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Aquaculture Maintenance using Raspberry Pi and Zigbee

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Abstract: ***This paper presents the prototyped design of a wireless sensor network for shrimp pool in aquaculture. The system design in this paper includes a Raspberry Pi 3connected to Arduino Uno, Zbee S2C module, temperature sensor and other devices like Fan, aerator, light, DC motor and camera. These results of this help farmer log in apache server to check the temperature and manage the pool by auto-turn-on Fan when it is hot or turn on/off the aerator by the internet, control DC motor in 100m by Zigbee protocol or capture picture every 5 seconds to look at their pool when they are far away.***
Keywords: temperature sensor and camera

I. INTRODUCTION

Aquaculture is one of the thriving areas in many countries in the world since demand for fish and the fish prepared food is expanding day by day. According to The United Nations Food and Agriculture Organization (UNFAO) "2012 State of World Fisheries and Aquaculture ", Worldwide yearly production of fishery items add up to around 128 million tons. The animal protein intake per individual is about 15% and increase the human reliance on fishery resources. The average consumption of fish products is 19 to 20 kg per person per year today and will be 16.7 kg per year in 2030 according to UNFAO. Production of fisheries, advancement and future food needs are firmly related

Aquaculture comprises of the set of exercises, information and techniques for the rearing of aquatic plants the and a few animal groups. This activity has an awesome significance in financial improvement and food production. Commercial aquaculture is confronting numerous issues because of sudden climatic vacillation leading to changes in water quality parameters. Aqua farmers are relying upon manual testing for knowing the condition of the various parameters of the water. But this manual testing is time consuming and also give inappropriate results as parameters for measuring water quality changes continuously. It will be better if automatic monitoring can be done somehow. So modern technology should be brought to aquaculture to overcome this problem. For rural development, technologies have to support several key application areas, for example, living quality, wellbeing, environmental change etc. [20]. So we have to be more selective in choosing the appropriate technologies for this kind of advancement.

An integrated on chip computer Raspberry Pi is used in our system as data processing and storing device which has an inbuilt Wi-Fi module. Using the Dataplicity service we can also access the Raspberry Pi through internet [18]. So, no additional Wi-Fi or Internet module is required. Smartphones are very obtainable and most of the smartphones have Media Transfer
Protocol(MTP) today. Using these and performing some analysis on the water quality parameters make our work unique.

II. EXISTING SYSTEM

The existing system is manual based monitoring system in which the man power is needed for checking the temperature, pressure, humidity, PH level and pressure etc…..

A. Drawbacks

1) No wireless Communication.
2) Lack of continuous monitoring.

III. PROPOSED SYSTEM

In this system, many devices can be connected and controlled by relays 5V supplied from Raspberry Pi 3. The Fan or light were connected to relay modules with high level trigger and enabled by each python script separately. The Coordinator and Router Xbee were configured by XCTU and the MAC address of this one is the destination address of another. Using this Zigbee protocol helps our connection can be extended more 100m range in large pools in real life.

