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Monitoring the Transformer Oil Temperature and Load Sharing Using Gsm

Ramadas.K [1], Madasamy.P[2]
[1, 2] *Assistant Professor, Department of Electrical and Electronics Engineering, Aliquippa Chettiar College of Engineering and Technology, Karaikudi, Tamil Nadu, India*[1]

Abstract: ***This paper is about design and implementation of a embedded system to monitor and record key parameters of a distribution transformer like load currents, load voltage, open circuit, short circuit, ambient temperature. The idea of on-line monitoring system integrates a global service mobile (GSM) Modem, with a standalone single chip microcontroller and different sensors. It is installed at the distribution transformer site and the above parameters are recorded using an analog to digital converter (ADC) of the embedded system. The obtained parameters are processed and recorded in the system memory. If any abnormality or an emergency situation occurs the system sends information to an LCD display about the abnormality according to some predefined instructions programmed in the microcontroller. This embedded system will help the transformers to operate smoothly and identify problems before any catastrophic failure.***

Keywords: embedded system, distribution transformer, GSM, ADC, LCD display.

I. INTRODUCTION

In power systems, distribution transformer is electrical equipment which distributes power to the low-voltage users directly, and its operation condition is an important component of the entire distribution network. Operation of distribution transformer under rated condition guarantees their long life. However, their life is significantly reduced if they are subjected to overloading, resulting in unexpected failures and loss of supply to a large number of customers thus affecting system reliability. Overloading and ineffective cooling of transformers are the major causes of failure in distribution transformers. The monitoring devices or systems which are presently used for monitoring distribution transformer cause some problems and deficiencies.

Ordinary transformer measurement system generally detects a single transformer parameter, such as power, current, voltage, and phase. While some ways could detect multi-parameter, the time of acquisition and operation parameters is too long, and testing speed is not fast enough. According to the above requirements, we need a distribution transformer real-time monitoring system to detect all operating parameters operation, and send to the monitoring centre in time. This will help to identify problems before any serious failure which leads to a significant cost savings and greater reliability. Widespread use of mobile networks and GSM devices such GSM modems and their decreasing costs have made them an attractive option not only for voice media but for other wide area network applications.

Block Diagram And Description

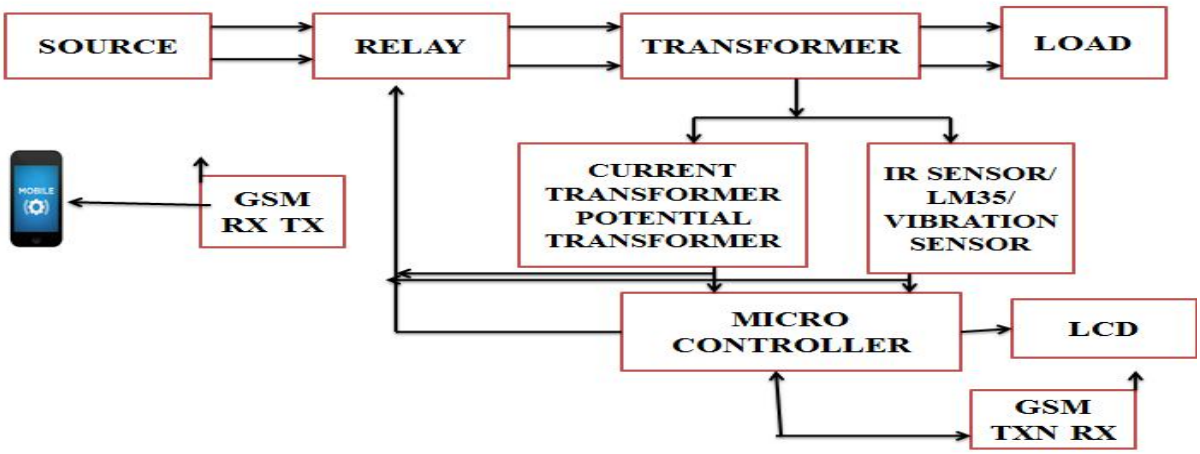


Fig.1. Block diagram

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Fig.1 shows the block diagram of monitoring the transformer oil temperature and load sharing using GSM. Sensors are installed on transformer site which reads and measure the physical quantity from the distribution transformer and then it converts it into the analogy signal. Sensors are used to for sensing load current, ambient temperature, winding temperature, oil temperature and oil level. The following general setup of sensors for example is proposed for the use at a distribution transformer:

A. PT 100 to measure top oil temperature
B. PT 100 to measure ambient temperature
C. CT to measure load current
D. Sensor to measure humidity in oil
E. Sensor for measuring gas in oil content

The current and potential transformers are used to measure current and voltage parameters. These measured parameters are transformed to Microcontroller where is compared with the actual value and based on it generates LCD display.

