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# Induction Motor Controller And Protection System

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## ABSTRACT

***Induction motors are widely used in different fields as ranging from domestic appliances to industrial purpose, thus protection of three phase as well as single phase induction motors are important because many industrial applications use induction motors. The primary goal of this paper is to develop a cheap and reliable protection system for induction motors. The protection system should protect motor from over current consumption, thermal protection and over vibration protection. Whenever motor crosses its threshold limit values of current, temperature and vibrations then system must turn off the motor through relay switch. In this concept we will able to control motors speed and direction of rotation as clockwise and anticlockwise. In this concept we are using AVR family microcontroller to control whole system. This controller continuously monitors current, power, temperature and vibrations on LCD and turn off the motor with beeping alarm if it crosses threshold limit.***

***Keyword:*** *- ACS712 Current Sensor, LM35 Temperature Sensor, Vibration Sensor, AVR Atmega328, LCD 16x2.*

## 1. INTRODUCTION

The protection of induction motors is an important because many industrial and household applications use induction motors. It is highly desired that induction motor works freely from all type of fault. Induction motors are most widely utilized motors. It requires less maintenance compared to other electrical motors. The primary goal of this project is to develop a cheap and reliable protection system for induction motor. The protection system should protect from over current, vibration, and thermal protection. We describe the system for monitoring and controlling of single-phase induction motor. A low cost of the system proposed to monitor the parameters of the induction motor i.e., current, power consumption, vibration of motor and temperature of the motor. Continuous monitoring is done for these elements. If there should be set limited value this provision in this proposed system facilitated the action to be taken before actual fault occurs on motor. What is more, henceforth enhancing the execution of the motor by maintaining a strategic distance from its tripping took after by fault. What's more with the monitoring, the speed control of the motor is performed. On the off chance that an over-load occurs i.e., Current exceeds the maximum limit the relay circuit will turn off the motor.

Induction motors have been used widely in different fields ranging from domestic appliances to industrial machinery. This necessitates a speed control mechanism that is efficient and is also safe to use, the induction motor can be run in either of the two directions which is quite useful in many industrial and household applications. But Induction motors like any other motors need efficient control to handle industrial applications. Along with-it motors are the most vulnerable parts to get damaged as they produce the desired motion in any machine. So, we also integrate a temperature, over current, over power and vibration detection alert in the system.

**This protection system provides following advantages:**

- Induction Motor Switching

- Induction Motor Speed Control
- Motor Direction Control (Clockwise/Anticlockwise)
- Motor Thermal Protection
- Motor Vibration Alert

Induction Motor Controller and Protection system serves this purpose of controlling the speed and direction of the induction motor along with protecting it from high vibration, over current and temperature. Induction motor runs through direct AC line the amount of power given to it decides to what RPM it does rotates. We can control the power of the AC line to vary the speed of the induction motor through AC driver circuit made up from TRIC and DIAC. An Atmega328 Microcontroller is used to control the whole system. In this project model we are using a LM35 temperature sensor to detect induction motor's temperature. The sensor is used to monitor temperatures of heavy-duty induction motors during operation. The sensor constantly monitors motor temperature and displays on LCD Display. As the temperature rises above certain limit, the system turns off the motor to avoid fires or coil burning. The ACS712 Current sensor is used here to read the current and power consumption of motor, if current limit exceeds beyond threshold current limit, the system turns off the motor automatically to avoid any damage to motor. Similarly, we use here a vibration sensor to monitor the motor vibrations during operation. The vibration of motor is displayed on LCD. If the motor vibrates above certain limit the system turns off the motor to avoid any damage to machine so that it can be fixed in any time and avoid any accidents. Thus, the system provides a complete induction motor controlling as well as protection system for industrial and household applications.

