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Sewage Environment and Workers Health Monitoring System Using IOT and ML

Raviteja R[1], Rohith N[2], S Sushank[3], Vamshi S[4], Anjana H S[5]
[1, 2, 3, 4, 5]*Information Science and Engineering, East West Institute of Technology*

Abstract: ***This project aims to provide intelligent solutions for sewage environment monitoring and is working on a live sewage level detection and monitoring system. Many sanitation workers suffered from serious health problems at a young age and died from constant exposure to toxic sewage. Various types of work have been undertaken to identify, maintain and manage the drainage system, but very little has been done. to protect the lives of the people who do it. The goal of this monitoring system is to have an effective, flexible and cost-effective solution to verify and maintain an update through sensors and to collect and analyze data using the Internet of Things and machine learning. The device monitors the person's pulse rate via heartbeat sensor, sewer temperature, water level and hazardous gases such as CH4, CO to warn the worker and the outdoor unit when the parameters deviate from the safe range. The information is sent along with various values indicating whether it is safe for the worker to clean or work in that environment. If the values exceed the threshold, it sends an alert to the connected mobile devices of authorized people remotely at work. This result will quickly alert the worker to stay safe and detect toxic gases before damage occurs. The machine learning model then uses the data obtained from the cloud to perform further systematic analysis and intelligently leverages this vast amount of data to predict worker health with considerable reliability and accuracy.***
Keywords: Internet of Things, Machine Learning, Threshold, Intelligently, Methane.

I. INTRODUCTION

Many kinds of research and surveys have discovered that the dearth of remedies for sewage after crossing risky stages ends in the deaths of lots of sewage cleaners at some stage in the 12 months. This proves the inadequacy of our fitness tracking system. The loss of previous being concerned of sewage paintings is the witness to the deaths of lots of sewage cleaners at some stage in the 12 months from injuries and numerous illnesses including hepatitis and typhoid because of surprising or sustained publicity to unsafe gases like CO, hydrogen sulphide, methane. Sewage gases typically rise from the herbal decomposition of sewage and their combos shaped with the aid of using slurries which end up in the manufacturing of poisonous wastes that launch unsafe gases. These gases may be deadly if inhaled in excessive concentrations or for an extended length of time.

Septic tank gases are typically constructed from methane, diffused strains of carbon dioxide, a few components of Sulphur dioxide, ammonia, pointers of hydrogen sulphide (H2S), nitrogen dioxide, and strains of carbon monoxide. Drainage is the gadget or system with the aid of using water, sewage or different drinks are tired from a place. To keep the right feature of drainage, it needs to be monitored regularly. It is likewise tough to reveal all of the places of drainage due to the bodily drawbacks of a human being. The abnormal tracking consequences in clogging the drainage that bureaucracy the silt which triggers flooding withinside the neighborhood. Manual tracking is likewise inefficient. It required a committed group that is simplest capable of keeping the confined document with much less accuracy. These weaknesses cause the gradual managing of troubles in drainage. It additionally has collapsed due to an excessive amount of rain. These troubles may be mitigated with the assistance of Wireless Sensor Networks (WSN) and its far tracking era which includes low-strength sensor nodes. It is likewise tough to reveal all of the places of drainage due to the bodily drawbacks of a human being. The abnormal tracking consequences in clogging the drainage that bureaucracy the silt which triggers flooding withinside the neighborhood. Manual tracking is likewise inefficient. It required a committed group that is simplest capable of keeping the confined document with much less accuracy. These weaknesses cause the gradual managing of troubles in drainage. It additionally has collapsed due to an excessive amount of rain. These troubles may be mitigated with the assistance of Wireless Sensor Networks (WSN) and its far tracking era which includes low-strength sensor nodes. The proposed gadget offers a technique to preserve a tune of the fitness fame of those employees and additionally make certain their safety. The hardware of the gadget may be connected thru a wrist band or placed into the jacket making it wearable for the employees. This will assist offer required facts and then the processed facts may be uploaded to the tracking gadget through IoT and through the device getting to know the skilled facts will expect the suitability of the environment for the worker.

