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Protecting Human Life by Detecting Toxic Gases in Underground Drainage and Mining using IoT

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Abstract: ***The value of human life is priceless and nowadays people are not aware of other person's lives and thus lead to wrongful death claim. One such thing is, death due to cleaning the underground drainage and our project Drainage system monitoring plays an important role to keeping the city clean. In fact, not all areas has drainage monitoring team. Irregular monitoring of the system occurs generally. The irregular monitoring leads to the blockage of the drainage. Manual monitoring is also not possible all the times. It requires a professionals but they can only monitor very finite amount of time and maintain low accuracy rate. Also sometimes due to lack of knowledge the worker may meets to an accident as they have no idea that how will be the conditions in those manhole. This paper represents the application and design function of a smart and real-time Drainage Monitoring System with the help of Internet of Things. This system will have a module which is having microcontroller interfaced with gas sensor, level sensor. The system will monitor and sense the rise in amount of various gases which are harmful to the human beings, and also a system of monitoring the water level and will provide those information to the person to whomsoever it may concern. The system will able to monitor all these things in real-time scenario which will allow us to take proper actions of the particular problem in drainage system and this system can also be used in coal mining areas.***

I. INTRODUCTION

Drainage system plays a very important role in big cities where millions of people live .In order to maintain its proper function drainage conditions should be monitored. Where, all areas does not have drainage monitoring team and it leads to irregular monitoring of the condition of drainage. The irregular monitoring has the contribution on blocking the drainage that results in the salutation which leads to flood in neighborhood. Manual monitoring is also not possible all the time. It involves a lot of man power where they are able to record limited number of report with low accuracy. The main problem arises in such drainages that leads to the serious issues to the daily routine of the city. Problems like blockages due to waste material and also sudden increase in the level of water and as well as various harmful gases can be produced if proper cleaning actions are not taken at the right time. Where today's drainage system is not digitalized because it is hard to know where blockage is particularly occurring in the location. And also sometimes because of the waste in those drainage lines can produce various gases like methane (CH4), carbon monoxide (CO), etc which are harmful and can cause serious problem if inhaled by human's in large amount and these problems are generally faced by the drainage workers due to which death can occurs. Also we don't get early alerts of the blockage or rise in amount of those gases or the increase in water level. Hence detection and repairing of the blockage becomes time consuming and hectic. Every node consist the data processing (Microcontroller, e.g. - Arduino) memory (program, data, flash memory), power supply system and involves two or more sensors. This system have a higher level of precision than wired network system with respect to cost; flexibleness and reliability are expected to replace hybrid or combined technology. According to an estimation we made till 2019, at least 22327 men die in India every year because of inhaling the poisonous gas while doing the drainage related work and also two to three workers must be dying every day inside manholes across India.

1) It just took a few minutes for six people to fall dead, one after another, when noxious gas emanating from a septic tank in sriperambudur which is 40km from Chennai on Tuesday(26-03-2019).
2) And also two staffers where dead while cleaning restaurant's sewage treatment plant in the capital of India on Saturday (23-03-2019) and many such incidents.

A. Healable And Inhalable Gases

Oxygen-21% in and 16% out
Nitrogen-78%
Carbon dioxide-0.4%in and 4% out
Hydrogen
Methane.

II. LITERATURE SURVEY

IoT proves to be a reliable one for Drainage Monitoring by solving the problems like toxic gas detection, level monitoring and outputting the result action using the algorithm in efficient manner. Consider the scenario in paper [1] the authors are purposed the way to detect gas and alert us about the leakage and also mechanically turn off the knob of the gas cylinder to seize any leakage of gas by using C2000 Piccolo MCU.

In paper [2], the author has used the direct cylinder pressure monitoring system (cpms) for the use of pressure sensor directly mounted on the transport cap of the cylinder. The pressure inside the cylinder is measured continuously by the pressure sensor and the information will be continuously sent to the system using the Radio Frequency Technology. The output of the pressure sensor is analog signal, which when striking the cylindrical surface produces the electromagnetic wave which is sensed by the RFID and communicated by the controller. Once the pressure reaches the threshold value the controller sense the message to the Auto dialer.

