Generator Monitoring using Android Phone

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***Abstract*—Remote Monitoring System is widely used application which needs to be precise and compact. Project proposes an innovative design and development of remote monitoring system for a three-phase generator based on arduino and Zigbee Wireless device. The arduino controls the three phase generator by monitoring the current, voltage, temperature and power. Parameters can also be monitored by android phone interfaced to WiFi module. The Zigbee-based wireless device is used as a long range communication channel between the transmitter and receiver Modules. WiFi area is created using ESP8266 WiFi module. Monitoring can also be done through the android devices which are connected to the wireless local area network (WLAN). An alert system is enabled through arduino if the load current is more than the full load capacity of the generator.**

Keywords— Three Phase generator Parameters, Arduino, ESP 8266, Zigbee module, Potential Transformer, current sensor, Step down transformer, LCD Display, Android Phone, Alert System .

I. INTRODUCTION

Generators are used as backup power supplies in the case of power outage. It is important to ensure that the generators operate safely with high reliability. Generator in its perfect running condition maintains its specified rate of performance for several years, but it also does withstand some excessive load repeatedly. If the generators are operated without exceeding rated conditions they will have long service life. To ensure the safe operation of the generator some preventive measures must be taken against overloading and abnormal conditions. Generator faults can be minimized by monitoring the generator regularly. Remote monitoring system eases this task and also saves time and manpower requirement. On-line Monitoring of the generator allows the operator to remotely control the load and ensure the safe operation.

II. PROBLEM STATEMENT

Generators are currently monitored manually where a person periodically visits generator room for maintenance and records parameters of importance. Such monitoring cannot provide information regarding occasional overloading and overheating of generator. This type of monitoring becomes difficult when bad weather conditions persist and during night conditions. All these factors can significantly reduce the generator life. Hence need for automated monitoring system arises.

Hazards in the generators are mainly due to overloading and improper maintenance. Hence it becomes important aspect to monitor the generator continuously. Monitoring systems currently used poses some deficiencies. Ordinary measurement system detects single phase parameters such as voltage, current, power. Some detects are able to measure multiple parameters but the acquisition time is too long also the data transfer rate is not quite fast enough. Drawbacks offer additional measurement systems include low data measurement accuracy, system instability and poor reliability.

PLC based transformer monitoring and control systems were developed for permanent installation. These are intended to monitor single unit. Local Area Network (LAN) provides input to the central processing unit. It also gives access to WEB page where the transformer parameters can be monitored. The process of data acquisition of this system is slow.

Embedded system based monitoring for 10kVA switchable transformer uses three microcontrollers to measure parameters of all three phases. Separate microcontroller is used to measure temperature and graphic LCD interface. Embedded Ethernet is used to transfer data to remote location. Client server applications were developed by using embedded Ethernet to enable the monitoring through LAN. Using multiple numbers of microcontrollers makes the overall system bulky. Wired LAN connection makes the system complex and unreliable.

I. METHADOLOGY

A. Transmitter

The transmitter station monitoring system block diagram consists of arduino as a processing unit. Temperature sensor is connected to digital pin of the microcontroller. Temperature sensor library is used to read the variation in temperature and display it on LCD. LCD is enabled and written through different pins of arduino. Potential Transformer will step down the voltage from the generator and then this voltage is converted to DC and given to the Analog pin of the arduino. Three phase voltages from the

generator are given to arduino through PT1, PT2, PT3 through analog pins of it. Current sensors are used to read the load current of all three phases of the generator. These sensors are connected to analog pins of arduino. Power is calculated using voltages and current, then displayed on LCD along with all three voltages, current, temperature of the generator. A ZigBee (also known as X bee) transmitter is connected to digital pins of the arduino, which is used to transmit all the monitored data to a remote location. An Alert system is provided in the design so as to notify if the load current is greater than the capacity of the generator. LED and a buzzer are initiated in the alert system.

