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Effective Load Sharing of Distribution Transformers With Safety Cut-Off Using Gsm Technology

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Abstract: ***The aim of the project is to detect the various faults on the transformer under overload condition by load sharing. Due to overload on transformer, the efficiency drops and windings get overheated and may get burnt. Thus by sharing load on transformer, the transformer is protected. This will be done by connecting another transformer in parallel through a micro-controller. The micro controller compares the load on the first transformer with a reference value. When the load exceeds the reference value, the second transformer will share the extra load. Therefore, the two transformers work efficiently and damage is prevented. In this project three modules are used to control the load currents. The first module is a sensing unit, which is used to sense the current of the load and the second module is a control unit. The last module is micro-controller unit and it will read the analogue signal and perform some calculation and finally gives control signal to a relay. A GSM modem is also used to inform the control room about switching. The advantages of the project are transformer fault detection, uninterrupted power supply, and short circuit protection.***

Depending upon the sensing action immediate actions are taken to avoid damage to transformers. The signal is sent to control room and here we are using a GSM technique interfaced with 8051 controller. When the power is cut due to faults in transformer-1 then load sharing is done, Thus from the control room they send the signal to microcontroller to switch for transformer-2 for time being unless the transformer-1 is ready.

Keywords—Microcontroller, GSM , Load sharing and control.

I. INTRODUCTION

Transformer is a static piece of device which can transfer voltage from one coil to the coil without changing its frequency. It is an electrically isolated inductively coupled device which changes voltage level without change in frequency. Transformer transfers ac voltage from one electrical circuit to another by the principle of mutual induction. Distribution transformers are one of the most important equipment in power system and are also known as the heart of the power system. The reliable operation of a power system depends upon the effective functioning of the distribution transformer. Therefore monitoring and controlling of key parameters like voltage and current are necessary for evaluating the performance of the distribution transformer. Thus it helps in avoiding or reducing the disruption due to the sudden unexpected failure. Transformers being one of the most significant equipment in the electric power system, needs protection as a part of the general system protection approach. Moreover the increasing population and their unavoidable demands have led to an increasing demand on electrical power. With this increased needs, the existing systems have become overloaded. The overloading at the consumer end appears at the transformer terminals which can affect its efficiency and protection systems. Due to overload on the transformer, the efficiency drops and the windings gets over heated and may get burnt. It takes a lot of time to repair and involves a lot of expenditure. Transformers are occasionally loaded beyond nameplate ratings because of existing possible contingencies on the transmission lines, any failure or fault in power systems, or economic considerations.

The modern electrical distribution system requires lot of automation for the proper and safe distribution. The existing method of distribution suffers from problems like indicating the particular transformer fault is possible only after a lot of delay or after some observation and power cut off will takes place unless the transformer gets ready. The system shown below solves the problem with a real time indication of the transformer problems by using sensors.

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II. OBJECTIVES OF TRANSFORMER FAULT DETECTION

A. The main objectives of this paper are

1) Detection of the transformer oil temperature.
2) Determining the oil level of transformer.
3) Determination of over current in the feeders.
4) Design of micro-controller part
5) Sending fault signals to control unit through GSM technology
6) Automatic changeover of transformer in switching unit for load sharing
7) Reconnection of previous transformer position by giving message to switching unit through GSM.

