MONITORING AND CONTROLLING OF SUBSTATION USING IOT IN DISTRIBUTION POWER GRID

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Abstract

A new smart voltage and current monitoring system (SVCMS) approach is proposed. It monitors a single-phase Electrical system using a Node MCU as a microcontroller to read the voltage and current from sensors and then wirelessly send the measured data to monitor the results employing a new Android application. The integrated SVCMS design uses a NODE MCU to measure the results from voltage and current sensors and then send this data after calculation to the Android smart phone device of an end user using Wi-Fi module. It also measures the oil level of a transformer through ultrasonic sensor connected to the Node MCU. The Node MCU controller with ESP8266 Wi-Fi module is a cheap microcontroller and wireless device respectively. The new Android smart phone appeal that monitors the voltage and current measurements uses the open-source MIT app Inventor2 software. It Permit for monitoring some elementary fundamental voltage power quality properties. The system also computes frequency and power factor of line using zero crossing detectors and from calculation of voltage and current respectively.

Keywords: Voltage sensor, current sensor, ultrasonic sensor, Android, Node MCU

Introduction

As power is generated at power plant and is used to be carried out by transmission line to distribution substation. The substation step downs the voltage through the transformer and distributes it to the different area. We need to monitor the parameters of distribution line current, voltage, power, power factor, and frequency of the substation. So, we have a made a system where we can monitor all these parameters through an android application. As electricity is most advantageous form of energy which is used in todays industrial world.

As the complexity of distribution network has grown(increased), automation of substation has become a need of every utility company to increase its efficiency and to improve quality of power being delivered. Because of the extension advanced in technology, smart systems are increasingly being used. This system allows technicians, administrators, and managers to monitor and control the performance of devices from a safe distance. The monitoring system is very dominant when working in the field of three phase systems some users and companies utilize smart monitoring software programs. The Node MCU has an in-built WIFI module and these programs are installed on the user smart phone are company computers to allow employers to make decisions if there is an error. The main intent of this paper is to fabricate a smart monitoring system based on an intelligent control system. The proposed structure is called as a smart voltage and current monitoring system or SVCMS. The SVCMS are designed to observe the execution of a three-phase grid by measuring voltage and current. The SVCMS design build up of two parts; the first is the control system and second one is the monitoring system. This system has been designed to utilize the Node MCU as a microcontroller to read and calculate the RMS voltage and current from sensor units. The Node MCU is an open-source platform that is very cheap, flexible, and has special-purpose data processing capabilities. Similar appeals have been proposed for previous versions of this microcontroller.

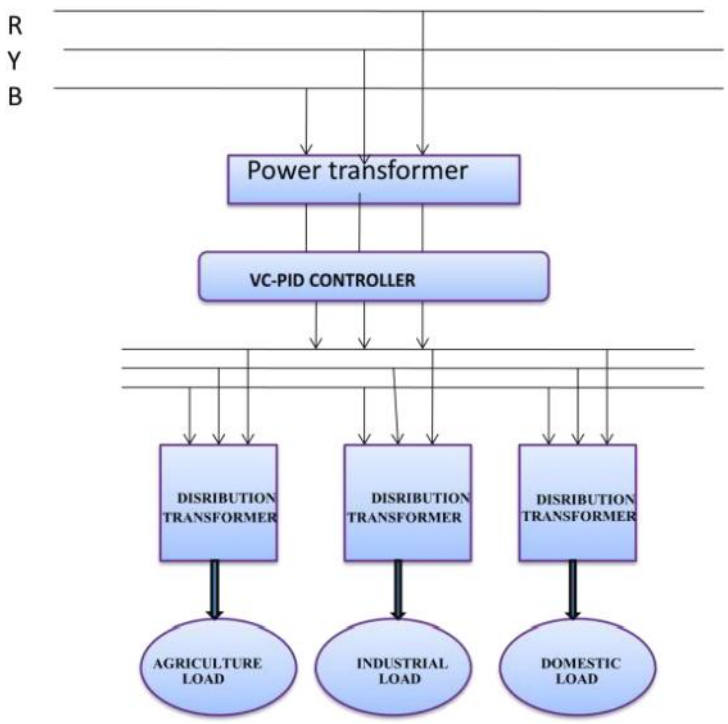


Fig. 1Functionalblock diagram of substation

All the information is transmitted to Node MCU. The received information will be displayed through MIT app and all the data can be monitored through Thing speak cloud. At the same time this information is uploaded to substation through the cloud server by using IoT.

