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IoT Based Transformer Protection And Load Sharing Automation

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ABSTRACT- A transformer is a permanent device that transfers power from one level to another. The primary goal of load sharing is to prevent the transformer from overload. The effectiveness of the transformer decreases as a result of the overload, and the windings become overheated and maybe burned. As a result, the transformer is protected by sharing load on it. This will be accomplished by using a Atmega-328 microcontroller to connect another transformer in parallel. The load on the first transformer is compared to a reference value by the microcontroller. When the load exceeds the reference value, the additional load is shared by the second transformer. As a result, the two transformers operate effectively and harm is avoided. The benefits include transformer protection, continuous power delivery, and short circuit protection.

KEYWORDS: Atmega-328, Microcontroller, Short circuit protection

I. INTRODUCTION

Internet of Things (IoT)-based load sharing for single-phase transformers involves the integration of IoT technologies to enhance the monitoring, control, and efficiency of the load-sharing system. This approach leverages interconnected devices and sensors to collect real-time data, enabling intelligent decision-making for optimal load distribution among single-phase transformers A transformer is a fixed device that transforms energy from one voltage level to another. It's an inductively connected electrically separated device that adjusts voltage level without changing frequency. The heart of the power system is the distribution transformer, which is one of the most critical pieces of equipment in the system. The distribution transformer's ability to operate reliably is critical to the operation of a power system. As a result, essential factors such as voltage and current must be monitored and controlled in order to evaluate the distribution transformer's performance. As a result, it aids in preventing or minimizing the disturbance caused by a sudden unexpected breakdown. Transformers, being one of the most important pieces of equipment in the electric power system, require protection as part of the overall system security strategy. The internet of things aims to link previously disconnected objects. By utilizing these linked items and data created, the internet of things has the potential to improve everyone's quality of life. As a result, we may use IOT to monitor the transformer characteristics on the screen. A transformer is a fixed device that transforms energy from one voltage level to another. It's an inductively connected electrically separated device that adjusts voltage level without changing frequency.

1.1 OBJECTIVES

The objectives of IoT-based transformer protection and load sharing automation encompass enhancing operational efficiency, ensuring robust protection against faults, and optimizing resource utilization. Through IoT integration, real-time monitoring and data analytics enable proactive fault detection and timely intervention, minimizing downtime and maintenance costs. Load sharing automation facilitates dynamic redistribution of loads among transformers, ensuring balanced utilization and prolonging equipment lifespan. Additionally, IoT-driven insights enable predictive maintenance, optimizing asset performance and reducing the risk of unexpected failures. Overall, the integration of IoT in transformer protection and load sharing automation aims to enhance reliability, efficiency, and sustainability of power distribution systems.

1.2 SCOPE AND STUDY

- Designing an IoT-based system for transformer protection and load sharing automation involves studying various aspects such as sensor integration, communication protocols, data analytics, and control algorithms.

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- ❖ The scope includes ensuring real-time monitoring of transformer health, implementing predictive maintenance, optimizing load distribution among transformers, and enhancing overall system reliability.
- ❖ Additionally, the study would involve researching existing solutions, identifying key challenges, evaluating different IoT platforms, and considering cyber security measures to ensure the integrity and security of the system.

II. COMPONENTS

- ❖ Transformer
- ❖ Driver
- ❖ Atmega-328
- ❖ Relay
- ❖ Current Measuring Unit
- ❖ LCD Display
- ❖ Current Transformer

