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Military Safety and Surveillance Robot with Two-Way Communication

Mr. Vinod Kumar S[1], Bhanu Prakash Naidu S[2], Sadashiv N Mantur[3], Shri Harsha S[4], Yashwanth Gowda S[5]
[1]*Guide,* [2, 3, 4, 5]*Student, Department of Electrical and Electronics Engineering, New Horizon College of Engineering*

Abstract: ***This paper focuses on developing an Unmanned Ground Vehicle (UGV) wireless robot. It can sense the different parameters of the surroundings; transmit the data through a wireless medium and display data in LCD as well as on a Remote PC. It controls the direction of the robot from a remote location using wireless communication and thereby performing military surveillance and analysing the battlefield environment and challenges that the soldiers may potentially face. By using a Wi-Fi camera and many sensors the robot can help the soldiers in the war fields to examine various environmental conditions and challenges. The arduino and NRF (Nordic Radio Frequency) technologies are used to achieve the above tasks. The different sensors and the robotic arm are connected to the Arduino Uno which in turn is connected to the Nordic Radio Frequency module. Data transmission and receiving are done through Nordic Radio Frequency communication technology. The proposed model eliminates the limitations of the existing models and thus provides better assistance to the soldiers and enables them to handle their missions better.***

Keywords: Unmanned Ground Vehicle, Arduino, Nordic Radio Frequency, Military surveillance.

I. INTRODUCTION

India is rising as a primary manufacturer of defence technologies. Military forces want to enhance themselves unexpectedly and put together for current day threats. This paper focuses on the design of a semi-self-governing, Unmanned Ground Vehicle (UGV) that can be utilized for different military observations and analyzation of battlefield conditions. This reduces the risk of losing the lives of soldiers and increase their preparedness in facing the harsh war field conditions. Using Arduino and NRF technology, the above-mentioned tasks can be achieved. From service industries to medicine, manufacturing, disaster relief, war, intelligence, rescue operations, autopilot cars, elderly care, and dangerous goods dangerous tasks such as bomb disposal, enemy territory surveillance, search and rescue can be efficiently carried out by the aiding soldiers.

The machines with artificial intelligence and robots are slowly replacing humans in these fields for the past few years. Using these robots many manual tasks and operations are being automated thereby saving time and money. The robots are proving to be far more efficient and beneficial than humans in many areas. Robotic applications have increasingly developed in health care industry, search and rescue operations, tutor children, cars with autopilot, elderly care, military robots in automated combat, to helping military units etc. In this way, robots are making our lives quicker and simpler. Robots must adapt to humans, without a doubt pretending that they are morally capable of helping humans consider their feelings, beliefs, and respect.

Some of these robots are designed to destroy enemies whereas few other robots are meant to rescue lives of people. Military robots also have their advantages and disadvantages. The military robots are built for effectively performing even under the harsh conditions like temperature extremes, unfavourable climatic conditions breakdown of system hardware components, etc., These types of robots can be either fully human controlled, semi-autonomous or fully autonomous. Autonomous robots have number of challenges to face in military. In many countries autonomous robots are not allowed to be used and face lot of curtailments because unlike humans they are not driven by emotions or feelings and are merely driven by the programming done on them and any malfunction may lead to severe disasters.

It is very difficult to implement this type of a robotic design. Also manually operated system also has its own set of disadvantages. Hence it is more preferrable to use a semi-autonomous design. In existing system, one way communication robot available. In this proposed system an Arduino microcontroller is used for NRF communication. So, the robot will not depend on any another network. It will work on personal network and use without any issue. The NRF module is connected to the microcontroller through the SPI (Serial Peripheral Interface) protocol and can communicate with the Arduino UNO by transmitting and receiving radio signals. In the existing system it is possible to communicate one-way only i.e., either by transmission or reception. This proposed system will work for two-way communication. Using Nordic Radio Frequency module, it is possible to control the robot up to 800m of distance.[2]

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II. PROPOSED TOPOLOGY

The robot consists of sensors and actuators which will send the real time data to the user through NRF module is included in section one. The section two used to control the robot and to get data from the robot through NRF module. Arduino Uno is a significant part of this framework which is customized utilizing the Arduino programming language in Arduino programming variant 1.8.7.

