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An Agro Advisory for Pomegranate Field using Wireless Sensor Network

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Abstract: Modern agricultural techniques and systems are needed to detect and prevent the crops from being affected by different diseases. Agriculture environment is dynamic entity and changing continuously. Ground water depletion, soil erosion, attack of new pest and diseases, fragmentation of land, rural-urban migration and power supply availability for farming are some of the new challenges presently being encountered in the agricultural sector. In the field conditions at the farm in terms of Temperature, Soil Moisture, Humidity and Water level are acquired with the help of corresponding sensors and the real time values of the parameters is stored on the cloud. The Values of the parameters is communicated to the cloud with the help of NodeMCU Microcontroller Unit which is the heart of the system which acts as a gateway between field and the Internet. This system helps the farmer in accessing the field parameters on the go. Thus promotes smart Agriculture.
Keywords: NodeMcu, Sensors, Temperature, Humidity, Soil, Water level parameters.

I. INTRODUCTION

India is leading country for pomegranate production. In last decade, there is sizable growth in area and production. Pomegranate exportation from country has increased by 3-5 times in this period. It can be taken under varied conditions of country but better in arid and semi-arid regions. Also it is one of the fruit crops taken in semi-arid and arid regions of world.

Crop losses for pomegranate due to diseases and pests are quite normal in case of semi-arid region conditions. Bacterial blight, thrips, fruit borer and wilt in pomegranate are considered powerful attacks leading to economical loss and force farmers to repetitive sprays. As these issues exist there is a need to take corrective actions to combat them. So with the help of sensors such as Temperature, Humidity, Soil Moisture and Water will give necessary inputs to farmer so that he can take actions.

To mitigate the adverse climate changes and environmental conditions precise irrigation, effective use of fertilizers and nutrient management is required. It also prevents the crops from any type of diseases. To make it possible farmer should know the field conditions in terms of Temperature, Soil Moisture, Humidity and Water level. The field conditions can be acquired with the help of sensors and it enables to take corrective actions as and when necessary.

In order to have smart agriculture various new technologies such as IOT can be implemented and the data can be transported to the end points for the analysis. It also includes energy efficient way to develop a smart system for Agriculture.

The Wireless Sensor Network will provide a gateway to convey the sensor information to farmer over internet and real time monitoring of the field conditions is possible. With the help of NodeMCU, low cost and efficient system can be developed.

II. LITERATURE SURVEY

K. Jyostsna Vanaja, et.al [1] presents the smart agriculture using IOT has been to work monitoring the values of humidity and temperature successfully. It also stores the sensor parameters in the timely manner which controls the electronic devices using a smart phone. It also offers an efficient use of energy. It is used in all areas of industry, smart building environmental monitoring, including smart agriculture, healthcare transportation, smart parking, , and many more.

Deepika G et.al [3] says the Wireless Sensor Networks (WSNs) consist of multiple unassisted embedded devices. This processes the transmitted data and collected from different on-board physical sensors such as Temperature Humidity and Pressure. This technology utilization would be allowed for the remote measurement of factors such as plant growth condition including temperature, humidity, atmospheric pressure, soil moisture, water level. The wireless system also improves the crop productivity.

Tamoghna Ojha et.al [5] suggests the current state-of-the-art in WSNs and their applicability in agricultural and farming applications. These are analyzed with respect to communication and networking technologies, standards, and hardware. The microcontroller provides few advantages such as low cost, flexibility to communicate with other nodes, ease of programming, and low power consumption over the traditional processors.

K. S. V. Grace, et.al [6] presents the automated system to make effective utilization of water resources for agriculture and crop growth monitoring using GSM. The effective utilization of drip water resources process is improved by using the signals obtained from soil moisture sensor. The microcontroller is coordinated by the output signals of the sensors and transmitted to the user with the help of GSM Modem.

