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AutoNeuro Warfare Robot Autonomous Path, Metal and fire Detecting System Based on The Concept of Machine Learning

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Abstract: ***A military is a force authorized to use lethal force and weapons to encourage the interests of the state. It typically consists of an Army, Navy, Air Force, and in certain countries the Marines and Coast Guard. The task of the military is for the defense of the state, and the prosecution of war against another state. As with any occupation, since the ancient times, the military has been distinguished from other members of the society by their tools, the military weapons, and military equipment used in combat. As the speed of technological advances accelerated in civilian applications, so too warfare became more industrialized. The impact and advantages of military robot can often be stated as lifesaving. So, this paper focuses on building an autonomous warfare robot using neural networks for its path determination. This robot is trained for the path using image frames. Image frames form the neurons for path determination. The war field has other challenges viz. fire, metals and bombes. Sensor interface to detect metals, fire and water is included in this work for better judgment of the field. Surveillance is the key component for security which has been provided by the camera interface to the microcontroller.***
Index Terms: Autonomous, neural networks, fire, intruder and metal detection.

I. INTRODUCTION

The progress in science and technology is a non-stop process.[1] New things and new technology are being invented. As the technology grows day by day, we can imagine about the future in which thing we may occupy every place. The impact and benefits of military robot use are often lifesaving. The first major advantage and most important of robots is that they are capable of performing duties similar to human duties without the actual danger to human lives. These robots are easily replaceable at a cost, unlike human life. For example, when the U.S. invaded Iraq there was no robotics used during ground invasions. A short time later in 2004, there was 150 [2] robots used on the ground. A year later, 2,400 and by the year of 2008 there were over 12,000 seen on the ground. This shows how effective the use of robots is in the military. Another advantage of robots is that they come in various sizes. Some robots are able to fit into spaces that are not easily accessible to humans. At a basic level, robots are defined as automated machinery with the ability to sense, be stimulated, and imitate cognitive processes. A wide array of such machines has already been created for military programs. Currently, militaries employ robots to conduct duties such as spying for surveillance to inspect high-risk zones and assist the wounded. Meanwhile, the movement in Iraq and Afghanistan of US counterin-surgency that has included robotic systems such as Global Hawk vigilance drones and armed Predator and Reaper drones were widespread. These unmanned systems were successful in driving out improvised explosive devices (IEDs) but faced challenges in terms of surviving in conflict zones and meeting budgetary constraints. However, later on in the wars in Iraq and Afghanistan, the inventory of drones numbered in the tens of thousands, demonstrating the revolution of unmanned robotic systems in military technology. Beyond the United States, over eighty other countries have successfully used military robotics. Russia and China are two that have made adequate progress with automated warfare to alert concern among US Pentagon officials. The Beijing 2015 World Robot Conference show-cased three robots that have parenthetically operated assault capabilities, a technology that the Beijing police department has already started investing in. In this case, small defense contractors have led the way for the development of cutting-edge technology. In addition, Russian Chief of the General Staff Valery Gerasimov announced that the Russian military is preparing to fight on a robotized battlefield in upcoming future. The alarmed response to such developments comes from those who anticipate a world where automated systems are so involved in warfare that they entirely replace human sol-diers. Most acknowledge that robotics represents the inevitable future of warfare. Although these perceptions, there has been abnormally confined progress toward the development of truly autonomous robots that could replace human fighters. So far, fully automated robots have played a very limited role in warfare. The Defense Advanced Research Projects Agency (DARPA), the agency of the US Department of Defense

responsible for developing military technologies, has funded some projects that explore the possibility of robot soldiers. Inadequate artificial intelligence and operational functionality crucial for action in combat roles, the humanoid prototypes are far off from the vision of robotic soldiers that many have in mind. In this sense, the development of robotic systems is undoubtedly challenging the human role in warfare. Despite the currently marginal operation of automatic robotic software in actual combat, there is an undeniable movement towards increased autonomy. Robots in warfare elucidate the tension between the potential benefits and destabilization posed by technological progress.[3]