The Arduino is fuelled by means of the Mini-B USB association. The ultrasonic sensor is associated with the Arduino to give sign to it at whatever point an object is recognized inside the scope of the ultrasonic sensor. A signal and a LED are associated with the Arduino to offer notice to the driver demonstrating the monitor to make essential move when the snag is inside perilous nearness to the vehicle.

The different sensors like gas sensor, temperature sensor and humidity sensor are used in the proposed system. The gas sensor senses the gases like carbon dioxide and detect smoke, the temperature sensor is used to determine the atmospheric temperature, and the humidity sensor is used to determine the humidity level in the atmosphere.

The ultrasonic sensor is used to determine the distance between the robot and obstacle by using the equation (1):

$$Distance = Duration * \frac{0.034}{2} \qquad (1)$$

An additional metal detector sensor is incorporated in the hardware circuit to sense the presence of explosives like bombs. An LCD module is associated with the Arduino to indicate all the above-mentioned sensor parameters. A Wi-Fi camera is used to capture the footage of the range of its lens and display it on the PC for monitoring and surveillance purposes. DC Motors are responsible for the movement of the military robot.

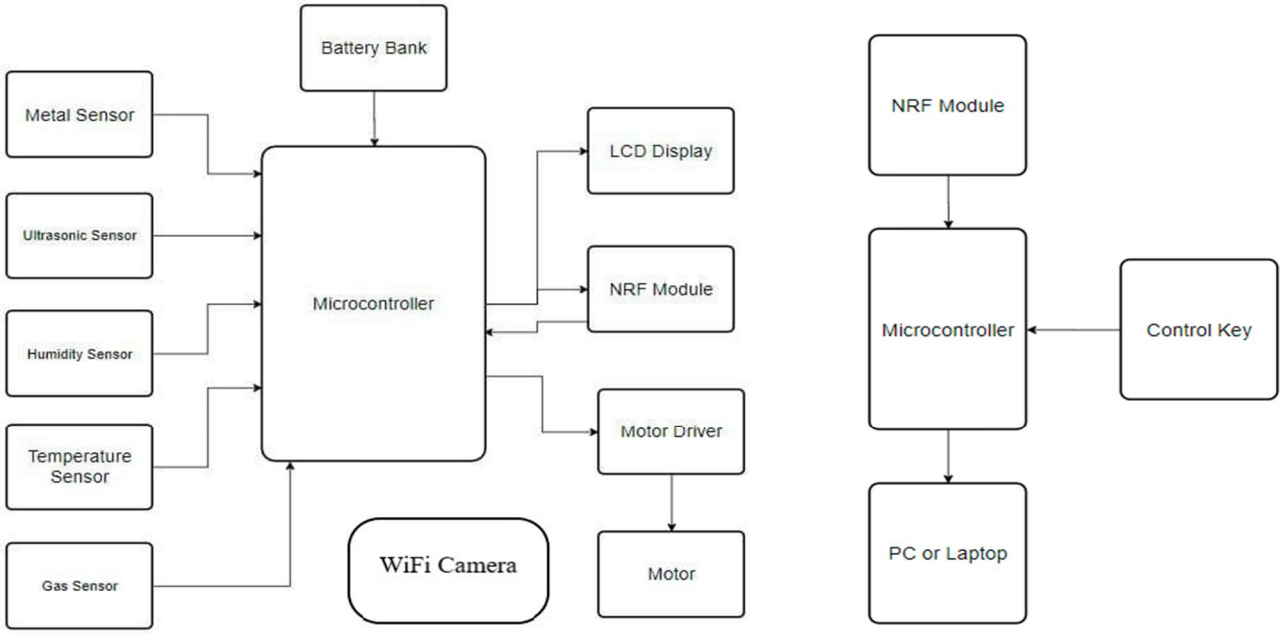

Fig 1: Block Diagram

A. Arduino UNO

The Arduino uno bolstered over a separable, double inline-bundle ATmega328 AVR microcontroller. This component has simple information/yield (I/O) ports which are assembled to fluctuated development sheets (or shields) and different circuits. This is a microcontroller board upheld on the ATmega328. The board comprises of 14 and six digital and analog pins respectively, which can be programmed by the aid of Arduino Isolated Development Environment by means of a USB link.

