SPEED CONTROL OF INDUCTION MOTOR USING UNIVERSAL CONTROLLER (MOBILE PHONE)

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Abstract- Speed control of induction motor is an advancement of all other techniques introduced before. This can prove to be the next mode of controlling all the electrical machines using mobile phones and tablets. The operation of the circuit is controlled by using a microcontroller AT89c51. The circuit will have all the capability of providing a supply for 3 phase induction motor with variable ac voltage. This setup requires simple components which decreases the complexity of the design. Hence this proves to be the better technique of controlling the speed of an induction motor as it will be compatible with all type of induction motor. This proposed theory can be used for Industrial applications. This idea is different from others as it can be controlled by using mobile phones with the help of an application which can be accessed in android and iPhone. Hence this involves easy way of changing the speed of the induction motor.

Index Terms- Microcontroller AT89C51, Induction Motor, Mobile Application, Speed Control.

I. INTRODUCTION

The fact of increase in losses cannot be neglected. But the advantages of ac machines conquer the disadvantages of ac machine. When specifying induction motors being cheaper in cost due to the absence of brushes, commutators and slip rings makes it advantageous for industrial and domestic use. They do not require more maintenance and also they are independent of the environment. The absence of brushes gives no spark. Hence it provides easy operation without causing harm to the humans. There are a lot of advantages of AC machines on DC machines[18].

Now when talking about induction motors, the principle on which it runs is the Electro-Magnetic Induction. There are basically 2 types of induction motor – Single phase induction motor and three phase induction motor. The three phase induction motor is further categorized into two types according to the construction. These are:

- Squirrel cage induction motor
- Slip ring induction motor

The speed control of three phase induction motor from stator side are further classified as:

1. V / f control or frequency control.
2. Changing the number of stator poles.
3. Controlling supply voltage.
4. Adding rheostat in the stator circuit.

By changing the number of stator poles of the induction motor, smooth speed control is not acquired as required for the application. And other methods also possess few disadvantages. When the supply voltage is controlled, there is a problem of overheating. What happen is, even for a small change in speed it requires large reduction in voltage, and hence the current drawn by motor increases, which cause over heating of induction motor.

Hence the safest method of controlling the speed of induction motor is the V/F method which is simple without any complexity. Hence the proposed method is compilation of V/F method and the advancement in new technology.

The PWM method which has been implemented these days have more drawbacks compared to the other methods. They are:

- Heating of the motor resulting in breakdown of the insulation. This is due to the transistor switching at high frequency.
- Non-regenerative operation
- Production of harmonics

Hence the PWM method has not been implemented as the drawbacks do not justify for the economical method of controlling the speed of the induction motor.

The era of using mobile phones and applications have increased to such a great extent which makes to access the newly emerging technologies. The principle of smart town and smart house can be implemented to start a smart industry where the speed control of induction motor can be controlled by entering the value of the speed on the phone through an app. This method can initialize to a smart factory for other machines too.

II. BLOCK DIAGRAM

The proposed paper mainly includes the use of microcontroller AT89C51, an IGBT, a 3 phase inverter, and transmitter.

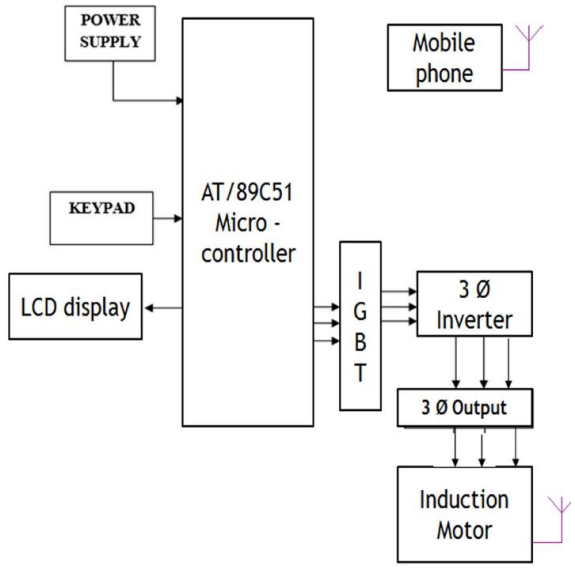
The selection of this microcontroller specifically is for the following reasons:

1. Low power consumption
2. High performance
3. 4K bytes of Flash programmable
4. Erasable read only memory
5. Uses high –density memory technology
6. Reprogramming can be done
7. Highly flexible
8. Cost effective solution

The best thing about this system is that anyone can operate using the mobile phones. The software will be interfaced in an application. This application can be installed in a mobile phone. But the access to the speed control can be given only to employee or the person to whom the control is allotted.

Block Diagram:

Fig. 1 Block diagram of system



The block diagram of proposed system i.e the speed control of induction motor using universal controller is shown in the figure 1. The system includes Microcontroller- AT89C51, speed sensor, a three phase inverter, IGBT, Transmitter, Two LCD screens and one Keypad. The input and the power flow from each of the component used is mentioned in the block diagram. This block diagram clearly specifies as from where to where and how the system works.