Statement of the Problem

The problem impacting mainly due to calculating of power. This takes much time to calculate the values and need to display on lcd. That was identified and all measured values will be sent to an android mobile using MIT SOFTWARWE which reduces the time and accurate values. These effects the loss of time, resources, and data cannot be transfer to a long distance due to lesser band width in Arduino due to un availability of WI-FI module. The proposal section of a problem statement contains several possible solutions to the problem, and identified the problem by investing research papers and concluded that it sends all the controlled parameters values immediately and can be easily monitored.

Objectives of the study

- To design and implement a low cost and safe electrical quantity measuring system.
- To monitor and control all the electrical parameters (voltage, current, power, power factor and frequency) using IoT module.
- To interchange the power between two areas if particular area has a grid problem.
- To improves the quality of power and reduces the time to calculate the measured values.
- Power and Power factor values are automatically calculated and send real time data to mobile.

Review of Literature

A GSM-based system is also integrated into the design which is used to convey a message to substation. The microcontroller will cooperate with the sensors proposed by A. Balamurugan, R. Bhavya, K. Radhakrishnan, M. Kannan, and N. Lalitha in the year 2019 for improving the quality of power. Also, real time monitoring of different parameters is done which can ensure safety to the substation and its equipment. So, the GSM makes the substation astute in the sense that it can transmit signals and information and receive commands.

Power factor is the proportion of the genuine current or voltage gotten by a

Quantity to the root mean square (rms) estimation of the current or voltage that should be obtained by a similar load proposed by Karthik Subramanian, Shantam Tandon in the year 2018. The way that the two wind up various is because of the nearness of particular power in the circuit which gets dispersed. Enhancing the power factor implicit diminishing the stage contrast among voltage and current. Since lion's share of the heaps is of inductive nature, they require some measure of receptive power for them to work.

To protect the electrical circuitry by operating(working) an spdt relay. This gets activated whenever the electrical parameters exceed the predefined values the information will be sent through SMS proposed by Krupal Dhimar, Jenish Patel, Yasin Shaikh, Anas Musani, Krishn Patel. The controller is dispensed with some internal memory to hold the code. This memory is used to discard some set of assembly instructions into the controller and the functioning of controller dependent on these assembly instructions. The controller is programmed by using embedded C language.

Research Methodology

The proposed system helps to monitor the parameters of the substation and kept it safe by using different sensors. The purpose beyond this undertaking is to secure the unknown electrical parameters like Voltage, Current, Frequency, Power Factor, and Power and send these ongoing qualities over IoT based checking and control with the temperature at the power station. This Relay gets perform at whatever point the electrical parameters surpass the predefined esteems.

