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Coolant Quality Sensor

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Abstract: ***The cooling system is one of the important things but also the most ignored thing when it comes to maintenances. Very few people are known about how to keep the maintain the coolant properly or when to replace the coolant. As distilled water is not readily available everywhere people usually top up their coolant with tap water which will cause deposition of mineral which may damage the radiator.***
These minerals are responsible for the rusting of internal components of the engine. A survey shows that majority of the people don't check their coolant. Therefore, we intend to make a system that will display the condition of the coolant. The system will be IR based which will indicate the condition of the coolant based of its color. A different threshold is set for a different color. Some of the previous research use electrodes to check the condition of the coolant but it could only detect the rusty coolant, not the degraded one.
The degraded coolant will not absorb as much heat as the new coolant. The aim was to create an in-expensive system which has an easy construction and also use readily available components. The system that we are using indicates according to the color of coolant which more accurate.
Keywords: Coolant, ATmega328p, IR sensor, vehicle electronics, cooling system

I. INTRODUCTION

Now a day's liquid cooling is used in vehicles with almost any engine capacity. The coolant flows through the water jackets which are present in the engines and absorbs heat and keeps the engine at idle temperature.
The coolant is first circulated around the engine with help of the water pump once it heats the thermistor open and coolant from the radiator flows into the engine. The radiator has a fan behind it which draws the atmospheric air through the radiator which keeps the coolant at the desired temperature which between 80̊ C to 90̊ C. A well maintained cooling system can make the engine silent and also improves efficiency.
The coolant has additives like anti-freeze and corrosion. The anti-freeze avoids it from freezing at low temperature and the anti-corrosive nature of the coolant will help prevent rusting of parts like the cylinder head and gasket. The coolant has a high boiling point which improves the thermal efficiency of the engine. By the time the coolant gets old and loses its properties. Most of the companies recommend changing the coolant every 2 years.
If the coolant turns rusty it may cause damage to the engine internally. So, it is necessary to keep the condition of the coolant in check. A recent survey was conducted in which it was seen that there are very few people who have knowledge about the coolant and what are the side effects it may cause when not taken care of. After considering all this problem into consideration it was decided to make a system which will not only detect the rusty coolant but also will detect the degraded coolant. As we have known a good coolant is very bright and reflective when you compare it with the rusty and degraded one. This system will work on the principle of reflectance. As the coolant has the most reflectance it will show good and for the rest, it will show bad. The system is IR based circuit controlled by a micro-controller ATmega328p.

II. AIM

The purpose here is to make sure that the driver is informed about the condition of the coolant. This system will provide a live status of coolant condition to the driver. The information will be displayed on an LCD. The system will also be less complex.

III. OBJECTIVE

A. To create a system which will detect all three stages of a coolant
B. To provide a proper indication to the driver which easy to read and understand
C. To make sure that the system is less complex and uses easily available components.

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IV. LITERATURE REVIEW

A. *("Sachat et al., 2017-Characterization of Industrial Coolant Fluids and Continuous Ageing Monitoring by Wireless Node—Enabled Fiber Optic Sensors")*

This paper is a study to develop a coolant quality sensor for industrial use that can withstand rough use. The sensor used for this process is a wireless photonic sensor. This is used to reduce the complexity which is usually caused by the wire. Different stages in the lifecycle of coolant are thoroughly examined that data is used while programming the system so that when the sensor will scan the coolant it will show the exact results. Based on optical fiber various pH sensors were developed and tested. The sensors proved to be efficient and pefect for industrial use.

B. *("Gonsalves et al. - 1987 - Sensor for Monitoring Automotive Coolant Condition.pdf," n.d.)*

This thesis focuses on the development of a sensor that detects the condition of the coolant. The sensor is electrode based. The electrodes are dipped inside the coolant. The sensor has two electrodes that are dipped into the coolant which detect the amount of rust particle present and also indicates the coolant level.

C. *("Shubham Gupta et al., 2017-International Journal of Scientific Research in Computer Science, Engineering and Information Technology")*

This paper focuses on developing of color detection circuit which is Arduino based. The color detector works on the principle of the luminous source which passes light to measure the obstacle in front of another sensor is used to detect the color of the object using the light reflected. All this data above is processed using data processing. It is mainly used for checking the marker on the packaging. The study here states that this system is very easy, accurate, and inexpensive when compared with other systems.

