iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** II **Month of publication:** February

DOI: http://doi.org/10.22214/ijraset.2019.2038

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue II, Feb 2019- Available at www.ijraset.com

E-Agriculture based on AI and IOT

Dr. T. Rajesh[1], K. Tiwin Kumar[2], M. Muthamizh Balan[3], M. S. Sidhartha[4]
[1, 2, 3, 4]*Department of Electrical and Electronics Engineering, Info Institute of Engineering,cbe,India.*

Abstract: Demand for agriculture goods is consistently growing to keep up with the world's population growth. The relationship between land, population, and field production is a complex one. Since agriculture becomes modernized, its dependence on land as well as on individual labour decreases. In the backdrop of those challenges, farmers are in need to adopt new technologies. E-Agriculture is a one of such concept that is playing a part in the enhancement of processes associated with Agriculture. This new technology can help improve operational planning and accelerate decision making on farms, large and small. Artificial Intelligence and Internet of Things (IOT) is emerging as part of the solutions towards increased agricultural productivity. IOT in an agricultural refers to the use of sensors, cameras, and other devices to show every factor and action involved in farming into data. This particular data is stored on farm management systems that allows for better processing and analysis. Typically the availability with this data and other related data is paving a way to deploy AI in agriculture.
Keywords: Agriculture, Sensors, IOT, Database, Artificial Intelligence

I. INTRODUCTION

Agriculture is the backbone of the economic system of a nation. Population growth results in the deforestation and decreases the quantity of agricultural land but since well as enhance in the necessity of food. To manage with these difficulties, adopting the new technologies is the best way. The benefits associated with adopting new technologies include: Increased crop productivity, reduced utilization of water, fertilizer, and pesticides, which keeps food prices down reduced effect on natural ecosystems. Nowadays agriculture routinely utilizes advanced technologies such as robots, temperature and moisture sensors, aerial images, and GPS technology. IOT has been used keep track of the field by using a smart phone which gathers the data from the sensors and store it in the cloud [1]. AI is usually another technology which process the stored data and gives useful information to the end user who is usually an along with live field monitoring and suitable recommendations to get higher yield as well as high income[2]. In this paper, IOT and AI combined technique in order to modernize the agriculture is discussed.

II. LITERATURE SURVEY

Precision Agricultural Management System (PAMS) is based on IOT and webGIS. PAMS have four architectures which are the spatial information platform, the IOT infrastructure platform, the Agricultural Management system and the Mobile client. The key techniques of PAMS are IOT, webGIS, ICT, and location based service. The main function of PAMS is monitoring and management of agricultural farms. It analyses the data collected and gives suggestions to the staff about what to do at next stage. It reduces monitoring time and promote the level of management on the farm. It plays a major role in development of agriculture in china. [3] The objective of Intelligent Agricultural Management Information System (AMIS) based on IOT proposal is to apply Agricultural Information Technology [AIT] to every aspect of agriculture and has become the most effective means and tools for enhancing agricultural productivity and for making use of full agricultural resources. It makes the digitization of each process in every aspect of agriculture and unites all the collected data. The purpose of AMIS is to improve the level of agricultural information process and enhance the intelligent management and decision of agricultural production. The three layers of AMIS are data collection using RFID and provides processing information from farm gate to restaurant plates, data transmission using GSM and wireless sensor networks (WSN) and data processing. [4] E- Agricultural concepts proposed that the usage of ICT makes agriculture more efficient. It helps in both the product efficiency and process efficiency by means of reducing the cost and time in the functionalities involved in agriculture. E-agriculture is an emerging field in the intersection of agricultural informatics, agricultural development and entrepreneurship, referring to agricultural services, technology, technology dissemination and information delivered or enhanced through the internet and related technologies. The objective of his study was to increase agricultural productivity and decrease the poverty by introducing the new technologies to enhance agricultural processes and to educate rural communities about the importance of introducing new technologies in their production process. The ICT tools in this sector are Geographical Information System (GIS), Community Radio Stations, Internet and Web based Applications and Global Positioning System (GPS). The role of ICT is to monitor, processing and provide suggestions for pre-cultivation, crop cultivation and harvesting and post-harvest. [5]

