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# Greenhouse Monitoring Using IOT

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***Abstract:*** ***Agriculture plays vital role in the economic of developing country. This paper Proposes, monitoring and access control system for greenhouse by using IOT. Our Proposed system will check for certain common conditions, for instance such as moistness, soil condition, temperature, humidity, light intensity, Carbon monoxide detection and operate the water supply through phone itself. All the environmental instance information are send to cloud server using Wi-Fi module ESP32. If any climatic condition crosses certain specific threshold limit related action will be taken place like if the temperature becomes high the rooftop of the green house will be opened or the exhaust fan will be switch ON manually by the user and if the light intensity goes down the external light supply will be given to the plants. The microcontroller will turn ON the motor if the moisture content of soil doesn't meet the required condition. The sensors used in the proposed system are Resistive soil moisture sensor, DHT11 sensor, MQ9 sensor and LDR. The user can monitor and control parameters through mobile phone by using BLYNK app. This model was attempted in order to achieve the intelligent monitoring of greenhouse environment parameters like temperature, humidity, soil moisture etc., keeping the user continuously informed of the conditions inside the greenhouse using IOT technology.***

***Keywords: Greenhouse, Temperature, Humidity, Soil moisture, Light intensity, Esp32 Microcontroller and IOT.***

## I. INTRODUCTION

The atmospheric and other climatic condition plays a vital role for growth of the plants. Farmers cannot effectively detect the climatic conditions inside the green house. They are meant for predicting the condition inside the greenhouse manually and by sensing it themselves. Ultimately, experiences play a major role in their daily operations. If the condition is too dry, they will go in person to water the plants, but if it is too sultry, the owner will open the rooftop of the greenhouse setup, especially during the daylight. Most of the agricultural sector in the country is facing the low economical resource, but some of the greenhouse running in the low tech In order to achieve high yield of plants at minimal price, good quality and low environmental impact. It is necessary to have the effectiveness in greenhouse crop production, so many researches have been focusing on automated embedded wireless intelligent system using IOT. If wired networks were implemented for monitoring the crops, then cable is connected to the devices need to be rearranged for every crop where it is waste of money, man power and time. So it needs to be replaced by Internet of Things (IOT) because as it provides a new method for accessing and monitoring the farmland Information. By using Internet of Things (IOT), the user can monitor greenhouse which involves refrigeration, ventilation, heating, cooling etc. This greenhouse monitoring system using IOT can be controlled from anywhere by focusing on the environmental parameters such as temperature and humidity. An individual person can automatically monitor the environmental parameters of greenhouse. Automation plays a major role for doing the things automatically by reducing the tasks of going in person for switching ON or turning OFF the switch. Automatic greenhouse setup will not hundred percent remove or reduces the human mistakes but it helps to cut back on mistake to some certain levels. In the demand of today's world that everything should be automated.

We got the knowledge of IOT concept in the field of Green House and we understood how we can monitor the greenhouse setup using IOT[1]. From this [2] proposed paper we carried out the idea of how the temperature and Humidity can be read and sensed. From this [3] paper we got the concept of how the temperature and Humidity can be read and sensed using DHT11 sensor. We came to know why it is better than DHT22. The drawback of the paper is they used DHT22 which can give the data for every 2 seconds whereas in our proposed system we have used DHT11 sensor which give the data for every 1 second. From [4][5][6] the knowledge of Resistive Sensor and how it works and can be used is grabbed. And also why it is better than capacitive soil moisture sensor is explained here. From [7] we got an idea of light intensity parameter. The proposed system have sensors which continuously reads data from the greenhouse setup and reports it to gateway node, then it is been examined and filtered .Here we use Wi-Fi module ESP32 that plays an essential role in sending the information to BLYNK APP. This gateways are utilized to transmit the data to standalone webserver.

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## II. HARDWARE COMPONENTS USED TO IMPLEMENT THE SYSTEM

### *A. ESP32*

The ESP32 is a microcontroller which is used in our proposed system in order to achieve the purpose of Wi-Fi module. It is also called as Wireless Fidelity (Wi-Fi) module. It is cost effective & power consumption is less on a chip microcontroller and it is also integrated with dual-mode Bluetooth &Wi-Fi. We are using ESP32 microcontroller, because we can add more number of sensors and the capacity is also much more than other microcontroller. And also there are three ways by which we can power this microcontroller. One is by using USB port, other is by supplying 3.3V and the next one is by supplying 5V power to the ESP32 microcontroller. In this project all the sensors will be connected to ESP32 Controller.

