iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** IV **Month of publication:** April 2025

DOI: https://doi.org/10.22214/ijraset.2025.68925

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue IV Apr 2025- Available at www.ijraset.com

Hand Gesture Control Wheelchair for Disabled People

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Abstract: ***A new assistive technology, called the Hand Gesture Control Wheelchair (HGCW) system, is designed to help individuals with mobility impairments increase their independence and mobility. Thesystem consists of a wearable device with sensors that detect hand movements and Arduino microcontrollers for real-time data processing andwheelchair control.The HGCW system usesgesture recognition algorithms to translate hand gestures into corresponding wheelchair movements, such as forward, backward, left, and right turns, and communicates wirelessly with the wheelchair's control unit. The system is cost-effective, customizable, and intuitive, making it accessible to a wide range of users. The HGCW system has the potential to revolutionize the way disabled individuals navigate their environment, empowering them to lead more independent and fulfilling lives. Through the adjustment of the head motion, the information goes wirelessly tothe microcontroller dependentmotor driving circuit to control the rotation of the WheelChairin five differentmodes, including FRONT, BACK, RIGHT, LEFT anda special STAND lockingdevice. The proposed system is assembled using components obtained from the local market and checked in the laboratory for efficient performance, the test results are included in this article.***

I. INTRODUCTION

Mobility improvement is a significant challenge faced by millions of individuals worldwide, greatly affecting their independence and quality of life. For people with disabilities, particularly those with limited upper body mobility, conventional wheelchair controls can be cumbersome and restrictive. However, advancements in technology, particularly in the fields of Internet of Things (IoT) and Arduino, offer promising solutions to enhance mobility and autonomy for disabled individuals This paper presents the development and implementation of aHand Gesture Control Wheelchair (HGCW) systemdesigned to empower individualswith mobility impairments through intuitive hand gesture-based control. By leveraging IoT and Arduino technology, the HGCW system provides an innovative approach to wheelchair navigation, enabling users to manoeuvre their chairs with simple hand gestures The motivation behind the HGCW system stems from the need to address the limitations of traditional wheelchair controls, which often require precise manual manipulation andmaynot besuitablefor individuals with dexterity issues. By introducing a hands-free control mechanism based on natural hand movements, the HGCW system aims to improve accessibility and usability for users with diverse mobility needs.

II. LITERATURE SURVEY

The G. Bourhis and K. Moumen in a published paper show that a number of guidance systems are currently available in the market to ensure comfortable navigation for a physically challenged person. The systemsdeveloped are highlycompetitive in bringing change to old traditional systems**[**1]

Rakhi A. Kalanthri and D. K. Chitra demonstrated in their work that the wheelchair can be controlled in four directions by tilting the acceleration sensor. Ultrasonic sensors are used to control the movement of the wheelchair, avoiding the possibility of collisions with objects until the user is able to takeover some of the responsibility of steering. It simply calculates the degree of inclination and decides which direction to move [2]

Mahipal Manda and B Shankar Babu developed a wheelchair using MEMS technology, can be integrated to develop a useful wheelchair control system using hand movements. Powered wheelchair withhigh navigational intelligence can be counted as one of the big steps towards integration of physically challenged [3**]**.

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III. SYSTEM OVERVIEW

On-The main objective of this proposed system is to find an alternative option for wheelchairs presentin the market and to do by creating the affordable model. The study of our team shows the benefits of our proposed system. The proposed system "HAND GESTURE CONTROL WHEELCHAIR", Was design to caterpatientswithvarious kindof physical disabilities. The chair movesaccordingtothe handmovement with the wearable devicewhich can send the signals to chair for goingforward taking back.

We envisioned this system can be better alternative to joystick & remote-control wheelchair model as well as automated costly chairs. As for future work, a statistical analysis is taken by our end and find new feature for making this system more comfortable to the peoples with disabilities. The methodology section outlines the plan and method that how the study is conducted. This includes universe of the study, sample ofthe study, Data and sources of data, variables and analytical framework

