iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3435

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Wireless Transformer Parameter Measurement and Protection

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Abstract: This paper is focused on a device used for measurement of transformer parameters through wireless system, which has in built step-down transformer with voltage and frequency and measurement circuit for measuring input voltage and frequency of a transformer. This paper will aim to monitor the different parameters like voltage, frequency, temperature, oil level in the transformer tank and also protect the transformer from overload and high voltage and use of GSM module for transmitting the data through wireless media.

I. INTRODUCTION

Initially 230 v ac input voltage from mains supply is stepped down into 12v ac through 12-0-12 step down transformer and then its output given to frequency and voltage measurement circuit and at end these measurement data output is feed to microcontroller for processing [2]. All these parameter are sending through GSM module. Here we using P89V51RD2 microcontroller for processing information. 8051 architecture based P89V51RD2 microcontroller from NxP is used, which controls the whole system [1]. It contains 1k RAM, 64k Flash, 3 Timers, 2 external interrupts, 1 UART, 32 GPIO's, ISP programming support etc. KEIL IDE is used to program the microcontroller and the coding will be done using Embedded C. GSM module is used to send SMS to the required GSM mobile. This module is programmed using AT commands through UART. Monitoring of Transformers data related to various parameters, predict and prevent the failure of transformer by observing deviation of the transformer parameters expected values [4]. Transformers are the most critical assets of electrical transmission and distribution system. Transformer failures could cause power outages, personal and environmental hazards and expensive rerouting or purchase of power from other suppliers [2]. Transformer in-service interruptions and failures usually result from dielectric breakdown, winding distortion caused by short-circuit withstand, winding and magnetic circuit hot spot, electrical disturbances, deterioration of insulation, lightning, inadequate maintenance, loose connections, overloading, failure of accessories such as OLTCs, bushings, etc [3].

II. PROBLEM STATEMENT

From this paper transformer will be monitored and protected from faults occurring during real time , with the help of microcontroller based wireless monitoring system. In this project the over voltage , temperature and overload are monitored in single system. This project is fully automated and require no manual interface`

III. LITERATURE REVIEW

Most power companies use Supervisory Control and Data Acquisition (SCADA) system for online monitoring of power transformers but extending the SCADA system for online monitoring of distribution transformers is an expensive way of monitoring of transformer.

Distribution transformers are currently monitored manually where a person periodically visits a transformer Site for maintenance and records parameter of importance. This type of monitoring cannot provide information about occasional overloads and overheating of transformer oil and windings. All these factors can significantly reduce transformer life. A number of techniques are currently being used for offline as well as online monitoring of power transformers.

The Transformer Load Monitoring system (TLM) is a project aimed to reduce cost, increase efficiency and improve services to customers. The project was created by Metropolitan Electricity Authority (MEA) Thailand. The purpose was to build a monitoring system for medium voltage distribution transformers. These transformers have been installed on roadside electric poles around Bangkok. Transformers' data is significant to load management and research about transformers. An advanced distribution transformer load monitoring system is capable of measuring voltage, current and power.

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IV. OBJECTIVES

The main aim of this project is to monitor and protection of Distribution transformer Acquisition of different parameters of the transformer by the use of GSM Microcontroller used to monitor and protection of the transformer. 8051 architecture based P89V51RD2 microcontroller from NxP is used to implement this project. Microcontroller acts as the heart of the project, which controls the whole system. It contains 1k RAM, 64k Flash, 3 Timers, 2 external interrupts, 1 UART, 32 GPIO's, ISP programming support etc. KEIL IDE is used to program the microcontroller and the coding will be done using Embedded C.GSM module is used to send SMS to the required GSM mobile. This module is programmed using AT commands through UART. These are the main Objectives of our project

Voltage Measurement.
Frequency Measurements.
Temperature Measurements.
Oil Level Measurements.
Overload Protection.

