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Implementation of Accident Detection and Alert System for Emergency Medical Asassistance using Mobile Application with MIT App Inventor

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Abstract: ***Nowadays accident rates on roads are very high, especially using two wheelers. Timely medical help needed to save the lives on the road A system is proposed to provide immediate medical aid to detect an accident and alert friends and relatives about the accident. The system is designed to understand the seriousness of the accident. In this, attached accelerometer in the vehicle senses the tilt of the vehicle and the abnormality of the heartbeat known by the heartbeat sensor on the user's body. The accelerometer and heartbeat sensor connected to Smartphone. The system will make the decision and sends the information to the Smartphone through Bluetooth. The mobile phone with android application will send text message to the friends and relatives. With this application, the exact location of accident occurred also be shared that can save the time.***

Telematics model has been proposed in this research field that contains three main modules. This method is proposed to confine the site of the vehicle with GPS receiver. SMS sends the captured location information to vehicle owner's mobile and same information shared to the telematics operator server with GPRS. An added design method proposes to detect and make available earlier help to traffic accident sufferers. Prototype architecture is designed to get well the chances of survival for people met in car accidents. The proposed system designed with vehicle to vehicle communication technologies that offer automated detection, reports, and assistance to passengers involved in road accidents.

The proposed design uses a low cost alert system to provide immediate medical aid to the accident victims. The exact place of accident and the details of the patient sent through SMS in order to alert the victim's friends and relatives. The design of proposed system also takes the medical condition of the injured party by checking the heartbeat to know the seriousness of the accident and inform the people whose contacts are saved.

Keywords: Raspberry Pi, Android, ,MIT

I. INTRODUCTION

Now days, use of motor vehicle populace increasing on an exponential rate than the population as well as economic growth. Accidents and the death rate increasing at an alarming rate because of road accidents, particularly two wheelers [3]. According to WHO reports, road traffic accidents account for more than 1.25 million deaths worldwide every year

The majority of the accidents deaths that occur on the roads mainly express highways happen are due to the lack of instantaneous medical assistance. Facilitating immediate medical assistance to the accident area can decrease the fatal accident to a greater level [1].In this cost an idea of an alert system used that senses the accident and its seriousness to alert the victim's friends and relatives for providing ambulance or medical aid to the accident area.

Fig: 1.1A person met with an accident (image taken from imagesbazar.com)

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In the proposed system, the heartbeat of the victim is measured to know the seriousness of an accident and then the system will notify the relatives and friends of the victim about the incident. The exact location will be communicated by Victims mobile phone. With this information, the rescue team can rush to the spot immediately without any delay. For this we use a hardware module which can be attached to the vehicle and an android application installed in victim's mobile, which is connected through Bluetooth and sends messages using the messaging application in the mobile phone.

II. RELATED WORK

Accident detection with alert system has been studied deliberately over the past several years. The working research group in this this field has proposed a Telematics model under which three main modules developed [1]. The proposed system used to confine the location of the vehicle with GPS receiver. SMS send to vehicle owner's mobile number that contains location information and in addition to the telematics operator server with GPRS.

Purva Javale et.al [2] proposed another prototype system to detect and make available to faster assistance for traffic accident victims.

Manuel Fogue[3] proposed a prototype architecture to improve the chances of survival for passengers involved in car accidents.

The proposed system facilitates automated detection, information, and assistance to people involved in road accidents by makes use of the capabilities existing with vehicle to vehicle communication technologies. In this, a low-cost alert system has proposed to provide immediate medical aid to the accident victims by alerting the nearby medical help center. The exact place of accident and the details of the patient sent through SMS.