II. FLOW CHART OF THE ENTIRE SYSTEM

The flowchart gives a diagram representation of the program algorithm. The system flowchart is designed as shown below

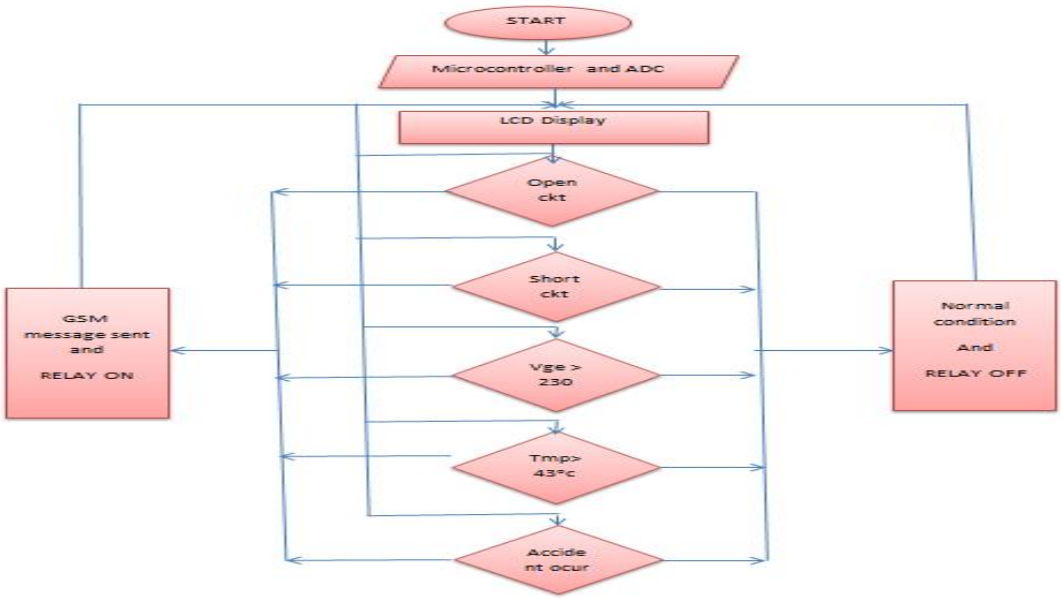


Fig.2. Flow Chart

The flowchart above shows the initial description of the system program code. The first thing the program will do is to initialize and read the ADC and the USART pins then sends the transformer parameters which are fed to the ADC to the personal computer system using the UART1_Write command, then to the LCD display. The microcontroller ADC will continuously capturing the transformer parameters, as soon as the transformer secondary current is greater than 1A, it sends a trip signal to the over current relay, and it cuts off the load that leads to the over current, thereby protecting the transformer from burning. Same process goes to the over voltage protection, it will check whether the transformer input voltage is greater than 230Vac, if so, it sends a trip signal to overvoltage relay, thereby protecting the transformer

III.CIRCUIT DIAGRAM

The circuit section consists of AVR microcontroller; step down transformer circuit for voltage sensing, current sensing circuit, relay circuits, a temperature sensor, RS232 and the MAX232 circuit. The step down transformer used is a 230V AC to 12V AC transformer and is used For the purpose of sensing the input voltage to the main transformer with a voltage rating of 230V AC to 160V AC. The step down transformer is been rectified and filtered to a pure dc which goes directly to the microcontroller ADC for monitoring the input voltage. For the purpose of current sensing, a current transformer was used for that purpose. It went through rectification and filtering process then directly connected to the microcontroller ADC for monitoring the load current. The microcontrollers send the monitored parameters to LCD display and also transmit them to a personal computer. The transmission to personal computer was made possible by interfacing the microcontroller with the computer using MAX232 through RS232 serial

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communication. RS232 (recommended standard 232) supports both synchronous and asynchronous transmission and its user data is send as a time series of bits. While monitoring the parameters, whenever a fault occurs which might be high voltage or over current, the microcontroller sends a trip signal to the relay and thereby protecting the transformer from burning. AVR Studio and Pro Load are two software's used to program microcontroller.

