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A Review Paper on PV Plant Ambient Parameters Real Time Monitoring and Logging using Microcontroller

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Abstract: ***The project will measure different solar power plant parameters like light intensity, voltage, current, power, energy production and temperature by using multiple sensor data acquisition. The project uses a solar module to monitor sunlight and Arduino board which has At-mega family microcontroller attached to it. The project requires an LDR sensor for measuring light intensity, a voltage and current sensor (INA219) to measure voltage & current and a hybrid temperature and humidity sensor to measure the temperature and humidity. These measurements are then displayed by the microcontroller to an LCD screen. Thus, this system allows user to effectively monitor solar parameters using this system. In addition to this, one control circuit will be there which is useful in making series and parallel combination of solar modules to observe the difference in output.***

Index Terms: Arduino, current sensor, solar module

I. INTRODUCTION

Photovoltaic (PV) tracking is an important trouble as the world broadens its portfolio of energy alternatives to satisfy growing energy needs and increasingly more stringent environmental concerns; solar energy is emerging as an attractive option .Of all of the routes for conversion of solar into useful energy, direct conversion of sunlight to power through solar PV generation is nicely accepted. Solar PV has been diagnosed as a critical direction for generation of huge portions of energy by utilizing the light strength from solar radiation.[1] Solar Energy is inexhaustible and pollutants free electricity. Solar energy useful resource is the amount of sunlight to be had to the solar panels to generate electricity. Solar electric generation is growing very quickly; its international use is increasing hastily as expenses of other electric power sources rise. Today, PV is one of the fastest growing renewable electricity technologies and it is anticipated that it'll play a chief position in the destiny global energy generation. The photovoltaic is the direct conversion of sunlight to power. Light striking sun cells is transformed into electric electricity. This happens in keeping with a principle called the „photo-electric powered effect". Solar electric gadgets are also referred to as photovoltaic or PV devices. The generation has spread rapidly in the course of the arena for each on-grid and off-grid application. Millions of rural off-grid homes are using sun photovoltaic (PV) systems for the duration of the developed and developing world. The sun photovoltaic structures are installed in extraordinary rural areas. The systems (PV) also are situated in dusty, dry and challenging location.[2] produce photovoltaic cells [1]. A PV is basically a p-n semiconductor junction. When exposed to light, a DC current is generated. PV offers several advantages such as: high reliability, low maintenance cost, no environmental pollution, and absence of noise

The project will measure different solar power plant parameters like light intensity, voltage, modern-day, energy, strength manufacturing and temperature with the aid of using multiple sensor statistics acquisition. The undertaking uses a solar module to reveal sunlight and Arduino board which has AT mega own family microcontroller connected to it. The assignment requires an LDR sensor for measuring light intensity, a voltage and current sensor (INA219) to measure voltage & modern-day and a hybrid temperature and humidity sensor to measure the temperature and humidity. These measurements are then displayed through the microcontroller to an LCD screen. Thus, this system permits user to successfully reveal solar parameters the use of this system. In addition to this, one manipulates circuit might be there which is beneficial in making collection and parallel combination of solar modules to examine the difference in output.

A. Objective

The objective of this study is to increase a microcontroller-based totally PV monitoring device with easy-to-attain hardware ,bendy that meets the accuracy requirements mounted via the IEC61724 standard related to photovoltaic monitoring systems .This study uses set of electronic sensors that are interfaced with Atmega328 microcontroller with Arduino Board to get the PV system parameters (i.e. PV panel temperature, irradiance, PV battery voltage, temperature, humidness and cargo current) in real time and to show and store the parameters in personal computer.[1] The goal of this paper is to facilitate common tiny scale installations with additional economical and price effective and reliable observance system. Finally, a centralized observance of PV system conjointly reduces the value of system operation & maintenance.[2]

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II. LITERATURE REVIEW

Y.Y. Agawa, "Development of Microcontroller Based Monitoring System for PV System", Nigerian Journal of Technology, vol. 35, no. 4, pp. 904-911, Oct. 2016.