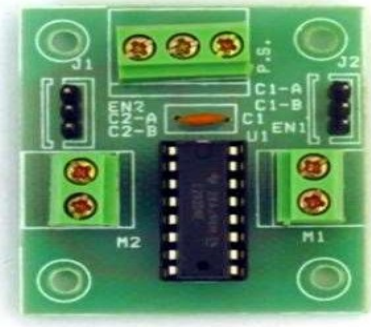
A. Arduino UNO

The Arduino UNO is a popular microcontroller board that serves as the core component in numerous electronic projects, including the Hand Gesture Control Wheelchair (HGCW) system. Developed by Arduino LLC, the UNO board is based on the ATmega328P microcontroller and features a simple yet powerful design, making it ideal for prototyping and experimenting with various sensors and actuators. In the context of the HGCW system, the Arduino UNO serves as the control unit responsible for processing sensordata, interpreting handgestures, and generating commands to drivethe wheelchairmotors. Through its flexible I/O capabilities and extensive community support, the Arduino UNO facilitates the seamless integration of various components and enables the realization of a reliable and efficient control system for individuals with mobility impairments.

Figure1 ArduinoUNO

B. L293DMotorDriver

The L293D is a popular motor driver integrated circuit (IC) widely used in robotics and automation projects, including the Hand Gesture Control Wheelchair (HGCW) system. Developed by Texas Instruments, theL293Disspecificallydesignedtocontrolthe directionandspeedofDCmotors,making it an essential componentfor driving the wheelchair's motors based on userhandgestures



Fiaure2L293DMotorDriver

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
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C. Transmitter Receiver Module

The Transmitter Receiver Module, often referred to as a wireless communication module or RF (Radio Frequency) module, plays a crucial role in facilitating communication between the wearable hand gesture detection device and the Hand Gesture Control Wheelchair (HGCW) system. These modules enable the transmission of control signals wirelessly from the wearable device to the wheelchair's control unit, allowing for seamless and intuitive operation without the need for physical connections.

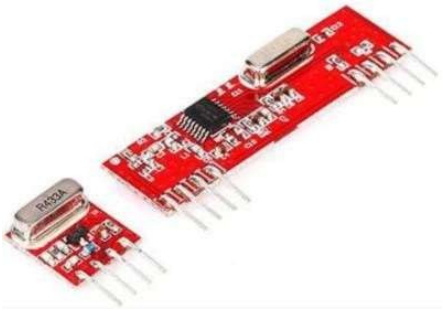

Figure3TransmitterReceiverModule

D. Transmitter Receiver Module

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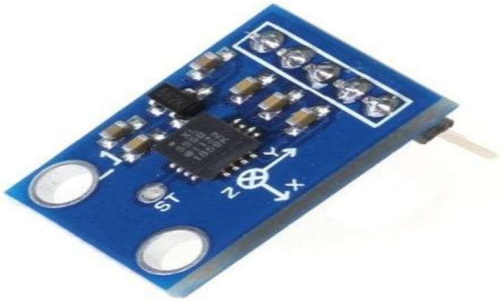

Figure4ADXL335Accelerometer

E. DC Motor

In the context of the Hand Gesture Control Wheelchair (HGCW) system, DC (Direct Current) motors playa critical role in driving the movement of the wheelchair in response to the user's hand gestures. These motors are responsible for propellingthewheelchair forward,backward,and steering it left or right based on the commands received from the control unit.

Figure5DCMotor

F. Ultrasonic Sensor

Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self- parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object's proximity.

Figure6UltrasonicSensor

G. Universal Buzzer

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses ofbuzzers and beepers include alarm devices, timers, train, and confirmation of user input such as a mouse click or keystroke.

