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Development of a Mobile based Voice Controlled Surveillance Robotic Vehicle

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Abstract: ***Voice Controlled Robotic Vehicle is an example of controlling the bot with the help of daily used voice commands. An Android app is used for giving input voice commands and in order to control the motion of robotic vehicle. The voice commands given by us is processed by the app and voice module converts speech into text. A controller should be implemented with a Bluetooth module through the UART protocol. The converted text commands reach the controller via Bluetooth. The microcontroller will process this text and take a necessary action to control the motion of the robotic vehicle. The hardware development board used here is Atmega Arduino Board. The software programming part is done in Arduino Ide using Embedded C. The objective of the project described in this paper was to regulate the movement of the robotic vehicle using commands such as Forward, Backward, Left, Right. There is still a plenty of scope for research and development in the project described in this paper. Adding a very small size camera and using http communication protocol we can receive video streaming from the camera which is placed on the robotic vehicle. The Robotic vehicle now can be used for surveillance of terrorist prone areas, suspected areas.***

Keywords: Arduino, Embedded C, Bluetooth, Android.

I. INTRODUCTION

The world is growing at a greater pace and in future we can definitely see robots occupying places of humans in work places where it is harmful for the human beings to work like chemical factories, factories where machinery is used etc. Now-a-days a smart phone is used to control the electronic devices including motors, music, lights etc. In the same way, in this project a smart phone with an application installed in it is used for the control of a robotic vehicle with help of voice human voice commands. The main components used in the project are an Arduino microcontroller board, L293D Motor Driver, HC05 Bluetooth Module, DC Motors. An Android app is used for giving input voice commands and in order to control the motion of robotic vehicle. Voice Module converts the voice into text and will send commands to microcontroller via Bluetooth and micro controller based on the commands received from the android app controls the movement of the robotic vehicle. Programming Arduino is done in Arduino Ide using Embedded C programming language. The prototype will be very helpful to disable people when we use it in wheel chairs etc. The embodiment of camera to the robotic vehicle makes it very much useful for surveillance of border areas, terrorist prone areas or any other places where there is any doubt about suspicious and illegal activities.

II. LITERATURE SURVEY

With reference to press releases by International Federation of Robotics dated September 18, 2019 shows us that there was an annual global sales value of 16.5 billion USD in 2018 and 4,22,000 units were shipped globally in 2018 with an increase of 6 percent compared to the previous academic year. IFR expected an average growth of 12 percent per year from 2020 to 2022. This shows us the demand that a robotics industry is having across the world. Many Researchers contributed various research papers with respect to the concept and ideology. Some of those papers are mentioned below stating their ideology and implementation and technology used. “Vito M Guardi developed the method of communication between an android application and a microcontroller with the help of Bluetooth technology. His work showed that a micro controller can take actions from the inputs given by an android application”.[1]

“Ranjith Kumar Goud and B. Santosh Kumar has developed a pick and drop robot for the purpose of diffusing a bomb remotely with safety. For the purpose of robotic arm they used a pair of motors and for the purpose of movement they used wheels. The communication for the control of robotic arm is done with the help of Bluetooth technology. They used LPC2148 microcontroller. They have also embedded a wireless camera for the purpose of surveillance. They have made it mainly to use it for military purposes”. [2]

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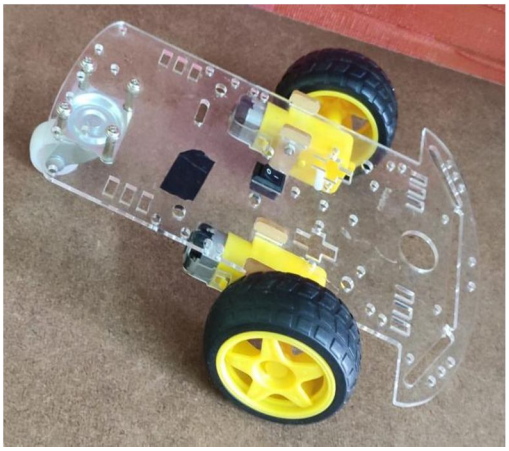
"Xiao Lu, Wenjun Liu, Haixia Wang, Qia Sun[3] used internet of things to connect smart phone of Android System to robots performing various services using wireless communication, where it is programmed based on TCP socket. The interesting part of their project is the robot can sing, dance and so on according to the command and they made the characteristics visual and portable." [3]