III.IOT IN AGRICULTURE

The basic idea of the IOT is that virtually every physical thing in this world can also become a computer that is connected to the Internet [6]. The sectors in agriculture where IOT is used are Crop water management, Precision Management, Integrated Pest management and control and Food production and supply [7]. The system architecture in Fig. 1 the connection between used components. The circuit consists of Arduino ATMEGA 2560, ESP 8266 Wi-Fi module, GPS sensor, PIR sensor, Soil moisture sensor and DHT 11/22 Temperature and Humidity sensor And I2C LCD screen.

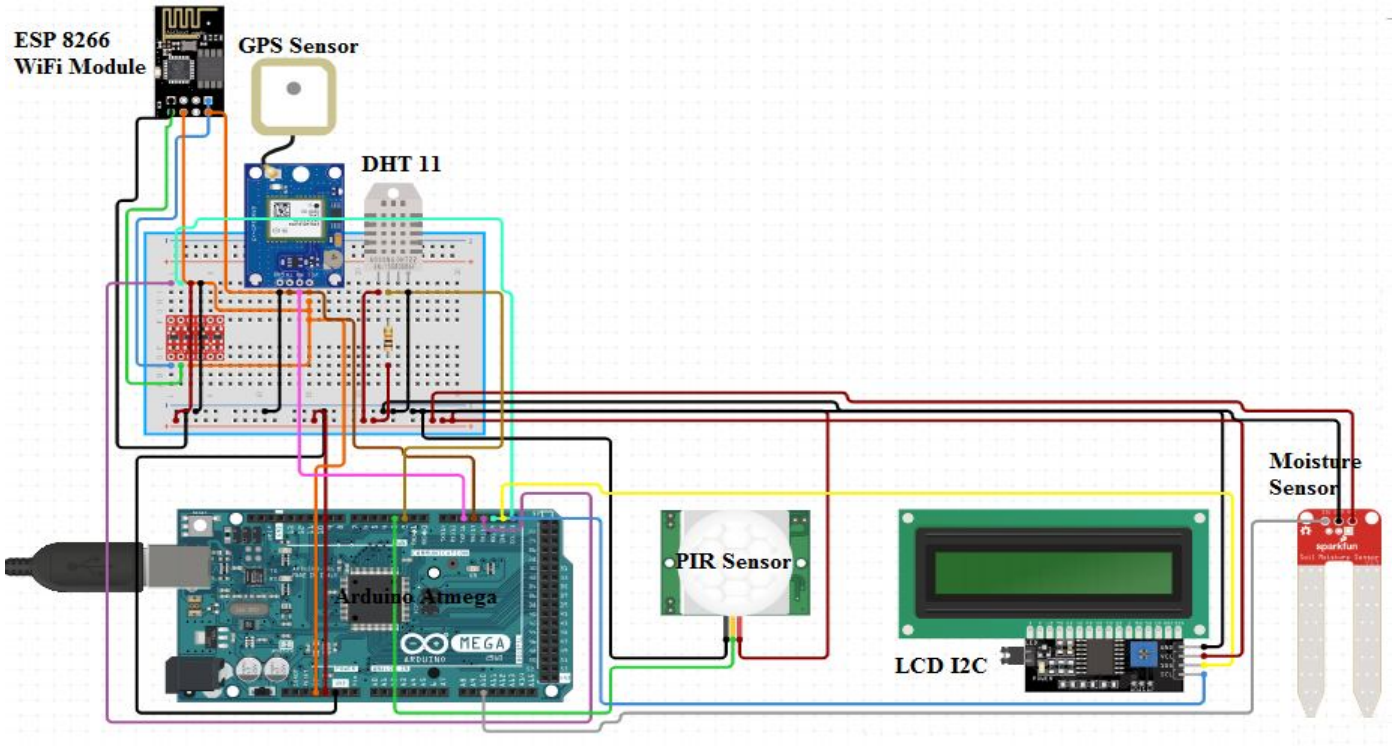

Fig. 1 System Architecture

The features and characteristics of the components used are given below

A. Arduino Mega 2560 R3

It is a microcontroller board depending on Atmega 2560 microcontroller. This board with includes 54 pins and 16 analog pins with more storage to store the code. In terms of coding, these board will be programmed in Arduino IDE software.

