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Water Quality Monitoring System using Smart Sensors

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Abstract: ***Water pollution is one of the biggest fears for the green globalization. In order to ensure the safe supply of the drinking water the quality needs to be monitor in real time. This project present a design and development of a low cost system for water quality monitoring system in water tank. The system consist of several sensors which is used to measure physical and chemical parameters of the water. The parameters such as pH, turbidity of the water can be measured on real time basis. This system displays the measured values on LCD, and the GSM is also used for remote monitoring purpose. This will help to know the water quality at consumer level. The sensors are interfaced with ARDUINO UNO controller and SIM300 GSM module is used for data transferring. The system is very reliable & can work for a long time. It also helps to reduce the manpower. The proposed system is an embedded system which will measure the different physical and chemical parameters of water in water tank based on the predetermined standard range of the pH and turbidity value. This system is incredibly versatile and economical. As a result, by replacing the sensors and modifying some changes within the computer code the system will be created to measure completely different parameters of water. The system is reliable, easy and it will be extended to measure water pollution and so on. It is used as a widespread application.***

Keywords: Water quality Monitoring, pH Sensor, Turbidity sensor, GSM, Arduino UNO.

I. INTRODUCTION

The proposed monitoring system of water quality in water tank consist of two sensors pH, turbidity this sensor will sense the physiochemical water parameters in the water tank and then compare it with the standard ranges of pure water and turbidity water. These physiochemical parameters are used to detect water contaminants. The sensors, which are designed from first principles and implemented with signal conditioning circuits, are connected to a microcontroller-based measuring node, which processes and analyzes the data. In this design, GSM receiver and transmitter modules are used for communication between the measuring and notification nodes. The notification node presents the reading of the sensors and outputs an buzzer alert when water quality parameters reach unsafe levels. Various qualification tests are run to validate each aspect of the monitoring system. The sensors are shown to work within their intended accuracy ranges. The measurement node is able to transmit data by GSM to the notification node for audio and visual display.[1]

In this method, an ATMEGA328P microcontroller is used as the core controller of the system. Once the code is uploaded to the microcontroller, the system functions automatically and independently according to the code uploaded to the microcontroller. Embedded C language is used for programming. In this system, two sensors are used to measure the water parameters. As it was studied from the previous researches, the most essential water parameters such as pH, Turbidity level are needed to be monitored manually by the average users.

Sensors circuits are connected to the microcontroller and the probes of the turbidity, pH sensors are placed inside the water. All sensors read the water quality parameters and send the data to the microcontroller in the form of electrical signals. The microcontroller is programmed such that it will analyze the result and compare it with the standard ranges which are preprogrammed in the code.

If the water parameter crossed the standard range, the system will turn on and the message will be displayed on the LCD display and user will also receive message via GSM module. A LCD (Liquid Crystal Display) display is used to display the water physiochemical parameters of water which is inbuilt in the device itself.

In order to communicate with the users, who monitor the quality of water from a far distance, a GSM (Global System for Mobile Communications) network is used. The GSM module is connected to the microcontroller and programmed so that it will receive a copy of the analyzed data from the microcontroller and sends it in the form of SMS (short message service) to the user's mobile.[3]

GSM module is an information transferring module which is based on dual tasking both transmission and receiving simultaneously. The message sent to the user's mobile include all the data readings of the sensors as well as the condition of the water quality compared with the standard ranges. Two mobile numbers can be registered in the system in order to avoid the problems caused by any interruption in the mobile service provider networks. This project are designed and operated to treat contaminants known to occur in source water, completely in drinking water standards, and meet customer expectations. Unanticipated changes quality or the presence of unusual contaminants in source water can adversely impact the ability of a utility to meet these objectives. Proposed design can improve a ability to detect variations in source water quality. Provide information to facilitate protection of the public water supply for all intended uses. Observe long-term trends in source water quality to prepare for future challenges or regulations.[2]

SWM (source water monitoring) involves the measurement of various water quality parameters in source water or watersheds. An SWM location is the site in a water body where water is sampled for measurement automatically. SWM locations are selected relative to control points, which are locations where a treatment process can be modified (e.g., addition of pretreatment chemicals) or a response action can be implemented (e.g., closing an intake). SWM stations are installed at or near SWM locations and consist of online water quality instruments that measure parameters and communications equipment that transmits data to a central location, such as a utility control center.

