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Detecting Power Grid Synchronization Failure on Sensing Frequency or Voltage beyond Acceptable Range

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Abstract: ***This main objective of this paper is to build a simulation model of a system ,in proteus software ,which monitors voltage and provides a breakpoint by low and high voltage tripping mechanism that keep away from any damage to the load, Majority of industrial and domestic systems would encounter fluctuation in the AC mains supply. The chance of damaging electronic devices is very big as they are quite sensitive to these fluctuations. So, Tripping system that avoids any damage to these loads is necessary. This system has tripping mechanism that monitors the input voltage and trips according to limits provides. The system delivers an error as soon as the input voltage falls out of the window range. This system is also configured with an alarm that goes on as soon as tripping takes place.we use mainly microcontroller, comparator and led display for detection of over/under voltage and frequency and we also use GSM to send notification in web terminal.***
Keywords: proteus software , tripping mechanism, fluctuations in AC main supply, GSM , microcontroller

I. INTRODUCTION

In this paper, we discuss about simulation model of embedded system,a microprocessor- or microcontroller-based system of hardware and software designed to perform dedicated functions within a larger mechanical or electrical system,that can be used to detect voltage or frquency fluctuations over or under the acceptable range while synchronization and disconnects from grid, by doing so, it prevents from from power outage.

An electrical grid is an interconnected network for electricity delivery from producers to consumers. Grid consists of power stations, electrical substations , electric power transmission , electric power distribution. Synchronization means the minimization of difference in voltage, frequency and phase angle between the corresponding phases of the generator output and grid supply. An alternating current generator must be synchronized with the grid prior to connection. It can't deliver the power unless it is running at same frequency as the grid.

A synchronization failure can affect the healthy power system and results in electrical and mechanical transients that can damage the prime mover, generator, transformers and other power system components.so, we develop a model ,that detect synchronization failure based on two parameters: voltage and frequency , by detecting the transients in these parameter using the proposed model ,we can save the disturbance in power system due to synchronization failure.

II. DESIGN OF THE PROPSED SYSTEM

A. Software Requirement

1) *Keil MicroVision software:* Keil MicroVision is a free software which solves many of the pain points for an embedded program developer. This software is an integrated development environment (IDE), which integrated a text editor to write programs, a compiler and it will convert your source code to hex files too.
2) *Proteus Design Suite:* The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronic design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards.The micro-controller simulation in Proteus works by applying either a hex file or a debug file to the microcontroller part on the schematic. It is then co-simulated along with any analog and digital electronics connected to it. This enables its use in a broad spectrum of project prototyping in areas such as motor control,temperature control and user interface design. It also finds use in the general hobbyist community and, since no hardware is required, is convenient to use as a training or teaching tool.we design the model with reference to the following block diagram.

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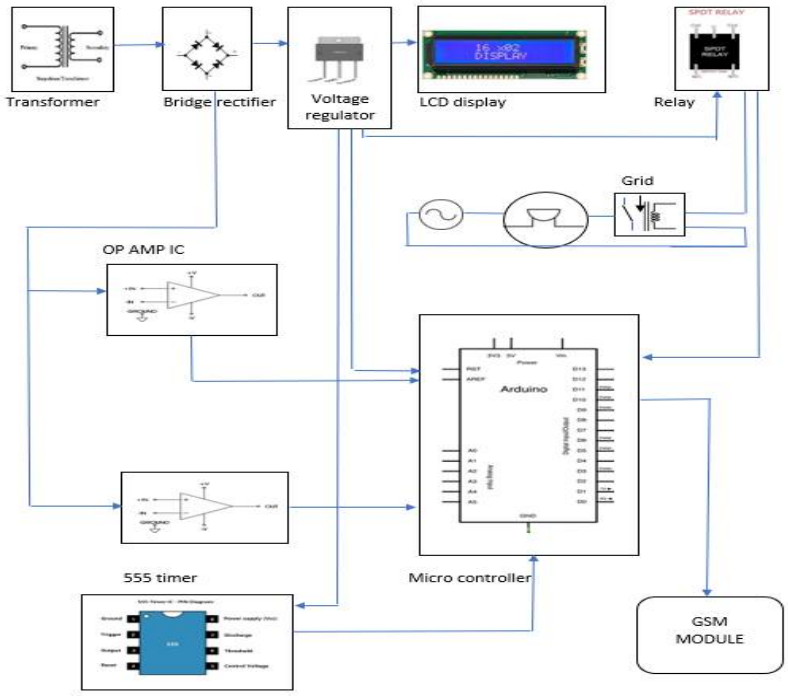