B. ESP8266 -01 –Wi-Fi Module

The ESP8266 Wi-Fi Module is a self-contained SOC with incorporated TCP/IP protocol collection that may give any kind of microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions through another application processor chip.

C. PIR Sensor

It is used to monitor the growth of a crop in a field.

D. LCD display screen

This LCD Display utilizes an I2C interface, This I2C 16x2 Arduino LCD Screen is using an I2C communication interface. It only needs 4 pins for the LCD display: VCC, GND, SDA, and SCL.

E. UBLOX NEO-6M GPS Module

To get the location of the field to store and process data respect to the current location.

F. Soil Moisture Sensor

To measure the moisture level of the soil.

G. DHT22/11 Humidity And Temperature Sensor

To measure and monitor the temperature and humidity level of the field.

By using the above mentioned sensors and the Arduino ide, the data are collected from the field and using the ESP 8266 Wi-Fi module data are stored in a database for analysing purpose. The data which are collected from field and sent to cloud are field GPS coordinates, moisture level, temperature and humidity and user id, soil type and ph values are stored using a webpage. By using all these data the user can get a real time information about his farm. The agricultural parameter measurement is shown in Fig. 2.

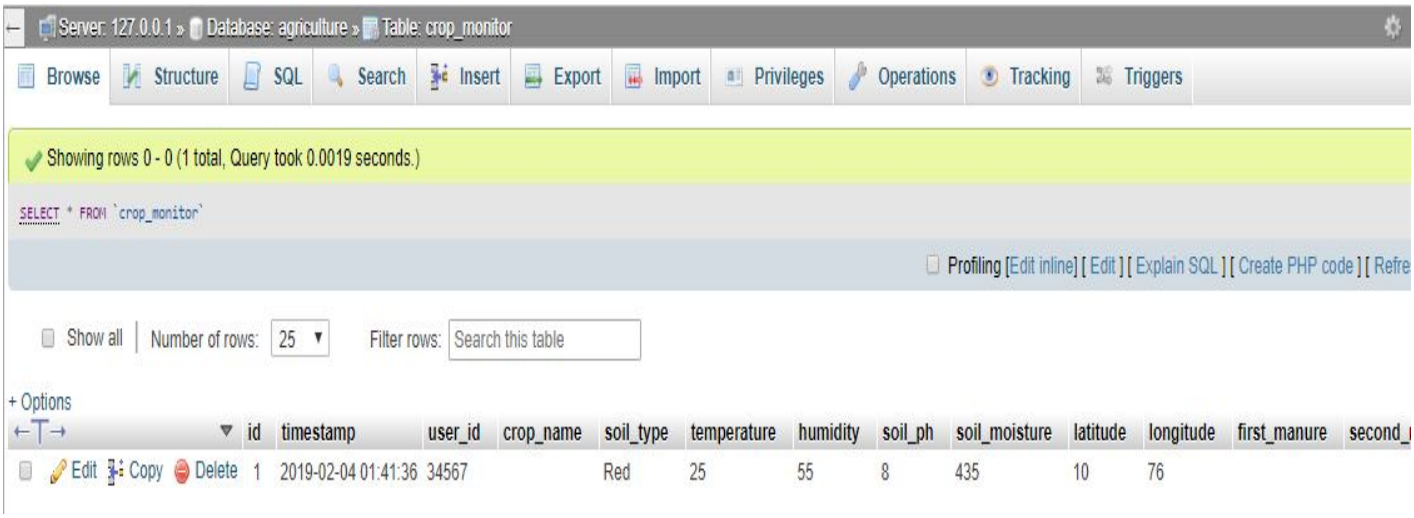

Fig. 2 Agricultural parameter measurement

IV. ARTIFICIAL INTELLIGENCE IN AGRICULTURE

Artificial Intelligence is emerging as part of the solutions towards improved agricultural productivity [8]. Agriculture is slowly becoming digital and AI in agriculture is emerging in three major categories, (i) agricultural robotics, (ii) soil and crop monitoring, and (iii) predictive analytics [9].