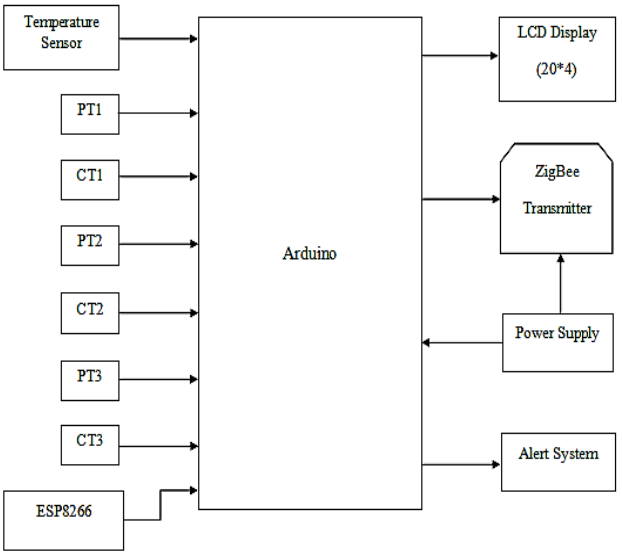


Fig. 1 Block diagram of transmitter design

B. Receiver

The parameters sent by the transmitted end can be monitored using android phone. The Wi-Fi module is interfaced with android application through which we can access the parameters.

The block diagram of receiver side monitoring system contains arduino as a processing unit. LCD display is connected to arduino. Receiver ZigBee is connected to digital pin of the microcontroller. Receiver ZigBee will receive the parameters sent by the transmitter ZigBee. Received data is processed by arduino and display them on LCD attached to it. Receiver module is installed at a remote location. Hence the operator can monitor the generator from remote location. An alert system is provided at the receiver end to alert the operator in case of generator overload and is tripped to avoid failure of the generator.

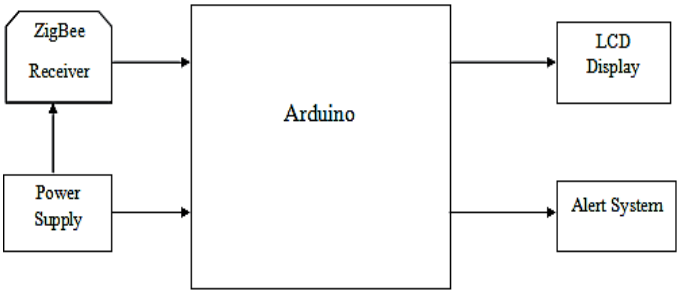


Fig. 2 Block diagram of receiver design

II. HARDWARE DESCRIPTION

The generator parameters like temperature, current and voltage fluctuations are monitored remotely through ZigBee network. The sensors sense the change in temperature, current and voltage levels and send the signal to the micro controller. The microcontroller is powered by a power supply sends the signal to a ZigBee transmitter. ZigBee offers high functionality concerned with network structure, message routing and security. Measured data i.e. the values of the temperature, current and voltage levels of the generator are displayed on the liquid crystal display(LCD) attached to the transmitter microcontroller and the ZigBee transmitter module (router module) transmits the data through wireless communication at a baud rate of 9600 bytes per second. This data is received by the ZigBee receiver module (coordinating module) at the same baud rate. The Zig-Bee modules are kept apart at a maximum distance of 100 metres line of sight. The parameters received by the receiver microcontroller are displayed on 20*4 LCD attached to it. Thus, the data is displayed at Transmitter as well as the Receiver end. At the same time, the microcontroller checks whether the levels of temperature, current and voltage are beyond or within the generator rating. Alert pin of the microcontroller is activated if load current is more than the generator capacity, and causes LED to glow, Buzzer will generate beep. This means that, the generator must be tripped to ensure the smooth functioning of generator. ESP8266WiFi module is interfaced with the microcontroller at the transmitter end to create a WiFi network zone. Electronic devices such as smart phones and laptops can be used to monitor generator parameters by accessing the WiFi IP address.

