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Precision Agriculture using LoRaWAN

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Abstract: The growing world population as well as increased awareness of the stress, agriculture places on the atmosphere has put farmers beneath intense pressure. Its value is noting that the farmers have long leveraged the technological breakthroughs and to adapt agricultural practices to ever-changing in times and this era is no exception, significantly with the emergency of fine Agriculture.

Advanced commercial enterprise is fully dependent on power to efficiently manage resources so as to cut back the environmental impact, minimize the price and maximize the yield. Farmers are facing the associate degree interconnected to host of challenges and thus, having interest in incorporating the innovative technological solutions. Harnessing technology to alter precision agriculture has emerged to produce farmers with the tools they need to serve a half-hour larger population within the future in a very property approach that's harmonical with nature. The wireless sensor network (WSN) is a technology that has quickly been evolved over the years by enabling the spectrum of applications like industry, military, and agriculture. The LoRa devices have provided the ability to mechanically monitor the crops and the animals, which further provides the profitable knowledge which has been collected manually. During this project we tend to come up with a technology, to form a wireless network and alter the irreversible consequences of poor irrigation management. By dispersing the sensors that are connected to the phones or computers of the farmers will instantly receive the data on soil moisture and temperature, weather and rain, crop growth, and also receive the alerts on fire or theft and will activate irrigation instrumentation. All the data collected can feed into call management tools that helps the farmers to take the correct call at the correct time to get optimized results and will guarantee the property of his farm so high price knowledge are often transmitted over distances of up to fifteen metric linear unit from the sensors whose batteries which is lasting up to 10 years, leading to lower the maintenance and in operation prices beside the larger operational visibility, that successively empowers farmers to build their businesses.

Keywords: Farmers, Agriculture, Sensors, Wireless Technology

I. INTRODUCTION

The Wireless Sensor Network (WSN) is a technology that has speedily been evolved over the years by enabling a spectrum of applications like industry, military and agriculture. WSN's offer favorable provisions for agriculture applications through price-efficient method resulting in increase of crop yield. It facilitates the farmers to reduce the wastage of pesticides and effective management of pests. This, in turn will improve the agricultural production and quality of the crop. Large areas of agricultural land to be monitored using the sensors and this will forward information through the wireless communication to the receiving entrance. WSN's will be utilized in sub-divisions of the agricultural applications like fore-casting the crop health, and then guarantee of the adequate quantity of the nutrients, sickness detection, irrigation plan, and the climate watching.

Several analysis contributions are done concerning PA, mainly within the area of the data collection strategies, information analysis, diagnosis of many parameters at the side of fore-casting sickness, field operation and analysis of PA techniques. The PA employs an price-effective management strategy using the information technology in 2 ways: 1st by identification of the spatial variation and addressing of the appropriate statutory activities. 2nd by dominant the usage of weeds, the pesticides, and the sickness to proliferate the crop yield. Agriculture as well as cultivation, they both demand an economical theme for the dominant minute climatic conditions like humidity, temperature, and gas concentration to keep up close setup for the crop cultivation. WSN's offer an efficient answer for PA however on another aspect, it needs associate degree economical strategy in several elementary aspects like property, different type of sensors, network optimization, and power supply. Completely different applications like climate watching, irrigation coming up with, feeding required nutrition and fore-casting of the crop health need a heterogenous system with large variety of sensing capacity. Yet, there are few challenges in WSN deployment that has decrease the exact uses of PA; like associate degree optimum readying theme, manage the coverage and property required for needed communication range, quantifiability, and the energy-efficient network for longer battery life. The sensing nodes are largely battery power-driven. Thus, the proper choice of communication network and low-power sensors is imperative for PA. Most of them used Zig-Bee to transmit the information, however a trade-off should be created between quantifiability and dependability.

LPWANs are best suited in wireless communication for PA because of their long communication distance and low power consumption. One among the assuring protocols during this opportunity is the LoRaWAN. This protocol will use Long-Range modulation in their physical layer and it also features a low data rate with low complexness and long coverage. It specially highlights the importance of the accurate readings from the sensors along with a requirement for the better data visualization and analysis.

