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Speech Recognition for Robotic Vehicle using Regional Language

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Abstract: ***Speech Recognition (SR) is the ability to translate a dictation or spoken word to text. Speech Recognition is known as "automatic speech recognition"(ASR) or speech to text (STT). Speech recognition is the process of converting an acoustic signal, captured by a microphone or any peripherals, to a set of words. To achieve speech understanding we can use linguistic processing. The speech input is given through the headphones or microphone and received speech input is processed by voice module. The voice module sends a command message to the robot's microcontroller, when a command for the robot is recognized. The microcontroller takes the appropriate actions based on the received message .The goal of this project is to introduce hearing AI sensor and also the speech recognition to the mobile robot such that it is capable to interact with human through Spoken Natural Language (NL). The robotic system is also controlled using multi regional language. This system uses a windows based application to recognize human voice and is converted to text; text is further processed and used to control the mobility of robotic vehicle.***

Keywords: Speech recognition, speech to text, voice module, robotic vehicle

I. INTRODUCTION

A robot is a machine—especially one programmable by a computer— capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within. Robots may be constructed on the lines of human form, but most robots are machines designed to perform a task with no regard to their aesthetics. Speech recognition is a prominent point in today's life. The applications of Speech recognition is discovered all over, which make our life more feasible. For example the applications in the mobile phone, instead of typing the name of the person who we need to be called, people can just directly speak the name of the person to the mobile phone, and the mobile phone will automatically call that person. It is also known as automatic speech recognition, computer speech recognition or speech to text (STT).Some speech recognition systems require "training" where an individual speaker reads text or isolated vocabulary into the system. The system analyzes the person's specific voice and uses it to fine-tune the recognition of that person's speech, resulting in increased accuracy. Systems that do not use training are called "speaker independent" systems. Systems that use training are called "speaker dependent".
Microsoft Visual Studio is an integrated development environment (IDE) from Microsoft. It is used to develop computer programs, as well as websites, web apps, web services and mobile apps. Visual Studio uses Microsoft software development platforms such as Windows API, Windows Forms, Windows Presentation Foundation, Windows Store and Microsoft Silverlight. It can produce both native code and managed code. The AURDUINO Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.
C# is a dialect of Microsoft visual studio that allows the developers to create specific application which includes both graphical and code end which can be connected to database.
C# runs only on windows machine by using C# developers can create windows based client application, data base integration
Xml for web related services and many more features are included by using visual studio frame work user can compile, debug and build the application

II. LITRATURE REVIEW

Papers discussed here explain the basic concepts of fabrication which is the most important concept in this project. According to this project, it gives detailed information about detecting fabrication using different technologies.
Tom Mathews and V. Gopi [1] proposed a robotic vehicle using the solar panel which aims on the design of efficient charging system of batteries. Based on the PIC micro-controller they discussed the design concept of the charging and discharging cycles of the batteries. On the basis of PIC micro-controller the efficient charging system concept was designed. The energy system consists of two efficient charging batteries and are,

A. From the solar panel for charging independently
B. The Robotic vehicle consumes the energy from other battery.

It is possible to manage the efficient power by implementing this technique. By control algorithm programmed in the PIC micro-controller the switching time between the efficient batteries can also be reduced.

Tom´as de J. Mateo Sanguino et al. [2] focused on the design and construction of Li–Po batteries which are optimized charging system by means of tracked solar panels .Thus, the optimized energy management system applied to a robotic vehicle. VANTER robotic platform was used to test the proposed system. To increasing the rover's power regardless of the mobility Robotic system presents the construction of a solar tracking mechanism. Based on a pack of two batteries it proposes an alternative design of power system performance.

Sang Choi et al. [3] present an industrial robotic system which performs ultrasonic welding of metal tabs on battery cells on the electric vehicles.

By performing robotic welding of the battery module tab of general or/and specific configuration, collecting and analyzing vibration data at various locations of interest on the robot and work piece, they investigate the robotic ultrasonic welding. and they finally notice the technical problems, and proposed a feasible solutions.

Gyu-Jin Jo et al. [4] proposed a three-wheeled robotic vehicle which is electric driven and used for the personal mobility. Rim, tire, brake, suspension, transmission, motor, and robotic wheels these are the major components for the proposed robotics vehicle which is electric driven. They proposed an electric driven robotic vehicle with three wheels for new transportation which provides personal mobility.

