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Condition Monitoring, Fault Detection and Protection of 3Φ Induction Motors Using Sensors

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ABSTRACT: Induction motors are widely used types of motors in industries.. These motors are rugged, reliable, and highly robust .But like any other machine, they are vulnerable to faults, A breakdown of the motor can lead to the shutdown of a whole production line and results in expensive downtime. It is thus important to have a reliable condition monitoring and fault diagnosis system in place to continuously monitor the healthy condition of such machine components. thus offering a very high degree of reliability With escalating demands for reliability and efficiency, the field of fault diagnosis in induction motors is gaining importance..Early fault detection & condition monitoring of the motor can increase the machine performance, reduce the damage consequently, prolong the useful lifespan of the machine, reduce spare parts inventories, prevent unexpected breakdown, and ensure timely maintenance schedules. The improvement of science and technology has lead to many changes in the way of life. The latest technology is used in most of applications like robots, space research, medical appliances, automobiles, military, education etc., In this regard an attempt is made to design a micro controller based fault detection & protection system, which takes the responsibility of checking all the parameters of the industrial unit and controls when a dangerous condition is found.

RF (Radio Frequency) is the technology that underpins most of the world's mobile phone networks. The RF platform is a hugely successful wireless technology and an unprecedented story of global achievement and cooperation. Today's RF platform is living, growing and evolving and already offers an expanded and feature-rich 'family' of voice and multimedia services. RF currently has a data transfer rate of 9.6k. New developments that will push up data transfer rates for RF users are HSCSD (high speed circuit switched data) and GPRS (general packet radio service) are now available. In the proposed scheme RF technology is used to send message to the owner immediately after the occurrence of problem in industrial unit. The RF with micro controller will be wired to the system with some sensors like temperature sensor, over voltage and under voltage detector, Vibration sensor and an emergency alarm or the main power switch. Whenever any sensors send an output, the RF device will analyse according to what is programmed and then it sends to the micro controller. The micro controller will check this command in the database and then sends the required SMS to the owner by connecting to the GSM modem connected to the micro controller. The owner responds to this and takes the necessary action to control the disaster. Mean while the load cutter automatically cuts off the load to prevent damage to the device.

KEYWORDS: Fault detection, Protection Under voltage, Over voltage, Sensors.

I.INTRODUCTION

An Induction motor is an AC electric motor in which the electric current in the rotor needed to produce torque is obtained by electromagnetic induction from the magnetic field of stator windings Three phase Induction motors are most widely used AC electric motors in all most all the industries. This is because of its ruggedness, reliability, economical use and more importantly because of its variable speed applications. The three phase Induction motor does

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not require mechanical commutation, separated excitation or self excitation, for all or part of energy is transferred from stator to rotor. Avoiding the unexpected shutdowns is important task for industries. In order to achieve this task the induction motor has to be continually monitored to identify faults in early stages. Detection of these faults in advance enables the maintenance engineers to take the necessary corrective actions as quickly as possible. The main types of external faults experienced by an induction motor are over-loading, single phasing, unbalanced supply voltage, locked rotor, phase reversal, ground faults, and under/over voltage.

However the three phase Induction motor experiences certain faults which would degrade the performance of the device. Some of the most commonly occurred faults

- 33% of electrical related faults. Such as over voltage, under voltage, phase reversing, unbalanced voltage, single phasing and earth faults.
- 32% of Mechanical related faults. Such as rotor winding failure, stator winding failure and bearing failure and bearing faults.
- 15% of Environmental Faults. Such as external moisture contamination, vibration of machine etc.

These electrically related faults such as over voltage, under voltage; temperature and environmental fault such as vibrations are frequently occurring faults in 3 phase induction motors which will produce more heat on both stator and rotor windings. This leads to reduction in the life time of the induction motors. Also these faults when left undetected would cause sudden system failure or also may cause catastrophic damage to the industry. Avoiding the unexpected shutdowns is important task for industries. In order to achieve this task the induction motor has to be continually monitored to identify faults in early stages. Detection of these faults in advance enables the maintenance engineers to take the necessary corrective actions as quickly as possible.

Therefore to protect the induction motors from these faults a low cost, reliable protection scheme using sensors is developed to detect occurred fault, RF technology and integrated micro controller which would display the occurred fault on the LCD display also sends SMS to the concerned person through GSM(Global System for communication Modem) so that required action is taken. Also mean while the load will automatically cut off by the load cutter to prevent further damage to the device.