A. Advantage

The data will directly update to the Node Section and Fast Response

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IV. PROJECT DESGIN

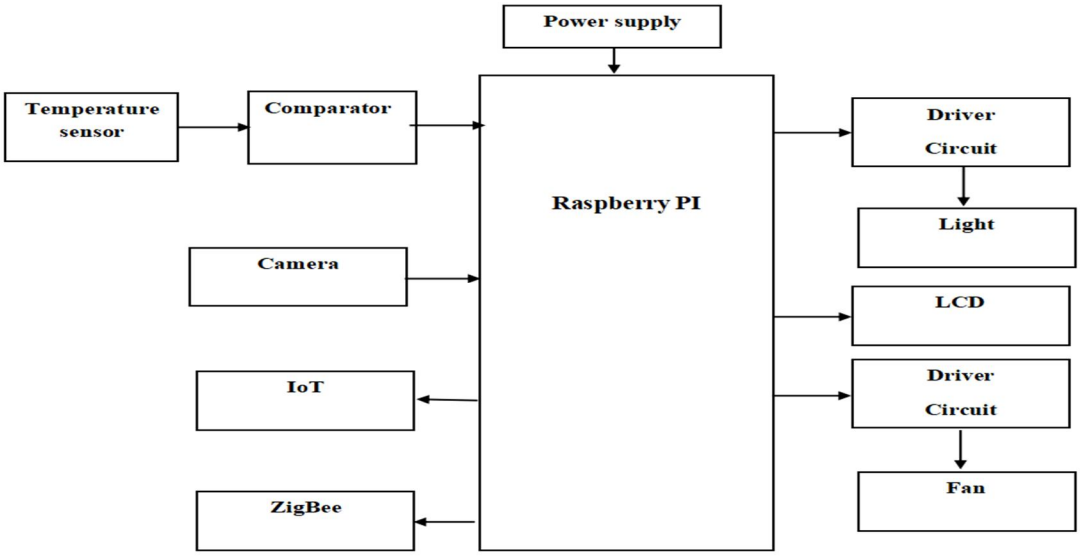

Fig: Block Diagram

A. *Temperature Sensor(LM35)*

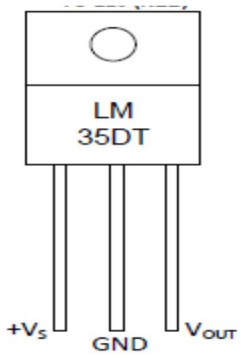

FIG: Temperature sensor (LM35)

The LM35 series are precision integrated-circuit temperature sensors, with an output voltage linearly proportional to the Centigrade temperature. Thus LM35 has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from the output to obtain convenient Centigrade scaling.

B. *Zigbee*

ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power, wireless sensor networks. The standard takes full advantage of the IEEE 802.15.4 physical radio specification and operates in unlicensed bands worldwide at the following frequencies: 2.400–2.484 GHz, 902-928 MHz and 868.0–868.6 MHz

1) The power levels (down from 5v to 3.3v) to power the zigbee module.

2) The communication lines (TX, RX, DIN and DOUT) to the appropriate voltages

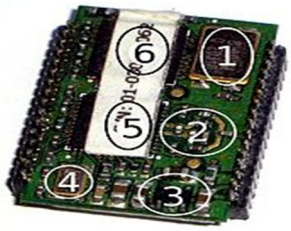

FIG:Zigbee module

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C. Raspberry Pi

The Raspberry Pi is a series of credit card–sized single-board computers developed in the United Kingdom by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools and developing countries. The original Raspberry Pi and Raspberry Pi 2 are manufactured in several board configurations through licensed manufacturing agreements with Newark element14 (Premier Farnell), RS Components and Egoman. The hardware is the same across all manufacturers.

This block diagram depicts models A, B, A+, and B+. Model A and A+ and Zero lack the Ethernet and USB hub components. The Ethernet adapter is connected to an additional USB port. In model A and A+ the USB port is connected directly to the SoC. On model B+ the chip contains a five-point USB hub, of which four ports are available, while model B only provides two. On the model Zero, the USB port is also connected directly to the SoC, but it uses a micro USB (OTG) port.

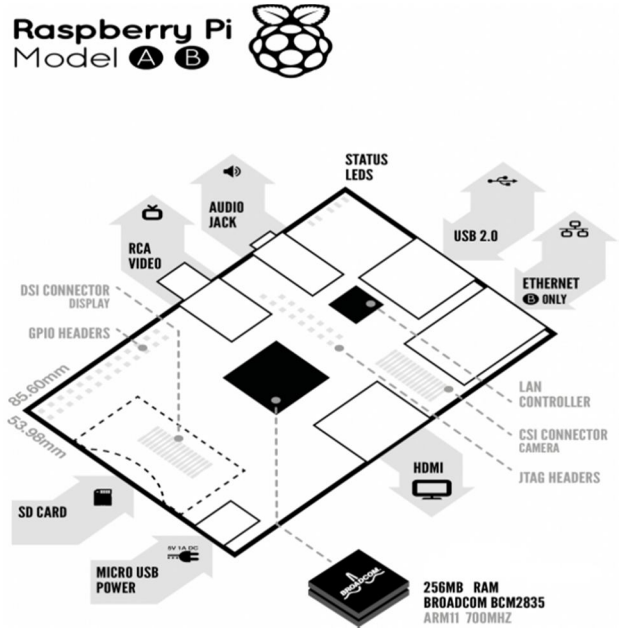

Figure : Block Diagram of Raspberry Pi

D. ULN2003:(Driving Circuit)

The ULN2003 is a monolithic IC consists of seven NPN darlington transistor pairs with high voltage and current capability. It is commonly used for applications such as relay drivers, motor, display drivers, led lamp drivers, logic buffers, line drivers, hammer drivers and other high voltage current applications. It consists of common cathode clamp diodes for each NPN darlington pair which makes this driver IC useful for switching inductive loads.

E. IOT

Internet of things (IoT), is another advance technology in IT sector, provides internetworking for numerous of devices such as sensors, actuators, PLCs and other electronic embedded smart devices and controls, and various software's' and provides systems network configuration and connectivity, which enables communication between these numerous devices for information exchanging.