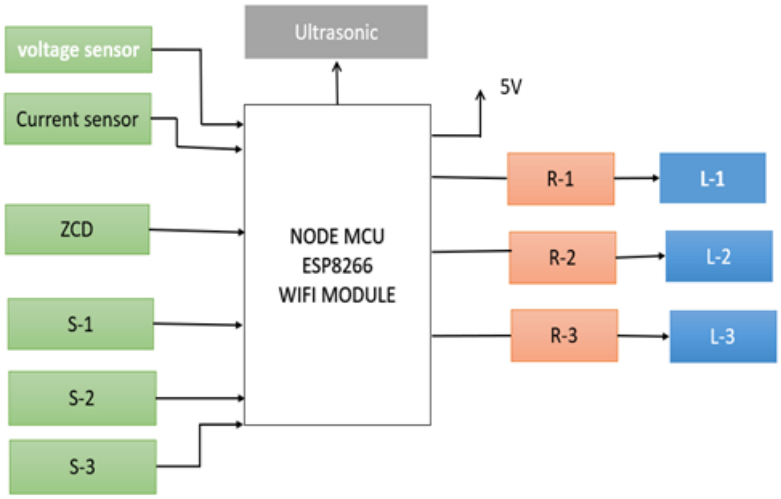


Fig. 2 Proposed block diagram for controlling a substation

The main idea of this controlling system identifies the irregularities and abnormalities of the system. The Node MCU which acts as a microcontroller continuously compares the measured data with preset values to decide if the values are within the safe range or attention needs to be placed on it or immediate action is required. First alert is generated when voltage values start to deviate slightly from its recommended range. The Relay can be utilized to run a Circuit Breaker to turn off the fundamental electrical supply. The client can send orders as IOT to peruse the remote electrical parameters. This system additionally can consequently send the continuous electrical parameters intermittently (in view of time settings) a Message. After identified and all measured values will be sent to an android mobile using MIT SOFTWARWE which reduces the time and accurate values. These effects the loss of time, resources, and data cannot be transfer to a long distance due to lesser band width in Arduino due to unavailability of WI-FI module. The proposal section of a problem statement contains several possible solutions to the problem, and identified the problem by investing research papers and concluded that it sends all the controlled parameters values immediately and can be easily monitored.

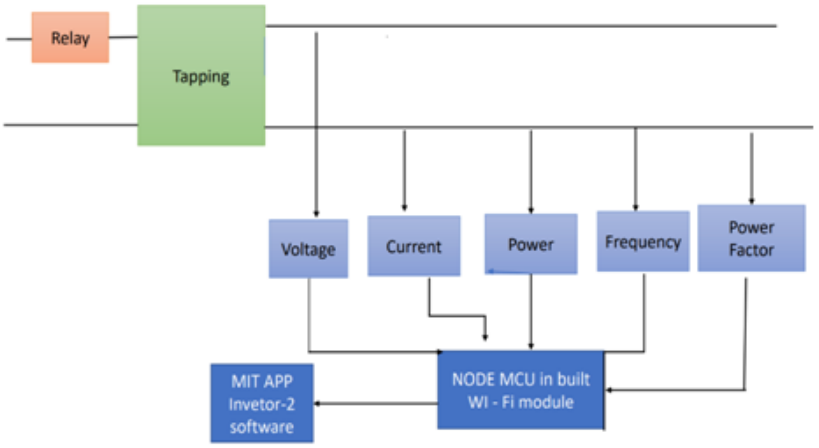


Fig. 3 Proposed block diagram for monitoring part of substation

After identified and all measured values will be sent to an android mobile using MIT SOFTWARWE which reduces the time and accurate values. These effects the loss of time, resources, and data cannot be transfer to a long distance due to lesser band width in Arduino due to unavailability of WI-FI module. The proposal section of a problem statement contains several possible solutions to the problem, and identified the problem by investing research papers and concluded that it sends all the controlled parameters values immediately and can be easily monitored

The Following is the Flow chart of the prototype for a substation monitoring by controlling the electrical parameters by using MIT app software which can be installed easily. It acts open source software it displays the values that are taken from Node Mcu.

All the sensors that are connected gives the information to the Node MCU which acts a microcontroller and that received information will be sensed through WIFI module which is having longer range bandwidth