II. METHODOLOGY

The war field itself includes a terrain which is hard to predict. So the robot built should self-judge the path. So, to determine the path/lane we are using the concept of neural networks in this paper. The algorithm used to implement neural network is back propagation.[4

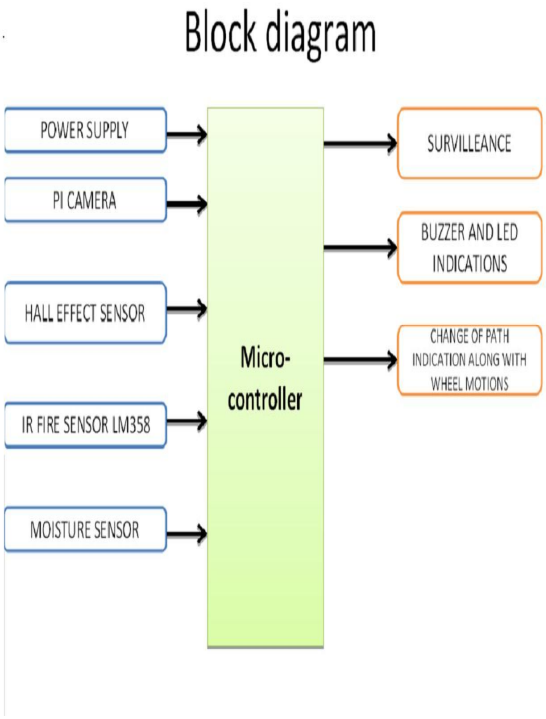

Fig. 1. Block diagram

A. Software Architecture

The software architecture comprises of following components:[5]

1) *Python:* Python is a wonderful and powerful program-ming language with ease to use and with Raspberry Pi lets you connect your robot to the real world. Python syntax is very clean, with an emphasis on readability and uses Standard English Keywords. Start by opening IDE.[7
2) *PyGame:* Pygame is a cross-platform set of Python modules designed for writing video games. It incorporates every computer graphics and sound libraries constructed for usage with the Python programming language. Pygame is built over the Simple Direct Media Layer (SDL) library, with the intention of allowing real-time computer game development without the low-level mechanics of the C programming lan-guage and its derivatives. This is possible to use a high-level programming language which can be abstracted from the game logic, such as Python[8], to structure the game.

B. Hardware Architecture

The hardware components comprises of following compo-nents:

1) *Raspberry Pi Micro-controller:* The Raspberry Pi is a series of small single-board computers developed in the United Kingdom by the Raspberry Pi Foundation to promote the teaching of basic computer science in schools and in developing countries. It has 4 USB ports,40 GPIO pins, Full HDMI port, Ethernet port, Combined 3.5mm audio jack and composite video, Camera interface (CSI), Display interface (DSI), Micro SD card slot and Video Core IV 3D graphics core. It can also run the full range of ARM GNU/Linux distri-butions, including Ubuntu Core, as well as Microsoft Windows 10 because it is embedded with an ARMv7 processor.

Fig 2. Raspberry Pi Model B

2) *Pi-camera:* The Raspberry Pi Camera Board plugs di-rectly into the CSI connector on the Raspberry Pi. Its able to deliver a crystal clear 5MP resolution image or 1080p HD video recording at 30fps. Latest Version 1.3. The Raspberry Pi Foundation in the UK has Produced and Custom designed, the Raspberry Pi Camera Board features a 5MP (25921944 pixels) Omni vision 5647 sensors in a fixed focus module. The module attaches to Raspberry Pi, by way of a 15 Pin Ribbon Cable, to the dedicated 15-pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor.[9]
3) *IR fire sensor lm358:* The Grove - Flame Sensor can be used to detect fire source or other light sources of the wavelength in the range of 760nm - 1100 nm. It is based on the YG1006 sensor which is a high speed and high sensitive NPN silicon phototransistor. Due to its black epoxy, the sensor is sensitive to infrared radiation. In fire fighting robot game, the sensor plays a very important role; it can be used as a robot eyes to find the fire source.
4) *Hall Effect Sensor:* A hall effect sensor is a transducer that varies its output voltage in response to a magnetic field. Hall effect sensors are used for proximity switching, position-ing, speed detection, and current sensing applications A Hall probe contains an indium compound semiconductor crystal such as indium antimonite also has presence of aluminum backing plate done by mounting on it, and encapsulated in