BLOCK DIAGRAM

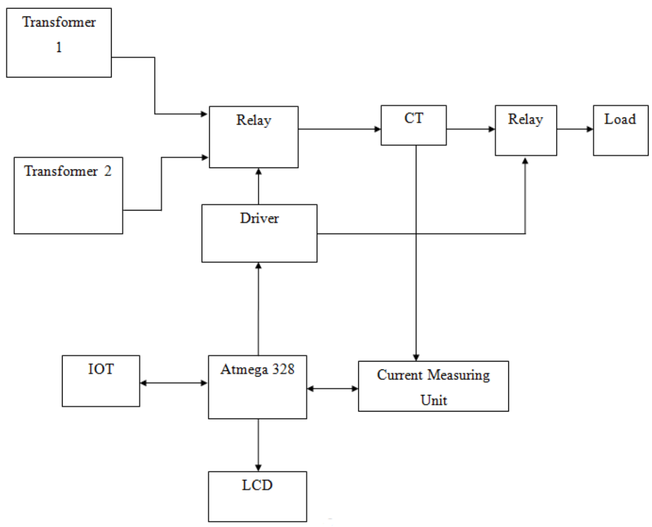

FIG-1 BLOCK DIAGRAM

ATmega 328

ATMEGA 328 microcontroller, which acts as a processor for the arduino board. Nearly it consists of 28 pins. From these 28 pins, the inputs can be controlled by transmitting and receiving the inputs to the external device. It also consists of pulse width modulation (PWM). These PWM are used to transmit the entire signal in a pulse modulation. Input power supply such as Vcc and Gnd are used. These IC mainly consists of analog and digital inputs. These analog and digital inputs are used for the process of certain applications .From these 28 pins, the inputs can be controlled by transmitting and receiving the inputs to the external device.

Transformer

The two single-phase transformers are connected in parallel to a common load. This allows both transformers to share the total load demand. Before connecting the transformers to the common load, they need to be synchronized. This involves ensuring that both transformers have the same frequency, phase angle, and voltage magnitude. Synchronization is crucial to avoid phase mismatches and ensure that the transformers operate harmoniously together. The overall working of load sharing with two single-phase transformers is a complex process that involves real-time monitoring, communication, and control mechanisms to ensure the reliable and efficient distribution of electrical power.

Driver

In the context of load sharing of single-phase transformers, the term "driver" typically refers to a control device or a component responsible for driving or controlling certain functions within the system. The specific working of a "driver" in

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the load-sharing system depends on its role and the components it interacts with. It's crucial to understand the particular context and function of the driver in the overall control and automation architecture of the load-sharing system.

Relay

In the context of load sharing of single-phase transformers, relays play a crucial role in protecting the transformers and the overall power system. Relays are devices that monitor electrical parameters and respond to abnormal conditions by initiating specific actions, such as isolating a faulty transformer. Relays continuously monitor electrical parameters, including current, voltage, and temperature, in the transformer and the connected system. If a fault or abnormal condition is detected, the relay initiates a protective response to prevent further damage.

Current Transformer

In the context of load sharing of single-phase transformers, a current transformer (CT) plays a crucial role in accurately measuring the electrical current flowing through the system. The primary function of a current transformer is to step down the high primary current to a lower, measurable secondary current, making it suitable for monitoring and control purposes. A current transformer is installed in series with the primary conductor (the electrical conductor carrying the current to be measured). The primary winding of the current transformer is connected in series with the load or the primary conductor carrying the current to be measured.

Current Measuring Unit

A Current Measuring Unit (CMU) is a component used in electrical systems to measure the current flowing through a conductor or a circuit. In the context of load sharing for single-phase transformers, a Current Measuring Unit is likely employed to monitor and measure the current in the transformers. The Current Measuring Unit utilizes a current sensor or transducer to measure the electrical current flowing through a conductor. Common types of current sensors include current transformers (CTs) or Hall-effect sensors.

LCD Display

In the context of load sharing for single-phase transformers, an LCD display (Liquid Crystal Display) is likely used as a Human-Machine Interface (HMI) to provide real-time information, status updates, and other relevant data to system operators or users. The working of an LCD display in this scenario involves presenting information in a clear and visual format for easy monitoring and control. The LCD display, as part of the HMI, plays a crucial role in facilitating communication between operators and the load-sharing system. It enhances situational awareness, allows for quick decision-making, and provides a user-friendly interface for monitoring and controlling the operation of single-phase transformers.

CIRCUIT DIAGRAM

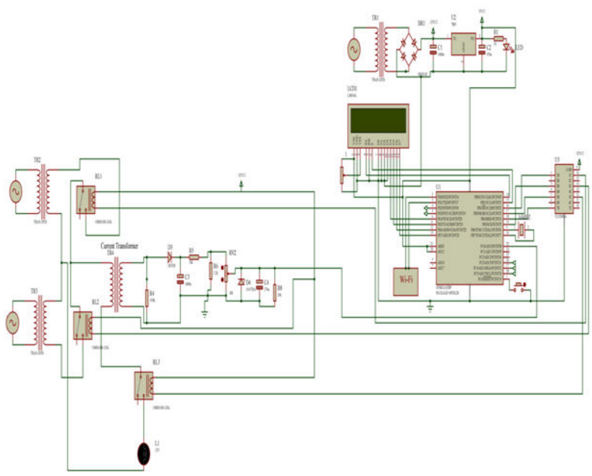

FIG-2 CIRCUIT DIAGRAM

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Working

IOT-based transformer protection and load sharing automation involve integrating sensors, communication modules, and intelligent algorithms to monitor, protect, and optimize the operation of transformers in power systems. Here's a basic overview of how it works:

1.Sensor Deployment: Sensors are installed on the transformer to monitor various parameters such as temperature, oil level, moisture, vibration, and current.

