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An Innovative Communication System For Deaf, Dumb and Blind People

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Abstract: ***One of the most precious gifts to a human being is an ability to see, listen, speak and respond according to the situations. But there are some unfortunate ones who are deprived of this. Making a single compact device for people with Visual, Hearing and Vocal impairment is a tough job. Communication between deaf-dumb and normal person have been always a challenging task. This paper proposes an innovative communication system framework for deaf, dumb and blind people in a single compact device. We provide a technique for a blind person to read a text and it can be achieved by capturing an image through a camera which converts a text to speech (TTS). It provides a way for the deaf people to read a text by speech to text (STT) conversion technology. Also, it provides a technique for dumb people using text to voice conversion. The system is provided with four switches and each switch has a different function. The blind people can be able to read the words using by Tesseract OCR (Online Character Recognition), the dumb people can communicate their message through text which will be read out by espeak, the deaf people can be able to hear others speech from text. All these functions are implemented by the use of Raspberry Pi.***

Keywords: ***Raspberry Pi, Tesseract OCR (Online Character Recognition), espeak, Speech to text (STT), Text to Speech (TTS).***

I. INTRODUCTION

We live in a digital era with advancement in information and communication technology. Sign language is an expressive way of communication between normal and dumb-deaf people in order to improve the life style of dumb, deaf and blind people the proposed system is developed.

Approximately 285 million people are visually impaired in the world. In which 39 million are blind and 246 million have low vision. Blind people can only read Braille script. To improve the learning process of blind people we have developed an innovative device for them which capture the image through a camera and convert the image not only into text but also into speech form. By using this device a blind person can easily be able to read the text.

About 9.1 billion people are deaf and dumb in the world. They face plenty of problem in communication in daily life. The deaf and dumb people are not involved with the social world because of their disabilities. Unintentionally, they are treated in an unusual manner by the rest of the society. Sign language is a communication skill that is used to convey a meaning of a speaker's thought using gesture. It is a well-structured code gesture, each gesture has a meaning assigned to it. The gesture is a non-verbal communication which includes the movement of the hand,head and other body Parts. Basically, there is two main sign language recognition approach namely image- based and sensor based. A lot of research is going on image based approach because of an advantage of no need to wear devices like hand gloves and helmet etc like in sensor-based approach. Gesture recognition is gaining importance in many application areas such as human interface communication, multimedia and security.

Normal person face problem in communicating with disabled people because they cannot understand sign language. There are not many sign language institutions in our society. So, many of dumb people use usual sort of sign language to communicate and they do not have a customized sign language. It is also not possible for the masses to learn sign language. Therefore, a large communication gap still exists between dumb, deaf and normal people.

Despite the large number of dumb and deaf people very less research is done in order to reduce the communication barrier. We propose a system which helps normal and deaf dumb people to effectively communicate with each other. In resolving these difficulties with visually and vocally impaired people, we have used a tiny credit card size computer named Raspberry Pi. We provide the solution for blind deaf and dumb people by using this device. For blind people, the image is captured using Logitech camera which is converted into text using Tesseract OCR and the resulted text is converted into speech using espeak which is spelled out by speaker and the text is also displayed. When the dumb people communicating with normal people, the text written by dumb is spelled out by the speaker which can be understandable by normal people. Dumb people, can also use hand gesture to

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communicate with normal people. For deaf people the speech is converted into text by using a website called speechtexter.com.
The rest of the paper is organized as follows: Section II deals with an existing system, Section III and IV deals with hardware and software requirements and section V deals with design and implementation.

Fig. 1 ASL Numbers

II. EXISTING SYSTEM

In the earlier days, blind people can only read Braille script. Braille is a tactile writing system used by people who are blind people. It is traditionally written with embossed paper. Now a days Braille user can read computer screens and other electronics support using refreshable braille displays.
Traditionally,gesture recognition method was divided into two categories namely vision based and sensor based method. In vision based method, the computer camera is an input device for varies gestures of hands and figures. In sensor based systems, gloves are used which can achieve the accurate positions of hand gesture. Lots of studies have been done on sensor-based approaches like gloves, helmets etc. But wearing it continuously is not possible. Therefore further work is concentrated on image-based approaches.
The paper “intelligent sign language recognition using image processing” deals with the computer system in which sign language is captured and processed and translated to speech. For deaf people speech is analyzed and converted to sign language on screen.The sign language can be understood through devices like sign language translator and electronics gloves.

