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An Innovative Prototype to Prevent Accidents using Eye Blink Sensor, Ultrasonic Sensor, Alcohol Sensor, MEMS Accelerometer

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Abstract: ***The ever increasing number of major traffic accidents around the world can be significantly reduced if modern technology is incorporated within the automobile to assess the physical condition of the driver as well as the outside situation of the automobile at regular intervals during the movement of the vehicle and preventive measures are automatically taken for the safety of all concerned entities, both within the vehicle and outside the vehicle. In this paper, design of a model incorporated with four sensors, namely, Eye Blink Sensor, Ultrasonic Sensor, Alcohol Sensor and MEMS Accelerometer, is presented which can monitor the physical state of the driver and the outside situation of the vehicle at regular intervals during his/her driving and raise an audible alarm within the vehicle to alert the driver. The prototype uses Eye Blink Sensor, Ultrasonic Sensor, Alcohol Sensor and MEMS Accelerometer to assess the physical condition of the driver and the outside situation of the vehicle and raise an alarm to alert the driver if any sensor senses any change in the normal condition. The prototype of the design has been successfully implemented which leads to the conclusion that such a system can help in keeping the driver alert at all times and monitor the outside situation while driving and hence facilitate in avoidance of any traffic accidents involving driver's alertness.***
Keywords: Eye Blink Sensor, Ultrasonic Sensor, Alcohol Sensor, MEMS Accelerometer.

I. INTRTODUCTION

Travelling is the essential part of everyone's life. The means of travelling have wide range, one such mean is road travel, which is the easiest one but also the most prone to the accidents. The main objective here is to design a real time prototype which would avert accidents caused due to decline in driver's vigilance. To be able to do this the prototype uses sensors such as Eye blink sensor which is used to monitor driver fatigue early enough to debar an accident, Ultrasonic sensor which is used to measure the distance of the vehicle in front, Alcohol sensor which detects the presence of alcohol gas in the air to analyze the breath of the driver, MEMS accelerometer which is used to measure tilt, and vibration or shock, which provide the data to the microprocessor which compares these data with data stored in it and if the result varies above the safety limit it gives signal to the alarm to turn on so that the driver get alert.

II. EYE BLINK SENSOR

Most traffic accidents are caused by reckless driving by drivers due to drowsiness. It is estimated that 10-20% of fatal crashes and about 5-10% of all car crashes can be related to tired drivers. According to the National Highway Traffic Safety Administration, there could be as many as 100,000 driver fatigue crashes each year, with about 1,550 fatalities, 71,000 people injured, resulting in economic losses of $ 12.5 billion. These numbers may be the tip of the iceberg, as it is currently difficult to attribute accidents to drowsiness. In India, around 250 people die every day in road accidents.

The Eye Monitoring System (EBM) will alert the driver in the event of drowsiness. An eye movement monitoring system would be useful in alerting drivers when they fall asleep. The driver's eye is continuously monitored using an infrared sensor. The normal rate of eye blinking will have no effect on system output. If the driver has fallen asleep, the infrared sensor receives an abnormal blink rate and an alarm sounds to wake him up. This system is based on the principle of monitoring the driver's eye movements continuously using an infrared sensor. If he falls asleep, an alarm sounds to wake him up. Basic electronic concepts are used with the microcontroller to implement this system. The infrared transmitter and detector are used to monitor the driver's eye, which will provide a corresponding output based on the driver's eye blink rate. The output of the IR sensor is given to the microcontroller where it is decided to sound the buzzer or not. The working status is displayed on the LCD screen, which is connected to the microcontroller. As the output of the microcontroller is low to drive the buzzer, an integrated drive circuit is used to amplify the output of the microcontroller.

The eye is illuminated by an IR LED, which is powered by the + 5V power supply and the reflected light is recorded by an IR photodiode. The IR photodiode converts this reflected light into an electrical signal and transmitted to Op-Amp. The Op-Amp output depends on the intensity of the light received by the IR photodiode. The microcontroller drives the buzzer according to the output of the op-amp.

When the eye is open, a maximum amount of light will be reflected from the eye because our eyeball is transparent, while a minimum amount of light will be reflected from the eye, when it is closed because part of the skin of the eye is opaque.