## 2. HARDWARE COMPONENTS:

The main hardware components to implement the system are: single phase induction motor, current sensor, vibration sensor, temperature sensor, 16x2 LCD and 12V SPDT relay. The detailed description of components used in this project work are mentioned below,

### 2.1 ACS712 Current Sensor

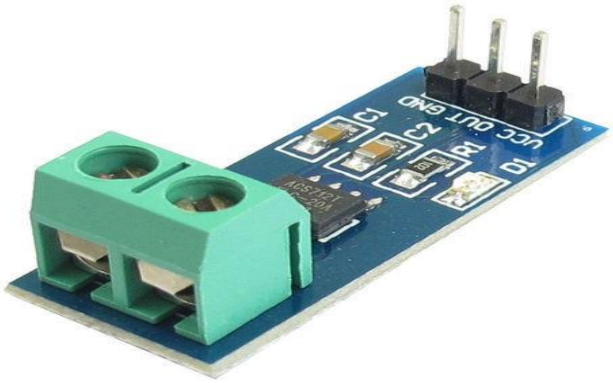


**Fig -1**: ACS712 Current Sensor

ACS712 is a hall-effect based linear sensor module. This has 2.1kV RMS voltage isolation along with a low resistance current conductor. This sensor capable of detecting AC as well as DC current. This module detects maximum current is up to 10Amp. Indirect sensing method uses ACS712 Current sensor to calculate the current. To sense current a liner, low-offset Hall sensor circuit is used in this module's IC. This sensor is located at the surface of the IC on a copper conduction path. When current flows through this path it generates a magnetic field which is sensed by the Hall effect sensor. A voltage proportional to the sensed magnetic field is generated by the Hall sensor, which is used to measure current. It has three terminals as VCC, GND and Output.

### 2.2 Vibration Sensor

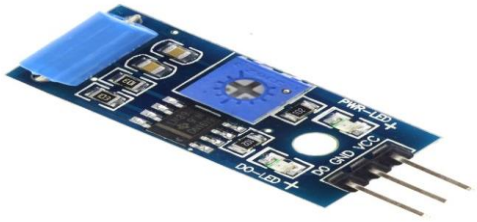


**Fig -2**: Vibration Sensor (SW-420)

Vibration sensor (SW-420) is high sensitivity non- directional vibration sensor. The default state of the switch is closed. Its digital output supply voltage is 5V DC. It's onboard indicator LED to show the results status. When the module is stable the circuit will be briefly disconnected and output low SW-420 based sensor, normally closed type vibration sensor.

### 2.3 Temperature Sensor


**Fig -3**: LM35 Temperature Sensor

The LM35 series are precision integrated-circuit temperature devices with output voltage linearly-proportional to the Centigrade temperature. The LM35 device does not require any external calibration to provide typical accuracies of ±¼°C at room temperature and ±¾°C over a full −55°C to 150°C temperature range. The low-output impedance, linear output, and precise inherent calibration of the LM35 device makes interfacing to readout or control circuitry especially easy. The device is used with single power supplies as dc 5V. The LM35 device is rated to operate over a −55°C to 150°C temperature range.

### 2.4 16x2 LCD

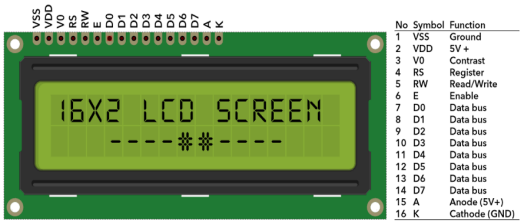


**Fig -4**: 16x2 LCD Display

LCD stands for Liquid Crystal Display; this screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic and is very commonly used in many devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons are: LCD is economical, easily programmable, no limitation of displaying special & even custom characters. A 16x2 means it can display 16 characters per line and there are 2 such lines, each character is displayed in 5x7 pixel matrix. A command is an

instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc.

**2.5 Microcontroller ATmega328**

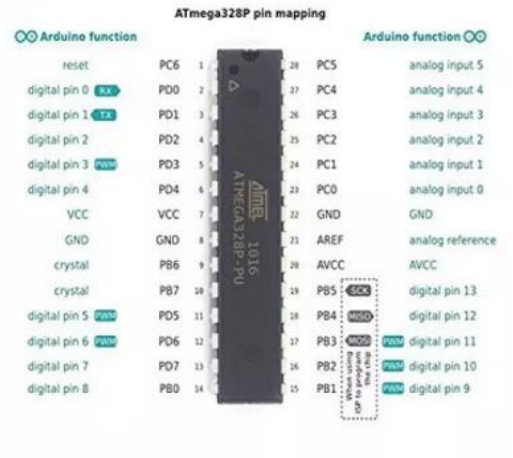


**Fig -5**: Microcontroller ATmega328

It is an Atmel 8-bit AVR RISC-based microcontroller with 32KB ISP flash memory and read-while-write capabilities, 1KB EEPROM, 23 general purpose I/O lines, 32 general purpose working registers, 3 flexible timer/counters with compare modes, internal, external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