It is regularly controlled by means of a USB link or by means of 5V supply or greater, however it acknowledges voltages in the range of 5 to 18 volts. This also utilizes Arduino IDE software to make sketches, like other Arduino family development boards (Arduino programs are called sketches). The sketches created on the Arduino IDE can be transferred directly through the USB port connection of the computer and IDE is compliant with operating systems such as Linux, MAC or Windows Programming languages C and C++ are included.

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Nordic Radio Frequency module(nRF24L01) is a wireless highly integrated, ultra-low power device with a data transfer rate of 2 Mbps. It is a radio frequency transceiver for the ISM (Industrial, Scientific and Medical) 2.4GHz frequency band. It incorporates an entire 2.4GHz radio frequency transceiver, radio frequency synthesizer, and a baseband logic inclusive of Enhanced ShockBurst hardware protocol accelerator supporting a high-speed SPI (Serial Peripheral interface) for the utility controller. This device is used to communicate with the Arduino Uno by establishing a two-way communication.

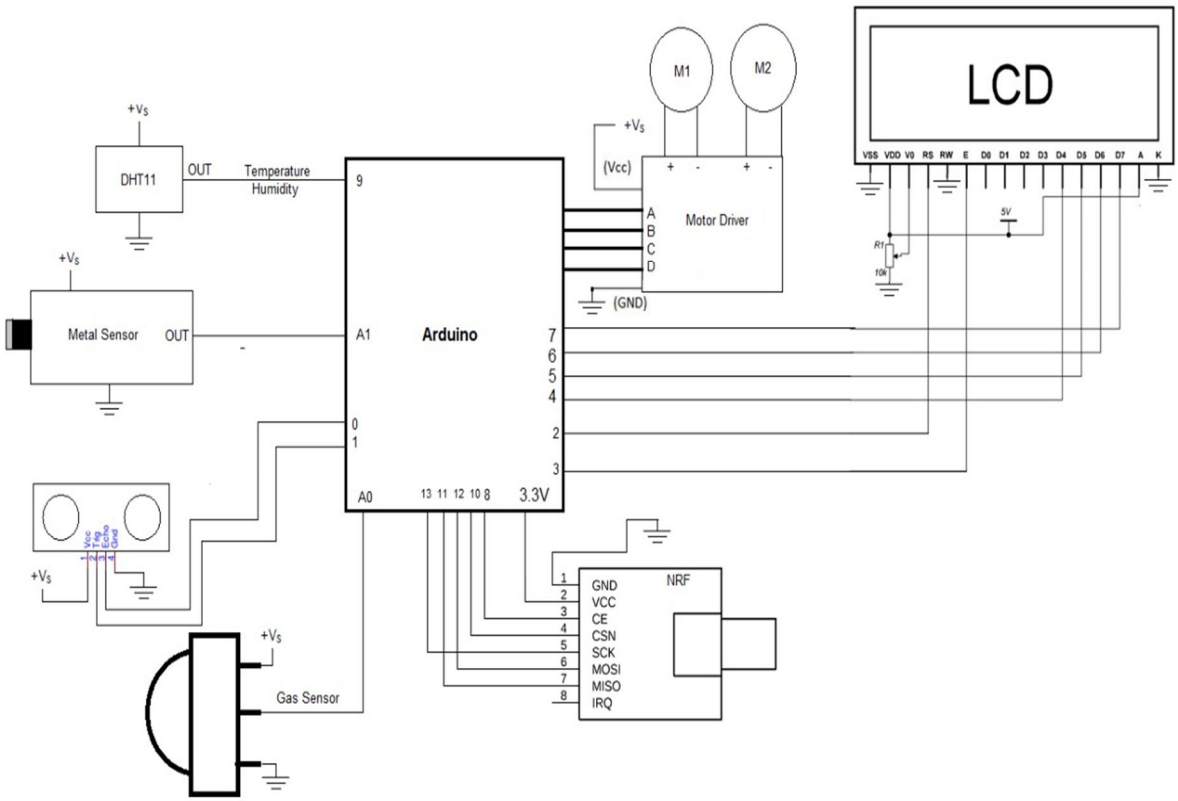


Fig 2: Circuit Diagram of the proposed system

The Fig.2 shows the circuit diagram of proposed system. The Arduino Uno microcontroller is connected to all the sensors and NRF wirelessly. The sensor reads the information and pass it to the microcontroller (Arduino Uno). The Arduino Uno will store the sensor data and print it on the LCD screen. Then the data is sent to NRF transmitter module. The sensory circuit including smoke sensor, metal detector sensor, ultrasonic sensor, temperature and humidity sensor is connected to the analog input pins of the Arduino Uno and the Arduino output is given to the LCD and NRF (Nordic Radio Frequency) modules. The LCD used here is a 16*2 display and it is attached to a potentiometer for background lighting control.

