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Voice-Assisted Blind Spot Detection for Vehicles with Accident Detection

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Abstract: ***It can't be looked either by forward or through the side or rear view mirror. Blind spots exist in a wide range of vehicles: aircraft, cars, motorboats, sailboats, and trucks. A major cause of road accidents is the lack of proper warning systems about the presence of objects in the vehicles' blind spot, making the task of switching lanes or changing direction all the more daunting and dangerous. The objective of building this system is to reduce the probability of occurrence of an accident caused due to the 'blind spot' phenomenon. The system tackles the phenomenon by using ultrasonic sensors to notify the driver of objects present in the blind spot of the vehicle, thus signaling when it is and isn't safe for the driver. What makes this project reliable is that the surrounding vehicles' distance is notified in a vocal form making it very convenient for the driver and reinforcing the safety.***

Keywords: blind spot, voice output, collision avoidance, monitoring, accident detection, record and playback.

I. INTRODUCTION

[1] This is partly due to individuals adjusting their mirrors properly, or not properly checking their blind spots before changing lanes.

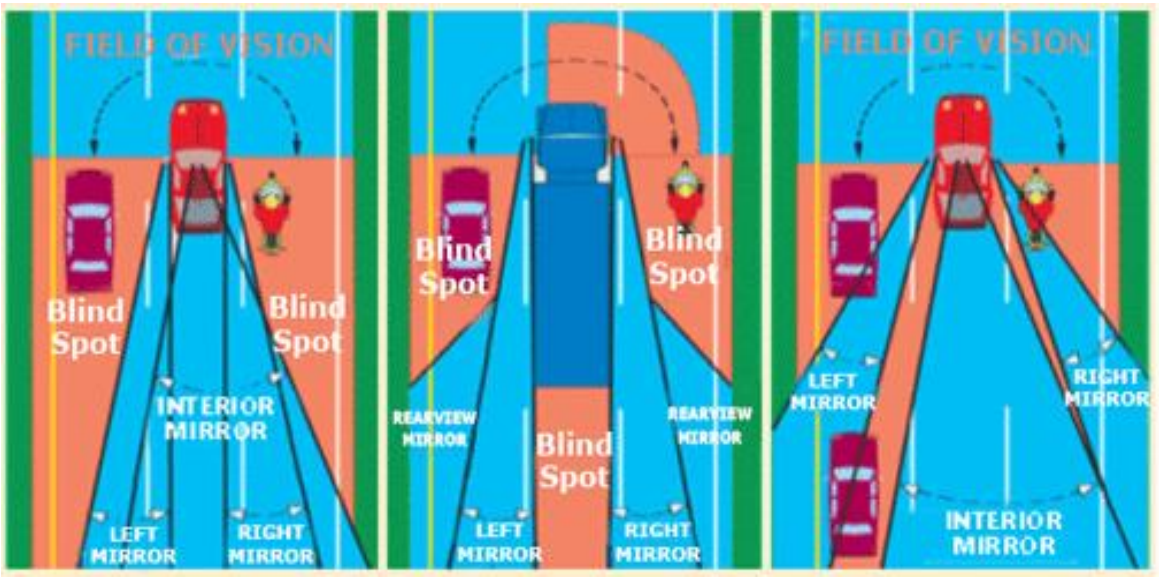


Figure 1: Various blind spot regions

However, it is difficult for a driver to always adjust the mirrors while driving. It is essential to install an automatic system inside the car for drivers' convenience and safety. This is where our project comes in. A handy, automatic system that notifies the driver about any vehicle present in the blind spot area thus helps in minimizing accidents.

The blind spot detection system involves mounting sensors exterior of a vehicle to sense the presence of obstacles within a vehicle's "blind spot" and to generate a signal to the vehicle's operator indicating the presence of the object.

This project uses ultrasonic sensors to detect the objects and a voice module to give a vocal output of the presence and distance of the other vehicles to the driver. Thereby making sure that the driver need not worry about the adjustment of mirrors and can drive safely. Whenever the distance between the vehicles crosses the threshold value, the driver can take necessary actions to mitigate the risk in the situation. Otherwise, ignore it.

The technology used is embedded systems (Arduino is used to interface). Associating it with sudden accident detection and sending the location to emergency contacts (with the help of accelerometer, GSM and GPS modules).