"Mr. K. Kannan and Dr. J. Selvakumar have written a paper that dealt with the existing speech recognition system and its usage in their project. They have used EasyVr module which is incorporated in their project to convert the input voice commands given by the user into digital values with the help of analog to digital converter (ADC) and compare it with predefined voice commands and transmit those values as per the voice commands in the form of binary bits. They have used ATmega 2560, servo motors, ZigBee module (at the receiver side) . Based on the binary values received by microcontroller via ZigBee module, servo motors will be driven in a continuous loop. The paper helped us to understand about the microcontroller, speech recognition system and its disadvantages and the measures to be taken to make the speech recognition system free of errors".[4]

III. HARDWARE AND SOFTWARE DESCRIPTION

A. *Hardware Components*

1) Chassis: Chassis is the structural component of our voice controlled Bot.



Chassis

.It is analogous to the skeleton in living organisms. It supports the load of our voice controlled Bot . It provides the space for all our components which includes DC motor, Arduino Board, HC05 Bluetooth module, L293D Motor Driver. In our project voice Controlled Bot, we have used two wheel Chassis with a castor wheel at front.

2) Geared DC Motor

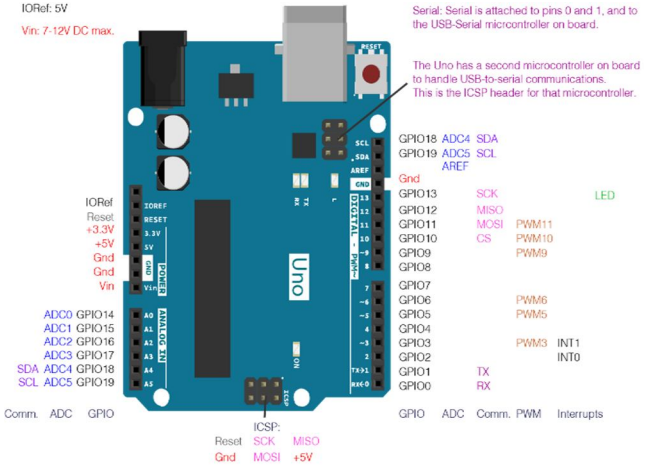


Geared DC Motor

In our project called Voice controlled Bot ,we have used a DC Motor with a gearbox of 1:120 ratio, here gearbox has a reduction in speed, which gives much more power to engine. We fix Rubber wheel with 65mm diameter to this DC Motor. The Motor can drive with a input voltage ranging from 3V to 7.5 volts. We supply 5v volts to these DC motors using a Battery from Motor Drivers. With a higher voltage within the given range, we can get more output.

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3) *Arduino Uno:* Arduino Uno is a Micro-controller Board. It has 14 Digital pins, 6 Analog pins, 16MHz ceramic Resonator, a power jack, a USB connection, an ISP header and a reset button. We need to connect our Arduino Board to our Computer using USB connector and we need to program it through Arduino IDE. To start our voice controlled bot we can power up the Arduino Board using power jack or by USB connection.



Arduino Uno

4) *L293D Motor Driver*



L293D Motor Driver

L293D is a 16 pin Motor Driver IC. It is used to drive motors. L293D IC is capable of driving two DC motors at the same time. Direction of the two motors rotation whether in clockwise or anticlockwise can be controlled by passing the signals from Arduino Board to the motor driver. Based on the instructions received from the Bluetooth Module, Arduino will send the commands to the Motor Driver which are generally logic high or logic low signals. The signals received from the Arduino to the motor Driver are low current signals which are insufficient to drive the motors. So motor driver will convert the low current signals to high current signals which are capable to drive the motors.

