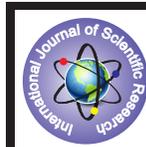


Higher Degree Protection Technique of a Motor by Using Pic Microcontroller



Engineering

KEYWORDS : Protection method using PIC Microcontroller for motor, current sensor, Temperature sensor, Current, applied voltage. Higher Degree Protection technique (HDP) device. Analogue to digital converter ADC

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ABSTRACT

Higher Degree Protection of Motor by Using PIC Microcontroller" is an innovative, alternative, effective, efficient and more reliable method of protecting technology of an Electrical motor. This paper describes the design and implementation of this method and possible future improvements in this field. Electrical power consumed by Motor is higher level comparing other electrical loads. The motor is play major role in electrical consumer. Generally the motor faults occur due to the Voltage fluctuation, Current fluctuation on electric power input side. To protect the motor monitoring the voltage and current is an important responsibility. Otherwise motor may damaged by means of burning of the coil. It leads other malfunction in the electric power circuit. The new technology based on electronic circuit which operated digital electronic. The logic digital system is an advantage of very fast response. The monitoring and executing the protection system is used with microcontroller. The process can be fed to the computer for data storage and continues reference for future operation. The protection system is implemented and the results are shown in the paper. The scope of this system and possible improvements are on design also given in this paper.

I. INTRODUCTION

Motor is commonly used in everywhere in household application, domestic usages, Official places and small, medium and major industries in all over the world. Electrical power consumption by motor load is approximately 90% of entire production of electrical power energy. The protection of the motor from various liabilities is an important. The following facts may be the reasons for initiate the fault on the motor. 1, Supply voltage may be higher or lower to the rated voltage of the motor. 2. Current drawn may be higher or lower to the rated current of the motor. 3. Temperature of motor may be higher than the given specification. 4. Mechanical anomaly. Motor is versatile machine in every nook and corner; Most of the people are using the motor on different ways and maximum Electrical power is spending by the motor. Since the motor protection is very imperative. And it should be reliable and activate rapidly. So the new technology is used in this system for fast and reliable operation for the protection of motor.

The digital logic system is used in this protective device. Digital communication is operated in high-speed between various components of the system. So the activation speed of the system is rapid. This is major advantages than other conventional type of safety relays. Our system connected sensors are continuously fed the data to the PIC microcontroller. The PIC initiating our appropriate programme and activate and send relevant data signal to the power controlling devices appropriate to the sensor input. Then the controlling devices are deactivating input power supply to the motor depending upon our pre defined programme, so that the fault occurrence is avoided. The programme may be modified various motor specifications and process, depending upon the required operation. The default values of the motor can be adjusted according to the various functions. The data are fed to the computer for self monitoring and checking. The micro controller based system has much adjustable characteristic, superior flexibility, very high accuracy, various ranges of operation, compact size, lesser cost and further many ancillary functions are also possible.

II. SYSTEM DESCRIPTION

We have analysis and implement the circuit design with the help various literature reviews. Finally we conceived the following design for the high degree protection technique of a motor by using PIC microcontroller

As shown in Fig.1. The electrical power input connected through the starter relay of the motor. This relay is connected series with

starter and motor. The relay energized and operated on the control of our HDP. A voltage sensor is connected on the line which comprise with a, step down transformer b, AC/DC rectifier c. ADC. The input power supply voltage fed to PIC through ADC. Whenever the voltage fluctuation appears on the power supply, which is immediately sense by the PIC with the help Voltage sensor. PIC initiates the relay driver to disconnect the electric power to the motor based on programmed voltage value data and also depending upon higher voltage or very low voltage of the power supply.

The Current sensor is connected series with load, Here it is motor. The sensor data is fed to the PIC. The load current exceeds its limit, the PIC initiate to send signal to the relay driver to disconnect the electric power to the motor. The PIC functions as expert operator for safe guard the motor. It is heart of the system and it will monitor the voltage and current flow of the motor as desired level. If any anomaly appears in the circuit, it activates rapidly to disconnect the power supply. Generally fuse type system is used for safety. But this PIC system has more advantages than conventional fuse system. The LCD displays also an additional feature to this system for monitor periodically by human beings. One more additional improvement of this is, the data also fed to the computer for future use and analysis. If necessary computer interface also we can provide for the various motor in the working place.

MAIN CIRCUIT

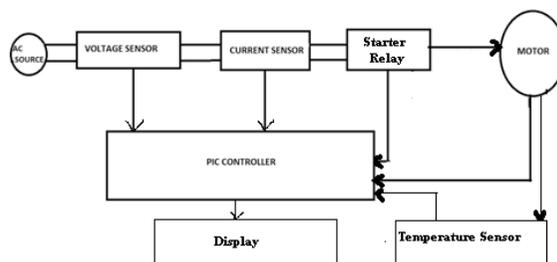


Figure 1. Main Block Diagram

A. Excess current protection trip circuit

Now a day's analogue ammeter is not used for current measurement. The total load current will pass through the ammeter or current transformer. Since there is a voltage drop, and overheating the current coil which produces magnetic force. The PIC of

our protection technique system required only DC. We used current sensor BB-ACS756 which capable to measure up to 50A. The desired output of the digital signal from ACS756 sensor (ADC) data value corresponding to the motor load current fed to the PIC. The digital display shows the current value.