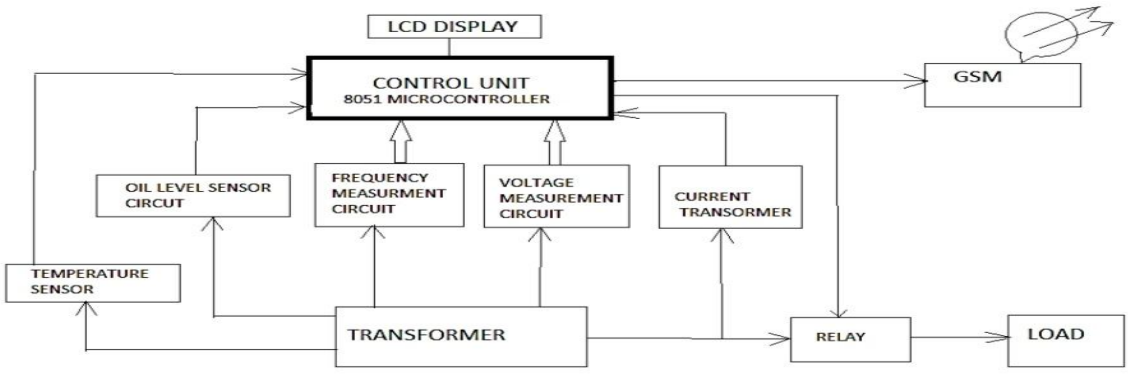
V. METHODOLOGY

The basic setup of the complete project consists of microcontroller P89V51RD2 , Transformer, LM317 Adjustable Regulator, Timers, Alpha Numeric LCD display, Power Supply, ACD. The proposed system demonstrates measurement of transformer parameters and its protection through wireless system. Main center pat of our project is microcontroller which is 8051 based Philips P89V51RD2 Microcontroller.

VI. WORKING

It is a micro-controller based wireless monitoring and protection of the transformer. Particularly our project is implemented for distribution transformers, because it is difficult to check the transformer parameters by going there manually. So this paper will aim to monitor the different parameters like voltage, frequency, temperature, oil level in the transformer tank and also protect the transformer from overload and high voltage. Here we are using micro-controller as a controlling unit, different sensors are being used and it is interfaced with the micro-controller like temperature sensor, floating sensor. And also different parameter measuring circuits like frequency, voltage and over-load current. Working of this module has fallows, initially 230V ac input is stepped down into 12V ac through 12-0-12 step down transformer and then its output given to frequency , voltage, oil level measurement circuit and at end these measurement data is feed to microcontroller for processing. All these parameter are sending through GSM module. Here we using P89V51RD2 microcontroller for processing information. 8051 architecture based P89V51RD2 microcontroller from NxP is used to implement this project. Microcontroller acts as the heart of the project, which controls the whole system. It contains 1k RAM, 64k Flash, 3 Timers, 2 external interrupts, 1 UART, 32 GPIO's, ISP programming support etc. KEIL IDE is used to program the microcontroller and the coding will be done using Embedded C. GSM module is used to send SMS to the required GSM mobile. This module is programmed using AT commands through UART.

VII. BLOCK DIAGRAM



FUNCTIONAL BLOCK DIAGRAM OF THE TRANFORMER PARAMETER MEASUREMENT USING GSM

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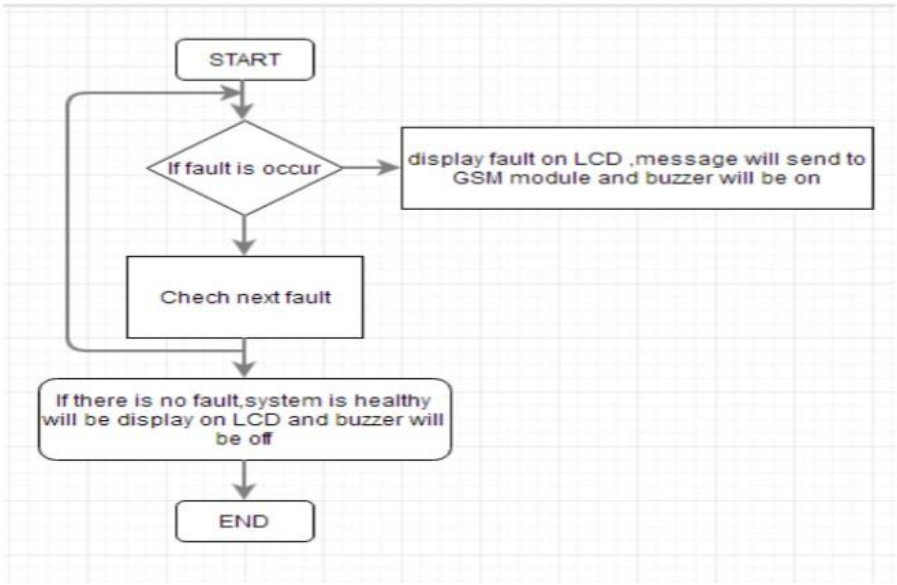
VIII. ALGORITHM

