IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research

in Electrical, Electronics and Instrumentation Engineering

Volume 9, Issue 12, December 2020

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.122

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IOT Based Inductive Machine Energy Management System with Power Factor Correction

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ABSTRACT: The conservation of electrical energy is an important aspect because the resources are decreasing as the day by day. There is huge demand for electrical energy in the industries but they are facing two major hurdles, one is scarcity of energy and another one is increasing cost of the available energy. In industrial sector most of the loads are inductive in nature that is lagging type load. These lagging type loads require reactive power which is to be provided by power generating station. But the loads are continuously varying, so the need of reactive power gets varied. The most of the losses occurred in the power system is due to the poor power factor. The industrial and commercial installation has large inductive loads which causes lagging power factor and gives penalties to consumers by utilities. So, we can compensate the reactive power requirements in the load by using power factor correction technique. Automatic power factor correction unit can be achieved with the help of Arduino to compensate the reactive power by switching capacitor banks automatically and maintain power factor near to unity. Energy management system is used to measure the power factor of the individual machine.

KEYWORDS:IOT, Sensors, Gsm Module, Arduino Microcontroller.

I.INTRODUCTION

Power factor will simply measure electrical system efficiency. Mathematically, it is ratio of actual electric power dissipated by electric circuit to apparent load power. The inductive loads like three phase induction motor, various drives require reactive power to be generated and to maintain magnetic field in order to operate. Poor power factor will lead to large demand of KVA, the high temperature increase, poor voltage regulation etc. Power factor improvement maximizes current carrying capacity and it will also improve equipment voltage.

The capacitor bank generates reactive current and they help to compensate the reactive power used by inductive loads and hence power factor improved. The transmission and distribution losses are also reducing when electricity is utilizes near to unity power factor. The demand of power is increasing day by day due to more industrialization, increase in inductive load etc. Hence the use of more inductive load in industries and at house hold, the systems power factor gets lagging in nature that means the system power factor gets poor due to excess of reactive power consumed by the inductive load which increases the reactive losses. It has been a critical and essential resource for all nation building activities which will develop the country and improves economy of the country. Due to this the demand of electricity is increasing day by day from domestic, commercial and Industrial sectors.

II. OBJECTIVE

The major objective from this paper is to live monitor and controlling of electrical machines from faults and power losses. Inductive machines have lagging power factor and also have some faults. The propose system uses to continuously monitor current and voltage using their sensors from the load terminal. The received data form the sensor is collected and processed by using Arduino and it gives command to the relay. Using the relay, the capacitor bank is connected parallel to the load and compensates the power respective factor. If fault occurs the relay is activated and the load is tripped. Using IOT we can live monitor and control the system in the remote area and GSM/ GPRS module acts as a transmitter and receiver.

III. LITERATURE SURVEY

1. TITLE: Power Factor Improvement Techniques in Domestic and Industrial Loads
   AUTHOR: Silpa Thomas, Anjali Shalimar, Unnikrishnan.L

   Have proposed that suitable circuit for Automatic power factor correction can be developed and the same technique can be applied to the industries, power systems and households such that stability of the system can be increased. Microcontroller can be economically used for the development of the circuit.

2. TITLE: An Efficient AC/DC Converter with Power Factor Correction.
   AUTHOR: Suja C Rajappan, K. Sarabos, Neetha John

   Have proposed various techniques for power factor correction and also harmonic reduction have been reported. A bridgeless power factor correction boost converter is proposed in this paper which results in power factor improvement and reduced harmonics content in input line currents as compared to conventional boost converter topology.It is used to eliminate the line-voltage bridge rectifier in conventional boost power factor correction converter, so that it reduces the conduction loss. Different compensators along with the sizing and strategic location was also considered.

3. TITLE: Single-phase power factor correction.
   AUTHOR: Jiang et al, Qureshi and Aslam, Novak and Kohler

   The different methods for power factor correction are outlined and carried out an experimental case study to explore the areas which will be suitable for compensation. After a practical demonstration, significant improvement in power factor was completed. They identified that it would release the capacity of distribution transformer and the problem of over voltage on low load was avoided. There is an argument between the different protection equipment to check the inherent electrical faults in the mining system. The power factor correction for improved voltage regulation was emphasized within the high voltage distribution in underground coal mines constrains.