Fig1.block diagram

III.SIMULATION MODEL

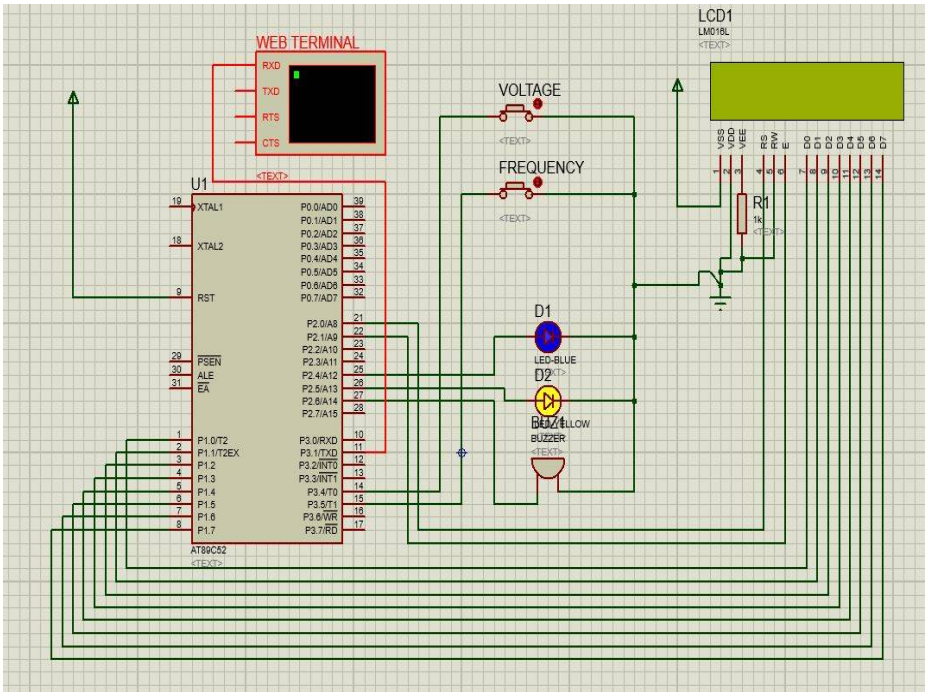

Fig.2 simulation circuit layout in proteus

In this Proteus software, the circuit is layed out as seen in the above figure.in keil microvision software, we write the code for microcontroller in c and save the file with c extension. Then in proteus software, we install that c extension file in microcontroller and run the program.

B. Components

1) *AT89S52:* The AT89S52 is a low-power, high-performance CMOS 8-bit microcontroller with 8K bytes of in-system programmable Flash memory.The AT89S52 provides the following standard features: 8K bytes of Flash, 256 bytes of RAM, 32 I/O lines, Watchdog timer, two data pointers, three 16-bit timer/counters, a six-vector two-level interrupt architecture, a full duplex serial port, on-chip oscillator, and clock circuitry.
2) *LCD:* To display interactive messages we're using LCD Module.The display consists of internal byte-wide registers, one for instructions (RS=zero) and the second for characters to be displayed (RS=1). It additionally includes a user-programmed RAM vicinity (the man or woman RAM) that may be programmed to generate any favored character that can be fashioned the usage of a dot matrix
3) *BUZZER:* A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or electronic. Typical uses of buzzers and beepers include alarms, timers and confirmation of user input such as a mouse click or keystroke.
4) *SPDT Relay:* A relay is an electrically operated switch used to isolate one electrical circuit from another. In its simplest form, a relay consists of a coil used as an electromagnet to open and close switch contacts. Since the two circuits are isolated from one another, a lower voltage circuit can be used to trip a relay, which will control a separate circuit that requires a higher voltage or amperage.A single pole double throw (SPDT) relay configuration switches one common pole to two other poles, flipping between them.A single pole double throw relay can be used to alternate which circuit a voltage or signal will be sent to.
5) *GSM:* A GSM modem or GSM module is a hardware device that uses GSM mobile telephone technology to provide a data link to a remote network. From the view of the mobile phone network, they are essentially identical to an ordinary mobile phone, including the need for a SIM to identify themselves to the network. GSM modems typically provide TTL-level serial interfaces to their host. They are usually used as part of an embedded system.