B. Voltage level protection circuit

The objective of the protection is based on advance detection of fault occurrence. So we can avoid the fault or burning of the wound coil and damages of motor. The voltage is major role in the electrical power, since based on voltage the current flow takes place in the circuit. A step down transformer and analogue to digital (ADC) converter is used to get the supply voltage level, to monitor the input supply voltage for the motor. The voltage may be higher than the rated level or lower than the rated level. The corresponding digital signal fed to the PIC. The PIC activate according to our pre determined voltage of higher or lower level. The advantage of PIC is that we can modify the voltage level of system depending upon the working voltage arrangement. If the PIC detects any deviation in the voltage level it send the trip signal to the relay drive circuit.

III. SYSTEM FUNCTION EXPLANATION

Our system has to be new in the filed of protection of the motor. The common use of the over load relay working as a thermal expansion system or magnetic strength increase system. In both cases the sensing time duration, that is time required for development of heat or time requirement for development of magnetic flux on the plunger is high. Since both cases sensing is based analogue system. In the higher degree protection technique system the sensing is based in digital system. So it has very fast sensing the voltage and current level. We know the data transmission is also very fast in digital system which is used here for the PIC. The PIC is also a digital system. We programmed the PIC with relevant voltage and current rating as minimum and maximum level for activation. The PIC activate comparatively very fast. The commanding signal also initiated by PIC and send to the relay driver to disconnect the power supply. There is a provision for voltage setting arrangement in the voltage sensor depending up in the motor voltage and also the current rate setting arrangement in the current sensor depending up in the motor rating. The PIC has also additional provision for the above limit setting by software programme for voltage and current. The Commanding signal produced form the PIC is based on the voltage and current setting program and the signal fed to the relay driver. The relay driver is used to cut of the power supply to the motor for emergency purpose like fault occurrence period. The Voltage and current information can be seen from display unit available with our system.

IV. SYSTEM FLOWCHART

Flowchart is a diagram representation of the program algorithm. The figure below shows the system flowchart.

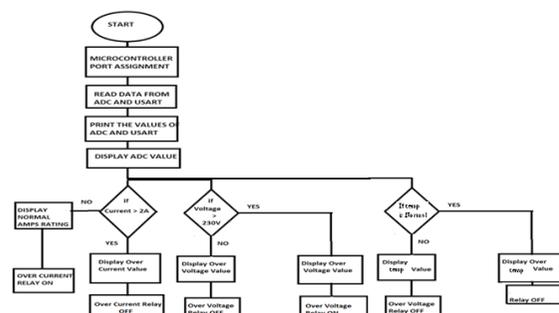


Figure 2 System Flowchart.

The Flowchart illustrates the coordination of all activities of this higher degree protection technique as chronological approach. This is a fool proof method of implementation of HDP system. The program will initialize, with self test for validate the input, output connections and the entire connected devices. The LCD monitor reflects the condition of the system and with appropriate data. The micro controller and ADC are capturing the data from the Voltage, current and thermal sensors throughout. The micro controller continuously receives the data from the sensors and simultaneously analysis the data with predefined records which programmed in the PIC based on motor specifications. When the received data from sensors are not match with the level of predefined data of the motor, the PIC initiate to send the signal to the relay driver to cut off the power supply. The speed of data capture, sending the data to PIC, data analysis and sending the relay signal are takes place with in a mille seconds.

V. HARDWARE DESIGN IMPLEMENTATION AND SOFTWARE EXECUTION

A. Complete schematic diagram

PIC 16F877A WITH CONNECTIONS

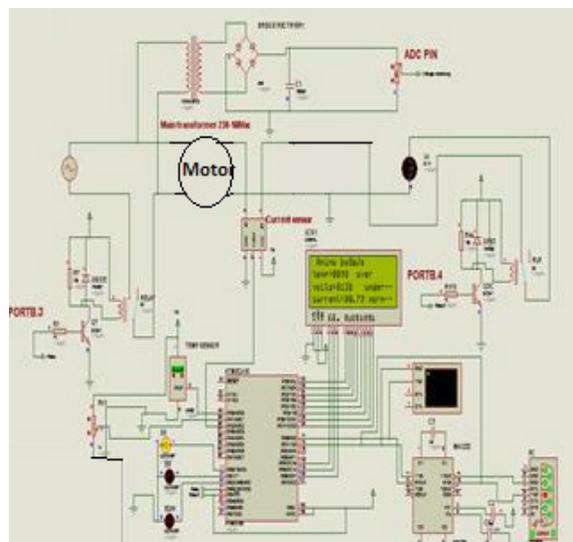


Figure 3 Simulation Diagram

The circuit consists of PIC16F877A microcontroller; step down transformer circuit for voltage sensing, current sensing circuit, relay circuits, a temperature sensor, RS232 and the max232 circuit.