H. Chang, N. Zhou, et.al [10] present a new agriculture monitoring system based on WSNs (Wireless sensor networks) with IP cameras, which can be controlled remotely to have close vision of plants. WSNs can deploy freely, collect sensor data periodically to the control centre, process and store historical data, which could facilitate clients and experts in agriculture to monitor the conditions in a large field.

B. B. Bhanu et.al [12] claim that the continuous monitoring of many environmental parameters such as temperature, humidity and carbon dioxide can help in analyzing the optimal environmental conditions to achieve more crop productiveness, for the high productivity and to achieve remarkable energy savings.

Akshay, N. Karnwal, et.al [13] propose that the system basically comprises of CPU for monitoring the data in LABVIEW platform and Zigbee module along with PIC microcontroller to establish wireless communication between two distant locations. This purpose of the work is to sense the monitor and control the temperature, humidity and irrigation in the greenhouse from remote location using the Zigbee technology at low cost.

III.PROBLEM STETEMENT

It is essential to know the real time environmental conditions in terms of Temperature, Soil Moisture, Humidity and Water level. So with the help of sensors this data can be communicated over Internet taking help of energy efficient and low coat system such as NodeMCU.

When farm is dry without human presence and avoiding water wastage in irrigation process. Also monitor the soil parameters like temperature, humidity and soil moisture level. It will also be possible to control various operations of the field remotely from anywhere, anytime by mobile.

IV.METHODOLOGY

NodeMCU is an open source IoT platform. it includes firmware which runs on the ESP8266 Wi-Fi Serial Wireless Module from Expressive Systems, and hardware which is based on the ESP-12 module.

The programming code is being written for ESP8266 Wi-Fi chip using Arduino IDE, for which installation of ESP8266 library is required. Wireless Sensor Network field on sensor nodes are directly communicating with Node MCU (Microcontroller Unit) which is also placed near to application field. Real time temperature, relative humidity, amount of irrigation and soil moisture will be sensed by on field sensor nodes. Sensed data will be sent to the Node MCU which does the task of receiving data.

NodeMCU Microcontroller Unit collects the data from four different sensors and it analyzes the data. Each sensor node having number of sensors which do the task of sensing the environment as temperature, relative humidity, amount of irrigation and soil moisture. Power supply can be provided to the node by using battery. Also sensor node communicates with NodeMCU (Microcontroller Unit) to transmit the data.