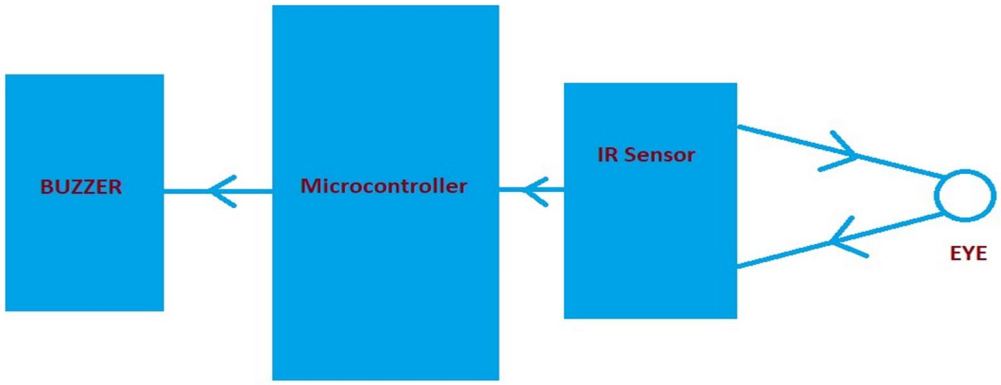

Figure 1: Block diagram of Eye Blink Sensor.

III. ULTRASONIC SENSOR

During winter seasons and during rainy season, the visibility on the road reduces considerably due to the Fog. Fog is one of the most dangerous weather condition to drive the vehicle for both new and experienced drivers as it reduces visibility significantly. And this reason is also among the reasons which cause accidents on the roads.

Due to the reduced visibility, the driver finds himself/herself unable to see clearly on the road and if there is a vehicle in front then in that case accident might occur. Also sometimes, the vehicles parked on the roadside or stopped due to the traffic is also not visible during fog as a result the driver even he/she drives at slow speed severe accidents can take place. So there is the need of a system which can aware the driver about the vehicle in front (if any) so that the driver get alert on time and slow down the speed and lower the chances of the accident.

By using Ultrasonic Sensor, we can make the driver aware about vehicle in front (if any), so that the driver slow down the speed of the vehicle.

In Ultrasonic Sensor, the transmitter transmits the ultrasonic sound waves, these sounds waves get reflected back upon falling on the vehicle infront over a wide solid angle which might be as high as 180 degrees. These reflected waves returns back quickly if the vehicle is close, but if the vehicle is far away the from the sensor, the waves takes longer time to return. As the waves return, the receiver receives these waves and produces an output which is given to the microcontroller which then sends the signal to the alarm to turn on so that the driver get alert and slow down the speed.

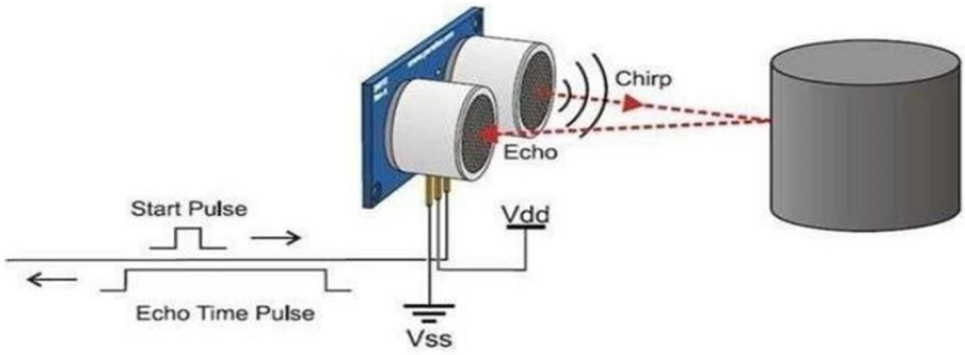

Figure 2: Ultrasonic Sensor.

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IV. ALCOHOL SENSOR

Alcohol impairs the judgement of a person. A person loses his/her ability to think properly when he/she has consumed alcohol which leads to drinking and driving that results in to major road accidents.

Drinking and driving involves operating a vehicle with the blood alcohol content (BAC) level of atleast 0.08 percent. Any amount of alcohol in driver's bloodstream may impact his driving ability and puts the driver at risk for causing an accident or highway injury.

Safe driving requires the ability to concentrate, make precise judgement and quickly react to situations. But, alcohol affects these skills of driver and put his and others life in danger. Therefore, there is a need of a system inside the vehicle which forbid the driver to consume alcohol before or while driving.