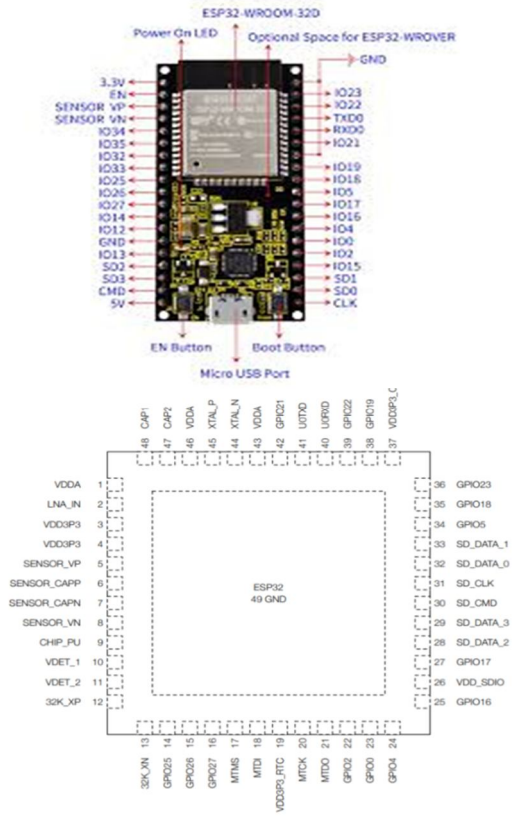


FIG.1.ESP32 Microcontroller

### *B. Soil Moisture Sensor*

We are using resistive type soil moisture sensor. This resistive type sensor will contain two split-shaped probe which contains two exposed conductors, and this will behave as a variable resistor. When we insert probe in the soil, the resistance will vary according to the water content in the soil. Before we start storing the data, we should first check what readings we are actually getting from the sensor. Based on these values, we can define the ranges to determine the status of the soil. (i.e.) If the soil range is less than 500 (<500) the soil is too wet. If the soil range is between 500-750 that will be the target range. If the soil range is above 750 (>750) the soil is dry and it has to be watered.

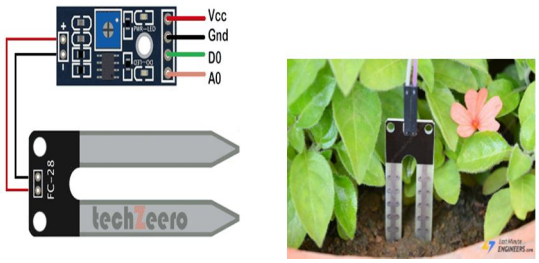


FIG.2. Soil moisture sensor

*C. MQ9 Carbon Monoxide Sensor*

In our proposed system we have used MQ9 sensor for sensing CO and other combustible gases**.** Sensitive material of MQ9 gas sensor is Tin dioxide, with lower conductivity in clean air. The sensor will sense in both high & low temperature, also detects Carbon Monoxide at low temperature. Whenever the sensor's conductivity reaches higher, along with that gas concentration also rises. At high temperature, it senses Propane, Methane & other combustible gases. It is cost effective and used in many fields.

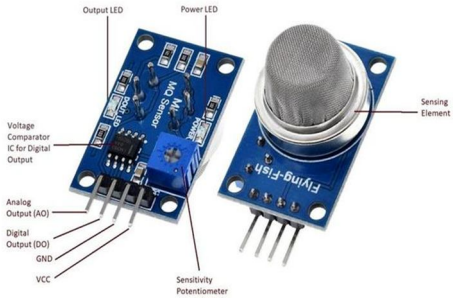


FIG.3. MQ9 Sensor

*D. LDR (Light Dependent Resistor) Sensor*

In our proposed system we have used the LDR for the main purpose to get the data of Light intensity which is required for plants. LDR sensor is passive device which converts light energy into electrical signal, in both analog and digital output pin. Where the snake like track is cadmium sulphide film. LDR is a light dependent device in which the resistance will decrease when light falls on it and vice-versa. It consists a potentiometer knob which is used to adjust the sensitivity of LDR towards light. LDR works on the principle of photo conductivity. When photon strikes the device, the electron in valence band of the semiconductor will be excited to conduction band. The photons present in the incident light should have greater potential than the band gap, to make electrons jump from valence band to conduction band.