II. FAULT DETECTION AND PROTECTION SCHEMES

The history of fault monitoring and fault isolation started with the use of electromechanical relays to protect the motor against faults (Elmore, 2004). However, these electromechanical relays are slow in operation, consume significant power, and require periodic maintenance due to mechanical parts involved. The introduction of semiconductor technology 2 had a positive impact on the induction motor protection field, and replaced the electromechanical relays by solid state relays as their operating speed is faster, consume less power, cheaper to manufacture and provide more reliability. Development of microprocessor technology in late 1970's enabled their application in the induction motor protective relays (IEEE, 1997). These relays allow the protection logic to be implemented by software programs Different type of 5 protection scheme for induction motor are explained below and their tripping delay is described for finite duration of voltage dips.

Bayindir Ramazan [2, 3] explained the three phase induction motor protection using sensors. PLC based protection has been employed and compared with PIC based protection. PLC has proved to be cost efficient. Need of ADC card has been eliminated by using PLC. PLC can be implemented on different kind of motors by applying small changes.

Kastha D. and Bose B.K. [1] investigated the faults of voltage fed inverter system for the three phase induction motor. Different fault modes has been discussed that can occur in PWM inverter system employed for the induction motor. Different types of fault probabilities regarding to fault in inverter system, has studied in this paper. The fault tolerant level is discussed to improve the reliability of the inverter system.

Maier Reinhard [2] presented the protection of squirrel cage induction motor and utilization the instantaneous power for the motor. Protection scheme for starting condition and running condition has been discussed. The method presented the ground faults, short circuits, interim fault and phase failure. It is sensitive to small deviations in voltage and load changes.

Kernstock Harald and Plassneggar Bernd [3] proposed that efficiency of the motor can be increased with low conduction and switching losses during inverter operation. Resonant circuit has been employed for the soft-switching

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of the MOSFET. The technique has been employed on a three level inverter. Result of hard switching and soft switching has been compared. Soft-switching shows less conduction and switching loss.

Bellini A. et.al. [4] discussed the previous ten years papers published on protection schemes for three phase induction motor. Research activity completed the study of electric faults, mechanical faults, signal processing for monitoring the induction motor and artificial intelligence approach for decision making. It has been suggested that the induction motor should be fully diagnosed for good protection.

Gomez J.C. et.al. [5] stated the effect on three phase induction motor of short interruption of power supply and voltage sags. Extremely deep voltage sag proves the worst case for the three phase induction motor. In most cases the short time voltage sags do not effect on the induction motor. The protection system should be designed in a way that the motor should not restart in a non-interfering fault.

Christopher W.I. and Ramesh R. [6] presented the hardware design of a nine-level inverter controlled by microcontroller. This technique has been employed to reduce the overall system cost. Microcontroller capabilities reduced the number of components required and made the system small in size and cost effective.

Julian A.L. et.al. [6] presented a scheme to apply a standby system for VSI controller. A secondary standby system can make the system reliable when primary VSI controller fails during operation. The controller has been implemented on different FPGA boards. Two boards communicate with each other during normal process and during fault on the primary board, secondary board override the primary board.

Lai J.S. et.al.[7] described the soft-switching technique for the inverter to overcome the over-voltage and over-current problem. In this inverter a single auxiliary switch and an inductor per phase is employed to produce zero voltage across main switch. Various techniques has been described to protect the MOSFET from switching voltages spikes. MOSFET protection is described with use of inductors for single phase and three phase inverter.

Li Tin-ho et.al. [8] investigated the Gate drive ON resistance losses of MOSFET snubber diode. Switching losses and different characteristics of the snubber circuit for the MOSFET protection has been studied. The experimental results are shown on 1kW, 230 V motor. On a single phase inverter, the sequence step are followed to describe the each part of the inverting process.

Al-Nasseir J. et.al.[9] described the RCD and RLD snubber circuit for the inverter circuit. RCD and RLD snubber circuits are designed on a three-level inverter. The results are compared with and without this snubber circuit. According to results, circuit without snubber circuit has many switching states and with snubber circuit the switching is reduced. This helps to reduce the false triggering of MOSFET and it helps to reduce switching losses.

Hanna R. and Schmitt D.W. [10] presented the failure analysis on a 7500 HP induction motor. Study shows that the small mechanical damages may not interrupt the motor normal operation. Comparison has been done between direct on line starting and soft starting. Historical data of the motors has been studied to show the various electrical and mechanical faults.

