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Smart Alcohol Detector for Road Safety Enabled with IoT

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Abstract: Drunk and drive detection is in interest since has potential to save accidents whose main cause is over drinking of alcohol. Much research is currently being undertaken to develop detection technique of alcohol limit which cause unconsciousness and the human will not in able to work, walk and understand things properly. The research is primarily achieved by utilizing the significant of electronics and automobile parts, components and concept. A variety of devices exists including different MQ series sensors, ESP cam, GPS, RTC etc. Among these, the MQ-3 Sensor has shown potential within the field of Electronics, which detect the concentration of alcohol in human beings. Aspects related to the long-term environmental impact of drunk and drive detection technology are taken carefully and are considered carefully.
Index terms: MQ sensor, GPS, ESP cam and RTC.

I. INTRODUCTION

This device detects the alcohol level concentration and if the alcohol concentration is above specific concentration level, then the ignition system is collecting the person photo and vehicle photo and date and time and current location the overall data is save to be cloud [1-3]. As we know drunk driving is a very dangerous behavior. People will become slow in reacting and can't situations when they are driving. The investigation done by the World Health Organization in 2008 shows that about 50%-60% of traffic accidents are controls their actions [4-6]. Drunk drivers are not able to deal with the emergency related to drunk driving [7-9]. The drunk driving has been listed as the main for the fatal car accident. Drunk driving is a significant problem in modern society, causing countless injuries and fatalities every year [10]. According to the National Highway Traffic Safety Administration (NHTSA), drunk driving accounted for 28% of all traffic fatalities in the United States in 2019. In response to this problem, many efforts have been made to develop innovative technologies that can help prevent drunk driving, such as the Smart alcohol detector [11-12].

II. PROPOSED SYSTEM

An alcohol detection system is designed to measure the level of alcohol intake, display the percentage of alcohol detected, and trigger an alarm if the level exceeds a predetermined threshold. This system utilizes an alcohol sensor connected to a microcontroller, which processes the sensor's Analog output. The microcontroller calculates the alcohol concentration and displays the corresponding percentage on an LCD screen. If the detected alcohol level surpasses the set limit, a buzzer alarm is activated to alert the user.

The system triggers an alarm when the detected alcohol level exceeds a specified limit. It accurately measures the alcohol concentration and displays the percentage on an LCD screen, ensuring effective monitoring of alcohol intake.

This work propose the constructed circuitry, the onboard display of the devices used and the CAM notification sent to a remote location using GPS technology shown in Fig.1. If alcohol is detected the microcontroller outputs signal to the Liquid Crystal Display (LCD) Display and Global Positioning System (GPS) module notifying the subject and other relevant bodies of the discovery. The microcontroller also outputs activation signal to a relay ensuring the vehicle is brought to a stationary position at the instant. In addition to that, Real time clock notification prompting immediate attention has been in-cooperated to make the system more robust. This section will detect the alcohol take the photo and location will be sending the admin.

When a person exhales alcohol vapor, it reacts with potassium dichromate, an orange solution that changes to green in the presence of alcohol. This color change generates an electrical current, which the breathalyzer interprets to calculate the Blood Alcohol Concentration (BAC). In the United States, the legal BAC limit is typically 0.03%.

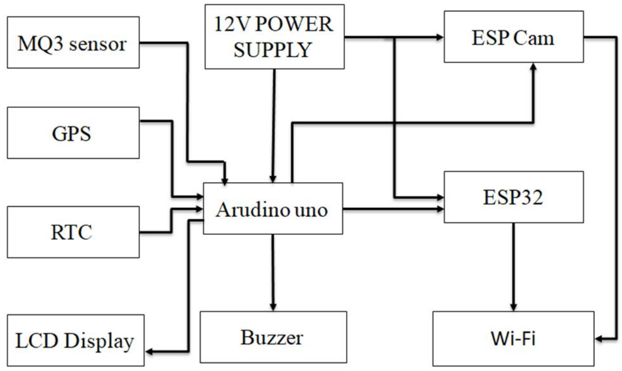

Fig.1. Block diagram of proposed system

1) *ESP Microcontroller:* The ESP32 microcontroller, developed by Espressif Systems, is a powerful and versatile chip widely used in Internet of Things (IoT) applications. It features a dual-core 32-bit processor based on the Xtensa LX6 architecture, providing high processing power and efficiency.
2) *Wireless Connectivity*: Wi-Fi Supports 2.4 GHz Wi-Fi, allowing for wireless communication and internet access. Bluetooth Includes Bluetooth 4.2 and Bluetooth Low Energy (BLE), enabling wireless data transfer and connection to Bluetooth-enabled device.