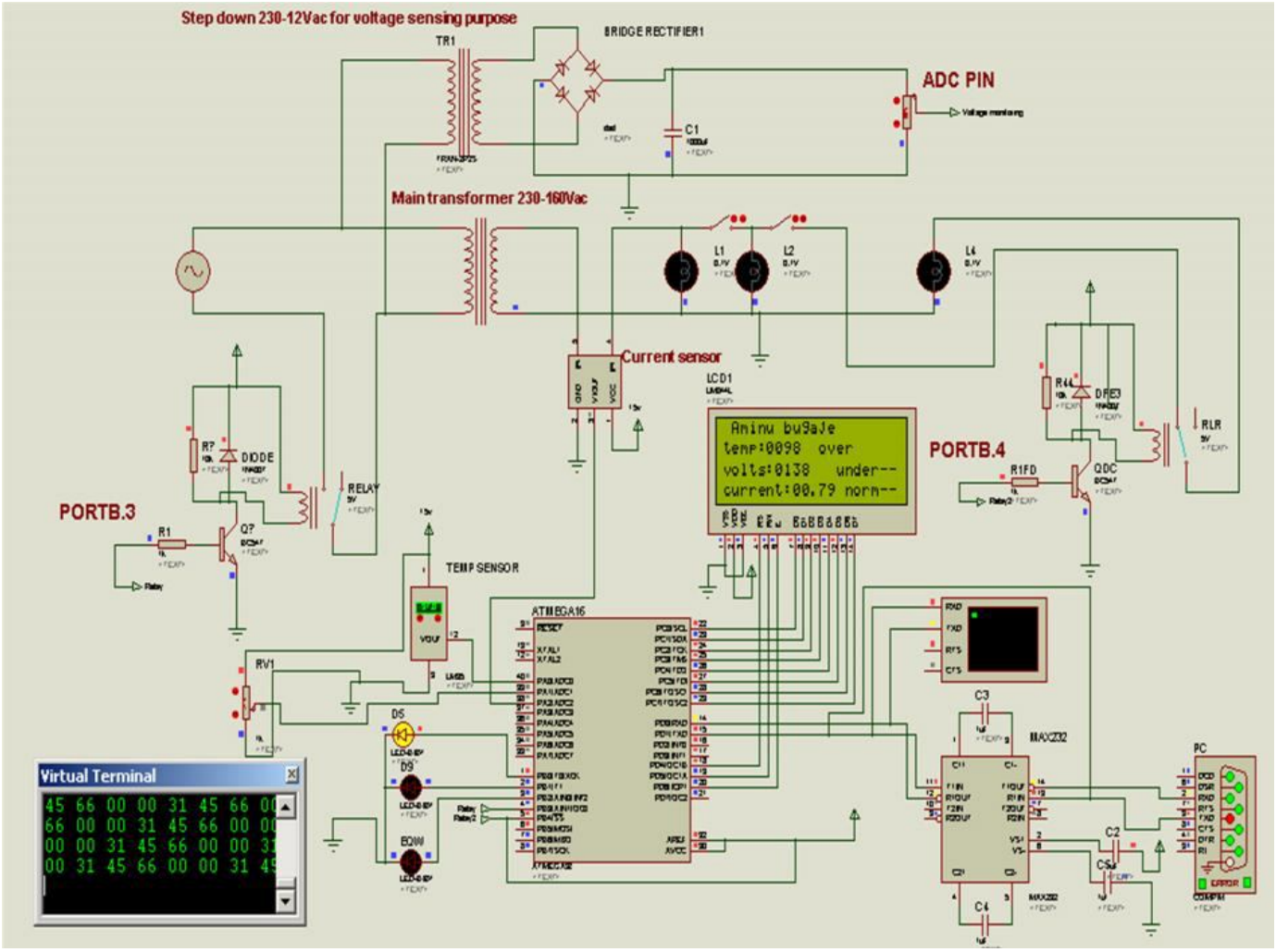


Fig.3. Simulation circuit

The compiler for high level language helps to reduce production time. For programming ATmega16L AVR Studio is used. The programming is done in embedded C language. The compilation of the C program converts it into machine language file (.hex). This is the only language the microcontroller will understand, because it has the original program code converted into a hexadecimal format. During this process some errors and warnings occur. If there are no errors and warnings then run the program, the system performs all the given tasks and behaves as expected the software developed. If not the whole procedure is repeated again. AVR studio is software used where machine language code is written and compiled. After compilation machine source code is converted to hex code to be burnt into the microcontroller. The program is written in C language code. Proload is software that accepts only hex files. After the machine code is converted into hex code, that hex code has to be burnt into the microcontroller which done by the Proload.Proload is a programmer which contains a microcontroller in it other than the one which is to be programmed. The program is written in the proload microcontroller in such a way that it accepts the hex file from the AVR Studio and burns this hex file into the microcontroller which is to be programmed. The Proload programmer kit requires power supply to operate, this power supply is given by the power supply circuit. It is noted that this programmer kit contains a power supply section in the board but in order to switch on the power supply, a source is required. This is accomplished from the power supply board with an output of 12 V.
Microcontroller Software Compiler generates a Hex file
Hex file accepted and sent to MCU program Loader. Hex file programmed into Target Microcontroller device.