A. LM35Temprature Sensor

The LM35 produces higher output voltage than thermistors. Hence there no need of amplifying the temperature sensors output. LM35 has output voltage proportional to Celsius temperature. Scaling factor of temperature sensor is 0.01V/degree Celsius.

B. Voltage Sensor

The voltage transformer is used in this project along with voltage sensor module to reduce the complexities in the

connections and to get accurate results. Sensor reduces the input voltage 5 times the original voltage. The maximum input voltage to microcontroller is 5V, so the input voltage to the sensor module should not be more than 25 V. Features of voltage sensors are: Voltage input range: DC 00 - 25 V, Voltage detection range: DC 0.02445 V - 25 V, Voltage analog resolution: 0.00489 V, DC input interface: There is one pin each for Vcc and GN.

C. Current Sensor

ACS712 accurately detect AC or DC signals. The maximum AC or DC load that can be detected can reach 20A, and the present current signal can be read via analog I/O port of the microcontroller.

The current sensor consists of linear Hall sensor circuit, which consists of copper conduction path near the die surface. Magnetic field is generated when applied current flows through this path. Integrated Hall IC senses this magnetic field and converts it into proportional voltage. Internal resistance of conduction path is 1.2mW. This provides low power loss. Conductive path is isolated from sensor IC leads. Hence ACS712 sensors inherently provide electrical isolation without requiring any opto-couplers or any other costly isolation techniques.

D. Zigbee

ZigBee wireless modules starts with the IEEE 802.15.4 packet radio standard. This packet standard defines low-rate physical layer. ZigBee wireless modules communicate over unlicensed network areas of the spectrum which is also used by cordless telephones and microwave ovens. Most of the ZigBee chips and modules use 2.4-GHz bandwidth while some use the 900-MHz bandwidth. This frequency band offers longer range communication and greater penetration through concrete walls.

E. WiFi Module

ESP8266 WiFi module contains integrated TCP/IP (Transmission Control Protocol/ Internet Protocol) through which WiFi network can be accessed by any microcontroller. This WiFi module can host application or offload WiFi network functions from other processors. A firmware of AT command set is pre-programmed to ESP8266 module. It has on-board processing and memory.

IV. FLOW CHART

A. Transmitter

The Figure 3 shows the code flow of transmitter. Once the arduino is powered up, it initializes the LCD. Then temperature read request is sent to temperature sensor. Temperature read from the digital pin is displayed on the 20*4 LCD. Next it reads the voltage and current sensor values of the first phase, calculates power and displays them on LCD. Similarly second and third phase voltage and current values are read, power is calculated and displayed on LCD. These parameters are then transmitted through ZigBee. The arduino checks if the each phase load current value is greater than the preset value. If YES, then activates the alert system. If NO, then continues to read the parameters.

