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# "IOT Based Substation Monitoring System"

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## ABSTRACT

An IoT-based substation monitoring system leverages Internet of Things (IoT) technology to enable real-time remote monitoring, control, and optimization of electrical substations. Substations are vital components in power grids, responsible for voltage transformation and energy distribution. This system integrates various IoT devices such as sensors, communication networks, and cloud platforms to collect and analyze data from key equipment, including transformers, circuit breakers, and switchgear. It monitors critical parameters like voltage, current, temperature, and humidity, enabling operators to detect anomalies and potential faults early. The system enhances operational efficiency by providing insights into the health and performance of substation assets, allowing for predictive maintenance, which reduces downtime and operational costs.

Key benefits include improved reliability, increased safety through real-time alerts, and reduced need for manual inspections, as remote access allows operators to monitor substations from anywhere. Additionally, the system enables better decision-making through data-driven insights and facilitates the integration of renewable energy sources into the grid. However, challenges such as data security, system scalability, and cost of implementation must be addressed. Overall, IoT-based substation monitoring contributes to the modernization of power distribution networks, ensuring more efficient, reliable, and safe operation of electrical substations in smart grid environments.

## Introduction

An IoT-based Substation Monitoring System is a modern solution that utilizes the Internet of Things (IoT) technology to remotely monitor and manage electrical substations in real-time. The system integrates various sensors, devices, and communication technologies to track key parameters such as voltage, current, temperature, equipment status, and more within the substation. These parameters are then transmitted to a central monitoring platform where operators can analyse data, detect anomalies, and make informed decisions to ensure the substation's optimal performance and safety.Key features of an IoT-based substation monitoring system include:

1. Real-time Data Collection: Sensors collect real-time data from transformers, circuit breakers, bus bars, and other substation components.
2. Remote Monitoring: Operators can monitor and control the substation's systems from any location, reducing the need for on-site presence.
3. Predictive Maintenance: By analysing sensor data, the system can predict potential failures or malfunctions before they occur, minimizing downtime.
4. Automation: Automated alerts and actions (such as equipment shutdowns) can be triggered

in case of abnormal conditions, improving safety and reliability.

5. Data Analytics: Historical data can be analysed to improve performance, optimize energy distribution, and detect inefficiencies.

Overall, an IoT-based substation monitoring system enhances the reliability, safety, and efficiency of electrical power distribution by enabling predictive maintenance, reducing manual intervention, and providing real-time insights into substation operations.

**Proposed Methodology**

Identify Parameters: Select environmental parameters to monitor, such as temperature and humidity, using the DHT11 sensor. For a substation, you may also want to add sensors for other parameters like voltage and current, depending on the requirements.

Hardware Components: Identify all necessary hardware components, which typically include:

DHT11 sensor for temperature and humidity.

A microcontroller (e.g., ESP8266, Arduino, or Raspberry Pi) to interface with the DHT11 sensor.Wi-Fi module (if not included with the microcontroller) for IoT connectivity. Power supply for reliable operation.

Connectivity: Use WI-Fi or another suitable communication protocol to transmit data to a remote server.

***Figure :System Architecture***

**System Architecture:**

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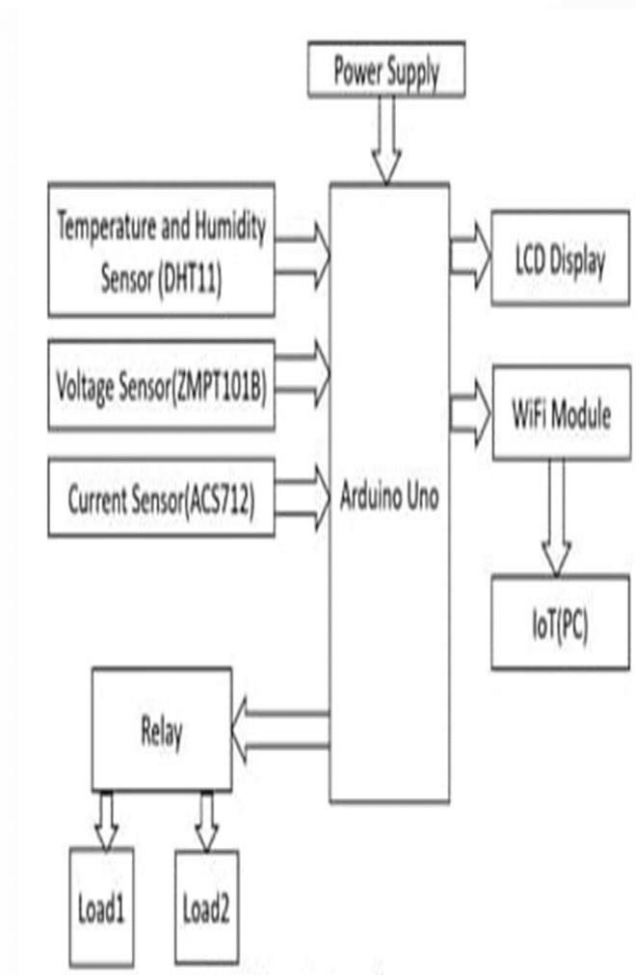