V. HARDWARE DESIGN

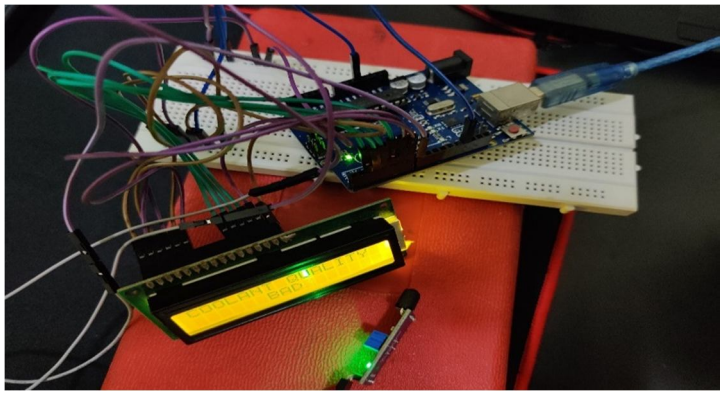

Figure 1 Coolant quality detection system

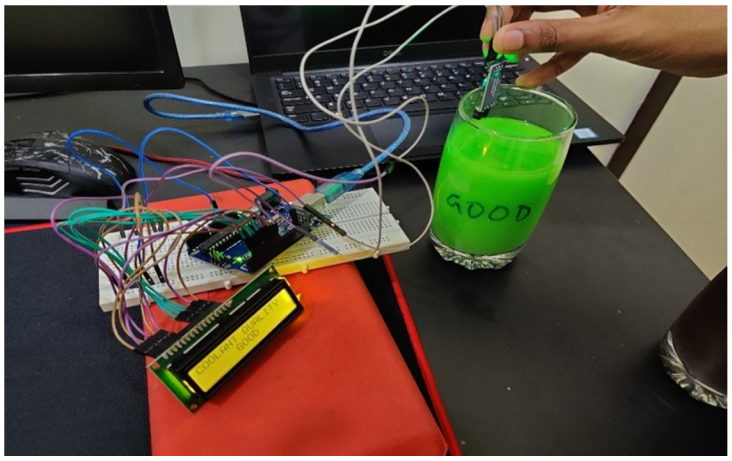

Figure 2 Coolant quality detecting system display good (demonstration)

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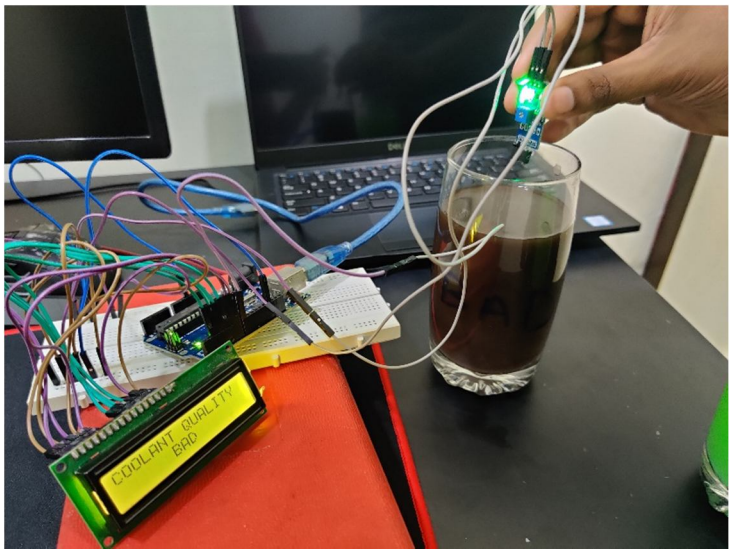

Figure 3 Coolant quality detecting system display bad (demonstration)

This is a coolant quality detection system which works on the principle of reflectance. As we have known a good coolant is very bright in color and reflective whereas the rusty and degraded are not as bright and reflective when compared to the good coolant. This system has components like an IR sensor, micro-controller(ATmega328p). The IR sensor has an emitter and a receiver. The light passes from the emitter hits the surface of the coolant this reflected light is collected by the receiver which will happen in the case of good coolant. In the case of the degraded and rusty coolant, it will not reflect as both the liquid are dark. All this information will be displayed on the 16 X 2 LCD.