Also, remote control and monitoring techniques become a considerable solution to eliminate these hazards. Hence, wireless data communication is used in various industries. Wireless communication called Wi-Fi is capable of high data rate transmission, Bluetooth, and 3G in industrial companies. These devices use system resources a lot and are proportional to transmission speed. The Institute of Electrical and Electronics Engineers (IEEE) developed 802.15.4 standards and helped the production of RF (Radio frequency) protocol and devices that support this protocol. As a result, RF supported devices have low-cost, intelligent network topologies and are energy saving features. So, they have their place in daily life and industrial companies in various ways [12, 13]. A lot of devices and machines can be controlled, and data can be received and sent at the same time by RF wireless technology. So, system running can be achieved without any trouble.

Therefore RF Technology is used to send message to the owner immediately after the occurrence of problem in industrial unit. The RF with micro controller will be wired to the system with some sensors like temperature sensor, fire sensor, over voltage and under voltage detector, access control and an emergency alarm or the main power switch. Whenever any sensors send an output, the RF device will analyse according to what we have programmed and then it sends to the micro controller. The micro controller will check this command in the database and then sends the required message to the owner by connecting to the RF TX connected to the micro controller. The load will cut off if any parameters will vary so protection will automatically done .The owner also get message and responds to this and takes the necessary action to control the disaster . The microcontroller will receive it and then process according to the command.

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III. METHODOLOGY

The “Fault Detection and protection of Induction Motor” system mainly consists of 2 parts i.e. Transmitter section and Receiver section.

Transmitter section mainly consists of following components. They are

- Sensors
- Buffers, Drivers and Relays
- Load Cutter
- RF Transmitter

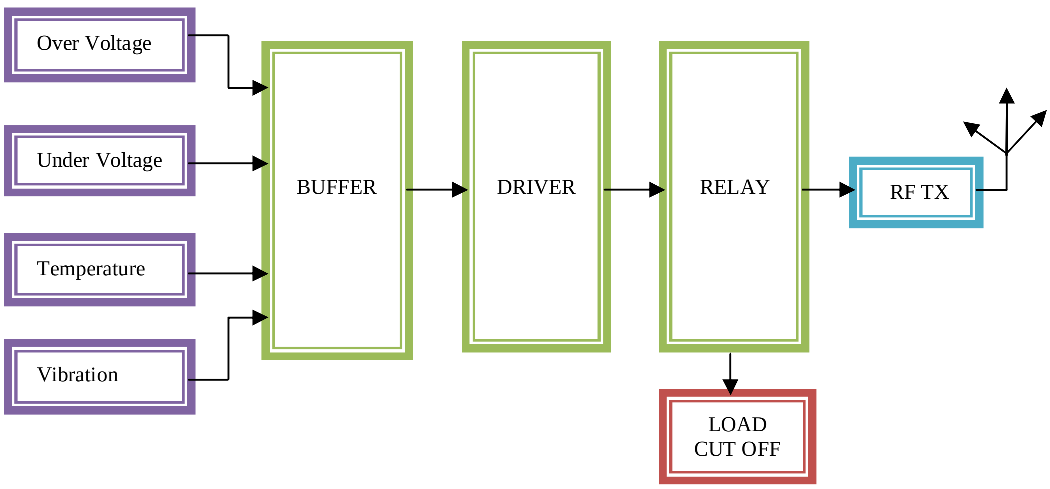

Fig. 3.1 Transmitter Section

At the Transmitter section as shown in the fig 3.1 the system consists of 3 sensors i.e Temperature sensor, Vibration Sensor and voltage sensor to check sensitive points of the industrial unit .The output of sensors will be in the order of milli volts. These voltages are amplified and scaled to give analog voltages of 0 to 5 volts using Buffers, Drivers and relays. These voltages are fed to analog inputs of micro controller for digital conversion by using ADC. The output of ADC is stored in memory locations and then compared with standard reference values of lookup table to decide whether the specific parameter is safer or not. The same procedure is used to check all other parameters. When an abnormality is found the specific unit is turned off automatically to control the subunit from damage. At the same time the abnormalities in the parameters will be transmitted through RF transmitter.

