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EFFICIENCY ANALYSIS OF LT/HT AND INDUSTRIAL TRANSFORMERS

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ABSTRACT

Electricity is a basic need worldwide and has met people's needs and developed. Continuous migration to urban areas due to population growth requires maintenance of all infrastructure, including water and electricity. Unfortunately, this progress often leads to significant environmental impacts and poor quality of life. In this case, the distribution of electrical equipment plays an important role in managing the electrical equipment required by users, but age, frequent overloads and internal or external external factors can cause the generator to become a burden on its own. Frequent overloads, uncertain loads, unbalanced voltages, unbalanced phase power consumption and other factors cause the transformer to fail or reduce its efficiency. Inefficient transformers can negatively affect their connections, creating imbalance in the distribution system and causing household appliances and equipment to malfunction. Domestic load is particularly affected by changes in peak and off-peak periods, where commercial applications are disaggregated by temperature and mitigation processes reduce local energy management. To solve these problems, online monitoring is important to preserve variables and establish effective and weak links. Observe the loaded and unloaded characteristics of the transformer, track load changes, monitor the oil level in the transformer lubricating oil tank and transmit this information to the supervisory organization. The plans provide solutions to long-standing problems in power distribution systems and are suitable for both LT/HT and industrial transformers. Appropriate sensing transformers, signal conditioning circuitry, computational embedded controllers, and field programmable software systems facilitate the use of the monitoring system.

I. INTRODUCTIOIN

The performance of the best transformer is known for its quality and is characterized by low power loss. In this ideal area, the power entering the transformer exactly matches the power leaving the transformer, leaving no room for losses. However, the reality of the physical world shows the exact opposite. In the context of real-world transformers, large losses occur from many sources. Although there is no action to prevent damage to electrical equipment, electrical damage is inevitable. This article covers the entire spectrum of losses encountered in transformers, highlighting various phenomena such as copper losses, hysteresis losses, eddy current losses, iron losses, stray losses and dielectric losses. Each of these losses has its own consequences, and together they paint a picture of the complexity of transformer operation. Through research and analysis, we seek to uncover the complexity of these losses and demonstrate their impact and significance in the energy industry, as shown in Figure 1.

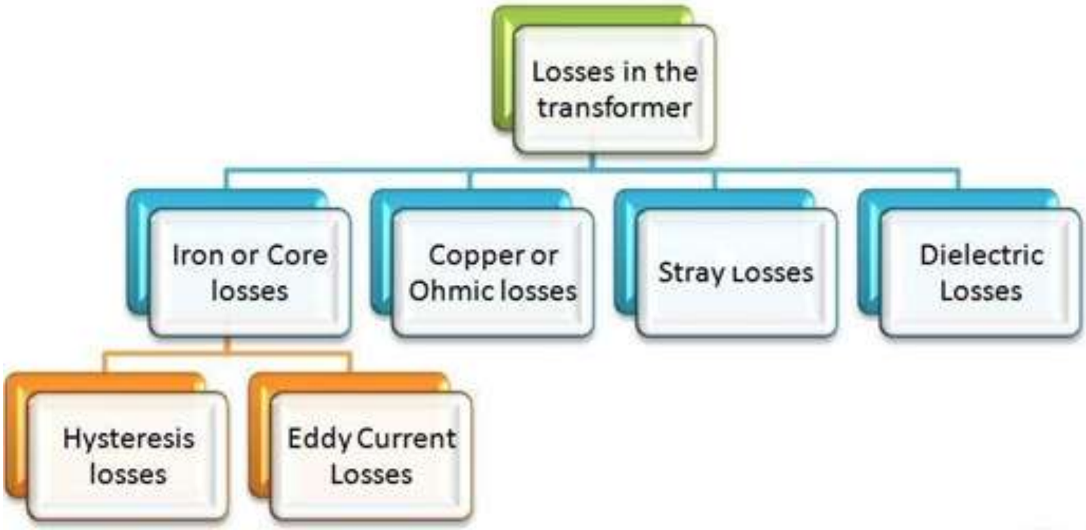

Figure.1:Losses in Transformer

II. PROPOSED SYSTEM

- OIL Level monitoring
- Oil quality (Contamination)
- Oil temperature monitoring/controlling
- Load shedding as per plan
- Over load permission based on availability Utility Factor
- Voltage and Current Monitoring
- Remote data transfer of transformers through IoT
- Online graphics/animation of variables
- Reduction of T&D losses by3%