Algorithm of proposed system is:
Step 1. Start
Step 2. Initialize LCD, timer, interrupt, relay, sensors, GSM modem
Step 3. Clear LCD
Step 4. Display collage name on LCD
Step 5. Wait for 4sec
Step 6. Clear LCD
Step 7. Display project name on LCD
Step 8. Wait for 4sec
Step 9. Clear LCD
Step 10. Check fault
Step 11. If fault is occur, display fault on LCD, message will send to GSM Module and buzzer will be on
Step 12. Else if check next fault
Step 13. If there is no fault, system healthy will be display on LCD and buzzer will be off
Step 14. End.

IX. FLOWCHART



COMPONENTS
Microcontroller P89V51RD2
Timer
Transformer
Alpha Numeric LCD Display
GSM
LM-317 Adjustable regulator
ADC

X. COMPONENTS DESCRIPTION

A. Microcontroller-P89V51RD2

The main center part of the project is the microcontroller. Here we are using the 8051 based Philips P89V51RD2 microcontroller. The P89V51RD2 are 80C51 microcontrollers with 64kB flash and 1024 B of data RAM. A key feature of the P89V51RD2 is its

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X2 mode option. The design engineer can choose to run the application with the conventional 80C51 clock rate (12 clocks per machine cycle) or select the X2 mode (six clocks per machine cycle) to achieve twice the throughput at the same clock frequency. The flash program memory supports both parallel programming and in serial ISP. Parallel programming mode offers gang-programming at high speed, reducing programming costs and time to market. ISP allows a device to be reprogrammed in the end product under software control. The capability to field/update the application firmware makes a wide range of applications possible.

B. Timers

The two 16-bit Timer/counter registers: Timer 0 and Timer 1 can be configured to operate either as timers or event counters. In the 'Timer' function, the register is incremented every machine cycle. Thus, one can think of it as counting machine cycles. Since a machine cycle consists of six oscillator periods, the count rate is 1 to 6 of the oscillator frequency. In the 'Counter' function, the register is incremented in response to a 1-to-0 transition at its corresponding external input pin, T0 or T1. In this function, the external input is sampled once every machine cycle. When the samples show a high in one cycle and a low in the next cycle, the count is incremented. The new count value appears in the register in the machine cycle following the one in which the transition was detected. Since it takes two machine cycles (12 oscillator periods) for 1-to-0 transition to be recognized, the maximum count rate is 1/12 of the oscillator frequency. In addition to the 'Timer' or 'Counter' selection, Timer 0 and Timer 1 have four operating modes from which to select. The 'Timer' or 'Counter' function is selected by control bits C/T in the Special Function Register TMOD. These two Timer/counters have four operating modes, which are selected by bit-pairs (M1, M0) in TMOD. Modes 0, 1, and 2 are the same for both Timers/counters. Mode 3 is different. The four operating modes are described in the following text.

C. Transformer

A transformer is a device that transfers electrical energy from one circuit to another through inductively coupled conductors—the transformer's coils. A varying current in the first or primary winding creates a varying magnetic flux in the transformer's core and thus a varying magnetic field through the secondary winding. This varying magnetic field induces a varying electromotive force (EMF), or "voltage", in the secondary winding. This effect is called inductive coupling. In the vast majority of transformers, the windings are coils wound around a ferromagnetic core, air-core transformers being a notable exception. Transformers range in size from a thumbnail-sized coupling transformer hidden inside a stage microphone to huge units weighing hundreds of tons used to interconnect portions of power grids. While new technologies have eliminated the need for transformers in some electronic circuits, transformers are still found in nearly all electronic devices designed for household ("mains") voltage. Transformers are essential for high-voltage electric power transmission, which makes long-distance transmission economically practical. The primary and secondary coils are wrapped around a core of very high magnetic permeability, such as iron, so that most of the magnetic flux passes through both the primary and secondary coils. If a load is connected to the secondary winding, the load current and voltage will be in the directions indicated, given the primary current and voltage in the directions indicated (each will be alternating current in practice).