III. ARDWARE REQUIREMENTS

A. *Raspberry Pi*Raspberry

Pi is a credit-card sized computer that connects to a computer monitor or TV and uses input devices like keyboard and mouse. It is capable of performing various functionalities such as surveillance system, military applications, surfing internet, playing high definition videos, live games and to make data bases The paper is implemented using a Raspberry pi 3B board and their specifications are as follows.

1) *Memory:*1 GB LPDDR-900 SD-RAM (i.e. 900MHz)
2) *Processor:* Raspberry Pi has a Broadcom BCM2837 system on chip module. It has quad core ARMv8 CPU. It can run at 1.2 GHz video core for multimedia GPU.
3) *OS:* Boots from SD card and running a version of Linux Raspbian OS.
4) *Power:* The Pi requires a 5v power supply. It is powered by a micro-USB charger or GPIO header.
5) *GPIO (General Purpose Input-Output):* GPIO is a generic pin on an integrated circuit which can be configured as input and output pin. The Raspberry Pi board has 40 pins, 2.54mm expansion header. In this paper, we have used GPIO pin 4, 17, 27 and 18 to their respective switches.
6) *SD card:* Raspberry Pi has no storage on board so an external memory is required to store the OS.
7) *Connections:* 4 USB ports,10/100 Mbps Ethernet and 802.11n wireless LAN connections,3.5mm jack for audio out,BCM43438 Wi-Fi, Bluetooth low energy(BLE).

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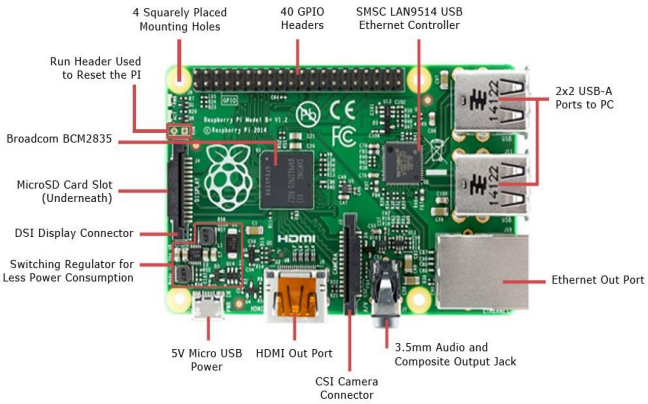

Fig 2. Raspberry PI

B. Logitech Camera

It is a plug and play setup which is easy to apply. You can easily make video calls on major IMs. It has a 5MP camera with high resolution. It has built in mikes with right sounds gives you a clear conversation without any noise. XVGA video recording system has a reach of about 1024x768 resolution. In this project, we are using a Logitech camera which is capturing the image and gesture control function.

Fig 3. Hardware required to design the system

IV. SOFTWARE REQUIREMENTS

In our project, Raspberry Pi is interfaced with the computer monitor by using the 5V power cable. Through this line, we operate the kit with the following software.

A. Tesseract OCR

Python Tesseract is an optical character recognition (OCR) engine for various OS. Tesseract OCR is the process of electronically extracting text from images and reusing it in a variety of ways such as document editing, free-text searches.

OCR is a technology that is capable converting documents such as scanned papers, PDF files and captured image into editable data. Tesseract can be used for Linux, Windows and Mac OS. It can be used by programmers to extract typed, printed text from images using an API. Tesseract can use GUI from available 3rd party page.

The installation process of tesseract OCR is a combination of two parts-The engine and training data for a language. For Linux OS, Tesseract can be obtained directly from many Linux distributers. The latest stable version of tesseract OCR is 3.05.00.

