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SPEED SYNCHRONIZATION OF MULTIPLE BLDC MOTORS

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ABSTRACT
Multiple motor setup has wide number of application in industries. The application can be in textile mills, paper mills and robotics. In these all application the synchronization is required between the motors to perform given task. Speed synchronization is very important 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.

INTRODUCTION
In industry many processes required speed synchronization of more than one motors involved in the process. Speed control of motor is very essential especially in the fields including industrial applications, robotics, textile mills, sugar factory, etc. In all these application motor speed synchronization is invigorate in conveyor belt driven by multiple motors. Sudden changes in load cause unwanted behavior in DC machine.
There are so many methods which is used for controlling the DC machines. Among all these method **master-slave** synchronization is a widely used technique. 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.
The ADC checks the voltage level of the motor and accordingly the voltage level of the motor can be maintained at a fixed level. A driver circuit is used to drive the motor. Hence, a closed loop motor speed control circuit is designed and the total amount of power delivered to the motor is varied depending on load conditions. In this technique, the regulation of motor's speed is achieved by changing the voltage of the motor which is adjusted by the duty cycle of PWM.

LITERATURE SURVEY
EXISTING SYSTEM
"A self-tuning PI controller for the speed control of electrical motor drives" 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.
"Speed synchronization control for integrated automotive motor transmission power train system with random delays" says that 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.

"Development of a Micro controller Based Motor Speed Control System Using Intel 8051" says 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.

NEED OF SPEED SYNCHRONISATION

The major problems in applying a traditional control technique in speed controller are the effects of non-linearity in a DC motor. The non-linear characteristics of a dc motor such as saturation in friction could affect the performance of traditional controller.

In textile industry, rolling of clothe should be synchronized with the speed of weaving spindle to avoid damage. Large load variations cause hunting or oscillatory behaviour in DC machine.

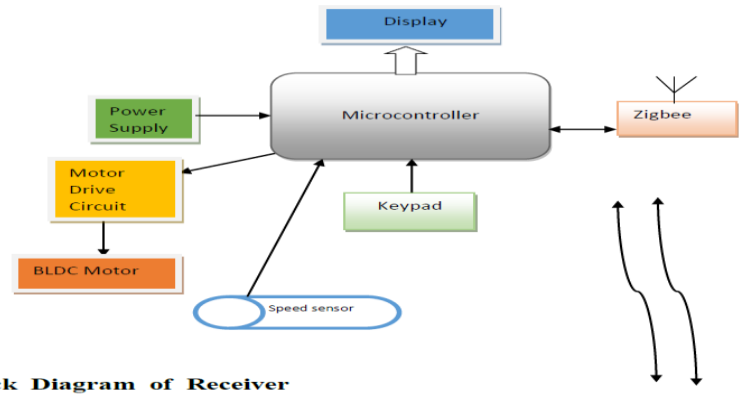
DRAWBACKS OF USING CONVEYOR BELT FOR SPEED SYNCHRONIZATION.

- 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.

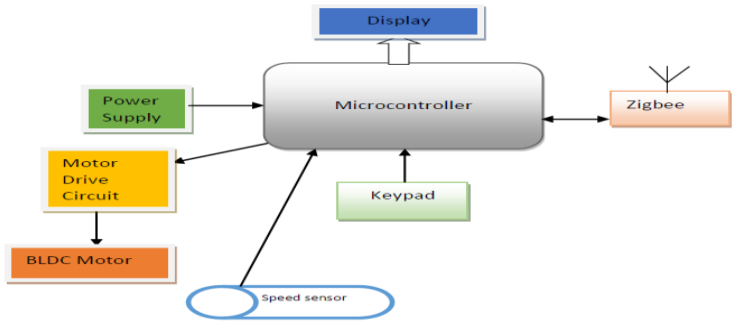
Maintenance is bit difficult as there are more mechanical parts in the system.

BLOCK DIAGRAM

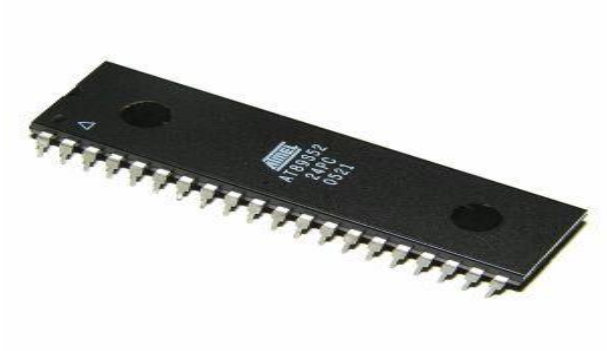
- **Block Diagram of Transmitter**



- **Block Diagram of Receiver**



- **MICROCONTROLLER AT89S52:**



MICROCONTROLLER AT89S52

MICROCONTROLLER AT 89S52 FEATURES

- Compatible with MCS 51 products
- 8k bytes of in system Re-programmable Flash Memory
- Fully static operation : 0 Hz to 24 MHz
- 256 x 8 bit internal RAM
- 32 programmable I/O Lines
- Three 16 bit Timer or Counters
- 8 Interrupt sources
- Programmable serial channel
- Low power Idle & power down modes

- **LCD DISPLAY:**

LCD indicates different mode settings & set point adjustment. Also 16 char are divided to indicate speed output. The LCD Display used here is 16 character by 2 line display. The 16 characters in both lines are equally divided to indicate commands and speed. In sub routines 'Enter Speed' and 'Current Speed' message, set Speed value is indicated on screen.
In our project LCD is interfaced with the port-0 (D0-D7) i.e. from pin number 32 to pin number 39. In other words the data-bus D0-D7 is connected to port-0 of IC 89s52. Pin RS is directly connected to Pin11 of controller and one more another important pin EN (LCD enable) is directly connected to pin 14 of the controller. On the other hand pin R/W of LCD is connected to ground. The LCD interfacing is done here for indicating various display messages for the user.