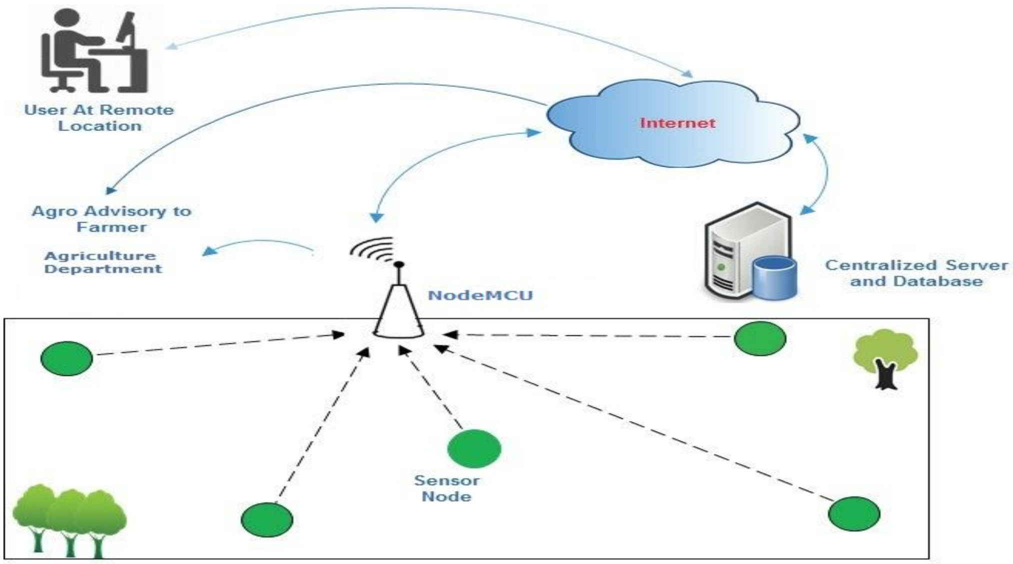

Fig1: System Architecture

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Fig. 1 shows that we applied single-tier architecture for Wireless Sensor Network on field sensor nodes are directly communicating with Node MCU which is also placed near to application field. Real time temperature, relative humidity, amount of irrigation and soil moisture will be sensed by on field sensor nodes. Sensed data will be sent to the Node MCU. Which does the task of receiving data and forwarding it to the remote centralized server (Thingspeak) by using communication medium (Internet).

Cloud application which is deployed on server can be accessed by user from remote location. Different algorithms are stored on server which will be executed automatically when required conditions are satisfied.

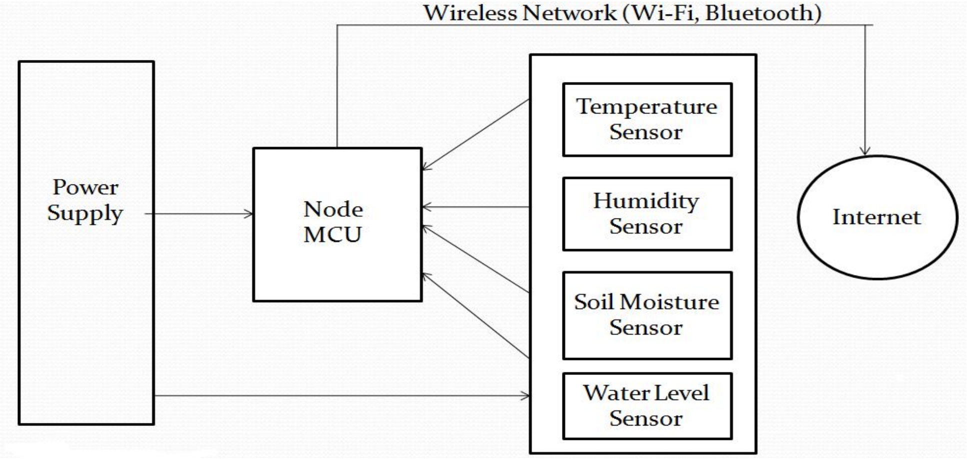


Fig2: Block Diagram of System

As shown in fig2 NodeMCU Microcontroller Unit collects the data from four different sensors and analyze it and takes necessary actions to pass it on to the cloud so that the end user can monitor the parameters remotely.

Each sensor node having number of sensors which do the task of sensing the environment as temperature, relative humidity, amount of irrigation and soil moisture. Power supply can be provided to the node by using battery. Also sensor node communicates with NodeMCU to transmit the data.

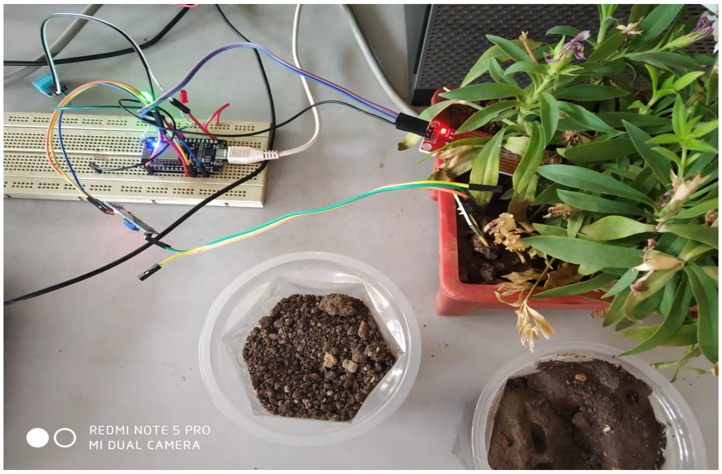


Fig3: Experimental setup

The setup includes NodeMCU and Sensors connected to it. Various types of soil are tested with the help of soil moisture sensor. Water depth level sensor and Temperature Humidity sensor are attached to NodeMCU to detect the field conditions.