**Key parameters for ATmega328:**

Flash (Kbytes):32kBytes, Pin count :28, Max. Operating Frequency (MHz): 20MHz, CPU: 8-bit AVR, Touch channels: 16, Hardware touch Acquisition: No, Max I/o pins: 22, Ext Interrupts:24, SPI: 221, TWI (12c):1, UART:1, ADC Channels:8

ADC Resolution (bits): 10, ADC speed (kbps): 15, Analog comparator:1, DAC Resolution:0, Temperature sensor: yes, Operating voltage: 1.8 to 5.5

## 3. PROGRAMMING SOFTWARE DISCRIPTION (ARDUINO IDE):

Arduino IDE is open-source software that is mainly used for writing and compiling the code into the Arduino Module. It is an official Arduino software, making code compilation too easy that even a common person with no prior technical knowledge can get their feet wet with the learning process. It is easily available for operating systems like MAC, Windows, Linux and runs on the Java Platform that comes with inbuilt functions and commands that play a vital role for debugging, editing and compiling the code in the environment. A range of Arduino modules available in market, each of them contains a microcontroller on the board that is actually programmed and accepts the information in the form of code. The main code, also known as a sketch, created on the IDE platform will ultimately generate a Hex File which is then transferred and uploaded in the controller on the board. The IDE environment mainly contains two basic parts: Editor and Compiler where former is used for writing the required code and later is used for compiling and uploading the code into the given Arduino Module. This environment supports both C and C++ languages.

## 4. BLOCK DIAGRAM AND WORKING PRINCIPLE

### 4.1 Block Diagram of System

The block diagram of induction motor controller and protection system is shown below,

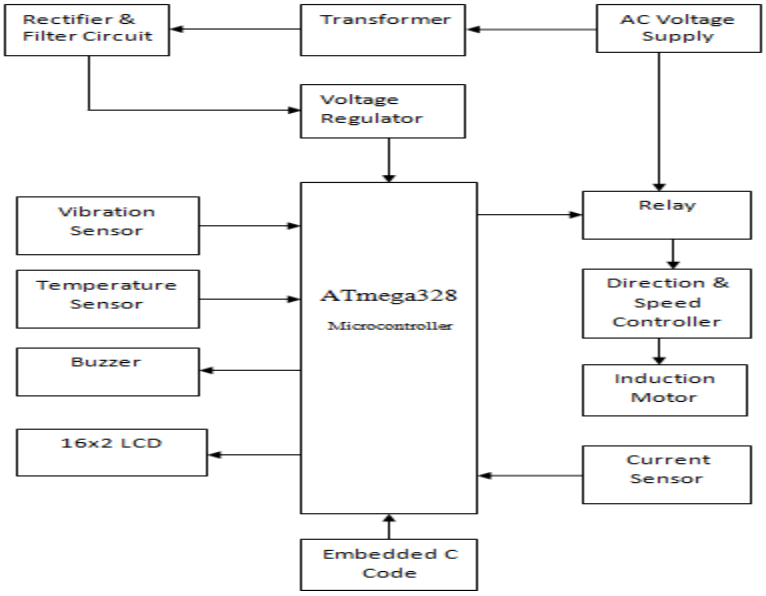


**Fig -6**: Block Diagram of System

### 4.2 Working Principle

The circuits connections are made as per block diagram. First the AC power applied to primary coil of step-down transformer, at secondary coil we get the unregulated AC 12v. Then this 12V AC applied to bridge rectifier and filter capacitors, so we will get a pure DC output. This pure DC output given to the 7805-voltage regulator, so we will get a regulated DC 5 Voltage. 5V DC is given to the microcontroller, Temperature sensor, Vibration sensor, Current Sensor and 16x2 LCD. The 12 Volt DC is for Relay. In this system 16x2 LCD is used to monitor the parameters as temperature, current and power consumption of motor and vibration status. The sensor is used to monitor temperatures of heavy-duty induction motors during operation. The sensor constantly monitors motor temperature and displays on LCD Display. As soon as the temperature rises beyond certain limit, the system turns off the motor to avoid fires or coil burning. The ACS712 Current sensor is used here to read the current and power consumption of motor, if current limit exceeds beyond threshold value, then the system turns off the motor automatically to avoid any damage to motor. Similarly, we use a vibration sensor to monitor the motor vibrations during operation. The vibration of motor is displayed on LCD display as it runs. If the motor vibrates beyond certain limit the system turns off the motor to avoid any damage to machine or motor so that it can be fixed in time and avoid any accidents. Thus, the system provides a complete induction motor controlling as well as protection system for industrial applications. We have written an Embedded C code in Arduino IDE as, Whenever the current, temperature and vibration rating crosses its threshold values, then microcontroller turn of the motor through relay circuit and starts for beeping buzzer and also monitors fault status on LCD displays. We can activate the system back to work by pressing reset button.