In paper [3],the sewage level monitored using magnetic float level sensor. The minimum and maximum levels are set and level sensor keeps on monitoring the level of the sewage. When the level reaches the maximum set point the sensor detects and sends the signal to the controller where the alert message is generated and dispatch the message to the municipal and corporation in prior to overflow. The message is repeatedly sent until the level reaches to the minimum set.

In the paper [4], the author have used water flow sensor for level detection. When the respective sensor reach the threshold level, the indication of respective value of the sensor is being sent to the microcontroller. The location of the manhole is send to the municipal corporation through GSM and GPS. The sensor calculates the water flow rate for every second and readings will be displayed in the serial monitor.

In paper [5], the author used wireless sensor network that communicate some sensor nodes that are implemented in some areas. The sensor used are rainfall sensor, water level sensor and velocity sensor. Hardware on the node sensor unit, signal conditioning, processor, real time clock (RTC), SD cards, Radio frequency modules and supply unit. Water level sensor is used to determine the water level and contributes to calculation of water discharge. Stages of drainage monitoring system are design of sensor nodes, design of communication units, and design of layout for sensor nodes, design of database system.

In paper [6], accelerometer sensor is used to measure an objects orientation, velocity etc. It is used to obtain the positions in space. The authors have only used MQ4 gas sensor which is used to detect the presence of dangerous LPG gas and water level sensor is used to detect the level of the substance that can flow, such substances include liquids slurries, granular materials and powders. Such measurements can be used to determine the amount of materials within a closed container or the flow of water in open channels. Once the threshold level has been reached a buzzer starts ringing.

The paper [7], uses sensors to detect blockage, flood, and gases. The system identifies the clogging inside the drainage system details of location and other information. The gases sensed are methane (ch4), sulphur dioxide (so2), carbon monoxide (co). The module is implemented using wireless sensor networking (WSN) technology, each node will carry it own data of neighboring nodes and will pass it to next node by hopping technology. The blockage sensors will detect the blockage in the sewer lines and the provides the early alarms so that we can clean it as early as possible.

[8]Designed a predictive disaster and alert generation system using WSN to provide weather information and early alerts. Smart city infrastructure could be in terms of intelligence traffic signals, sensors, active lands, communication and so on. Thus, smart device were integrated into the city's infrastructure to the efficient deployment of ICT, can make life in a city a lot easier.

Sunitha.G, Sujatha.P and Lalitha Bhaskari, have used ultrasonic sensor, NodeMCU, IoT, GPS and GSM Modems for monitoring the garbage as well as drainage levels and sends the data to municipal communication system.

Yash narale apurva jogal et.al, [10] also gives the description of water-wise system and detection method to detect leakage detects in sensor pipeline. Also, some part of condition rating model for underground infrastructure sustainable water mains and intelligent system for underground pipeline, assessment, rehabilitation and management are explained.

Eunice David Likotiko Devotha Nyambo gives an explanation in their work about the waste level data are updated and recorded continuously and are provided to decision algorithms to determine the vehicle optimization route for waste collection to the distributed bins in the city. Several simulation case executed and result validated. The presented solution gives substantial benefits to all the waste stakeholders by enabling the waste collection process to be more efficient.

In the existing system, the sewage is collected by the municipality servants on the scheduled routine basis i.e., six months to one year. Because of the cleaning process, the workers died by assuming that the drainage has not been filled. The cleaning process will create bad smell and that leads to air pollution which may cause diseases that affects the human health. Thus, this becomes a big issue. To avoid such conditions we have decided to use gas sensors and level sensing sensor for detecting the toxic gases and monitoring the level of the underground drainage.

III. PROPOSED SYSTEM

The drainage system will have:

A. Sensor to detect gases and levels.
B. The intelligence of sensors and system will identify the clogging inside the drainage system and will give the details of the location and other information for further actions.
C. Ultrasonic sensor senses the level of the drainage system by short and high frequency pulses at regular intervals. They reflect back the echoes as soon as they hit the target.
D. Gas sensor senses the gas that has been present in the drainage by producing the electrical signal that is proportional to the gas concentration.
E. The system will also sense the presence of various harmful gases such as Methane (CH4), Sulfur dioxide (SO2), Carbon monoxide (CO) etc.
F. The module is implemented using Wireless Sensor Networking (WSN) technology eachnode will carry its own data.

Using our smart drainage system we can easily monitor, modify and rectify the problems in real time.