MQ3 alcohol sensor has been used here. It is a Metal Oxide semiconductor (MOS) type of sensor. MOS sensors are also known as Chemiresistors , because sensing is based on the change of resistance of the sensing material when exposed to alcohol. This alcohol sensor works on 5V DC and draws around 800Mw. It can detect Alcohol concentrations anywhere from 25 to 500ppm.

This sensor is comprised of a perspective layer of tin dioxide (SnO_2) inside aluminum oxide microtubes (measuring electrodes), and a heating element inside a tubular casing. The sensor's end face is enclosed by a stainless steel net and the connection terminals are present at the backside.

The sensor draws the driver's exhaled breath and if alcohol is present in the breath then it is oxidized into acetic acid and passed through the heating element which results in the decrease in resistance as the ethyl alcohol is cascade on the tin dioxide sensing layer. By using external load resistance the resistance variation is converted in to a suitable voltage variation. This variation in voltage is fed to analog to digital converter which converts this voltage variation in to digital signal. This digital signal is given to the microcontroller which sounds the alarm to aware others about the alcohol consumption by the driver.

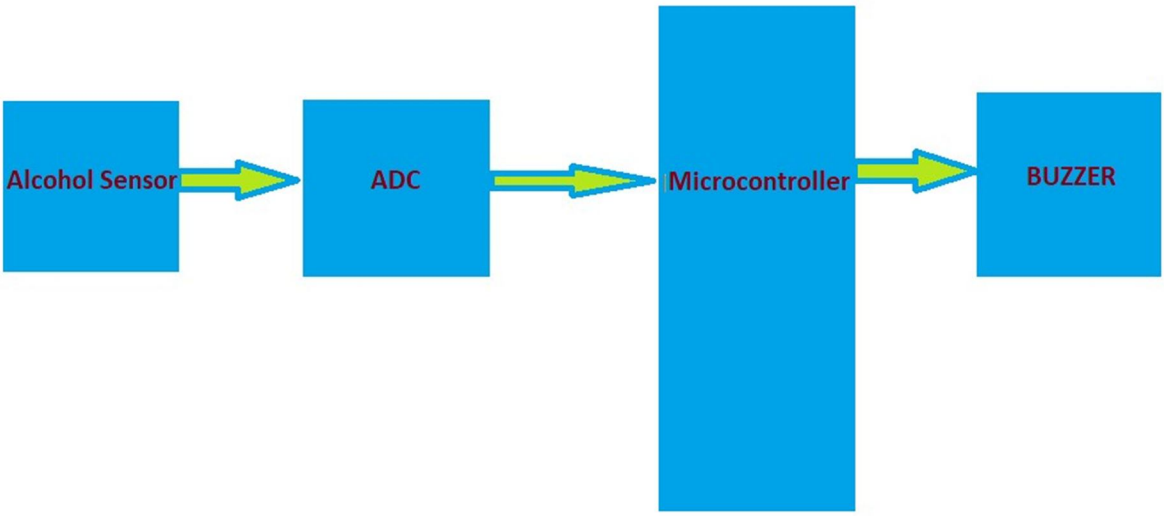

Figure 3: Block diagram of Alcohol Sensor.

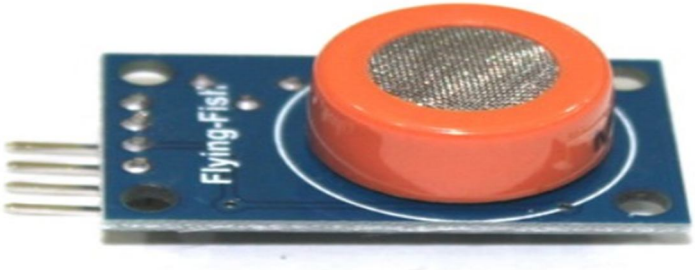

Figure 4: Alcohol Sensor.

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V. MEMS ACCELEROMETER TILT SENSOR

Roads on the hilly areas and places with sharp turns are tilted to provide the necessary centripetal force to avoid the risk of skidding. But if the speed at those places is above the safety limit then skidding of the vehicle may occur. Thus, the objective of incorporating the vehicle with the Tilt Sensor is to alert the driver about the tilt in the road so that driver get aware and drive the vehicle under the safety limit of the speed.

MEMS short of micro electro mechanical system which applies to such type of sensor that is manufactured using microelectronic fabrication techniques. MEMS sensors can be used to measure physical parameters such as acceleration.

Variable capacitive (VC) MEMS accelerometers are low range, high sensitivity devices used for structural monitoring and constant acceleration measurements.