III.BLOCKDIAGRAM

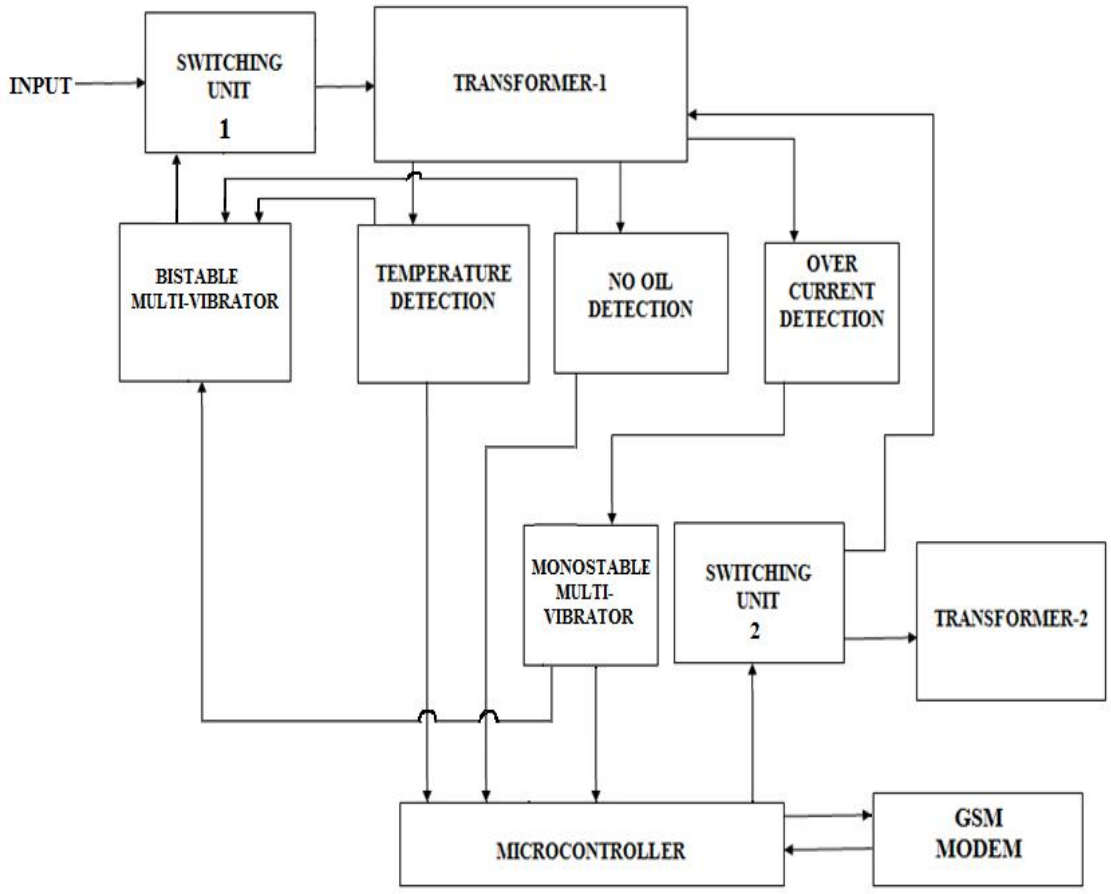

Fig. Proposed block diagram

The signals from all the sensors are fed to microcontroller which is inbuilt 4K flash memory (89C51) the predefined text messages are stored in internal memory and each message is representation of the particular abnormality. When any of the sensor gets activated this data reads through controller port and push the stack pointer to fetch the text message and send serially from serial port with RS232 interface with GSM modem. With the help of AT commands the text message now sends to the engineer mobile unit and control room mobile unit. As soon as the message appears in user mobile depending upon need user can send a coded message from his mobile to a SIM number where this is fixed in the GSM modem itself. Once the message which is picked up and further this will be interfaced with RS 232 port of modem to serial port of the microcontroller. The communication build up with the modem is through a AT commands with microcontroller and the message has been decoded and with general I/O ports of microcontroller interfaced to electromagnetic relays (switching unit) to enable disable the process or particular parameter or to switch from one transformer to other to prevent further accidents and provide load sharing.

Volume 5 Issue VI, June 2017
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IV. MODE OF OPERATION