D. Alpha Numeric LCD Display

A liquid crystal display (LCD) is a flat panel display, electronic visual display, based on Liquid Crystal Technology. A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present information. Liquid crystals do not emit light directly instead they use light modulating techniques.

The size of LCDs comes in wider varieties.

They do not use Phosphor; hence images are not burnt-in.

Safer disposal

Energy Efficient

Low Power Consumption

E. GSM

GSM stands for Global System for Mobile Communications formerly called as Group Special Mobile. This is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe technologies for second generation (or "2G") digital cellular networks. Packet data transmission speeds were later increased via EDGE. The GSM standard is succeeded by the third generation (or "3G") UMTS standard developed by the 3GPP. GSM networks will evolve further as they begin to

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incorporate fourth generation (or "4G") LTE Advanced standards. "GSM" is a trademark owned by the GSM Association. GSM networks operate in a number of different carrier frequency ranges (separated into GSM frequency ranges for 2G and UMTS frequency bands for 3G), with most 2G GSM networks operating in the 900 MHz or 1800 MHz bands. Where these bands were already allocated, the 850 MHz and 1900 MHz bands were used instead (for example in Canada and the United States). In rare cases the 400 and 450 MHz frequency bands are assigned.

F. LM-317 Adjustable Regulator

A liquid crystal display (LCD) is a flat panel display, electronic visual display, based on Liquid Crystal Technology. A liquid crystal display consists of an array of tiny segments (called pixels) that can be manipulated to present information. Liquid crystals do not emit light directly instead they use light modulating techniques.

The size of LCDs comes in wider varieties.

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Low Power Consumption

G. ADC

The heart of this single chip data acquisition system is its 8-bit analog-to-digital converter. The converter is designed to give fast, accurate, and repeatable conversions over a wide range of temperatures. The converter is partitioned into 3 major sections: the 256R ladder network, the successive approximation register, and the comparator. The converter's digital outputs are positive true.

The 256R ladder network approach was chosen over the conventional R/2R ladder because of its inherent monotonicity, which guarantees no missing digital codes. Monotonicity is particularly important in closed loop feedback control systems. Additionally, the 256R network does not cause load variations on the reference voltage. The first output transition with analog signal has reached +1⁄2 LSB and succeeding output transitions at every 1 LSB later up to full-scale. The successive approximation register (SAR) performs 8 iterations to approximate the input voltage. For any SAR type converter, n-iterations are required for an n-bit converter and a 3-bit converter. In the ADC0809, the approximation technique is extended to 8 bits using the 256R network. The A/D converter's SAR is reset on the positive edge of the start conversion pulse. The conversion is begun on the falling edge and will process a new pulse. The Continuous conversion is used to end-of-conversion (EOC) output to the SC input and power up. End-of-conversion will go low between 0 and 8 clock pulses after the rising edge of start conversion. The A/D converters compare the comparator and get ultimate accuracy.

XI. POSSIBLE OUTCOMES

The project focuses much on efficiency of controlling process of the transformer and mainly through wireless communication that eliminates the use of large cables which are of high cost, low reliability and maintenance.

The GSM helps in better way of communication which enhances the improvement steps in this process. So, use of P89V51RD2 MICROCONTROLLER makes the system real time embedded system and aids very much in industry needs.

In this project the overvoltage, temperature and overload are monitored in single system. The project is fully automated and require no manual interface.

XII. APPLICATIONS AND ADVANTAGES

The main application of this project is wireless monitoring and protection of the distribution transformer. It protects transformer from fault conditions.

It can also be implemented for automation purpose and for industrial applications like temperature, oil level and protection of electrical machines, this system can be implemented.

It will reduce the maintenance cost as the system gives the early warning of any abnormal conditions.

Time will also be reduced as we need not to go on checking every transformer manually.

The transformer will be monitored and protected from faults occurring during real time, with help of microcontroller based wireless monitoring system.