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II. LITERATURE REVIEW

Sensing is used to detect entities present at the blind spot regions of the vehicle. This system alerts drivers. The light display on their side-view mirror housings begin to flash and also steering wheel starts to vibrate [5].Another example of implementation of BSD is the Volvo vehicle based on radar sensing, that informs the driver about vehicles in the blind spots on both sides of the car. It is also detects and alerts the driver about rapidly approaching vehicles up to 70 meter behind the car [1]. Below are some of the systems presently available for blind spot and accident detection

1) *C.T. Chen and Y.S. Chen [3]* proposed a solution, to detect vehicles in the blind spot, in their paper on "Real-time approaching vehicle detection in blind-spot area" where they will continuously take pictures of the blind spot using camera. Then they will use image processing to detect if there are any vehicles in the images taken. This problem with this type of system is it is very complex to implement. It will have some delay to process. Also, it is costly compared to the system with ultrasonic sensors.
2) *T. S. Ajay and R. Ezhil [4]* proposed a system which uses an ultrasonic sensor to detect the vehicles in the blind spot. A led will blink when there is something in the blind spot. The issue with this system is the driver has to take his eyes from the road to see if there is something in the blind spot.
3) *Jiun-Ren Lin and Timothy Talty [5]* suggested a system of intra-vehicular Network in their paper "A Blind Zone Alert System based on Intra-vehicular Wireless Sensor Networks" where all the vehicles will communicate with each other, thus they can know if a vehicle is in blind spot of other vehicle. Unlike other systems this system needs all the vehicles to be equipped with it. This won't work if there is a vehicle without this equipment in the blindspot.
4) *Rohit Ganiga, Rohit Maurya and Archana Nanade[6]* demonstrated an equipment in their paper "Accident Detection System Using Piezo Disk Sensor" where they used a Piezo Disk Sensor which will monitor vibrations to detect accidents. They used GPS module to get the location of the vehicle and GSM to send the message. The issue with this type of system is a vehicle vibrates a lot and there may be false accident detections.

Coming to our project, we not only aim at blind spot detection but also have an additional feature added, that is, accident detection. Using blind spot detection we have the accidents detected and if an accident has occurred we have a gsm and gps modules to enable the near and dear of the driver to be informed about the location and to act immediately for the driver's safety. We also use a voice module to enable the driver to tell him or her about the distance of the vehicle in the blind spot vocally.