C. Microcontroller code

```
#include<reg51.h>
#define ldata P1
sbit rs=P2^0;
sbit en=P2^1;

sbit voltage=P3^4;
sbit frequency=P3^5;
sbit blue=P2^4;
sbit yellow=P2^5;
sbit buzzer=P2^6;
void lcdcmd(unsigned char ch);
void lcddata(unsigned char ch);
void lcd_str(unsigned char temp[]);
void delay(unsigned int t);
 unsigned int j;
  unsigned char rx;
void main()
{
        lcdcmd(0x01);
    lcdcmd(0x38);
        lcdcmd(0x0E);
          lcdcmd(0x80);
transmit("Detecting Power grid Synchronization failure on sensing frequency or voltage beyond acceptable range \r\n");

        lcd_str("POWER GRID CONTINs");
        lcdcmd(0xC0);
        lcd_str("Monitoring SYSTEM ");
```

```
        while(1)
        {

        if(voltage==1)
        {
        blue=0;
        lcdcmd(0x01);
         lcdcmd(0x80);
         lcd_str("High Voltage ");
         lcdcmd(0xC0);
         lcd_str("  Detected   ");
         transmit("Power Grid Monitoring .....High Voltage detected so power supply source switched off \r\n");
                  }
         else
         {
    blue=1;
          }
                  if(frequency==1)
        {
        yellow=0;
        lcdcmd(0x01);
         lcdcmd(0x80);
         lcd_str("High frequency ");
         lcdcmd(0xC0);
         lcd_str("  Detected   ");
         transmit("Power Grid Monitoring .....High frequency detected so power supply source switched off \r\n");
                  }
         else
         {
    yellow=1;
          }

}
}
void lcdcmd(unsigned char ch)
{
   ldata=ch;
        rs=0;
        en=1;
        delay(1);
        en=0;
}
void lcddata(unsigned char ch)
{
        ldata=ch;
        rs=1;
        en=1;
        delay(1);
        en=0;
}
```

```
void lcd_str(unsigned char temp[])
{
        unsigned int i;
        for(i=0;temp[i]!='\0';i++)
        {
                lcddata(temp[i]);
        }
}
void delay(unsigned int t)
{
        unsigned int i,j;
        for(i=0;i<t;i++)
        for(j=0;j<12750;j++);
}
```

IV. WORKING

The voltage and frequency are the two main things that we discuss in this paper. The frequency is to be maintained constant for any electric device or else due to the supply of high or low frequency to the electric device there are the chances that device gets damaged .Thus we need to avoid the changes in frequency values.

The voltage is another important factor that is to be kept constant in this . For every electronic device there will be having some voltage rating on it which is input voltage to be supplied to the device . If there is any change in supply voltage to device then the device gets damaged and thus we need to maintain voltage constant .This voltage and frequency are different for different countries .The country like USA use 100V and 60Hz but country like India use 240V and 50Hz. This change in value can be adjusted in program to use in different counties accordingly.

In this the power supply is given of 240V to the transformer .The transformer used here is Step down transformer .The transformer rating is of 12V .After step down of voltage the Bridge rectifier comes into play .The Bridge rectifier which has diodes in it .It converts the AC into DC.

The output of the bridge rectifier is given to the capacitor filter thus we can obtain pure DC power from the rectifier .The Microcontroller output is given to the LCD display of 16X2 or 20X2 but we use here only 16X2 type LCD display . There is also a Buzzer is used here which makes sound when there is a change in frequency or voltage occurred. The relay circuit is opened and the buzzer makes sound thus we can protect the damage occurance.

A 555 timer is connected in this and it runs in astable mode . The main purpose of this 555 timer is to change the frequency value .we cannot obtain varying frequency directly thus we use 555 timer here so that the variable frequency is obtained in this.The variable frequency is obtained by change in value of resistance and the change in capacitor value . This change in frequency is detected if it is not in the range of 46 to 54 Hz . When there is a frequency value above or below the given range thus the 555 timer output is given to the Microcontroller of pin 3.0 of port 3 of microcontroller. So that the microcontroller will get the change in frequency and gives the sense to relay and relay gonna operate and thus the buzzer makes sound and LCD gonna display that frequency is increased.

A VARIAC is also present in this to get variable voltage . This VARIAC is adjusted such in away that the input AC voltage more than the normal value. The high pin of OP AMP IC will go low and given interruption pulse to pin of Microcontroller thus the microcontroller sends high logic pulse to turn on the relay and the relay starts to turn on and makes the buzzer to make sound. This situation occurs when there is an high voltage occurred. We also add GSM modem to this model ,so,we will message notification in web terminal, whenever there is voltage or frequency beyond acceptable range

If there is the voltage is lower than the normal voltage than the low pin of OP AMP IC goes high and microcontroller gets the signal and sends a signal to the relay and thus the buzzer makes sound. We use two comparators here one of them is Inverting input and other is Non inverting input these comparators output is given to the Microcontroller of pin 0.1 and pin 0.2 of port 2 remain high for lower voltages and remain low for higher voltages occur.