III. DESIGNING AND IMPLEMENTING THE ACCIDENT DETECTION AND ALERTING SYSTEM

A. Architecture

The Accident Detection System consists of a hardware module which is mounted to the two-wheeler and which detects tilt of the two-wheeler. This module consists of raspberry pi, accelerometer, Bluetooth module, ADC, Heart beat circuitry. A clip sensor attached to the finger of the victim is used to measure the heartbeat of victim. Both the tilt angle of the two-wheeler and the heartbeat of the victim are monitored simultaneously and continuously. Android hardware application module to be installed in the victim's smart phone and running actively in order to facilitates communication

The smart phone with android application will retrieve victim's location from the GPS coordinates of the smart phone and sends message through SMS in order to know the accident location and accident victim details. The Application will communicate this information to the emergency contact numbers of the friends and family that has saved already in the application.

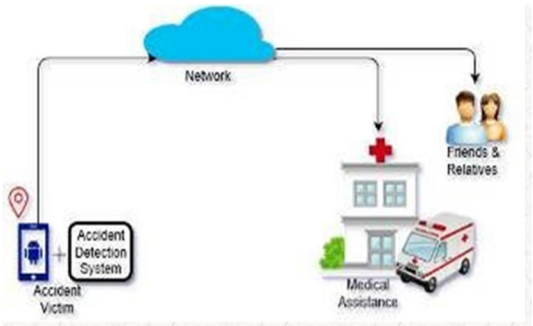

Fig: 3.1 Basic architecture of the system (image taken from images. Google)

B. Design of Accident Detection System

Bike accidents are being monitored in the proposed system. In this design, for monitoring the bike accident, perpendicular axis is taken as the reference. With this reference, in the accident, the vehicle will fall either left side or right side will be traced. Accelerometer is used to detect the tilt of the vehicle [2]. Checking of bike fallen or not has been taken with Y-axis of accelerometer. If the angle of inclination is more than the critical value then the output voltage of the accelerometer made low. Then low signal output being produced and sent to the Raspberry Pi, it will confirm an accident being occurred and then an interrupt is generated and the information sent using Bluetooth [4]. If the heartbeat is more than or less than the normal range then it will confirm the seriousness of the accident. Thus, decision has taken as serious accident has being occurred. Fall detection accelerometer module is mounted on the vehicle and the clip sensor is attached to the body and these are integrated as a smart watch. The smart phone designed with android application controls and connects the hardware module using Bluetooth.

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C. Fall Detection Using Accelerometer

The fall detection structure will constantly monitor posture of the bike. It consists of an accelerometer and Bluetooth module controlled by Raspberry pi 3b module. ADXL335 is a 3-axis accelerometer which is used in this module [6]. This IC has three pins X, Y and Z that gives acceleration in terms of voltage. Tilt angle of the bike has been measured with signal from the Y-axis. In this design, analog voltage signal fed into the ADC module and ADC digital output sent to Pi3b and mapped resultant to the angle of the tilt. The fall of bike determined if the angle below 10 degree or greater than 170 degree. An interrupt is generated if Raspberry Pi 3 detects the fall, and sends a control signal to the Smart phone application through Bluetooth [5].In this, HC-06 Bluetooth module used and connected to Raspberry Pi 3 using serial communication.

D. Heartbeat Sensing

The Heartbeat sensing module continuously measures the heartbeat of the victim. It consists of heartbeat sensor, Raspberry Pi 3, Bluetooth module HC-06. The heartbeat count is sent in the message to friends and relatives [3]. Heartbeat sensor used to detect the heartbeat and helps to count the heartbeat to check whether the rate is normal or abnormal. In proposed design low cost system used, with this the heartbeat sensor designed and developed using photo diode and IR LEDs. Reflectance Photo Plethysmography [1] principle is used for designing of heartbeat sensor. IR LED used to observe the reflected light intensity. Light is allowed to fall on the body part particularly on finger or wrist. The reflected light intensity changes due to the change in the volume of blood through the body. It is observed that highest amount of light reflected from the heartbeat beat or systolic peak. Electric signal produced by capturing the reflected light on Photodiode. Noise is filtered with a low pass filter after signal amplification. The spike of the heartbeat obtained with the switching function of transistor when signal passed to the base of the transistor. To check the heartbeat rate the signal fed to Raspberry Pi 3 to count the number of pulse per minute .This is used to know the heartbeat is normal or not. Raspberry Pi 3 will send a message to the user's smart phone through Bluetooth module HC-06 when heartbeat is abnormal. This message informs that an accident had occurred and the heartbeat of the fatality is abnormal.