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IV. RESULT

Thus the various faults have been noticed and their outputs are displayed on LCD whose results are shown below in Fig.4, Fig.5and Fig.6.

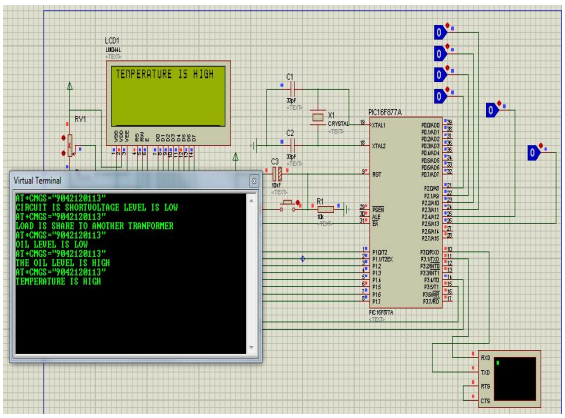


Fig.4. Output indication on LCD

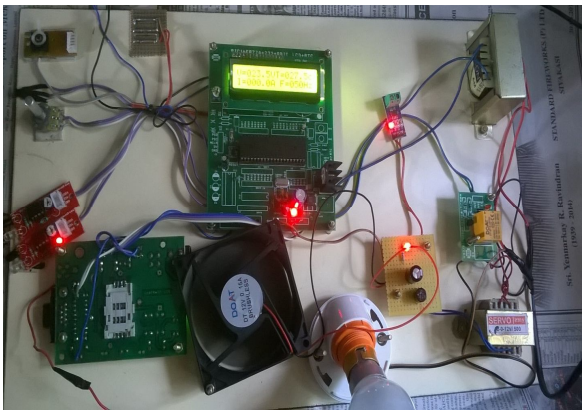
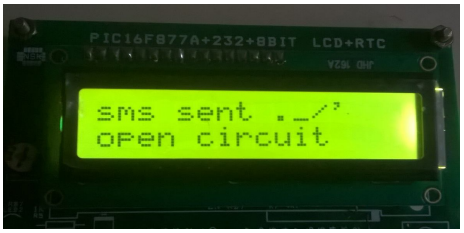


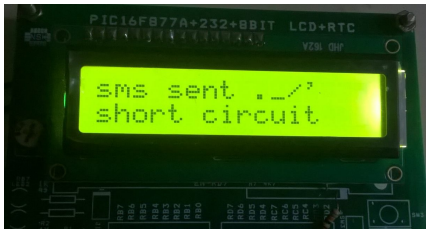
Fig.5. Hardware circuit

Open Circuit Indication



Sms received: current status update: open circuit!!!!!!

Short Circuit Indication



Sms received: current status update: short circuit !!!!!!

Low Oil Level Indication



Received message:transformer oil level is low!!!!!!

High Oil Level Indication



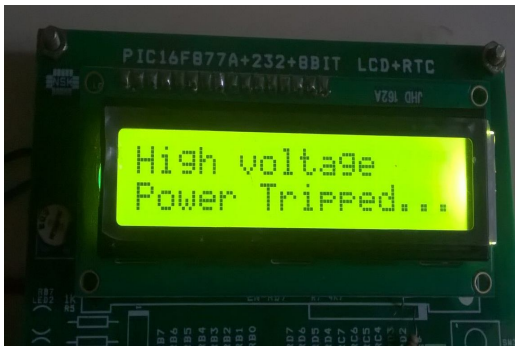
Sms received: transformer oil level is high!!!!!!

Accident Occuring Indication



Sms received: accident occur in transformer!!!!!!

High Voltage Indication



Sms received: high voltage!!!!!!

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Temperature Indication



Sms Received: Temperature level got exceeds in transformer due to heavy load!!!!!!

Fig.6. SMS Status

A. Advantage

1) Fault can be easily cleared in this proposed model.
2) Easily controllable and have an efficient working which is mainly noticed in time management.
3) No manual maintenance required.
4) Installation work is also simple and easy when compared to the existing model.
5) Reduce the service man work by fast messaging service that is carried out by GSM.
6) Prevent the circuit before the fault occurs and hence it is a protective method.