Sensors	Gases Detected
MQ2	LPG-Liquefied Petroleum Gas, CH4-Methane, Smoke
MQ3	Alcohol vapor
MQ7	CO-Carbon Monoxide
MQ9	Liquefied gas Coal gas

IV. IMPLEMENTATION

In this project we designed the title for monitoring gases and level of water (or) clogging in the underground drainage system. The water level will determine the extent of the flood as low, medium or high. The gas sensors are used to measure the amount of hazardous gases of which drainage workers can take functions while entering into manholes.

A. Explosion Limit

MQ2-CH4 (4.4-17%)
MQ3-Ethanol (3-3.3%)
MQ7-CO (12%)
MQ9-Liquified gas (>5%)
Coal gas-temperature range (20 degree- 80 degrees) & pressure range (0.1-0.2Mpa)

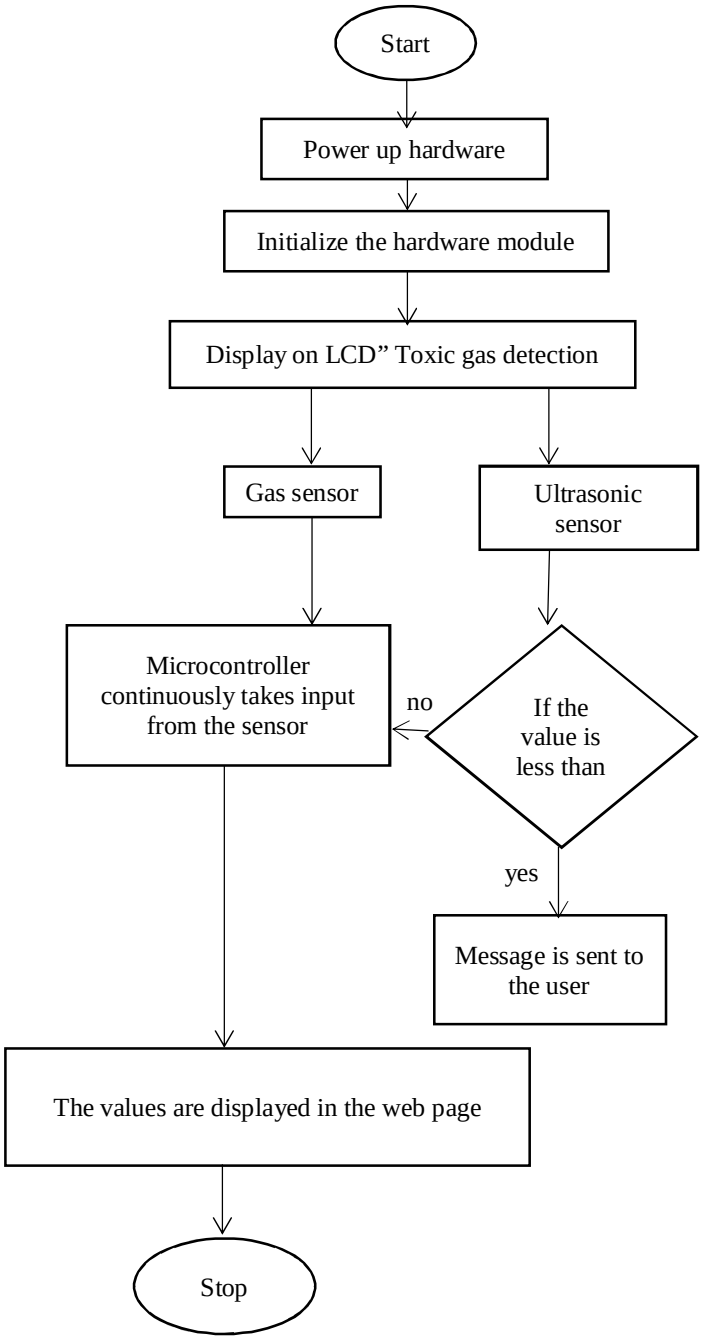
B. Working Principle

1) Power up hardware.
2) Initialize hardware module.
3) Display on LCD as “Toxic Gas Detection”.
4) Microcontroller sense sensor value:
a) Gas sensor senses different types of toxic gases.
b) Ultrasonic sensor detects the level of the drainage when level increased the message will be sent to the user by using GSM.
c) The sensor related data will be updated on the web page.
d) All the information will be displayed in LCD.