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VI. SIMULATION RESULTS

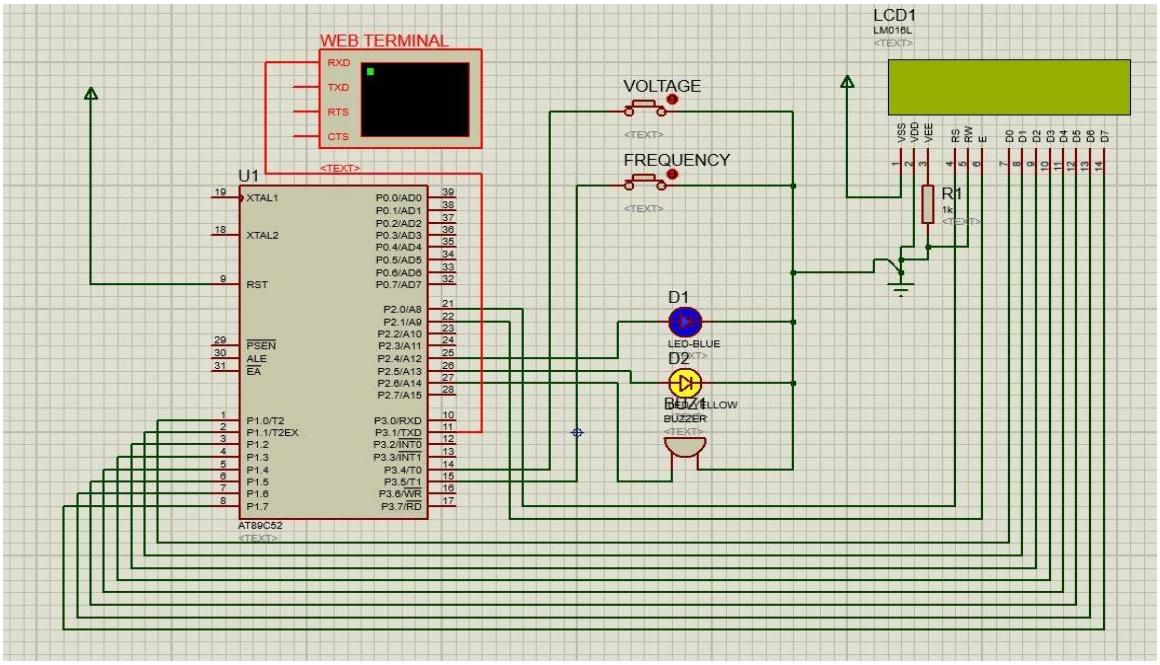

Fig.3 simulation circuit layout

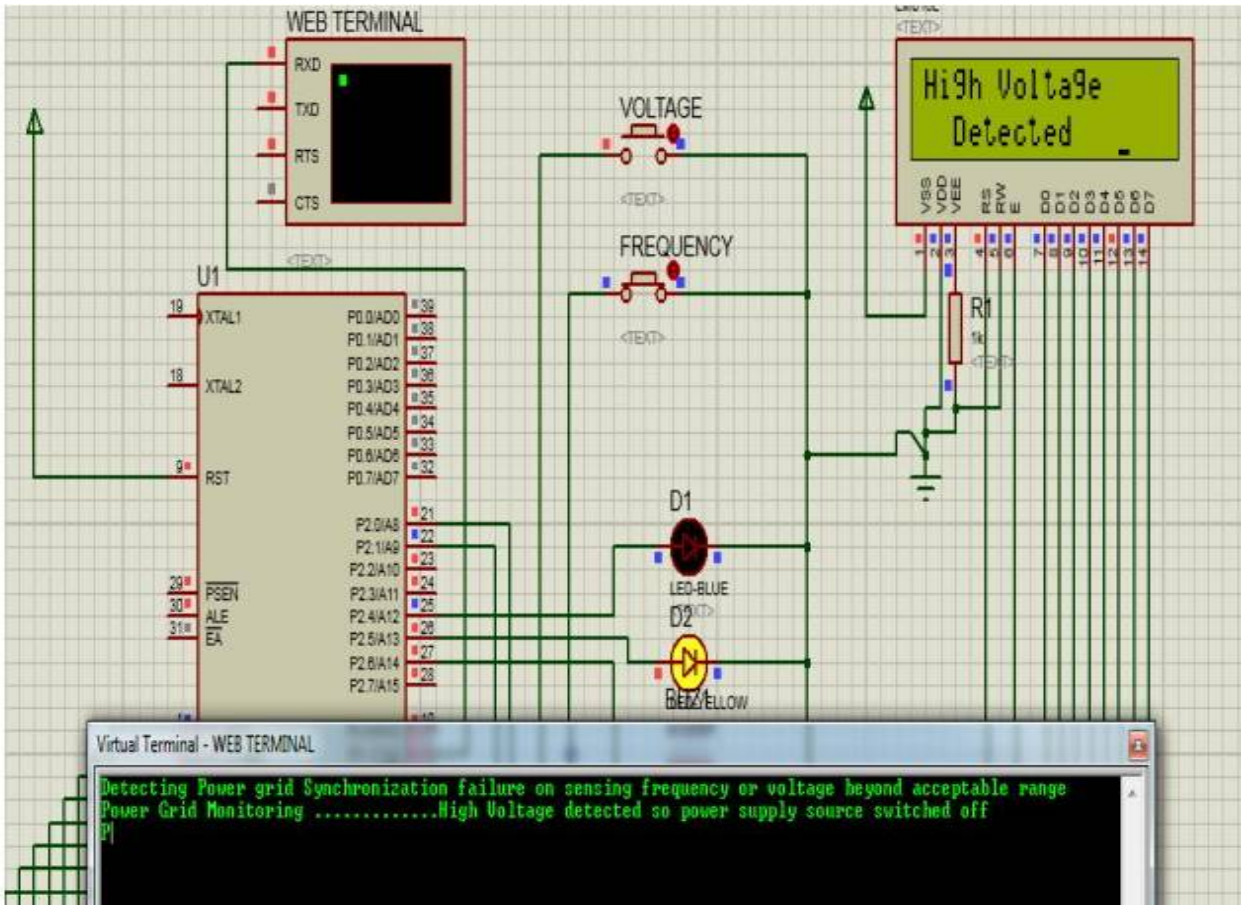