E. Android Application

Android application is used with Bluetooth device and this Android application will get back the victim's location coordinates. Information regarding location of the accident communicated using SMS with the GPS. Android application developed with MIT App Inventor [2]. Google provides MIT (Massachusetts Institute of Technology) for Android and this is an open-source web application. MIT App Inventor uses a graphical interface in order to create an application that can work on Android devices, which allows users to drag-and-drop visual objects.

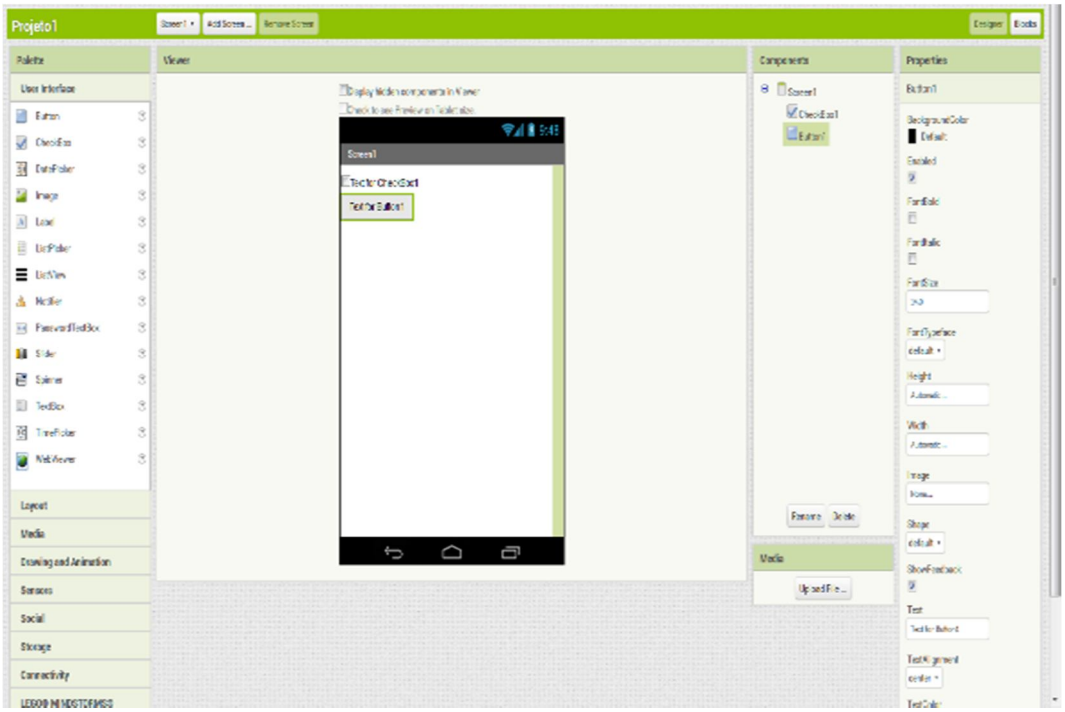

Fig: 3.2 Sampleimage of MIT app inventor

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F. Flow Chart

The flow chart as shown below gives working procedure. Accelerometer readings are continuously communicated to the phone with the Bluetooth module. Whenever the system detects a tilt of vehicle. it initially gives the victim a threshold time of 10 seconds whether he is conscious. Then reset the system indicating that the accident is not so severe; otherwise, it sends an alert to the victim's relatives and friends indicating victim's location plus heartbeat.