A. Advantages

1) We can check the field conditions on the cell phone with internet connectivity.
2) Precise irrigation to the crops is possible.
3) Corrective actions can be taken as per the requirement.
4) System design is simple and the overall cost of the system is low.

V. EXPERIMENTAL RESULTS

In this project we can control the field parameters based on humidity, temperature and Soil moisture level. The Moisture level of soil, Temperature & Humidity, Water Depth level are measured or sensed by the sensors.

```
17:03:26.085 -> scandone
17:03:26.085 -> no Redmi found, reconnect after 1s
17:03:26.188 -> reconnect
17:03:26.495 -> MOISTURE LEVEL : 44
17:03:26.529 -> Moisture Level is High; SOIL IS WET
17:03:27.481 -> MOISTURE LEVEL : 44
17:03:27.516 -> Moisture Level is High; SOIL IS WET
17:03:28.494 -> MOISTURE LEVEL : 44
17:03:28.528 -> Moisture Level is High; SOIL IS WET
17:03:29.031 -> scandone
17:03:29.031 -> no Redmi found, reconnect after 1s
17:03:29.131 -> reconnect
17:03:29.502 -> MOISTURE LEVEL : 44
17:03:29.502 -> Moisture Level is High; SOIL IS WET
17:03:30.479 -> MOISTURE LEVEL : 44
17:03:30.512 -> Moisture Level is High; SOIL IS WET
17:03:31.508 -> MOISTURE LEVEL : 44
17:03:31.508 -> Moisture Level is High; SOIL IS WET
17:03:31.977 -> scandone
17:03:31.977 -> no Redmi found, reconnect after 1s
17:03:32.071 -> reconnect
17:03:32.493 -> MOISTURE LEVEL : 44
17:03:32.539 -> Moisture Level is High; SOIL IS WET
17:03:33.477 -> MOISTURE LEVEL : 44
17:03:33.524 -> Moisture Level is High; SOIL IS WET
17:03:34.492 -> MOISTURE LEVEL : 44
17:03:34.526 -> Moisture Level is High; SOIL IS WET
```

Values of Soil Moisture printed on Serial Monitor of NodeMCU IDE

Threshold for wet =<50
Threshold for Dry =>50

Value of Moisture Level	Type of Soil
44	WET
48	WET
56	DRY
34	WET
65	DRY
102	DRY

```
13:38:43.878 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:38:45.531 -> scandone
13:38:45.531 -> no Redmi found, reconnect after 1s
13:38:45.633 -> reconnect
13:38:46.912 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:38:48.461 -> scandone
13:38:48.495 -> no Redmi found, reconnect after 1s
13:38:48.562 -> reconnect
13:38:49.941 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:38:51.425 -> scandone
13:38:51.425 -> no Redmi found, reconnect after 1s
13:38:51.525 -> reconnect
13:38:52.938 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:38:54.351 -> scandone
13:38:54.385 -> no Redmi found, reconnect after 1s
13:38:54.452 -> reconnect
13:38:55.973 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:38:57.323 -> scandone
13:38:57.323 -> no Redmi found, reconnect after 1s
13:38:57.425 -> reconnect
13:38:59.009 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
13:39:00.257 -> scandone
13:39:00.290 -> no Redmi found, reconnect after 1s
13:39:00.357 -> reconnect
13:39:02.013 -> OKCurrent Humidity =    40.00Current tempreature =      30.00
```