Basant Kumar Sahu et al. [5] developed an autonomous robotic vehicle and also they provide the hardware setup of this robotic vehicle. Based on the computer vision technology the controller of the vehicle was developed. To provide the movement of the vehicle in different directions an algorithm was developed based on color detection .The directions of the movements such as stop, left turn, right turn was captured by the Raspberry Pi camera. The proposed algorithm for robotic vehicle was verified experimentally.

Barry Gilhuly and Stephen L. Smith [6] investigate the UAV problems. In front of a moving ground vehicle they provide the current map information of the environment.

To enable a UAV to scan the route ahead of the ground vehicle they propose a simple coverage plan called a conformal lawn mower plan. The plan needs only a few knowledge of the ground vehicle's future path. They show that the proposed plan requires a UAV velocity that is no more than twice the velocity required to cover the optimal plan for a class of curvature-constrained ground vehicle paths.

Relative to the ground vehicle velocity, required to successfully cover any path in the curvature restricted they also establish necessary and sufficient UAV velocities.

Md. R. Raihan et al. [7] Proposed the design and implementation of a robotic vehicle. By using the hand movement with a wireless camera vehicle can be controlled from all directions. To broadcast wireless live streaming to the user end camera is installed at the top of the vehicle.

To control the movement of a robot in different directions it removes the hassle of gesture recognition and image processing technique or even the use of switches or joysticks. To ensure the surveillance feature for the users they provides a wireless surveillance facility to the user, Raspberry pi, software, namely Virtual Network Computing (VNC) and Foundation Internet Nouvelle Generation (FING) are used.

A survey is made on conventional robotic vehicle and different speech recognition techniques. Robotic vehicles are widely comes with automatic operations like line follower robot, industrial manufacturing robots which are controlled by the remote operation, but the current project is executed with the concept to controlled robotics using speech. This project reports a couple aftereffects of a progressing research extend that expects to investigate approaches to charge a mechanical robot utilizing the human voice with provincial dialect.

This component can enthusiasm with a few mechanical, research center and clean-room applications, where a nearby participation among robots and people is alluring.

III. EXISTING SYSTEM

As seen in many conventional robotic systems based on the literature survey made, robotic system comes widely with automatic operations like line follower robot, industrial manufacturing robots but the current project is executed with the concept to controlled robotics using speech. Hence in the current project work a robot interacts with user conveniently through natural language of speech and button events.

A. The Main Objectives Of The Project Are Mentioned Below

1) To provide a suitable hearing sensor amicable to the mobile robot.
2) To conceptualize speech to text conversion and voice recognition algorithm to synchronies the movement of the robot with the spoken language using Microsoft Visual c#.
3) To design a robot competent enough to connect with human through spoken natural language
4) To decrease the manual exertion for achieving and recognizing the order for controlling the movement of a robot by determined charges.

B. Expected Outcomes Of The Project Are Listed Below

1) Robotic system can be made highly efficient and effective.
2) The setup for maintaining the robot will be a onetime investment for any real life application.
3) The motor drive and control arrangement of the model has been exhibited.
4) The microcontroller based voice worked keen robot will bring more comfort in hazard environment surveillance; also the robot has function of rotating wheel.

C. The Limitations Of The Project Are Mentioned Below

1) The robotic vehicle is controlled over 30 meter distance, because of the low cost X-bee.
2) The system is not too flexible in the case of battery life of robot vehicle.
3) Robotic vehicle is difficult to recognize the voice in the noisy area.

IV. METHODOLOGY

A demonstration is presented using industrial robot and a personal computer (PC) equipped with a sound board and a headset microphone. The demonstration is coded using the Microsoft Visual Basic and C#.NET 2010 and associated with two simple robot applications. Robot is capable of picking-and-placing objects and going to predefined positions, and also it is capable of performing a simple linear weld on a work-piece. The speech recognition grammar is specified using the grammar builder from the Microsoft Speech SDK This project introduces the concepts of speech-to-text translation and voice recognition, and shows how these features can be used with applications built using the Microsoft.NET framework. C# based multi language voice controlled robot consists of transmitter unit and receiver unit. They are connected together wirelessly.

