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Smart Drip Irrigation System Using Soil Moisture Level and Weather Data

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Abstract: Irrigation has major significance in agriculture and is vital because of unavailability of freshwater in abundance, use of water resources in an optimal way has been provided using automation up to a greater extent. Conventional wired systems which uses discrete wiring arrangements, challenges the user on measuring and controlling the systems over large areas. So, there is a need for smart drip irrigation system using soil moisture level and weather data. The concept has 3 units: moisture-sensors, weather-sensing unit and rain-sensors. Using this, the system will understand the changing conditions of soil moisture and humidity level according to weather and will schedule the proper timing and water supply quantity.
Keywords: Automation, Drip Irrigation, Rain, Soil Moisture, Weather data, Water

I. INTRODUCTION

Successful administration of water plays a critical part in the water system based agricultural irrigation systems since water system process is exceptionally noteworthy underway of harvests wherever around the world. The interest for imaginative water sparing practices in water system is developing quickly in the present situation. With the motivation behind delivering more product per drop, agronomists in (semi) dried locales by and by investigate water system techniques in the exhibit from utilizing a base measure of new water. An imminent answer to improve, collect and boost water use productivity for rural fields is to build up a remote sensor-based site-specific water system control system. With the headway of remote advancements, a several researches concentrated on independent water system with sensors in agricultural systems. Among these investigations, a small-scale sprinkler system has a prominent place, and it was intended for locking the controlled solenoid valves in a citrus estate with remote. Consequently, soil moisture sensors and sprinkler valve controllers had started to be viable for site-specific water system robotization. The advantages of utilizing remote sensors are to decrease the wiring and channeling costs, and to encourage less demanding and quick establishment and support in widespread fields. The created system consolidates another innovation that coordinates climate information to enhance the overarching system.

Water system with the assistance of freshwater assets in farming territories has a fundamental importance. On account of exceedingly increase of interest for freshwater, ideal use of water assets has been furnished with more prominent degree through mechanizing the agribusiness system and its contraption, for example, sprinkler water system, solar power, remote and sensors-based control. Customary instrumentation in perspective of detached and wired game plans, offers various troubles on estimating and controlling the systems particularly in the expansive zones. Along these lines, there is a requirement for smart drip irrigation system utilizing soil moisture level and weather information. The proposed system has three components viz. Soil moisture detecting unit, weather detecting unit and rain detecting unit. By utilizing these sensors, the system will comprehend the changing states of soil moisture level and rain probability as indicated by weather. By using these sensors, the system will understand the changing conditions of soil moisture level and humidity level according to weather. By using this data, the system will be able to schedule the proper timing and quantity of water supply. Feedback is received by the system from one or more sensors in the farming field, that give uninterruptedly refreshed information to the system parameters that are impacted by the system lead, (for instance, soil dampness level and rain). With the help of estimations obtained by the sensors and the pre-modified parameters, (for instance, the sort of plants and measure of water required), the system picks the duration of the solenoid valve to be opened. Along these lines, the input parameters that the system utilizes are:

A. Soil moisture level.
B. Rain Probability.
C. Weather conditions.

The output parameters are:
Opening/shutting the valves for water or potentially altering the sum required.

II. OBJECTIVE

The key objective of the study is to design a small scale automatic irrigation system for agricultural fields that would use water in a more proficient manner, so as to avoid water loss and minimize the cost of manual labor. Secondly, the installation should be made simple enough so that the users can comprehend it. Lastly, to operate the system with improved consistency such that the power consumption by soil moisture sensor, weather sensor and rain sensor must also be monitored.

III. RELATED WORKS

According to Veena Divya and Ayush Akhouri's "A Real time implementation of a GSM based Automated Irrigation Control System using drip Irrigation Methodology" which deals with Irrigation Control System based on GSM, offers the keeping up of identical environmental conditions. An item stack known as Android is utilized for cell phones that consolidate a functioning framework, vital applications and middleware. Tools are provided by Android SDK and APIs play an important role in order to start creating applications on the platform of Android utilizing the Java programming language. Mobile phones have become a vital part of human being serving numerous necessities of people. Cell phone GPRS is used for this application as resolution for irrigation control system. The proposed system secured lesser area of agricultural acreage and was financially ineffective.

