iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35485

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Implementing a Real Time Virtual Mouse System and Fingertip Detection based on Artificial Intelligence

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Abstract: ***Artificial intelligence refers to the simulation of human intelligence in computers that have been trained to think and act like humans. It is a broad branch of computer science devoted to the creation of intelligent machines capable of doing activities that would normally need human intelligence. Despite the fact that Artificial intelligence is a heterogeneous science with several techniques, developments in machine learning and deep learning are driving a paradigm shift in practically every business. Human-computer interaction requires the identification of hand gestures utilizing vision-based technology. The keyboard and mouse have grown more significant in human-computer interaction in recent decades. This involves the progression of touch technology over buttons, as well as a variety of other gesture control modalities. A normal camera may be used to construct a hand tracking-based virtual mouse application. We combine camera and computer vision technologies, such as finger- tip identification and gesture recognition, into the proposed system to handle mouse operations (volume control, right click, left click), and show how it can execute all that existing mouse devices can.***
Keywords: Finger-tip identification, Human computer interaction, cursor movements, Computer Vision, Hand Tracking.

I. INTRODUCTION

Human-computer interaction requires the recognition of hand gestures utilizing vision-based technology. The keyboard and mouse have become increasingly significant in human-computer interaction in recent decades. However, because to the rapid advancement of technology and software, new types of Human Computer Interaction solutions have become necessary. Speech recoginition and gesture recognition are two technologies that have received a lot of interest in the field of human-computer interaction. A gesture is a visual depiction of a physical action or a statement of emotion. It is made up of both hand and body gestures. Static gestures and dynamic gestures are the two forms of gestures. In the case of the former, a sign is expressed by body posture or a hand gesture. The latter sends signals through the movement of the body or the hand. Gesture can be used to communicate between a computer and a person.

Hand gestures are employed in this project to control the cursor movements of the laptop utilizing parameters gathered during the hand capture. Using this, numerous libraries may be used to open and close windows, and the screen may be controlled virtually utilizing suggested system modules for hand gesture detection using the openCV platform.

AI algorithms are utilized to identify hand movements and assign landmarks to them in order to construct an HGR system. The hand detection module is utilized to recognize the gesture and finger tip. Cursor motions can be accessible by setting various criteria. The work flow of hand gesture recognition is that, the hand area is first recognized from the input devices' original pictures. Then, to define hand motions, various characteristics are extracted.

II. LITERATURE SURVEY

Eye Gesture Control System, The System prototype uses camera input to detect and tracks the pupil of the user in real time. This tracked information may is then utilized by micro controllers or computers to do a variety of activities. For example, the project hopes to measure the movement of pupil and then saves the monitored eye movement in order to operate the mouse pointer, allowing someone as a handicap like Amyotrophic Lateral Sclerosis to connect with others. It comes along with a webcam with high-definition that is precisely positioned, as well as an open source platform and simple-to-install software module that is all window-based operating systems are supported and can be installed on any current laptop or desktop computer. This system may be viewed as a seamless journey from idea to proof of concept. It entails part execution of a research paper, part cooperation with the open source community on prototyping, all while ensuring that only open-source, low-cost, widely available, and commercially off-the-shelf (COTS) items have been utilized.

Head Tracking driven Virtual Computer Mouse, The hMouse, a virtual human interface enabling hand free mouse operation that can be installed on a standard PC. The implementation is depicted in the diagram below. hMouse is made up of a virtual tracking module and a mouse control module, just like a standard camera mouse. The visual tracking module uses the incoming motion parameters to travel the pointer and manipulate virtual mouse buttons using simple synchronization control and temporal smoothing. Finally, the operating system responds to all mouse events created by this PUI.