In MEMS VC accelerometers, the sensing element consists of a micro-machined proof mass which is suspended between two parallel plates. The proof mass is suspended on flexures which is attached to a ring frame. The reason for this configuration is that this forms two air gap capacitors between the proof mass and upper and lower plates.

When acceleration is applied, then the proof mass moves and one air gap decreases and the other air gap increases creating a change in capacitance proportional to the acceleration.

This change in capacitance proportional to the acceleration will be measured and processed and it will correspond to a particular acceleration value.

Both the plates, Upper and Lower are laminated with a glass bond to the proof mass. This lamination creates a hermetic enclosure for the proof mass and provides mechanical isolation and protection.

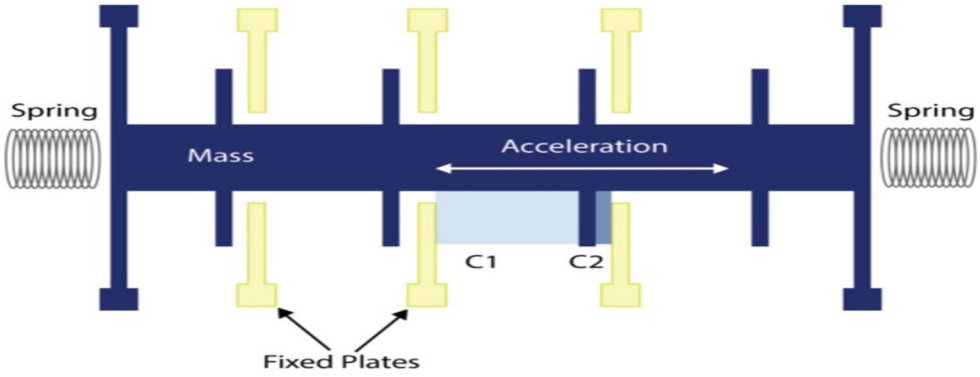

Figure 5: MEMS Accelerometer.

The tilt sensor measures angular rate using the Coriolis Effect. When a mass is moving in a particular direction with a particular velocity and when an external angular rate will be applied as shown in fig. 7 with the green arrow a force will occur, as show with the blue red arrow, which will cause perpendicular displacement of the mass. Similar to the accelerometer, this displacement will cause change in capacitance which will be measured and processed and it will correspond to a particular angular rate.

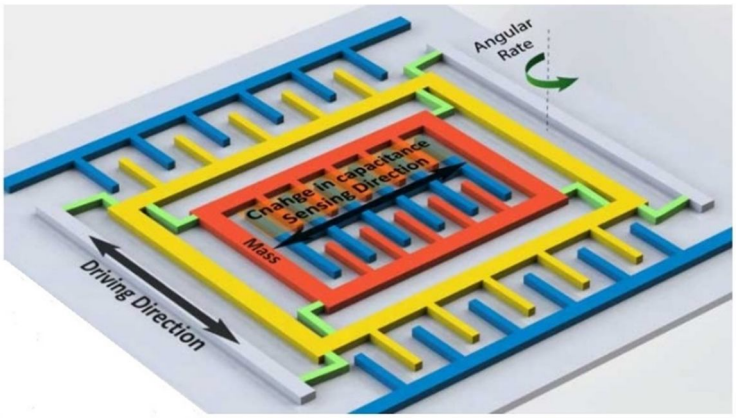

Figure 6: MEMS Gyroscope.

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VI. PROJECT OVERVIEW

The block diagram of proposed project is shown in Fig. 7. In the present prototype, microcontroller, which is an electronic device is acting as the central processing unit of the model. Eye blink sensor, Ultrasonic sensor, Alcohol sensor, MEMS accelerometer tilt sensor are connected to the microcontroller. A buzzer which is an alarming device is connected to the microcontroller.
All the four above mentioned sensors are connected to the microcontroller. These sensors continuously scan the situations inside and outside of the vehicle and give these as input to the microcontroller. The microcontroller compares these inputs with the safety limits (which are the predetermined conditions that are stored in it) and if the result is logic 1 or TRUE then an output signal is given to the buzzer to give an alert to the driver.