II. PROPOSED METHODOLOGY

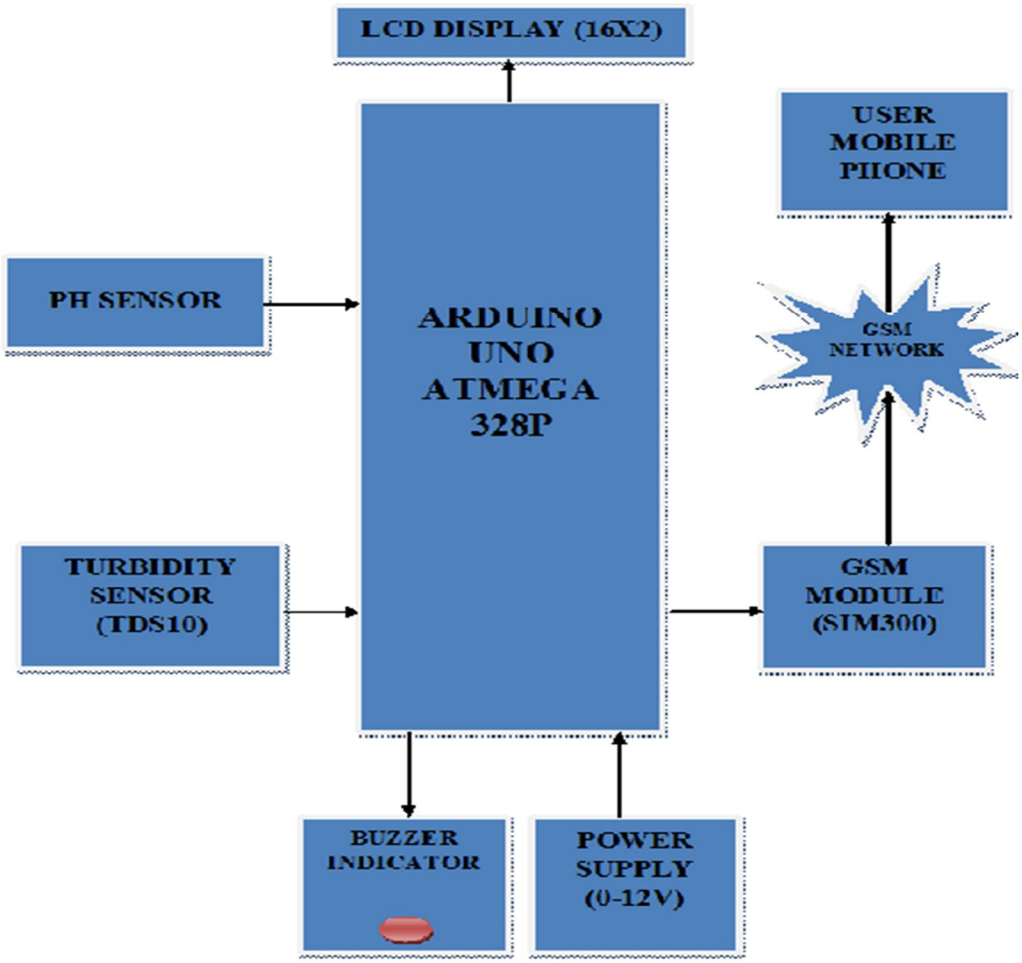
An objective of proposed system is to provide methods of Automatic Water Quality Monitoring and Notification System in water tank which saves time and resources of human by notification system. This notification will be get by Authorized person when sensor will detect bad water quality and if any user wants to know the current status of the water just he need to give the miscall to the our GSM system. For this features, our System has a mobile device and field setup device to monitor water quality remotely.[4]

This system has Turbidity sensors, pH Sensor to detect physiochemical parameters present in water. This system which provides instruments/tools present in water tank setup device which automatically detect and store the captured water quality parameters in local storage of the portable monitoring device. Even this system has small display unit present in water tank setup device to see the water quality parameter at home without any separate mobile device. It also has GSM module present in water tank setup device to accept the commands given by the mobile device remotely and it send to controller unit. The result of the command processed by a control unit is sent back to mobile device as SMS. Through this device it is possible to have 24x7 monitoring module which keeps monitoring the water quality round the clock.[3]

The System also has functionality of monitoring the water quality 24x7 and if it detects the water quality to be unusable or dirty and the quality is poor and impurity of water is above the standard threshold value then an alert message is send to authority automatically as text message so that the concern authority like head of apartment or owner of the house or the head of the water resource/reservoir management can take appropriate and timely action.