In our project Tesseract is used to convert the captured image text into text format.
Tesseract Features:

1) Page layout analysis.
2) More languages are supported.
3) Improve forecast accuracy.
4) Add UI.

B. OpenCV (Open Source Computer Vission)

It is a library of programming1functions mainly aimed at real-time1computer vision. It is developed by Intel research center and subsequently supported by1Willow Garage and now maintained by itseez. It is written in C++ and its primary interface is also in C++. Its binding is in Python, Java, Matlab. OpenCV runs on a variety of platform i.e. Windows, Linux, MacOS, openBSD in desktop and Android, IOS and Blackberry in mobile. It is used in diverse purpose for facial recognition, gesture recognition, object identification, mobile robotics, segmentation etc. It is a combination of OpenCV C++ API and Python language.
In our project we are using OpenCV version 2 OpenCV is used to gesture control to open a camera and capture the image. It is also used in the image to text and voice conversion technique.

C. Espeak

It is a compact open1source software speech synthesizer for English and11other languages for Linux and Windows platform. It is used to convert text to voice. It supports many languages in a small size. The programming1for espeak software is done using rule files with feedback. It supports SSML.
It can be modified by voice variant. These1are text files which can change1characteristics such as1pitch range, add effects1such as echo, whisper and croaky voice, or make systematic adjustments to formant frequencies to change the sound of the voice. The default speaking speed of 180 words per minute is too fast to be intelligible. In our project Espeak is used to convert the text to voice signal.

D. VNC Viewer

Virtual Network Computing (VNC) is a graphical1desktop sharing system used to control to another computer remotely1using RFB protocol. It shares keyboard and mouse events to another computer over a network.
VNC is a platform independent remote access software for commercial and personal use. It uses VNC technology to connect to a remote computer using a VNC server application. VNC Viewer collects input and sends it for VNC Server to achieve *remote* control.
We are using a VNC viewer software for remote logging in Raspberry Pi in our project. Real VNC is a company that provides remote access software.
RealVNC has ported their VNC1server and viewer applications to Pi, and they are now1integrated with the system. To enable the server, select1the option on the Interfaces11tab in Raspberry Pi Configuration; you'll see the VNC11menu appear on the11taskbar, and you can1then log in to your Pi and control1it remotely from1a VNC viewer.

E. OpenCV Python

Python is a widely used high-level programming language for general-purpose programming. It became popular programming language because of its simplicity and code readability.The feature of python is that it can easily use with C/C++ extension.

F. Mechanize

Mechanize gives you a browser like an object to interact with web pages. Mechanize Browser implements the urllib2. The mechanize module in Python is similar to Perl WWW:Mechanize. Mechanize works with Python 2.4, Python 2.5, Python 2.6, and Python 2.7.

G. Chromium

Chromium is an pen-source browser, to provide the source code to Google chrome browser for. Chromium browser supports AAC,

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H.264,MP3, Crash and error reporting, security sandbox and google update. Chromium gets updated with security updates through your Linux distribution's software repositories Chromium is a1much more demanding1piece of software than Epiphany, but it runs well on Pi 2 and Pi 3.Chromium browser can be directly installed from Linux distribution's software responsibilities.

V. DESIGN AND IMPLEMENTATION

A. Block Diagram

The proposed system consists of two units. A Subsystem which can clip on the collar of the shirt. This consists of input condenser microphone and output speaker section and a camera to capture the images. The Amin system is a portable device where the user sends and receive a message as a text. The device can act as a mobile phone.

When a normal people tries to interact with the disabled people using this device it takes input from the microphone. Then the device did speech to text (STT) conversion displays on it the device screen, based on what the normal people conveys. The user can give reply as a text message and the device does text to speech (TTS) conversion. The output is obtained from the speaker.