According to Purnima and S.R.N Reddy's, " Design of Remote Monitoring and Control System with Automatic Irrigation System using GSM-Bluetooth ", suggested supply of water to plot where cultivated harvests were present Generally for irrigation, canal water, hand pumps and downpour were a noteworthy source of water supply. The proposed technique prompted serious downsides as over-irrigation and under irrigation, which thus causes damage of nutrient content and draining.To conquer the above downside, utilizing weather data and internet system spares over half of the water quantity. This is one reason for increment in harvest. The paper exhibits our advance in building up a framework that utilizes weather data and sensor data to avoid the excess use of water.

IV. PROPOSED MODEL

The proposed system comprises of two controllers (Fig.1). The controllers used here are Arduino mega 2560. The first controller C1 is put outside on the agricultural field and the second controller C2 is kept inside in the pump house. The controller C1 is kept in a sheltered case to keep it from getting damaged. External peripheries like soil moisture sensor, rain sensor and radio frequency transmitter are associated with the controller C1. Other fringe like radio frequency receiver is associated with the associated C2. The valve control is given to C2. The controller C1 takes the input from soil moisture sensor and rain sensor and transmits the received information to the controller C2 utilizing radio frequency transmitter.

The controller C2 gets these information through radio frequency receiver. By utilizing the constantly updated weather forecast information and received sensors' data, controller C2 controls the valves as per the water necessity. The system gets to the weather forecast information from the website www.openweather.org.