A. Temperature sensing unit

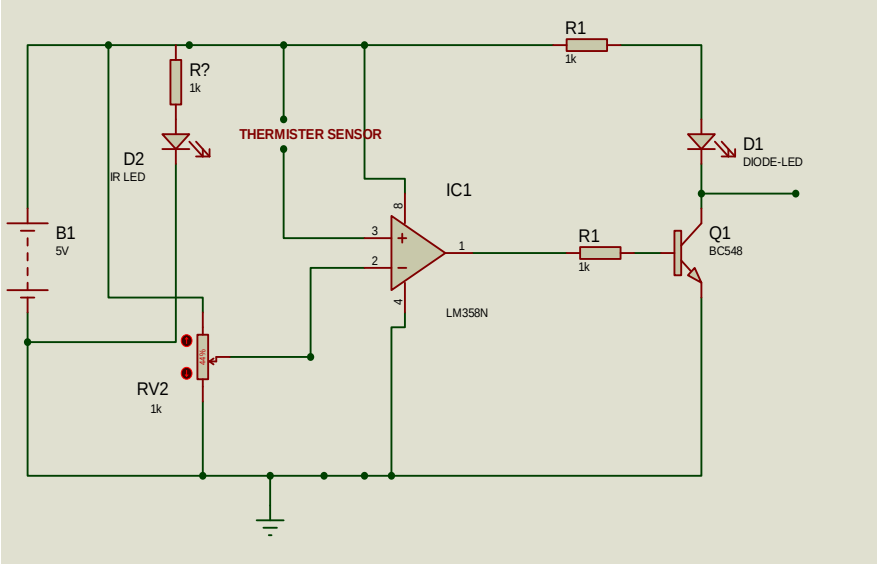

Fig: Temperature sensing circuit

To protect the transformer against over temperature sensing circuit is designed with Thermistor, OP_AMP, which sense the working temperature of pump. The Thermistor is used as a "thermal sensitive resistor". The Thermistor resistance is very high at normal temperature. Here the OP_AMP is used as a voltage comparator. As soon as temperature increases its resistance decreases which increases the voltage at Pin No 3 i.e. non-inverting terminal of the OP_AMP. Now because of this condition the potential difference between two inputs at comparator also changes and the output of the comparator goes from its low to high state to activate (Saturate) the transistor. The collector of the transistor further drives the signal to microcontroller .As long as the temperature is maintained high the OP_AMP output remains in the same state. When pump temperature falls down on Thermistor, its resistance goes to increase. This decrease the voltage at Pin No 3. Because of this condition the OP_AMP i.e. comparator output changes from its high to low state. At this instant the transistors goes to cut-off and the collector signal connect to switching unit which disables the transformer to prevent the damages.

B. Oil level detection circuit

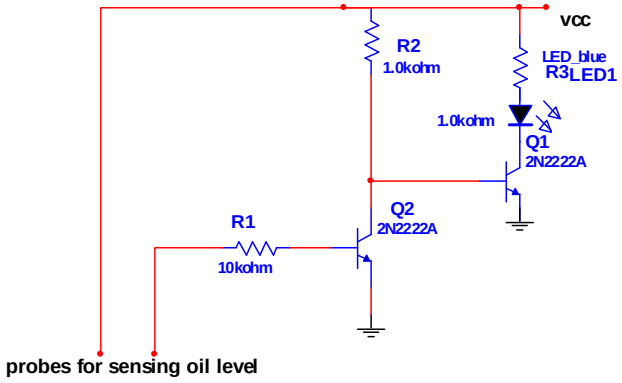

Fig: Oil level detection circuit

For the sensing of oil level in the transformer can be possible with contact type sensor which goes to detects the level of the oil and also indicate the leakage conditions also. The copper conducting probe detects the level of the oil by providing the number of sensors at different intervals. When the oil level falls below the safe limit the circuit breaker stops the functioning of the

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transformers and prevents the damages to the transformer. The circuit is designed with op amp IC 741.

C. Over load detection circuit

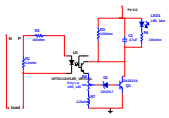

Fig: Overload detection circuit

The over current can be detected with transistorized circuit which goes to detect the excess current flow. The excess current flow indirectly give the indication of power theft in the areas if the area usage exceeds the limit of current this leads to damage the transformer and also leads to excess heating also. As the transistor base circuit detects the excess current the circuit breaker breaks and stop the working of transformer which prevents the damages. The level of current sensing for every transformer cab be possible to set separately also.

D. Microcontroller

The controller used here is 89c51 which is having inbuilt 4k of ROM, the message data is stored in the ROM the programme execute the particular data as per the i/p means the data is different for different transformers so every time any of the transformer fault will indicates with the different name and number, the data is sent through GSM and the message is displayed to particular authorized person in his mobile unit.

E. *Switching Unit (Electromagnetic Relay)*

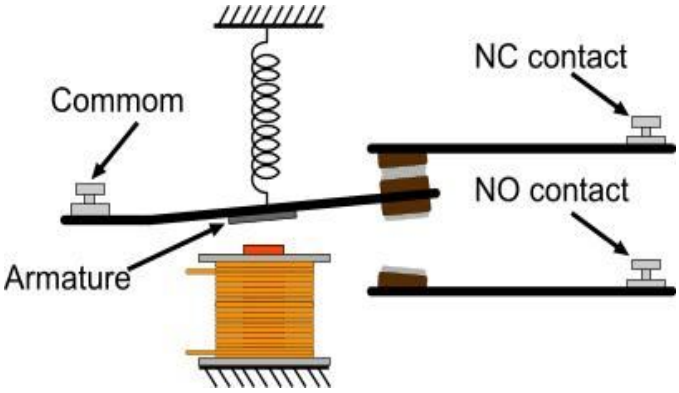

Fig: The relay internal circuit along with the electromagnetic coil

Relay is an electromechanical switch & it works on the principle of energizing an electromagnet. It consists of primary coil, 2 contacts one is normally open contact “NO” & the other is normally closed contact “NC”& pole normally identified a common. The input for the relay coil can be connected to the required DC coil energizing voltage from its COM, N/O and N/C terminal any device of any voltage can be connected for switching actions. The relays are acting as switching device depending upon the signal sent by microcontroller either to switch to transformer-1 or transformer-2.