Transmitting block is shown in figure 1 gives the detailed function of speech processing on C# using visual studio platform speech input is given though condenser microphone. This input is converted into electrical signal and is sampled & converted to digital values and further processed through speech recognizing processing block through c#. This depends on the trained processes code, to recognize the given audio sample. This input &output signal is sent to wireless unit via RS232 port.

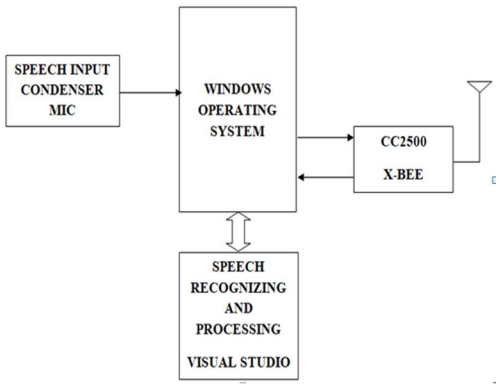

Figure 1: speech and touch input to C#

Receiving section is shown in figure 2. The signal transmitted is received through CC-2500 X-BEE module and sent ATMEGA-16 microcontroller. The Microcontroller performs all the controlling and monitoring operation for the corresponding command received by UART through cc2500. ATMEGA-16 operates at 16 MHz and has a flash ROM of 16kb and RAM of 2kb.

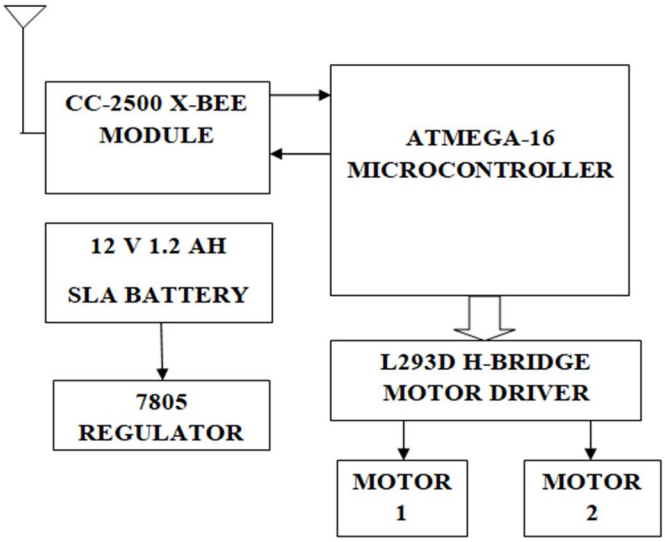

Figure 2: receiving unit

The course diversion is carried using two 30 RPM geared DC motor which is used to give the robot the mobility operation, driven by the microcontroller with the help of l293d h-bridge motor.

A. ATMEGA328 Microcontroller

In addition to all the features of the previous board, the Uno now uses an ATmega16U2 instead of the 8U2 found on the Uno (or the FTDI found on previous generations). This allows for faster transfer rates and more memory. Drivers needed for Linux or Mac, and the ability to have the Uno show up as a keyboard, mouse, joystick, etc..The Uno R3 also adds SDA and SCL pins next to the AREF. In addition, there are two new pins placed near the RESET pin. The ARDUINO Uno has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button as shown in figure 3.

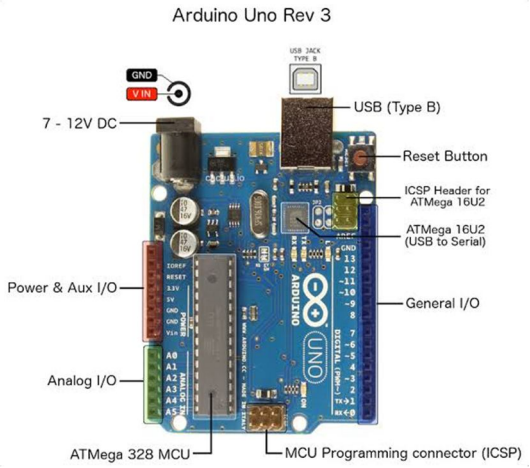

Figure 3: ARDUINO Uno board

It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

B. X-bee Module

X-bee module is shown in figure 4.It is an wireless transceiver used to send and receive data at maximum communication speed of 250Kbps the name x-bee replicates for the bee hive for the mesh network by point to point communication advantage of using x-bee over other conventional wireless is it provides long range communication personal area network support long battery life , beacon option for remote locating usually x-bee is used for data acquisition and transmission x-bee operates at 3.3v and low stand by idle current communication frequency is of standard permissible for wireless test purpose at 2.4Ghz x-bee can communicate with one device at a time or multiple devices depending on pan here x-bee is used to send data from pc to robot by using serial communication operating at nine thousand six hundred baud rate eight bit data, one stop bit, not start no parity.