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III. PROPOSED SYSTEM

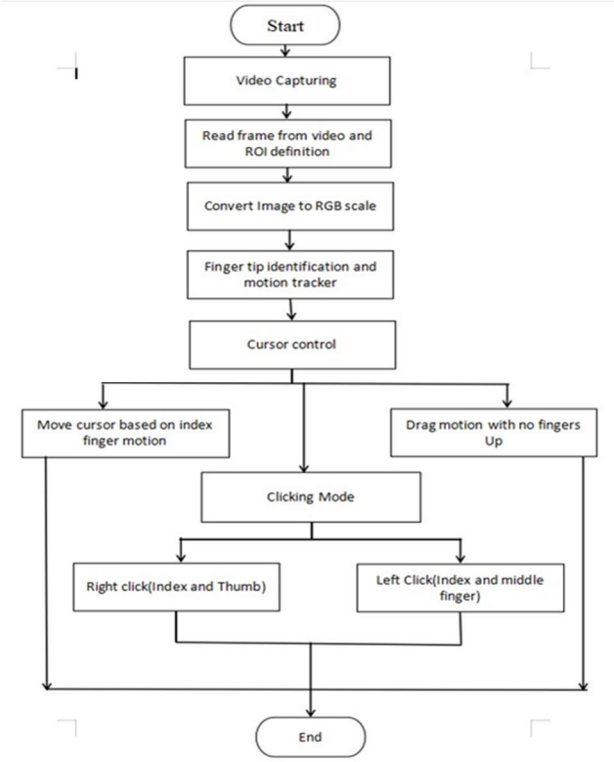

Fig.1 Flow Chart of our proposed system

In the proposed system 21 3D landmarks are used for hand gesture recognition. These 21 nodal points are created based on the joints of our fingers. For each finger, a finger id is given to recognize the fingers and for each finger there are four nodal points given starting from one to four. First video capturing will be started after checking whether the camera is connected or not. After the camera connection is successfully done then it will start reading the captured video using the functions in the imported libraries. The image which is captured by the laptop camera will in the form BGR. To process that image it need to be converted to RGB. So image is converted from BGR to RGB in Hand Discernment algorithm. Then the by taking region of interest(ROI) the dimensions of camera and frame are reduced in order to capture the hand properly. By reducing the dimensions the hand image is taken correctly without capturing any other parts like face.With the images of the hand coordinates are created for all the nodal points. From the video each frame is read and coordinate values and finger tip ids are stored. Using the finger intuition algorithm it will detect which fingers are up. If only index finger is up then it will turn into moving mode. In moving mode the cursor will move according to the index finger movements. If both thumb and index fingers are up then it will turn into right clicking mode. Here the distance between these fingers should be less according to the condition given in the rendition algorithm. If the index finger and the middle finger are up then it will turn into left clicking mode. Here also the distance between fingers should be less to perform the left clicking action. If no fingers are up then it will be in dragging mode. Using dragging mode a particular area can be dragged and selected with no fingers up gesture. In this way cursor movements like right click, left click, drag and cursor moving is done using hand gestures.

ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
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IV. ALGORITHM

The most important task is to capture the image and read the image. To capture and read the image VideoCapture function is used which is a pre-defined function in openCV libraray where it captures the image in the form of frames.

Media pipe library is imported for locating hand landmarks .For image processing BGR is converted to RGB using cvtcolor .Here converted RGB image is processed and with the help of package named hands landmarks are taken. If the result contains multiple landmarks stored in it then it takes the values of handLms and draw them using mpDraw on the hand image that is displayed.

To append the values of the coordinates for every landmark, various lists are created. The results of multi hands to myhands is assigned. By using id and landmarks the values of its coordinates and append those values in the respective lists are taken. From the shape of the image height, width and coordinate values are taken. After extracting coordinate values, identifying the fingers that are up using various conditions, distance between the fingers using math function.

Height and width of the webcam screen is limited accordingly using set function. In order to access the whole window the size of frame is reduced. By using the previous algorithms values of various variables are taken and also it checks which fingers are up. Checking the coordinates of the respective finger tips that are required for execution. A rectangle box is created to limit the frame size.

Converting the coordinates from the range of webcam to the whole monitor. Smoothening the values, so that movement of the mouse is easily done. If the index finger is up then it will be in moving mode. If both index finger and middle finger are up then it will be in clicking mode based on the distance between two fingers. If no fingers are up it will be in dragging mode.