The data collected and stored in the databases are processed to get a useful information. Here data processing is used to select a proper crop for the field and the suggestions while monitoring and the post- harvest details too [10]. The data is classifies into location based, soil condition based and then pre-sales and current farming data. This is the place where the algorithm developed can act as an AI by choosing best crop in all the conditions and suggesting appropriate suggestion to the user[11].

The data based on location are already stored in the database. By properly retrieving that data the algorithm classifies location based on two categories which are based on temperature and based on rainfall in a location. Crops suitable for that temperature are listed and also the crops suitable for rainfall are listed and assigned a prioritized count to each. The Fig. 3 shows the crops suggestion based on temperature and rainfall. Here crop A, B, C are grown under the appropriate temperature and crop A, C, D are under the mentioned rainfall of the location.

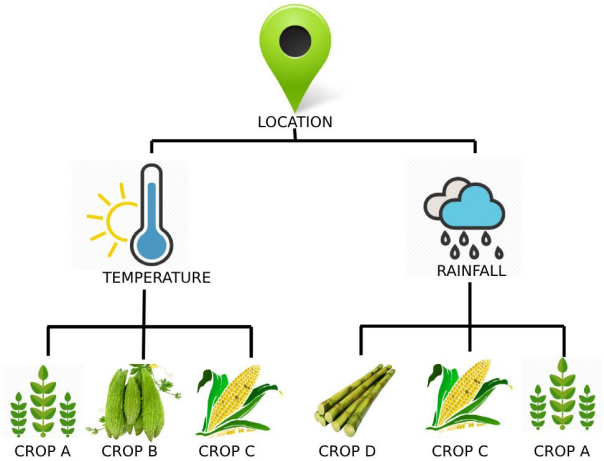

Fig. 3 Location based crop suggestion

The data regarding the soil condition are collected from the field using soil tests and sensors. By properly retrieving that data the algorithm classifies soil condition based on two categories which are based on pH of the soil and based on Nitrogen, Phosphorus, and Potassium (NPK). Crops suitable for the appropriate pH are listed and also the crops suitable for NPK amount on soil are listed and assigned a prioritized count to each. The Fig. 4 shows the Soil condition based crop suggestion. Here crop C, D, E are grown within the soil pH and crop B, C, F are based on the NPK content of the soil.

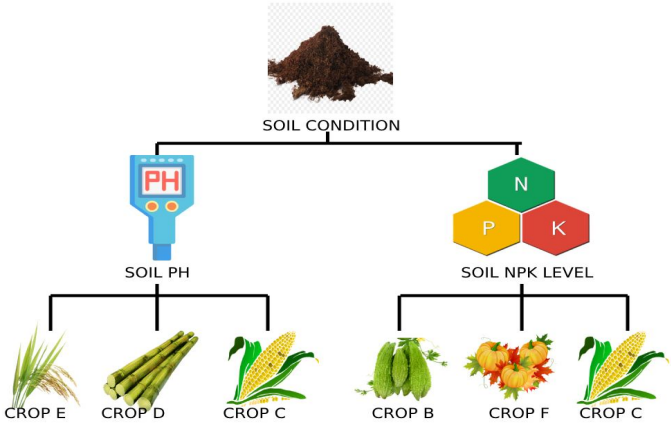

Fig. 4 Soil Condition based crop suggestion

The user can get a good profit when there is a demand for the crop while harvesting and by avoiding over production by extreme the demand which leads to wastage and a huge loss[12]. To check the demand it process data from the pre-sales database and suggesting the crops which have demand over the harvesting period. To avoid the overproduction checks with the current databases which consists of the amount of production and also it doesn't crosses the demand then it too suggests the crop otherwise it suggests other crops. Fig. 5 shows the profit based crop suggestion and the Current farming data. Based on the Real time data algorithm suggests the Crops C, F, G and based on the Pre-sales report it suggests A, C, E.