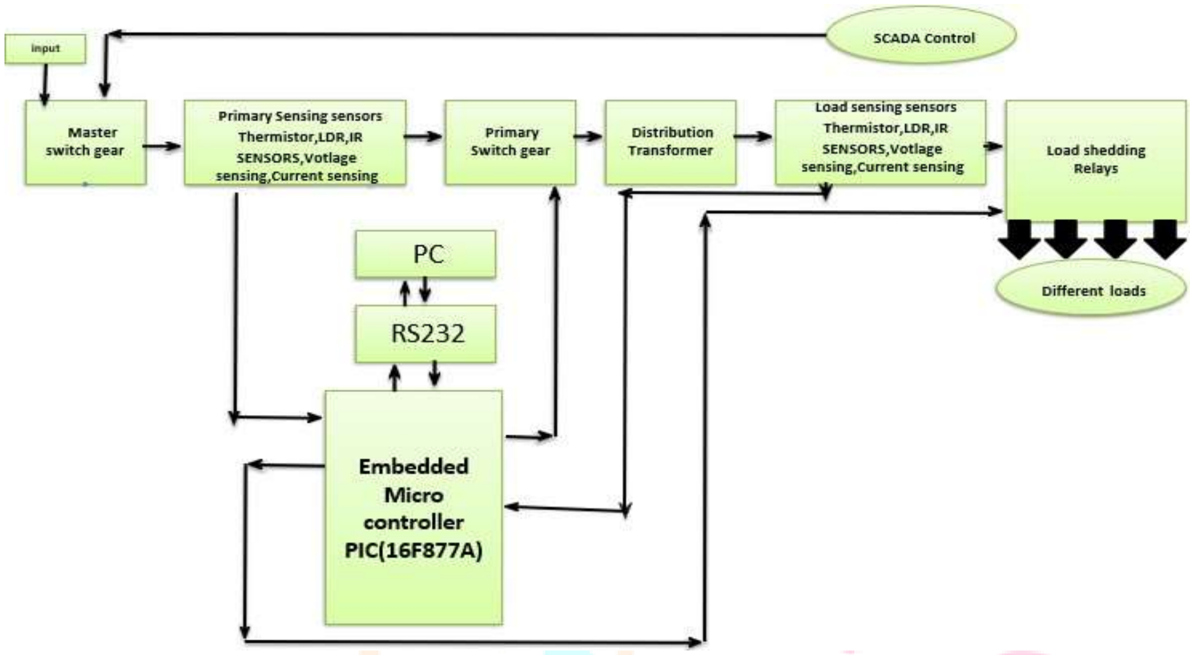

Figure 2 Block Diagram Proposed System

III. SENSING SYSTEM

Temperature

A thermistor is an electronic device (sensor) that converts heat (temperature) into resistance. Almost all thermistors have a negative temperature coefficient (NTC); This means that their resistance decreases as the temperature increases. Thermistors with a good temperature coefficient (their function increases with temperature) are possible, but rarely used. If no information is provided always assume NTC. A multimeter can be used to measure the temperature of the variable; For example, these are some readings

- Icywater0°C: high resistance, about 12k .
- Room temperature 25°C: medium resistance, about 5k .
- Boilingwater100°C: lower resistance, about 400 .

Vendors usually state that thermistors are maintained at 25°C (room temperature). Thermistors take a few seconds to react to a sudden change, and the smaller thermistor responds faster. Thermistors can be connected in any way and without special precautions when welding. If the thermistor must be submerged in water, the thermistor and its connections must be insulated, as water is a poor conductor.

LIGHT DEPENDENT RESISITOR (LDR)

LDR is a sensor that converts light into a resistor. It is made of cadmium sulfide (CdS) and its resistance decreases as the light loss of the LDR increases. The advantages of the LDR model are

- Darkness: maximum resistance,about1M Ω.
- Very bright light: minimum resistance, about 100 Ω.

CIRCUIT DESCRIPTION

As can be seen from the circuit, after the analog power supply is used, it is stabilized by the 9V regulator, enters the Zener diode through resistor R1 and is stabilized again to 5V, because the Zener diode is used at 0. 5V. . A dual-tuned, fully filtered analog reference source. R2 is the voltage divider that adjusts the dynamic response of the device. The ability to read more clearly. . The analog input that the ADC will process is given to these pins. Y1 is a crystal oscillator. Its frequency is 10MHz and baud rate is 9600bit/s. When the power is turned off, capacitor C1 is in the cut-off state. When the power is turned on or reset, the capacitor charges through resistor R2 and then through R1 appearing on the MCLR pin of the PIC.