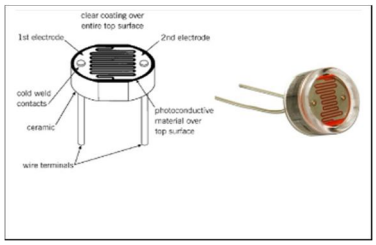


FIG.4.LDR SENSOR

*E. Submersible DC Water Pump*

The Water pump used in our system is submersible DC motor. Which is used in Gardens for water circulation. It is cost effective, small size and can be operated between (3 ~ 6V) power supply. It can take up to 120 liters per hour with very low current of 130~220mA. It has two pipe which is connected to outlets of the motor, where one end is submerged in water tank and other end is used to water the plants. The water level should be higher than the motor, because dry run may damage the motor due to heating, it will produce noise.

The main advantage of using DC over AC water pump is that it can be operated by using battery which makes it more convenient & portable.

FIG.5.Submersible DC Water Pump

### *F. DHT11 Sensor*

We have used DHT11 because it is a cost effective sensor used for sensing temperature and humidity. It can be easily linked with any microcontroller like arduino, raspberry pi etc.., to measure humidity and temperature instantaneously. The DHT11 sensor module has 3 pins Vcc (3~5v), Data Pin (O/p of temp and humid) and GND.This sensor combines of three components in it, respectively humidity sensing component, NTC temperature or Thermistor and 8 Bit Microcontroller for communication purpose. There are two different DHT sensor namely, DHT11 and DHT22.Here in this proposed system we use DHT11 over DHT22 because of its sampling rate and it is cost effective.

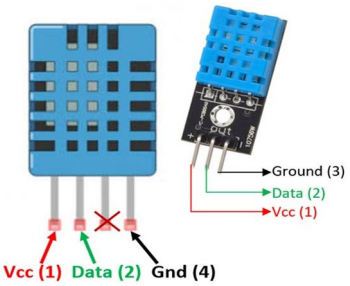


FIG.6. DHT11 SENSOR

## III. SOFTWARE USED TO IMPLEMENT THE SYSTEM

### *A. Arduino IDE*

We have used Arduino software in our proposed system which is used for the coding purpose and execute the code. This Arduino IDE can be used by ESP32, ESP8266 and etc. types of boards. It is not only for Arduino board usage. It can be operated or worked in any platform like Windows, MAC and Linux. In Arduino IDE we can code in C and C++ coding languages. We need to type our code in the sketch field and we can upload code in the respected board (in our proposed system it is ESP32).

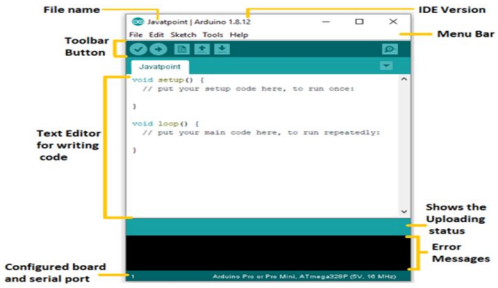


FIG.7.ARDUINO IDE

### *B. BLYNK APP*

BLYNK app is a smartphone application which can be installed and used in both Android and IOS phones. In our proposed system the BLYNK app is used in the feature of access controlling. The BLYNK is downloaded in our respective phone and the gauges like temperature reading, Humidity read, Carbon monoxide reading, Soil moisture Reading and Intensity light reading is added with the notification panel and a switch for motor operating. And also there are widgets present in our BLYNK app which is used for the pin controlling and for displaying the outputs.