V. RESULTS

Fig 2: Identification of fingers which are up

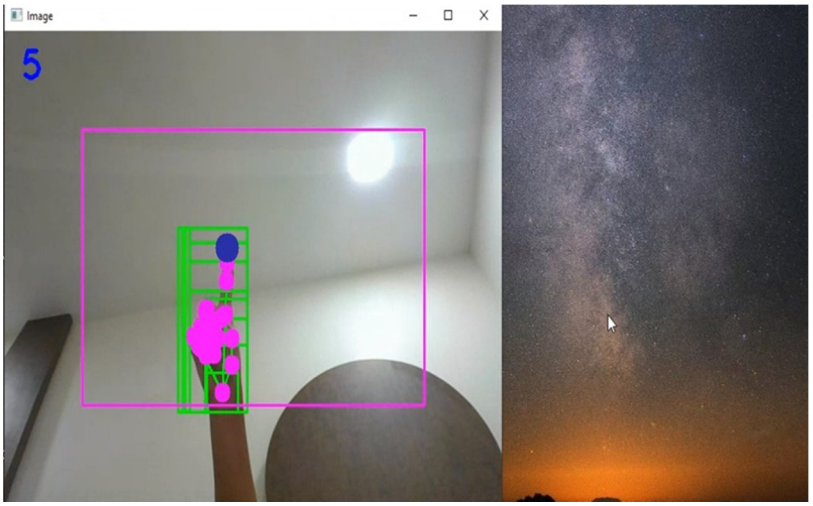

Fig 3: Index finger acting as cursor

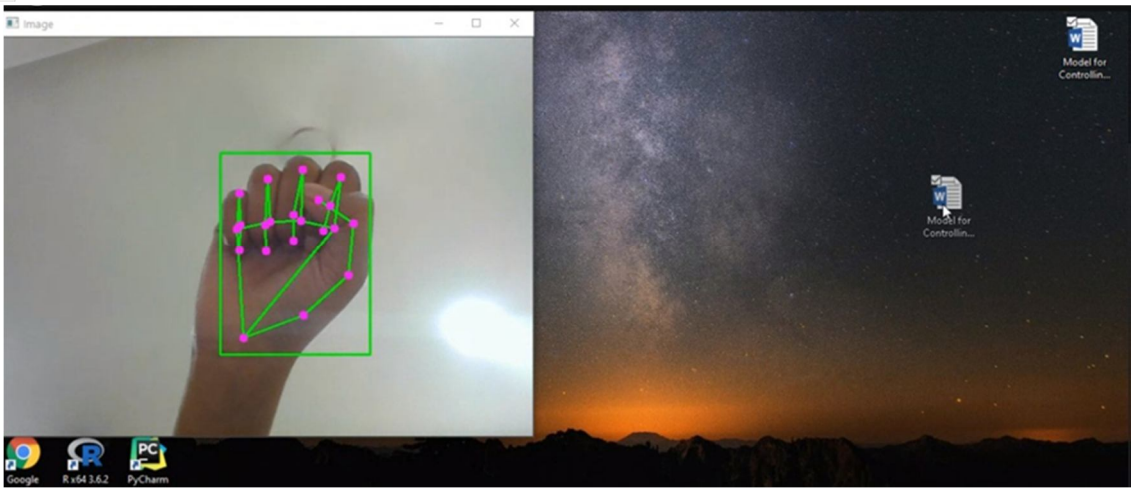

Fig 4: Dragging the file when no fingers are up

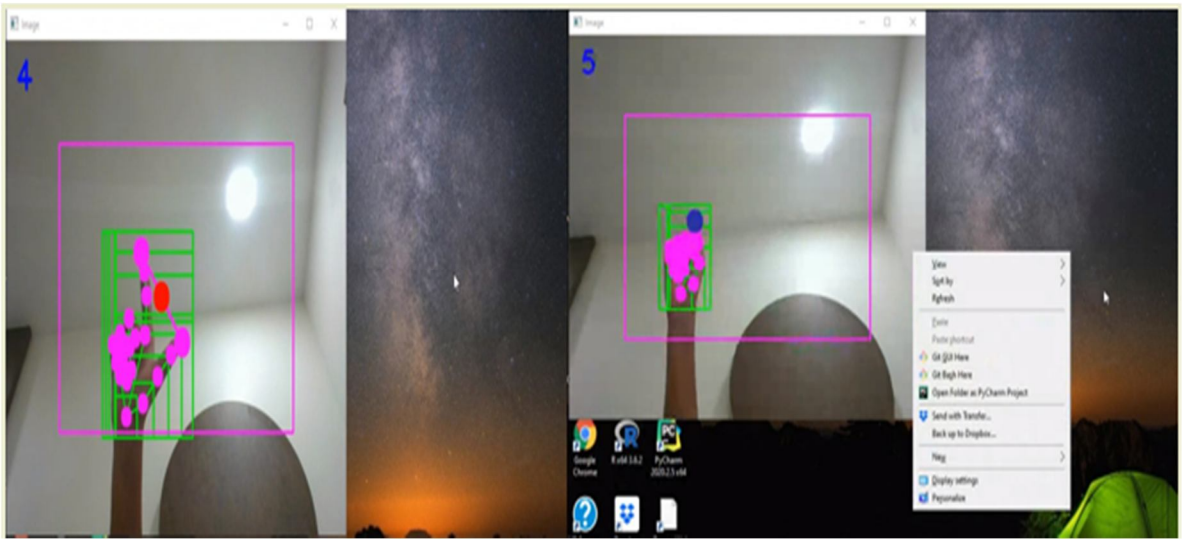