This paper is described different technologies and mechanisms for PV monitoring exists which depends on the availability of materials. Based on survey literature, the fundamental components associated with typical PV monitoring systems are:

A. Sensors
B. Controllers
C. Display

III. METHODOLOGY

A. Block Diagram

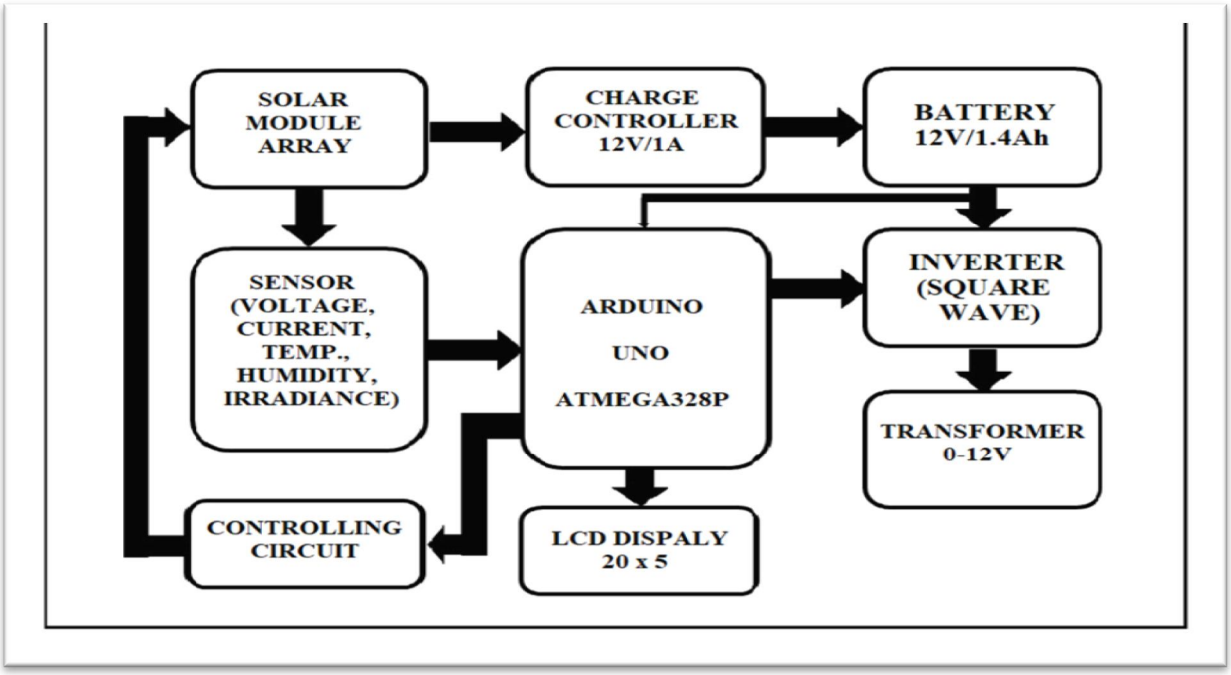

Fig.3.1 Block Diagram Representation

In the above diagram we can see that a no, of solar module are connected in the combination of series and parallel to attain the desired voltage and current values. 2 output are taken out from the solar module from which one is given to the Charge Controller and another is given to the different sensors such as voltage, current, temp., humidity, irradiance sensors. Charge controller is a device that prevents the battery from over-charging and also prevents the battery from discharging completely. The battery of 12V/1.4Ah is connected next to the charge controller which stores the dc power generated from the solar module array. The power stored in the battery is provided to the square wave inverter which converts the dc power to ac power. Here the output ac power is square in nature. This ac power is then stepped-up using a step-up transformer.

The sensors are provided operating supply through the solar module itself. The sensors provide real time information to the Arduino UNO At mega 328P where it is monitored, stored, and compared with the reference values provided. If the generated values exceed or drops below the reference values the Arduino sends a signal to the controlling circuit which acts as a feedback in the system. The controlling circuit then controls the generation of the solar module array. Hence the loop continues in the same manner.

B. Hardware Description

The monitoring system uses the AT Mega328P microcontroller with the sensors like current sensor, voltage sensor, temperature sensor, light sensor, humidity sensor, irradiance sensor with a power supply

1) *Controller:* Arduino uno is a microchip AT Mega 328P microcontroller and developed by Arduino. the board consist of the 14-digital input /output pins (into which 6 can be used for PWM o/p), 6 analog pins,16 MHZ crystal oscillator, USB connection, power jack and the reset switch.

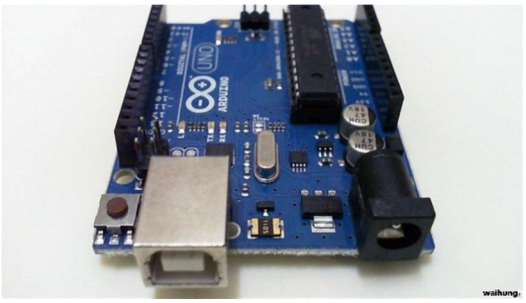

Fig.3.2.1 Pictorial View of Arduino UNO

2) *Sensors:* Sensors are the devices which detects the parameters from environment such as light, heat, temperature, pressure, moisture and any other form, and converts it into suitable form which human can be easily readable and useable.