F. Camera

Specifications

1) *Image Sensor:* High quality COMS Sensor
2) *Capture Image:* 640*480
3) *Frame Rate:* 30 FPS/VGA
4) *Min Sensitivity:* 2.0 V / Lux.
5) *Sec Focus Range:* 20mm to extremely close.
6) *Vision Depth:* 50mm infinity
7) *Flash Control:* Frequency 50 Hz

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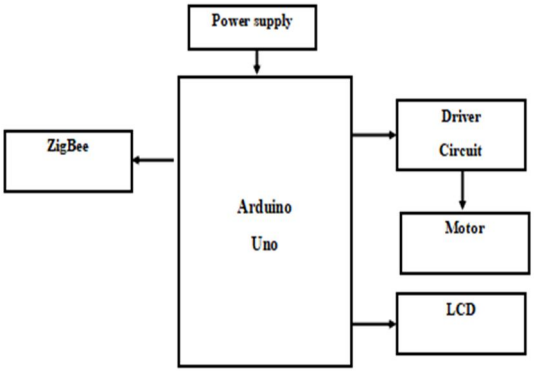
G. Block Diagram Node Section



1) *Arduino Uno:* Arduino/genuino uno is a microcontroller board based on the atmega328p (datasheet). It has 14 digital input/output pins (of which 6 can be used as pwm outputs), 6 analog inputs, a 16 mhz quartz crystal, a usb connection, a power jack, an icsp header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a usb cable or power it with a ac-to-dc adapter or battery to get started.. You can tinker with your uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. The uno board and version 1.0 of arduino software (ide) were the reference versions of arduino, now evolved to newer releases.

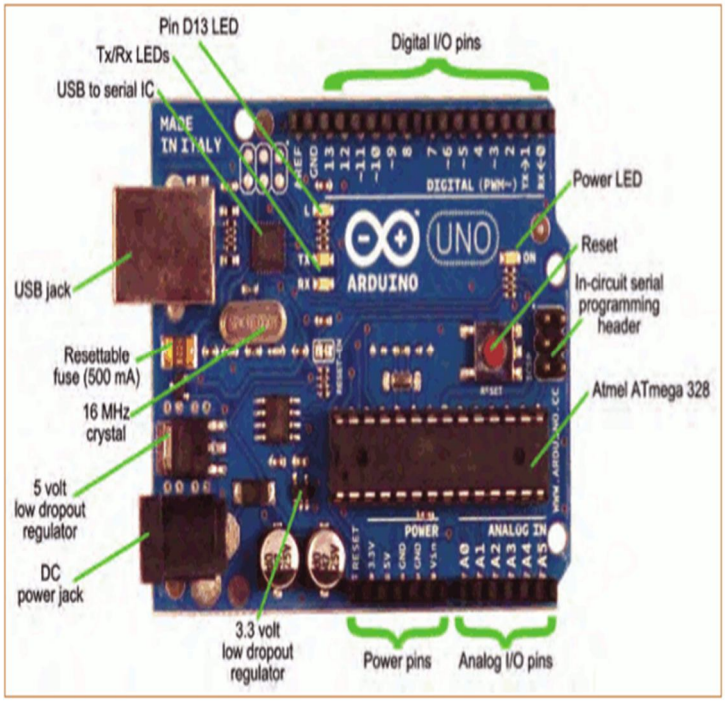


Fig: Arduino

2) *DC Motor:* A DC motor in simple words is a device that converts direct current(electrical energy) into mechanical energy. It's of vital importance for the industry today. A DC motor is designed to run on DC electric power. Two examples of pure DC designs are Michael Faraday's homo-polar motor (which is uncommon), and the ball bearing motor, which is (so far) a novelty. By far the most common DC motor types are the brushed and brushless types, which use internal and external commutation respectively to create an oscillating AC current from the DC source—so they are not purely DC machines in a strict sense.

3) Liquid Crystal Display (LCD)

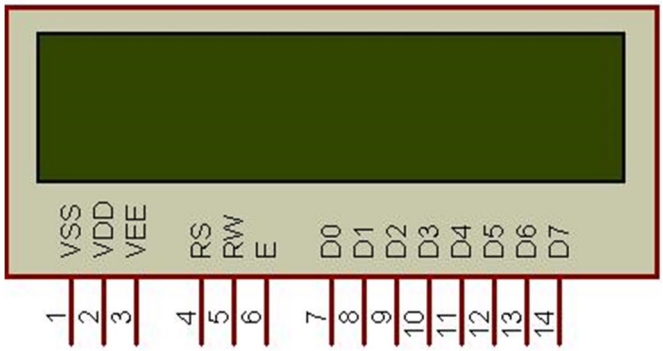


Fig. 16x2 LCD

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on.
A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

V. PROJECT WORKING

In this project mainly we have camera and temperature sensor which are majorly used for the monitoring the fish in the aquarium or small ponds.
In this project we maintain the aquaculture using two circuits .One circuit is present at the aquarium or pond and another circuit is present at the node or user section.
The circuit present at the aquarium consists of camera, RPI, Fan, Light, temperature sensor (LM35) and Zigbee .
The Node or user section consists of arduino uno, Zigbee and Motor.