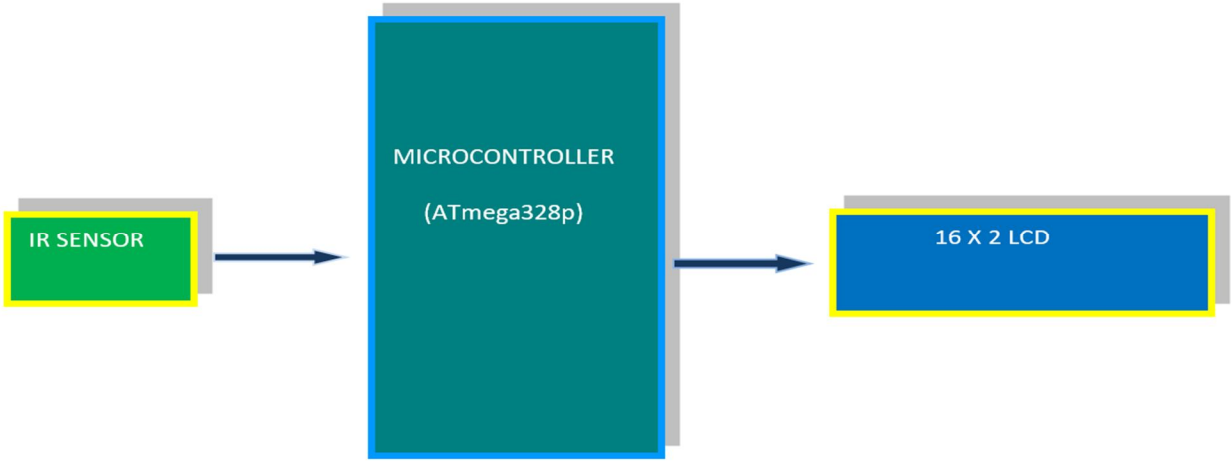

Figure 4 Block diagram

VI. TECHNICAL SPECIFICATION

A. IR sensor

Operating voltage	5 VDC
I/O pins	5V and 3.3V
Range	20cm
current	20mA

("IR Sensor Module Pinout, Features & Datasheet," n.d.)

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1) Pin Specification

Pin Name	Description
VCC	Power Supply Input
GND	Power Supply Ground
OUT	Active High Output

("IR Sensor Module Pinout, Features & Datasheet," n.d.)

B. Micro-controller (ATmega328p)

Microcontroller	**ATmega328P – 8 bit AVR family microcontroller**
Operating Voltage	**5V**
Recommended Input Voltage	**7-12V**
Input Voltage Limits	**6-20V**
Analog Input Pins	**6 (A0 – A5)**
Digital I/O Pins	**14 (Out of which 6 provide PWM output)**
DC Current on I/O Pins	**40 mA**
DC Current on 3.3V Pin	**50 mA**
Flash Memory	**32 KB (0.5 KB is used for Bootloader)**
SRAM	**2 KB**
EEPROM	**1 KB**
Frequency (Clock Speed)	**16 MHz**

("Arduino Uno Pin Diagram, Specifications, Pin Configuration & Programming," n.d.)

1) Pin Specification

Pin name	Description
PC6 (RESET)	Pin6 of PORTC
PD0 (RXD)	Pin0 of PORTD
PD1 (TXD)	Pin1 of PORTD
PD2 (INT0)	Pin2 of PORTD
PD3 (INT1/OC2B)	Pin3 of PORTD
PD4 (XCK/T0)	Pin4 of PORTD
VCC	
GND	
PB6 (XTAL1/TOSC1)	Pin6 of PORTB

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PB7 (XTAL2/TOSC2)	Pin7 of PORTB
PD5 (T1/OC0B)	Pin5 of PORTD
PD6 (AIN0/OC0A)	Pin6 of PORTD
PD7 (AIN1)	Pin7 of PORTD
PB0 (ICP1/CLKO)	Pin0 of PORTB
PB1 (OC1A)	Pin1 of PORTB
PB2 (SS/OC1B)	Pin2 of PORTB
PB3 (MOSI/OC2A)	Pin3 of PORTB
PB4 (MISO)	Pin4 of PORTB
PB5 (SCK)	Pin5 of PORTB
AVCC	
AREF	
GND	
PC0 (ADC0)	Pin0 of PORTC
PC1 (ADC1)	Pin1 of PORTC
PC2 (ADC2)	Pin2 of PORTC
PC3 (ADC3)	Pin3 of PORTC
PC4 (ADC4/SDA)	Pin4 of PORTC
PC5 (ADC5/SCL)	Pin5 of PORTC

("Arduino Uno Pin Diagram, Specifications, Pin Configuration & Programming," n.d.)

C. 16 x 2 LCD Display

1) Technical Specification

Dimension	80.0 × 36.0 mm
Character Size	2.95 × 5.55 mm
Input Voltage VDD	5V
VDD-VO	3.7V

("16x2 Character LCD Display, 16x2 LCD Displays - Winstar 16x2 Display," n.d.)