4. TITLE: A low cost power factor improvement device for small signal low power loads.
   AUTHOR: Choudhury, Celtekligil, Shwehdi and Sultan.

   Designing of small signal model load, selecting appropriate capacitors, and designing appropriate switching circuits in order to select proper combination of capacitors. Some mathematical calculations for power factor and reactive power requirement along with the capacitor size estimation method. Using automatic power factor controller current, voltage and power factor was monitored constantly. The proposed system connects the inductive loads in parallel with the capacitive system to improve the power factor.

IV.PROPOSED SYSTEM

Inductive machines have lagging power factor and also have some faults. In our paper we can continuously monitor current and voltage using their respective sensors from the load terminal.v. The received data from the sensor is collected and processed by using Arduino and it gives command to the relay. Using the relay, the capacitor bank is connected parallel with the load. Capacitor bank is used to compensate the power factor. If fault occurs the relay is activated and the load is tripped. Using IOT we can live monitor and control the system in the remote area and GSM/GPRS module acts as a transmitter and receiver.

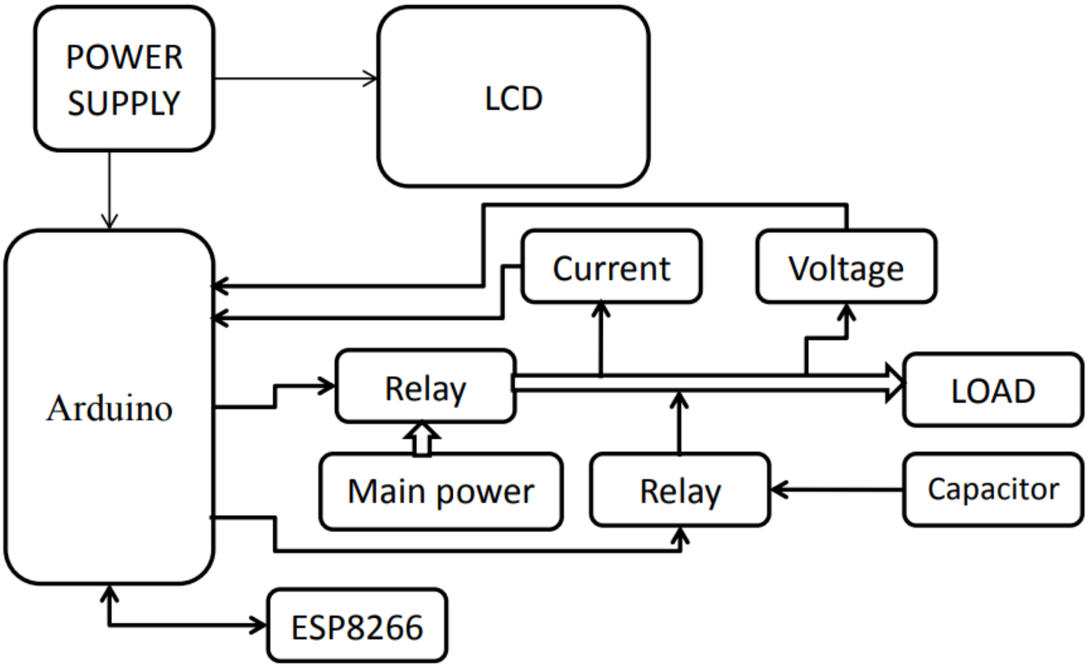

Fig 1: Block Diagram of Proposed System

V.HARDWARE DESCRIPTION

1. ARDUINO:The open source electronic prototyping platform which is basically based on flexible, easy-to-use hardware and software is called an ARDUINO. Artists, designers, hobbyists and anyone interested in creating interactive objects can use this platform. It's a physical computing open source platform based on an ARDUINO board and a development environment for writing software for the board.