The NRF module transmits data to the Arduino and its output is given to the 12V DC motors. The motors are used in propelling the robot and it also transmits the sensory information to the remote PC where the user can read all the parameters and analyse the battlefield conditions. The motors are driven by a L293D Motor Driver circuit. The data transmitted is displayed on the PC at the base. The soldiers working nearby can view the atmospheric composition of harmful gases through a LCD which is present on the robot.

The sensors, along with the motor drivers and other components like LCD, NRF module, etc., are fixed onto a cardboard placed on the metallic robotic base. NRF receiver module will receive the data and pass to receiver of the Arduino Uno microcontroller. This information will pass on to the Laptop or PC by the Arduino Uno. The user can send control command from receiver to robot back for control direction of robot. The robot is having a chainwheel mechanism for it to be able to easily maneuver over the difficult terrains. The proposed military robot can be controlled from a range of up to 1km as per the NRF module specifications which is higher as compared to other wireless communication protocols like Bluetooth, Zigbee or Wi-Fi.

III. RESULTS

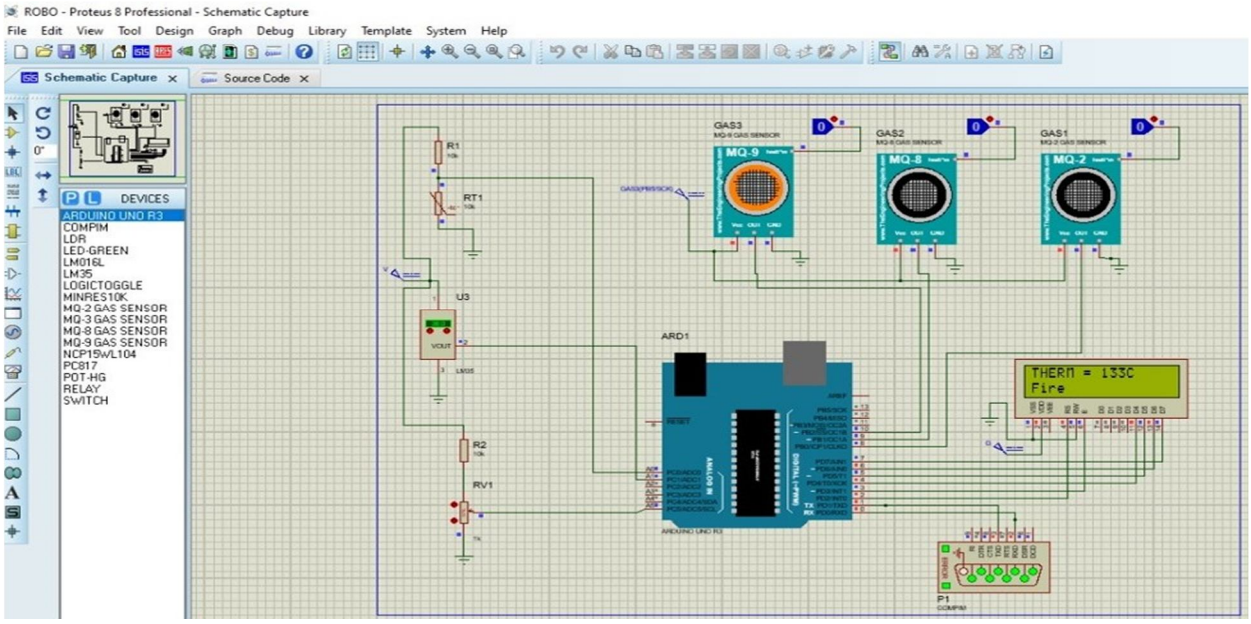
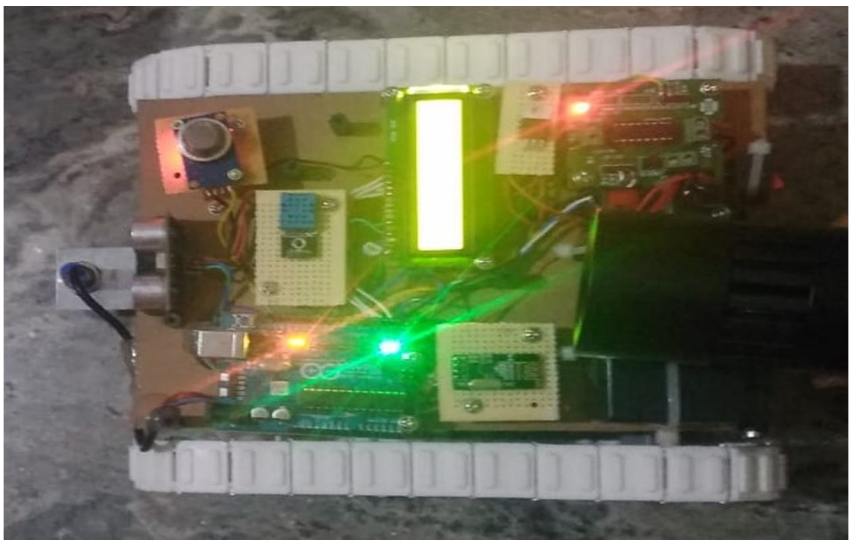