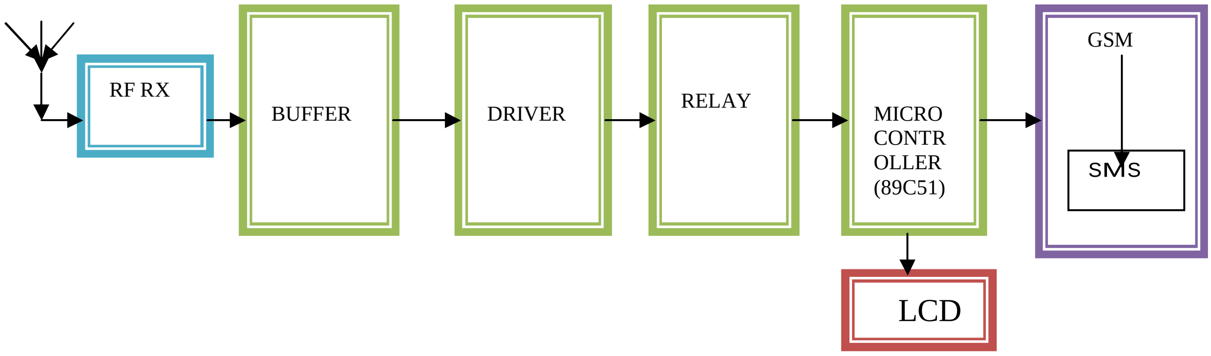

Fig 3.2 Receiver section

Receiver section mainly consists of following components. They are

- RF Receiver
- Buffers, Drivers and Relays
- Micro Controller
- LCD Display
- GSM Modem

The receiver section as shown in the fig 3.2 receives the transmitted signal. The RF receiver with micro controller will be wired to the system with some sensors like temperature sensor, over voltage and under voltage detector, access control and an emergency alarm or the main power switch. Whenever any sensors send an output, the RF device will analyse according to what we have programmed and then it sends to the micro controller. The micro controller will check this command in the database and then sends the required SMS to the owner by connecting to the RF modem connected to the micro controller. Or even it makes a call to the required person. The microcontroller will send a request command to the modem to send the message with the sender phone number. The microcontroller will receive this data and first verify the phone number with master (owner) phone number. If it matches then it will compare the SMS with the stored SMS in the database. When any of the SMS matches then will see what function has to be carried out, once this SMS is received.

IV.HARDWARE DESCRIPTION

POWER SUPPLY UNIT:
The circuit needs two different voltages, +5V & +12V, to work. These dual voltages are supplied by specially designed power supply. The power supply, unsung hero of every electronic circuit, plays very important role in smooth running of the connected circuit. The main objective of ‘power supply’ is, as the name itself implies, to deliver the required amount of stabilized and pure power to the circuit.

BUFFER, DRIVER & SWITCHING MODULE:
When the user programs the schedule for the automation using GUI [Graphical User Interface] software, it actually sends 5-bit control signals to the circuit. The present circuit provides interfacing with the Microcontroller and the controlling circuitry. This circuit takes the 5-bit control signal, isolates the MICROCONTROLLER from this circuitry, boosts control signals for required level and finally fed to the driver section to actuate relay. These five relays in turn send RC5 coded commands with respect to their relay position.

MONOSTABLE MULTIVIBRATORS (555 TIMER):
The timer comprises two operational amplifiers (used as comparators) together with an RS Bistable element. In addition, an inverting output buffer is incorporated so that a considerable current can be sourced or sunk to/from a load. A single transistor switch, TR1, is also provided as a means of rapidly discharging the external timing capacitor. The standard 555 timer is housed in an 8-pin DIL package and operates from supply rail voltages of between 4.5V and 15V. This encompasses the normal range for TTL devices and thus the device is ideally suited for use in conjunction with TTL circuitry.

SENSORS (TEMPERATURE SENSOR: THERMISTOR):
The **Thermistor** is another type of temperature sensor, whose name is a combination of the words THERM-ally sensitive res-ISTOR. A Thermistor is a special type of resistor which changes its physical resistance when exposed to changes in temperature. Thermistors are generally made from ceramic materials such as oxides of nickel, manganese or cobalt coated in glass which makes them easily damaged. Their main advantage over snap-action types is their speed of response to any changes in temperature, accuracy and repeatability. Most types of Thermistors have a Negative Temperature Coefficient of resistance or *(NTC)*, that is their resistance value goes DOWN with an increase in the temperature, and of course there are some which have a Positive Temperature Coefficient, *(PTC)*, in that their resistance value goes UP with an increase in temperature. Thermistors are rated by their resistive value at room temperature (usually at 25^{o}C), their time constant (the time to react to the temperature change) and their power rating with respect to the current flowing through them. Like resistors, Thermistors are available with resistance values at room temperature from 10’s of MΩ down to just a few Ohms, but for sensing purposes those types with values in the kilo-ohms are generally used. Thermistors are passive resistive devices which means we need to pass a current through it to produce a measurable voltage output. Then thermistors are generally connected in series with a suitable biasing