Initially, power up the tool by connecting it with the power source and initialize the hardware module. LCD displays “Toxic Gas Detection for Underground Drainage and Mining using IoT”. The toxic gases and the level are sent to the micro controller from the sensors. The gas sensors like MQ2, MQ3, MQ7 and MQ9 detects the gases like carbon monoxide (CO), Methane (CH4), etc. The

level monitoring sensor that is the Ultrasonic sensor senses the level of the drainage by passing ultrasonic waves. Once the waves hits the target, the echo is bounced back to the sensor. These waves are converted to analog values and sent to the microcontroller. The density of the gas and the level of the drainage is displayed in the Liquid Crystal Display. When the level of sewage increases the message will be dispatched to the municipal corporation.

Ubidots is an IoT Application Development Platform that automates the process of IoT application creation for enterprises and individuals to deploy any IoT solution to scale and do quickly. The Ubidots platform is a user focused point and click on IoT app builder with data analytics, dashboard visualizations, device management tools, BI events, and alarm engine, and end-user authentication to give users the data Ubidots collects, enhances, and delivers sensor, actuator, and beacon data that matters for businesses and users understand systems better, ultimately improving overall efficiency



In the below figure [1] , the dashboard refers to the output of MQ2 gas sensor which senses methane , butane , LPG and smoke.

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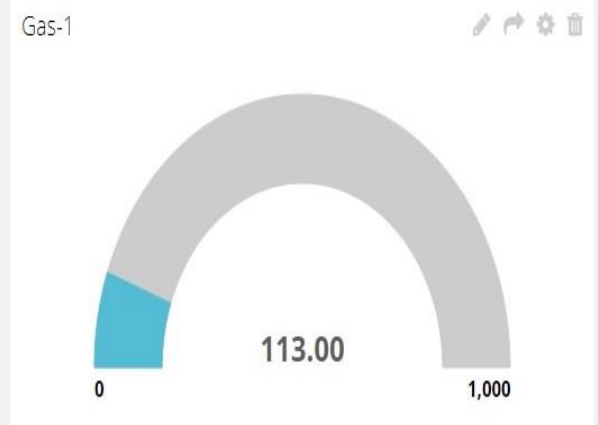

Figure [1]\ Dashboard Representation of MQ2 Sensor

The figure [2] indicates the output of MQ3 gas sensor which senses alcohol, ethanol and smoke

Figure [2] Dashboard Representation of MQ3 Sensor

The figure [3] indicates s the output of MQ7 gas sensor which senses Carbon-monoxide.

Figure [3] Dashboard Representation of MQ7 Sensor

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The figure [4] indicates the output of the MQ9 gas sensor which sense Carbon-monoxide and flammable gases.

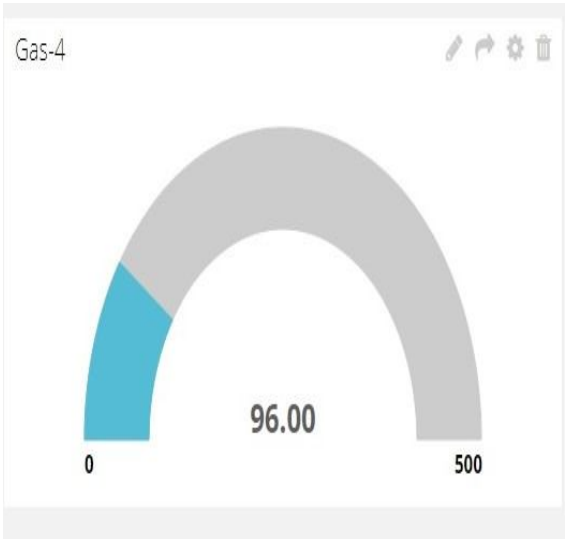

Figure [4] Dashboard Representation of MQ9 Sensor

The figure [5] indicates the level of the drainage which is being sensed by the Ultrasonic sensor.

Figure [5] Dashboard Representation of Level

In the figure [6] the graph indicates the distance. The x-axis indicates the time at which the value is updated and the y-axis indicates the range.

Figure [6] Graphical Representation of Drainage Level

In the figure [7] the graph indicates the representation of gas level sensed by MQ9 . The x-axis indicates the time at which the value is updated and the y-axis indicates the range.