Fig 5: Right Click when distance between thumb and index finger is less

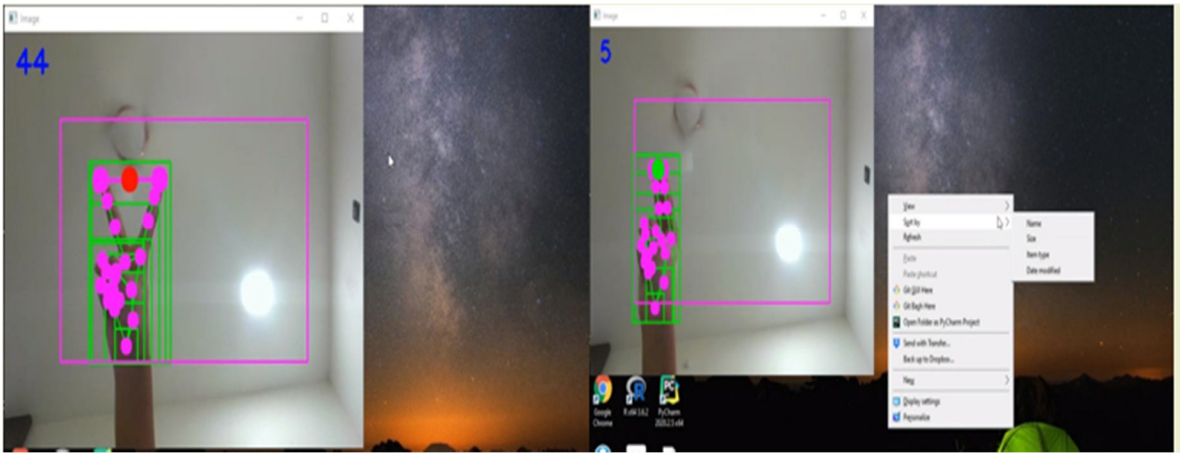

Fig 6: Left Click when distance between middle and index finger is less

Above figures illustrate the cursor movements according to hand movements.