II. PROPOSED SYSTEM

Different sorts of infectious sellers like viruses, bacteria, and protozoans are found in sewage water which comes in touch with employees. These sellers purpose illnesses like Gastroenteritis, Aseptic meningitis, Poliomyelitis, Salmonellosis, Shigellosis, Amoebic dysentery, and Meningoencephalitis that have signs and symptoms of temperature rise, similarly, breathing troubles are not unusual to place the various sewage employees. To keep away from those troubles on the first actual level sensors that can measure growth in frame temperature, pulse charge, and oxygen saturation can be available in handy. Also, Sewage employees are constantly uncovered to dangerous gases like methane, carbon monoxide, hydrogen di-sulfide, and ammonia. Prolonged publicity to those gases' reasons coronary heart cardiovascular troubles, imaginative and prescient troubles, respiratory troubles, and reminiscence troubles. Sensors can act as a beneficial device to display and feature manipulate over those gases to which employee is uncovered. The condition of the sewage environment acts as an input using Temperature, water level, and gas sensors. It measures and analyses the real-time levels of toxic gases, water levels, and sewage temperature in order to ensure the safety of the workers working under such severe conditions. To avoid problems at the very first stage sensors which are capable of measuring an increase in body temperature, and pulse rate can come in handy to monitor health conditions while in or out of sewage.

III.SYSTEM REQUIREMENTS

1) *ESP8826:* The ESP8266 Wi-Fi Module is a self-contained SOC with an incorporated TCP/IP protocol stack that could supply any microcontroller get right of entry to your Wi-Fi community. These sensors can be related to a microcontroller known as ESP8826 which has a Wi-Fi module integrated as a way to transmit those actual time records to the Blynk application.
2) *MQ2:* MQ2 sensor is a digital sensor used for sensing the awareness of gases withinside the air consisting of LPG, propane, methane, hydrogen, alcohol, smoke, and carbon monoxide. MQ2 is a steel oxide semiconductor kind of gas sensor. Concentrations of gas withinside the gas are measured by the usage of a voltage divider community gift withinside the sensor.
3) *DTH11:* DHT11 is a low-value virtual sensor for sensing temperature and humidity. DHT11 sensor includes a capacitive humidity sensing detail and a thermistor for sensing temperature, if the temperature rises above the brink of cost an alert message can be brought about withinside the Blynk application.
4) *Ultra-sonic Sensor:* The Ultrasonic Sensor makes use of Ultrasonic waves to decide the gap of an item. The Transmitter transmits an excessive frequency Ultrasonic sign and different acts as a receiver as a way to look ahead to the receiving of echo sign which receives pondered via way of means of any item in its path. The sewage water stage is decided via way of means of the usage of the extremely sonic sensor, it'll locate the water stage via way of means of estimating the gap between the floor of the water and the sensor.
5) *MAX30100 Heart Rate Sensor:* The MAX30100 is an incorporated pulse oximetry and heartrate screen sensor solution. It combines LEDs, a photodetector, optimized optics, and low-noise analog sign processing to locate pulse oximetry and heart-fee signals. The MAX30100 operates from 1.8V and 3.3V energy supplies.
6) *Help Button:* This is the maximum typically used pushbutton having a small length and springs in four pins. It is in ON whilst driven operation and bounces again to OFF on released.

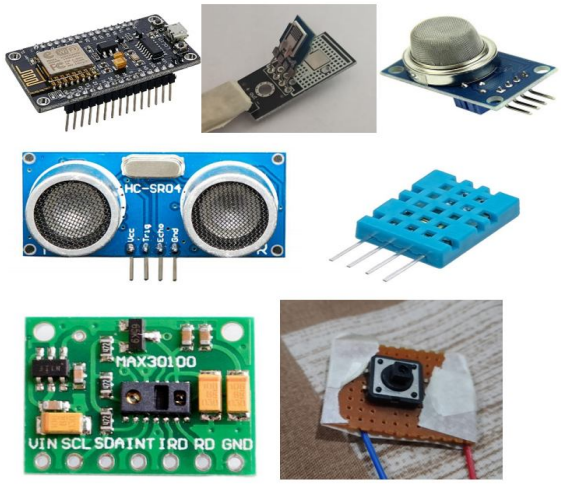

Fig. 1. Hardware requirements.

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IV. DESIGN AND IMPLEMENTATION

A. System Design

The system uses MQ2 sensor, ultra-sonic sensor, DTH11 sensor and help button. Sensors are calibrated. Sensors are connected using connecting wires to send physical values sensed by sensors. These sensors are connected to a microcontroller called ESP8826 which has a Wi-Fi module that will transmit these real-time data to the Blynk application. Whenever it detects the presence of gas it sends a signal which will be seen in the Blynk application. It detects methane, carbon monoxide, smoke, etc when detected. The sewage water level is determined by using an ultrasonic sensor, it will detect the water level by estimating the distance between the surface of the water and the sensor. The DTH-11 is a sensor that detects surrounding temperature. A certain threshold value will be described for the temperature sensor, if the temperature rises above the threshold value an alert message will be triggered in the Blynk application. The accumulated real-time data is sent to the Blynk application which also acts as a cloud for collecting and analyzing data through the Wi-Fi module.

