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Flood and Drought Management using IOT

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Abstract: ***"Internet" is a very familiar word in today's world. Nowadays whether it is inventions or advancement related to technologies, all are evolving around the internet. In today's era, the Internet has become a source through which people can get connected to the whole world. IoT is being used in various fields in identification and in mitigating the risk. This paper describes the process in which IoT can be used in notifying the people during the floods and can help in minimizing the casualties. The device contains the sensor which senses the water level and will send the data to the cloud, and people can access the data through the applications in their mobile phones. This paper also explains the methods using IoT through which we determine the quantity of water needed by any plant to be irrigated. Using this method, the goal of managing the water in a proper way can be attained.***

Keywords: Internet of Things (IoT), catastrophe, Agriculture, Sensors, Arduino,Calamities.

I. INTRODUCTION

Over the past amount of time, we have witnessed a mammoth number of advancements in the various fields of Science and Technology. In today's modern world, technology has made our life easier and more convenient. In this easy and convenient life, people have to go through some of the calamities such as floods and droughts. Advancement in technology is also a reason that led to environmental changes that have cause dome from Agriculture. The importance of water cannot be ignored in our day to day life but an increase and superfluous body of water or a perpetuate session of unnatural low rainfall, directing to scarcity of water can be ches and it results in heavy rain in some parts of India and scanty rain in the other parts leading to flood in one part and drought in the other part allenging to life. In developing countries like India, more than 72% of the total population depends upon agriculture for earning their livelihood. 17% of the total GDP comes from agriculture. Most of the farmers in India bank on the monsoon for watering their cultivation land, But the monsoon cycle has been disturbed for a few decades.

In a vast country like India, climatic conditions vary in every direction now and then. Owing to the fact of this, at some places crops are destroyed due to lack of optimum water whereas at other places it is destroyed due to excessive water due to rainfall, floods etc. So there is an immediate need for India to produce its agricultural products in the most efficient and productive ways through the medium of smart technologies like Smart Irrigation System

that will help them in providing the correct amount of water to the crops. Using this we can avoid the squandering of water, on the other hand it will produce a constructive way to bypass crop destruction. A Database can also be maintained to analyze the proper requirements of water regionally and according to the type of crop which will help the farmers in analyzing the data over the period of time. An arduino based water pump will automatically be switched on (with the help of sensors) if there is lack of water as per the crop requirements and a water suction pump will get activated (using sensors) if there is excessive water due to heavy rainfall or flooding conditions.

This paper addresses the above problem and suggests some devices which can be used to detect and to prevent the flood and drought on a regular basis, technology like IoT plays a crucial role in it. IoT devices are cost-efficient and are easily manageable, maintenance cost is less when we use sensors in IoT devices. Using the IoT technology, people can access the information virtually at any location.Risks involved can be reduced as the people will be aware of what situation will be in the future based on the data collected by the devices. Situation can be mitigated, and the loss of lives and properties can be prevented from an upcoming disaster if we have an alarming system, or the system which provides us data on the basis of which we can plan and use the water in a way that it can be used at the time of drought.

II. RELATED WORK

G. Balakrishna [1] talked about the past experience and what is ahead. Paper also talked about the challenges faced in the field of agriculture by the farmers and how the IoT can be proved helpful in tackling the issue. He put a light on how we can use the IoT device alone and also with different sensors like soil sensor, ph sensor and with technologies like data mining and machine learning. Machine learning and data mining are used in extracting the data and by analyzing that data the problems are detected and the solutions are generated by some calculations.

Algorithms of data mining are used in detecting the disease of crops and in finding the crop productivity factors. Paper also explains how to achieve the cost optimization using the IoT devices in agriculture by reducing the number of people. Using the devices we can increase productivity which will increase the profit.

Harmeet Kaur[2] describes how we can gain the GDP and agricultural growth, and how the structure is framed in Indian economy. She talked about the various issues that are being faced by the farmers like climatic change, water and irrigation management.

Meenakshi Roy[3] discussed what are the challenges faced by the people during flood and what are the methods through which we can alert them in advance and can help them in getting a shelter in an earlier phase of the flood. She talked about how an IoT device can be programmed with an arduino and can be synced with the cloud and users can access the data on their phones. Paper explains the way in which we can develop a device which will be cost efficient and will require low computation.