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VI. COMPARATIVE ANALYISIS

A comparative research is used to establish and quantify correlations between two or more variables by monitoring various groups that are exposed to various treatments, either by choice or by circumstance. By comparing two or more similar groups, persons, or situations, a comparative research is conducted. To gather further information, we examination of suggested and existing models of our project is done. The project may be simply understood by comparing the current and suggested models. The present and suggested approaches have been described. A bar chart is created to highlight the results of the comparison between the existing and suggested models.

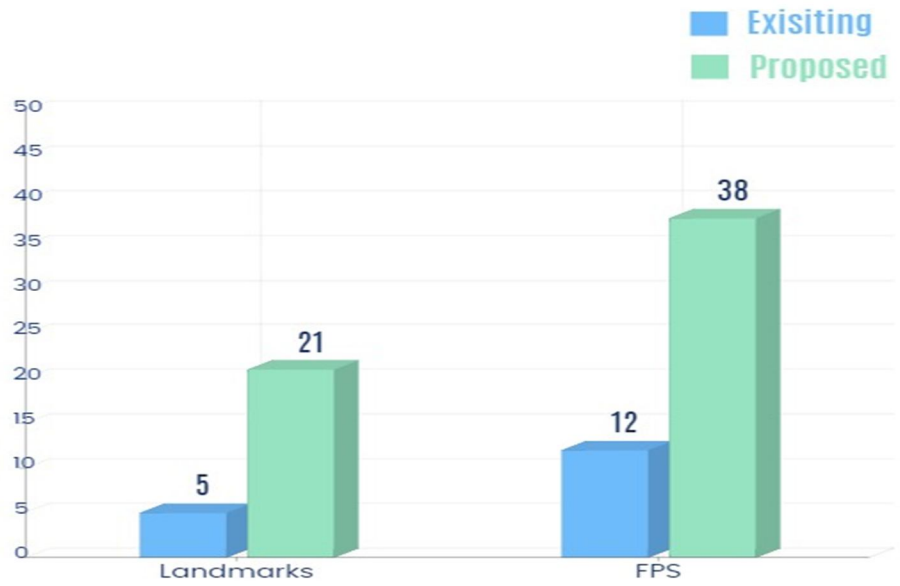

Fig 7: Bar plot of existing and proposed systems results

A. FPS - Frames Per Second

The amount of frames displayed each second is known as FPS (frames per second) or frame rate. A video can be thought of as a sequence of images, or frames, that are presented at a certain rate to create motion. If you only need to identify the object in the video, a frame rate of 20 frames per second should suffice.

B. Landmarks

Land markings are points that are utilized to identify each movement of the hand by pointing to the 21 joints that make up the hand. Adding 21 3D landmarks to the hand aids in efficiently capturing movement.

When 5 nodal point hand gesture system is used the hand gesture movement is not captured properly but when 21 nodal points are used hand gestures are captured accurately by the webcam.

Hence the output of the hand gesture recognition system will be more accurate with 21 nodal points than 5 nodal points.

VII. CONCLUSION

In this research, using the finger intuition algorithm it will detect which fingers are up. If only index finger is up then it will turn into moving mode. In moving mode the cursor will move according to the index finger movements. If both thumb and index fingers are up then it will turn into right clicking mode. Here the distance between these fingers should be less according to the condition given in the rendition algorithm. If the index finger and the middle finger are up then it will turn into left clicking mode. Here also the distance between fingers should be less to perform the left clicking action. If no fingers are up then it will be in dragging mode. Using dragging mode a particular area can be dragged and selected with no fingers up gesture. In this way cursor movements like right click, left click, drag and cursor moving is done using hand gestures. The needed equipment is simple and inexpensive, which favors the use and promotion of gesture recognition. The field of human-computer interaction is advancing at a rapid pace. Because the combination of gesture recognition with mouse control will make people's life easier and more intelligent, this gesture movement recognition system has a lot of potential and room for improvement.

VIII. FUTURE WORK

In future, zooming in and zooming out of the pictures can be included. As in the present work we are making use of the thumb, middle and index figures for right and left clicks, these can also be used for zooming In/out images and control the quality of video player. When an image is encountered the hand gestures will automatically perform the zooming function and when text is encountered the hand gestures will perform the other functions like right/left clicks, dragging and moving the cursor.