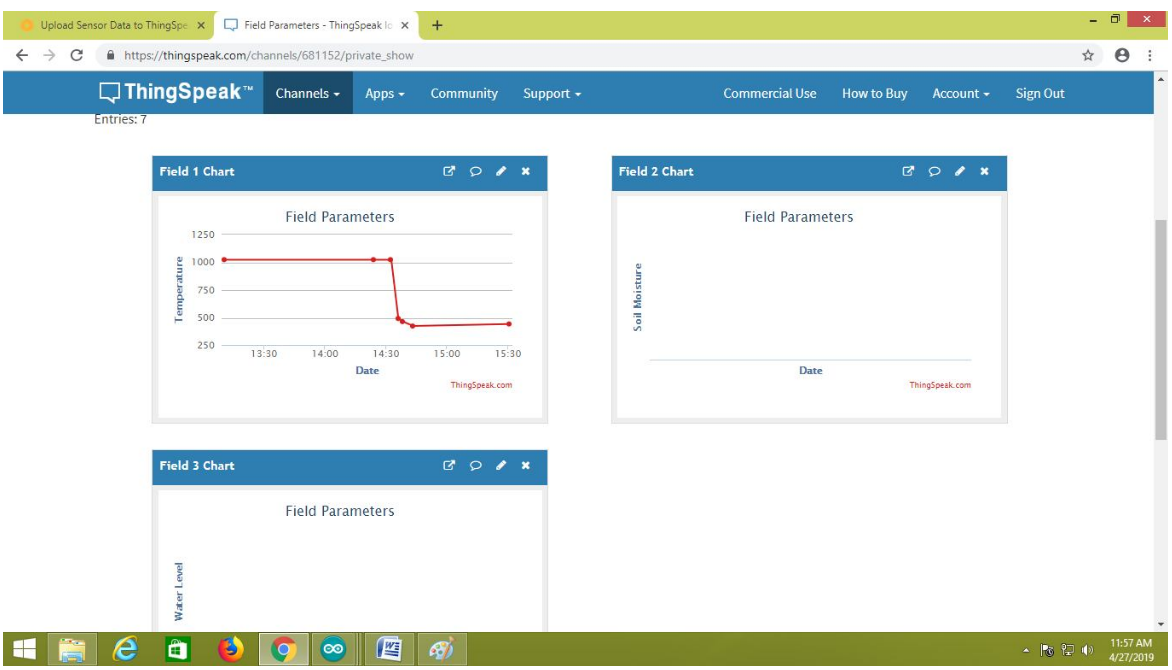
Values of Temperature and Humidity printed on Serial Monitor of NodeMCU IDE