V. ADVANTAGES AND DISADVANTAGES

A. Advantages

1) Transformers can be operating always in safe condition
2) Suitable for electric grid transmission.
3) Suitable for industrial distribution system
4) The method of sensing parameter is through sensors because of this accuracy can be achieved.
5) Immediate repair and alert can be possible.
6) Losses can be avoided.
7) The user gets a perfect interaction between sensors so a higher
8) End security is achieved
9) The GSM modem works on messaging technique so the cost is very less\
10) The sensing system is through electronic method so the Accuracy is more.

B. Disadvantages

1) Initial implementation is little difficult.
2) Initial implementation cost is little high.

VI. RESULT AND DISCUSSIONS

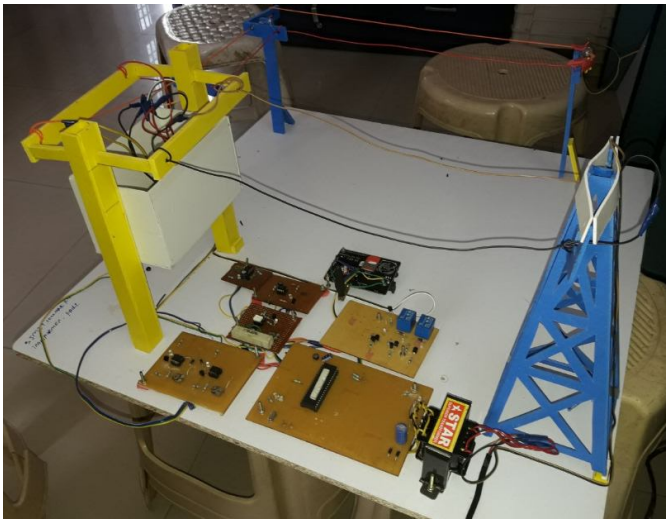

Fig: Hardware implementation

Transformer and its protection system, it is most commonly done with the single transformer followed by if any kind of a fault occurs there are some circuit breakers which may trip and prevent the transformer damage but sometime the intimation of the fault is not possible to send to the control room or some specialties are added at distribution station so in that case what the project we design here, that is the solution for a such a problem as soon as some fault occurs along with the tripping of the transformer to disable for its safety as well as its sends what kind of fault to the respective department which means sub-station so that may be cause of over load condition of the transformer or that may be less amount of level of a cooling oil and that may be excess temperature because some other faults like eddy current loss, copper loss and as soon as intimation through Micro-controller and through GSM. So there are two major devices which are reason to send the message.

The role of a Micro-controller is sensing the three inputs over load, over temperature as well as no-oil in the transformer tank and connected with the serial communication with a GSM modem. The serial communication found on 8051 are Transfer pin, Receiver pin and pin 3.0 and 3.1, using these two pins Transfer and Receiver pin of our GSM modem is connected and the role of a GSM is because the Micro-controller can communicate it cannot able to send anything , for sending the information we need GSM modem. This is at 900/1800MHz frequency which is same as our mobile only.

As soon as the any fault detected using the bistable multi-vibrator will disable the transformer that’s nothing but a tripping action.

Bistable is connected to the relay, it will disable the input of the transformer only. So the transformer will be protected and now the message which is already written in the internal memory of the Micro-controller.

So that message will be selected and serially that Data will be sent to the GSM modem, here it is possible to concern two numbers, one is sub-station in-charge another one is executive engineer number. So that they will get that message i.e; which are, which transformer and what kind of fault and later on they can able to send a technical team to that main transformer so that they can able to rectify the fault, till that the auxiliary transformer will going to handle that line. Once again that sub-station people send one more message. So that it will disable the auxiliary transformer line after rectifying that main transformer fault and again it will come back to the main transformer and starts working. For these type of protection of the transformers the main advantages are less man power required as well as transformer safety management and also we can effectively manage the losses in the line as well as we increase the economy of the electricity board.

VII. CONCLUSION

With the knowledge of new techniques in 'Electronics' we are able to make our life more comfortable. One such application of electronics is used in "Fault Detection and protection of transformer" The approach we followed and which is explained in this paper is novel and has achieved the target of "Fault Detection and protection of transformer"" satisfying user needs and requirements.