Figure1 shows the block of this system. This system has a water tank setup unit which does the task of actual monitoring of water quality parameters. It has a sensor mechanism to monitor the water quality parameters. The sensors input end is put in water tank to be tested and the output of sensors is captured and processed further. Water tank setup unit has a controller mechanism to process the data of water quality parameters and the command sent by the user using mobile device. The controller unit in this mechanism can be an embedded processor or microcontroller or a smart device like Arduino UNO. The controller unit can perform the water quality analysis by using the parameters given as input by various sensors and send it to user as SMS. The controller can also interpret the commands send by user as SMS sting and can perform the task intended by the string command. It has a display unit to display data of water quality parameters. The display unit can be a simple 16X2 LCD display. The water tank setup unit has a GSM module to communicate with user mobile device. The GSM module is capable of receiving the command strings from user mobile device and sending it in turn to controller unit for processing. The GSM module also sends the result of the command string sent by user as SMS response. It also has a Mobile device provided to end user to communicate with field setup unit via GSM module. The user mobile has a SIM which is registered with field setup unit and using this SIM, the user can query the system to know the water quality parameter via SMS response from field setup unit. The mobile device can also issues the relevant commands to the controller unit to perform various processing tasks of the controller unit. It has functionality of accepting the miss call from the user which is then sent to the monitoring unit of the system. The system will immediately capture the water quality details by instant monitoring the water and the result as text message is sent to the user via GSM module of the system. It has functionality of monitoring the water quality 24x7.The continues water quality monitoring module detects the water quality after certain

predefined time slice and checks that whether the water is unusable or dirty. If quality of water is poor and its impurity is above the standard threshold value then an alert message or notification is send to authority automatically as text message so that the concern authority like head of apartment or owner of the house or the head of the water resource/reservoir management can take appropriate and timely action.



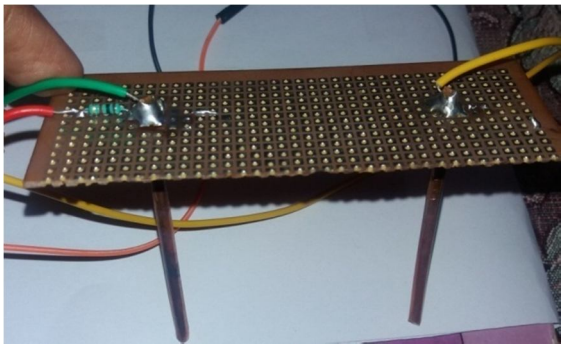
Figure(1)

III. COMPONENTS AND ALGORITHMS USED IN PROPOSED SYSTEM

In our proposed system we are working with pH sensor, turbidity sensor, Arduino UNO.

A. pH Sensor

A pH meter will be made up of a two electrodes. This electrode passes electrical signals to a analog input of the arduino which displays the reading in pH units. Here we have two electrodes one is connected to positive voltage through 1k resistors shown in fig(2). And other electrode is a reference electrode. The electrode is welded with the plastic dot board at the end of the measurement electrode consist of lithium ions doped to it which makes it act as an ion selective barrier and allows the hydrogen ions from the unknown solution to migrate through the barrier interacts with the plastic, developing a electrochemical potential related to the hydrogen ion concentration. The measurement electrode potential thus changes with the hydrogen ion concentration. On the other hand, the reference electrode potential does not changes with the hydrogen ion concentration and provides a stable potential against which the measuring electrode is compared.

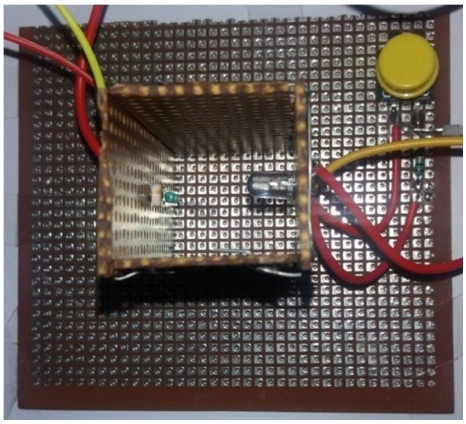


Figure(2)

B. Turbidity Sensor

Turbidity is defined as the reduction of transparency of a liquid caused by the presence of undissolved suspended matter. Turbidity is the measure of water clarity. These impurities in the water decrease the passage of light through the water. Turbidity sensor measures the cloudiness by measuring the quantity of light scattered at ninety degree. Turbidity sensor based on the operation of LDR and LED. This sensor uses light to convey information about turbidity of water. It has two horns like structure having top to bottom mono material body with a brown colored cap at the bottom.

The thick alloyed contact legs provide means for various connectors to hold the sensor. A white plastic slab protects the legs from damage and acts as fixture for good clamping .Outer part is covered with plastic so that it can survive high variations and mechanical abrasion. It works on 5V DC supply and current up to 30mA. It operates on temperature ranging from -10ºC to +90ºC.