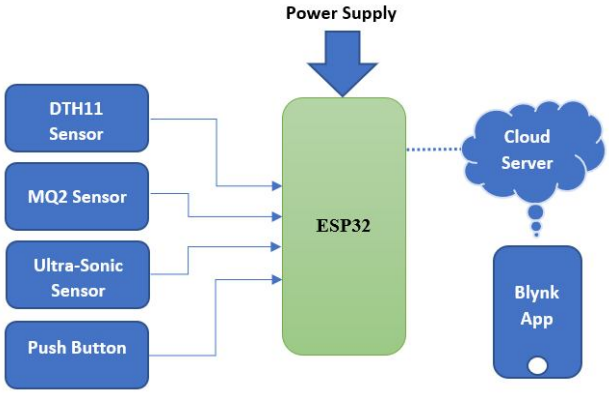

Fig. 2. Block Diagram of Sewage Environment System

Based on the factors addressed above withinside the proposed gadget we use the DHT11 sensor and MAX30100 Pulse oximeter and Heartbeat sensor for real-time bodily health tracking alongside the MQ2 sensor for outside surroundings tracking which collectively paperwork a senor community for measuring the frame temperature, oxygen saturation, pulse charge of the sewage employees and toxic gas stage tracking. These sensors are essential to locate early signs and symptoms of any fitness situation that may purpose a risk to the employee in real-time and keep away from any caused damage to the higher digestive tract.The health of sewage workers is monitored by integrating the sensors into their gloves or safety gear. These sensors include a temperature sensor that detects the body temperature of sewage workers, a MAX30100 sensor that detects the heart rate and oxygen level of sewage workers, and a help button that can be used by sewage workers whenever there is an emergency occurred during sewage operations. These sensors will be connected and controlled by an ESP8826 microcontroller which intact will be connected to a power supply or a battery.

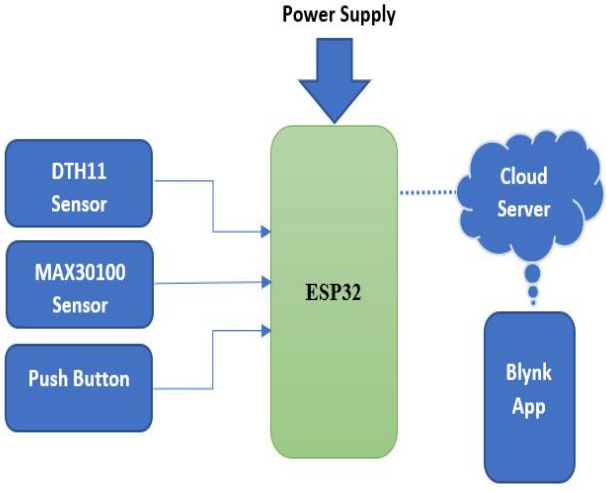

Fig. 3. Block Diagram for Health Monitoring System.

These data real-time data which are generated from the sensors are transmitted using a Wi-Fi module to the Blynk application which will run on android devices. The values of real-time data can be viewed in the Blynk application which makes it easier to use. Then the real-time data of sewage workers' health conditions will be passed to the Machine Learning Algorithm that is Random Forest which predicts and shows the estimation of sewage workers' health parameters such as body temperature, heart rate, and oxygen. This estimated value can be used as a threshold value in which it can be used to compare the real-time value and determine whether a sewage worker is fit to work or not.

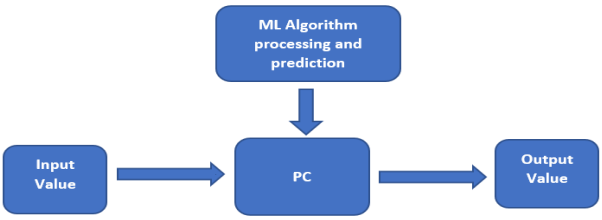

Fig. 4. Block Diagram of machine learning model.