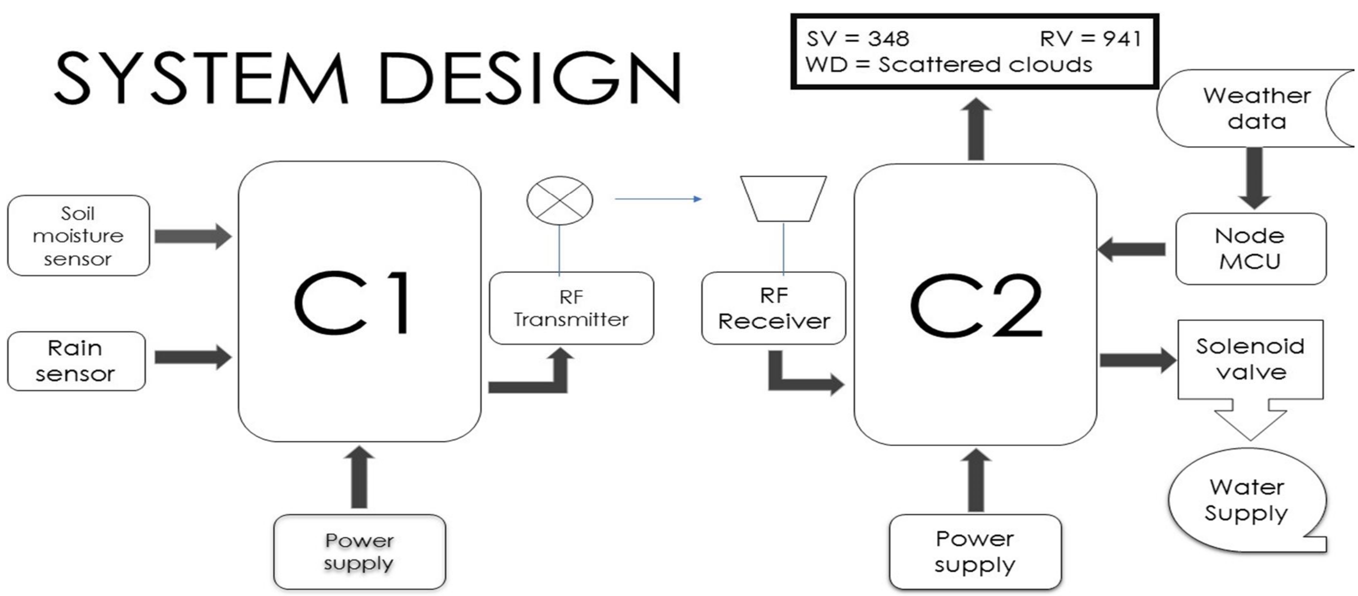

Fig.1 Proposed system

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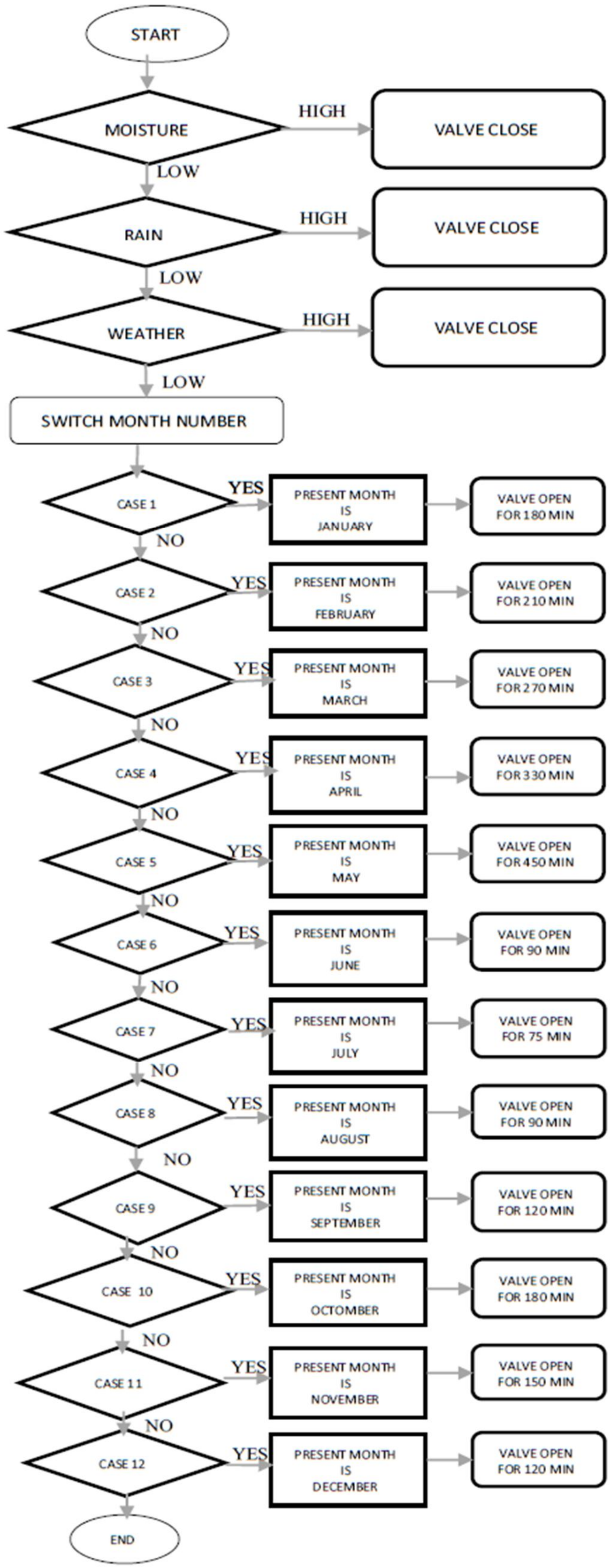

Fig.2 Flow chart of working

The drip irrigation system (Fig.3) is utilized as it utilizes upto about 90% of the water provided. The amount of water which gets evaporated is additionally less and the drip is straightforwardly provided to the roots of the plant which brings about efficient development of the plant. The proposed system keeps updating the client and responsible for the irrigation of the plants in a remote area.

Drip irrigation system functions by disseminating water specifically to the roots at a lower rate from a system of smaller diameter plastic tubing which is fitted with outlets called producers. Drip irrigation is profoundly proficient in light of the fact that the water splashes in the soil before it can vanish or overflow. Water is additionally connected near the plant root giving a high dampness content in the soil which can help the harvests to flourish. The fundamental segments of a tear framework comprise of a main pipeline, valve, reverse preventer weight controller, channel, tube connectors, drip tubes, fittings, producers and a end top.