Figure(3)

C. Arduino UNO

The device is manufactured using Atmel's high density non-volatile memory technology. The On-chip ISP Flash allows the program memory to be reprogrammed In-System through an SPI serial interface, by a conventional non-volatile memory programmer, or by an On-chip Boot program running on the AVR core. The Boot program can use any interface to download the application program in the Application Flash memory. Software in the Boot Flash section will continue to run while the Application Flash section is updated, providing true Read-While-Write operation.

By combining an 8-bit RISC CPU with In-System Self-Programmable Flash on a monolithic chip, the Atmel ATmega48PA/88PA/168PA/328P is a powerful microcontroller that provides a highly flexible and cost effective solution to many embedded control applications. The ATmega48PA/88PA/168PA/328P AVR is supported with a full suite of program and system development tools including: C Compilers, Macro Assemblers, Program Debugger/Simulators, In Circuit Emulators, and Evaluation kits.

D. Algorithms

1) Read the sensor values from Initialize, pH _count, Turbidity _count
2) PH _count=output value;

```
3)  Turbidity_Count=  Output value 1;
4)  if (buttonState == HIGH)
5)  {
6)    if(outputValue>=150 && outputValue<=165)
7)   {
8)    mySerial.println("AT+CMGF=1");
9)     delay(1000);
10)   mySerial.println("AT+CMGS=\"+91xxxxxxxxxxxx\"\r");
11)   delay(1000);
12)    mySerial.println(outputValue-140);
13)     delay(1000);
14)     mySerial.println("Solution is Basic; Harmfull Water");
15)      delay(100);
16)       mySerial.println((char)26);
17)      delay(1000);
18)           }
19)    if(outputValue>=11 && outputValue<=20)
20)     {
21)           mySerial.println("AT+CMGF=1");
22)           delay(1000);
23)           mySerial.println("AT+CMGS=\"+91xxxxxxxxxx\"\r");
24)           delay(1000);
25)            mySerial.println(outputValue-8);
26)            delay(1000);
27)             mySerial.println("Solution is pure water");
28)             delay(100);
29)              mySerial.println((char)26);
30)              delay(1000);
31)              }
32)          if(outputValue1>=492 && outputValue1<=427 )
33)    {
34)      mySerial.println("AT+CMGF=1");
35)     delay(1000);
36)     mySerial.println("AT+CMGS=\"+91xxxxxxxxxx\"\r");
37)     delay(1000);
38)     mySerial.println(outputValue1-430);
39)     delay(1000);
40)     mySerial.println("Solution is chemical; harmful Water");
41)     delay(100);
42)      mySerial.println((char)26);
43)     delay(1000);
44)    }
```

45) Send command to controller unit

a) Command processing by controller unit

b) Ger command processing output from controller unit

c) Send command processing output to mobile

d) Check whether system signal is ON or OFF

46) If ON then go to step 2

47) If OFF then stop.

IV. RESULT

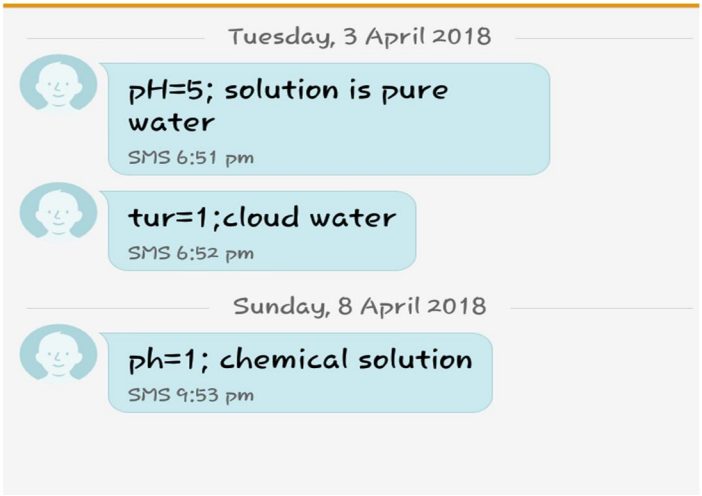
A. *Measured value on LCD*

a. Fig(1.1)

b. Fig(1.2)

b. Fig(1.3)

B. *Measured value on GSM via SMS*



Fig(2.1)