This is a clean memory pin, so as soon as the power is turned on the memory is extracted and ready for use. S1 is a synchronization switch that is also used for the same job, PC and PIC synchronization job. The outputs of the voltage and current sensing circuits serve as inputs to the PIC analog channels. The thermistor is connected to the analog channel and measures the temperature of the substation. FM receiver connected to PORTB. Here PORT B is configured as digital input port.

SIGNAL CONDITIONING BOARD

In this PCB, various sensing and measurement circuits are printed and assembled, including dual power supply circuits, voltage sensing and current sensing circuits, DC voltage measurement circuits and frequency-voltage conversion circuits. The light detection circuit is also located here. This PCB is connected to the microcontroller which can detect the parameters and operate the relay unit.

OPERATION

A bridge rectifier can be used to convert the current into direct current. But a conducting diode will drop the voltage by 0.6V. Therefore all 1.2V is lost. This is undesirable since the voltage to be measured is (for example) around 5V. For this reason, as we mentioned above, full wave rectifiers made from operational amplifiers are used due to the disadvantages of using bridge rectifiers.

An operational amplifier is a device with high input impedance and low output impedance. Therefore, they are used for correction purposes as they do not affect any product. The output of A1 is added to the original input signal at A2, an inverting summing hybrid gain amplifier Resistance.

Activity gain (A1) is -1. >. Op amp A2 produces an output of 10.908V on the gain-2 path and 5.454V on the gain-1 path. Therefore the final output voltage is 5.454V. It can be expanded to the required voltage by changing the trimpot potentiometer. Input 2 of A2 is 0V; so the output voltage is 0V. But the input of path 1 of A2 is 5.454V, so the voltage at path 1 is 5.454V. Exit. So the output voltage is pure DC voltage supplied to the ADC. A 1K resistor is used to limit the current to 5mA.

FEATURES

- Internal frequency compensation
- Short circuit protection
- Large common mode and differential voltage range
- No latch up
- Low power consumption

IV. PIC 16F877A MICRO CONTROLLER

A microcontroller is a software-driven electronic device. It is a single-chip, single-chip IC designed using VLSI design technology. It will perform arithmetic and numerical operations with the help of software. It is used to control and communicate with peripheral devices. It has a built-in A/D converter. Our project requires an A/D converter because the sensor output is in the form of an analog voltage signal. But the inner workings of a microcontroller are digital. That's why we need an A/D converter. It is an 18 pin package. Voltage range is from 3.0 to 5.5V. PIC 16F877A operates at 20MHz.

Functions

The main functions of the microcontroller are:

- To receive the signal from the computer.
- Compares the signal with the standard strings to red in the microcontroller
- Sends the output signal to the corresponding relays

Operation

Compare the current image with the reference image and pass the output signal to the MAX232 via serial connection. The MAX232 IC converts this to TTL logic and then passes the signal to a chip. The microcontroller is programmed using embedded C software using the PIC compiler.

Microcontroller Core Features

- High Performance RISCCPU
- Only35single-wordinstructionstolearn
- Operatingspeed:DC–20 MHzclock input;DC –200 nsinstruction cycle.
- Upto8Kx14wordsofFlashProgramMemory,Upto368x8bytesofData Memory (RAM), Up to 256 x 8 bytes of EEPROM Data Memory
- WatchdogTimer(WDT)withitsownon-chipRCoscillatorforreliableoperation
- InterruptCapability(upto14 sources)
- Direct,IndirectandRelativeaddressingmodes
- Low-power,high-speedFlash/EEPROMtechnology
- 100,000erase/writecycleEnhancedFlashprogrammemorytypical
- 1,000,000erase/writecycleDataEEPROMmemorytypical
- DataEEPROMRetention>40years
- Processor read/write access to program memory
- vide operating voltagerange(2.0Vto 5.5V)
- Low Power Consumption

RELAYS

A relay is an electrical component that turns on and off under the control of another circuit. In its original form, the switch is driven by an electric motor to open or close one or more contacts, because the relay can control electric current with more energy than the product using electricity, it can be considered an electronic amplifier.