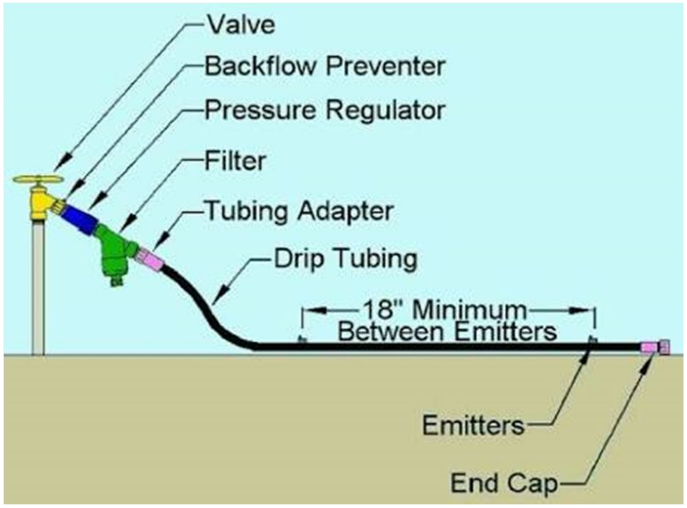

Fig. 3. Drip irrigation system

A. Proposed Technology

At first, the system (Fig.2) checks the measure of moisture exhibit in the soil. In the event that the moisture content is over the set reference (the reference is set by the water prerequisite of the plant in the given month), the valve will stay shut. However, in the event that the moisture content is beneath the reference, at that point the system, with the utilization of rain sensors, checks on the off chance that it is down-pouring around then. On the off chance that the rain sensor senses the rain drops, the valve will stay close. Furthermore, in the event that it isn't drizzling right now, the system next checks the weather forecast (Fig. 4). Following are the conditions as per which the valve will be opened or shut.

(I) Valve open conditions: Sky is clear, Haze, few clouds, broken clouds, Scattered clouds.

(ii) Valve close conditions: Overcast clouds, Light Rain, Moderate rain, Heavy intensity rain, Very heavy rain.

Water is given to the plants as indicated by the prerequisite of the specific month. For instance, in January, banana plant needs 10-12 liters of water for each day. Thus, the valve stays open for 180 minutes i.e., 3 hours as 4litres every hour is provided from the drippers. (Fig. 2)

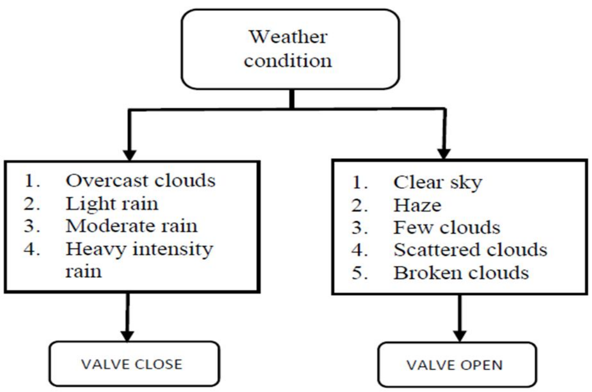

Fig. 4. Weather condition algorithm

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B. Implementation

The study was conducted in a banana cultivate of breed Musa acuminata. The water prerequisite for banana plant changes in amount for various months.

Table I Water Requirement For Banana Plants

Sl. No	month	Water Req. Lit/Day/Plant
1.	June	5-6
2.	July	4-5
3.	August	5-6
4.	September	6-8
5.	October	10-12
6.	November	8-10
7.	December	6-8
8.	January	10-12
9.	February	12-14
10.	March	16-18
11.	April	20-22
12.	May	25-30

Table 1 demonstrates the measure of water required in various month of a year. The point is to give the correct measure of water required by the plant for the specific month. Along these lines, a calculation is produced in the controller which gets the data about the month from the weather forecast website and utilizing the data of the table underneath, the valve remains open for the subsequent amount of time.

V. EXPERIMENTAL ANALYSIS

Through experimentation it was discovered that soil moisture sensor reading of 300 shows the nearness of high moisture content in the soil and a reading of 1024 demonstrates that the soil is dry. The following formula can be utilized to compute the level of moisture content in the soil. It is assumed that sensor reading of 300 to have 100% moisture content and the reading of 1024 to be 0%.

Percentage of moisture level in the soil

$= 100 - (x - 3007.23)$

Where 'x' is the reading obtained from soil moisture sensor

For instance, if the sensor reading acquired is 700, then using the formula,

Percentage of moisture level in the soil

$= 100 - (700 - 3007.23)$

$= 100 - 55.32$

$= 44.68\ \%$

Thus, it can be said that for the sensor reading of 700, there is 44.68% moisture content in the soil. Similarly, percentage of moisture content can be calculated using the above formula for all the readings obtained from the sensor. Fig 5 demonstrates the chart of Current measure of water provided and Actual measure of water required. As of now, 8 liters of water for every day is provided to the plants consistently however the genuine prerequisite changes throughout the year. The measure of water supply can be shifted by changing the dripper head.