a) Voltage sensor
b) Current sensor
c) Temperature sensor
d) Irradiance sensor
e) Humidity sensor

i) Voltage & Current Sensor: The INA219 is a current shunt and power monitor with an I²C- or SMBUS-compatible interface. The device monitors both shunt voltage drop and bus supply voltage, with programmable conversion times and filtering. A programmable calibration value, combined with an internal multiplier, enables direct readouts of current in amperes. An additional multiplying register calculates power in watts. The I²C- or SMBUS-compatible interface features 16 programmable addresses. The INA219 is out there in two grades: A and B. The B grade version has higher accuracy and better precision specifications. The INA219 senses across shunts on buses that can vary from 0 to 26 V. The device uses a single 3- to 5.5-V supply, drawing a maximum of 1 mA of supply current. The INA219 operates from –40°C to 125°C.

ii) Temperature Sensor & Humidity Sensor: The DHT11 may be a commonly used Temperature and humidity sensor. The sensor comes with a fanatical NTC to live temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is additionally factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So, if you are looking to measure in this range then this sensor might be the right choice for you. The DHT11 Sensor is factory calibrated and outputs serial data and hence it is highly easy to set it up. The connection diagram for this sensor is shown below.

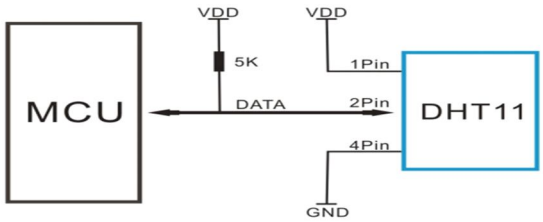

Fig 3.2.2 Working of Temperature Sensor

As you can see the data pin is connected to an I/O pin of the MCU and a 5K pull-up resistor is used. This data pin outputs the worth of both temperature and humidity as serial data. If you are trying to interface DHT11 with Arduino then there are ready-made libraries for it which will give you a quick start.

If you are trying to interface it with another MCU then the datasheet given below will are available handy. The output given out by the data pin will be in the order of 8bit humidity integer data + 8bit the Humidity decimal data +8bit temperature integer data + 8bit fractional temperature data +8bit parity bit. To request the DHT11 module to send these data the I/O pin has to be momentarily made low and then held high.

3) *LCD Display:* LCD display may be a flat panel display that uses the sunshine modulating properties of liquid crystals. liquid crystals cannot emit light directly, it uses a backlight or reflector to produce images in colors. It uses the interface IC like HD44780 is used, which is mounted on backside of LCD Module. the IC performs the operations like get the commands and data from controller and process them to display meaningful information on screen.
4) *RTC (Real Time Clock DS3231):* The DS3231 may be a low cost, highly accurate real time clock which may maintain hours, minutes, and seconds as well as day, month, and year information also. It has automatic compensation for leap years and for months with less than 31 days. The module can work on either 3.3 or 5 volt which is suitable with many development boards and microcontrollers. The battery voltage input is 3v and typical CR2032 (3volt) battery supplies power to the module. The module uses I2C Communication Protocol which makes the connection with the Arduino Board very easy. So, we used the 4 wires, the VCC and the GND pins provides power to the module and two I2C Communication pins such as SDA & SCL.

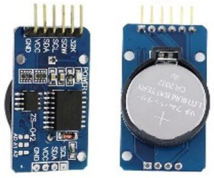

Fig. 3.2.3 Real Time Clock

5) *SD Card Reader Module:* The SD Card Module is a simply use to transfer the data to or from a standard SD Card. The pinout is directly compatible with Arduino, but also with other microcontrollers. It allows to add mass storage and data logging to the project. This module has a SPI interface which is compatible with any SD card. It uses 5V or 3.3 V power supply which is compatible with Arduino UNO.

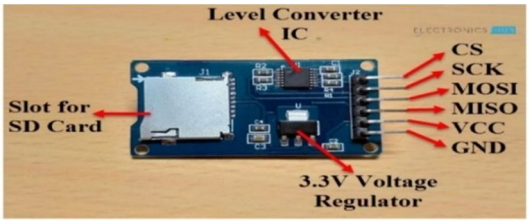

Fig.3.2.4 SD Card Reader

6) *Boost Converter – (XL4015):* The XL4015 is a 180 KHz fixed frequency PWM DC/DC Converter, having capability of driving a 5V load at a high frequency with the low ripple and excellent line and load regulation. It requires minimum number of external components; the regulator may be a simple to use and include internal frequency compensation and a hard and fast frequency oscillator. The PWM negative feedback circuit is in a position to regulate the duty ratio from 0 to 100%. The overcurrent protection function is built inside. When the short protection happens the operation frequency will be reduced from the 180KHz to 48 KHz.