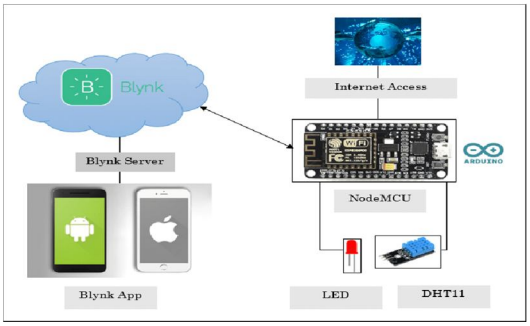


FIG.8. BLYNK APP

*C. Flow Chart*

The flow chart of the system is shown and explained from the below figure. All the sensors are given with the supply power of +5V whereas the MQ9 is provided with +3.3V. The sensors namely DHT11, MQ9, Soil moisture and LDR Sensors are connected to the ESP32 microcontroller, then the sensors will detect the environmental changes according to their specific characteristics and send the information in analog format to the ESP32. Firstly the DHT11 sensor will sense the temperature and humid of the surrounding, followed by the soil moisture sensor which detects the moisture content of the soil and sends it to ESP32. Similarly the LDR does the work of sensing the light intensity.

Based on the soil moisture reading, if the soil is wet then the motor (DC Submersible Motor) will turn OFF at the same time if the soil is dry it is requested to turn ON the motor. Further coming forward the carbon monoxide sensor i.e. MQ9 senses the combustible and other toxic gases and send it to ESP32.

All the information is sent to the server and uploaded. The output can be seen in the serial monitor and simultaneously through BLYNK APP. When temperature exceeds the threshold level the farmer is notified through the APP, so that he can switch on the exhaust fan manually or he opens the roof top of greenhouse to maintain the suitable temperature. When the soil becomes dry turn ON the water pump

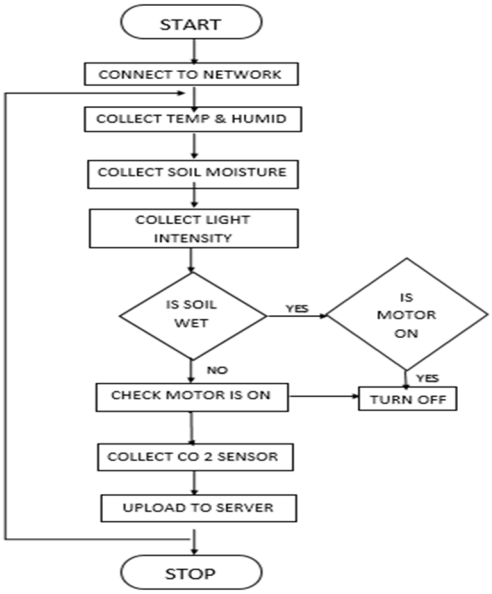


FIG.9. Flow Chart Representation

Through his phone which is linked with the BLYNK APP. The analog output from sensors are given to the ESP32 Microcontroller, where the analog form are converted to Human readable language. At the end the process is stopped if all are set perfectly.

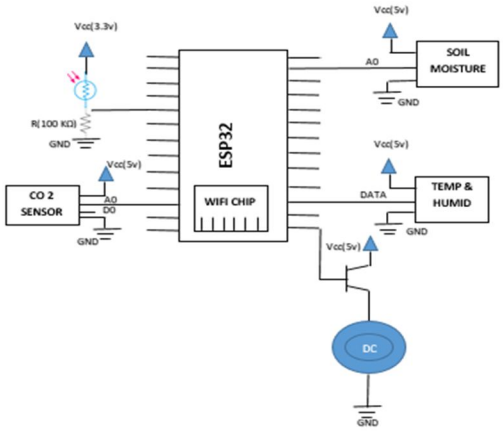


FIG.10. Circuit Diagram

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## IV. METHODOLOGY

The methodology of the project implementation is to design and develop a "Green House Monitoring Using IOT" based on soil moisture, light intensity (LDR), MQ9, DHT11 temperature and humidity sensors, and ESP32 microcontroller. All these sensors will be connected to the ESP32 microcontroller and it will process the data further it is upload to the web server to give the output in BLYNK APP. And necessary actions will be taken based on the output that is provided by BLYNK APP.

