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IoT Based Overloaded Power Monitoring and Controlling System

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ABSTRACT

One of the buzzwords in the Information Technology is Internet of Things (IoT). The future is Internet of Things, which will transform the real world objects into intelligent virtual objects. The IoT aims to unify everything in our world under a common infrastructure, giving us not only control of things around us, but also keeping us informed of the state of the things. The proposed system enhances electrical safety by fast disconnection of the power supply in case of fault events like leakage current, electrical arc, overcurrent or overvoltage and has been designed with the goal to be integrated in smart environments like smart homes or smart cities for protecting the electrical equipment. The system also enables real-time monitoring and notification events through an advanced communication interface using a data concentrator architecture. This paper provides an extended description of the proposed system's design and implementation, as well as the experimental validation results.

Keywords : IOT, overload control, smart control, smart monitoring.

I. INTRODUCTION

As the population is increasing the electricity demand is also increasing. Power generating plants are been installed to meet the growing demand. Due to depletion in natural resources the gap between the supply and the demand is continuously increasing. For the betterment of power distribution and generation this overload power detection and controlling technique is used.

The security and reliability of the electrical energy infrastructure is of vital importance today more than ever, given the degree to which electric-powered technology has become embedded in all human activities. Protecting the electrical power supply system against interruptions due to various faults is thus a main research concern. One of the components involved in power-system protection is the circuit breaker, which is responsible for closing the system when a fault or anomaly occurs in order to protect the electrical equipment.

In today's world, the technological trend of implementing "smart" technologies, fostered by the emergence of Cloud Computing and the Internet of Things (IoT), led to a transfiguration of ordinary devices and environments to "smart" entities. In this context, traditional electrical protection devices also tend to transcend and become "smart", and

consequently offer improved fault-detection and protection, remote monitoring and event notification. By becoming smart, a home is embedded with ubiquitous computing equipment that connects all the household devices to one another and the Internet. A smart city also embeds in the urban landscape computers, sensors, cameras and other sensitive equipment operating in the background. In these circumstances, protecting the power supply grid against faults becomes even more important, given the increasing number of sensitive devices connected in the emerging Smart world.

The revolution has been brought within the modern world by Internet of Things based technology after its discovery in the field of computer and internet. Thus we can practice the concept of IOT technology in the power system. Today the world is moving fast towards the more operative and well-organized smart grid technology by switching the existing timeworn technology with the new smart grid technology. Hence we can make use the technologies in order to make the existing power system more operational and well organized. The motive of this project is to improve the sharing out of power in India where problems like load shedding a common situation.

II. Literature Survey

Literature review plays an important role in deciding the objectives of the study. It helps in the successful completion of the work to arrive at the desired results. Many improvements in communication and hardware technology have been developed - a promising one is the IoT technology, from home automation to industrial IoT. The IoT is an emerging technology, and it has been a great interesting topic for the past few years. Much literature is available on monitoring, controlling, and protecting the transformer, and enormous work has been done in this area. A system based on the microcontroller to monitor and save the substation transformer from current rise due to overload is proposed [1]. A PLC-based automatic control system [2, 3] to monitor and detect the transformer's internal faults and external faults were proposed. In [4], a protective system using a temperature sensor, microcontroller, LCD, GSM, and Xbee was proposed to send the message to the electricity board. A conventional fault detecting method [5] have been employed for transformer protection. Nowadays, transformer fault monitoring based on vibration analysis drawing the attention of researchers because of added advantages. This method shows satisfactory results, but it can still be improved using computer algorithms to analyze the data and predict the fault. This work presents, development of an IoT based system for real-time monitoring and control of transformer parameters. This system is placed close to the transformer, and considered parameters are diagnosed and are transmitted to a centralized web server. Thus, the data is utilized to know the transformer's condition on a real-time basis and are stored within a server database for future analysis. system enables the two-way communication between the transformer and the operator by sending SMS alerts [5,6]. Misovic et al performed a detailed mathematical analysis on thermal imaging of power transformer to estimate its hot spot temperature. Data from remote terminal unit (RTU) is collected for monitoring and analysis purpose using GPRS technology [7]. Behera et al and Pai et al have discussed about an implementation of PLC based self-intelligent cooling and monitoring system for key operating parameters of DT [8,9]. Kumar et al work on the compact design of remote monitoring system for a 3-phase transformer. Remote monitoring of operating point of 3-phase transformer is achieved using Arduino microcontroller and ZigBee based wireless device [10]. Nelson et al and Cheng et al focused on the design of RTU for fault analysis in DT using GSM message technology [11,12]. Vishwanath et al has proposed the design of multiple incipient faults detection system for 3-phase distribution transformer using PIC microcontroller, LCD display GSM board and Xbee

technology. The designed system monitors the current, temperature and voltage parameters by sending messages at electricity board by GSM modem [13].