Fig.4 simulation output when voltage is beyond acceptable range.

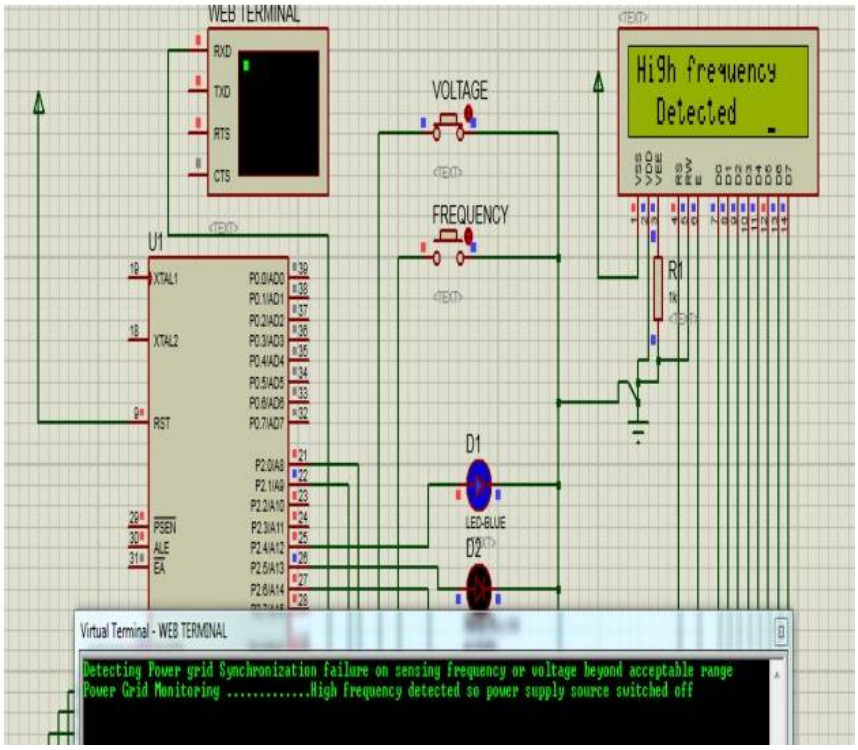

Fig.5 simulation output when frequency is beyond acceptable range.