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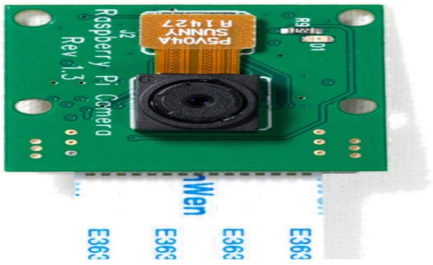

Fig. 3. Picamera

Fig. 4. Fire Sensor

Soil moisture sensors typically refer to sensors that estimate volumetric water content. Another class of sensors measure another property of moisture in soils called water potential. The specifications of the moisture sensor are Power supply: 3.3v or 5v,Output voltage signal: 0 4.2v,Current: 35mA,Pin definition are Analog output(Blue wire) ,GND(Black wire) ,Power(Red wire) Size: 60x20x5mm. Operation range: -40C (-40F) to 85C (185F) , Sensor accuracy: +/-1C typical, -2/+4C max , Sensor quantization level (resolution): 10-bit, about 0.25C (0.45F)

Fig. 5. Hall Effect Sensor

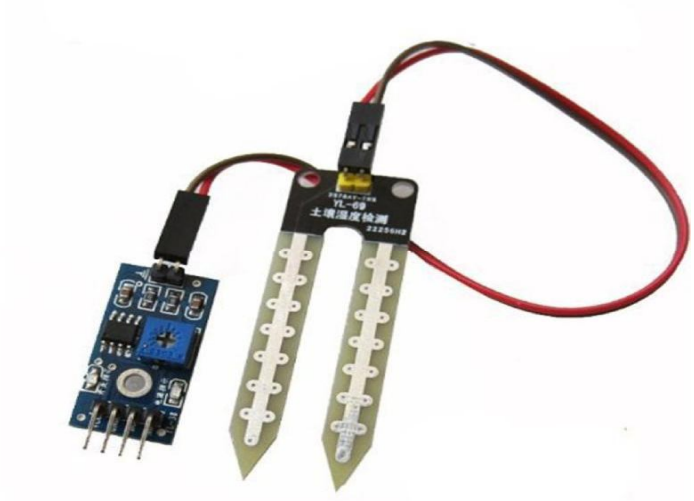

Fig. 6. Moisture Sensor

the probe head. The plane of the crystal is perpendicular to the probe handle. Connecting leads from the crystal are brought down through the handle to the circuit box. It may operate as an electronic switch. Such a switch costs less than a mechanical switch and is much more reliable. It can be operated up to 100 kHz. It does not suffer from contact bounce because a solid state switch with hysteresis is used rather than a mechanical contact. It will not be affected by environmental contaminants since the sensor is in a sealed package. Therefore, it can be used under severe conditions. In the case of linear sensor (for the magnetic field strength measurements). The specifications are 8-30 V dc with 5mA current, frequency required is 0-30 kHz.

5) *Moisture Sensor:* The moisture sensor uses the two probes to pass current through the soil, and then it reads that resistance to get the moisture level. More water makes the soil conduct electricity more easily (less resistance), while dry soil conducts electricity poorly (more resistance).