Analysis of Literature Survey

It is essential to monitor regularly the operational status of the loaded distribution transformer. Monitoring is the observation of transformer conditions and is of two types: offline and online. The difference between the two is that in off-line, the transformer is in the off state, and online, the transformer is in on state to measure the data. The transformer is to be protected from both internal and external faults. Among these temperature variations, oil level fall and load change require regular monitoring to safeguard the transformer [1, 7]. If transformers operate under healthy conditions, they have a long life; otherwise, their lives are significantly reduced. The main causes of failure in the transformer are overloading and ineffective cooling. Overloading of power transformers beyond the nameplate rating causes rise in temperature of both oil and windings. If the temperature rise of winding crosses the specified value, the insulation may get damaged [1, 3, 9]. Continuous heating weakens the insulation and causes an accelerated reduction in transformer life.

III. Proposed Work

In this technique to detect overloading power, a current sensor is used. This current sensor provides the current status of power value from the ac source. This value is then comparing with the reference value which is already being set in IOT device. The comparison is done in controller. If there is any over loading, it will be controlled by the relay which is directly connected to the load. The IOT mobile application used is Blynk app to feed reference value and to control the overloading from remote distance. "Blynk" app is free mobile application software that connects the robot with the internet and helps the user to control the device from a remote location. It has a live monitoring feature that enables the user to control the overloading power anywhere by using the "Blynk" app on his mobile phone. To provide internet of things (IoT) access, NodeMCU which is a microcontroller integrated with the Wi-Fi module on a single board is used.

NodeMCU is used to control the operation of motors connected. Controller read the data given by the IOT based application and then according to the commands given or the programming it will give command signals to the relays which will control the loads connected accordingly. NodeMCU is a Wi-Fi based module that provides an internet service to the microcontroller to execute the given command from the user.

Current sensor is usedACS712 which is 5ampere current sensor detecting the overload current from the AC source. A voltage sensor in the form of transformer is also used to detect voltage range but in normally voltage doesn't change its value so we are focusing over current. For display the output LCD display is used which is connected to the controller. Two relays are used to connect the respective load with controller. These relays will help to control overloading situation and prevent load from the damage.

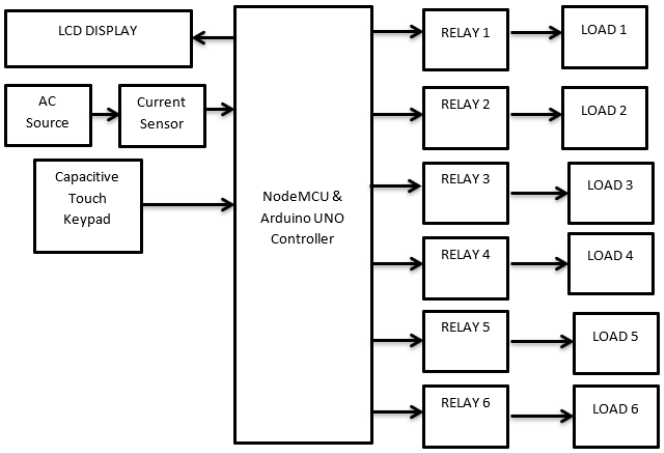

Fig.1 Block diagram

IV. METHODOLOGY

In Existing system, the load current is increasing in nature so it will directly influence to the consumers

equipment and utility side customers. The equipment connected in consumer side will be ruin due to over current flows in the circuit. No specific controller is installed in a power lines for the tenacity of fault recognition. The existing system was not able to detect the faults like short circuit of feeders, feeder overloading and earth faults because of probabilities of collapsing the equipment due to extra-large over load current.

In order to overcome the circumstances like overloading or short circuit, we have planned a simple prototype model of overload monitoring and controlling using IOT. This project is designed in such a way that it shows normal load for one light bulb and overload status when another bulb is connected or the load is increased. Current sensor is usedACS712 which is 5ampere current sensor detecting the overload current from the AC source. A voltage sensor in the form of transformer is also used to detect voltage range but in normally voltage doesn't change its value so we are focusing over current. For display the output LCD display is used which is connected to the controller. Two relays are used to connect the respective load with controller. These relays will help to control overloading situation and prevent load from the damage. In the system, current sensors are used to measure the incoming and outgoing current flowing through energy meter. When the outgoing current is greater than incoming then overloading occurs. For controlling through IOT device we have used BLYNK application. Two loads can be controlled by Blynk application from the remote distance. A notification will appear in case of overloading and user can turn off or turn on load by this application.