**Working:**

The IOT Based Substation Monitoring System we can measure voltage, current, frequency and temperature of the transformer coil. All the parameters like as voltage, current, frequency and temperature will be displayed on LCD. Step Down Transformer is a general-purpose chassis mounting mains transformer. This voltage cannot be shifted to the system sensor because it is required for the structure voltage or voltage transformer, and the circuit is a low-cost structure voltage. For low voltage amplification and evaluation, immediately available exchangers and monitors are designed. This is a clear example of passive change; the transformer is connected to the critical phase and is disconnected from the ground. Single possible transformers will close the bottom end of the current wave, which favors this current detection. This necessitates the precision of the current transformer and the low voltage necessary to isolate the structural voltage in the following circuit. The control switch and the neck contacts supply the relay source to the electromagnet. When current begins to flow via the control loop, the magnetic begins to empower and expands the attractive field. As a result, the upper contact arm begins to draw into the lower fixed arm, closing the short-term sources of the neck forces.Alternatively, if the contacts were in hand-off f-de-empowerment when closed, the contact would travel oppositely, resulting in an open circuit. When the current is turned off, the portable armature will revert to its original position. This power will be comparable to the majority of the attracting force's power. The majority of the two variables contribute to this power.The Internet of Things is the concept of linking any device (because it has an on/off switch) to the Internet and other connected devices. The Internet of Things (IoT) is a Goliath structure of connected items and people, all of which gather and give information about how it is utilized and its present state.

The IoT Based Substation Monitoring and Contr olling framework depend on various kinds of sen sors to quantify the different electrical boundarie s. The sensors incorporate ACS712 current sens or, AC voltage sensor, DHT11 (computerized da mpness and temperature) sensor, and recurrence sensor. Every one of the sensors is communicate d with the microcontroller, and the result of the r elative multitude of sensors is shipped off the mi crocontroller which sends the constant upsides o f the multitude of boundaries to show on the LC D interacted with the microcontroller.

The framework is worked on 220v AC, an ongoi ng sensor is associated in series with the mainlin e to quantify how much absolute current consum ed.

A voltage sensor is associated in corresponding with the mainline to gauge the quantity of all out voltages streaming all through the framework. T o gauge the dampness and temperature inside th e substation a DHT11 is utilized, which works o n 5V DC. Every one of the sensors comprise of s emiconductor gadgets (semiconductors) that nee d a VCC (5V DC) to turn on, so a buck converte r is utilized to give VCC to every one of the sens ors.

The result of the relative multitude of sensors is associated with the microcontroller and the micr ocontroller sends this worth to show on LCD in a sequential manner. The microcontroller is cust omized and interacted with an ESP module (a W i-Fi module). The ESP module is associated with the frameworks which get the information, the c ontinuous worth of every single electrical edge, f rom the microcontroller, and sends this worth th rough the web to the cell phone or PC associated with a similar organization. It additionally gets c ontrol orders from the gadget and communicates them to the microcontrollers which choose the a ctivity to do w.r.t the orders and the microcontro ller then executes these orders by exchanging th e ON\OFF the transfers, which control the heap.

## IV. RESULTS

For the construction of the model, the componen ts such as Arduino Uno, ESP8266 WiFi Module, LCD Screen, and different types of sensors are u sed. Figure 2 shows the connection of all the co mponents on the board that is used to develop th is project. The power to the Arduino Uno has to give by using either the laptop or power bank. In this project, the two Incandescent Bulbs as the lo ads and the electrical parameters passing throug h these loads have been calculated in this proje

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