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resistor to form a potential divider network and the choice of resistor gives a voltage output at some pre-determined temperature point or value.

OVER VOLTAGE AND UNDER VOLTAGE:

When the voltage in a circuit or part of it is raised above its upper design limit, this is known as **over voltage**.
When the voltage in a circuit or part of it is raised above its lower design limit, this is known as **under voltage**.
This sensor will be used to check whether the over or under voltage occurs to the circuit. If occurs then it will activates the buzzer to indicate over or under voltage has occurred. When the mains voltage is in the normal level, the voltage at the negative terminal of zener diode D4 will be less than 5.6 Volts. At this condition transistor T1 will not conduct. The same time voltage at the negative terminal of zener diode D5 will be greater than 5.6 and so the transistor T2 will be conducting. The relay will be activated and the green LED will be glowing. When the mains voltage is higher than the set limit the transistor T1 becomes conducting since the voltage at the negative terminal of D4 is greater than 5.6 v. At the same time transistor T2 will be non-conducting which results in the deactivation of relay to cut the mains supply from load. When the mains voltage is less than the set limit transistors T1 & T2 becomes non-conducting making the relay to de- activate and cut the load from mains.

VIBRATION SENSOR (PIEZO SENSOR):

A piezoelectric sensor is a device that uses the piezoelectric effect, to measure changes in pressure, acceleration, strain or force by converting them to an electrical charge. The prefix Piezo- is Greek for 'press' or 'squeeze'. This sensor buffers a piezoelectric transducer. As the transducer is displaced from the mechanical neutral axis, bending creates strain within the piezoelectric element and generates voltages.

Specifications:

- Detection Direction: Omni-directional
- Signal Output: Switch signals
- Output Pulse Width: The vibration signal amplitude is proportional to
- Operating Voltage: 12VDC (red V + shield V-)
- Sensitivity: Greater than or equal 0.2g
- Frequency Range: 0.5HZ ~ 20HZ
- Operating Temperature Range: 10 ~ 50

The Vibration Sensor Detector is designed for the security practice When Vibration Sensor Alarm recognizes movement or vibration, it sends a signal to either control panel Developed a new type of Omni-directional high sensitivity Security Vibration Detector with Omni-directional detection.

RF TRANSMITTER AND RECEIVER:

RF TRANSMITTER:

The RF transmitter is built around the ASIC and common passive and active components, which are very easy to obtain from the material shelf. The circuit works on Very High Frequency band with wide covering range. The Carrier frequency is 147 MHz and Data frequencies are 17 MHz, 19 MHz, 22 MHz & 25 MHz It should be noted that ASIC or Application Specific Integrated Circuit is proprietary product and data sheet or pin details or working principles are not readily available to the user.

ASIC:

Application Specific Integrated Circuit [ASIC] is another option for embedded hardware developers. The ASIC needs to be custom-built for a specific application, so it is costly. If the embedded system being designed is a consumer item and is likely to be sold in large quantities, then going the ASIC route is the best option, as it considerably reduces the cost of each unit. In addition, size and power consumption will also be reduced. As the chip count (the number of chips on the system) decreases, reliability increases.

OSCILLATOR:

An electronic device that generates sinusoidal oscillations of desired frequency is known as a sinusoidal oscillator. Although we speak of an oscillator as “generating” a frequency, it should be noted that it does not create energy, but merely acts as an energy converter. It receives D.C. energy and changes it into A.C energy of desired frequency. The frequency of oscillations depends upon the constants of the device. Hartley Oscillator is very popular and is commonly used as a local oscillator in radio receivers. It has two main advantages viz., adaptability to a wide range of frequencies and is easy to tune. The RF transmitter is built around the common passive and active components, which are very is to obtain from the material shelf. The circuit works on Very High Frequency band with wide covering range.