5) *HC05 Bluetooth Module*

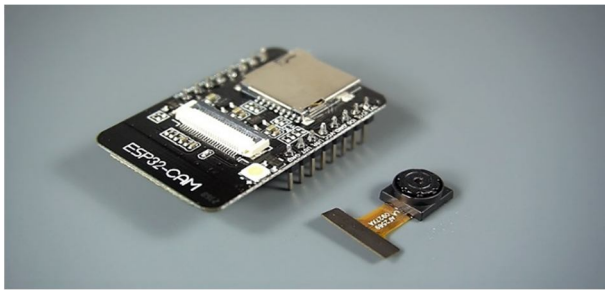


HC05 Bluetooth Module

HC05 is a module which allows full duplex wireless Communication. We use this module to have wireless communication between our mobile phone and Arduino Board. HC05 module receives text from the Mobile phone where Mobile phone is connected to the Bluetooth Module. Then Bluetooth Module communicates with the Arduino Micro-controller with the help of USART at 9600 baud rate. Using the Serial Port Protocol ,we pair up the HC05 Bluetooth Module with the Arduino Board.

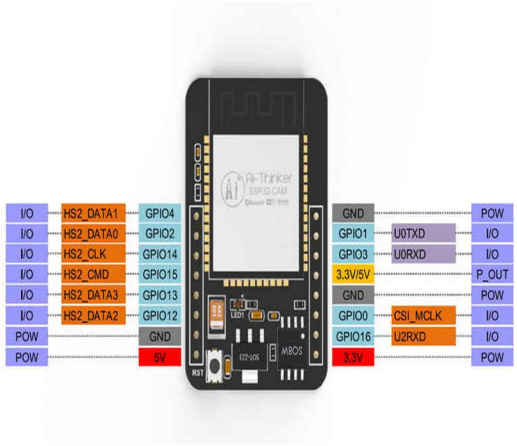
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6) *ESP-32 Camera Module:* The ESP32-CAM is a compact, low-power camera module based on the ESP32 . It features an OV2640 camera and a TF card slot onboard.Wireless video surveillance, WiFi image upload, QR identification are some of the applications of ESP32-CAM. Because the ESP32-CAM lacks a USB port, you'll need an FTDI programmer to upload code via the U0R and U0T pins (serial pins).



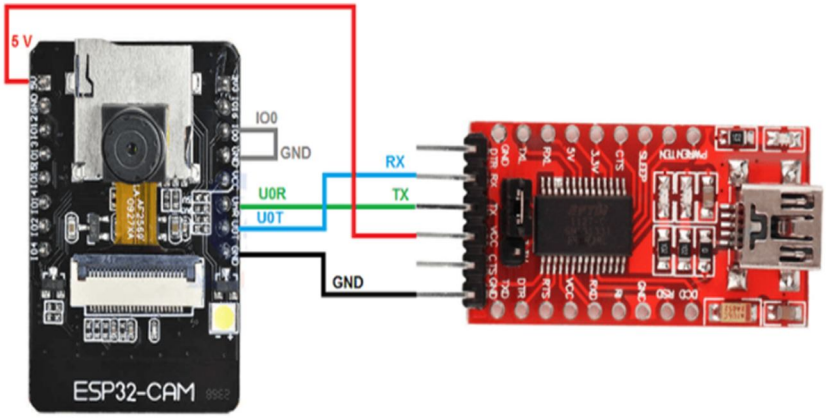
ESP- 32 Camera Module

Three GND pins and two power pins (3.3V or 5V) are available.The serial pins are GPIO 1 and GPIO 3. These pins are required for uploading code to your board. Furthermore, GPIO 0 is critical since it determines whether the ESP32 is in flashing mode or not. The ESP32 is in flashing mode when GPIO 0 is connected to GND.



ESP-32 Camera Pinout

Using an FTDI programmer, connect the ESP32-CAM board to your computer. Take a look at the following schematic diagram:
A jumper on many FTDI programmers lets you to choose between 3.3V and 5V. Make sure the jumper is in the right place to select 5V.If you want to upload code, you must connect GPIO 0 to GND.