Fig.2. ESP32 Microcontroller

3) *LCD Display module:* A Liquid Crystal Display (LCD) is a flat-panel display that uses polarized liquid crystals to show text or images by controlling light passage. An I2C LCD module connects through the I2C interface, utilizing just two lines—SDA (data) and SCL (clock)—for communication. This design minimizes wiring and simplifies the overall circuit.

Fig.3. LCD display

4) *ESP CAM module:* The ESP32 CAM module is an affordable microcontroller based on the ESP32, featuring an integrated OV2640 camera and a microSD card slot. It supports Bluetooth, Wi-Fi, and BLE Beacon and is powered by dual 32-bit LX6 CPUs, with a frequency range adjustable from 80MHz to 240MHz. The module includes a pipeline architecture, Hall sensor, on-chip sensor, and temperature sensor. It is ideal for applications such as industrial wireless control, smart home devices, wireless surveillance, and IoT projects requiring advanced camera functionalities like image recognition and tracking. The 4MB PSRAM on this board is used to buffer images from the camera for video streaming, allowing for higher image quality without causing the ESP32 to crash.

Fig.4. ESP CAM module.

5) *MQ-3SENSOR:* The MQ3 alcohol sensor is part of the MQ series of gas sensors designed to detect and measure alcohol vapor in the air. It can sense alcohol concentrations ranging from 25 to 500 ppm. This overview covers its pin configuration, technical specifications, and how to interface it with an Arduino.

Fig.5.MQ-3 sensor

6) *GPS Module:* The NEO-6MV2 is a widely used and affordable GPS module known for its reliable location accuracy, making it suitable for a variety of applications, including integration into smartphones and tablets. It is popular among hobbyists and engineers working on navigation-related projects. This module provides flexible connectivity options within a compact size of 16 x 12.2 x 2.4 mm, making it ideal for battery-powered mobile devices that require minimal space and cost efficiency. Its advanced design ensures excellent navigation performance even in challenging environments. Typically, GPS receivers consist of an antenna tuned to satellite frequencies, receiver processors, and a stable clock (such as a crystal oscillator), and may include a display to show location and speed data to the user.

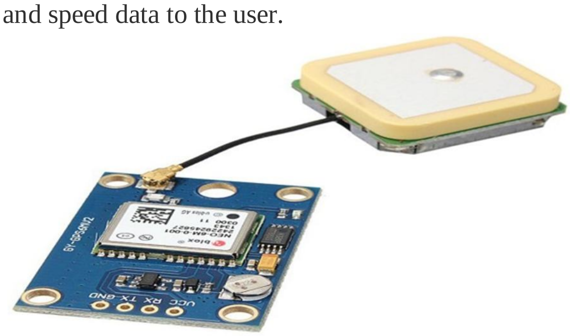

Fig.6.GPS module

7) *Level Shifter:* As digital devices become smaller and faster, the standard logic levels have shifted from the traditional 5V to lower voltages like 3.3V, 2.5V, and even 1.8V. This change has created compatibility issues between components operating at different voltage levels. For instance, a 5V device might not recognize a 3.3V signal as high, while a 3.3V device could be damaged by a 5V input. A level shifter, also known as a bidirectional voltage translator, addresses these issues by enabling voltage conversion between multiple logic levels. It can handle up to four independent signals, converting from as low as 1.5V on the low-voltage side to as high as 18V on the high-voltage side. Its compact design and breadboard-friendly pin spacing make it easy to incorporate into electronic projects.