V. CONCLUSIONS

By implementing this model in generating stations like solar plant etc. which has more fluctuations in frequency/voltage, we can detect the synchronization failure, prevent the effects of synchronization on the power distribution. With the use of GSM , the synchronization failure is also notified in web terminal. synchronization failure, which can cause power outage , can be prevented by using this model,as it is verified in simulation done in this project. We can also further ,modify microcontroller program to send voltage/frequency readings to web terminal , using this data and some additional parameters, machine learning algorithm can be obtained using this data , to predict synchronization failure.

VI. ACKNOWLEDGMENT

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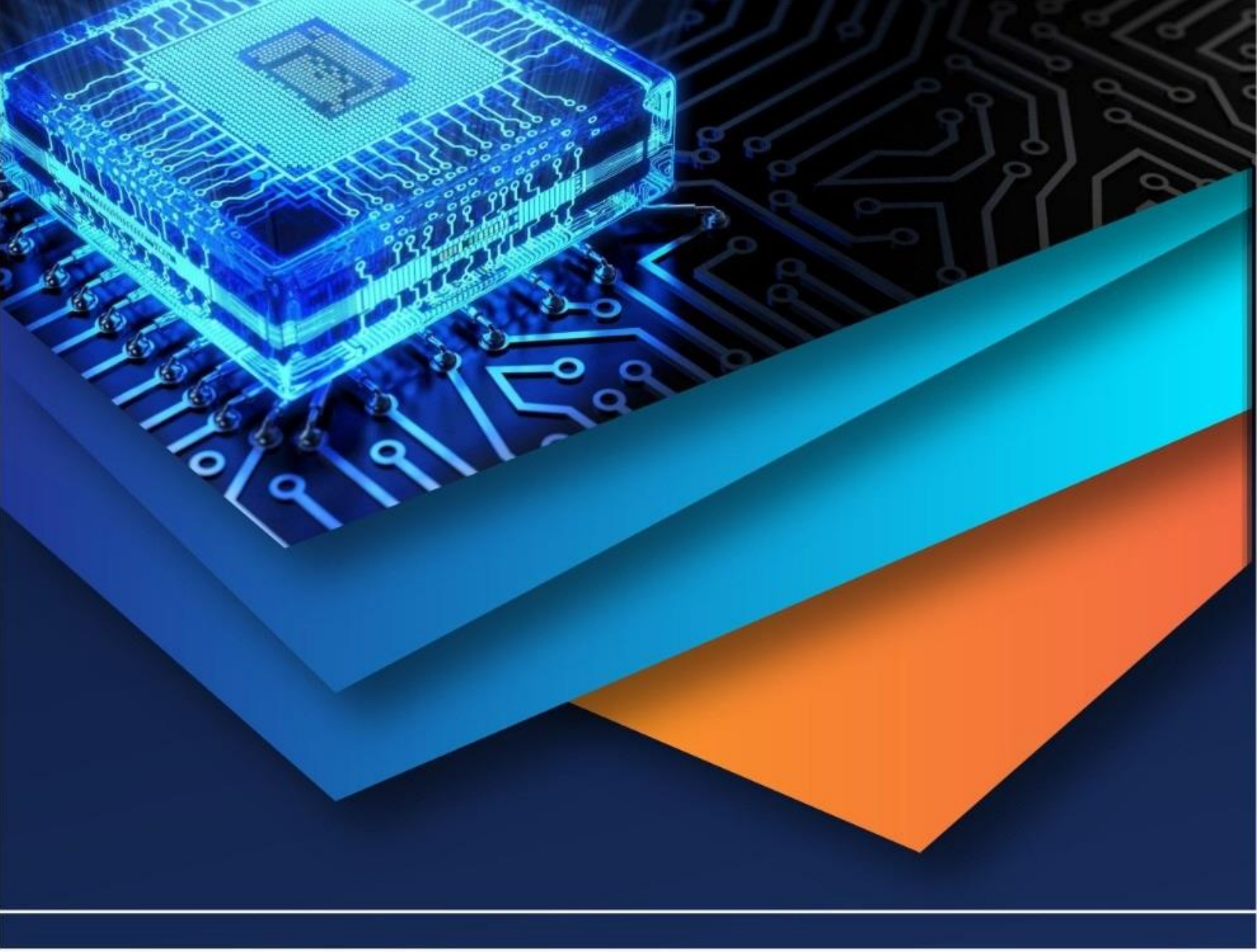

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