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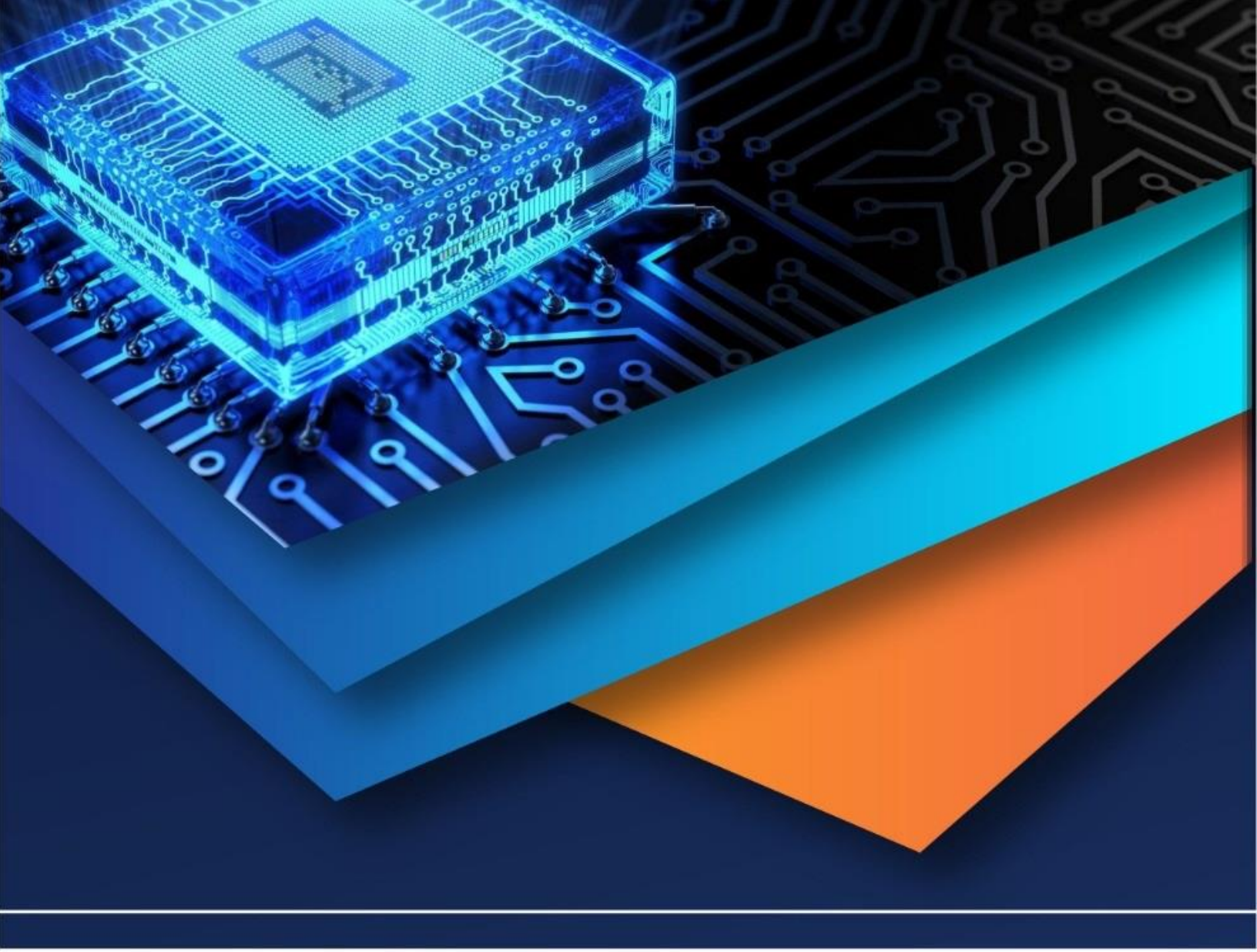

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