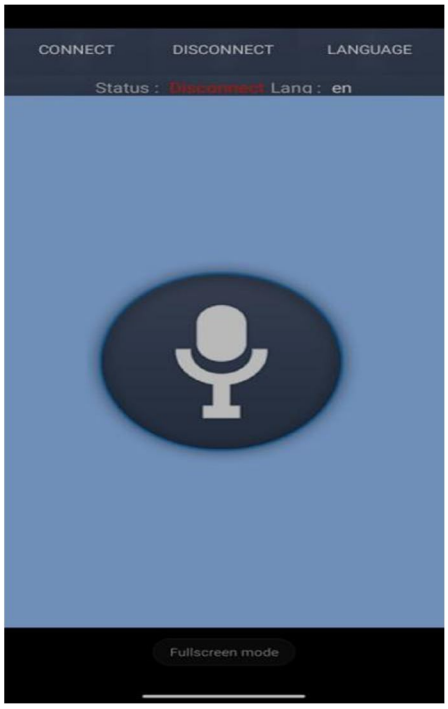
ESP32 Camera Module connection with FTDI Adapter.

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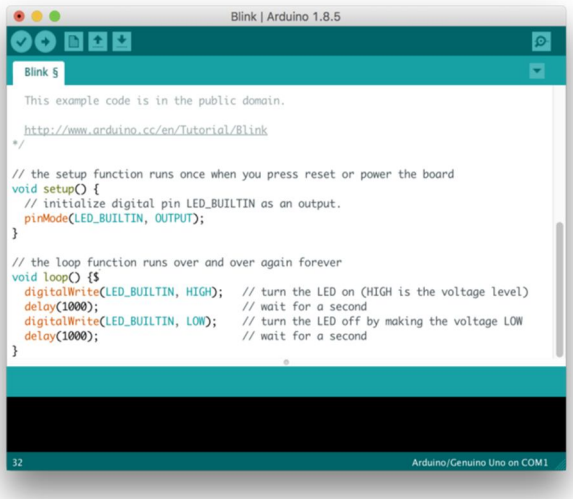
B. Software Description

1) Arduino Voice Control App: This app is developed with the help of MIT app inventor. Using this app, we will connect the Mobile phone to our HC05 Bluetooth Module. This arduino voice control app will convert the voice commands into text using google assistance. Converted voice commands into text are received by HC05 Bluetooth Module and by serial port protocol those texts will received to the arduino micro-controller.



Arduino Voice Control app

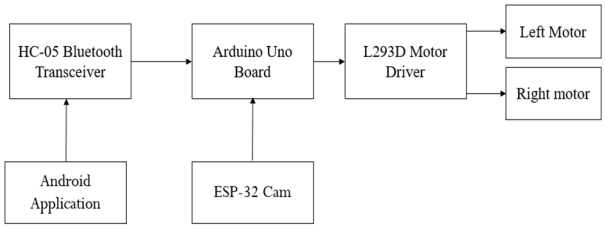
2) Arduino IDE: Arduino Integrated Development Environment is a cross-platform application for Windows, Mac OS, Linux written with functions from C and C ++. Used for writing and downloading programs on compatible Arduino boards. Arduino IDE supports C and C ++ languages using special coding rules. Arduino IDE provides a software library from the Wiring project, which provides many common installation and extraction processes. User-coded code requires only two basic functions, starting with the drawing and the main loop system, integrated and linked to the main stub () program in the active cyclic executive and GNU tool chain, integrated with IDE distribution.



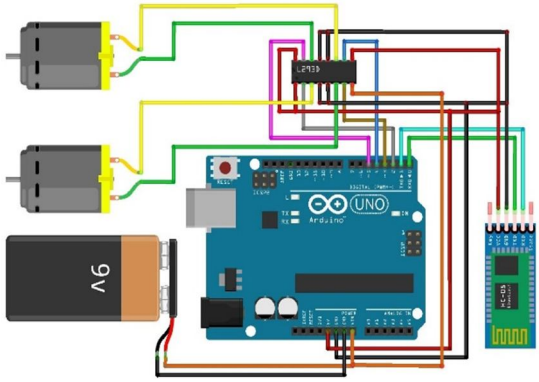
Arduino IDE

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IV. WORKING



Voice commands are processed over the phone, and the speech-to-text conversion is done within the app using Google's speech to text API. The text is then sent to the micrrocontroller via Bluetooth. The text is transmitted to the Arduino Uno board using the UART communication protocol Via Bluetooth communication wirelessly. Arduino code checks the received text. Whenever the text is the same thread, Arduino controls the robot's movement in a forward, backward, turn right, turn left & stop by sending commands to the motor Driver.