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RF RECEIVER MODULE:

The circuit is built around the ASIC i.e., Application Specific Integrated Circuit, hence less circuitry is observed. The Radio Frequency tuned circuit has 147 M Hz carrier frequency with four options viz., 17 KHz, 19 KHz, 22 KHz and 25 KHz. The transmitted signals are received on coil L1 which acts as receiver antenna. The oscillator transistor removes the received signals from 147MHz carrier frequency and fed to ASIC. The tank circuit formed by C1 and L1 gives the carrier frequency range. The current limiting resistor R1 and bypass capacitor C5 stabilizes the oscillator. The resistor R2, R3 and R4 provide the biasing voltage to the oscillator transistor T1. Capacitors C2 and C3 are there to bypass the noise and harmonics present in the received signals. Through coupling capacitor C7 output of the RF Receiver is fed to ASIC.

GSM MODULE:

GSM Shield (SIM 900a): The SIM900 which is a complete Quad-band GSM/GPRS solution comes in a SMT module which can be embedded in customer applications. Featuring an industry-standard interface, the SIM900 delivers GSM/GPRS 850/900/1800/1900MHz performance for Data, voice, SMS and Fax in a small form factor and with low power consumption. SIM900 can fit almost all the space requirements in the M2M application with dimensions of 24mm x 24mm x 3 mm. SIM900 is designed with a very powerful single-chip processor integrating AMR926EJ-S core. Quad - band GSM/GPRS module with a size of 24mmx24mmx3mm, SMT type suit for customer application, An embedded Powerful TCP/IP protocol stack Based upon mature and field-proven platform, backed up by our support service, from definition to design and production. GSM uses digital technology and is a second-generation (2G) cell phone system. GSM, which predates CDMA, is especially strong in Europe. EDGE is faster than GSM and was built upon GSM.

MICROCONTROLLER (Atmel 89C51):

The Atmel 89C51 is a low-power, high-performance CMOS 8-bit microcomputer with 4K bytes of Flash programmable and erasable read only memory (PEROM). The Atmel 89C51 device is manufactured using Atmel's high-density non-volatile memory technology and is compatible with the industry-standard MCS-51 instruction set and pin out. The on-chip Flash allows the program memory to be reprogrammed in-system or by a conventional non-volatile memory programmer. By combining a versatile 8-bit CPU with Flash on a monolithic chip, the Atmel AT89C51 is a powerful microcomputer which provides a highly-flexible and cost-effective solution to many embedded control applications. The Atmel 89C51 provides the following standard features: 4K Bytes of Flash, 128 bytes of RAM, 32 I/O lines, two 16-bit timer/counters, a five vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator and clock circuitry. In addition, the 89C51 is designed with static logic for operation down to zero frequency and supports two software selectable power saving modes. The Idle Mode stops the CPU while allowing the RAM, timer/counters, serial port and interrupt system to continue functioning. The AT89C51 Power-down Mode saves the RAM contents but freezes the oscillator disabling all other chip functions until the next hardware reset.

SPECIFICATIONS:

- Compatible with MCS-51 Products
- 4K Bytes of In-System Reprogrammable Flash Memory
- Fully Static Operation: 0 Hz to 24 MHz
- Three-level Program Memory Lock
- 128 x 8-bit Internal RAM 32
- Programmable I/O Lines
- Two 16-bit Timer/Counters
- Six Interrupt Sources Programmable Serial Channel
- Low-power Idle and Power-down Modes 40-pin DIP

LCD MODULE:

LCDs can add a lot to any application in terms of providing an useful interface for the user, debugging an application. The most common type of LCD controller is the Hitatchi 44780 which provides a relatively simple interface between a processor and an LCD. Using this interface is often not attempted by inexperienced designers and programmers because it is difficult to find good documentation on the interface, initializing the interface can be a problem and the displays themselves are expensive. The most common connector used for the 44780 based LCDs is 14 pins in a row, with pin centers 0.100" apart.

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V. RESULTS

FIG 5.1. LCD DISPLAY OF UNDER VOLTAGE

The Micro controller will be programmed in such a way that the occurred unbalance in the voltage will be displayed on the LCD screen. As shown in the above fig 5.1, If the voltage supplied to motor drops to value less than minimum voltage required to operate motor then LCD will display as “UV” indicating as under voltage.