II. LITERATURE SURVEY

N. Kaewmard and S. Saiyod, "The sensor data collection and an irrigation control on the vegetable crop using smartphone and WSN for smart farm" In International Conference for the LoRa- Smart farming explains the using of LoRaWAN technology of digital agriculture and its benefits for farmers. In a novel approach for Digital Agriculture was proposed describing Relationships between Precision Agriculture, Digital Earth, Information Agriculture, Virtual Agriculture, and Digital Agriculture [1].

M. K. Gayatri, J. Jayasakthi and G. S. Anandha Mala, "Providing Smart Agricultural solutions to farmers for better yielding using IoT" They have explained the usage of satellite and other on or underground instruments for the information collection, and also the automation and remote monitoring of agriculture is been discussed. In the use of agricultural drone for spraying the fertilizer and the pesticides in agricultural land depends on the requirement in fields was discussed [2].

G. R. Mendez, M. A. Md Yunus and S. C. Mukhopadhyay, "A WiFi based smart wireless sensor network for monitoring an agricultural environment" This paper shows the WAN technology study, of LPWAN which uses wireless network and requires very low power supply. It will also provide the long-range communication, by providing low bit rate and by using low bandwidth. (LPWAN) it is popular and the leading technology invented for the IoT networks. LPWAN is wireless based WAN technology that enables Low power consumption, long range, lower bandwidth with low bit rates [3].

Chetan Dwarkani M, R Ganesh Ram, S Jagannathan and R Priyatharshini, "Smart farming system using sensors for agricultural task automation" This paper is mainly concentrated on the automation of the irrigation by controlling the water flow by knowing temperature, soil moisture and humidity. Thus, by helping proper growth of the vegetable crops. This implementation uses ZigBee communication to execute above functions and communication was between the sensor nodes and smartphones for collecting the information or controlling the water flow in field [4].

Augustin, A.; Yi, J.; Clausen, T.; Townsley, W.M. A Study of LoRa: "Long Range & Low Power Networks for the IoT" LoRa device is a long-range, low-powered device, low-bitrate and wireless telecommunication system which is promoted as an infrastructure solution for the IoT: end-device uses LoRa across the single wireless hop to communicate to the gateway(s), which is connected to the network and which acts as a transparent bridge and the relay messages between these end-devices and a central network server. This paper provides the summary of LoRa and an in-depth analysis of its functional components **[5].**