V. CONCLUSION

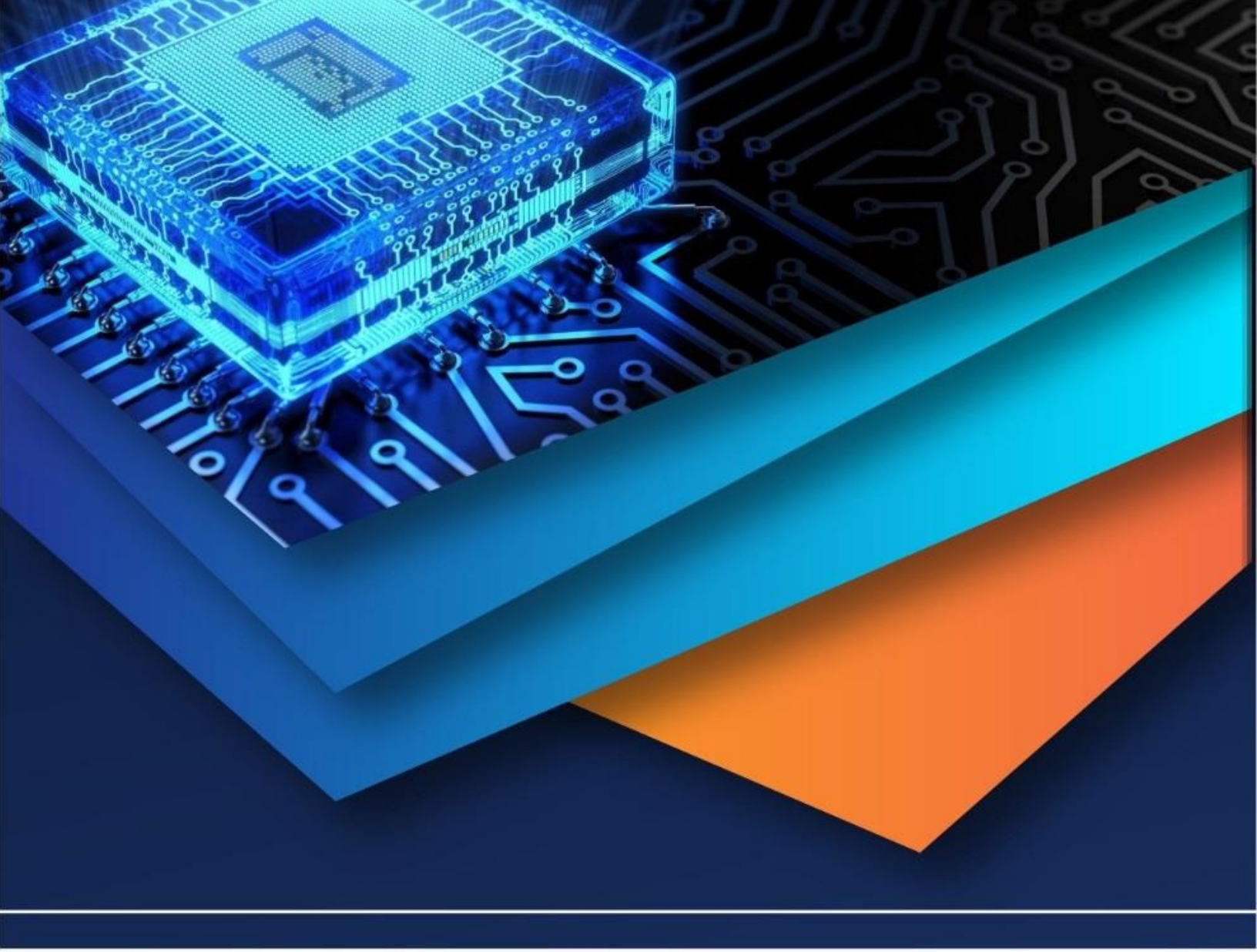
The GSM based monitoring of distribution transformer is quite useful as compared to manual monitoring and also it is reliable as it is not possible to monitor always the oil level, temperature rise of oil, ambient temperature rise, load current manually. After receiving of message of any abnormality we can take action immediately to prevent any catastrophic failures of distribution transformers. In a distribution network there are many distribution transformers and associating each transformer with such system, we can easily figure out that which transformer is undergoing fault from the message sent to mobile. We need not have to check all transformers and corresponding phase currents and voltages and thus we can recover the system in less time. The time for receiving messages may vary due to the public GSM network traffic but still then it is effective than manual monitoring.

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