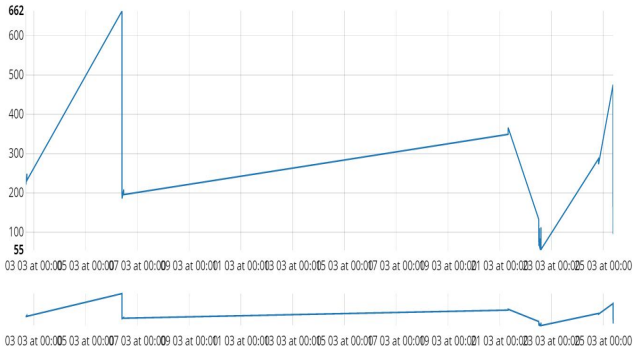

Figure [7] Graphical Representation of MQ9 Sensor

In the figure [8] the graph indicates the representation of gas level sensed by MQ7. The x-axis indicates the time at which the value is updated and the y-axis indicates the range.

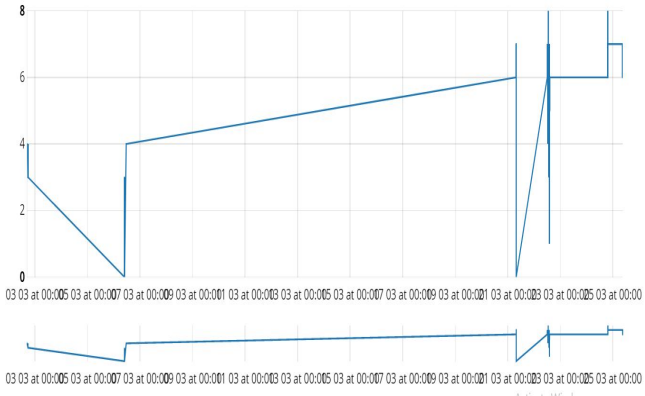

Figure [8] Graphical Representation of MQ7 Sensor

In the figure [9] the graph indicates the representation of gas level sensed by MQ3. The x-axis indicates the time at which the value is updated and the y-axis indicates the range.
All these Graphical Representations show only events inactive- once active, they display a horizontal line that highlights X- axis and Y-axis limits.

Here you can adjust the different settings and parameters of your graphs to your likeness.

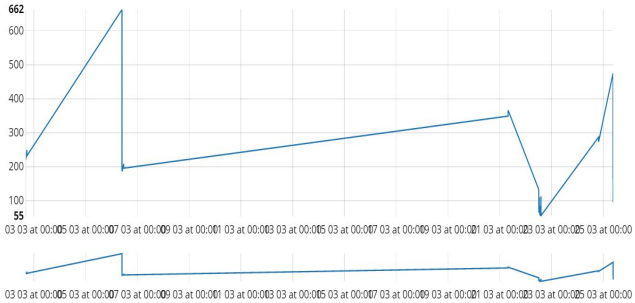

Figure [9] Graphical Representation of MQ3 Sensor

In the figure [10] the graph indicates the representation of gas level sensed by MQ2. The x-axis indicates the time at which the value is updated and the y-axis indicates the range.

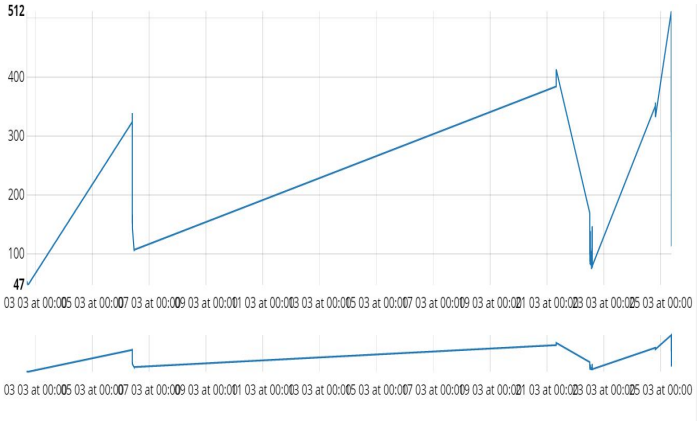

Figure [10] Graphical Representation of MQ2 Sensor

V. CONCLUSION

Sensor networks are considered as the key enablers for the IoT paradigm .This paper addresses all about smart and real-time Drainage monitoring system through IoT applications. By using various sensors such as gas detection, water level we can monitor the real time scenario of drainage system by for detecting the problems in drainage system. By doing this we can able to take particular action on the problems as we will receive the early alerts of level increase. This paper can be used to design the smart and real time drainage system for monitoring as well as troubleshooting purpose.