Figure 4: X-bee module

C. L293D Dual H-Bridge Motor Driver

L293D is a double H-Bridge motor driver this IC can drive two dc motors in both direction with fix course of movement by interfacing all i/o to microcontroller and up to four motors can be controlled in fixed direction this driver has yield current of 600ma and up to 1.2A for every line connected to motors mainly this IC have internal freewheeling diode which protects from back EMF generated during the rotation and works with wide input from 4.5v to 36v.The connection diagram of motor driver to DC motor is shown in figure 5.

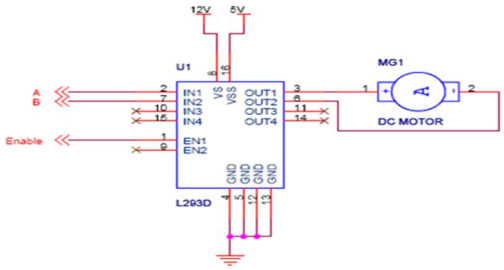

Figure 5: connection diagram l293d to motor

D. Gear Dc Motor

The internal architecture of Dc motor consists of driver and idle gear as shown in the figure 3.5.At whatever point a mechanical autonomy specialist discuss making a robot, the primary thing rings a bell is making the robot precede onward the ground. What's more, there are constantly two choices before the architect need to utilize a DC or stepper motor. With regards to speed, weight, size, cost. DC motors are constantly favored over stepper motor.

E. Battery

Power bank are major source to run the prototype here 12volt 1.2ampere/hour sealed lead acid battery is used to give constant supply for continuous operation of the system compared to conventional lead acid battery this bank won't spill and acid and no need to put distilled water an additional charger need to charge the battery 14.1 volts is knows as battery full and 10 volts is known as low battery discharging the battery beyond the level make the battery unusable. Additional voltage reducer IC7805 must be used to drive the digital part.

V. IMPLEMENTATION

This part gives the different flow diagram for transmitting and receiving section. Figure 6 shows the flow chart for the transmitting section. After running the Microsoft visual studio .NET 2010 the main framework will be opened which is used to interact with the robotic vehicle. The user has to enter the COM PROT number to transfer the data to the receiving side. After entering the valid COMPORT number user can select the command either by speech or button events. After receiving the command from user the synthesizer will generate a equivalent text to that particular input. Then the generated text will be transmitted serially through the X-bee.

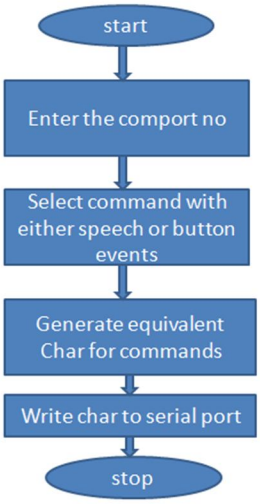

Figure 6: Flow chart for transmitting section

Figure 7 shows the working flow of robotic vehicle. In the receiving side the X-bee will ignore the data until it receive the valid character. The received data will be processed by the ATMEGA microcontroller and decision is made for the movement of robotic vehicle. Based on the microcontroller output the robotic vehicle will move forward, backward, left and right. After the resultant operation the received data will be cleared.

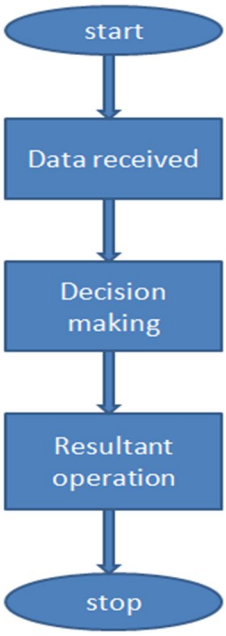

Figure 7: Flow chart for the movement of robotic vehicle

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VI. RESULTS AND DISCUSSION

The figure 8 shows the prototype of integrated robotic vehicle. With modernization in technologies and multiple research in the field of robotics from domestic to military usage has gone much forward in this project robot movement is controlled using voice as command input but the special feature is using multi-language user interactive input processed on C# platform using visual studio command is sent through 2.4ghz cc2500 wireless transceiver unit below details give the brief function of robot.