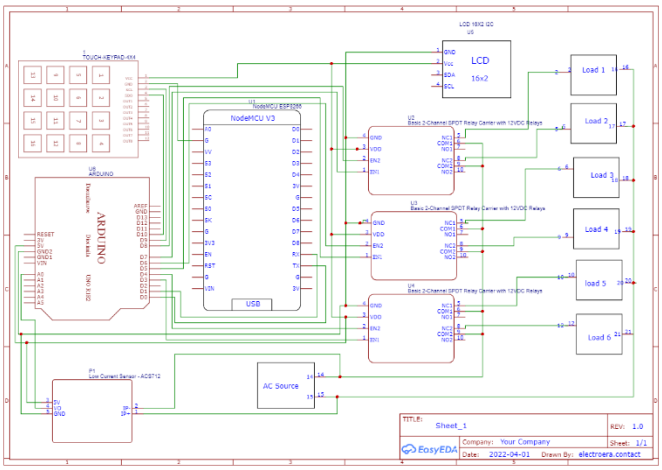

Fig.2 Circuit Diagram

Circuit description:

We have used NodeMCU as controller which has inbuilt Wi-Fi along with two relays and two loads. For displaying output 16X2 LCD display panel is used with I2C module to interface with NodeMCU controller. For current detection in the circuit a current sensor ACS712 is used.

Current sensor is connected between AC source and controller. This sensor will detect current from AC source and gives output to the controller. This current sensor module has 3 pins named as Vcc pin, ground pin and output pin Vout. The supply pin is connected to the Vin pin of the controller and ground pin is connected to the ground pin. Output the the current sensor is given to the controller at A0 pin which is analog pin. The current is varying in nature hence we used analog pin to detect changing current.

Relays are connected to the controller at pin number D3 and D4. The purpose of relays is to provide path for the current to reach the load. These relays will be ON or OFF by the IOT application when the overload occurs. One end of relays is connected to the controller and other end is connected to the load. When controller allows relay turn ON then only current reaches to the load.

Power value will be indicating on LCD display which is connected to the controller via I2C module which converts serial data from controller to parallel data for LCD display. I2C module has 4pins which are connected to the digital pins of controller. SCL and SDA pins of module are connected at D1 and D2 pins respectively. Rest 2 pins are ground and supply pins which are connected to ground and supply pins of controller.

V. Conclusion

This paper described the design, implementation and functional validation of an advanced power-system protection device with IoT-based support for integration in smart environments like Smart Homes or Smart Cities. In this work, the development and implementation of real-time monitoring and control systems for transformer protection and recording have been presented. This system is designed to protect the distribution transformer from overloading, overheating, and other abnormalities. An IOT system is employed to monitor and control the operational parameters of the transformer. The IOT system is located close to the transformer base, and the above parameters are sensed and then transmitted to the centralized web server. Thus, the data is utilized to know the transformer condition on a real-time basis and are stored within a server-based database for future analysis and immediate protective precautions.

VI. Future Scope

Today the world is moving fast towards the more operative and well-organized smart grid technology by switching the current time worn technologies by the smart grid technology. Thus we can make use of both the expertise in order to make the present power system more operative and well organized. Smart grid and IOT will be a perfect amalgam of two know-hows which results in improvement of the current power structure of India. In addition to that there are many such benefits of using technology. Many current problems that are present in the existing power grid structure can be solved out. The motive of the paper is to enhance the sharing out of power in India where hitches like load shedding a common situation.

VII. Results

This system is implemented on embedded microcontroller systems included with self-contained programs within the hardware. It is based upon online monitoring of overload power in the load and controlling has defined in this work. Code is written for NodeMCU controller to monitor the considered operational parameters and the ESP8266 Wi-Fi module to maintain connectivity with a BLYNK application which is IOT dashboard. When any one of the operating parameters varies beyond the predefined/set value, this device can alert the condition of power overload and help the utilities control operational parameters regularly and send a notification to the user on Blynk application. Then the operator reads the message, and immediate remedial action is initiated to protect the load.

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