V. CONCLUSION

Water quality monitoring system using smart sensors is associate economical system that uses water detection device and GSM network. The system is reliable and easy and uses low cost components i.e. Arduino UNO, GSM, LCD screen and other nominal components are used to achieve the objectives of the proposed design with acceptable accuracy. Compared to the previous related works, the cost of the system prototype is considerably low. It's real time system that measures physiochemical parameters present within the water with the assistance of device and send them to the user mobile.The designed system is used to test the water for various dose responses for more type of infection in a sample, at the various temperatures. This water quality sensor model is very beneficial for the society in various application of water. This work is used to design the system to study the water sample. The sample food material is checked under the different atmospheric condition. The impurity is added in the testing material is analyzed at the different interval of time by the monitoring pH value and by measuring the hardness of water. Chemical solution can also be measured using this pH sensor, in this proposed system hydrochloric acid solution can be tested using pH sensor. pH value of hydrochloric acid is 3.This system help us to reduce water impurity in the house owned water tank.

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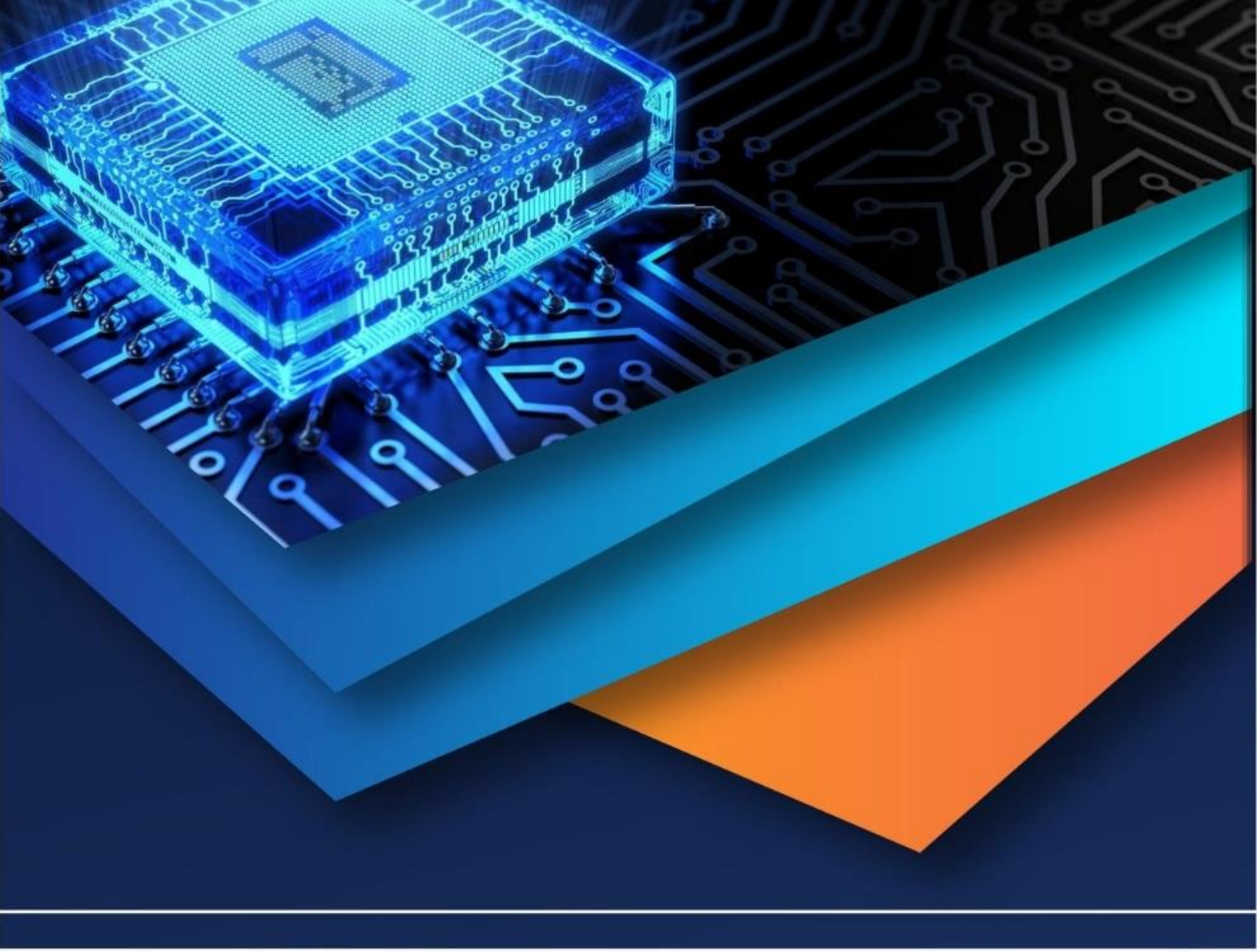

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