S.Surai[4] in his paper talked about various sensors like soil moisture sensor, temperature sensor, tilt sensor that are being used in IoT devices to detect the changes in the moisture, temperature and the movement of the object in the field.

Md Ashifuddin Mondal[5] has proposed the model which is using the idea of cloud computing with the IoT to enhance the property of the device.That device is used in a way that it reduces human intervention and the cost of farming will be reduced to a certain extent. Paper contains information about the threshold values that vary for different soil. Paper suggested that using the threshold value we can automate the irrigation system which will be helpful in managing the water wastage.

M.A. Abdurrahaman in [6] has proposed a device for the areas where water is scanty. The product is cost efficient as the product consists of sensors that are cheaper in price. System is designed in a way that it will control the flow of water whenever needed. Soil moisture level and temperature level is displayed on LCD. Based on the soil sensor level and the crop requirement, the water is poured to the plant.

V.V. Dixit and P.A. Bhosale[7] have proposed a low cost irrigation scheduler which is based on a microcontroller and is time dependent. Microcontrollers consist of various sensors which are used in detecting the soil moisture, temperature, humidity etc. The final data is captured and conveyed to the end user to their mobile phones through SMS.

J. Zhang [8] proposed a system which will be used to monitor remote areas which are based on wireless communication and Internet .The data will be collected in an information management system and will be used for research in agriculture.

Eric Samikwa[9] proposed a system which will be using the low power IoT wireless application. The paper talks about WSN technology that uses the low power sensors that are connected to the microcontrollers.

Azimah Abdul Ghapar[10] talked about different layers in IoT architecture namely perception, network and application. Paper explains the functions of each layer in detail.

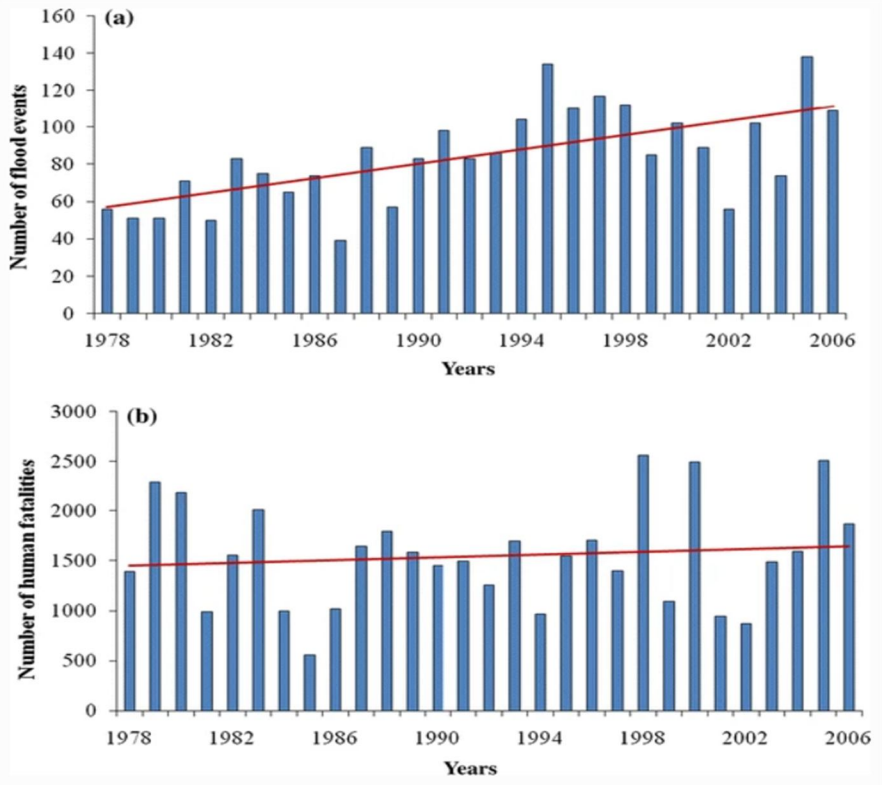
Herman Yuliandoko[11] proposed a device using a microcontroller,sensors and a dam prototype using IoT technology that will detect the water characteristics and will take the decision based on the status of flooding. Paper talked about the complexities faced when we use the rain gauges and river gauges in monitoring the flood.