III. PROPOSED SYSTEM

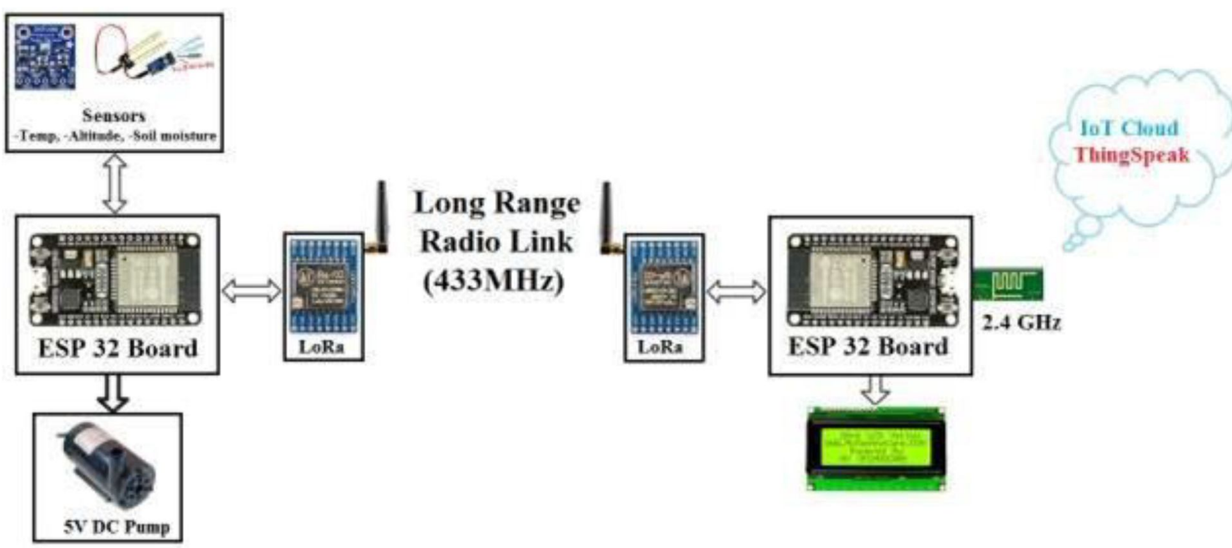

Fig. 1 Block Diagram

Each node within the network as shown in the following Fig. 1, consists of a ESP32 microcontroller, LoRa modem, GPS module and sensors. These nodes have the capacity to wirelessly intercommunicate with the remaining nodes installed at a close range or long range, from a few meters to as far as tens of kilometers without a repeater. Since the nodes are battery operated, we have carefully chosen the ultra-low power hardware to perform the desired task. Since different modules needed different DC power supply, we've used DC-to-DC converters which are more efficient. Also, the batteries can be charged with solar panel so as to have long battery life.

The LoRa module that we have been using here is SX1278 Ra-02. This operates on 433MHz. An important concern to have with the LoRa module is the Antenna. It is compulsory to use the LoRa module only with the antenna, or else the output transmitting power can damage the Module. The LoRa module includes of sixteen (16) pins with eight (8) pins on each side. Among these sixteen (16) pins, six (6) are utilized by GPIO pins starting from DIO0 to DIO5 and four (4) are utilized by Ground pins. This module operates with 3.3V and hence the 3.3V pin on LoRa is connected to 3.3V power supply. Then we will connect the SPI pin on to the LoRa and to the SPI pins on ESP32 Board. As a presentation of LoRa being employed with pair-to-pair communication, this project will feature two devices, one configured as the transmitter and also the other, as the receiver. The transmitter will attain temperature and altitude sensor employing a BME280 sensor connected to an ESP32.

We could also use Arduino Nano as local node to reduce the PCB size. The data/information from local node is forwarded to the receiver through a Ra-02 LoRa module. For the receiver, we will use an ESP32 DEV kit V1 board with another Ra-02 LoRa Module.