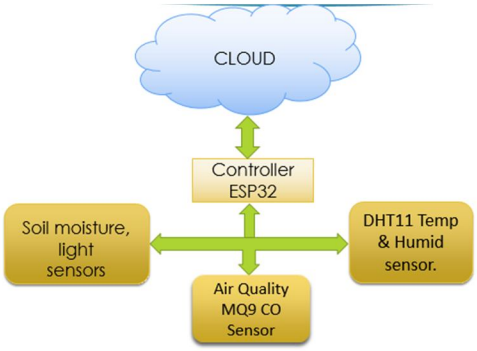


FIG.11. Block Diagram

Firstly download the BYLNK APP. it will ask us to login with our mail id and password. Later we should create a project with our project name. Then select the board of your convenient, in our proposed system we have used ESP32 Board. As soon as the project is created with suitable board we get a mail with an authentication token that is used in our project for the access control purpose. The soil moisture sensor probe is inserted in the soil through which the soil moisture level is detected and sent to the ESP32 controller through the analog and digital output pins.

DHT11 Sensor senses the Temperature and Humidity of the surrounding in the analog form, Similarly LDR senses the light changes in the surrounding and the MQ9 CO sensor senses the carbon monoxide gas in the surrounding .Finally all the analog output from sensors are given to the ESP32 Microcontroller, where the analog form are converted to Human readable Language. The water pump is controlled through the switch were we can ON and OFF the motor. One outlet of the motor is connected to a pipe which will be inserted inside a water tank whereas the other outlet is connected to pipe and that pipe is inserted inside the soil (The water pump itself can be inserted inside the soil).When the motor is turned ON in the BLYNK app the water is pumped to the soil, based on the soil moisture level we can turn OFF the motor through the BLYNK APP.

## V. RESULT AND CONCLUSION

Basically the output or the Result will be viewed in the Serial Monitor and in the BLYNK APP. In the serial monitor we get a message of saying the current status

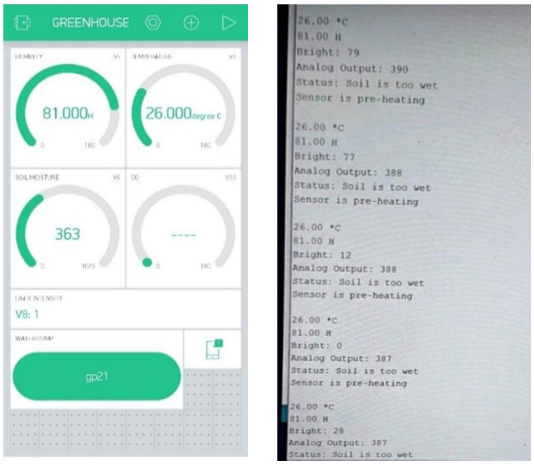


FIG.12. BLYNK APP and Serial monitor output

of the soil moisture like if the soil moisture is dry then we get a message saying the "The soil is too dry- time to water", if the soil moisture is correct means we get a message saying "The soil moisture is perfect" and Finally if the soil becomes wet We get a message saying the "The soil is too wet". The soil moisture Value will get displayed in analog output parameter in serial monitor whereas in BLYNK App in form ranging in the Gauge name soil moisture. If the range is less than 500 means the soil is too wet, if it is between 500 and 750 means the soil is perfect and finally if more than 750 means the soil is dry. The temperature and Humidity reading also we get where the temperature in the degree Celsius unit and Humidity in relative Humidity unit (H).Carbon monoxide reading we get where if the value of the voltage is zero means the sensor is not working properly at same time if the value is less than 0.4 means the sensor is preheating and NO toxin gas like Carbon monoxide is detected in our surrounding. The light intensity value will increase if we supply any external light like torch light. And in the serial monitor it is represented as BRIGHT and in BLYNK app as light intensity. DC water pump will be controlled by using the ON and OFF switch of the BLYNK APP which is connected to GPIO21 Digital pin of BLYNK app.