There are many other papers which talk about the same but most of them talk about the automated irrigation system. This paper's objective is to work for villagers who do not have access to costly devices or mobiles.

III. IOT FOR FLOODS

Flood is very frequent in Indian states like Bihar, Assam, Kerala, and Uttarakhand. If we will see the recent incident of flood in Uttarakhand which occurred on 08th February 2021, more than 202 people were reported missing, while more than 20 people lost their lives. The graph is taken from google which shows the number of floods and the number of human fatalities that happened from 1978 - 2006. Graph a shows the number of floods that have happened and we can clearly see the increasing number of floods in the last 3 decades. In graph b as technologies are advancing the human fatalities are kept under control but with these low cost devices we can reduce this number significantly. These casualties would have been reduced in number if we would have warned the people in advance so they can seek shelter or evacuate if necessary. On the other hand, if we take the example of countries like the USA, where the loss of life has been mitigated due to the emergency devices present there which informs them in advance about these kinds of incidents like thunderstorms, floods or cyclones.

From the example above, we may conclude what impact a device can have in the coup of the disaster. But developing an effective emergency system is a problem for the underdeveloped/ developing nations. Developed countries have a better economy than the countries which are developing, so the usage of resources is not limited. Warning system seems to be an expensive deal for the undeveloped countries. We need some technology through which we can develop the devices which are cost effective and proved to be reliable for the device and the computation.



For problems like this, the Internet of Things (IoT) can be used as a solution, in which a low-cost sensor will be used to detect the temperature, level of water, precipitation etc. This device also carries an Arduino controller, a display, a Wi-Fi, an IoT platform and an application that will run on an android operating system.

Device consists of sensors, which will measure the weather- related report and will monitor the data on a regular time interval. Obtained data will be sent to the Arduino on a regular basis. Arduino will look for any dissimilarities and will perform the calculations. Calculated data will be then sent to the IoT platform using Wi-Fi connections. Final value will be displayed on the LCD. Same can be viewed on the android Platform. There will be a fixed Threshold value up to which the data can be ignored. Values above the fixed Threshold value will trigger an alarm or will send the notification to the android users.

On Performing the experiment in a container in which the water was filled up to a certain limit, as the value goes above the fixed Thresholds, the alarm was triggered. These devices are placed near the water sources or outside the border of the village/city so that people will have sufficient time to act.

A. Implementation Overview

1) Hardware Required

a) Humidity and Temperature Detecting Sensor (DHT 22/AM2302): DHT 22 sensors are used to measure the amount of moisture and water vapour present in air and Temperature.

b) Arduino: The arduino is the central part of the device, sensors are attached to the arduino and sensors perform their task in a well synchronized way. Arduino can be considered as the heart of the device

c) LCD Screen: A LCD screen is used to display the output.

d) Float Sensor: Float sensors are used to detect the water level, when the level of water rises above the sensor, the sensor rises up to the surface of water. This sensor is connected to the circuit, when the level of water rises this sensor floats up which generates the stress and an alarm is generated for the users indicating a rise in water level.

e) HC- SR04 - Ultrasonic Sensor: HC- SR04 is an ultrasonic sensor which is used to detect the distance of the water level from the sensor and the amount of water. These devices emit the ultrasonic wave and the wave is then converted into an electrical signal.

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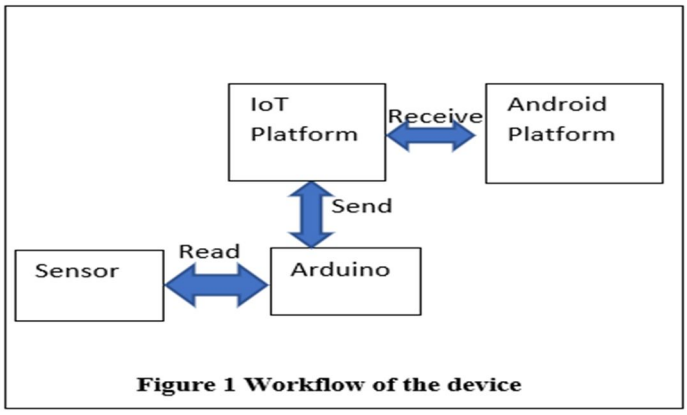