2. LCD:LCD is an electronic display that consists of liquid crystal segments. When electric charge is applied, they align to block the light, whereas when no charge is applied, they become transparent.

3. CURRENT SENSOR:It detects electric current and produces a signal proportional to it. The generated signal could be analogue voltage, current or even digital output.

4. RELAY:It is an electrically operated switch which can open and close the circuits by receiving electrical signals. It is also used to control high current circuits with low current signals.

5. ESP8266/GSM/GPRS (IOT):GSM is a digital mobile network that digitizes and compresses data. It is used for transmitting mobile voice and data services which are operated at various frequency bands.

VI. PROTOTYPE MODEL

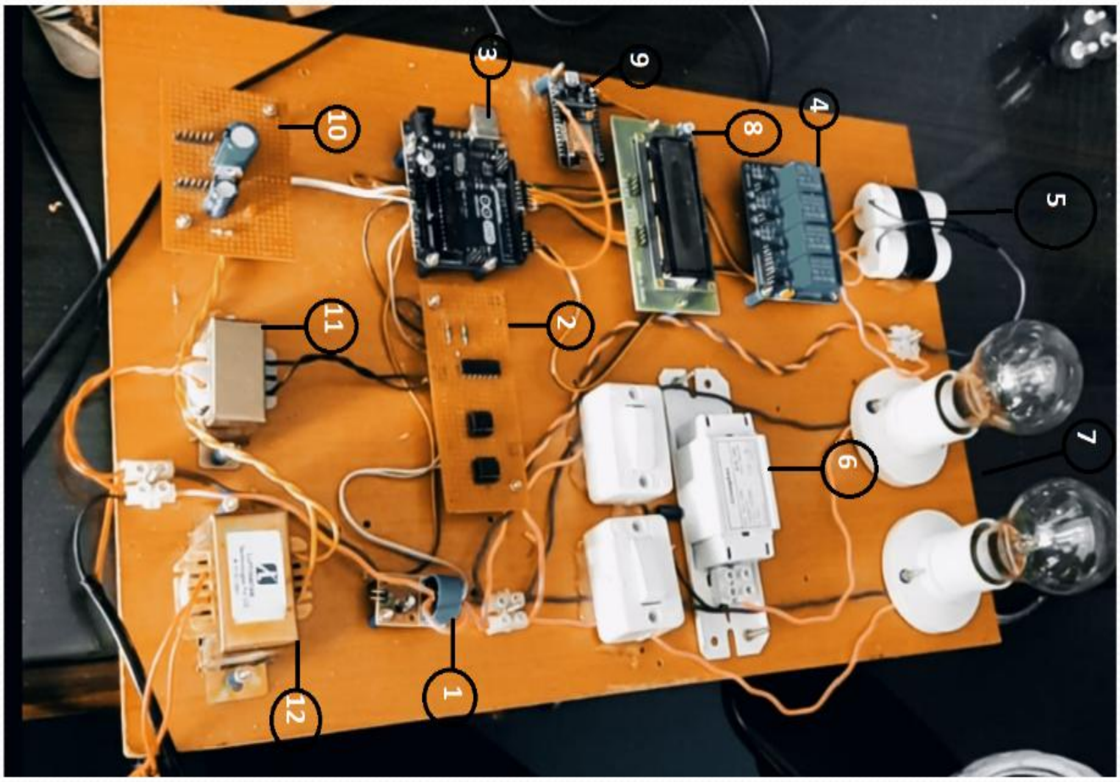

Fig 2: Prototype Model

VII. HARDWARE DETAILS

1. Current sensor
2. Operational Amplifier
3. Arduino UNO
4. Relay
5. Capacitor Bank
6. Choke
7. Bulb
8. LCD Display
9. Wi-Fi Module
10. Bridge Rectifier
11. Potential Transformer
12. Step Down Transformer

VIII. CONCLUSION

The Automatic power factor correction unit is economically the best way to implement the power factor compensation for the lagging loads which are continually varying. Also, we can characterize the power factor range which should be maintained for a selected system using this unit. It also checks the lagging and leading power factor and takes the control action. Energy management system helps to improve the efficiency of the machine. To encourage the efficient use of electricity the consumers using power near unity power factor is also provided incentives.