XIII. DISADVANTAGE

Not valuable unless many people accept it

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XIV. CONCLUSION

The paper focuses much on the efficiency of controlling process of the transformer and mainly through wireless communication that eliminates the use of large cables which are of high cost, low reliability and maintenance. The GSM helps in better way of communication which enhances the improvement steps in this process. So, use of P89V51RD2 MICROCONTROLLER makes the system real time embedded system and aids very much in industry needs. The Distribution Transformers failures are effectively protected against overload, over temperature and over voltage. The parameters of the transformer are continuously monitored and transmitted to the nearest electrical office for the necessary actions. Wireless communication systems are used for transmitting and receiving the data from the transformer and the nearest electrical office by using GSM communication. In this project the over voltage, temperature and over load are monitored in signal system. The project is fully automated and require no manual interface.

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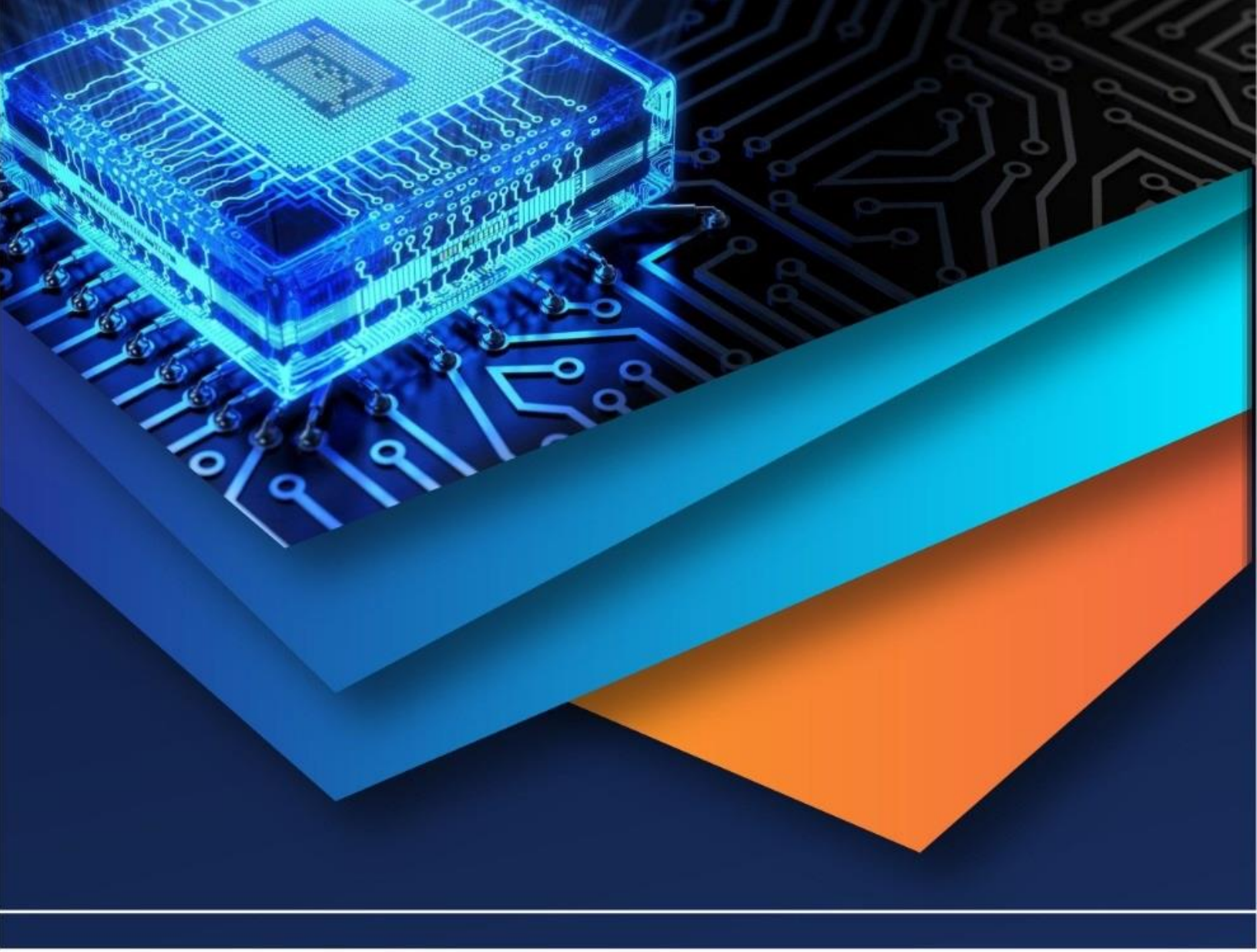

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