Figure 1 Workflow of the device

2) *Software Required:* The device is integrated with an android application that is made for the convenience of the users. Applications are easy to use and every user can have the accessibility to view the data as and when required. Notification will be sent to the users in advance if there is any possibility of flooding in their areas. We can take the example as if the level of water rises in dam/rivers/containers (in this case a container is used at the time of practice), the device is designed in a way that it can detect it and application is flexible enough to alert the users in advance such that the casualties can be avoided. The application can also be proven reliable in real time by providing the flow rate of the water, what is the temperature and the humidity of water, and the distance of the ultrasonic sensor from the water level. Versatility of the application makes it user friendly. Only the required data is displayed to the user to avoid the complication.

IV. IOT FOR DROUGHT

As mentioned earlier, farmers in countries like India mostly depend upon the monsoon for agriculture. Primary source of water for nearly 55% of the Indian population depends upon the monsoon. The rainwater is collected in nearby dams or canals and are used by the farmers in future for irrigation purposes. This scenario is helpful when the rain continues in the season, but the situation gets worse when the farmers harvest the crops in the hope of good rain and the rain stops in the mid-way of the season. The situation of drought takes place. If we look at the previously used practices, farmers at the time of drought used to go to their land early in the morning, and they used to collect the data from each irrigation site basically by digging the hole in the farms and watering it and by analyzing the data obtained from it, they further plan in what way they have to manage the water. As it is a manual process, it requires a lot of time and the results are not accurate all the time. Farmers are not aware about the amount of water that is needed by any plants. As the area of irrigation is vast, farmers are still using the predetermined way of irrigation for watering their fields. Amount of water sucked by the plants in some cases is more than that required. For example, Avocado trees can be taken as an epitome, these plants are known for absorbing the extra amount of water. If the farmer is not aware of exactly what amount is sufficient, he will keep watering the plant until he gets satisfied by himself that this amount is enough, the stored water goes in vain and then the problem arises. IoT can be a solution to this problem. Using this technology, the regular irrigation will be turned into automation irrigation. Soil moisture sensors can be a good pick that will help the farmers in conserving the water for a long time by ensuring that an ample amount of water is delivered to the crops. This irrigation method depends on the moisture of soil rather than the practiced way of irrigation in which water is provided on a regular basis. To avoid this kind of situation, we are applying soil moisture sensors. Volumetric water content sensors are used, which is used to determine the volume per liquid water to the soil. Volumetric water content (VWC) can be used to measure the soil water deficit for the scheduling of the irrigation. Irrigation can be scheduled based on the crops. Soil water content will be different for each crop at which they start experiencing the need to be irrigated or also called stress. Point when stress reaches to 30-50% of available water content, it is called as irrigation trigger point. Irrigation trigger points can vary from crop to crop or on the growth of the plant. These sensors will be attached to the Arduino that will notify the farmers based on the calculation of soil water depletion, when the moisture of soil starts decreasing than the normal. In rustic areas, network connections are the most challenging thing, for the proper working of any IoT device, we need a good internet connection otherwise it will be the same as manually checking the water levels. Customized IoT networks that are used to connect all the devices to a single point can be a perfect solution. As the farmers reside away from the irrigating land, he will irrigate whenever required to provide the fixed amount of water that is needed by the plant and will stop the irrigation once the plant gets sufficient water.

