IOT-Based Real-Time Failure Alert System for Distribution Transformer

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ABSTRACT

By overcoming the drawbacks of sporadic human monitoring, the system seeks to offer distribution transformers continuous monitoring and safety. IoT technology allows for remote monitoring of a number of parameters without the need for human interaction, including temperature, oil level, current, voltage, short circuit, overvoltage, overcurrent, and even copper theft. This system's quick detection of any critical circumstances reduces the chance of transformer failure or malfunction. When such circumstances arise, the system notifies operators via SMS notifications that are transmitted to them using Internet of Things modems. For quick visibility and action, fault conditions are also shown immediately on an LCD panel. By putting this technology in place, distribution transformer uptime and dependability can be greatly increased, which lowers the possibility of unplanned power outages brought on by transformer failures.

Keywords: ESP 32, Voltage Sensor, Current Sensor, Oil Level Sensor, Relay, Lamp.

I.INTRODUCTION

Transformers are essential parts of the power system that regulate voltage, which is necessary to provide customers with continuous electricity. Traditional monitoring techniques, which depend on manual inspections, are laborious and do not have the ability to detect faults in real time. Advanced sequential monitoring systems that make use of IoT technology are suggested as a solution to this problem. These systems allow transformer operations to be continuously monitored, allowing for the real-time detection of fluctuations and problems. Human intervention is decreased and monitoring becomes more precise and effective when manual inspections are no longer necessary. Additionally, the use of Android applications improves monitoring capabilities by giving operators access to real-time data visualization and enabling prompt resolution of any errors found. All things considered, these developments help power networks operate more reliably and efficiently, guaranteeing consumers a steady supply of electricity.

II. LITERATURE SURVEY

A recent huge interest in Machine-to-Machine communication is known as the Internet of Things (IOT), to allow the possibility for autonomous devices to use Internet for exchanging the data. This work presents design and execution of real time monitoring and fault detection of transformer and record key operation indictors of a dispersion transformer like load current, voltage, transformer oil and encompassing temperatures and humidity. They have to look at it continuously by using this project it can minimize working efforts and improve accuracy, stability, efficiency in this project, sensors are used to sense the main parameters of equipment such as voltage, current(over voltage, under voltage, over current) this sensed data is sent to microcontroller and this controller checks parameter limits which further send to the IOT web server Adafruit software using Wi-Fi module of these data makes sure the right information is in hand to the operator and operator can make useful decisions before any catastrophic failure on basis of that data of parameters.[1] Distribution Transformers Is One Of The Most Important Elements Of Electrical Power System. Transformer Is a Device Which Is Continuously Working in Order to Improve the Efficiency of The Transmission System. The Present Paper Proposes Continuous Online Monitoring of Distribution Transformer Using IOT (Internet of Things). The Internet of Things Connects the Unconnected Things. Previously The Things That Were Not Accessible Have Been Made Accessible Because Of It. The Transformer Is Subjected to Various Faults Such as Over-Voltage, Over-Current, Increase in Temperature, Oil-Level, Humidity Etc. All These Faults Are Persistently Monitored Throughout by The Arduino Which Regularly Sends the Health Information of The Transformer Via the Wi-Fi Module. This Data Can Be Accessed from Anywhere in The World by An Android Application. So, The Maintenance of The Distribution Transformer Can Be Successfully Implemented by The Use of This Project Ideology.[2] Transformer is one of the important electrical equipment that is used everywhere. Monitoring transformer's health had become a fiery task. Since incase of any damaged in the internal properties of the transformer will result in huge drawback.[3]

III. EXISTING SYSTEM

The Existing system mobile embedded system monitors and records key indicators of distribution transformer operation, such as load currents, transformer oil, and ambient temperatures. It consists of a standalone single-chip microcontroller, sensor packages, and a GSM Modem for communication.

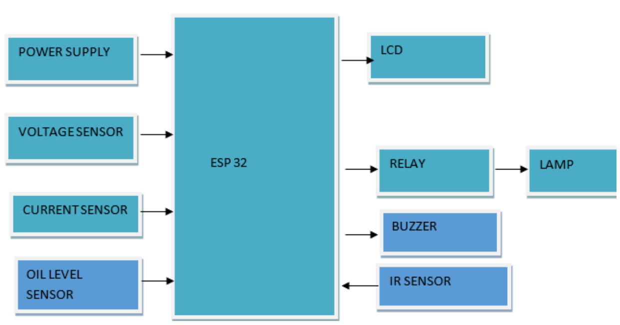
At the distribution transformer site, the system utilizes the built-in ADC to acquire parameters, which are then processed and stored in system memory. If abnormalities or emergencies occur, the system sends SMS messages to designated mobile phones based on predefined instructions stored in the system's EEPROM. Additionally, it sends SMS to a central database via the GSM modem for further analysis.