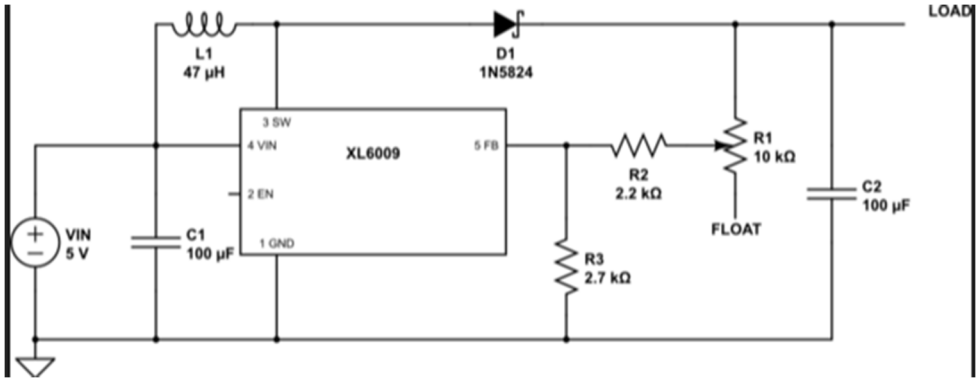

Fig 3.2.5 Boost Converter

C. Circuit Diagram

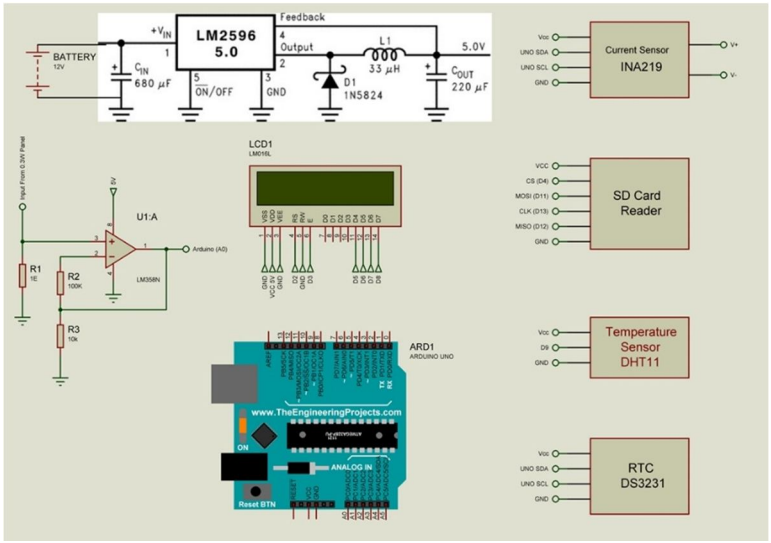

Fig.3.3.1 Circuit Diagram

1) Inverter Circuit

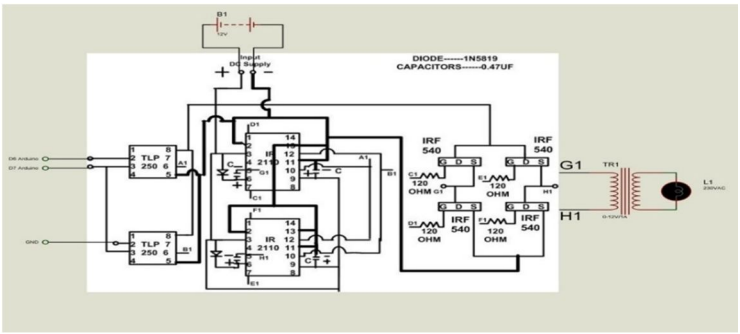

Fig.3.3.2 Connection Diagram of Inverter Circuitry

2) Circuit Description: Above is the circuit diagram of the pv plant ambient parameters real time monitoring and logging using microcontroller. The above circuit measures different quantities such as voltage, current, temperature, humidity, irradiance, it can also store the accumulated data into the SD card via SD card reader. One can also save the accumulated info to the cloud account online to get the results while being away from the plant. It can help to maintain the quality as well as it will also help in detecting the occurrence of abnormality in the system. The sensors are connected to the Arduino UNO. As the number of sensors in the system increases, we require multiple Arduino in the system. Here in this project we have used two Arduino UNO, both the Arduinos' and the sensors are provided supply through LM2596. As the generated power is unstable, the LM2596 circuit stepdown the voltage and maintain it at 5V as the sensors and Arduino works on 5V. As the sensors are connected to measure the voltage, current, temperature, humidity, irradiance of the system, all the information generated by the sensors is given to the Arduino. The data collected by the Arduino is verified with the reference data in the Arduino which is installed in the Arduino. There is a program installed in the Arduino for the uninterrupted service to the user. LCD display is provided for observer to observe the readings at the place where the system is installed. A liquid-crystal display (LCD) is a flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals. Liquid crystals do not emit light directly, instead using a backlight or reflector to produce images in colour or monochrome.