2.Data Acquisition: These sensors continuously collect data on the transformer's health and operational status. The data is then transmitted to a central monitoring system.

3.Communication Infrastructure: IoT devices or modules, such as GSM, Ethernet, or Wi-Fi, are used to transmit the collected data to a central server or cloud platform for analysis and processing.

4.Data Analysis and Processing: The data collected from the sensors is analyzed in real-time using algorithms to detect abnormalities or potential faults in the transformer. This analysis helps in predicting failures and taking preventive actions.

5.Transformer Protection: In case any abnormality or fault is detected, the system triggers protective measures such as isolating the transformer from the grid, activating cooling systems, or issuing alarms for maintenance.

6.Remote Monitoring and Control: Operators can remotely monitor the transformer's status, receive alerts, and even control certain operations through a user interface accessible via web or mobile applications.

III. RESULT AND DISCUSSIONS

Implementing IoT-based transformer protection and load sharing automation can yield significant benefits in terms of efficiency, reliability, and safety. By integrating sensors and actuators with IoT devices, transformers can be monitored in real-time, allowing for early detection of potential faults or abnormal operating conditions. This proactive approach can prevent catastrophic failures and minimize downtime, ultimately saving costs and improving system reliability.

Furthermore, load sharing automation enables optimal utilization of multiple transformers within a network, ensuring balanced distribution of loads and preventing overloading of individual units. This not only enhances operational efficiency but also prolongs the lifespan of the equipment by avoiding undue stress.

In terms of results, implementing such a system can lead to:

1. Enhanced protection: Early detection of faults allows for timely intervention, reducing the risk of equipment damage and power outages.
2. Improved reliability: Real-time monitoring and predictive analytics enable proactive maintenance, minimizing unexpected failures and downtime.
3. Optimized load sharing: Efficient distribution of loads among transformers maximizes their utilization and prevents overloading, thereby improving overall system performance.
4. Cost savings: By preventing equipment failures and optimizing load distribution, organizations can save on repair costs, downtime, and energy expenses.

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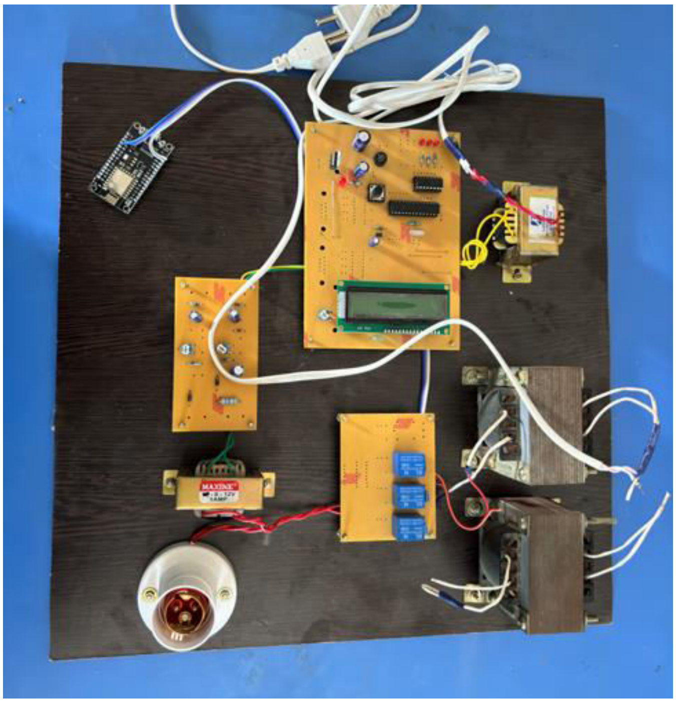

FIG- 3 HARDWARE KIT

IV. CONCLUSION

We discovered that if the load on one transformer increases, the relay will sense the change in current, the microcontroller will activate, and slave transformers will immediately activate to share the load. The work on "Automatic load sharing of transformers" has been successfully designed, tested, and a demo unit has been fabricated for operating three transformers in parallel to automatically share the load with the help of a change over relay and relay driver circuit, as well as to protect the transformers from overloading and thus provide an uninterrupted power supply to the customers.