The development of this paper has shown how much hard work goes into the creation of a system. "Fault Detection and protection of transformer" was a paper based on microcontroller, so that hardware requirement is reduced. Embarking of this paper has helped us in developing a team spirit, patience and time management required for today's technical professionals.

Hence we conclude that the required goals and objectives of our project have been achieved. By the electronic method monitoring the safety parameters like sensing temp, overload and no cooling oil it is possible to safe guard the transformer and also possible to monitor the status using mobile technology

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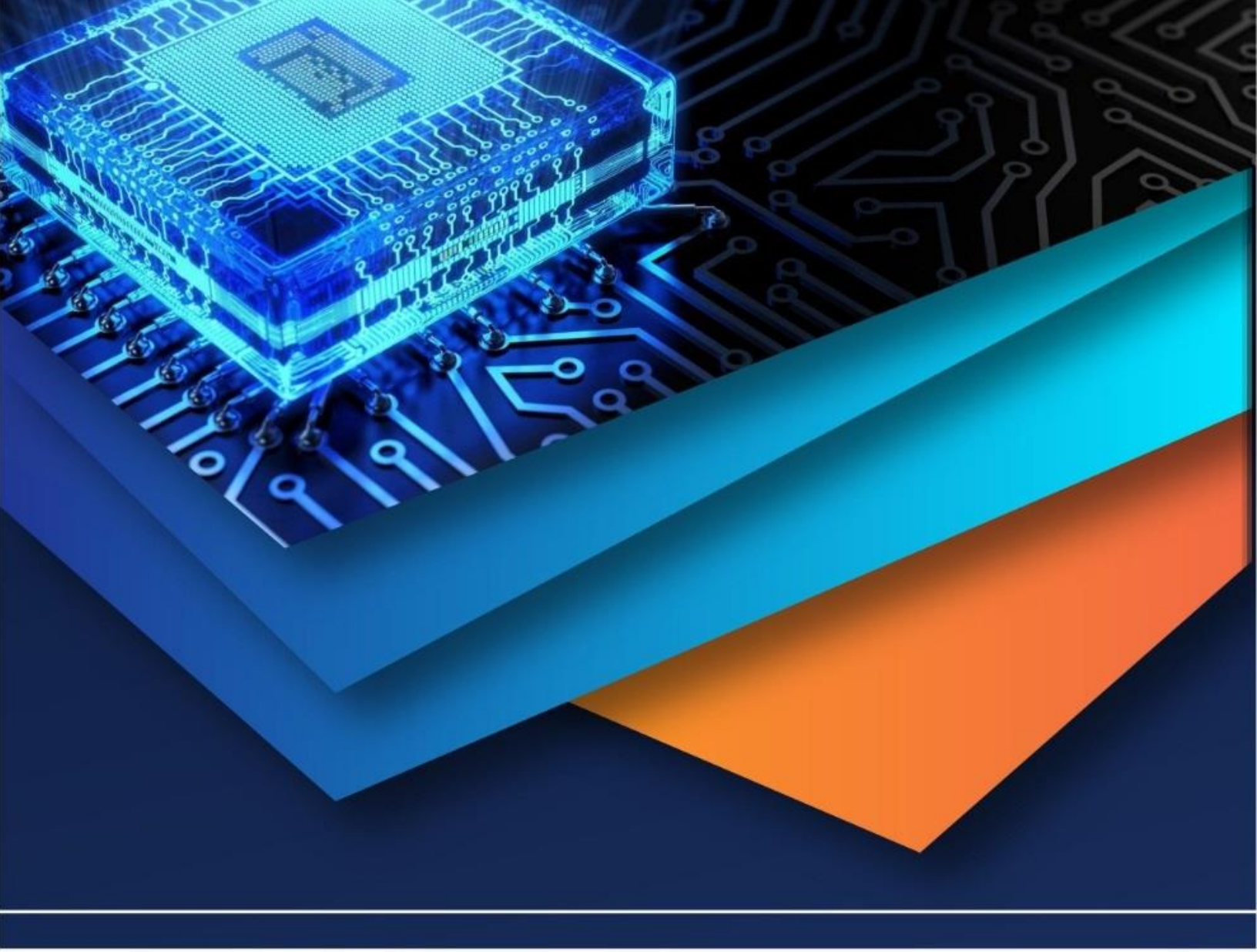

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