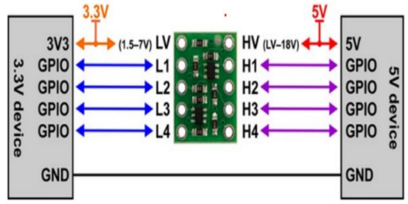

Fig.7.level shifter

III. CIRCUIT DIAGRAM

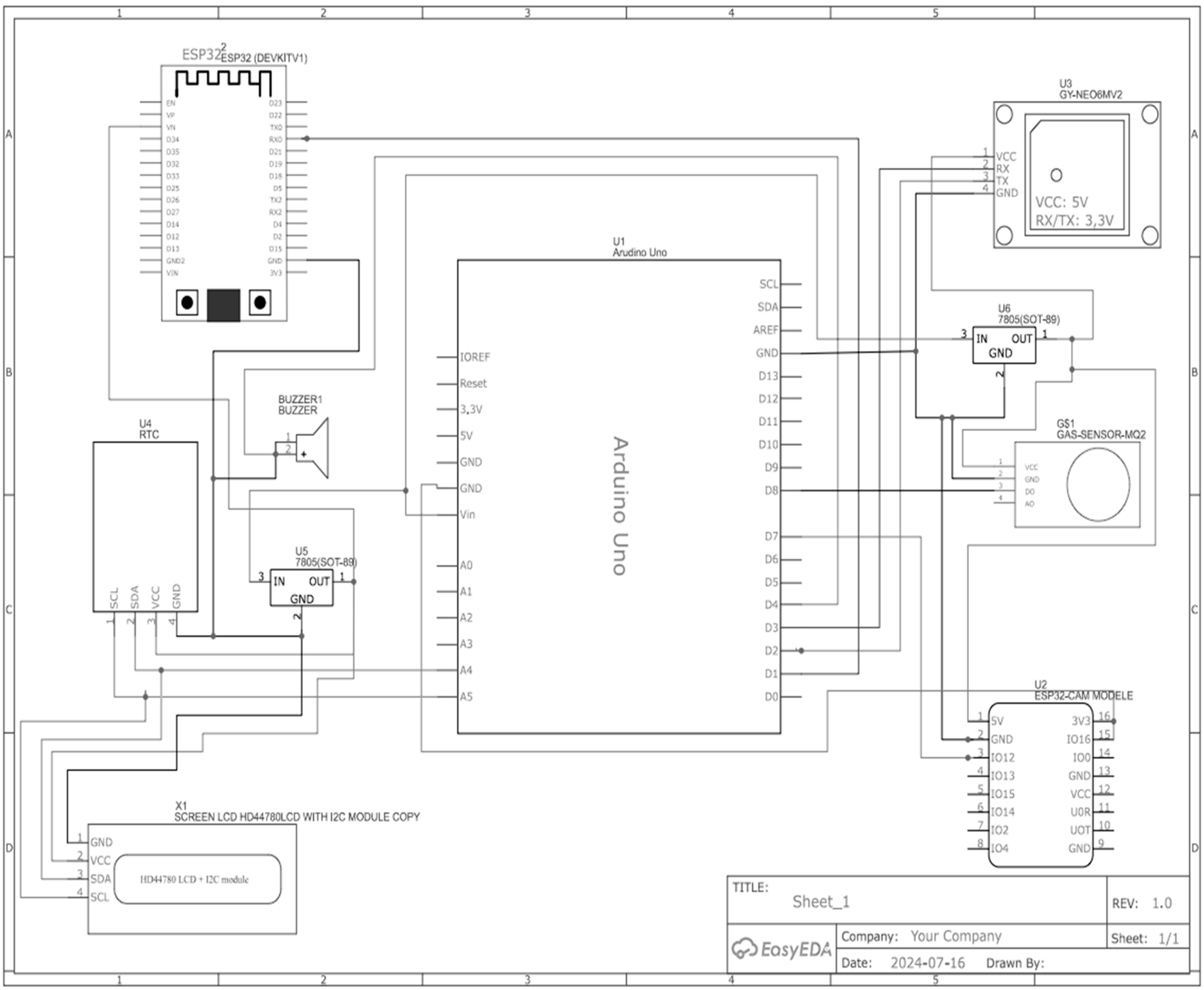

Fig.8. Circuit Diagram

IV. WORKING METHODOLOGY

When sensor read alcohol content, micro controller compares the upper threshold point of allowed limit. If sensed level crossed the limit, ESP32 cam will capture the image of the person and send it to cloud. At the same time when and where the sample is taken information's are need to enhance the work. Hence at the same time, actual date and time from RTC and present location received from GPS sensor are will be sent to clouds. Build with LCD and buzzer will intimate the status of the system as per programming coding.