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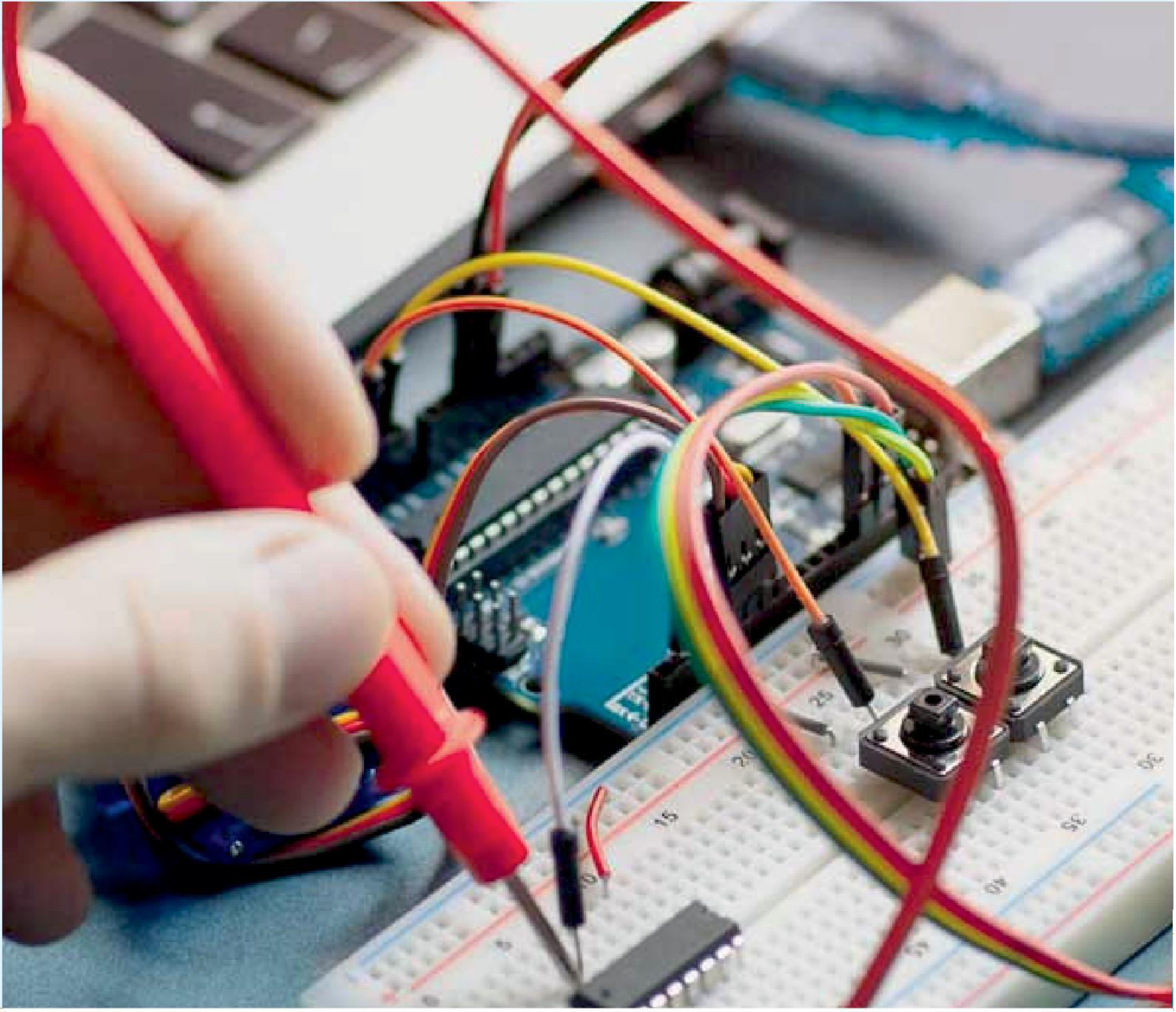

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