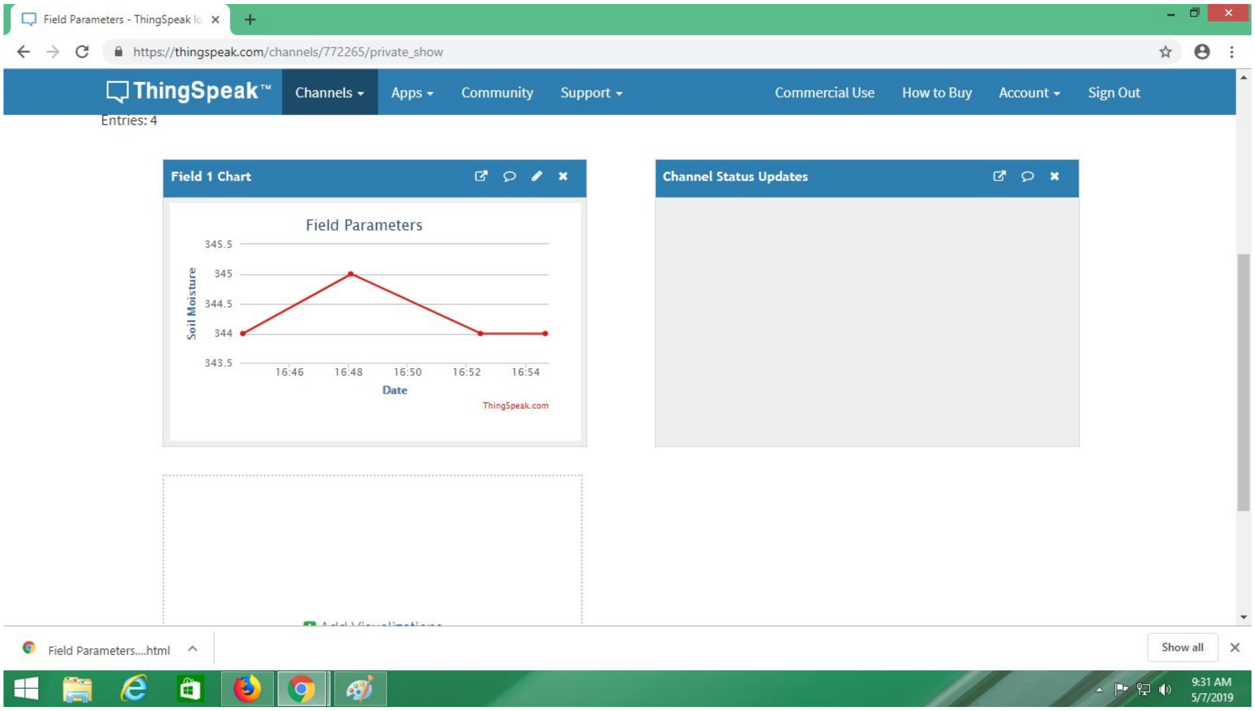
```
13:46:30.915 -> 601
13:46:30.948 -> Water level: 5mm to 10mm
13:46:32.090 -> scandone
13:46:32.090 -> no Redmi found, reconnect after 1s
13:46:32.191 -> reconnect
13:46:32.932 -> 601
13:46:32.932 -> Water level: 5mm to 10mm
13:46:34.917 -> 600
13:46:34.917 -> Water level: 5mm to 10mm
13:46:35.050 -> scandone
13:46:35.050 -> no Redmi found, reconnect after 1s
13:46:35.151 -> reconnect
13:46:36.930 -> 600
13:46:36.930 -> Water level: 5mm to 10mm
13:46:38.008 -> scandone
13:46:38.008 -> no Redmi found, reconnect after 1s
13:46:38.108 -> reconnect
13:46:38.916 -> 598
13:46:38.950 -> Water level: 5mm to 10mm
13:46:40.937 -> 598
13:46:40.937 -> Water level: 5mm to 10mm
13:46:40.971 -> scandone
13:46:40.971 -> no Redmi found, reconnect after 1s
13:46:41.037 -> reconnect
13:46:42.919 -> 597
13:46:42.919 -> Water level: 5mm to 10mm
```

Values of Water Depth Level printed on Serial Monitor of NodeMCU IDE

Water Level Content	For Red Soil	For Black Soil
601	5mm to 10mm	5mm to 10mm
552	5mm to 10mm	5mm to 10mm
666	15mm to 20mm	15mm to 20mm
492	0 to 5mm	0 to 5mm

The Real time Values of all the parameters is uploaded on Thingspesk Cloud. Upload the code. Once it is connected to Wi-Fi the data will start uploading to the ThingSpeak Channel. You can now open your Channel and see the data changes plotted on the ThingSpeak.





VI. CONCLUSION

The new technology involves detecting some environmental conditions and crop diseases effectively. The NodeMCU is used instead of WIFI serial wireless module. These new WSN technology is helpful for farmers in enhancing the productivity and increasing the net margin. This system will help in obtaining exact data of farm parameters and as these are shared over the internet, experts' advice will be available easily.

Temperature & Humidity sensor (DHT11) is used . Soil Moisture sensor and Water Depth Level sensors are used in the experimental setup. The soil moisture sensor output comments on the type of soil (WET or DRY) while water depth level sensor gives information about water level content in the soil.

Thingspeak cloud enables to save the parameter values in graphical form with a time stamp. Different fields in the channel store different parameter values .This thesis gives a low cost solution for the farmer to monitor the field parameters remotely and by analyzing the values corrective measures can be taken.