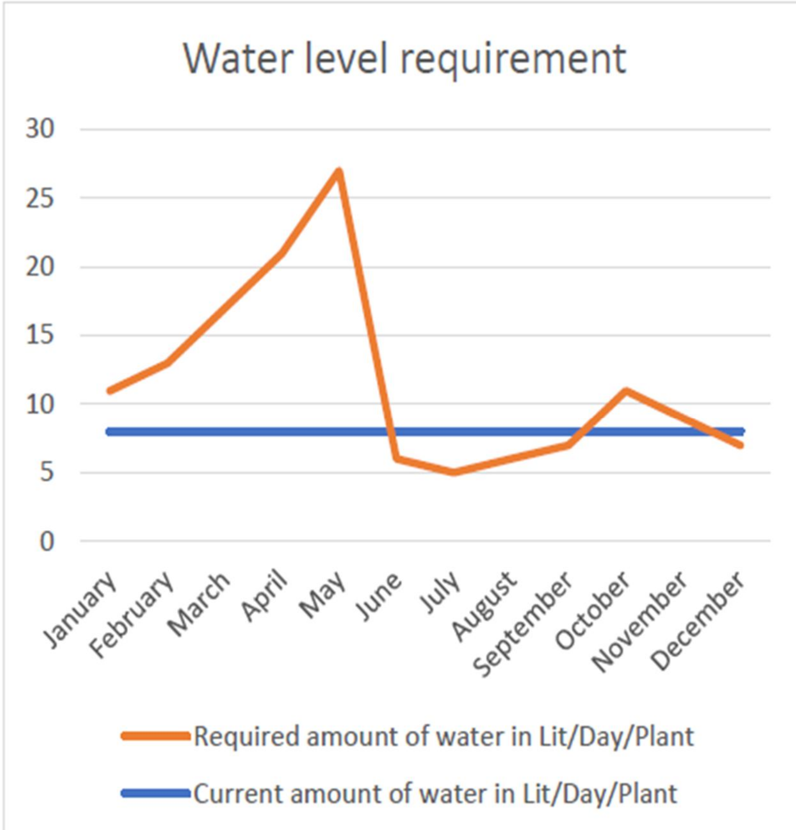

Fig. 5. Water level requirement

To check the repeatability, the system was utilized for 7days out of a column in the period of May where the plant requires on a normal of 27 liters of water for each day (Fig 6). Correct measure of water supply was not accomplished but rather the provided amount of water lies between the scope of required amount.

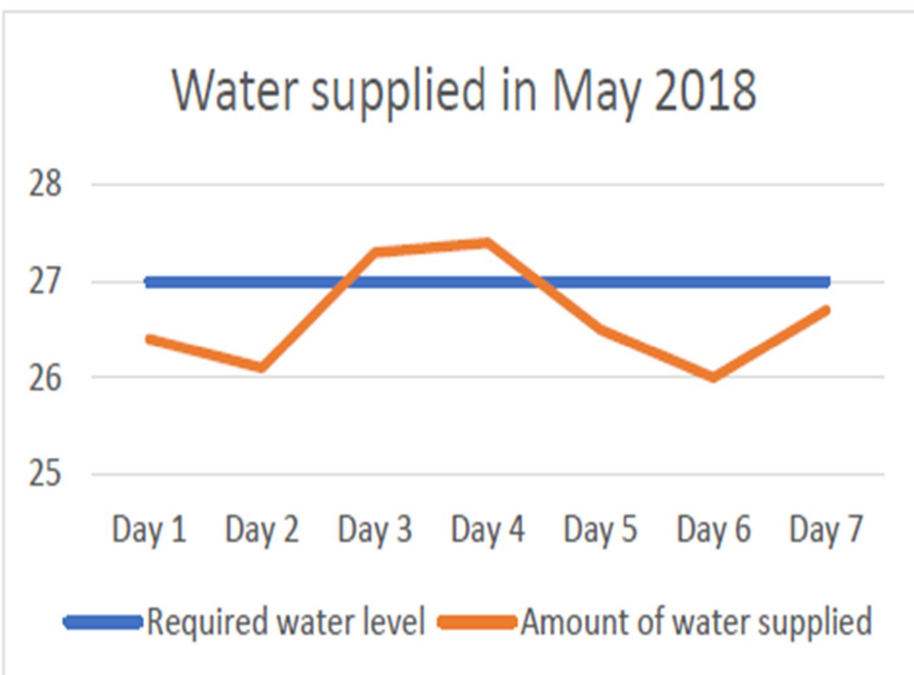

Fig. 6. Water supplied in May

VI. CONCLUSION

This paper has actualized three highlights principally drip irrigation, sensors estimations and weather information. To begin with, it clarifies the drip irrigation and how it is controlled by the Arduino mega 2560. The proposed system offers various advantages and can work with minimum labor. This system supplies water to the plants if the moisture of the soil goes beneath the reference level. Because of direct supply of water to the roots, preservation of water takes place and furthermore safeguards the moisture to soil proportion at the root. It is essential to take note of that such a system can spare a huge amount of water and has easier implementation. The framework is exceptionally simple, in this way making it recipient for a wide range of agriculturists. Thus, the system is water effective and enhances the plant development.