Figure7UniversalBuzzer

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IV. METHODOLOGY

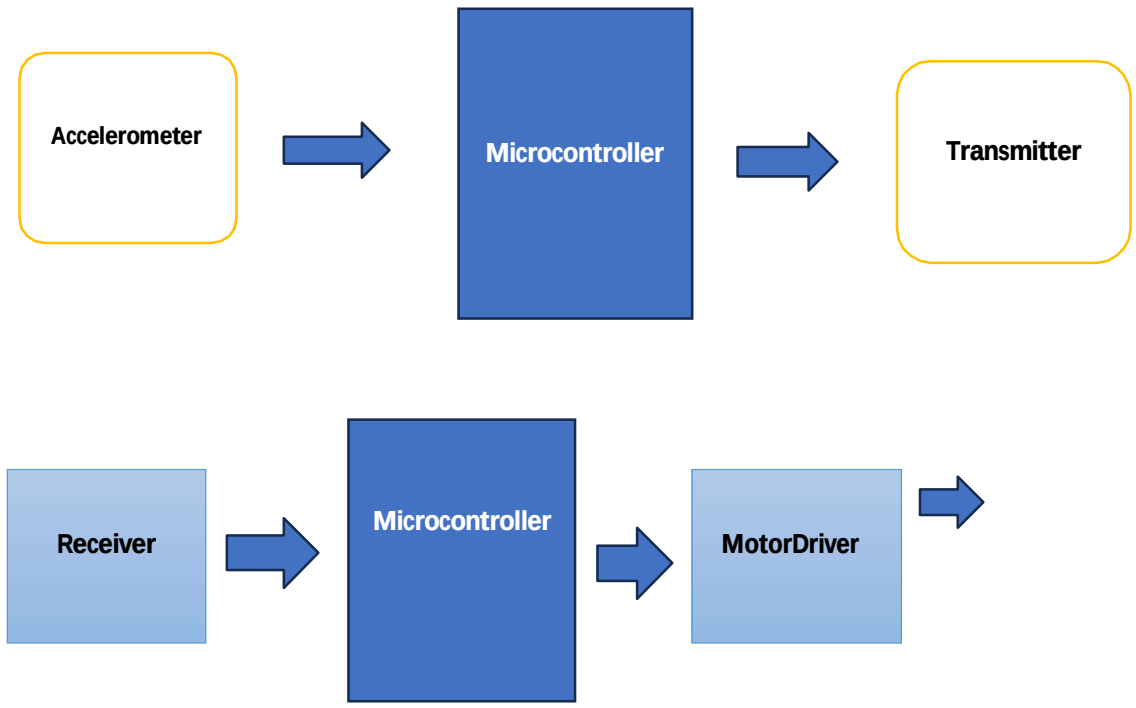
This work proposes an integrated approach for detection, tracking and recognition of hand gestures in real time. The approach uses acceleration technology to establish a reliable medium of human-machine interaction for the movement control of an intelligent wheelchair.

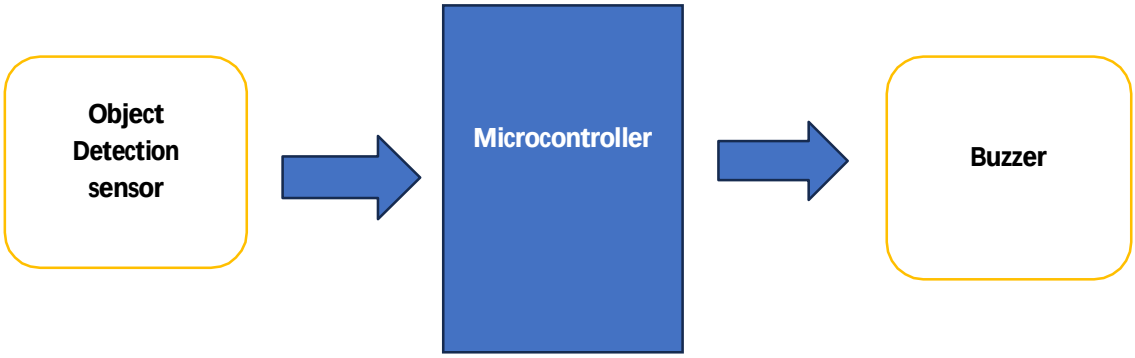
1) Component and functionality

Sr. No	Component	Function	Description
1	GestureRecognitionUnit	Capturehandgesture	Tracks hand movements and translates them into control signals using image processing. Data Glove: Equipped with sensors to detect finger and hand movements for a more comfortable user experience.
2	Microcontroller/Single-board Computer (SBC)	Process sensor data and control wheelchair	Arduino: A popular option for simple gesture recognition and control. Raspberry Pi: Offers more processing power for complex algorithms and additional functionalitieslikeIoTintegration.