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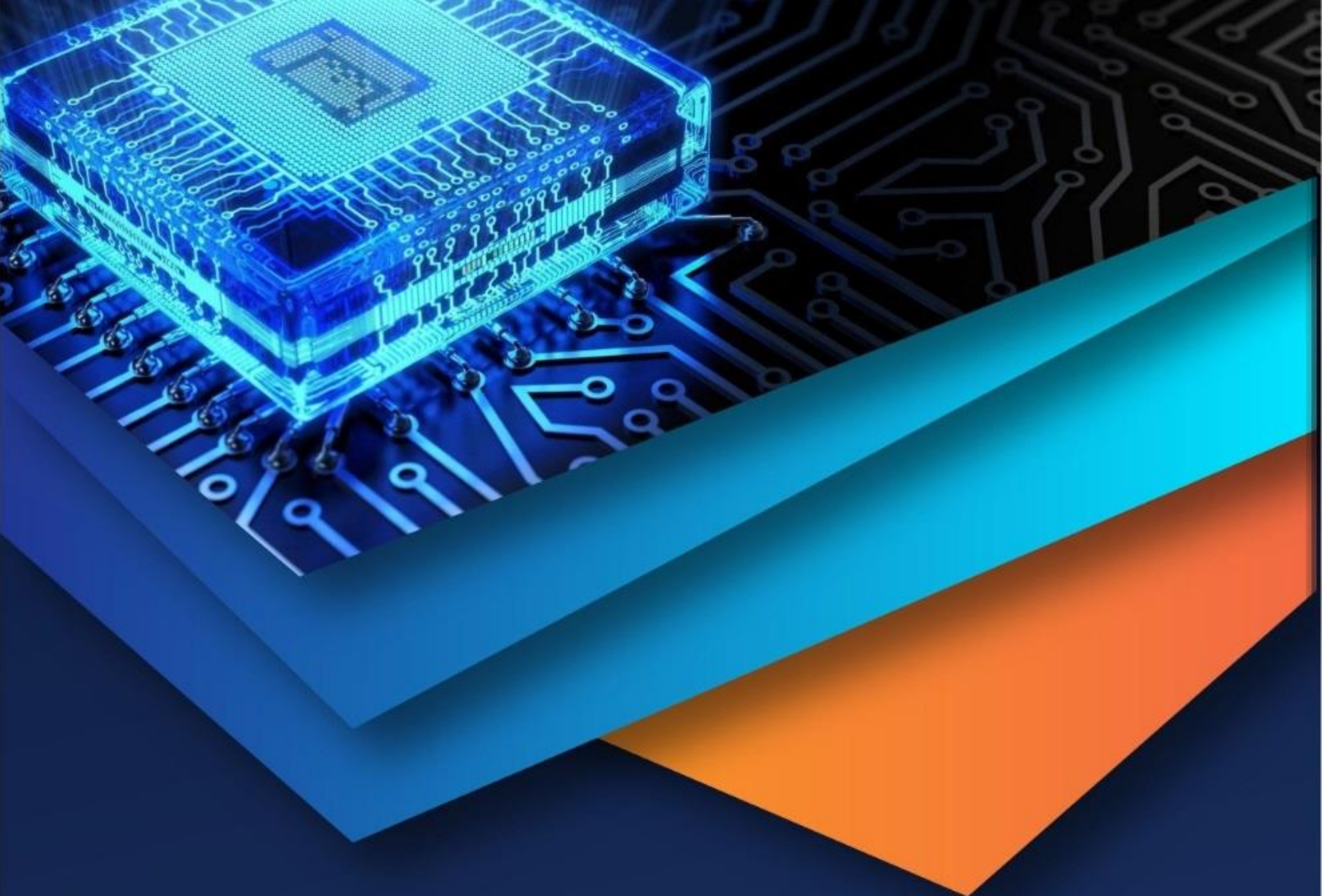

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