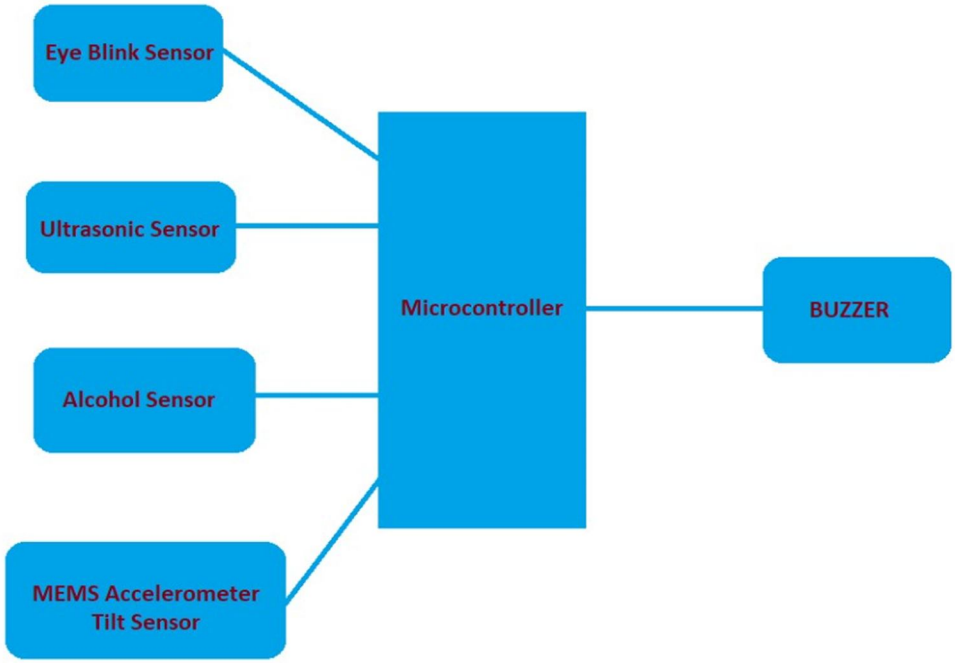

Figure 7: Block diagram of proposed prototype.

VII. RESULT

In this prototype we are intended to avoid some of the main causes of the accidents. And to do so we have used sensors which detect the driver's physiological signals (Driver Fatigue), driver's state (whether drunk or not) and exterior situations such as gap between cars, road tilt.

A. We have used Eye Blink Sensor to detect whether the driver is tired or not by measuring the time of his eye closing. When the driver closes his eyes for time more than the predetermined value then the buzzer gets activated to alert the driver.
B. To detect the consciousness of the driver we have used Alcohol Sensor which detects the alcohol gas released by the breath of the driver to detect whether driver is drunk or not. When the sensor detects the presence of the alcohol gas then the buzzer gets activated to alert the driver.
C. To maintain the safe distance between the vehicles on the highways we have used Ultrasonic Sensor to detect the distance between vehicles. When the distance between vehicles detected by the sensor is less than the safety limit then buzzer gets activated to alert the driver.
D. To detect whether there is tilt on the road or not we have used MEMS Accelerometer which detects the tilt on the road. When the sensor detects tilt on the road then the buzzer gets activated to alert the driver about it.

Through these sensors system continuously examines various parameters such as eye blink, distance between vehicles, alcohol and tilt on the road and if any abnormality is detected an alert is given to the driver in the form of ringing of buzzer. Hence, by alerting the driver about the situations which could turn into fatal accidents, the chances of accidents to occur reduces considerably.

VIII. FUTURE SCOPE

In future, the existing sensors can be made more accurate if possible or otherwise can be replaced with new and more accurate versions to improve the reliability of the system.

In alcohol detection system, new feature can be added such as once the alcohol is detected the vehicle would turn off the ignition and the vehicle does not allow the driver to start the vehicle.

As a new feature, displaying the warning on the display present in the vehicles may be added to give more detailed information about the abnormal situations to the driver which are detected by the the sensors.

The designed system can be further improved to send alert messages to vehicle drivers whenever an abnormal situation is detected. This expansion involves a mobile application which runs continuously on user's phone and gives alert.

Some new sensors can also be added in the future to detect uncovered abnormal conditions which can result into a fatal accident such as to detect the presence of potholes on the road which are one of the major cause of accidents, impact sensors to detect on which side the impact has occurred after collision and many more.