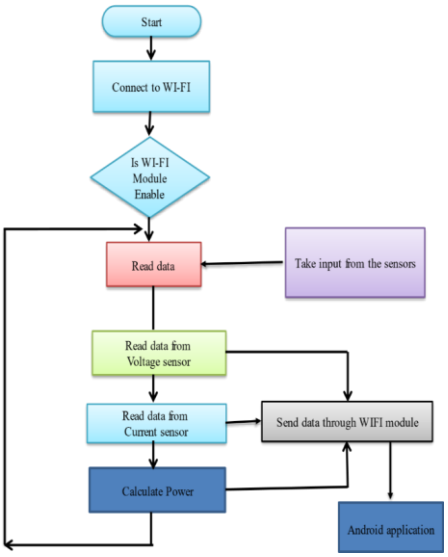


Fig.4 Flow chart

Results and Discussion

To verify the effectiveness of the proposed system, a hardware prototype has been implemented using Node MCU for controlling and are monitored the values through Thing speak and are displayed in the android mobile using MIT app inventor is used to measure all the parameters (voltage, current, power, power factor, frequency, oil level) using IOT and NODEMCU as a microcontroller which is used for controlling all the parameters. Three different switches are used for selecting different taps. Voltage is constant at all three cases. The values of current, power and power factor will be changed based on the loads vary accordingly and the values are displayed in

the mobile. It uses an open-source MIT App inventor 2 software.

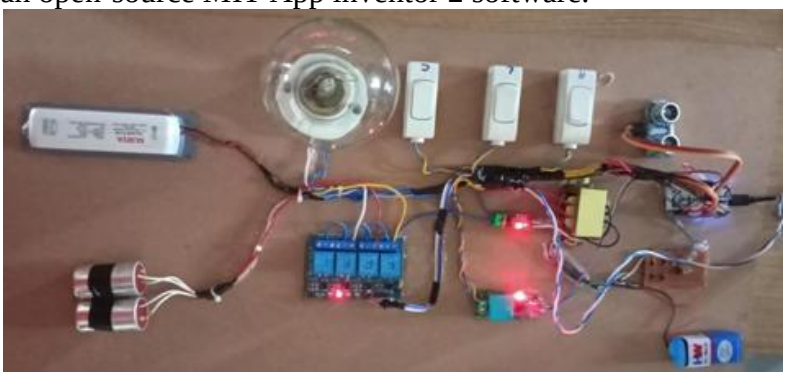
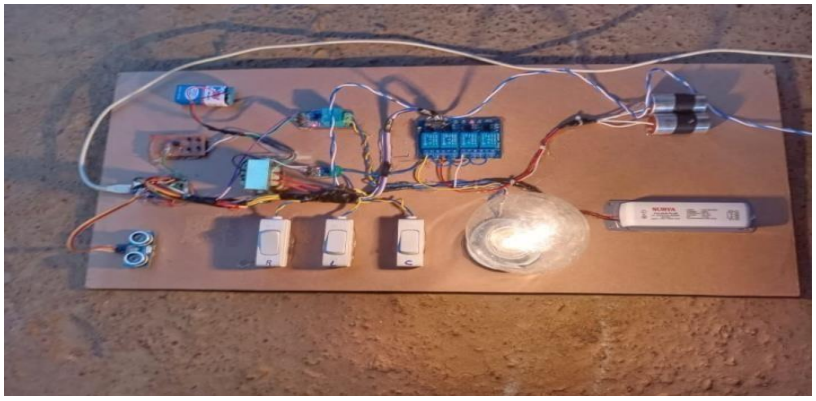


Fig.5 Hardware setup

MODE-1: R- LOAD

When the Node MCU gets activated after receiving all the values from the current sensor voltage sensor, and frequency including oil level of a transformer the following values that are obtained



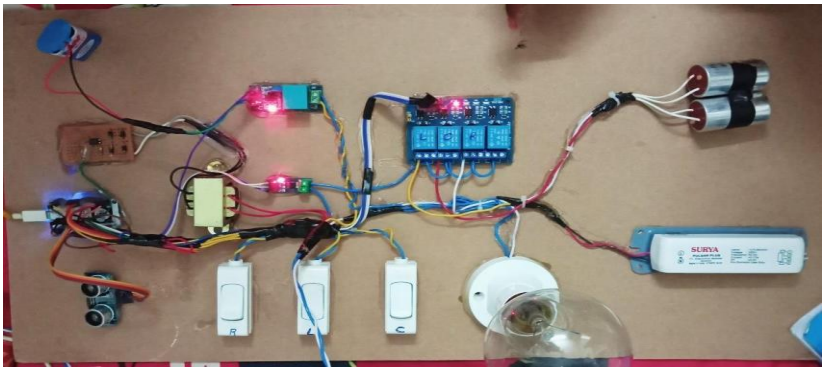
when switch on (**R-LOAD).** The Electrical parameters are included as follows for resistive load

Fig. 6 When R-LOAD is in on position

These are values of all electrical parameters that are considered through internet to the Mobile through an MIT APP inventor -2 Software which is an open-source software.