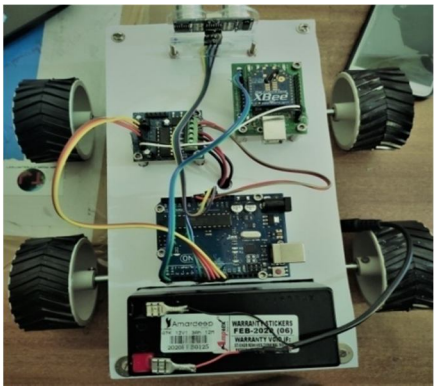

Figure 8: full integrated prototype

The voice processed for the robot control is as described in below figures. The figure 8 shows the main screen to configure the com port by giving the desired port no and need to open the port to start the process after this process user need to turn on the speech recognizer by ticking it otherwise only touch control through cursor can be done.

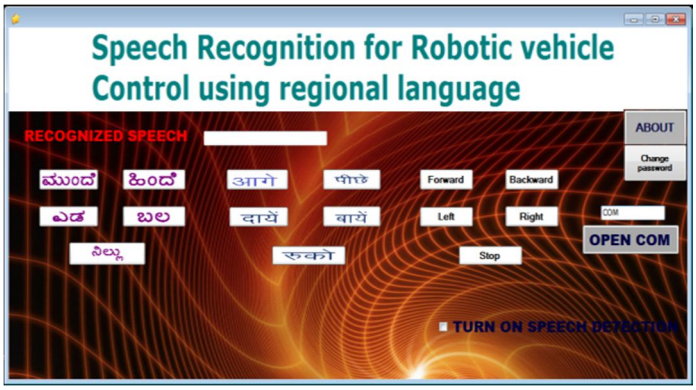

Figure 8: verbal control framework

User has given the voice command “mundae” means forward in English as shown in figure 9. For this command a char “A” is sent through the serial communication to wireless unit which will be transmitted to robot to movement.

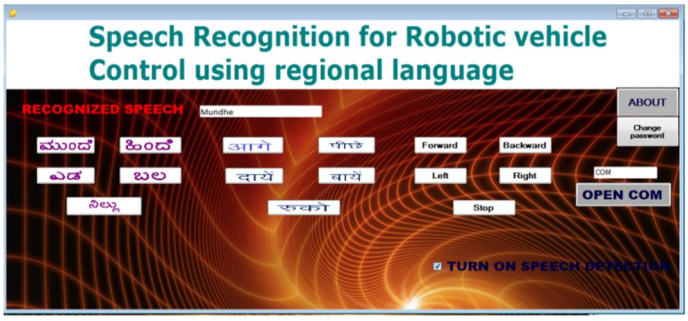

Figure 9: command for forward movement

Similarly for all the voice input equivalent character will be generated and it is sent trough the serial communication to wireless unit which will be transmitted to robot to movement as shown in table 1.

Command		processed char Written to serial port	Microcontroller port bits to driver L293D				Result
STANDARD	REGIONAL	ASCII CHAR	PC0	PC1	PC2	PC3	MOVEMENTS
Forward	Mundhe	A	1	0	1	0	Forward
Backward	Hindhe	B	0	1	0	1	Backward
Right	Balha	C	0	1	1	0	Sharp Right
Left	Yada	D	1	0	0	1	Sharp Left
Stop	Nillu	E	0	0	0	0	Stop

Table 1: Results and analysis

VII. CONCLUSION AND SCOPE FOR FUTURE WORK

This part gives the last conclusion drawn from the proposed work and the extension for future work. Suitable hearing sensors are incorporated in the voice module for the movement of robotic vehicle and also conceptualized the speech to text conversion and voice recognition algorithm to synchronies the movement of the robot with the spoken language using Microsoft Visual studio. Robotic vehicle is designed which connect the human through the natural spoken language and decreases the manual exertion. This project technique of controlling a robotic vehicle can be applied to any embedded (microcontroller) based system, It's not only limited to robotics since it is low-cost because by just updating code and interfacing a wireless device we can have this desired system control. We are actualizing programmed robot it has different preferences. We can likewise include new innovation in this robot.