IV. FLOW CHART

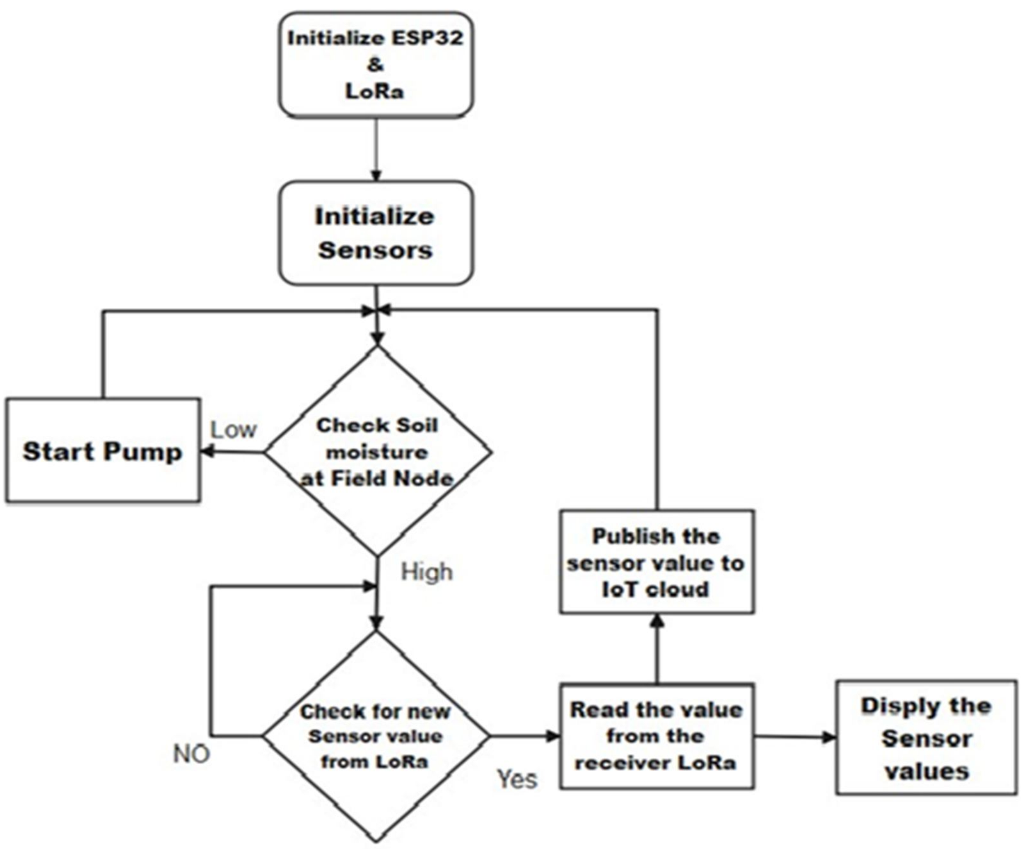

Fig. 2 Flow Chart

The flowchart shown in the fig. 2, displays the functioning of precision farming which is designed to monitor and control agricultural activities at a remote place using modern Hi-Tech. Data are collected using sensor for smart decision system. Each node is enabled to wirelessly intercommunicate with the rest of the nodes using LoRa technology. Thus, the sensor data and controlling signals are exchanged between gateway node and other nodes and eventually all the necessary agricultural data are made available at the central office.