The power supply of 5V is given to the microcontroller. The keypad is given for the dual operation- 1) to operate it through the mobile and the other to operate it when the operator is present near the system. The LCD is connected so that the system displays the speed entered by the operator. The signal is processed and the signal is sent to a three phase inverter through an IGBT. The three phase inverter inverts the dc supply into ac supply. The three phase output is then supplied to the induction motor. Here a speed sensor is connected which displays the speed on the LCD and then the user alters the speed according to his/her own wish. Three phase supply generated by the inverter drives the motor at user defined speed.

III. DESIGN SPECIFICATION FOR EACH BLOCK ARE GIVEN BELOW:

A. Power Supply

The power supply cannot be given directly to the microcontroller. As the microcontroller is an electronic device and hence cannot be given ac supply. And hence a set up is used to regulate the power supply. Hence the knob present will help to give a supply of 5V to the microcontroller.

B. Microcontroller

The microcontroller used earlier in other systems are found to be good but for each of operation, the microcontroller used for this setup is AT89c51. The microcontroller AT89C51 is a variant of 8051 manufactured by the ATMEL Company has a flash memory while the older version of this particular microcontroller has no memory that is it runs from external EEPROM.

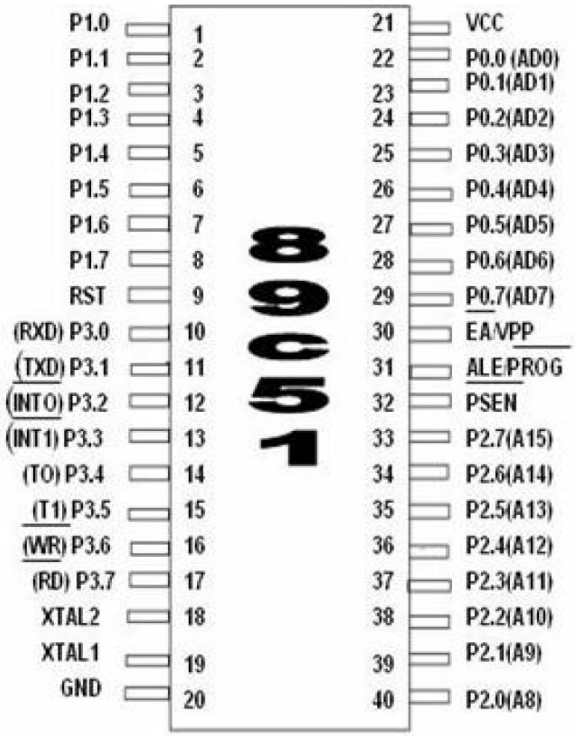
The selection of this microcontroller specifically is for the following reasons[14]:

1. It is compatible with MCS-51 products
2. It has 32 programmable I/O lines
3. It has static operation: 0Hz-24MHz.
4. Three level Program Memory lock
5. Two 16 bit Timer/Counters
6. High performance
7. 4K bytes of Flash programmable
8. Erasable read only memory
9. Uses high –density memory technology
10. Reprogramming can be done
11. Highly flexible
12. Cost effective solution

The flash memory of this microcontroller provides the following advantages[17]:

1. Its smaller size
2. Less power consumption which is the priority factor. All the systems designed are supposed to use less power to avoid large amount of power consumption.
3. This is less prone to damage.
4. And the most important advantage is that it is economizing. It is very cheap compared to that of other drives.
5. It does faster reading and writing compared to other traditional hard disks.

The fig.2 shows the pin diagram[13] of the microcontroller AT89C51 which is given below:



The microcontroller 8051 has been used for controlling the speed of the induction motor by Bluetooth. But this particular microcontroller i.e, AT89C51 provides to control the speed of the induction motor by using an application. This application can be accessed offline too. This is done by programming the way we want to.

C. IGBT

The insulated-gate bipolar transistor (**IGBT**) is a three-terminal power semiconductor device. It is used for the switching purpose. Now at present era, it combines fast switching and high efficiency. [15]

The particular drive was chosen because it allows medium power supply to the induction motor. Transistor and other drives were not use for the following reasons:

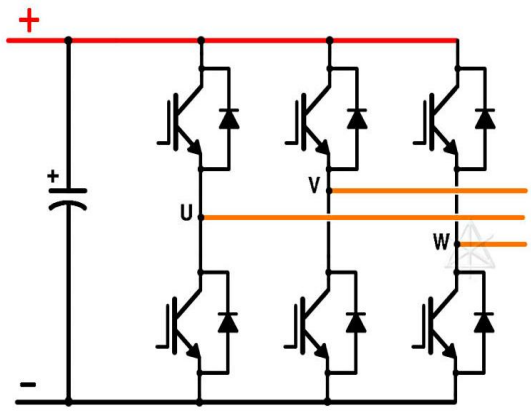
1. The current rating is very high
2. The V_{GE} is maintained between 4-8V
3. The Input impedance is very high
4. The output impedance is very low
5. The voltage rating is always high that too more than 1KV
6. Most importantly, the switching speed is medium. In BJT, the switching speed is very slow (uS) and in Power MOSFET, the switching speed is very fast (nS). But this provides a moderate speed of switching.