MODE-2: L-LOAD

When the Node MCU gets activated after receiving all the values from the current sensor voltage sensor, and frequency including oil level of a transformer the following values that are obtained when switch on (**L-LOAD).** The Electrical parameters are included as follows for inductive load



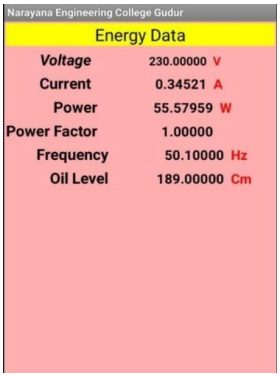


Fig.7 When L-LOAD is in on position

These are values of all electrical parameters that are considered through internet to the Mobile through an MIT APP inventor -2 Software which is an open-source software.

MODE-3:C-LOAD

When the Node MCU gets activated after receiving all the values from the current sensor voltage sensor, and frequency including oil level of a transformer the following values that are obtained

when switch on (**C-LOAD).** The Electrical parameters are included as follows for capacitive load

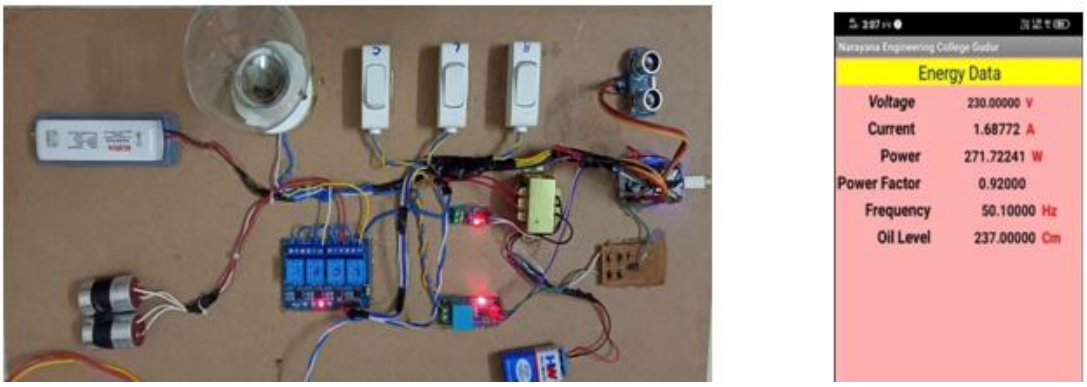


Fig.8 When C-LOAD is in on position

These are values of all electrical parameters that are considered through internet to the Mobile through an MIT APP inventor -2 Software which is an open-source software.

Conclusion

A smart voltage and current monitoring system (SVCMS), is designed and implemented to measure and monitor single phase voltage and current. It is also safer than having to compute the mains voltages very often. It is economical and simply applicable model for measuring and monitoring three phase system performance as compared with other models. The monitoring system uses a new android smart phone application designed by MIT App Inventor 2. In Addition, if there is any inadequacy in the protection, monitoring and control of a power system. The system might become unstable. Therefore, it required a monitoring system that is able to automatically detect, monitor, and classify the existing constraints on electrical lines. The purpose of this project is to obtain the remote electrical parameters like voltage, current and frequency, power, power factor, and oil level, sends the values to the Node MCU which is the controlling part and values are displayed in our android mobile.

So, through this technology we can improve the quality of power and can transmit the data through longer distances and can be easily monitored and controlled easily.

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