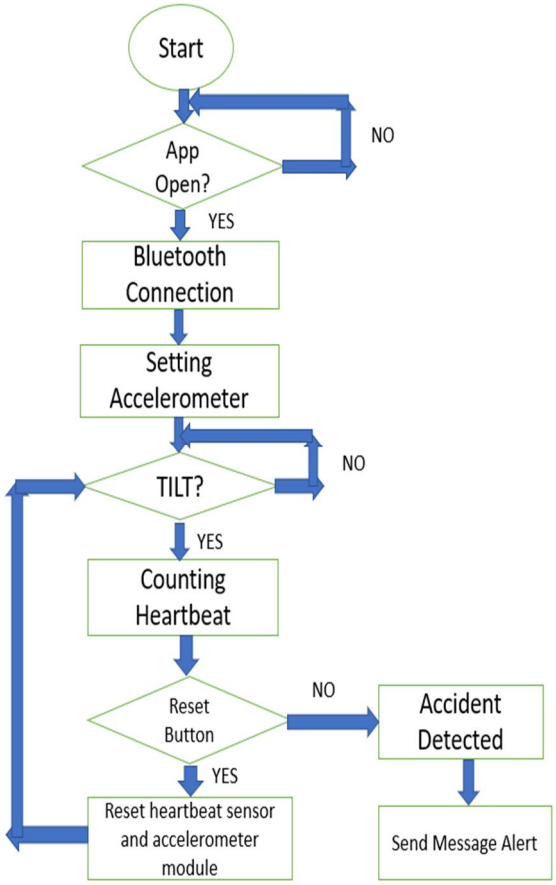

Fig: 3.3 Flow diagram of Accident detection and Alert system

G. Hardware Components

In this section discussion on the hardware components used along with their descriptions presented.
The block diagram of the proposed system

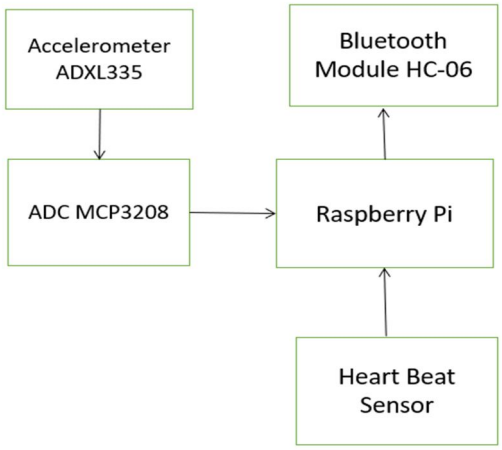

Fig: 3.4 Block diagram of Accident detection system

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The components we used are:

1) Accelerometer (ADXL335)
2) Raspberry Pi 3B board
3) ADC MCP3208 board
4) Bluetooth HC-06
5) Heartbeat sensor using LM358
6) Push button

H. Heartbeat Sensor

Heart beat sensor is designed such that it gives digital output of heartbeat when a finger placed in it. For each heartbeat the beat LED flashes when heartbeat detector starts working, [4]. BPM (The Beats Per Minute) rate measured with direct connection of digital output to micro controller. The working of blood flow through finger at each pulse based on the principle of light modulation [6].

The basic unit of heartbeat sensor contains a LED and LDR or a photodiode. Variations of heart beat pulses causes the flow of blood to different parts of the body. Light produced by tissue reflection when a tissue is illuminated with the LED. The light detector receives reflected light and it depends on quantity of the light absorbed by the blood. [4]. Heart beat rate produces the electrical signal, which is the detector output.

The signals used for tissues and the blood volume are actually a DC signal. AC components are synchronized with the heart beat and superimposed on the DC signal. Hence, isolation of AC component is of prime importance.