Functional Block Diagram

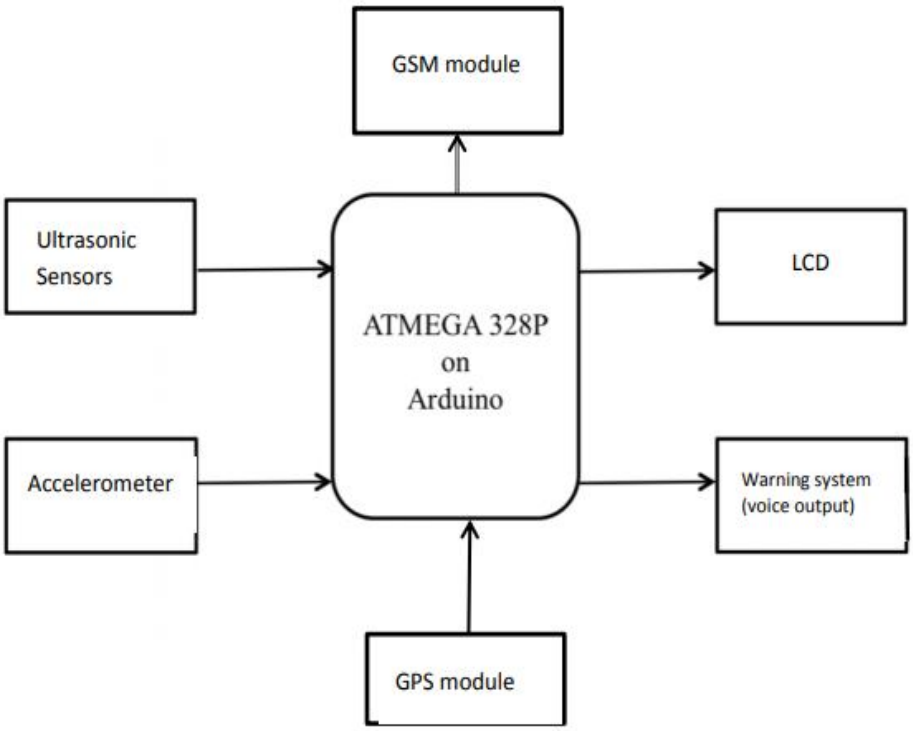


Figure 2: Block Diagram of Proposed System

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Flow Chart: Working

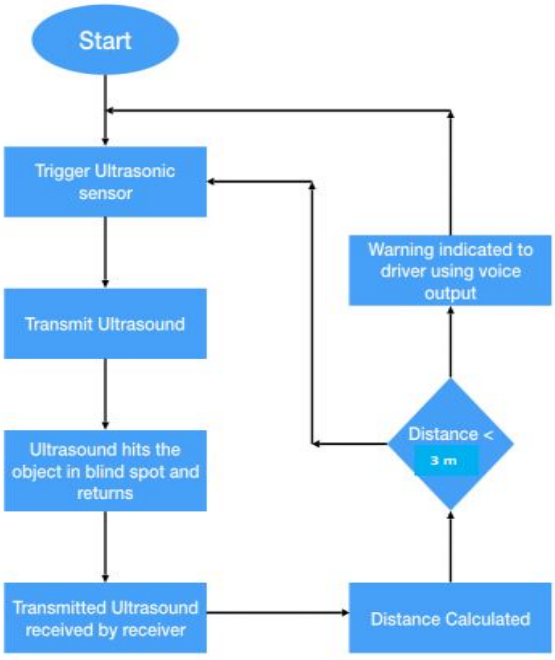


Figure 3: Flow Chart for vehicle detection

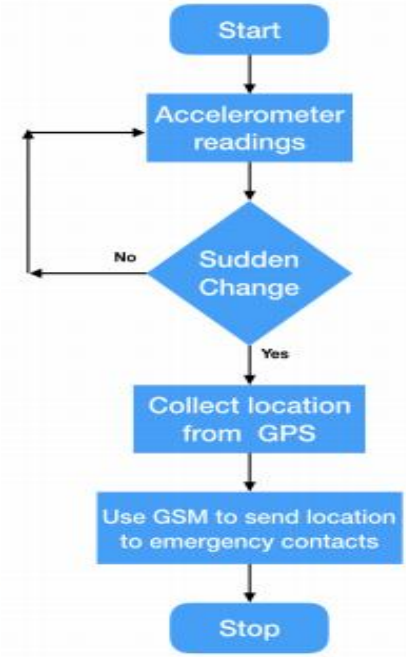


Figure 4: Flow Chart for accident detection

III. METHODOLOGY

This project is divided into two parts:

A. Notifying The Driver The Presence Of Vehicles In The Blind Spot

Figure 5: circuit diagram of blind spot detection

Two Ultrasonic sensors (HC-SR04) and the voice module (APR33A3) are interfaced using Arduino, the sensors each placed on the left and right of the vehicle. These sensors continuously detect vehicles in the blind spots and notify the driver in the form of an audio message of the format "**{0}** side vehicle in **{1}** meter(s)" where {0} and {1} can have values of left, right and 1, 2meters respectively. When there's no vehicle spotted in the immediate blind spot region, or if the probability of collision is less (vehicles are > 3 meters away), a green LED is turned on indicating its SAFE.

1) Ultrasonic Sensors



Figure 6 : Ultrasonic Sensor(HC-SR04)

The distance can be calculated with the following formula:

Distance L = ½ × T × C where L is the distance, T is the time between the emission and reception, and C is the sonic speed. (The value is multiplied by 1/2 because T is the time for go-and-return distance).

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2) Voice Module (APR33A3)

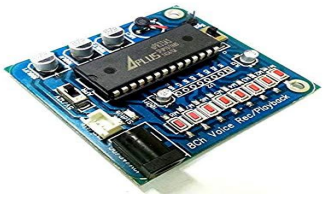


Figure 7 : APR33A3 Voice Module

8-message mode: The 8 channels in the module are used for storing of each message. Channel 1 is used for “Right side vehicle in 1 meter”, channel 2 is used for “Right side vehicle in 2 meters”, channel 3 is used for “Right side vehicle in 3 meters” and channel 4 is used for “Right side vehicle in more than 3 meters away”. Similarly channels 5,6,7,8 are used for Left side vehicle indication.

Initially the record button is pressed (made high) to record the audio messages. Later the play button is made high for playback mode. Based on the position of the vehicles, corresponding channel pin is made high in the program.

B. Accident Detection

In this section, when an accident occurs, the location is sent to the emergency contacts.