2) Pin Specification

Pin	Description
V_{SS}	Ground
V_{DD}	Power supply for logic
V_O	Contrast Adjustment
RS	Data/ Instruction select signal
R/W	Read/Write select signal
E	Enable signal
DB0~DB7	Data bus line
A	Power supply for B/L +
K	Power supply for B/L -

("16x2 Character LCD Display, 16x2 LCD Displays - Winstar 16x2 Display," n.d.)

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VII. SOFTWARE DESIGN

A. Program Code

Figure 5 program code

#include <LiquidCrystal.h>	Includes LCD library
LiquidCrystal lcd(7, 6, 5, 4, 3, 2);	Defines pin on Arduino
int IRSensor = 8;	Data pin of IRSensor connected on 8 of Arduino
lcd.begin(16, 2);	Both row of LCD are used
pinMode (IRSensor, INPUT);	IRsensor is defines as input
int statusSensor = digitalRead (IRSensor);	Read the value of IRsensor
lcd.setCursor(0,0);	Decides position of text
lcd.print("COOLANT QUALITY");	Displays coolant quality
lcd.setCursor(6,1);	Decides the row and position of text
lcd.print("GOOD");	Displays good
delay (35s0);	Adds delay
lcd.clear ();	Clears display
lcd.setCursor(0,0);	Decides the row and position of text
lcd.print("COOLANT QUALITY");	Displays coolant quality
lcd.setCursor(6,1);	Decides the row and position of text
lcd.print("BAD");	Displays bad

Figure 5 Code explanation

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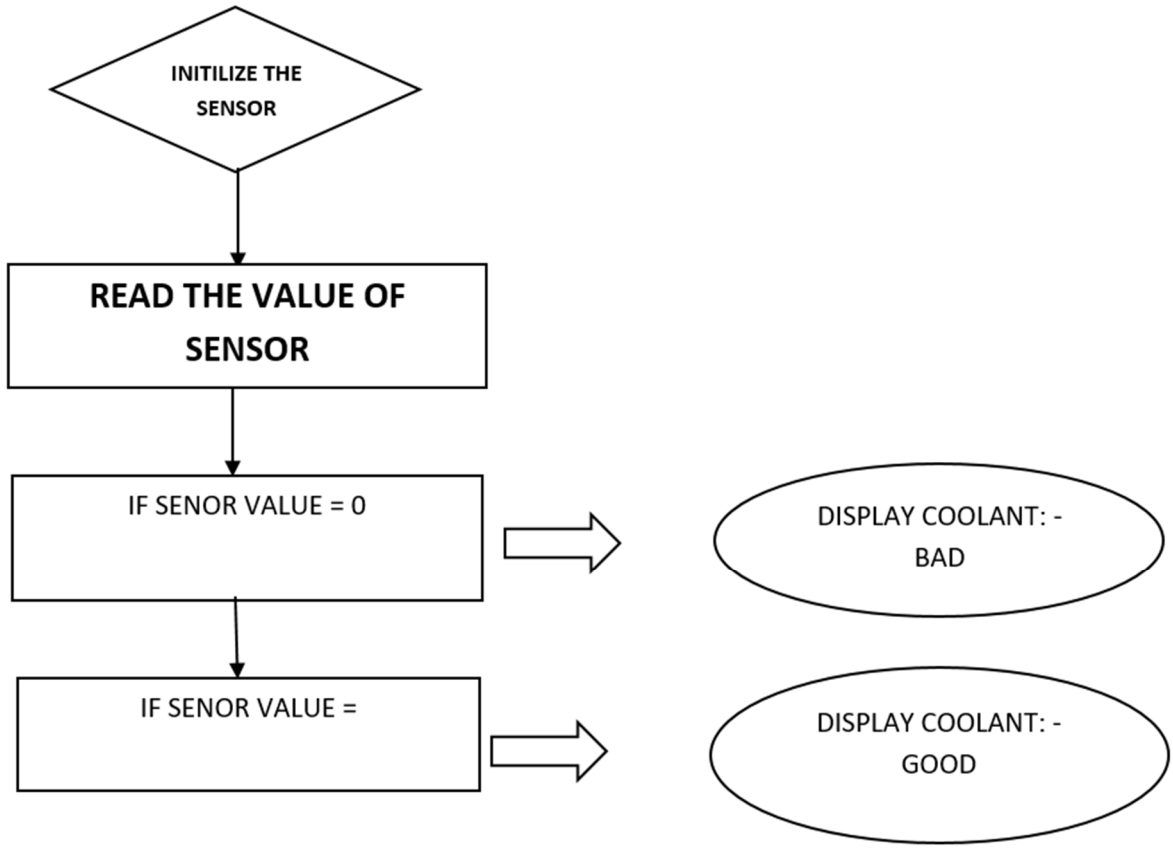

Figure 6 Program flow chart

VIII. RESULTS AND DISCUSSION

The above system with the help of a simple and in-expensive IR sensor cooling detection system was made. After a lot of trial and error while setting the sensitivity of the sensor the finally the right setting was achieved. Whenever the coolant color becomes dark or degraded it indicates bad coolant.