3	Wireless Communication Module	Enables communication and data transfers	Wi-Fi/Bluetooth: Allows remote monitoring, data transmission to cloud platforms for gesture refinement, or communication with additionalIoTdevices.
4	MotorDriver	Controlsthe movement of the wheelchair motors	H-Bridge: Bi-directional control for forward and backward movement
5	ElectricMotors	Provide power for wheelchair movement	DC Motors: Common choice for wheelchairs,considerpowerrating basedonweightanddesiredspeed.
6	Battery	Power Source for the entire system	Rechargeable Battery: Ensures long-lasting operation, consider capacity based on usage and motor requirements.
7	Sensors	EnhanceSafety and functionality	Ultrasonic Sensors: Detectobstacles for collision avoidance. Gyroscope/Accelerometer: Improve gesturerecognitionaccuracy.
8	UserInterface(Optional)	Provide user feedback and control	Alternative control method for users who might have difficulty with gestures. LCD Screen: Displays information like battery level or error messages.

2) ER Diagram HGCW





V. FUTURE SCOPE

The future scope for hand gesture wheelchairs for disabled people is quite promising, with potentialforincreased functionality, personalization,andaccessibility.Herearesomeexcitingareasfordevelopment.

1) Accessibility and Affordability:

- Cost Reduction: Focusing on cost-effective designs and materials to make hand gesture wheelchairsmore affordable for a wider range of users.
- Standardization: Establishingindustrystandardstoensurecompatibilityandeaseofuseacrossdifferent wheelchair models.
- Accessibility Features: Exploringdesignsthatcatertodiversephysical abilities,ensuringeveryone can benefit from this technology.

2) Enhanced Intelligence and Safety:

- EnvironmentalRecognition: Incorporatingobjectandobstacledetectionwithreal-timepathplanning for safer navigation.
- FallPrevention:Utilizingsensorsandalgorithmstopredictandpreventfalls,improvingusersafety.
- Smart Features: Integrating features like voiceassistants,environmental controls, and self-dockingcapabilities for greater independence.

3) Advanced Gesture Recognition:

- MultipleGestures: Expandingtherangeofhandgesturesbeyondbasicmovementstoinclude complex combinations for more intuitive control.
- Customization: Allowinguserstopersonalizethegesturesusedforspecificcommands,cateringto individual needs and preferences.

4) Multimodal Integration:

- FusionwithOtherSensors: Combininghandgestureswitheyegazetracking,headmovement,or voice commands for a more nuanced control experience.
- Brain-ComputerInterfaces(BCI): ExploringBCItechnologytopotentiallycontrolwheelchairs directly through brain signals, offering a powerfuloptionfor individuals with severe limitations.

VI. RESULT AND DISCUSSION

A. Result

When theusermoves theirhand,accelerometer sensors detect thesemotions. The system interprets this data to control movement. Figure 8 illustrates the completed hand gesture control gloves. The physically challenged peoples are easily move from one place to another.

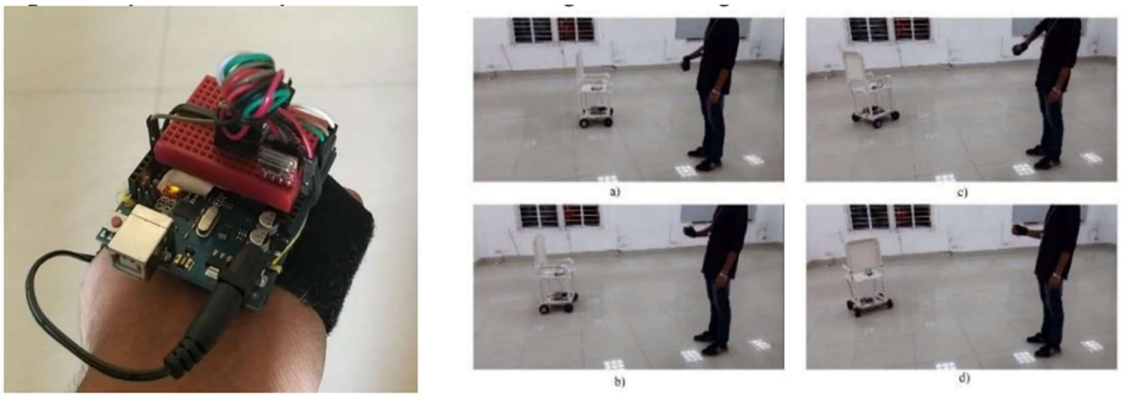


Figure8ImplementedprototypeHandGesturecontrolgloves

VII. CONCLUSION

The Our research effectively enables wheelchair control for individuals with disabilities through hand gestures. It incorporates object and fall detection for enhanced safety. Further advancements could utilize diverse body movements like eye tracking, leg motions, voice control, or head tilts, for personalized user experiences.