1) Accelerometer (ADXL 345)

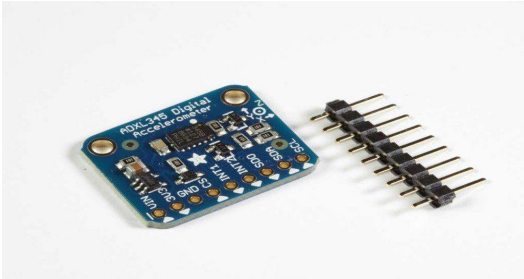


Figure 8 : Accelerometer (ADXL 345)

The ADXL345 [9] is a low-power, 3-axis MEMS accelerometer modules with both I2C and SPI interfaces. The ADXL345 features 4 sensitivity ranges from +/- 2G to +/- 16G. And it supports output data rates ranging from 10Hz to 3200Hz. The sensor consists of a micro-machined structure on a silicon wafer. The structure is suspended by polysilicon springs which allow it to deflect smoothly in any direction when subject to acceleration in the X, Y and/or Z axis. Deflection causes a change in capacitance between fixed plates and plates attached to the suspended structure. This change in capacitance on each axis is converted to an output voltage proportional to the acceleration on that axis. This is how it calculates the acceleration.
Velocity is moving distance in a certain time. Acceleration is a change in velocity. A crash involves a sudden, large acceleration from some velocity to zero. In this project, the accelerometer will monitor the acceleration and when you see a large output - possibly all the way to the max, then we can interpret that an accident has occurred. At this point, the GPS is activated.

2) GPS Module (NEO-6M)



Figure 9 : GPS module (NEO-6M)

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A GPS navigation device [10], GPS receiver, or simply GPS is a device that is capable of receiving information from GPS satellites and then to calculate the device's geographical position. Using suitable software, the device may display the position on a map, and it may offer directions.

When the accelerometer records maximum value, i.e., when it indicates an accident, the GPS module is activated. Using the GPS commands and parsing it as required is done in Arduino, where the longitude and the latitude i.e., the location of the vehicle is saved.

3) GSM module (SIM 900A)



Figure 10 : GSM module (SIM 900A)

GSM is a mobile communication modem; it stands for Global System for Mobile communication (GSM) [11]. It is widely used mobile communication system in the world. GSM is an open and digital cellular technology used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz frequency bands.

The location co-ordinates, once calculated by the GPS module, are sent to the selected contacts using the GSM module. In this project, the program is written in the Arduino that uses GSM commands to notify emergency contacts of the vehicle's exact location when an accident occurs, thus enabling a faster reach for the injured.

In order to avoid false alarms (message sent when there's false accident detection), the system comes with a button, which when pressed, sends an "I'm okay!" message to the contacts.

4) Advantages

a) Major number of the accidents can be avoided.

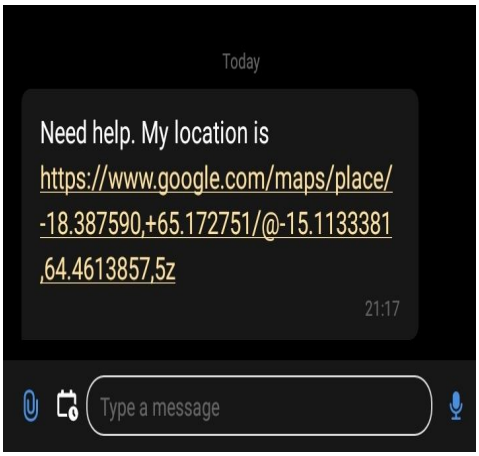
b) With the help of sudden accident detection, the chances of reaching the injured at the earliest are increased, thereby increasing the chances of his/her survival.

c) Helpful for large and heavy trucks who have poor visibility of smaller vehicles.

d) Increases the safety of bicycle riders especially at night.

e) Easy installation and cost-efficient.

IV. RESULT AND CONCLUSION



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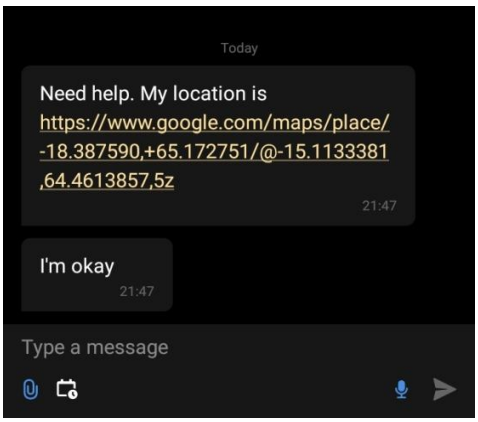


Figure 11: SMS received by emergency contacts

The project Blind spot detection using voice module and accident detection is a unique project unlike the previous ones which only detect vehicles in blind spot region. We not only detect it but also give the accurate output to the driver in two ways. One, displaying on the LCD screen and the other in the form of voice output.This project, therefore makes driver's job easier to monitor vehicles around. As we have also used the accident detection, which is an extended utility of the project, which uses GPS and GSM module, this enables all the near and dear of the driver to have his safety ensured. All the contacts are sent the location which can directly be viewed in Google maps. In conclusion, this project can be easily installed in any vehicle, with minimum costs and maintenance; it makes sure that the driver has a safe journey and faster help when needed.