Introduction to Industrial Internet of Things (IIoT):

The Internet of Things (IIoT) represents a revolutionary change in business by combining traditional business with technology. Unlike the broader Internet of Things (IoT), IIoT is designed for industrial use by integrating smart sensors, advanced analytics, and instant connectivity into manufacturing and critical processes. It allows the business to leverage the power of data to enable predictive maintenance, improve the supply chain and improve overall performance. Knowing how to decide. This connectivity enables remote monitoring, control and automation of business processes, providing cost savings, increased productivity and enhanced security standards.

Security Advantages of IIoT:

TheadoptionofIIoTcomeswithaheightenedfocusoncybersecuritytosafeguardcritical industrial systems from potential threats .Several security advantages are in here IIoT implementations:

1. Data encryption and integrity: IIoT systems often use strong encryption techniques to protect the security of data in transit and at rest, thus ensuring the confidentiality and integrity of sensitive information. Use strict controls and personal identification procedures to ensure only authorized personnel can enter and work on the premises, thus reducing the risk of illegal compromise.

2. Instant threat detection: IoT solutions integrate advanced analytics and machine learning algorithms to instantly detect vulnerabilities and potential security threats. This leads to a rapid and reduced response, preventing disruption to business operations.

3. Device management and patching: IIoT security involves effective device management, ensuring that devices are regularly updated with security patches for sensitive areas, thereby protecting all body functions.

4. Network segmentation: Industrial IoT networks are often segmented to isolate and protect critical components, limit the impact of security breaches, and prevent movement in the network.

REAL-TIME EVALUATION:

Planned projects are evaluated using real time equipment and power converters, suitable signal conditioning systems and computer interfaces are designed to be tested using 2k measurement models for time analysis. We can see the setup in Figure 3 above. To observe the above measurements, the equipment is connected to the computer via RS232 communication and connected to the transformer.

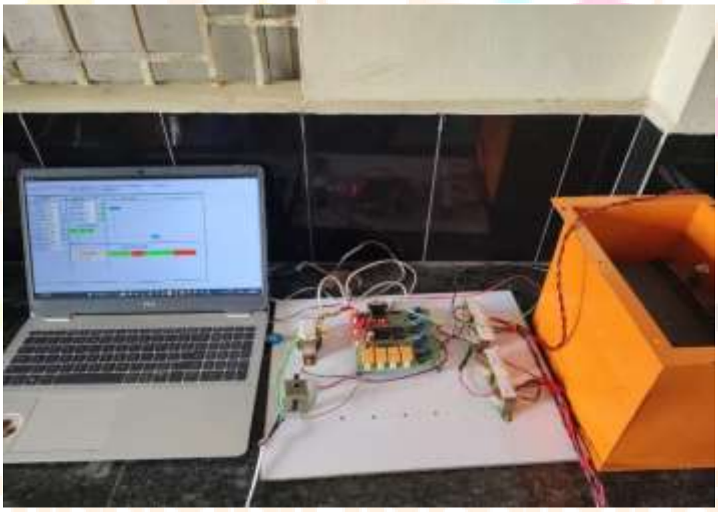

Fig 3 Complete Real-time model

V. FUTURESCOPE:

Expanding the horizons of transformer technology opens a promising field where innovation and efficiency interact to solve power distribution problems. A key hope is to change response time to disaster by integrating geolocation tracking into the change environment. By installing switches with geolocation capabilities, energy providers can quickly identify and resolve problems, reduce outages, and increase reliability. Additionally, the emergence of in-car diagnostic systems promises to revolutionize maintenance practices and usher in the era of proactive intervention. These systems enable employees to proactively resolve issues, prevent inefficiencies, and increase productivity through real-time monitoring and detection of anomalies. At the same time, the introduction of a dedicated RF channel represents an important step in strengthening the security of IoT transformers. These measures can reduce the risk of network intrusion by isolating communications and protect critical systems from malicious attacks. Adopting these future ideas not only increases the capacity and reliability of electrical equipment, but also demonstrates a commitment to pushing the boundaries of electrical engineering.

VI. CONCLUSION

Transformer efficiency analysis was performed instantly using MATLAB and a circuit was created from the results. Complete analysis of transformer using resistive and inductive loads to understand the concept of load shedding. The plans are designed to use only real-time components on the printed circuit board to reduce overall cost and system size. The proposed scheme was tested using a 2KVA transformer and was found to be satisfactory.

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