VII. ACKNOWLEDGMENT

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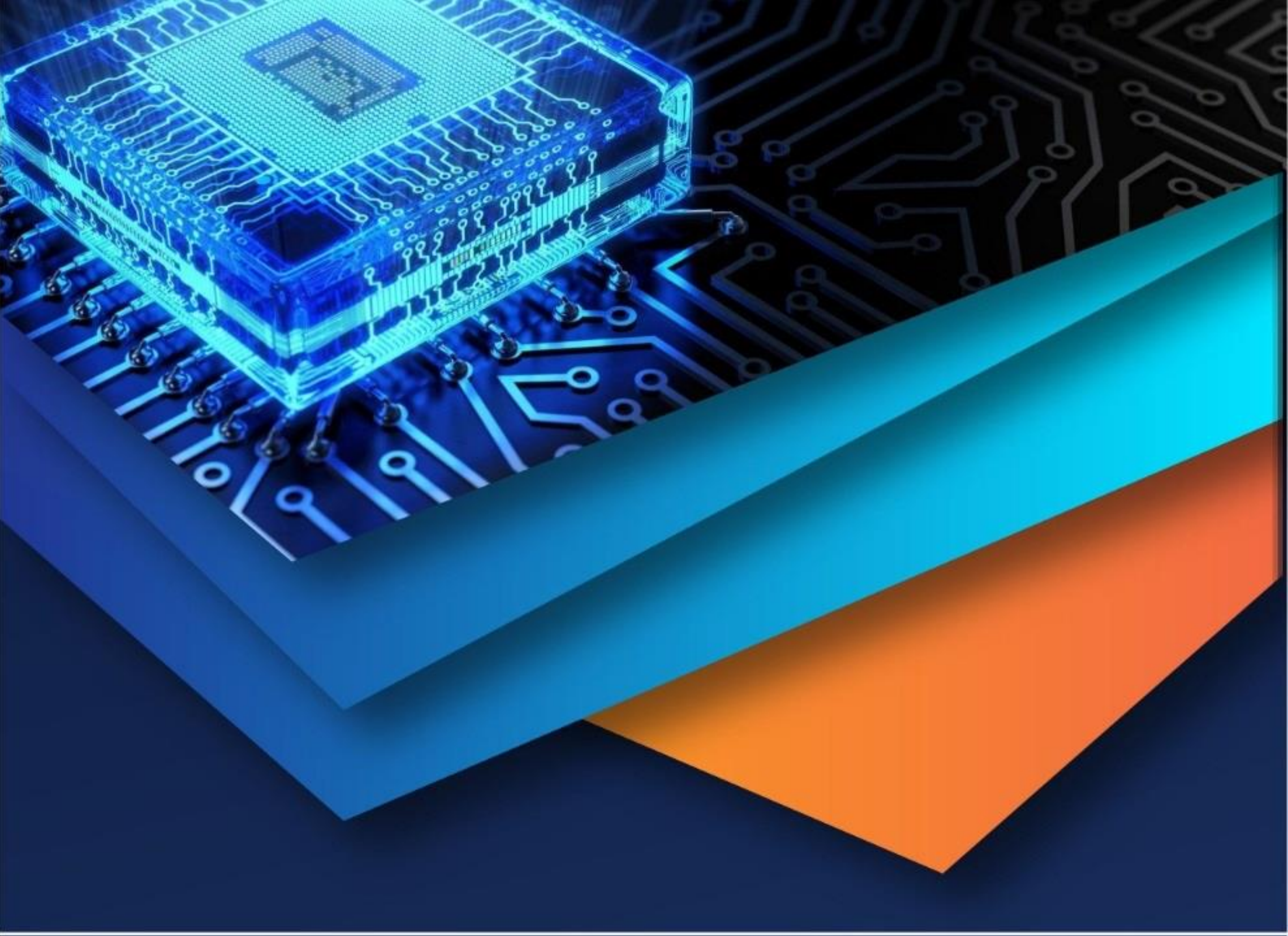

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