Fig 3: Simulation of proposed system

Fig 3. shows the simulation diagram of the 'Military Safety and Surveillance Robot' using Proteus software. The output including all the sensor parameters is displayed on the LCD screen. Proteus is a Design Suite also known as Virtual System Modelling (VSM) offering the ability to simulate micro-controller code and circuits. The software suite containing schematic, simulation and PCB designing. Proteus is a simulation software used to simulate components and is capable of drawing desired circuit. It is used for fast processing of code written for microcontrollers. Proteus software is very useful as it is having a huge list of components and many libraries available which can be added to include more components. The header files section part of the program is shown below with explanation using comments for better understanding:

The figure 4. shown below is the prototype of the Military Safety and Surveillance Robot which consists of two sections i.e., the robot section with all the sensor circuitry and the mechanical base of the robot, the next section is the controller unit which is used to remotely control the movement of the robot.



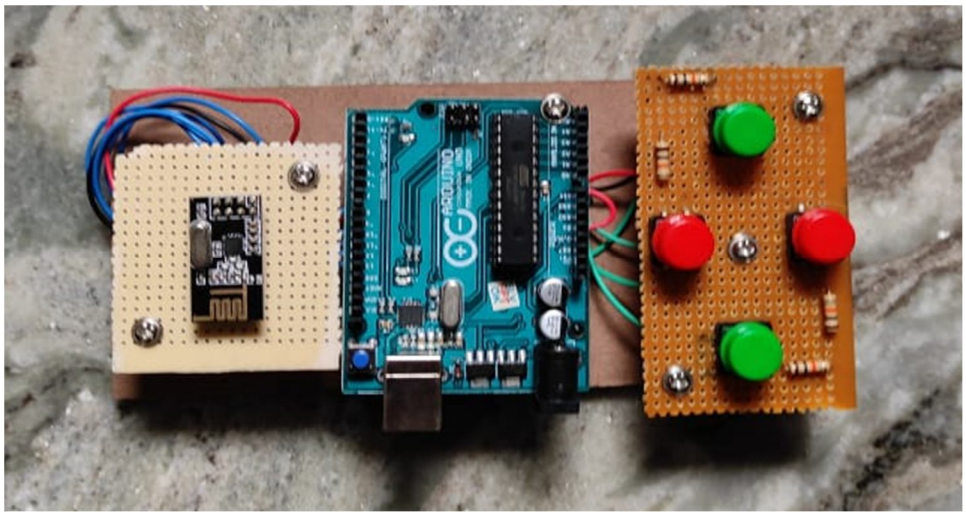


Fig 4: Military Safety and Surveillance Robot prototype

IV. CONCLUSION

The proposed system provides a better vehicle control for easy access to user as well as more advance with two-way communication. This military based circuitry is relatively simple, cheap, and low cost with different sensor integration for information. The Robot is working with wireless control and all sensor able to read information and microcontroller processing data and sending to receiver section using NRF wireless communication. The control of robot direction using wireless radio frequency communication is carried out. The robot is beneficial for the soldiers to assist and to perform their missions.