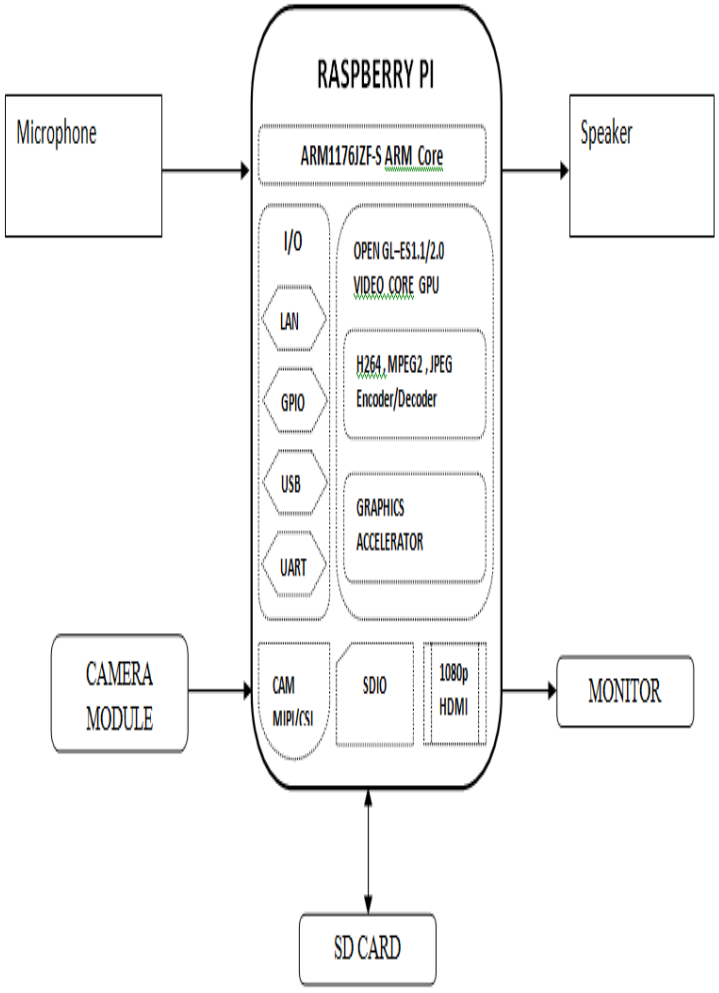

Fig 3. Block diagram of the system

B. Flow Chart

The entire operation of the project is performed using the flow chart as below:

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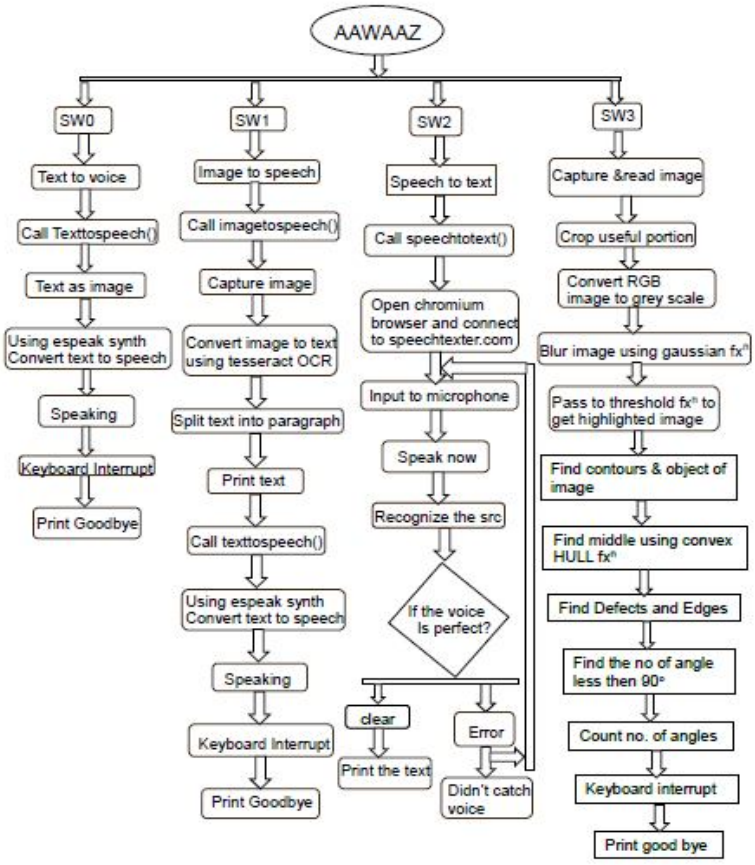