A. At Aquarium

Initially the power supply need the components is provided the using a transformer and using rectifiers, filters, regulators the AC power is DC power.
Power supply needed by the components is as follows:

Raspberry Pi	-5V DC
Light	-230V AC
Comparator	-5V DC
Zigbee	-5V DC
ULN2003	-5V DC
LCD Display	-5V DC
Fan	-12V DC

Now the connections are as per the above requirements and the internet access is given to the RPI using the mobile hotspot or wifi.
Camera would take the pictures of the aquarium or pond for every 10sec and send the pictures to the email which is registered while writing the python code for raspberry Pi.This makes the continues monitoring of the fishes in the aquarium or pond.
Temperature sensor comes into action when the temperature of the water exceeds the threshold value and immediately the LCD shows the “Temperature is High” and the Fan is automatically ON to it.Mean while zigbee module communicates with node section. Zigbee module at aquarium communicates with the Zigbee module at the node or user section by serial communication and the internet connected with the RPI helps the zigbee in serial communication. Zigbee connected at aquarium is transmitter module and the Zigbee at the node section is receiver module.The Zigbee transmitter send the message “Temperature is High” to the Zigbee receiver at node section through serial communication.
ULN2003 is used to drive the Fan and Light using two relays for each.Light is automatically turned ON during night time for the effective monitoring of the aquarium or pond.

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B. At Node Section

Initially power supply is provided to the components as follows:

Arduino -5V DC
Motor -5V DC
LCD Display -5V DC
Zigbee -5V DC

When the receiver Zigbee module connected to the arduino receives the message “Temperature is High”. The arduino controller analysis the message received by the Zigbee and immediately turns ON the motors such that it indicates temperature is high at the aquarium .

Here the user understands the situation at the aquarium and proceeds forward for further monitoring like :

1) If the tempuratue is too high ,user need to change the water in aquarium.
2) If any fishes are died due to the temperature they should be immediately removed from aquarium or else they may effect other living fishes.

This is the way we maintainthe aquaculture by RASHBERRY PI and ZIGBEE in our project.

Flowchart

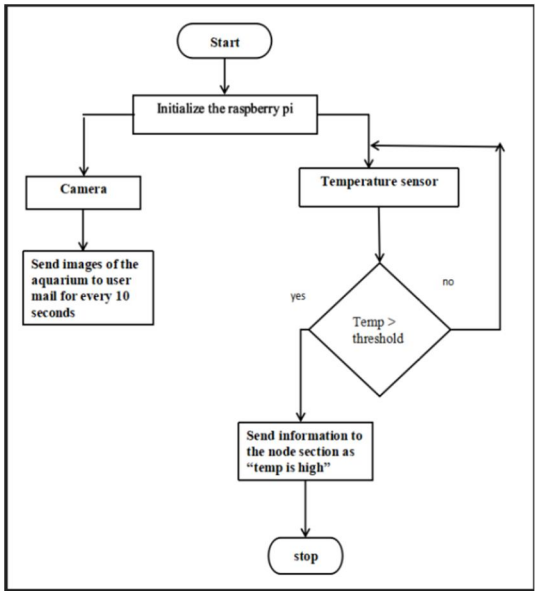
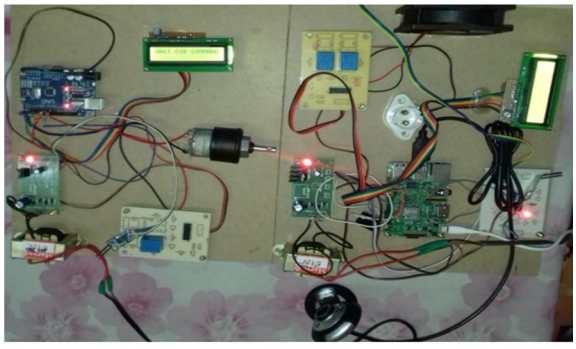


Fig: Flow Chart

VI. RESULT



Hence the using the rashbeery pi ans zeebig modules we have communicated the monitoring information at aquarium to the user section successfully.