V.FUTURE SCOPE

This model can be modified to increase the functionality and features of the robot. The solar panel can be used for charging the battery bank. The addition of gas sensors can be used to detect any other harmful gases present in the atmosphere and by making few more adjustments in the proposed model it is possible to perform victim identification and rescue in disaster-affected areas.

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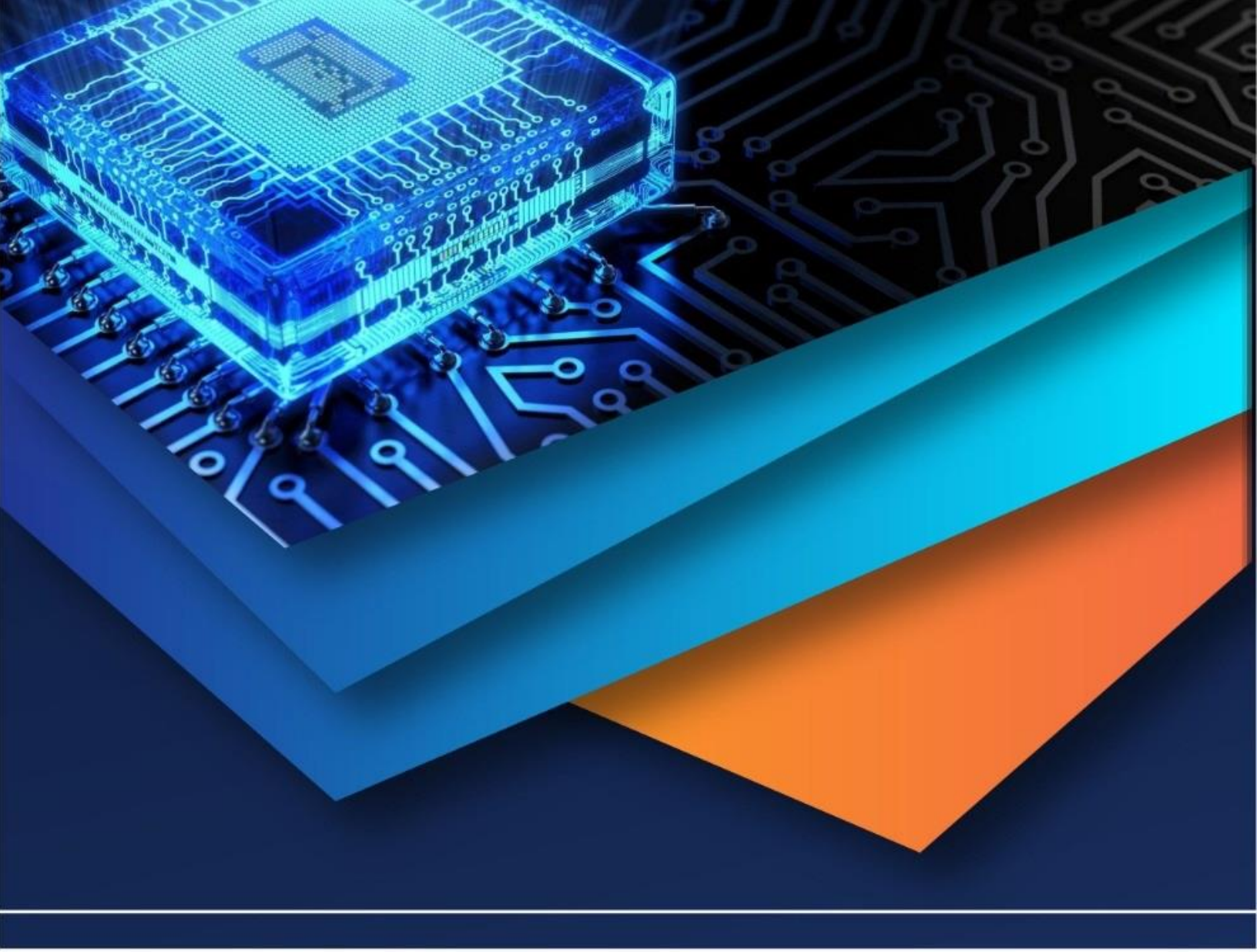

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