Fig 4. Flow Diagram of the system

C. Project Overview

We aim for developing the prototype model for blind dumb and deaf people by employing in a single compact device. The project provides a unique solution for these people to manage their sites by themselves. The project is catered with the source code of Python. It is the easiest programming language to interface with the Raspberry Pi. The project is run by the source code of Python to assist blind dumb and deaf people in a single device which is so compact and easy for them to manage.

The system is provided with 4 switches. Each switch has different functions. We have choosen the switch for necessary conversion.

1) Text to speech (TTS) using (SW0)
2) Text to speech using camera (TTSC) using (SW1)
3) Speech to text(STT) using (SW2)
4) Gesture control using(SW3)

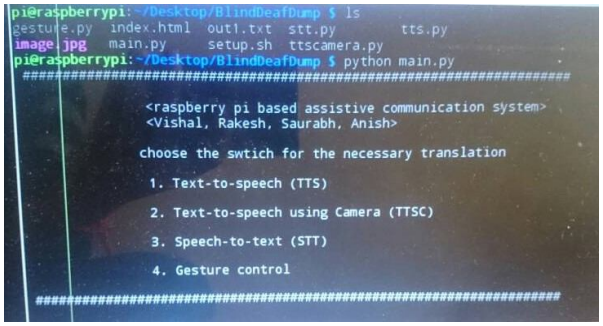

Fig 5. System Interface

1) *Text To Speech (TTS)*: The first process text to speech conversion is done for the dumb masses who cannot speak. The Dumb people convert their thoughts to text which could be transferred to a voice signal. The converted voice signal is speak out by espeak synthesizer. After pressing the switch SW0 the OS and sub process imported. Call text to speech function and enter the text as input. Enter The Text" is speak out by espeak for raw input. After entering the text from keyboard, the espeak synthesizer converts text to speech. The process also provided with the keyboard interrupt ctrl+C.
2) *Text To Speech Using Camera:* The second process is developed for blind people who cannot read normal text. In order to help blind people, we have interfaced the Logitech camera to capture the image by using OPENCV tool. The captured image is converted to text using Tesseract OCR and save the text to file out1.txt.Open the text file and split the paragraph into sentences and save it. In OCR, the adaptive thresholding techniques are used to change the image into binary images and the are transferred to character outlines. The converted text is read out by the espeak.
3) *Speech To Text (STT):* The third process is developed for the hearing impairment people who cannot understand the words of normal people. In order to help them, our project is provided with a switch which is used to convert the voice of the normal people text. We have used a chromium browser which is automatically connected to URL speechtexter.com. The process is performed by assigning a minimum threshold voltage to recognize the voice signal. The input is given through a microphone which is converted into a text format. The URL supports a variety of languages. If the voice signal recognizable it will print the text else it gives the error signal
4) *Gesture Control:* The fourth process is developed for the vocally impaired people who cannot exchange the thoughts to the normal people. Dumb people uses gesture to communicate with normal people which are majorly cannot be understandable by normal people. The prsocess started with the capturing the image and cropped the useful portion. Convert the RGB image into gray scale image for better functioning, Blur the cropped image through Gaussian blur function and pass it to the threshold function to get the highlighted part of the image. Find the contours and an angle between two fingers. By using convex hull function we can implement the finger point. Count the number of angles which is less than 90 degree which gives the number of defects. According to the number of defects, the text is printed on display and read out by the Speaker.

VI. CONCLUSION

We have designed the prototype model for blind, deaf and dumb people into a single compact device. The advantage of this device is that it can be easily portable due to its less weight and size. This paper fulfils the hand gesture recognition process with some limitations as both the hands cannot be used in this technique because the result is not efficient.