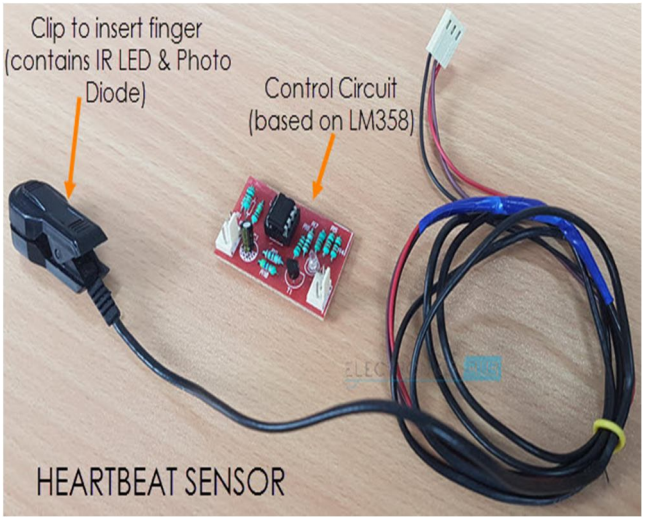

Fig: 3.5 Heartbeat sensor with clip to insert finger

I. Heartbeat Sensor with Raspberry Pi

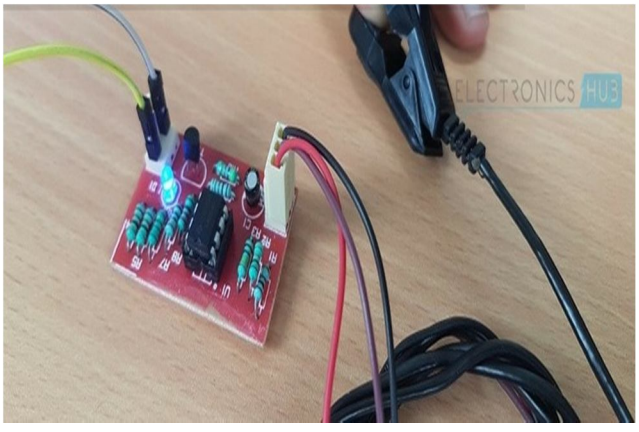

Fig: 3.6 Heartbeat sensor and clip interfaced with Raspberry Pi

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In this, Light Dependent Resistor is used as a light detector. In LDR, the resistance changes when it exposed to light. An increase of light intensity causes decrease of voltage drop across the resistor [3]. Comparator used to compare the output voltage from the LDR to that of the threshold voltage. The threshold voltage is defined as the voltage drop across the LDR when the light with fixed intensity falls directly on it. The non-inverting terminal is connected to the LDR and inverting terminal of the comparator LM358 is connected to the potential divider arrangement, which is set to the threshold voltage. The intensity of the light reduces, when a human tissue is illuminated with light source. The resistance increases when reduced light intensity falls on the LDR and the voltage drop increases [5]. If voltage drop across the LDR or the non-inverting input exceeds that of the inverting input, a logic high signal is produced at the output of the comparator else a logic low output produced. At the output a series of pulses developed and to get the heart beat rate these pulses given to the Raspberry pi. The information processed accordingly and then displayed on the display interfaced to the Raspberry pi.

Here the heartbeat sensor using LM358 connected to raspberry pi and it gets power supply from the ADC board. This setup of sensor and pi counts heartbeat for every second and updates it for every minute [5].

J. Pushbutton and Pi

A simple push button is interfaced and integrated with raspberry pi so that when the victim is fine even after falling from the two wheeler, he/she can press the push button to stop sending the message to the relatives and friends, but this should happen with in a specified time of 10 seconds.

K. Accident alert system (All hardware components interfaced together) Working of the System

The entire setup integrated with a two-wheeler. The person should connect the Bluetooth of his mobile with Bluetooth of the system and should insert his finger into the clip for heartbeat sensing. He/she should run the mobile application continuously in the mobile. The accelerometer sends analog tilting angle values to ADC for digital conversion. These digital values are sent to raspberry Pi to check whether the threshold values are met or not. This process will be done continuously until threshold levels are met. Using the clip and heartbeat-sensing module the heartbeat is calculated and will be updated for every minute. While traveling if the Raspberry Pi detects threshold tilting values, then raspberry Pi initializes the Bluetooth module to communicate with mobile application to send alert messages. The push button when pressed by the victim even after meeting the threshold values then alert message will not be sent and entire system will restart.