A. Implementation Overview

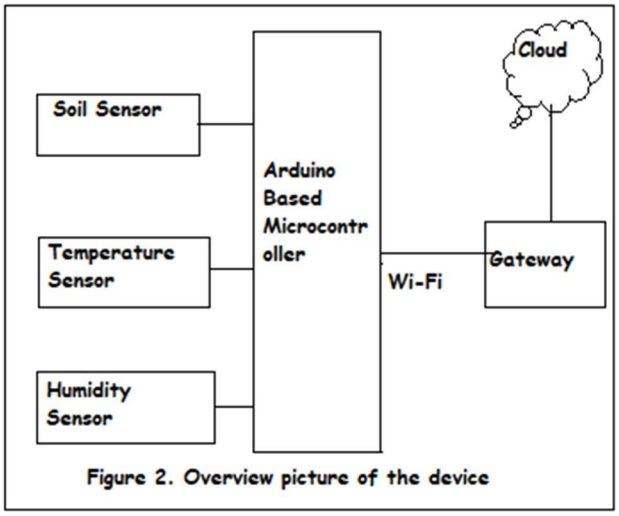


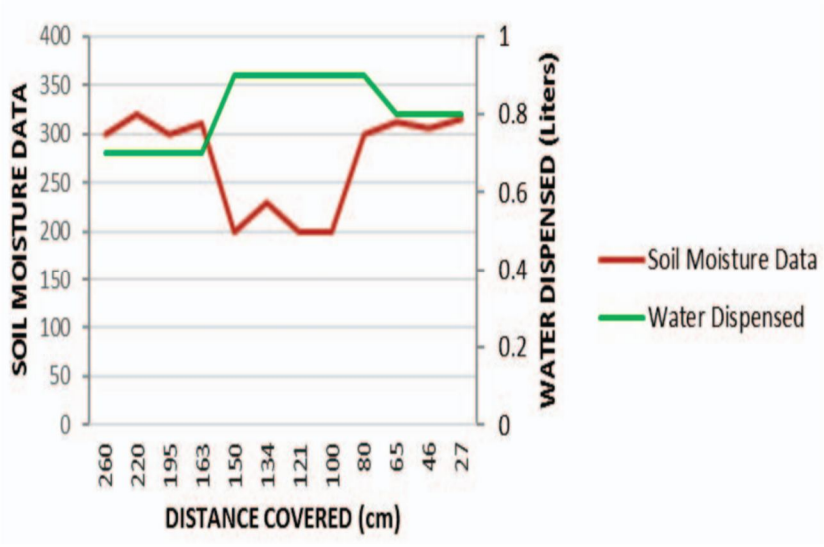
Figure 2. Overview picture of the device

1) Soil Sensor will detect the moisture present in the soil. EC-5 sensor can last upto 3-5 years which is cost efficient. More moisture will lead to less resistance and less moisture will result in high resistance. We can also say that resistance is inversely proportional to moisture.

2) Arduino board is used as a base for microcontroller onto which all the sensors are attached.Soil moisture sensor, temperature sensor and humidity sensor sends the data collected from the field to the arduino based microcontroller and the calculation is done here to see whether the irrigation is needed or not. If the threshold value is less than the expected value then it will turn on the irrigation mode. The proposed system takes 17% as the threshold value.

3) Sensed data from the field is then feeded to the cloud through a gateway. Wi-fi is used to communicate with the gateway instead of bluetooth because farmers reside far away from the field and wi-fi will give a higher range.

4) Final data will be displayed on the screen of the application which will be used by the end users. The data will be taken from the cloud.



The above graph shows how sensors will work and dispense water when it is necessary. Above graph is a 3 axis relation where soil moisture data will be collected from the IoT device and if the data is below the threshold value which is needed for that specific vegetation. Water dispensed value is in liters per minute. Distance covered shows the distance one IoT device can cover. This specific graph is for rice cultivation which requires a high amount of water for best results.

V. CONCLUSION

Disaster, the word itself suggests, destroys the lives and properties of the people irrespective of countries across the world. However, developing countries had to pay much more compared to the developed countries. Ramifications are worst in developing countries. As the famous proverb says "Prevention is better than cure", we can save the lives of people and prevent loss of the properties at a correct time if we will be having these devices which helps us in curing the problem at a correct time. Flood and drought can all be easily detected when it occurs, but with the help of IoT, we can detect it in the early phase, and we can warn the people about it. Through these well-equipped devices, we can get ample time to evacuate the place and to secure the property. These devices can be well used in the field of agriculture to tackle the problem of farmers during drought. Farmers won't have to be present at the field all the time to irrigate the field and the manual intervention will be less. As of now, a micro-model using a prototype has been built up : sensor utilization was key in gaining the necessary data required for detecting the drought and in monitoring the flood event, a live-demo has been performed for the end users. This system can further be used in solving the real-life challenges, by providing relief to the areas which are subjected to drought and flood.