V. RESULT

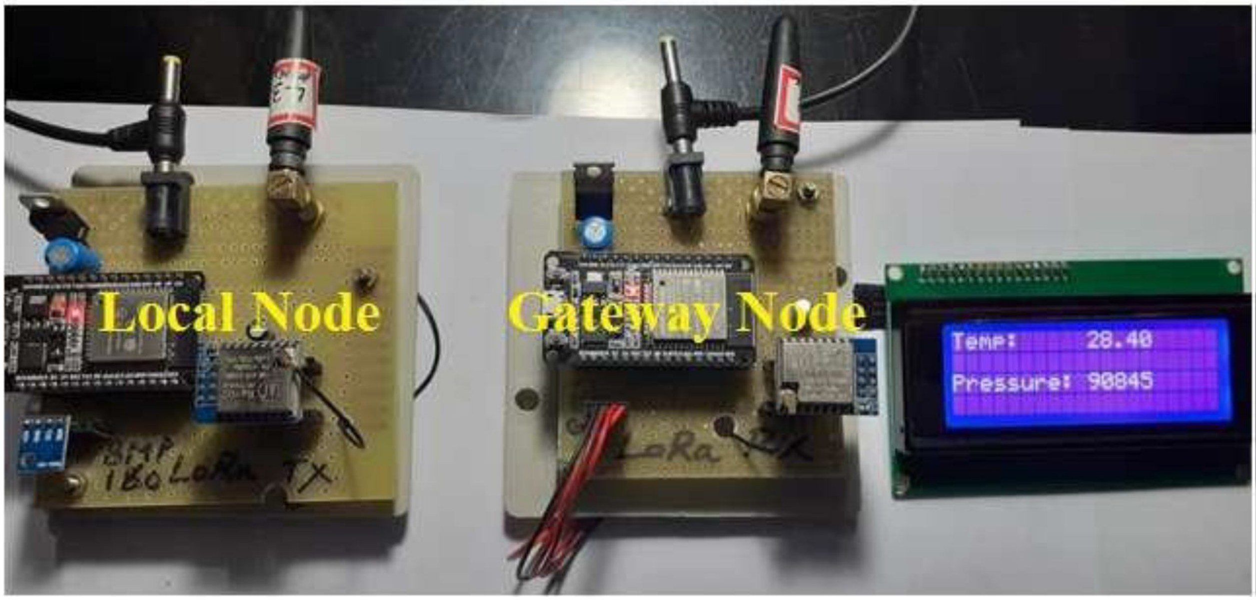

Fig. 3 Experimental setup with results on LCD display

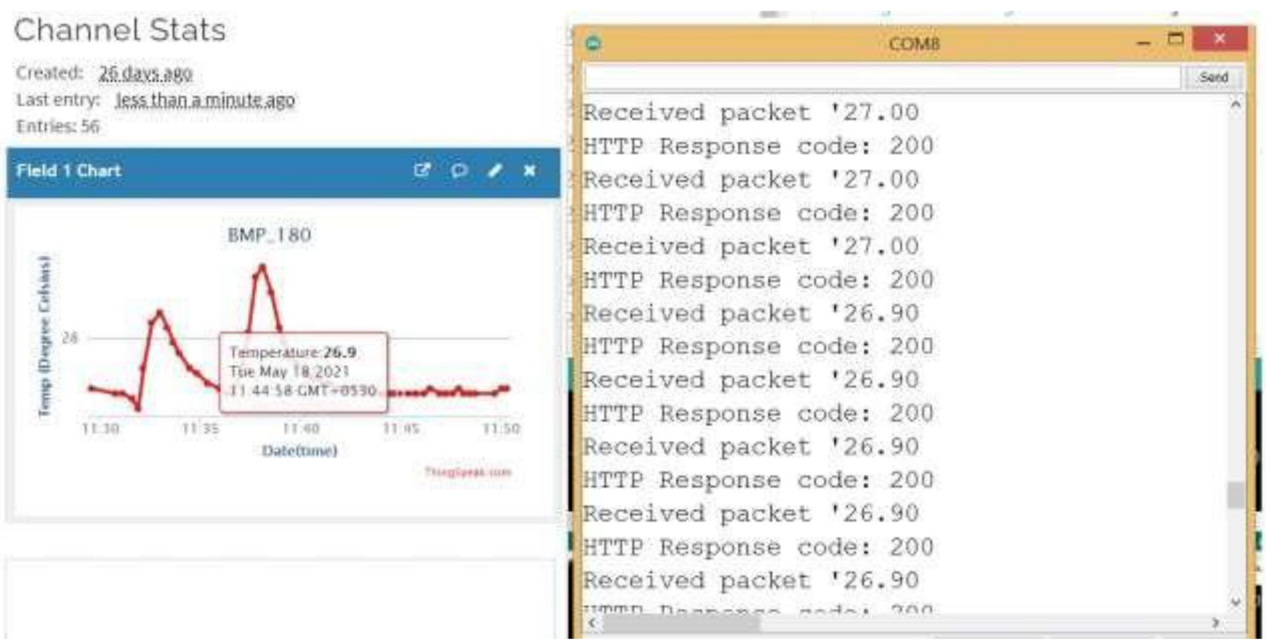

Fig. 4 Results from ThingSpeak & Serial monitor, reading room temperature.

VI. CONCLUSION

In this project we have presented a model of IoT agricultural system that makes use of LoRaWAN protocol for data or information transmission from the sensor nodes to the cloud services and the ThingSpeak network platform that implements the LoRaWAN's backend services. Through the use of open-source software and hardware designs, coupled with LoRa transceivers, inexpensive and power efficient sensing solutions can be developed for agriculture allowing for long transmission distances and wide coverage from a single gateway installation. The wireless sensor network developed in this project uses LoRa transceivers and an efficient channel management mechanism to reduce energy usage for data transmission. For the future work we have a plan to extend our data analytics service with much more prediction models and the data mining algorithms. Additionally, a large-scale network will be deployed in an agricultural setting to demonstrate the benefits of precision agriculture and ease of use of the approach.