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VII. CONCLUSION

This work designs and implements a unique aquaculture monitoring system based on IoT. Both Zigbee and Internet are combined in this system for convenience. This work finds a way to give better result with low cost than other available systems. Aqua farmers can avoid time consuming manual testing now. This will help the aqua farmers to produce more number of fishes which will help to fulfil the demand for fish.

VIII. FUTURE SCOPE

The degree behind building up the programmed fish bolstering framework is to lessen the manual fish sustaining framework which uses more work powers.

Also, there are sure preferences that lead to its advancement which are the measure of sustenance that will be conveyed to the water body that will measure orcontrolled keeping aquarium clean and fishes healthy.

The user can use high qualiy camera for monitoring the fishes in practical.

We can implement this project at the fishes maintaining ponds so that no illegal fishing is done.

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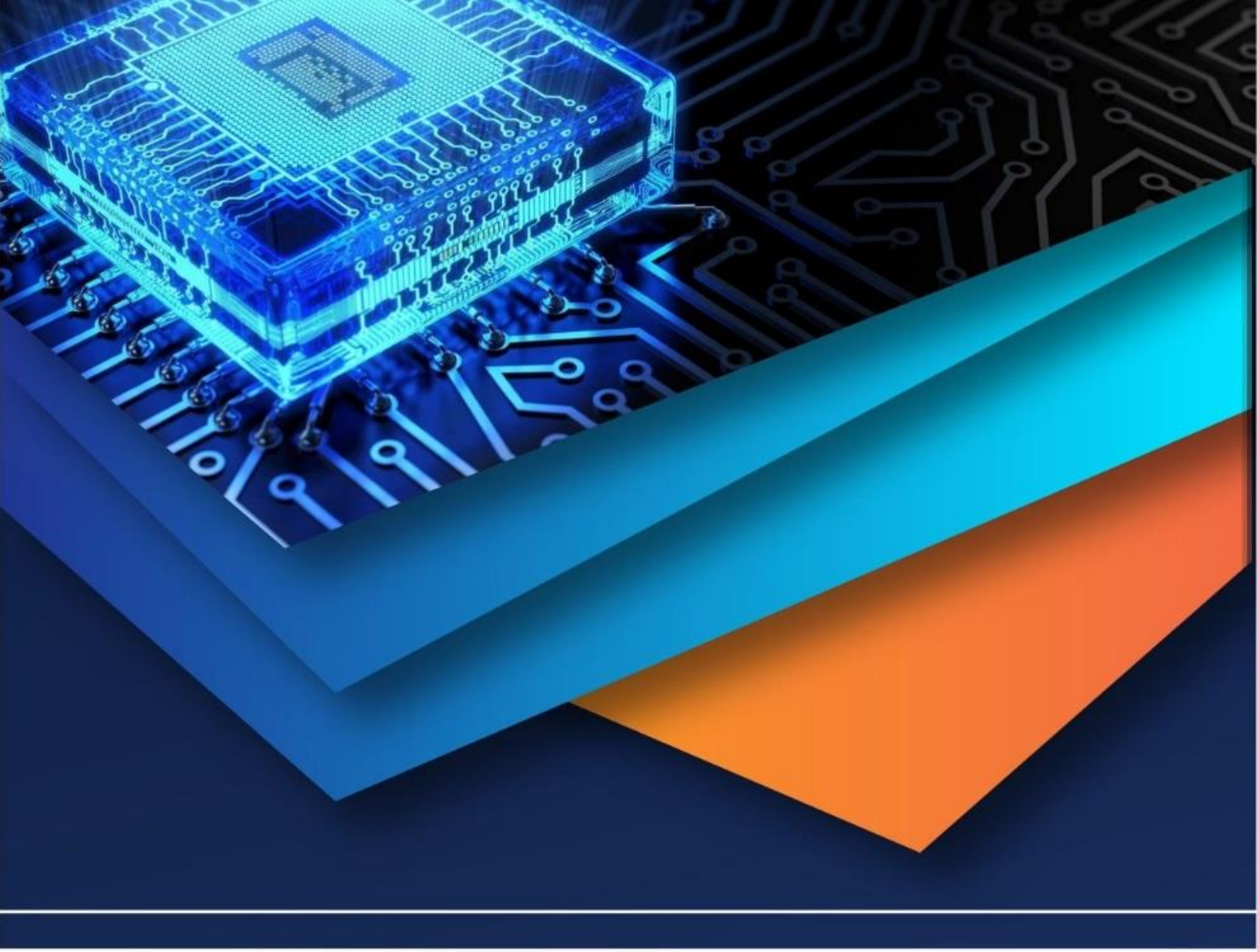

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