The step down transformer used is a 230 to 12 Vac transformer and is used for the purpose of sensing the input voltage to the motor with a voltage rating of 230 to 160Vac. The step down transformer is been rectified and filtered to a pure dc which goes directly to the ADC then microcontroller for monitoring the input voltage. For the purpose of current sensing, a current transformer is used for that purpose. This current also rectified and filtered for the purpose of reducing the ripple and noise then directly connected ADC and to the microcontroller for monitoring the load current.

The microcontrollers drive the LCD panel for display relevant data such as voltage, current, etc and also transmit them to a personal computer. Whenever a fault occurs which might be high voltage or over current, the microcontroller sends a trip signal to the relay and thereby protecting the motor from burning.

The system was developed with all the features of a microcontroller for higher degree motor protection. The loads are connected to the motor, and a current sensor is connected in series with motor for real time current monitoring. Based on the real time current monitored values, the microcontroller takes decision over the relay whether to cut off or not. The step down transformer connected to the input voltage is used for voltage monitoring, based on the input voltage values; the microcontroller takes decision over the on-off condition. The PIC16F877A microcontroller board contains all the sub circuits on-board including the high voltage sensing circuit, the liquid crystal display (LCD) for monitored values display, temperature sensor, relays for protection purposes and finally the MAX 232 and RS232 for transmitting the transformer parameters to PC.

V. RESULTS AND CONCLUSIONS

To check and confirm the results for the proposed higher degree protection technique for motor, a prototype was developed along with the microcontroller PIC16F877A. This is the heart of the HDP system. For analysis purpose, for operating various voltage and current level, we are used auto transformer for varying voltage level and spring balance load test arrangements for varying load (current) level. So the test will facilitate to higher or lesser voltage and excess and lower current. Voltage and current monitoring circuit with PIC designed as to cut-off the power supply to the motor when fault occur during voltage and current are exceeds their limits. The speed of data capture, sending the data to PIC, data analysis and sending the relay signal are takes place within a mille seconds

VI. CONCLUSION AND PROSPECT SUGGESTION

A. Conclusion

The motor protection is major task ahead in the electrical engineers and consumer forum. The electronics system, specifically the digital phenomena is covered every nook and corner of industrial sphere. Since its greater reliability, fast activation, easy modification of default settings, miniature in size and weight, and so many advantageous are going to the forefront to the new technology. This system has valuable and efficient hands on technology for motor protection. This system has more advantageous than traditional motor safety system. The conventional thermal expanding sensors or magnetic field type sensors are less sensitivity and response time required for activation is more. But this HDP technique using digital sensors and digital procedure of activation is rapid in operation. The maintenance and, wear and tear also eliminated. With the help of this new HDP technique there is more comfortable in motor safety. The motor users are free from un-necessary fear on the motor fault, damage and coil burning due to electrical supply. The prototype model gives good and agreeable results on this protection during our investigation trails.

B. Future Recommendations

As per our observation we recommend that the motor starter may be transformed to as electronics and digital operation system instead of presently used conventional system. It can be cost effective for higher power motor drives that are more than 35KW. The power semiconductor family has many advantages than other conducting starter operating system. So electronics and digital system may be used for motor protecting system.

If necessary the data of the input and output are to be used with computer for centralized operation of the plant for overall protection. The remote sensing operation is also applicable for this system provided some modification to be done on the system.

REFERENCE

- [1] P. M. Anderson (1998), Power system protection. New York: John Wiley & Sons, Inc. P.673. [2] J. Lewis Blackburn, Thomas J. Domin (2006). Protective Relaying Principles and Applications. 3rd ed. United States of America: CRC press Leonard L. Grigsby (2007). The Electric Power Engineering Handbook. 2nd ed. United States of America: CRC press. [3] Ali Reza Fereidunian, Mansooreh Zangiabadi, Majid Sanaye-Pasand, Gholam Pournaghi, (2003) 'Digital Differential Relays For Transformer Protection Using Walsh Series And Least Squares Estimators', CIRED (International Conference on Electricity), pp. 1-6. [4] Mazouz A. Salah Abdallah R. Al-zyoud (2010), 'Modelling of transformer differential protection using programmable logic controllers' European journal of scientific research, 41(3), pp. 452-459. [5] R. A. LARNER and K. R. GRUESEN, (1959), Fuse Protection of High-Voltage Power Transformers, pp.864-873. [6] S.M Bashi, N. Mariun and A. rafa (2007). 'Power Transformer protection using microcontroller based relay', Journal of applied science, 7(12), pp.1602-1607.