This system enables utilities to optimize transformer usage and identify potential issues before they lead to catastrophic failure, thereby enhancing reliability and efficiency in power distribution.

IV. PROPOSED SYSTEM

The proposed model aimsthe primary goal of this proposal is to remotely monitor the health of transformers in real-time using Internet of Things (IoT) technology. Parameters such as temperature, current, and voltage will be continuously monitored, and the data will be transmitted over the internet using the MQTT protocol. In the event of a power failure, users will receive alert messages via a GSM Module, ensuring prompt response to any disruptions. Additionally, the system incorporates a unique capability to detect phase failure, signaling any defects through LEDs on the development board. This comprehensive approach not only enables proactive monitoring of transformer health but also enhances the system's ability to quickly identify and address potential issues, thereby improving overall reliability and efficiency in power distribution networks.

BLOCK DIAGRAM



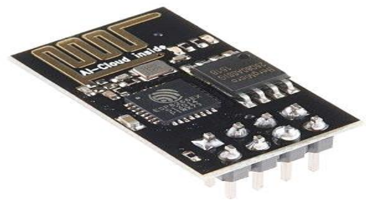
ESP 32

ESP32 based boards come in a variety of shapes and sizes and pinout of each board is different to other. Also, not all pins of the ESP32 Microcontroller SoC will be available on a development board as some pins might be permanently tied to a dedicated function.

One such case is the Flash Memory. We know that all ESP32 boards come with 4 MB of Flash Memory to store the programs. So, some of the GPIO Pins (6 to be specific) are connected to SPI Flash IC and those pins cannot be used as regular GPIO Pins.

Hence, it is important to understand the pinout of popular ESP32 boards so that you will know what pins are available for use in projects.

WIFI MODULE ESP8266



The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your lpc 2148 device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box).The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community.

This module has a powerful enough on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. Its high degree of on-chip integration allows for minimal external circuitry, including the front-end module, is designed to occupy minimal PCB area. The ESP8266 supports APSD for VoIP applications and Bluetooth co-existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF part.

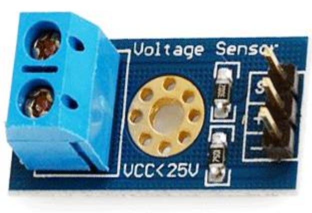
Current sensor:

A current sensor detects electrical current in a wire and generates a proportional signal. In a Hall effect-based sensor, magnetic flux from the primary current induces a Hall voltage in a gapped magnetic core containing a Hall effect device. This voltage is further amplified to provide an output proportional to the primary current, offering galvanic isolation.

In a closed-loop sensor, a secondary coil and feedback circuitry are added. This 'zero-flux' sensor feeds back an opposing current into the secondary coil to nullify the flux produced by the primary current, providing an exact representation of the primary current with galvanic isolation.

The output of a closed-loop sensor can be scaled using a burden resistor to produce a voltage output proportional to the primary current. Overall, current sensors play a crucial role in measuring current accurately and safely for various applications.

VOLTAGE SENSOR:



Sensors offer several advantages over conventional measuring techniques, including small size and weight, enhanced personnel safety, high accuracy, non-saturation, wide dynamic range, and eco-friendliness. They can integrate voltage and current measurements into a single compact device.

Focusing on voltage sensors, they excel in determining, monitoring, and measuring voltage supply, whether AC or DC. Voltage sensors can produce various output signals such as analog voltage, switches, audible signals, current levels, or frequency modulation. They operate based on voltage dividers and come in two main types: capacitive and resistive. Capacitive sensors rely on changes in capacitance, while resistive sensors utilize changes in resistance to measure voltage levels. These sensors play a crucial role in various applications where accurate voltage monitoring is essential.

RELAY:

The vibration sensor, also known as a piezoelectric sensor, is a flexible device used to measure various processes by converting mechanical vibrations into electrical signals. It operates based on the piezoelectric effect, were changes in acceleration, pressure, temperature, force, or strain result in the generation of electrical charges.

These sensors have a sensitivity typically ranging from 10 mV/g to 100 mV/g, with options for lower or higher sensitivities depending on the application requirements. It's crucial to select the appropriate sensitivity based on the expected levels of vibration amplitude during measurements.

The sensor detects system vibrations using different optical or mechanical principles, making it versatile for various applications. Additionally, it can even be utilized to detect fragrances in the air by measuring capacitance and quality. Overall, the vibration sensor plays a vital role in monitoring and analyzing vibrations in different systems for maintenance, safety, and performance optimization purposes.

BUZZER:

A buzzer or beeper is an audio signaling device used for various purposes such as alarms, timers, and user input confirmation. There are two main types: electromechanical and electronic.

Electromechanical buzzers are based on an electromechanical system similar to an electric bell but without the metal gong. They typically involve a relay connected to interrupt its own actuating current, producing a buzzing sound. These buzzers were often mounted on walls or ceilings to amplify the sound.