- **ZIGBEE:**

ZIGBEE

ZigBee is a protocol that uses the 802.15.4 standard as a baseline and adds additional routing and networking functionality. The ZigBee protocol was developed by the ZigBee Alliance. The ZigBee Alliance is a group of companies that worked in co-operation to develop a network protocol that can be used in a variety of commercial and industrial low data rate applications. Because ZigBee was designed for low power applications, it fits well into embedded systems.

Zigbee is basically a communication IC; in our project we are using this for the communication between transmitter unit and receiver unit.

Basically Zigbee devices are of three types:

- ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It stores information about the network, including acting as the Trust Center & repository for security keys.
- ZigBee Router (ZR): As well as running an application function, a router can act as an intermediate router, passing on data from other devices.
- ZigBee End Device (ZED): Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than a ZR or ZC.

- **KEYPAD:**

This 16-button keypad provides a useful human interface component for microcontroller projects. Convenient adhesive backing provides a simple way to mount the keypad in a variety of applications. The Keypad 4x4 features a total of 16 buttons in Matrix form.

This is a membrane keypad with no moving parts. It has a nice overlay depicting a telephone type keypad with additional four functional buttons. A female 8-pin berg connector is provided for interfacing it with your mirocontroller circuits.

Keypad

FEATURES

- Ultra-thin design
- Adhesive backing
- Excellent price/performance ratio
- Easy interface to any microcontroller

HALL EFFECT SPEED SENSORS

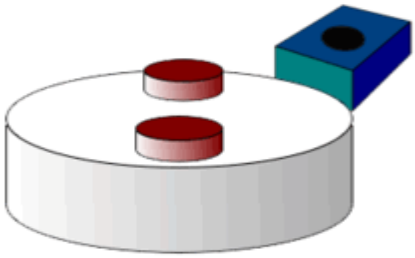


Fig .Hall Effect Speed sensor

MATERIALS FOR HALL EFFECT SENSORS

A Hall Effect sensor is a transducer that shifts its output voltage in light of an magnetic field. Lobby impact sensors are utilized for vicinity exchanging, situating, speed location, and current detecting applications.

WORKING GUIDELINE

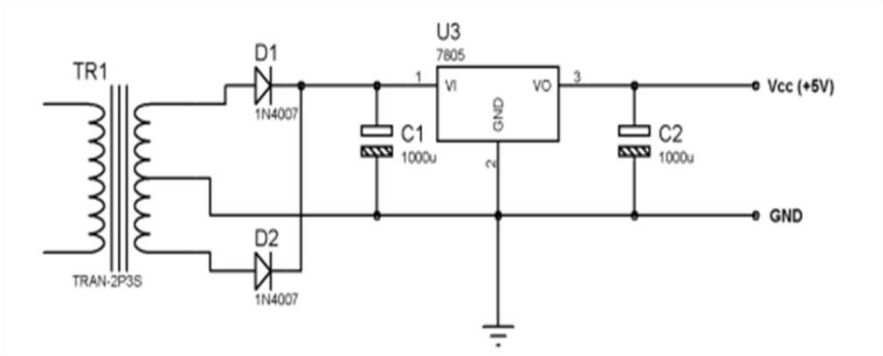
At the point when a light emission particles goes through an magnetic field, strengths follow up on the particles and the bar is diverted from a straight way. The stream of electrons through a conductor is known as a light emission transporters.

At the point when a conductor is put in an magnetic field opposite to the heading of the electrons, they will be avoided from a straight way. As an outcome, one plane of the conductor will turn out to be adversely charged and the inverse side will turn out to be emphatically charged. The voltage between these planes is called Hall voltage.

The key factor determining sensitivity of Hall effect sensors is high electron mobility. As a result, the following materials are especially suitable for Hall effect sensors:

- gallium arsenide (GaAs)
- indium arsenide (InAs)
- indium phosphide (InP)
- indium antimonide (InSb)
- graphene

- **POWER SUPPLY**
- The microcontroller need +5V DC, These specifications dictate the use of a low-cost, ubiquitous linear regulator National Semiconductor LM7805.
- The LM7805 requires an input voltage of at least 7.5V in order to guarantee regulation, so the unregulated power supply should supply at least this voltage under worst-case current consumption, assumed to be about 200mA.
- Because a full-wave rectifier will be used for efficiency (diodes D1-D2), we can assume that about 1.4V will be lost across the bridge (0.7V per conducting diode).
- We therefore need a transformer was selected as T1, which is of rating 9-0-9 secondary at 500 mA



RESULT

In this project we can control multiple BLDC motors by using a single motor. It is done with the help of zigbee. The hall sensor is used for measurement of speed. Speed variation of motors is shown in the chart below.

SPEED IN RPS	TIME IN SECONDS
0-15	10
15-17	2
17-19	2
19-20	2

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