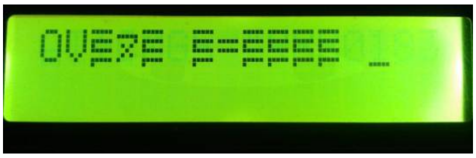

FIG 5.2 LCD DISPLAY OF OVER VOLTAGE.

As shown in the above fig 5.2, If the voltage supplied to motor suddenly increases to value greater than maximum voltage the motor can with stand then LCD will display as “OV” indicating as over voltage. This helps to protect the induction motor from voltage unbalance. At the same time the occurred unbalance will be sent as SMS to the phone no. that is programmed as “OU” and “UV”.

Fig 5.3 LCD DISPLAY OF VIBRATION

The Piezo sensor senses the vibration and displays as “VIBR” as shown in the fig.5.3. Therefore, a protection system has been designed for safeguarding induction motors against all possible faults such as temperature, vibrations, over and under voltage.

VI. CONCLUSION

In this proposed work “CONDITION MONITORING,FAULT DETECTION AND PROTECTION OF 3Φ INDUCTION MOTOR USING SENSORS” a protection system has been designed for safeguarding induction motors against all possible faults. Sensors are used to keep tabs on temperature, vibrations, over and under voltage. A temperature, vibration and voltage in induction motor is used in the system to check the a temperature, vibration and voltage respectively. Assuming that any error is seen throughout online operation of the motor, a cautioning message shows up on LCD and afterward the motor is halted also through GSM. SMS is sent to the concerned person to take further action. The point when an unclear flaw happens, the motor stops by giving warnings. Hence, load will be disconnected,. The test has been successful in locating the shortcomings and in re-coupling.

REFERENCES

[1] Bayindir R., Sefa I, Colak I. and Bektas A., "Fault Detection and Protection of Induction Motors Using Sensors," IEEE Transactions on Energy Conversion, Vol. 23, no.3, pp.734-741, Sept. 2008.

[2] Kastha D.K. and Bose B.K., "Investigation of fault modes of voltage-fed inverter system for induction motor drive," IEEE Transactions on Industry Applications, Vol. 30, no. 4, pp. 1028-1038, August 1994.

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[3] Maier R., "Protection of squirrel-cage induction motor utilizing instantaneous power and phase information," IEEE Transactions on Industry Application , Vol. 28, no. 2, pp. 376-380, April 1992.

[4] Kernstock H. and Plassnegger B., "High efficiency soft switched 3-level MOSFET Inverter for an Electric Vehicle PMSM Drive," 15th International Power Electronics and Motion Control Conference, EPE/PEMC, 2012, pp. DS1b.9-1 - DS1b.9-5, 4-6 Sept. 2012, Novi Sad

[5] Bellini A., Filippetti F., Tassoni C. and Capolino G. A., "Advances in Diagnostic Techniques for Induction Machines," IEEE Transactions on Industrial Electronics, Vol. 55, no. 12, pp. 4109-4126, Dec. 2008.

[6] Gomez J.C., Morcos M.M., Reineri C.A. and Campetelli G.N., "Behavior of induction motor due to voltage sags and short interruptions," IEEE Transactions on Power Delivery, Vol. 17, no. 2, pp. 434-440, April 2002.

[7] Christopher I.W., Deepa A., Hemalatha K., Madhubala S., Hemalatha J. and Ramesh R., "Microcontroller based single-phase simplified nine-level inverter fed induction motor," IEEE 5th India International Conference on Power Electronics (IICPE), pp. 1-6, 6-8 Dec. 2012.

[8] Julian A.L., Oriti G. and Blevins S.T., "Operating Standby Redundant Controller to Improve Voltage-Source Inverter Reliability," IEEE Transactions on Industry Applications, , Vol. 46, no. 5, pp. 2008-2014, Sept.-Oct. 2010.

[9] Lai J.-S, Young R.W., Ott G.W. Jr., White C.P., McKeever J.W. and Chen D., "A novel resonant snubber based soft-switching inverter," Tenth Annual Applied Power Electronics Conference and Exposition, 1995 APEC '95, Vol.2, pp. 797-803, 5-9 Mar 1995.

[10] Tin-ho Li, Jian-jing Wang and Chung H. S.-H., "An investigation into the effects of the gate drive resistance on the losses of the MOSFET-snubber-diode configuration," IEEE Energy Conversion Congress and Exposition (ECCE), pp. 362-369, Sept. 2010.