V. EMMBEDED CODE

```
#include <TinyGPS++.h>
#include <SoftwareSerial.h>
SoftwareSerial GPS_SoftSerial(2, 3);
TinyGPSPlus gps;
volatile float minutes, seconds; volatile int degree, secs, mins;
#include<LiquidCrystal_I2C.h> LiquidCrystal_I2C lcd(0x27,16,2);
#include "Arduino.h"
#include "uRTCLib.h" uRTCLib rtc(0x68);
char daysOfTheWeek[7][12] = {"Sunday", "Monday", "Tuesday", "Wednesday", "Thursday", "Friday", "Saturday"};
const int buzzer = 4;
const int gas = 8;
const int photo = 7;
void setup()
{
lcd.init(); lcd.backlight();
URTCLIB_WIRE.begin();
Serial.begin(9600); delay(100);
GPS_SoftSerial.begin(9600);
delay(100);
lcd.clear();
lcd.print(" WELCOME "); lcd.setCursor(0,1);
lcd.print("________");
delay(1000); pinMode(buzzer,OUTPUT);
pinMode(gas,INPUT);
digitalWrite(buzzer,LOW);
pinMode(photo,OUTPUT);
digitalWrite(photo,LOW);
}
int gas_flag = 0; void loop()
{
rtc.refresh();
lcd.clear();
lcd.print(rtc.hour());
lcd.print(':');
lcd.print(rtc.minute());
lcd.print(':');
lcd.print(rtc.second());
lcd.print(" ");
lcd.print(rtc.day());
lcd.print('/');
lcd.print(rtc.month());
```

```
lcd.print('/');
lcd.print(rtc.year());
delay(1000);
if( digitalRead(gas) == LOW && gas_flag == 0)
{
lcd.clear();
lcd.print("ALCOHOL");
lcd.setCursor(0,1);
lcd.print("DETECTED");
digitalWrite(buzzer,HIGH);
digitalWrite(photo,HIGH);
delay(3000);
digitalWrite(buzzer,LOW);
gas_flag = 1;
Serial.println("!!!ALERT!!! ALCOHOL PERSON DETECTED!!!");
Serial.print("DATE:");
Serial.print(rtc.day());
Serial.print("/");
Serial.print(rtc.month());
Serial.print("/");
Serial.print(rtc.year());
Serial.println("");
Serial.print("TIME:");
Serial.print(rtc.hour());
Serial.print(":");
Serial.print(rtc.minute());
Serial.print(":");
Serial.println(rtc.second()); neo_gps();
}
if( digitalRead(gas) == HIGH && gas_flag == 1)
{
gas_flag = 0;
digitalWrite(photo,LOW);
void neo_gps()
{
smartDelay(1000);
unsigned long start;
double lat_val, lng_val, alt_m_val;
bool loc_valid, alt_valid;
lat_val = gps.location.lat(); loc_valid = gps.location.isValid();
lng_val = gps.location.lng();
alt_m_val = gps.altitude.meters();
alt_valid = gps.altitude.isValid();

if (!loc_valid)
{
Serial.print("Latitude : ");
Serial.println("*****");
Serial.print("Longitude : ");
Serial.println("*****");
```

```
}
else
{
DegMinSec(lat_val);
DegMinSec(lng_val);
Serial.println("GPS Location:");
Serial.print("http://maps.google.com/?q=");
Serial.print(lat_val,6);
Serial.print(',');
Serial.print(lng_val,6);
Serial.println();
}
}
static void smartDelay(unsigned long ms)
{
unsigned long start = millis(); do
{
while (GPS_SoftSerial.available()) gps.encode(GPS_SoftSerial.read());
} while (millis() - start < ms);
}
void DegMinSec( double tot_val)
{
degree = (int)tot_val; minutes = tot_val - degree; seconds = 60 * minutes; minutes = (int)seconds; mins = (int)minutes;
seconds = seconds - minutes; seconds = 60 * seconds;
secs = (int)seconds;
}
```

VI. HARDWARE OUTCOME

The prototype hardware was implemented and its show in Fig.9 and the corresponding message and pictures outputs are shown in Fig. 10 and 11 respectively. Its proves alcohol detected notification, data time and GPS location has been received on MQTT Application.

