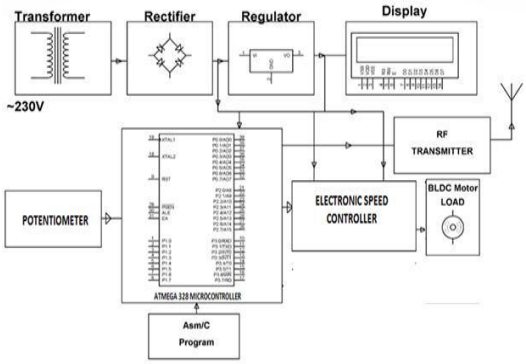

Fig 1 Block diagram of the transmitter system

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 4, April 2018

The above figure 1 shows the block diagram for the transmitter which consists of a potentiometer which acts as the input device (i.e.,) is used to give the speed input to the transmitter motor. The Radio frequency(433 MHz) transmitter is used to transmit the speed signal to the Radio Frequency receiver module. The analog to digital converter is used to convert the analog input given by the potentiometer into digital signal to the electronic speed controller. The electronic speed controller regulates the speed by adjusting the width of the pulse signal given to the BLDC motor.

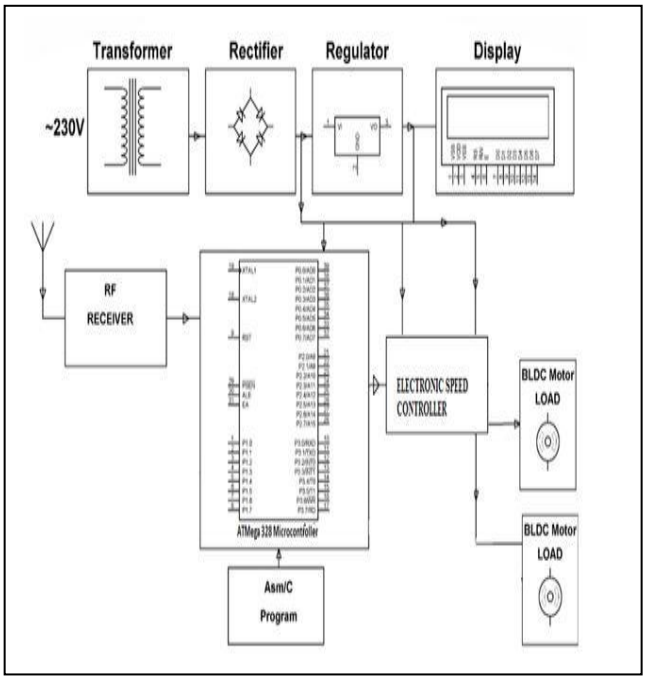

Fig 2 Block diagram of the receiver system

Fig 3 Brushless DC Motor

The figure 2 shows the block diagram for the receiver system. The receiver system consists of the Radio Frequency receiver module which is used to acquire the signal transmitted in the RF transmitter from the transmitter motor. The signal received has been given to the microcontroller as input. The pulse signal is generated which is given to the electronic speed controller. The width of the pulse signal is varied based on the received signal from the RF receiver module. Thus, pulse signal has been given to the receiver motors accordingly through the electronic speed controller.

B. Hardware Components

1) *Brushless DC Motor*: The Brushless DC (BLDC) motor is the ideal choice for applications that require high reliability, high efficiency, and high power-to-volume ratio. Generally speaking, a BLDC motor is considered to be a high performance motor that is capable of providing large amounts of torque over a vast speed range. BLDC motors are a derivative of the most commonly used DC motor, the brushed DC motor, and they share the same torque and speed performance curve characteristics. The major difference between the two is the use of brushes. BLDC motors do not have brushes (hence the name "brushless DC") and must be electronically commutated.

2) ATmega 328 microcontroller: The Atmel AVR core combines a rich instruction set with 32 general purpose working registers. All the 32 registers are directly connected to the Arithmetic Logic Unit (ALU), allowing two independent registers to be accessed in a single instruction executed in one clock cycle. The resulting architecture is more code efficient while achieving throughputs up to ten

times faster than conventional CISC microcontrollers. The ATmega328/P provides the following features: 32Kbytes of In-System Programmable Flash with Read-While-Write capabilities, 1Kbytes EEPROM, 2Kbytes SRAM, 23 general purpose I/O lines, 32 general purpose working registers, Real Time Counter (RTC), three flexible Timer/Counters with compare modes and PWM, 1 serial programmable USARTs , 1 byte-oriented 2-wire Serial Interface (I2C), a 6- channel 10-bit ADC (8 channels in TQFP and QFN/MLF packages) , a programmable Watchdog Timer with internal Oscillator, an SPI serial port, and six software selectable power saving modes. The Idle mode stops the CPU while allowing the

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 4, April 2018

SRAM, Timer/Counters, SPI port, and interrupt system to continue functioning. The Power-down mode saves the register contents but freezes the Oscillator, disabling all other chip functions until the next interrupt or hardware reset. In Power-save mode, the asynchronous timer continues to run, allowing the user to maintain a timer base while the rest of the device is sleeping.