IX. CONCLUSION

As liquid cooling was used in all kinds of vehicles and this system is expensive to maintain. The rusty coolant inside the coolant system causes internal rusting in the parts which may be expensive. So, a simple and less complex but effective system to detect the quality of the coolant was developed using an IR sensor. After testing we have also achieved detection of degraded coolant.

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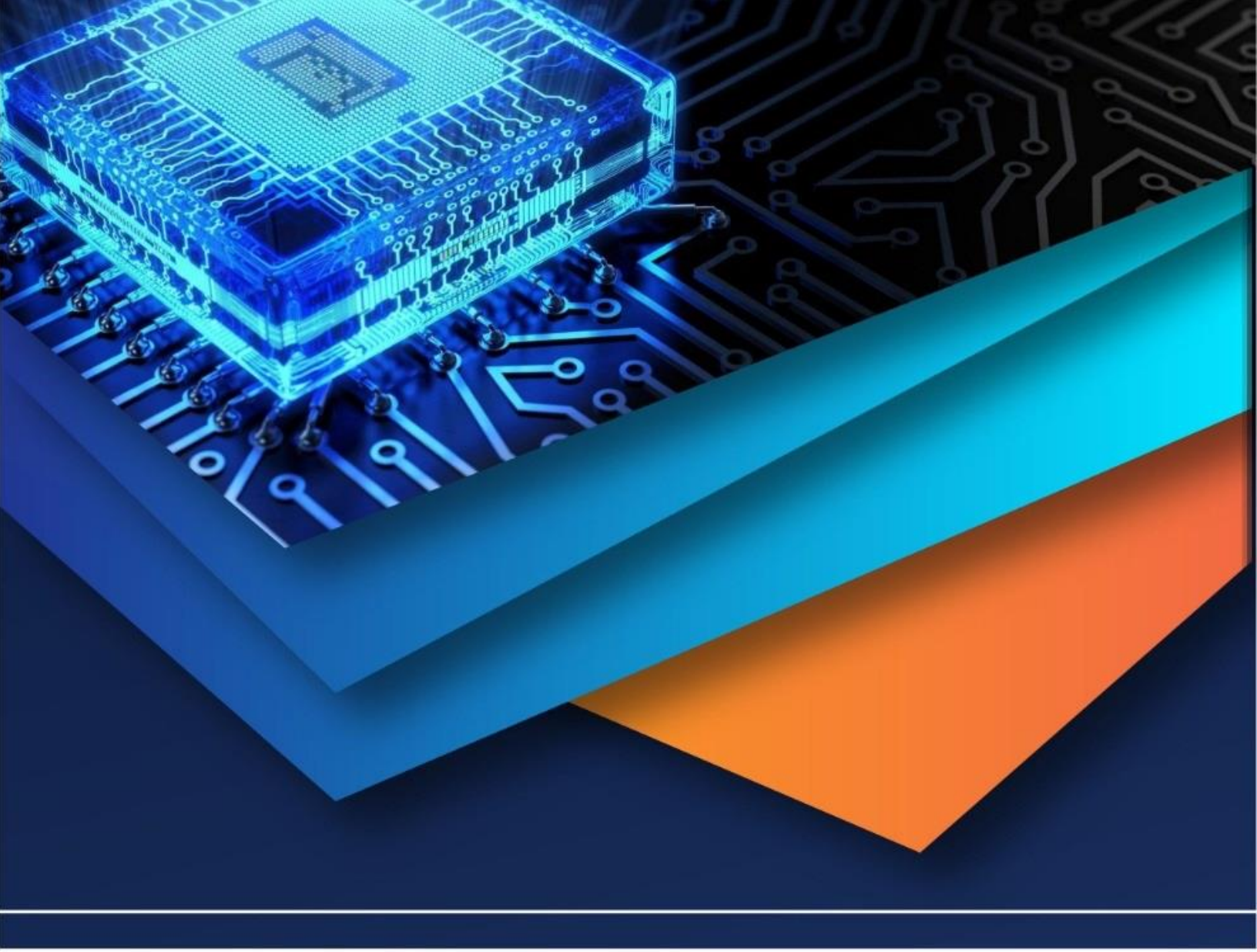

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