IV. RESULTS

Analog Voltage Values At The Accelerometer

Axis	Angle of tilt (Degree)	Voltage Level (Voltage)	Decision
Y	0-10	0-0.33	Accident
Y	90	3.24	Normal
Y	170-180	0-0.35	Accident

Table 4.1 Analog voltage values observed at accelerometer

We have taken the threshold tilting angles as between 0 – 10 degrees and 170-180 degrees we acknowledge it as an accident. The respective analog voltage values are observed at different tilting angles as mentioned in the table. These analog values are sent to ADC for digital conversions to work on raspberry pi.

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A. Mobile Appication Designing using MIT App Inventor

The mobile application designed using MIT App inventor 2 which consists of the status of position of the bike, heartbeat, latitude and longitude values, address of the accident is shown below. This application sends messages to the contacts added in the application using general messaging applications of the mobile. For this Bluetooth of mobile should be connected to Bluetooth of the accident alert system. The GPS location permission should be provided to the application and the application should run on the mobile for this entire procedure to happen.

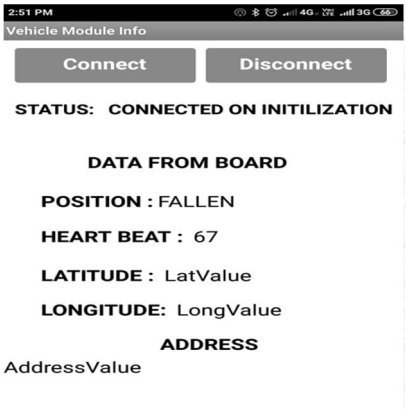

Fig: 4.1 Mobile application

B. Continuous Monitoring in a Rasberry Pi

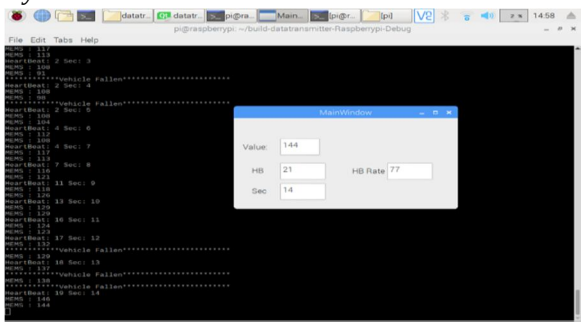

Fig: 4.2 Continuous monitoring on Raspberry Pi

Here the MEMS values i.e the tilting angle is monitored continuously and the heartbeat is measured for every second, and will be updated for every minute. If threshold values are met it shows the status that vehicle is fallen.

C. Message Alert Received on friends Mobile

Fig: 4.3 Message alert received on friend's mobile

This is the SMS alert which is sent through victim's mobile to relatives and friends mobile which shows the information that accident is occurred at certain location and the heartbeat of the person.

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V. CONCLUSION

Accident detection and alert system for emergency medical asassistance using mobile application with MIT app inventor designed and implemented successfully. This system detects the fall of a two-wheeler and monitors the heart beat of the user continuously.
Designed an android application by using MIT App Inventor which can be installed by user on his/her smartphone and which communicates with the system through bluetooth and sends an alert.
Whenever the system detects a tilt of vehicle, it initially gives the victim a threshold time of 10 seconds whether he is conscious and is able to reset the system indicating that the accident is not so severe, else it sends an alert to the victim's friends and relatives indicating the victim's location and heartbeat.
The Android application can be added to Play stores like Google Play Store, Apple store so that the application need not be kept opened for it to be active.
If the database of the medical centre's at various locations available, the SMS alert can be send to nearest medical center along with the victim's friends and relatives.
Heart beat sensor integrated as a smart watch so that an additional sensor can be removed.