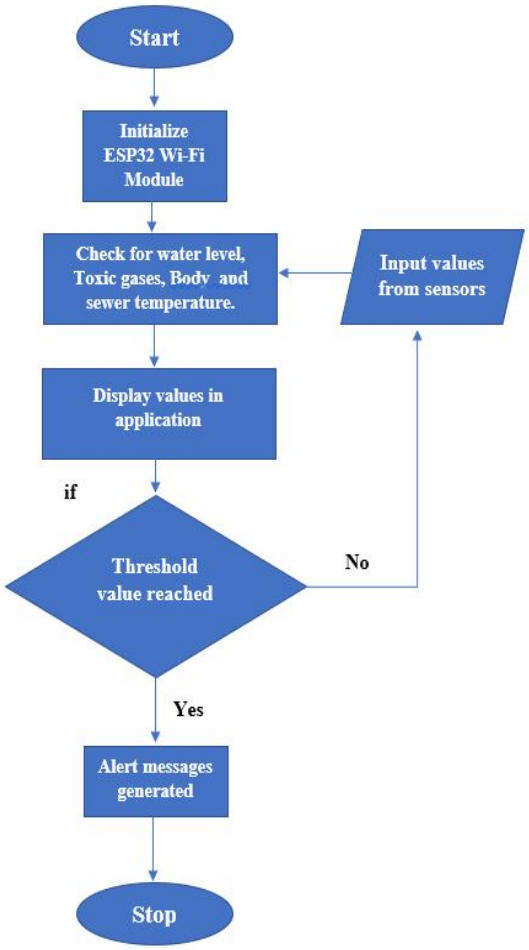

Fig. 5. System Design Flow chart.

Figure 4 Flowchart represents the working of the system proposed and implemented, it initializes the ESP32 module to collect data from sensors to sense the physical values of the environment and health condition of worker. I the values cross the threshold values defined in the system it generates alert messages, if not the system read the sensor values for continuously if crossed or not the system will be working.

B. Methodology

1) Data Processing

- The sensor network collects suitable parameters essential for system implementation.
- ESP8266WiFi performs the function for processing the information passed by sensors. It will sense information using the sensor network and also make synchronization with other devices and then send it to the cloud.
- Code is written and uploaded to the ESP8266 using Arduino IDE Application.
- Sensors used are: MQ2 Gas, Ultrasonic Sensor, DHT11, Help button, MAX30100 Pulse Oximeter.

2) Connecting ESP8266 to Blynk Application.

- Create a Blynk Account- Token is generated for Blynk cloud to store data generated from sensors.
- Create a project- By selecting the hardware component and copy paste auth token.
- Connect ESP8266 with Blynk Application.
- Create widgets to monitor the data in form of graphs or digital values.
- Run the project.

3) Machine Learning Model

- Using the parameters heartrate, body temperature and oxygen saturation values we will predict the health condition, whether the worker will able to work or not.
- Using random forest classifier, we construct a decision tree to predict accuracy of the health condition of the worker.
- Health values are described as true (1) worker is healthy and false (0) for unhealthy/unable to work under the sewage environment conditions.
- After applying random forest
- Total Accuracy achieved is 100%, precision is 100%.

C. Results

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Total Accuracy :  100.00
recall : 0.9987437185929648
Precision : 1.0
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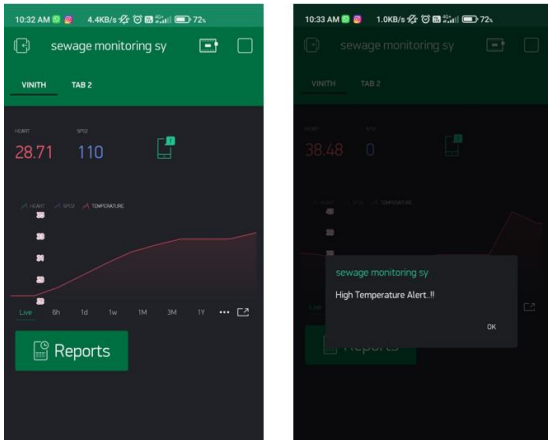
Fig. 6. Accuracy Achieved by using random forest algorithm.

The real-time application of the system is shown above: Sensors are Calibrated. Sensors are then provided with the physical conditions to be measured. The readings are processed and uploaded to the Blynk application. On exceeding the provided Threshold values alert messages are generated in the Blynk application. Below Figure represents the results of gas detection, water level detection, body temperature and sewer temperature alerts when threshold values crossed the give one.