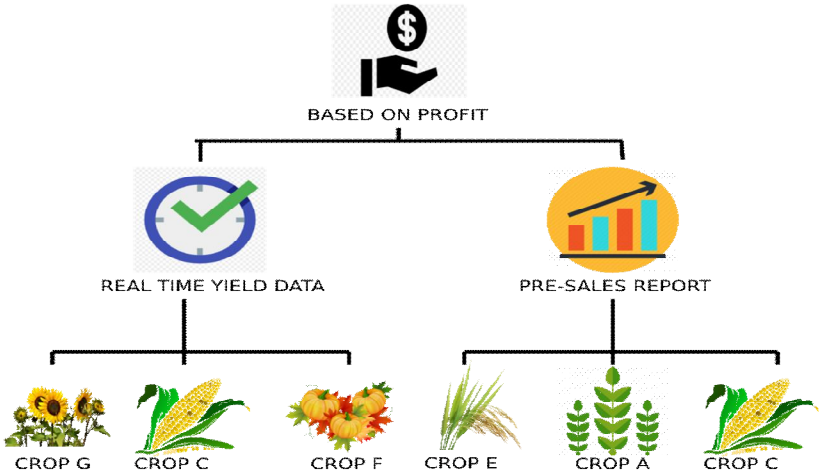

Fig. 5 Profit based crop suggestion

After the suggestion the crop data is classified into three categories they are sowing, monitoring and harvesting[13]. Before sowing using the AI algorithm the user can get the information about an investment cost per acre, maintenance cost per acre and the nearby approximate profit while harvesting [14]. The next thing is monitoring that's the user can monitor the humidity of his field, pH content of the soil, Fertilizers and Pesticides spraying data and the water level to be managed at the field. If any change or improvement needed in the above mentioned monitoring data the user can get a suggestion do an appropriate to maintain the physical conditions of the farm which enriches the farm and determines the quality of the yield. Finally after harvesting the user can stores his Farm products in the warehouses nearby. The ware house details are retrieved from the warehouse database. Fig. 6 shows the three categories and their functions.

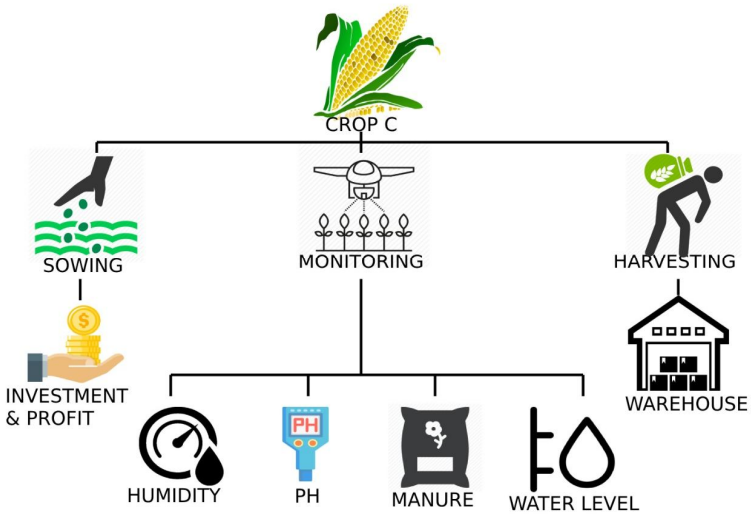

Fig. 6 Post suggestion and monitoring functions

V. CONCLUSION

In this paper the usage of IOT and AI in agriculture is discussed. Implementing a technology is the only way to satisfy the demand, IOT plays a major role by collecting the real time data from the field and the data is stored in a cloud where IOT gateway is used to upload it in cloud. Then the uploaded data is retrieved using the web scripting language, an AI algorithm is developed using the same language whether it suggests crops under the categories named location based, profit based and soil condition based. Then a crop with highest priority is suggested to the user and it is monitored regularly using the sensors. According to the data it calculates investment and profit while sowing to avoid the loss. If any change in the data collected then it notifies the user with an alert. A web application is developed as a user interface which gives the information about their farm and suggestions according to the collected data. The usage of these emerging technologies is robust and accurate. The future of agriculture is filled with AI controlled robots and IOT systems to reduce human effort and high yield.