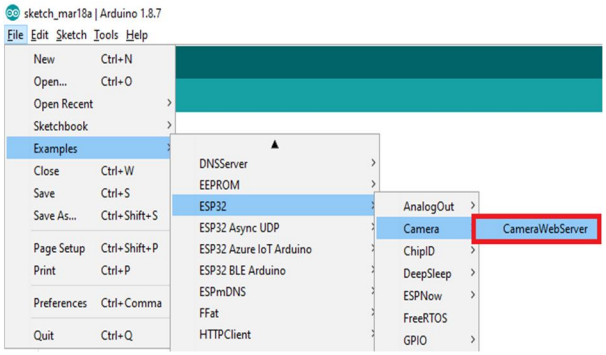
Circuit diagram

Build a video streaming web server with the ESP32-CAM that you may access on your local network by following the steps below. To programm the ESP32-CAM board, we utilise the Arduino IDE. As a result, you'll need to have the Arduino IDE installed as well as the ESP32 add-on.Go to File > Examples > ESP32 > Camera in your Arduino IDE and open the CameraWebServer example.

Follow these steps to upload the code:

1) Go to Tools > Board and select AI-Thinker ESP32-CAM.
2) Go to Tools > Port and select the COM port the ESP32 is connected to.
3) Then, click the upload button to upload the code.
4) Press the ESP32-CAM on-board RST button.

The code should be successfully uploaded to your board in a few seconds.



Camera WebServer Module

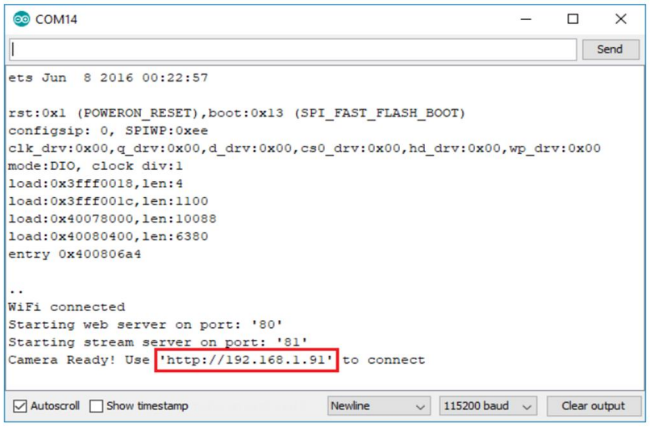
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A. Getting the IP Address

1) Disconnect GPIO 0 from GND after uploading the code.

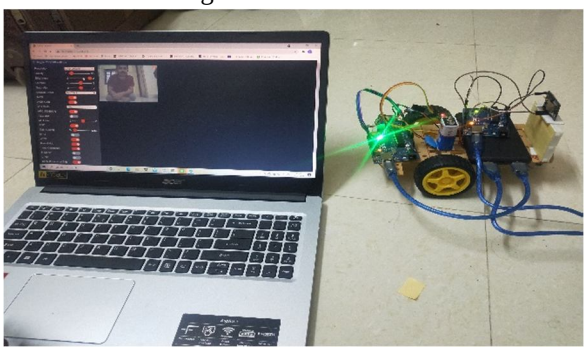
2) Using a baud rate of 115200, open the Serial Monitor. Press the on-board Reset button on the ESP32-CAM.

3) The IP address of the ESP32 should be displayed in the Serial Monitor.



IP Address on Serial Monitor

You can now use your local network to access your camera streaming server. Open a browser, type the IP address of the ESP32-CAM. To begin streaming video, press the Start Streaming button.



Implemented Model

V. APPLICATIONS

A. The project can be used in wide variety of areas such as military, home security, rescue missions, industries, medical assistance etc.

B. The Voice Control Robot is useful for disable people and monitoring purpose.

C. The size of this robot is small, so we can use this robot for spying purpose. It can be used for surveillance.

D. Robot controlled by smart phone may be used at the territory for disposal of hidden mines.

VI. FUTURE SCOPE

The future prospects of this project are as follows: The project can be brought into application in other mobile operating systems like ios, windows. Usage of wifi over Bluetooth for the wireless communication between smart phone and microcontroller can increase the range to a larger scale. When we use the same prototype in quadcopter we can capture aerial view.