VII. FUTURE SCOPE

The system can be further1expanded for the alphabet, numbers in gesture control. The input can be also taken in the1form of videos and the videos are divided into frames and the frames can be converted into text. We can also add grammatically structure for1sign language. The system1can be made handy by incorporating it1into a mobile phone.

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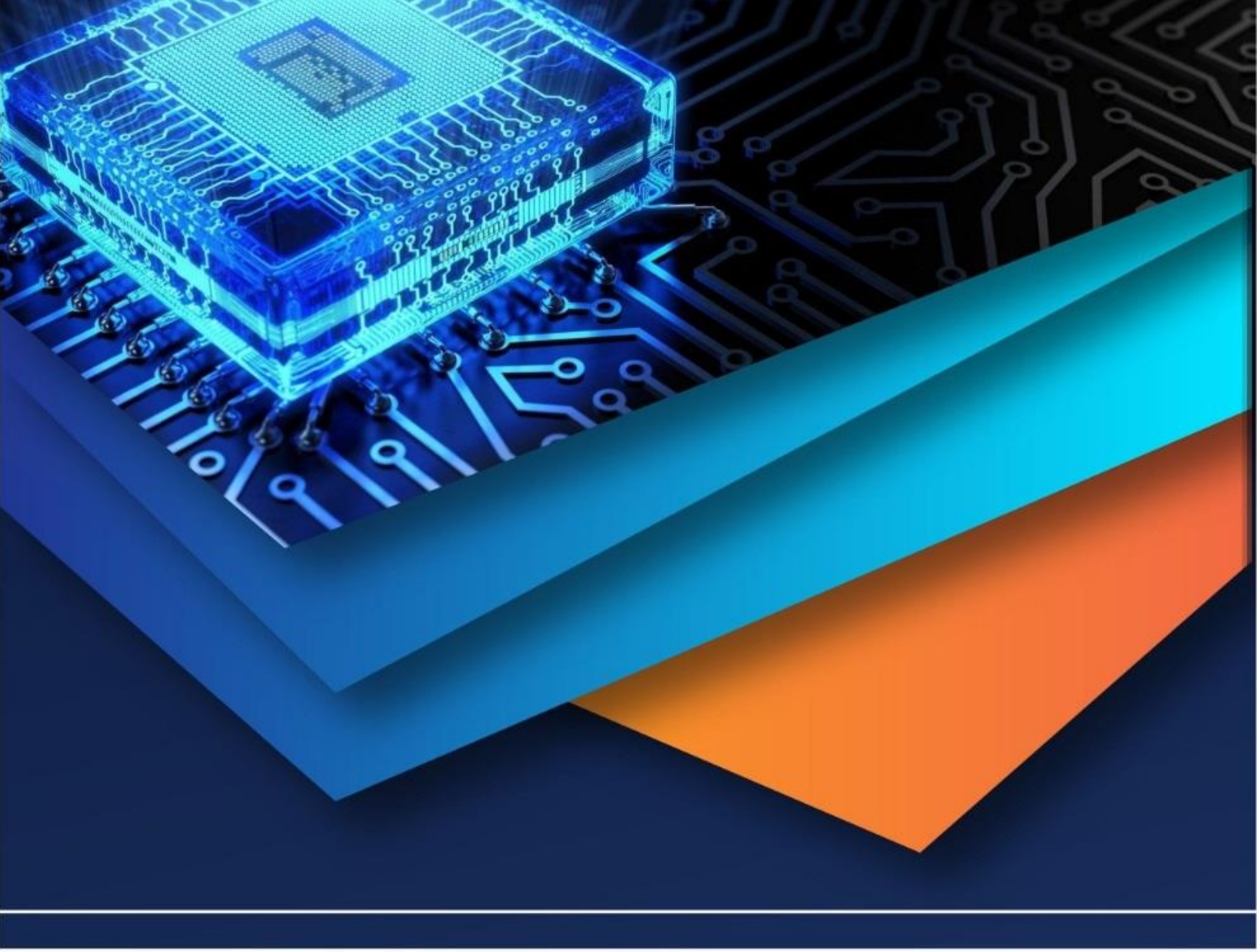

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