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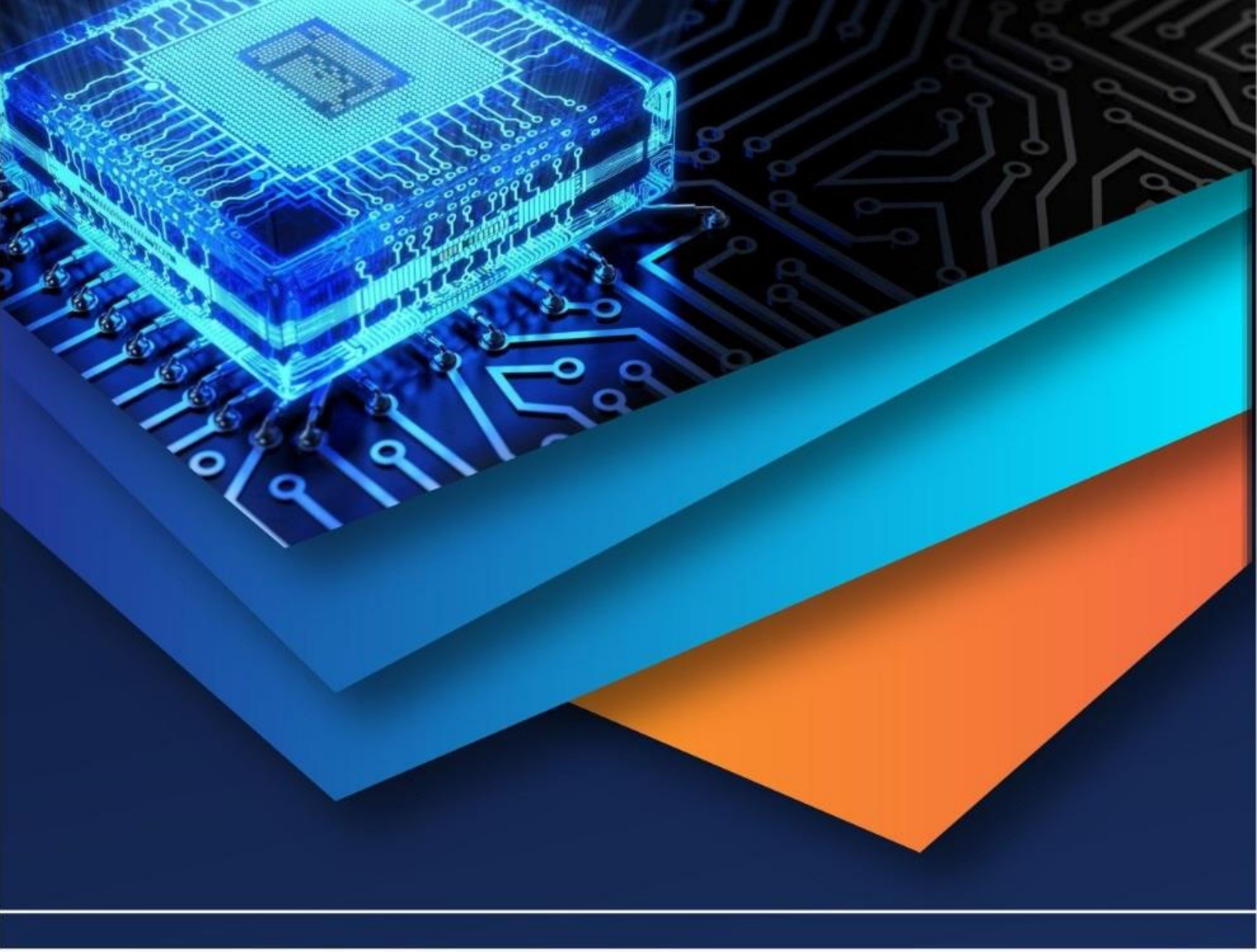

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