IV. CONCLUSION

A system measures the different parameters like as voltage, current, temperature, and humidity by using the INA 219 sensor and AT mega 328p. This flexibility makes the system more suitable for each intended application such as the monitoring of PV plants and the collection of data at remote locations in developing countries.

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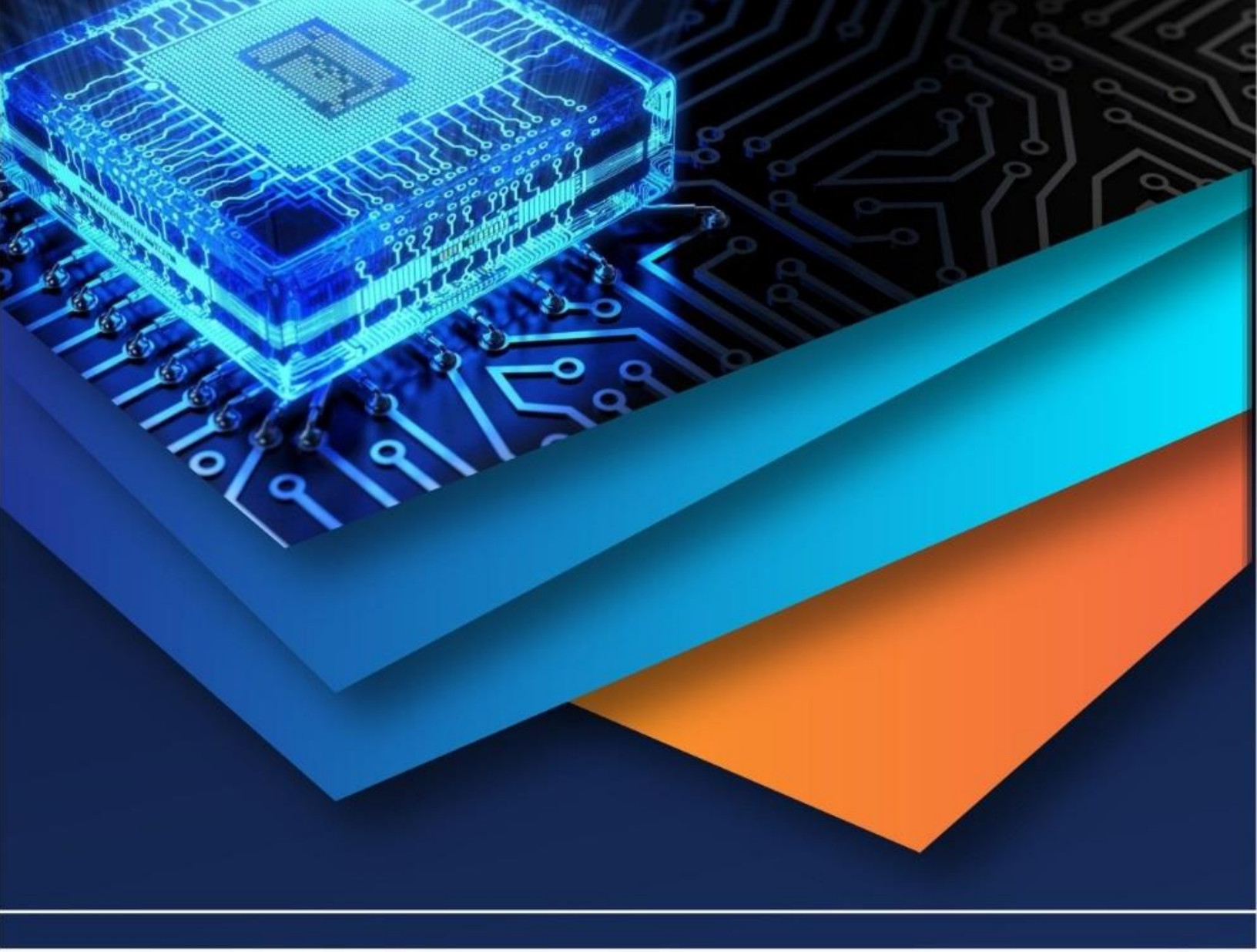

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