Fig 4 AT mega 328 microcontroller

3) Electronic Speed Controller: The term ESC stands for an "electronic speed control is an electronic circuit used to change the speed of an electric motor, its route and also to perform as a dynamic brake. These are frequently used on radio controlled models which are electrically powered, with the change most frequently used for brushless motors basically providing an electronically produced 3-phase electric power low voltage source of energy for the motor. The below figure 4.10 gives the overview of an ESC. An ESC can be a separate unit which lumps into the throttle receiver control channel or united into the receiver itself, as is the situation in most toy-grade R/C vehicles. Some R/C producers that connect exclusive hobbyist electronics in their entry-level vehicles, containers or aircraft use involved electronics that combine the two on a sole circuit board.

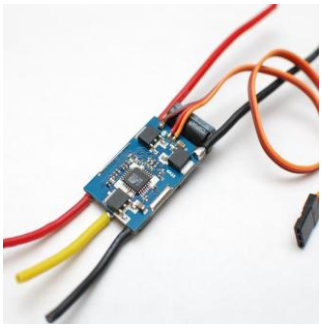

Fig 5 Electronic Speed Controller

4) Radio Frequency Module: Transmission
Through RF is better than IR (infrared) because of many reasons. Firstly, signals through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources. This RF module comprises of an RF. Transmitter and an RF Receiver. The transmitter/receiver (Tx/Rx) pair operates at a frequency of 434 MHz an RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The RF module is often used along with a pair of encoder/decoder.

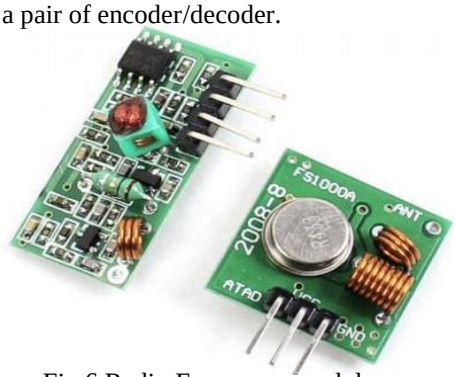

Fig 6 Radio Frequency module

ISSN (Online) 2278-1021
ISSN (Print) 2319-5940

IJARCCE

International Journal of Advanced Research in Computer and Communication Engineering
ISO 3297:2007 Certified
Vol. 7, Issue 4, April 2018

IV. RESULTS AND DISCUSSION

Results of speed given in the transmitter motor and speed obtained on the receiver motors are tabulated below:

Attem pts	TRANSMIT TER MOTOR SPEED (RPM)	RECEIV ER MOTOR 1 SPEED (RPM)	RECEIV ER MOTOR 2 SPEED (RPM)
1	2500	2470	2590
2	3300	3100	3120
3	3800	3710	3720
4	4500	4410	4690
5	6000	5890	6170

Table 1 Speed of motor in Transmitter and Receiver

The table 1 represents the speed which was given as the input on the transmitter and the speed which was received on the receiver side. In this proposed method the speed are transmitted by the means of Radio Frequency module. The Proposed system has achieved the main scope of the project that power dissipation of the motors has been reduced and the motors are more or less synced with the transmitting speed.

V. CONCLUSION

Major drawback of the existing system is the speed cannot be synchronized at the particular range. Many research papers have been proposed to synchronize the motors at particular speed but everything leads to failure approach. Old method of speed synchronization that is by means of conveyer belt has a speed variation of above 1000 RPM and the wired technique of speed synchronization had over the somewhat and gave the results of speed variation up to 600 RPM to 900 RPM. Above proposed system of speed synchronization has overcame all the drawbacks and speed of the motor can be synced at maximum set point given in the transmitter side. Now the variation has been reduced up to 100 RPM to 150 RPM.

REFERENCES

1. Motor Selection for Belt Conveyor Drives by Garry E. Paulson, P. English.
2. Unique Conveyor Problems and Solutions :-Fenner Dunlop
3. The Use of PIC Microcontrollers in Multiple DC Motors Control Applications by Dr. Steve C.Hsiung.
4. Wireless Digital Control and Synchronization of Master-Slave Multiple Motors Using Microcontroller Pratiksha Shingade, AratiDalavi, Priyanka Shipate, Megha Barge.
5. http://www.controldesign.com
6. “A self-tuning PI controller for the speed control of electrical motor drives” by Mohamed S. Zaky .
7. “Speed synchronization control for integrated automotive motor transmission power train system with random delays” by Xiaoyuan Zhu, Hui Zhang, Zongde Fang.
8. Development of a Micro controller Based Motor Speed Control System Using Intel 8051” by R.A. Ganiyu, S. Shoewu, O. Olatinwo , O. Omitola .