## VI. FUTURE SCOPE

This proposed system helps in monitoring the weather conditions that are favorable for the growth of a particular plant. By using this proposed system, the growth of the crops can be improved along with their yield, irrespective of the climatic conditions. The proposed system has a great scope in the agricultural platform. The features which are added in this project like temperature monitoring & sensing can be used in various applications like conference room, smart home etc.., In order to know the temperature of the room. This proposed system can be used in the field of greenhouses, botanical gardens and agriculture farms. And also by adding additional features & modifications, the product can be utilized by many Mechanical Companies to monitor & control various parameters.

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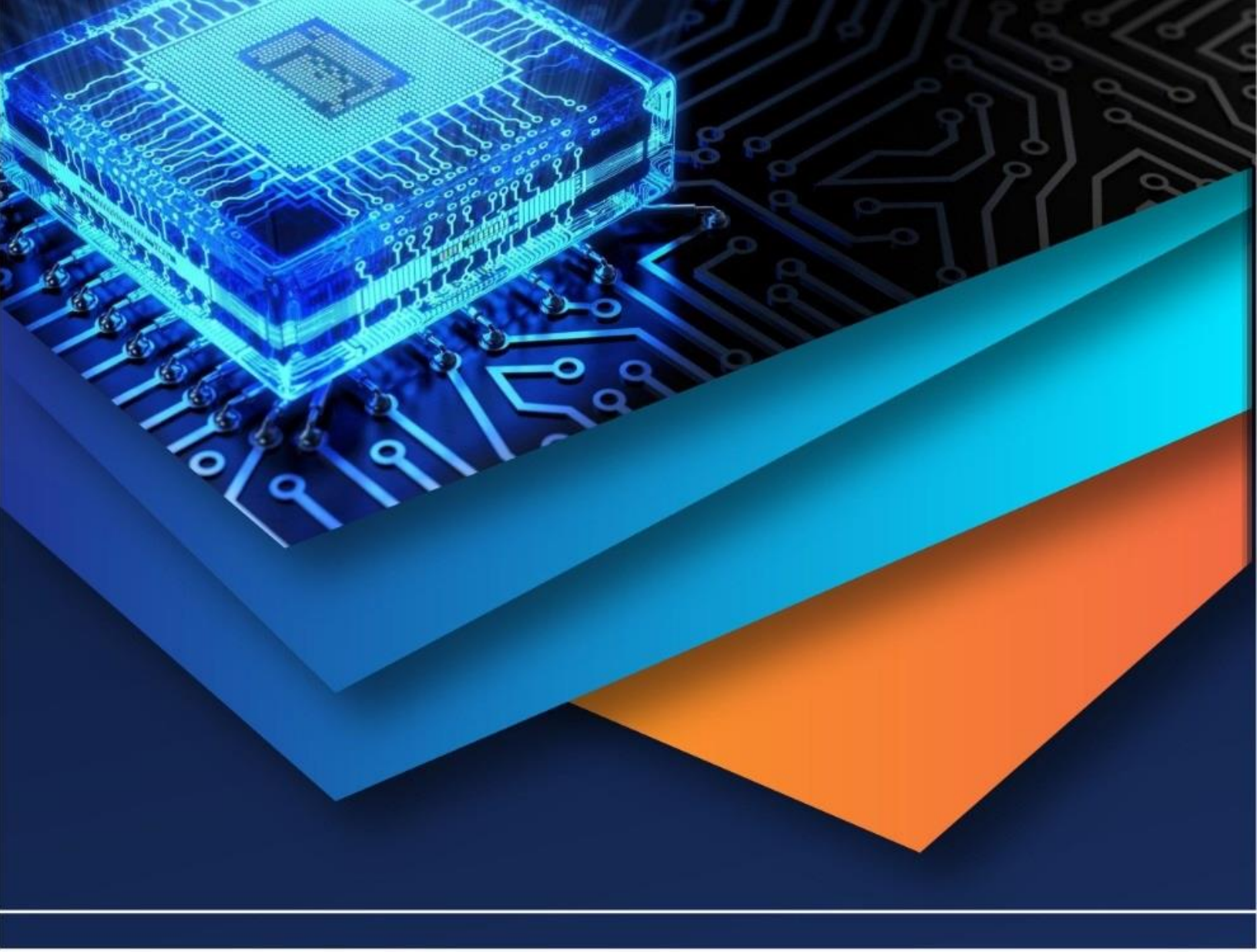

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