The *IGBT transistor* is a compilation of the two types of transistor which are BJT and MOSFET. It is a resultant of the high input impedance and high switching speeds of a MOSFET with the low saturation voltage of BJT and combines them together to produce another type of transistor switching device that is capable of handling large collector-emitter currents with virtually zero gate current drive.

D. 3 phase inverter

A 3 phase inverter converts the direct current to Alternating current. The design of the specific device or circuitry decides the input voltage, output voltage and frequency and even the overall power handling. It should be noted that the inverter never produces any power. The power is provided by the DC source. An inverter can be either completely electronic or may be a combination of mechanical effects and electronic circuitry.

Here the inverter converts the Direct current from the microcontroller into thee alternating current.
The fig.3 shows the circuit of a three phase inverter which is given below:



E. Speed Sensor

The speed sensors are connected to the induction motor. The speed sensors sense the speed of the induction motor. When the sensor senses any violation in the speed of the induction motor, it notifies the user.

The speed sensor is given a feed back to the microcontroller.

The notification is sent to the operator's phone through the application. Due to which the operator could be able to change the speed of the induction motor by simply entering the speed the operator wants.

F. Transmitter:

The transmitter is a set of equipment which is used for the generation and transmission of messages in the form of electromagnetic waves most probably that of radio or television. This set up itself generates an alternating current in the form of radio frequency

commonly known as rf alternating current. This radio frequency alternating current is applied to the antenna. The antenna is excited by the alternating current, the antenna radiates radio waves

Thus change in any speed of the induction motor of any electrical appliance or any machine will be notified to the operator on his/her phone through the application specialized for the induction motor.
This way even the fan can be operated without any regulator and hence the remote control is replaced by the application.

G. Keypad

The keypad is an input source to the microcontroller. By using keypad, we get to know that we are making it to be dual in operation. So that the user if he is present near the machine or the electrical appliance containing the induction motor, then he can use the keypad to enter the value of the speed he/she wants. The programming will be done in such a way that the user could be able to access any speed within the range specified or allowed for the machine or electrical appliance having induction motor.
This way, it becomes advantageous over the present system available

H. LCD screen

The LCD screen will be connected near the microcontroller. So that the user gets to know any change in the speed of the induction motor (especially in the case for an industrial use) whereas, for domestic use, the LCD screen displays any change in the speed of the induction motor or it also shows the entered value of the speed. This way even if the operator enters a wrong value, he could correct it as the entered value by him or her will be displayed on the LC screen.
The microcontroller will also notify the operator by notifying him on the LCD screen if the user enters a value violating the maximum speed allotted for the induction motor.
We can even use a seven segment display.

IV. WORKING

Starting with the power supply, it cannot be directly given to the microcontroller. Hence one setup can be used to regulate the power supply. In the other case we can use transformer. By using transformers, there is one disadvantage that the transformer may be heated due to the fluctuations. As in most of the cases, the power supply would not be constant. Hence a setup is used for this case. The setup consists of two capacitors, one rheostat, 1 resistor and one IC of value 78G. The knob which is present will be connected to the rheostat which will help to vary the voltage.

Then the power supply is given to the microcontroller. Here the voltage regulator will maintain a constant voltage across the microcontroller.

The microcontroller takes the necessary action as per given by the feedback. The speed sensor senses the speed of the induction motor. And any change in the induction motor is sensed by the speed sensor and the notification is sent to the operator. This is done with the help of a transmitter. The transmitter then notifies the operator on the application. The operator then enters the value of the speed which he or she wishes to have. Then the microcontroller gets notified and thus through the programming the microcontroller sets up the speed value entered by the operator. And this enables the speed change. And this command is sent to the induction motor through IGBT. IGBT is used here so that it supplies medium supply instead of high or low supply.
This way the working is carried out when the operator is absent near the setup.

When the user is present near the setup, then the LCD screen connected to the microcontroller is displayed with the speed change value which is sensed by the speed sensor. The user will also be notified on the LCD screen whether the speed of the induction motor violates the value allotted to that particular induction motor. The operator thus can change the speed of the induction motor by entering the value of the speed of the induction motor by using the keypad connected to the microcontroller. Again the speed change value signal will be given through the IGBT. This is further sent to the three phase inverter which converts the DC value into AC value and this is applied to the induction motor.
This is the working of the whole setup.

V. APPLICATION

- Motor speed regulation
- In manufacturing industries
- For domestic use
- Speed control of motor

CONCLUSION

This is a low cost system and can be used efficiently for the speed control of the induction motor by building up an application. This reduces time consumption and hence proves to be a next level technology.

ACKNOWLEDGMENT

It is an immense pleasure by taking this opportunity to express our gratitude to our Guide, Er. Fareeza for

her healthy support and also to our project co-ordinator Er. Pandi Sabareeswari and also our Head of the Department, Er. E. Sheeba Percis to encourage us to work on this project.

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