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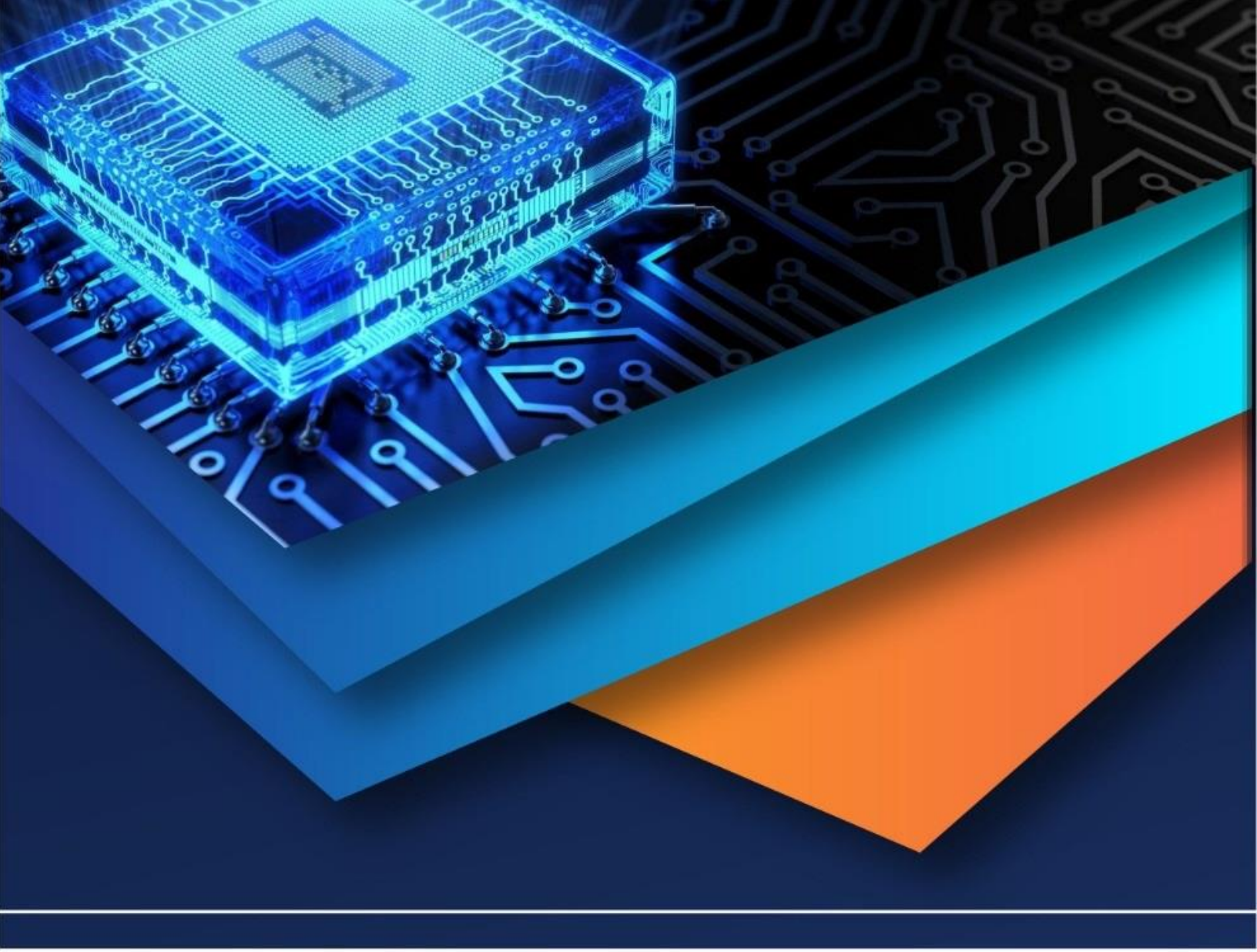

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