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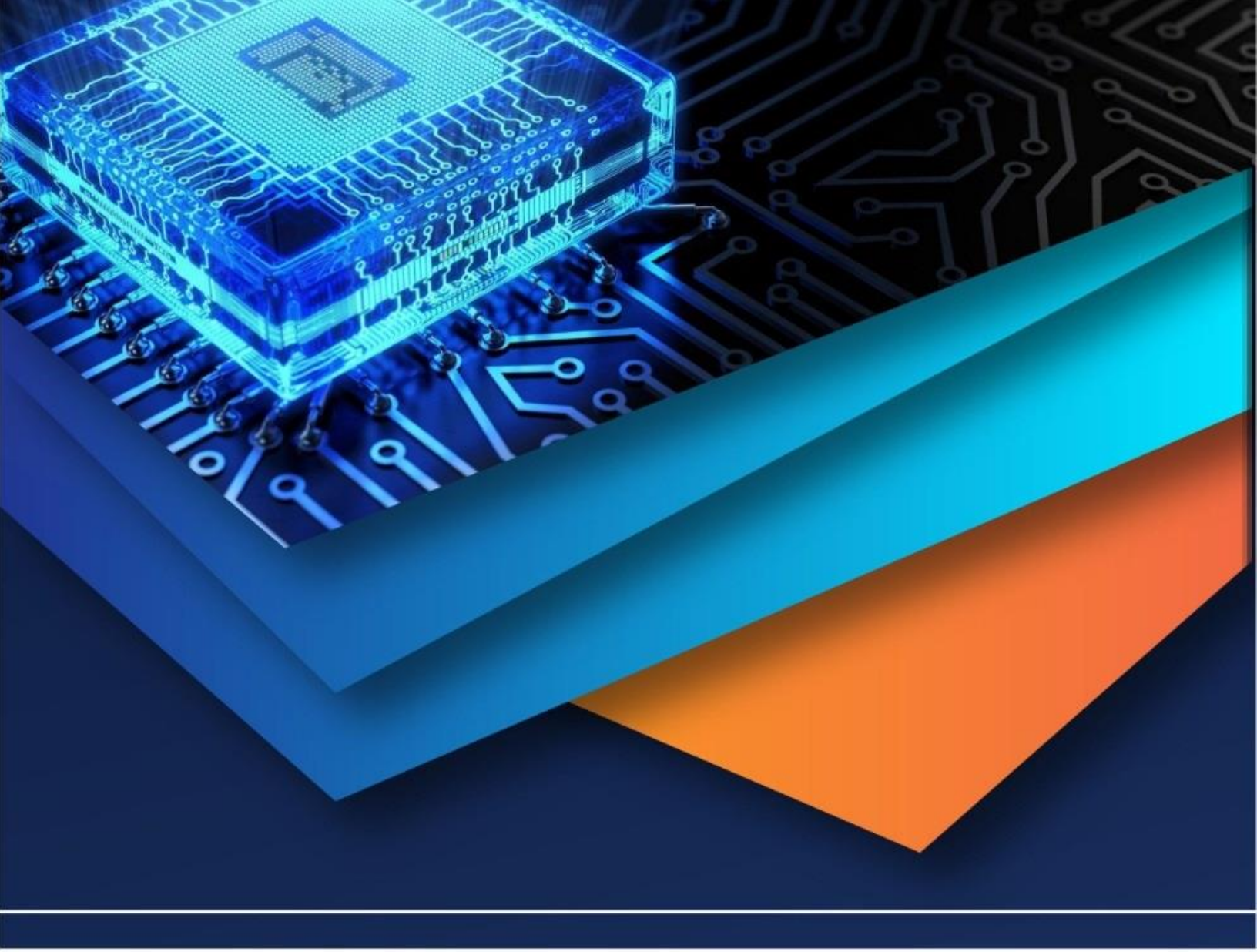

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