A. Scope for Future Work

1) The range of control could be increased by using long range wireless modules like Wi-Fi, etc.

2) Android based control with RTP based video rendering can be done.

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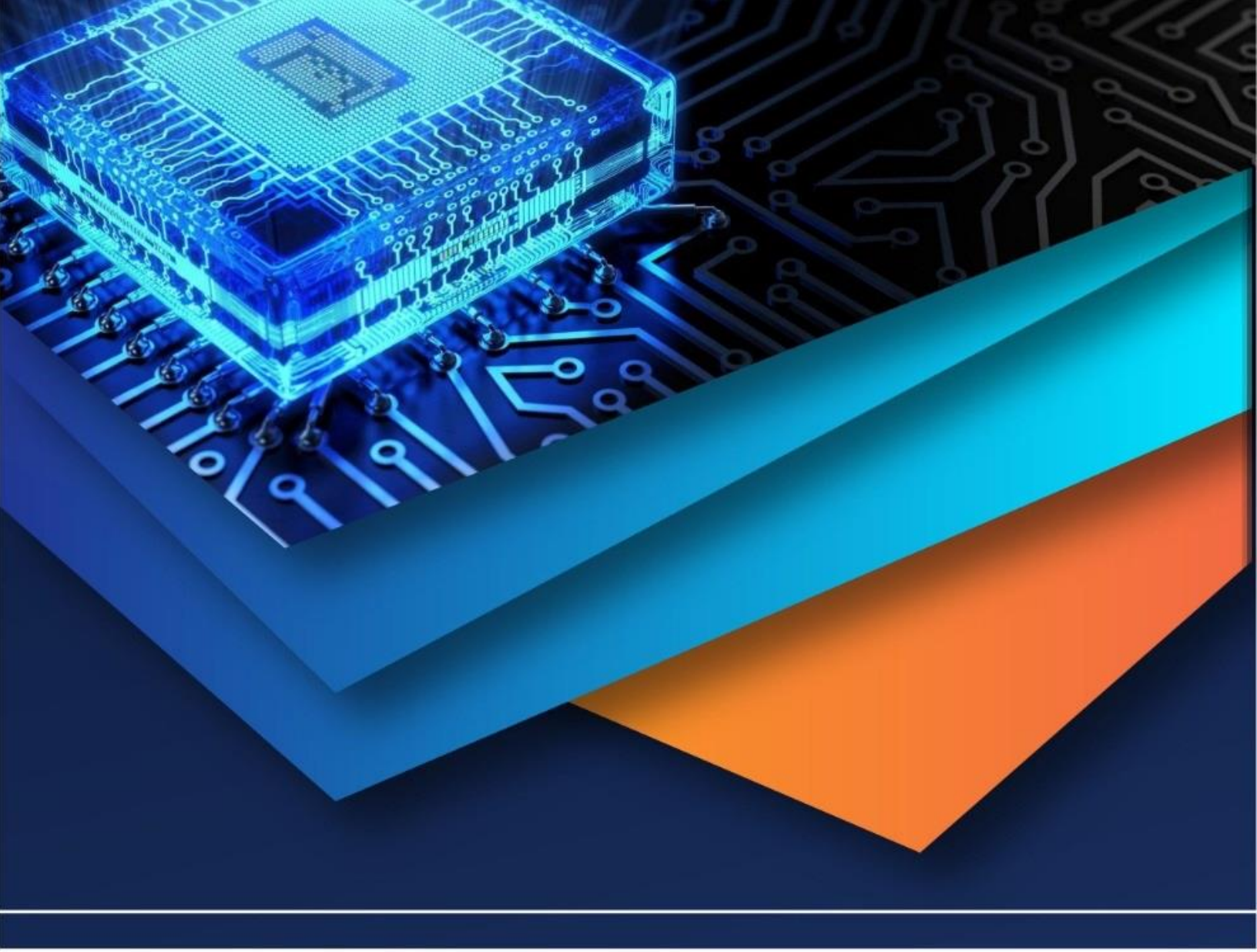

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