Figure 6 and 7 shows the body temperature of worker if threshold value is crossed above and if the temperature raised above threshold value if alerts message to exterior worker, same goes with sewer temperature. If toxic gases are detected in sewer a alert message is generated in mobile application and worker health condition is monitored using pulse oximeter sensor.



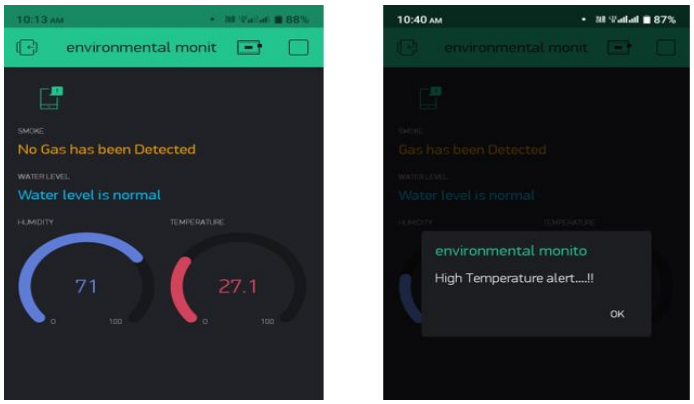


Fig. 7. Body temeprature and Sewer temperature alert

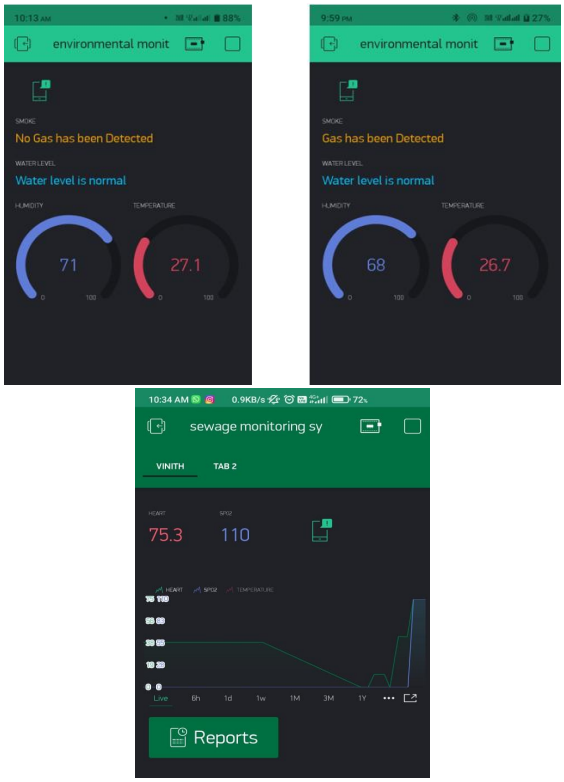


Fig. 8. Toxic gas detection and worker heart rate readings

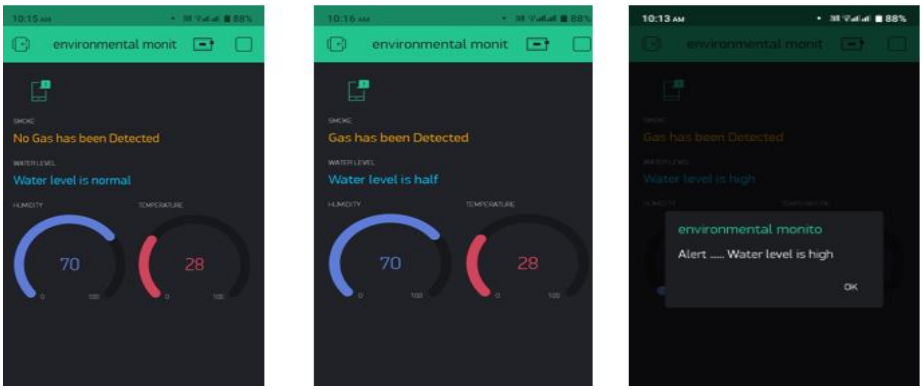


Fig. 9. Water level detection using ultra sonic sensor.