VII. CONCLUSION

In this paper we have discussed our approach to create a Arduino Integrated voice controlled Robotic Vehicle that runs with the help of an android application installed in the smart phone and we mounted an ESP-32 Camera module which is used for surveillance. The system is used for real time application and is secure.

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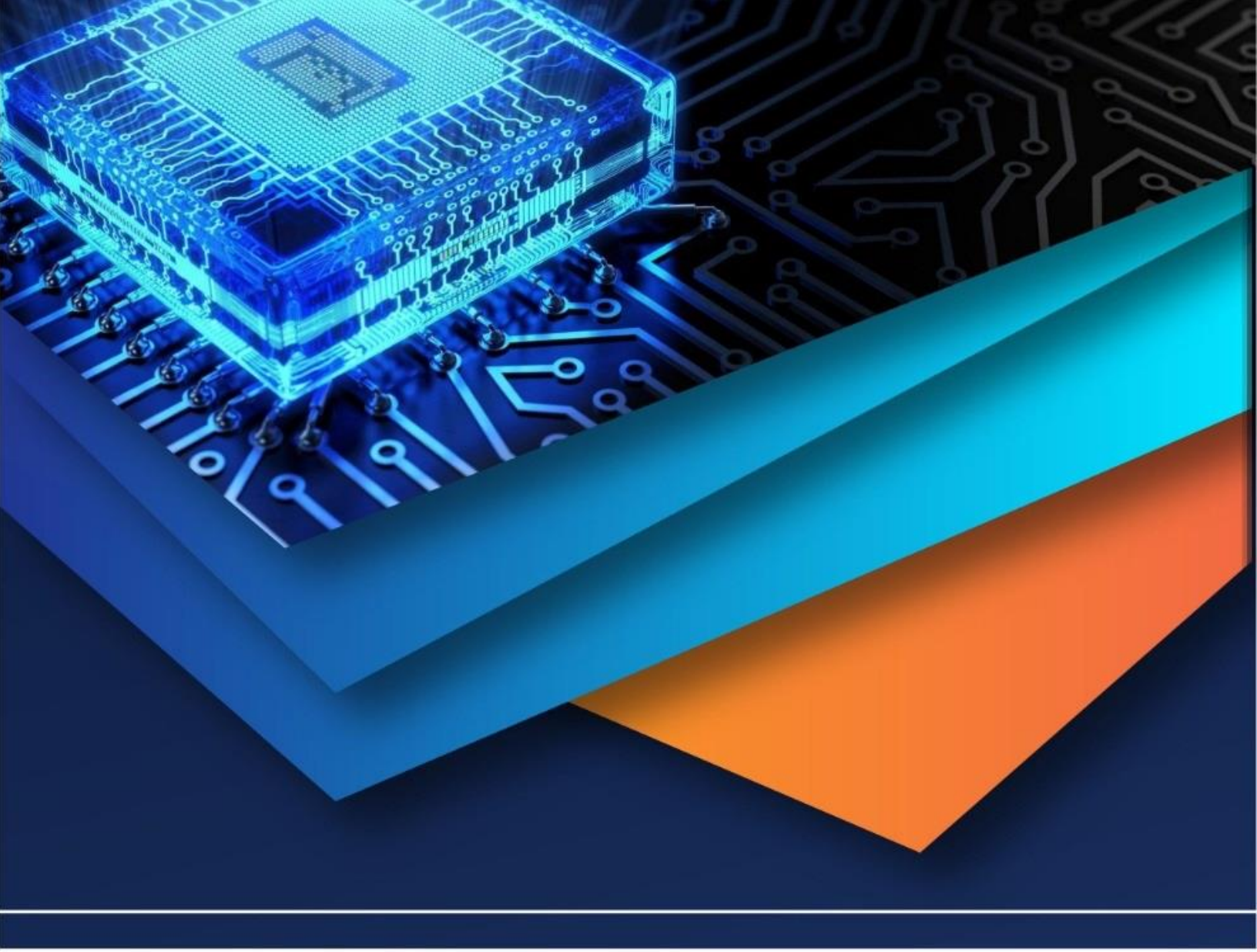
VIII. ACKNOWLEDGEMENT

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We have fortunate to work under the supervision of our guide Dr. G. Ganesh Kumar. His guidance and ideas have made this project work.
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