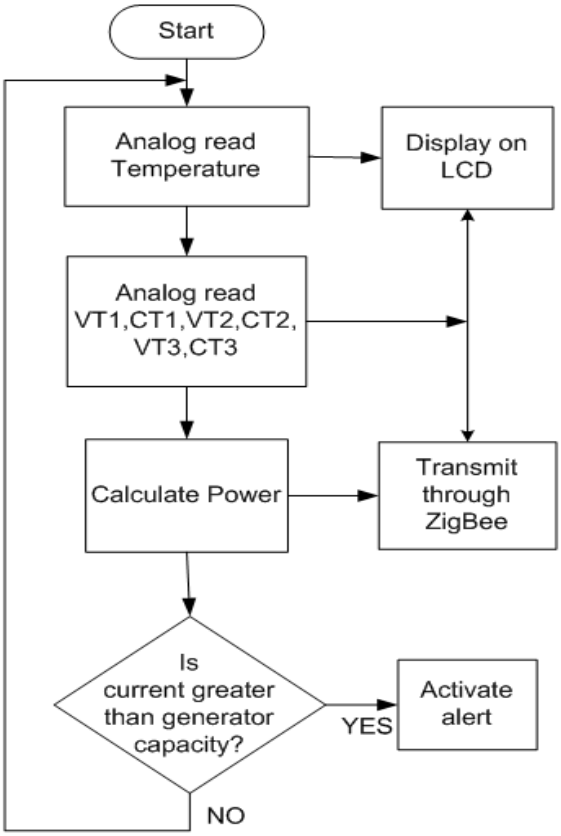


Fig. 3 Transmitter flow diagram

B. Receiver

The Figure 4 shows the code flow of receiver. Once the ZigBee receiver is powered up, it starts receiving the message sent by the transmitter continuously. Receiver ZigBee is connected to arduino, which processes the parameter received by ZigBee and displays it on 20*4 LCD. Alert system is activated at the receiver end, if the load current exceeds the generator rating.

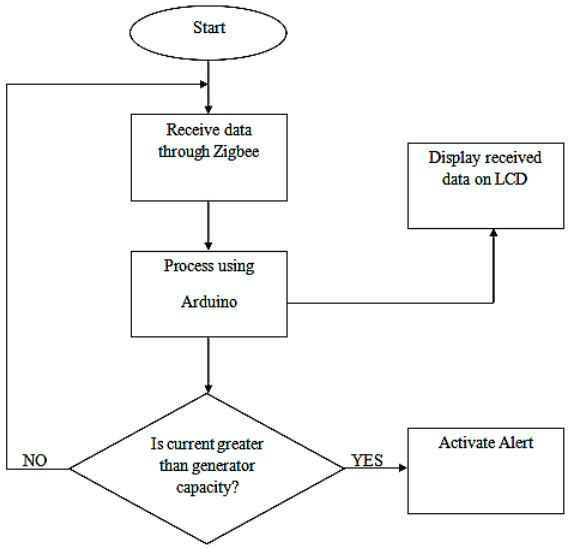
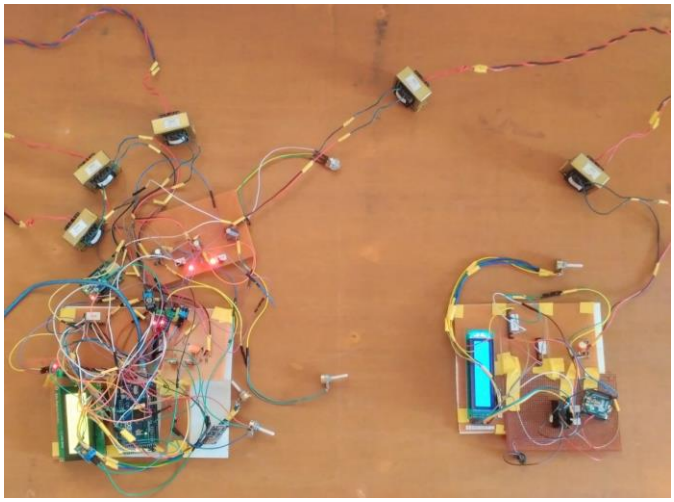


Fig. 4 Receiver flow diagram

III. EXPERIMENTAL RESULTS

The overall implementation of the proposed project is shown in Fig. 6.1. The three phase generator parameters are displayed at both transmitter and receiver side through LCD. These parameters can also be viewed in serial monitor at transmitter and receiver. At the transmitter the parameters read by sensors are displayed on 20*4 LCD. First, second and third column in the LCD shows the voltage, current and power reading of the first, second and third phase of the generator respectively. Last row on LCD displays the generator temperature. The parameters are also displayed on the serial monitor. These parameters are sent through ZigBee transmitter device. Baud rate set for ZigBee transmitter is 9600. At the receiver station, receiver ZigBee loaded with 9600 baud rate. After switching ON the receiver station, ZigBee will receive the data and displays on LCD. The Parameters received by the ATmega328P at the receiver station is also displayed on serial monitor.