## 5. FINAL IMPLEMENTATION

The final implementation of project model is shown below as,

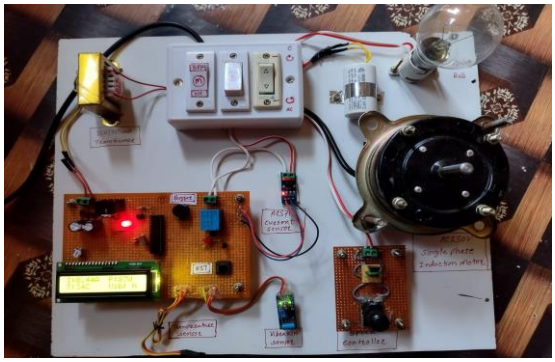

**Fig -7**: Final Implementation

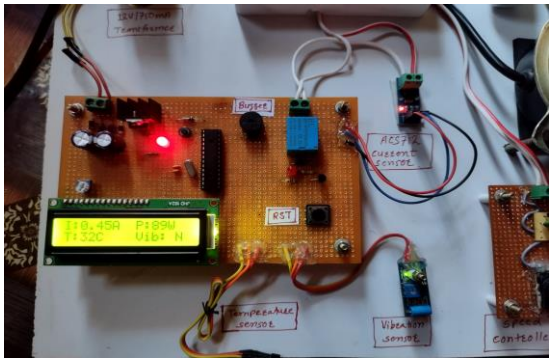

**Fig -6**: Parameters Monitoring on LCD

## 6. CONCLUSIONS

The maintenance of an induction motor is very important and essential. Induction motors are utilized as a part of all industry for example, paper process, sugar industry, for driving the mechanical frameworks. Protection of single-phase induction motor from over current, over power, thermal protection and over vibration give the smooth running of motor and enhances its life and efficiency. In single phase induction motor, while running at rated voltage, current and load these faults are not created. By using this concept, we have successfully implemented and tested induction motor controller and protection system.

## 7. REFERENCES

[1]. Vikram Singh, Abhishek Gupta, Ankit Gupta, Aniruddha Garg, Ankush Khandelwal, Akshay Gupta “Induction Motor Protection System”, Imperial Journal of Interdisciplinary Research (IJIR) Vol-3, Issue-3, 2017
[2]. Devesh Kumar, Piyush Kumar Verma, Brijesh Kumar Singh, Ravindra Singh, Vishal Singh “Single Phasing, Phase Reversal, Overvoltage, Under Voltage and Overheating Protection of Three Phase Induction Motor”, International Journal of Scientific Research and Management Studies (IJSRMS) ISSN: 2349-3771 Volume1 Issue 1,
[3]. Harsha Jain, Surbhi Shrivastava “Modern Method for Protection of Induction Motor Using Microcontroller and Wi-Fi Technology”, International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization) Vol. 4, Issue 6, June 2016
[4]. Horowitz SH, Phadke AG (2008) Power System Relaying. In: Horowitz SH, Phadke AG “Rotating Machinery Protection”, John Wiley and Sons, England, Pp. 159-178.
[5]. Distribution Automation Handbook, section 8.11, Motor Protection, pp. 6-13.
[6]. Anderdson Pm (1999) Power System Protection, Ieee Press Power Engineering, Nj,
[7]. Willy Interscience, New York, Usa, Pp. 783-787.
[8]. Kersting, Wh (2004), “Caused and Effects of Single Phasing Induction Motors”,
[9]. Proceedings Of Rural Electrical Power Conference, Ieee, Vol. 4, Pp. 1-6.
[10]. https://electrical-engineering-portal.com/induction-machines-historical-touch