V. CONCLUSION AND FUTURE WORK

Sewage gases are toxic and cause chronic illnesses and death if high concentrations are released into the body. The proposed methodology helps to stop the sudden accident of workers and also helps to stay the society clean. The device helps the worker to induce a knowledge to grasp the gas level, water level and sewer temperature before entering to the sewage works using blynk application and offers alert message to exterior team if any parameters crossed over threshold values This smart device can be implemented and used across the cities and also helps to monitor the overflow of the sewage water for different locations. System monitors health condition of the worker and displays physical values in application. a button is provided for worker, if any danger occurs worker can alert exterior team for help by pressing it. Further data is stored in cloud and analyzed in blynk application to monitor sewage environment and worker health condition using wireless sensor network. These data is used in machine learning model to achieve accuracy of worker health condition using ml algorithm. The future work focuses on GSM module, implementing in various location and monitor sewer environment of different locations.

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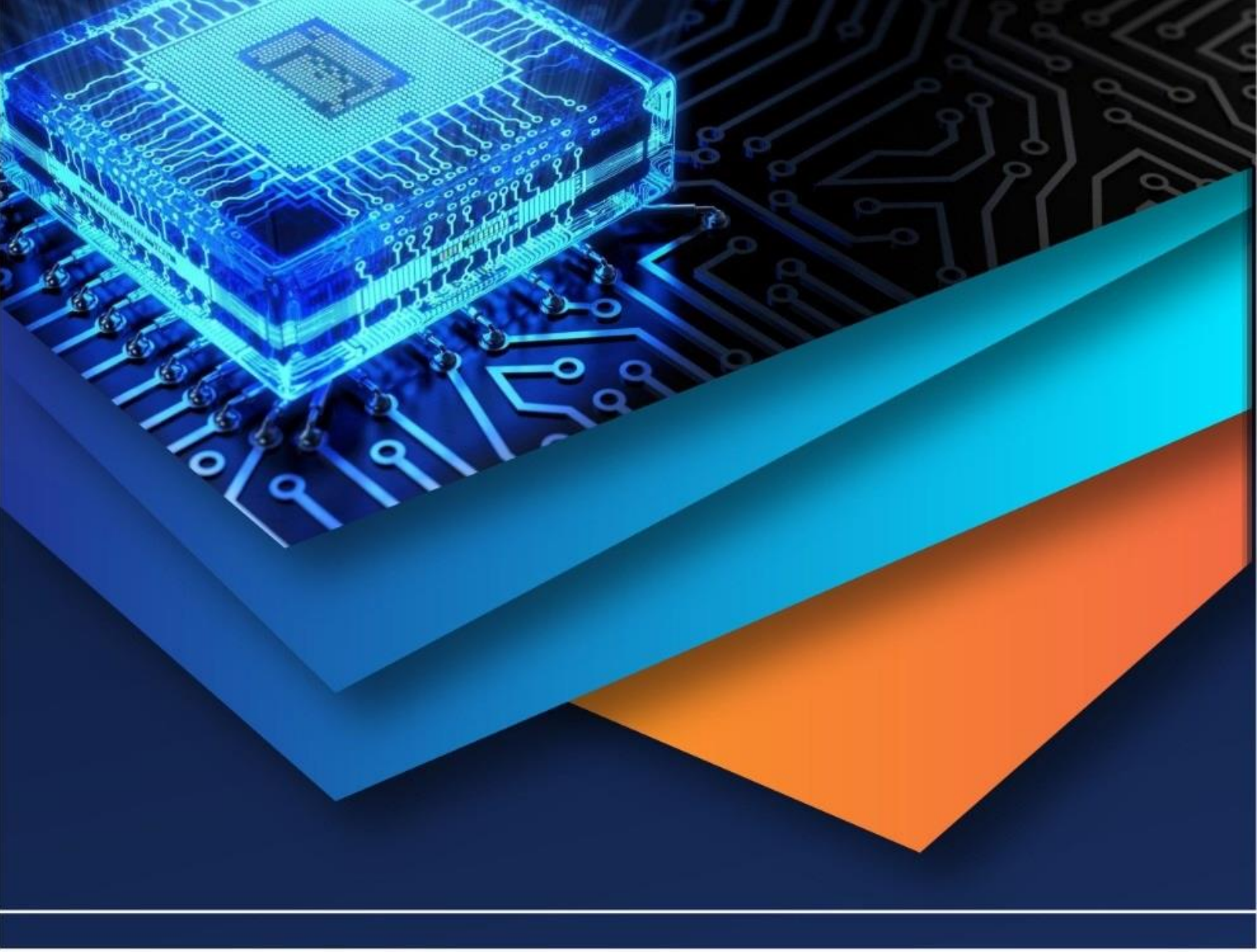

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