IX. CONCLUSION

The frequency of the accidents is increasing day by day, everyday thousands of accidents occur in India, which includes the loss of lives which is more valuable than anything in the world. So, we as an engineer need to take some action to against this and provide the desired solution. For the safety of human being automation is made which can detect the abnormal situations and alert the driver on time so that the probability of the accident can reduce. For this purpose, the proposed model is a advanced system to detect the fatigue symptoms in the driver through Eye Blink Sensor, to detect outside situation of the vehicle through Ultrasonic Sensor, to detect alcohol consumption by driver through Alcohol Sensor, to detect tilt in the road through MEMS Accelerometer Tilt Sensor. All these sensors work continuously to detect any abnormal conditions and alert the driver about those abnormal conditions, so that the driver can take necessary action on time to reduce any chances of accidents.

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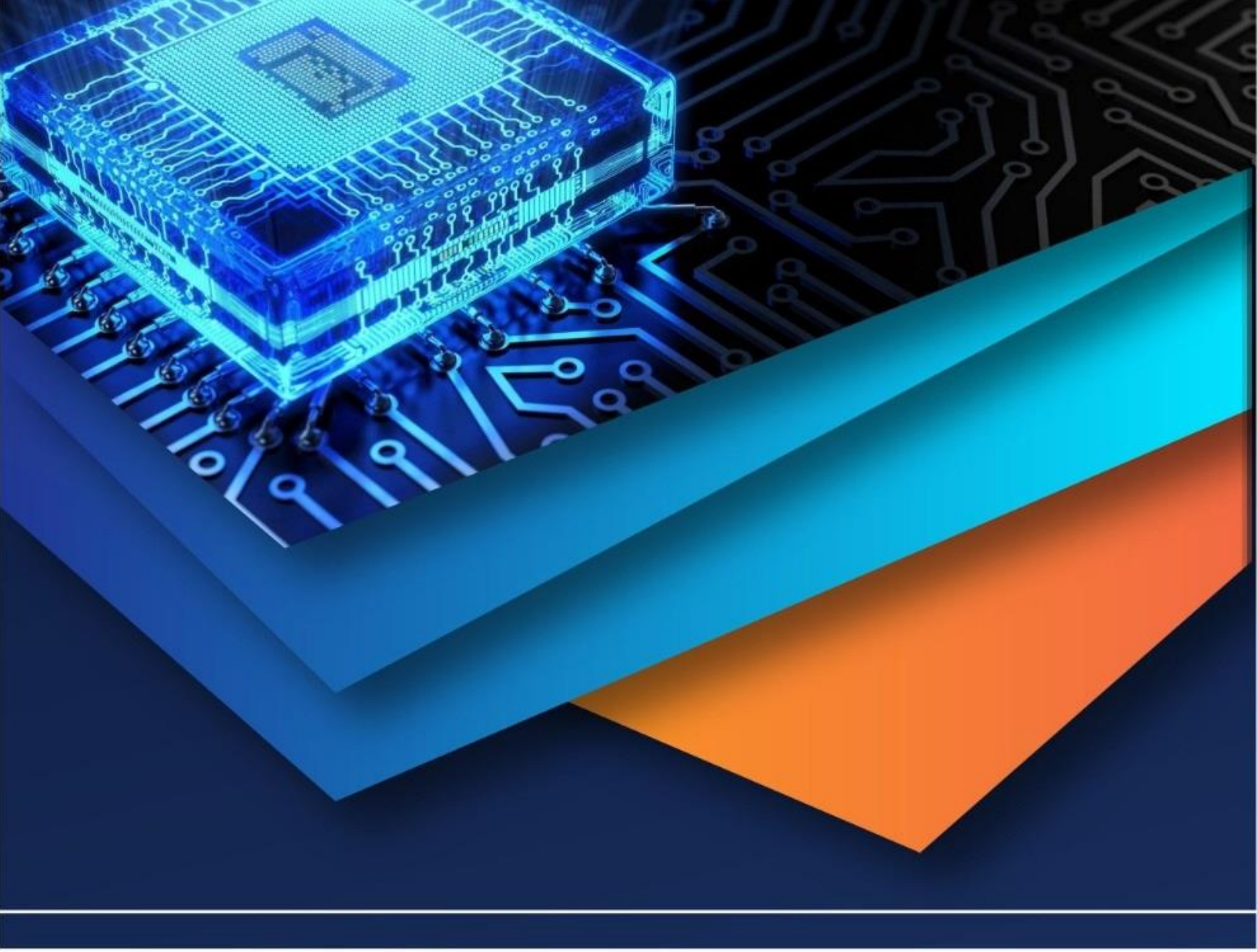

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