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||Volume 9, Issue 12, December 2020||

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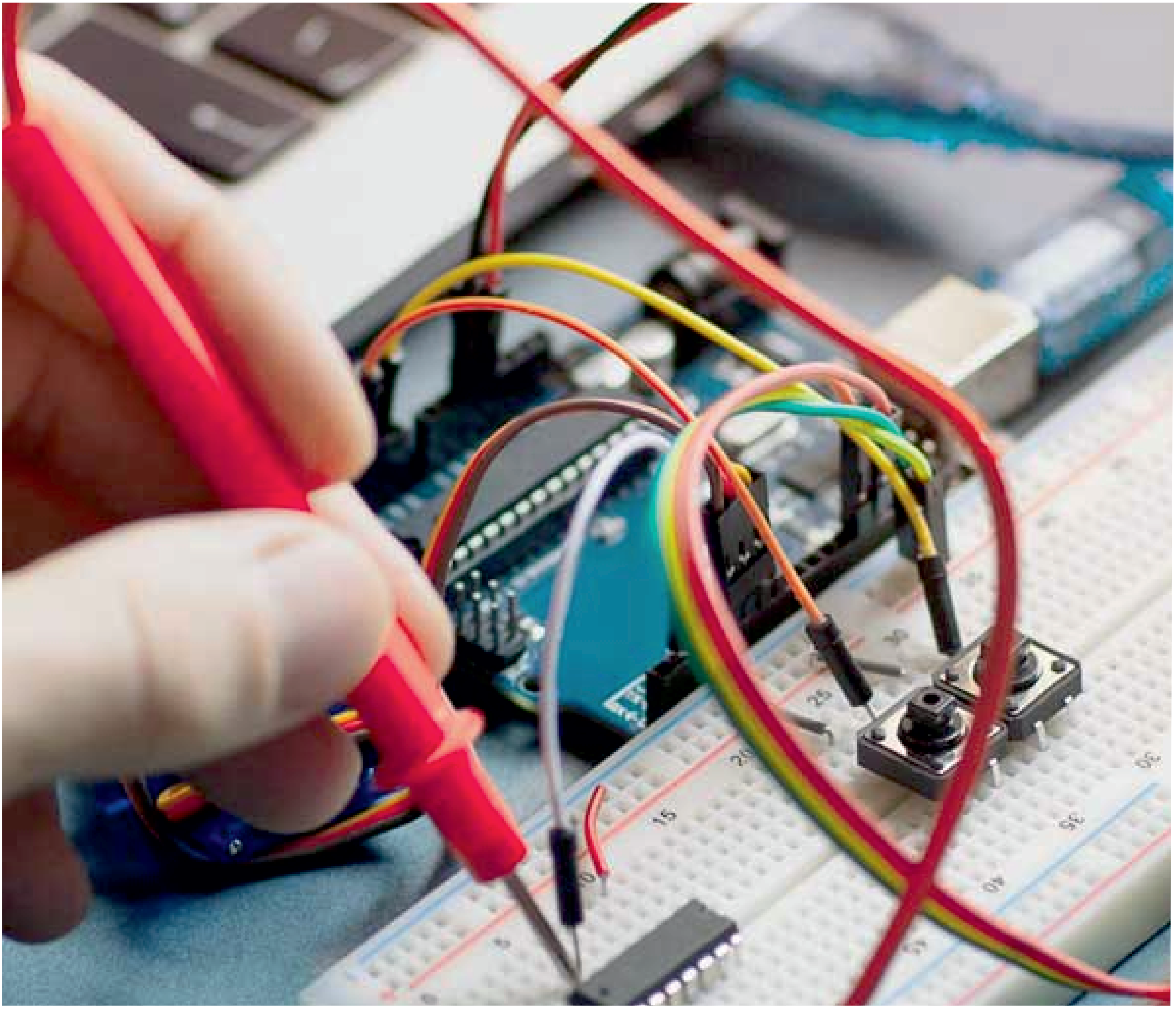

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