At the transmitter station ESP8266 WiFi module is interfaced with the ATmega2560. ZigBee module and NodeMCU ESP8266 module are connected to the different ports of the ATmega2560. NodeMCU ESP8266 uses 3.3V power supply. Hence 7833 regulator IC is used to generate 3.3v supply. TX pin of WiFi module is connected to RX pin of ATmega2560 and RX pin of WiFi module is connected to TX pin of ATmega2560. ESP8266 module creates a WiFi zone to which smart phones and laptops can be connected to monitor generator parameters. This WiFi zone has a unique IP address and access to this IP address can be password protected. TCP/UDP terminal application should be installed on the smart phone and the IP address should be configured to receive the data from NodeMCU ESP8266 ESP-12E.

A. Appications

- Industry

In industries proposed system can be used to avoid hazardous conditions that may occur due to generator failure and it is also helpful to indicate the overloading conditions.

- Health

In hospitals generators are used as power backup for the most of the medical equipment and monitoring of such generator parameters becomes much important. The proposed system will be helpful for monitoring the parameters.

- Education

In many colleges three phase generators are used as alternative source for power. The proposed system will alert the failure in those generators and alert the operator.

IV. CONCLUSION

Monitoring system is capable of detecting any changes in the measured generator parameters. The system measures key parameters of the generator such as three phase voltage, current, power as well as temperature of the generator. It continuously displays the parameters on LCD attached to it and also transmits the data through ZigBee to a remote location. LCD at the transmitter end helps the operator to record the parameters of importance without using any external measuring equipment. System is capable of acquiring the data from the remote location through ZigBee communication. ZigBee uses wireless communication which makes system more reliable. LCD at the receiver end allows the operator to monitor the data remotely. Alert system is provided at both the ends to notify the operator about the extreme conditions. Operator need to trip the generator during the alert so as to protect the generator. Data can also be accessed using smart phones by connecting to the Wi-Fi network. The developed remote monitoring system is user friendly for the control of three phase generator which is compact as well as cost effective.

REFERENCES

[1] Vrushabh G. Vyapari, Vaishnavi N. Waikar, Shweta D. Suryawanshi, Prof. S. J. Tikhe “A REVIEW ON SMART

GENERATOR CONTROL USING ANDROID APPLICATION" International Research Journal of Engineering and Technology (IRJET), Volume: 05, Issue 1, Jan-2018.

[2] Shubhangi Landge, Snehal Waydande, Sanjay Sangale, Somesh Gaikwad "MONITORING OF DISTRIBUTION TRANSFORMER PARAMETERS USING PLC", International Research Journal of Engineering and Technology (IRJET) Volume 4 Issue 3 Mar -2017.

[3] P.Mercy, N.Uma Maheswari, S.Deepika Devi, V.Dhamodharan "Wireless Protection and Monitoring of Power Transformer using PIC" International Journal of Computer Science and Mobile Computing, Vol. 4, Issue 3, March 2015.

[4] Chris Meetoo, Sanjay Bahadoorsingh, Neil Ramsamooj and Chandrabhan Sharma "Wireless Residential Power Monitoring System", 2015.

[5] Hari Arief Dharmawan and Sam A. M. Ali, "A Compact Remote Monitoring System for a Three-Phase 10-kVA Energy-Efficient Switchable Distribution Transformer" IEEE TRANSACTIONS ON INSTRUMENTATION AND MEASUREMENT, VOL. 61, NO. 3, MARCH 2012.

[6] Mei -Sung Kang, Yu-Lung Ke, He-Yau Kang, "ZigBee Wireless Network for Transformer Load Monitoring and Temperature Sensitivity Analysis", 978-1-4244-9500-9/11/$26.00 IEEE 2011.