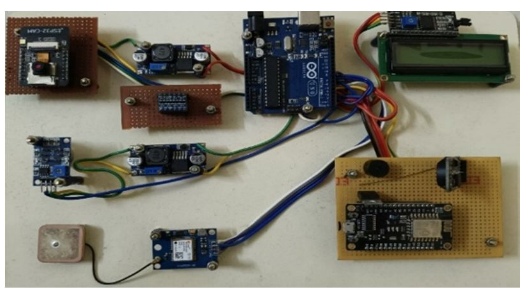

Fig.9. Proto type hardware implementation

Fig.10. Alcohol detected notification

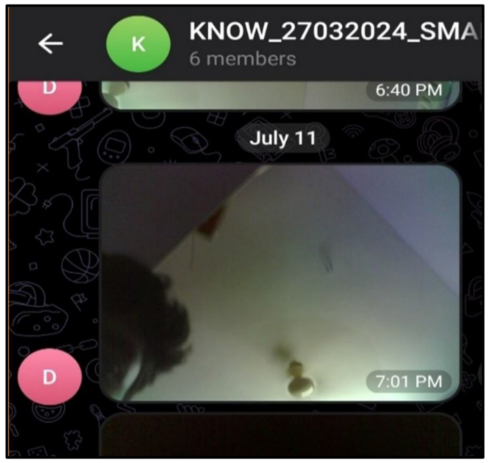

Fig.11.ESPcam output

VII. CONCLUSION

The system proposed has been implemented using a toy car. The test showed that the MQ3 sensor has high sensitivity to alcohol compared to other types mentioned in literature. The microcontroller helps to automate the system thereby reducing overheads that would have been incurred from personnel and maintenance cost. It is recommended that future work should consider tracking the subject driving under influence of alcohol via Global Position System (GPS). Motorcycles and bicycles can also be considered to have this system.

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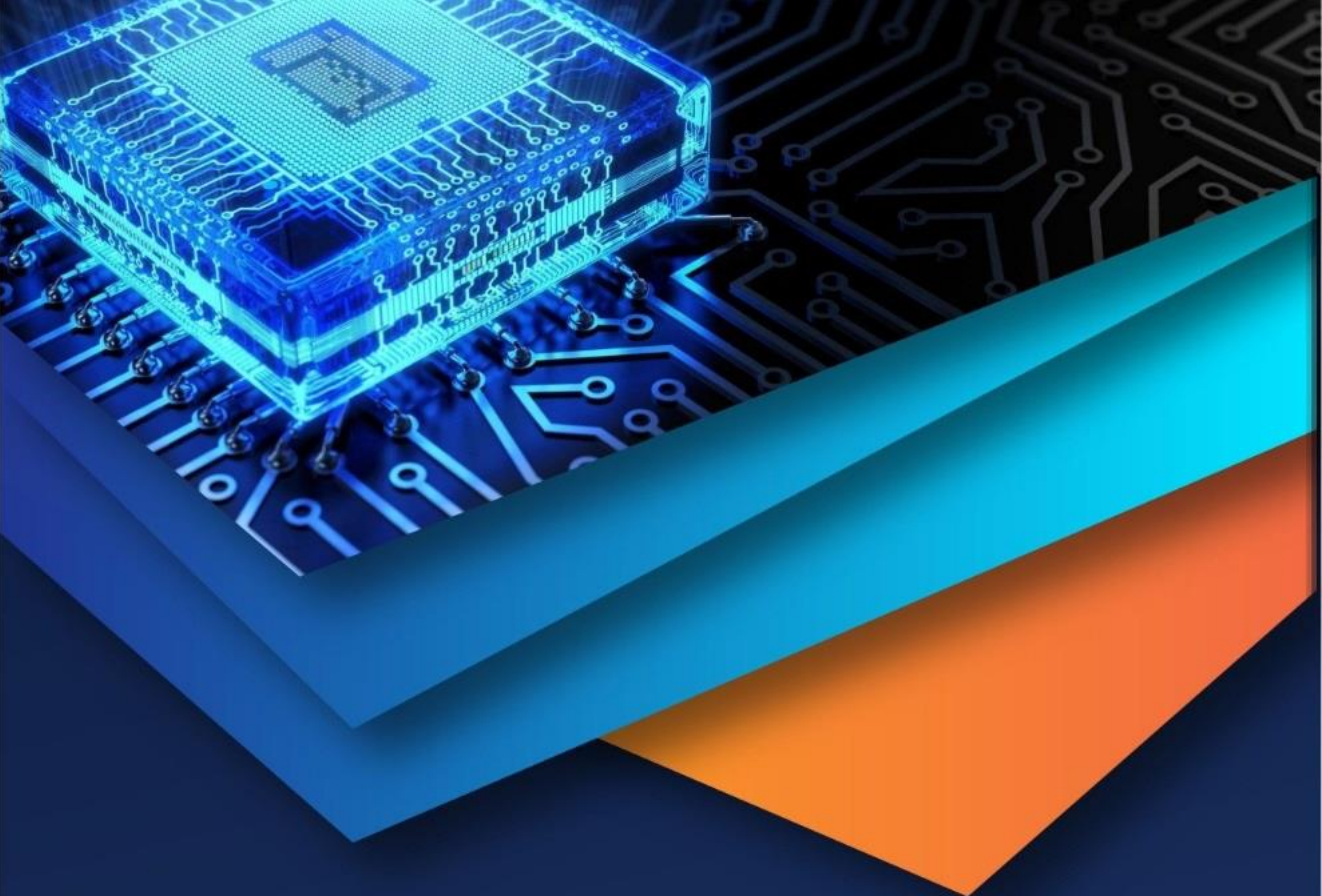

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