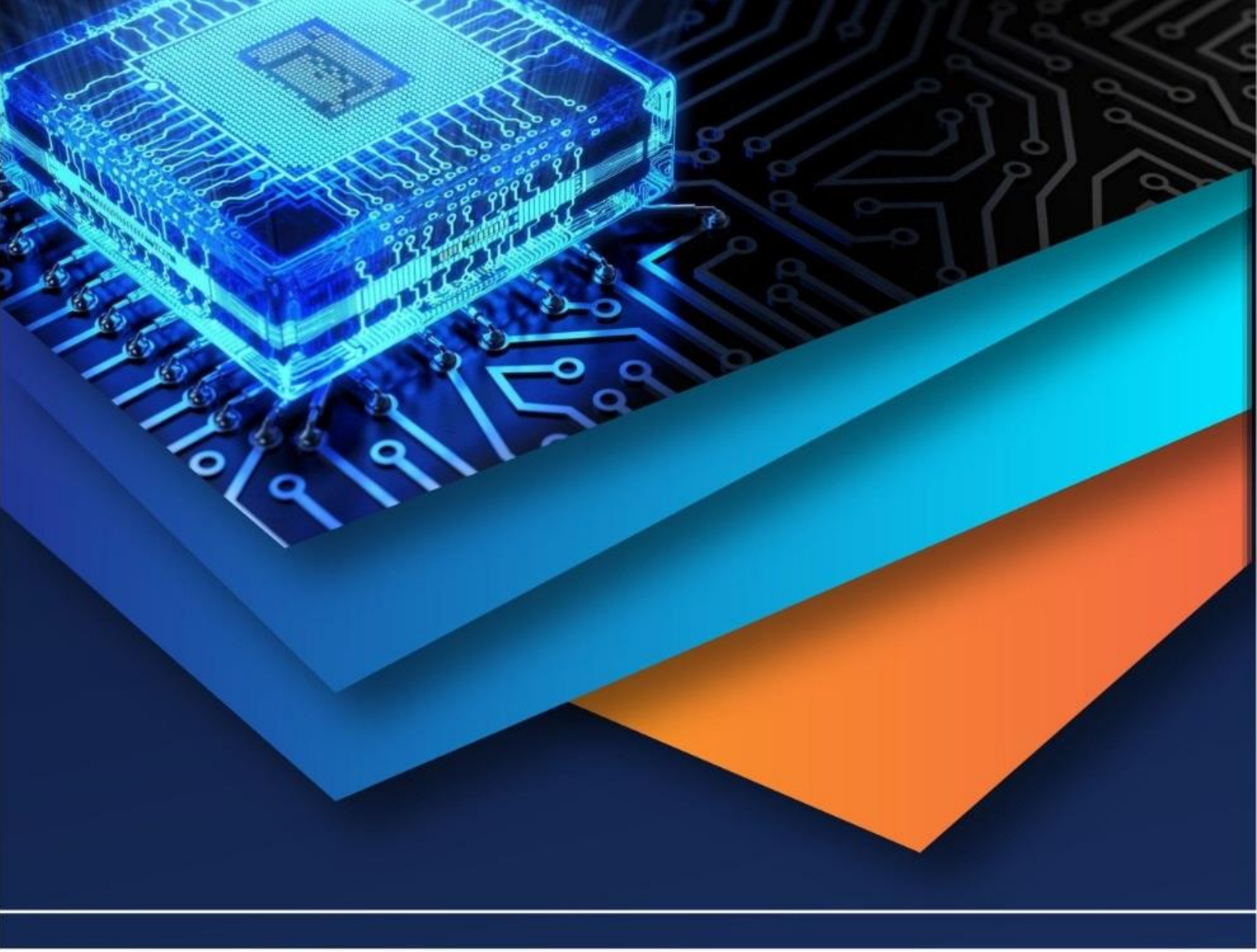
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