Electronic buzzers utilize a piezoelectric element driven by an oscillating electronic circuit or audio signal source. They produce sounds like clicks, rings, or beeps to indicate actions such as button presses. Electronic buzzers are widely used in modern applications due to their versatility and reliability.

IR SENSOR:

The infrared era has become ubiquitous in modern technology, national security, and various industries like agriculture and business. Infrared sensors are essential components of infrared measurement systems, categorized into five main classes based on their functions: radiometers, search and track systems, thermal imaging systems, infrared distance measurement and communication systems, and hybrid systems combining multiple functionalities.

These sensors operate on two main detection mechanisms: photon detectors, which rely on the photoelectric effect, and heat detectors, which utilize thermal effects. The composition of infrared systems typically includes a main optical system and auxiliary optical components, which together facilitate the detection and measurement of infrared radiation.

V.EXPERIMENTAL RESULT

This project involves monitoring transformer oil level, current, voltage, and detecting copper theft using sensors connected to an ESP32 microcontroller. The sensed values are compared with predefined nominal values using comparators. If any deviation is detected, a signal is sent to a relay to turn on/off lamps for visual indication. Additionally, data is sent to a mobile application called Blynk installed on an Android device via Wi-Fi using the ESP32 module.

The ESP32 also displays programmed outputs on a local LCD screen. Furthermore, the same data is transmitted through the Wi-Fi module to an internet server and then forwarded to the Blynk mobile application as programmed. This system provides real-time monitoring and alerts for various parameters related to transformer health and security, enhancing efficiency, and ensuring prompt response to any abnormalities.

VII. CONCLUSION

This paper is highly clever in detecting protection faults and notifies the user whether a power generator is operating as a dependable and effective system. With the use of a certain adjustable variable pot, we can monitor and identify problems in this system. Thus, we can adjust the settings to suit our needs. Without the need for human intervention, the system effectively monitors and protects the power generator by measuring its oil level, voltage, current, and copper theft. The transformer's operating parameters are monitored and managed by an Internet of Things system. The aforementioned characteristics are detected by the IOT system, which is situated near the transformer base, and subsequently sent to the central web server. As a result, the information is used to determine the transformer state in real time and is kept in a server-based database for later analysis and prompt safety measures.

REFERENCES

[1] Abdul-Rahman AI-Ali, Abdul Khaliq & Muhammad Arshad "GSMBased Distribution Transformer Monitoring System," IEEE MELECON 2004, May 12-15,2004, Dubrovnik, Croatia.

[2] BuyungSofiarto Munir, Johan J. Smi:"Evaluation of Various Transformations to Extract Characteristic Parameters from Vibration Signal Monitoring of Power Transformer"2011 Electrical Insulation Conference, Annapolis, Maryland, 5 to 8 June 2011.

[3] Suresh D S, Prathibha T, KouserTaj," Oil Based Transformer Health Monitoring System" International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064 Impact Factor (2012): 3.358 Volume.

[4] DraskoFurundzic, Zeljko Djurovic, Vladimir Celebic, and Iva Salom, "Neurel Network Ensemble for Power Transformers Fault Detection,"11th symposium on Neural Network Applications in electrical Engineering NEUREL-2012.

[5] Mallikarjun Sarsamba, Prashant Sangulagi, Dr. Raju Yanamshetty,"The Load Monitoring and Protection on Electricity Power lines using GSM Network," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 9, September 2013 ISSN: 2277 128X .

[6] Mohamed Ahmed Eltayeb Ahmed Elmustafa Hayati, Sherief F. Babiker," Design and Implementation of Low-Cost SMS Based Monitoring System of Distribution Transformers," 2016 Conference of Basic Sciences and Engineering Studies (SGCAC).

[7] Monika Agarwal, Akshaypandya,” GSM Based Condition Monitoring of Transformer,”IJSRD - International Journal for Scientific Research & Development| Vol. 1, Issue 12, 2014 | ISSN (online): 2321-0613 .

[8] Pathak A.K, Kolhe A.N, Gagare J.T, KhemnarSM ,”GSM Based Distribution Transformer Monitoring And Controlling System” Vol-2 Issue-2 2016, IJARIIE-ISSN (O).

[9] RavishankarTularamZanzad, Prof. Nikita Umare,Prof Gajanan Patle , ” ZIGBEE Wireless Transformer Monitoring, Protection and Control System”, International Journal of Innovative Research in Computer and Communication Engineering (An ISO 3297: 2007 Certified Organization), Vol. 4, Issue 2, February 2016. 2395-4396.

[10] Sachin Kumar B S, Dr.NageshPrabhu ,”Simulation And Analysis Of Compact Remote Monitoring System”, International Journal of Innovative Research in Electrical, Electronics, Instrumentation and Control Engineering Nitte Conference on Advances in Electrical Engineering NCAEE-2016 , Nitte Vol. 4, Special Issue 2, April 2016.