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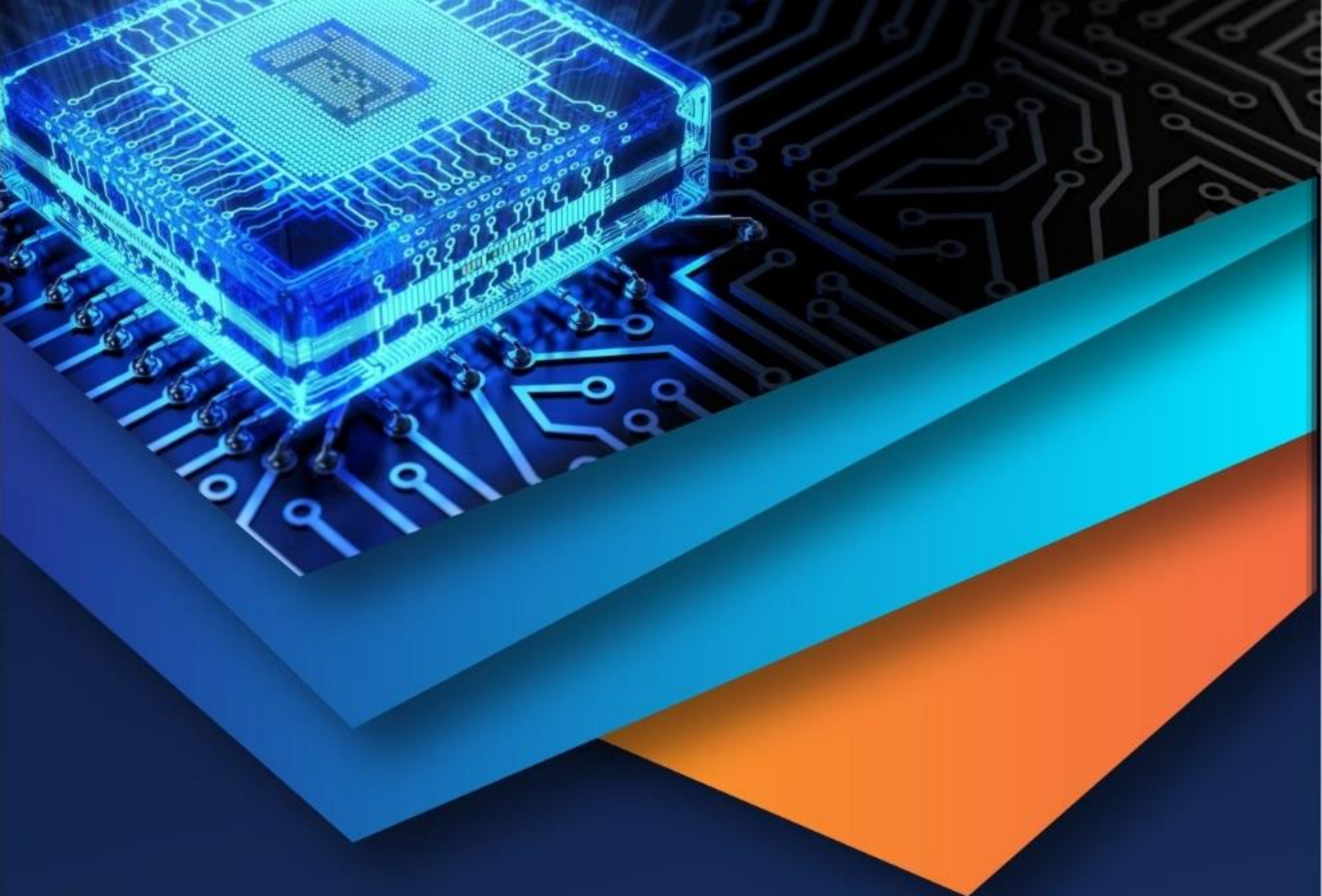

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