Our future work includes the changes in the algorithm and using machine learning so that farmers can irrigate their field from an android mobile and if there is excess water in the field which can damage their vegetation, they can use a motor to guide those water to another field where water is needed or to a well.

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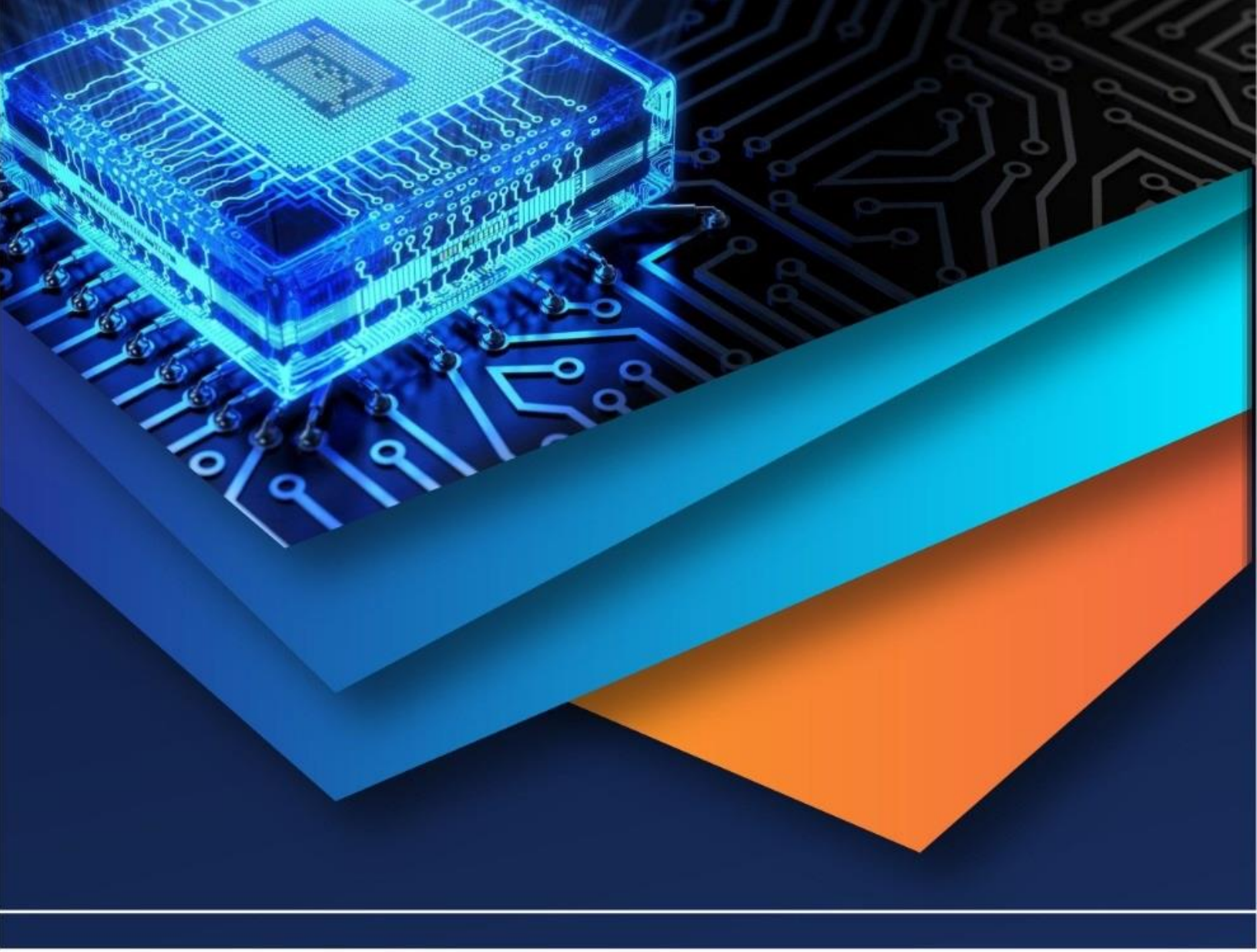

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