VIII. ACKNOWLEDGMENT

We express our sincere gratitude to our project guide, Dr Swarupa Wagh, for their valuable guidance, continuous support, and insightful feedback throughout this research. Their expertise and encouragement have been instrumental in shaping this review paper.

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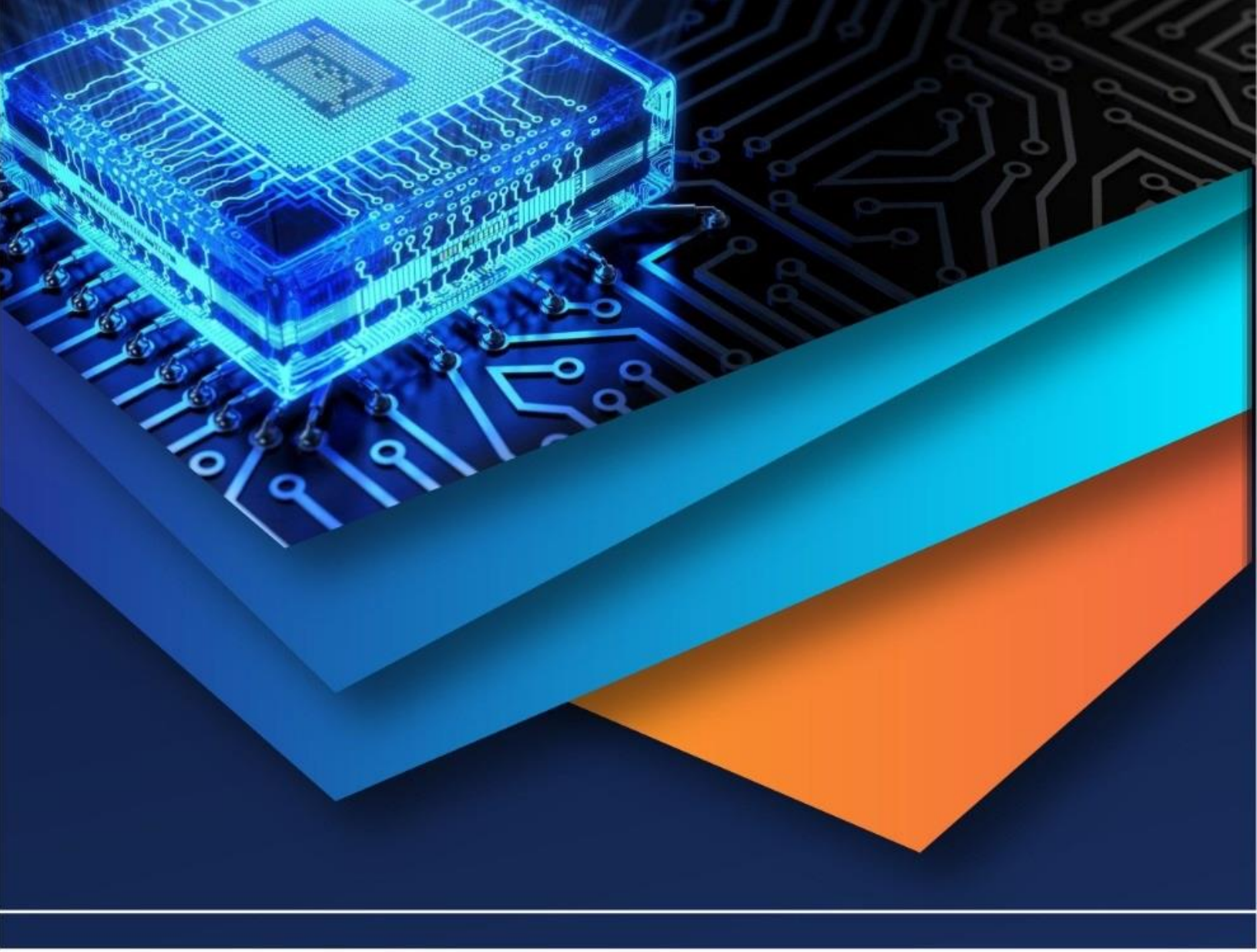

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