C. Implementation Procedure

Implementation of a robotic module to assist military per-sonnel during wartime by providing remote surveillance, Fire detection, remote detection of water spots and metal detection. Input supplied is: Power supply, Pi camera, Hall Effect sensor, IR fire sensor and moisture sensor. Outputs obtained are: Change in path indications along wheel motions, surveillance and buzzer and LED indications.[10]

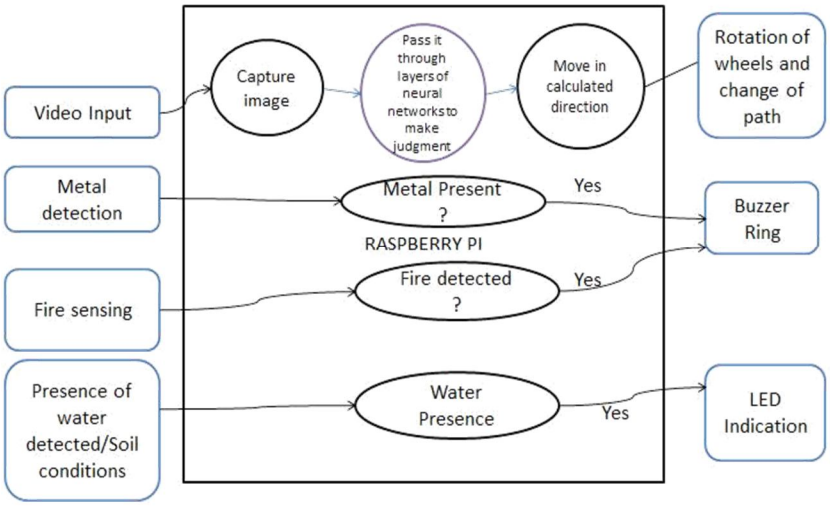

Fig. 7. Conceptual Block Diagram

For automatic detection of path we had used neural net-works. To train the neurons the robot uses the algorithm of Back propagation.

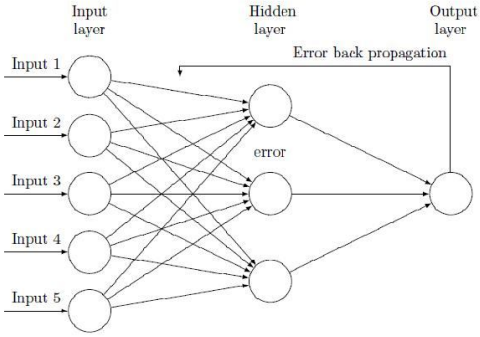

Fig. 8. Back Propogation

Back propagation algorithm is to optimize the weights so that the neural network can learn how to correctly map arbitrary inputs to outputs. The steps of the neural network are:

1) *Initialize network:* Each neuron has a set of weights that need to be maintained. One weight for each input connection and an additional weight for the bias
2) *Forward propagate:* It is the technique we will need to generate predictions during training that will need to be corrected, and it is the method we will need after the network is trained to make predictions on new data.
3) *Back propagate Error:* Error is calculated between the expected outputs and the outputs forward propagated from the network. These errors are then propagated backward through the net-work from the output layer to the hidden layer, assigning blame for the error and updating weights as they go
4) *Train network:* This involves multiple iterations of exposing a training dataset to the network and for each row of data forward propagating the inputs, back propagating the error and updating the network weights.
5) *Predict*: Making predictions with a trained neural network.

III. DISCUSSION OF RESULTS

The robotic module is deployed on hardware. It is mounted with picamera at the front so to capture the images and train the model. The sensor are fit at appropriate location because the proper signal need to be accessed by them. Based on the trainings the robot

judges its path. The neural network concept trains the neurons and helps it to judge its lane. The sensor inputs help in movement of wheels. The flame presence is detected by the change of wavelength. whenever fire is detected the buzzer buzzes to indicate it. The ferrous substance are detected by hall efect by its magnetic field changes. by alarm buzz metal presence is identified. the water puddles are a major hurdle for the robot to move. So as to make the lane free from water or moisture content, the moisture sensor detects water presence and guides the wheels for the change of path. So, in total a complete path adherence can be achieved.

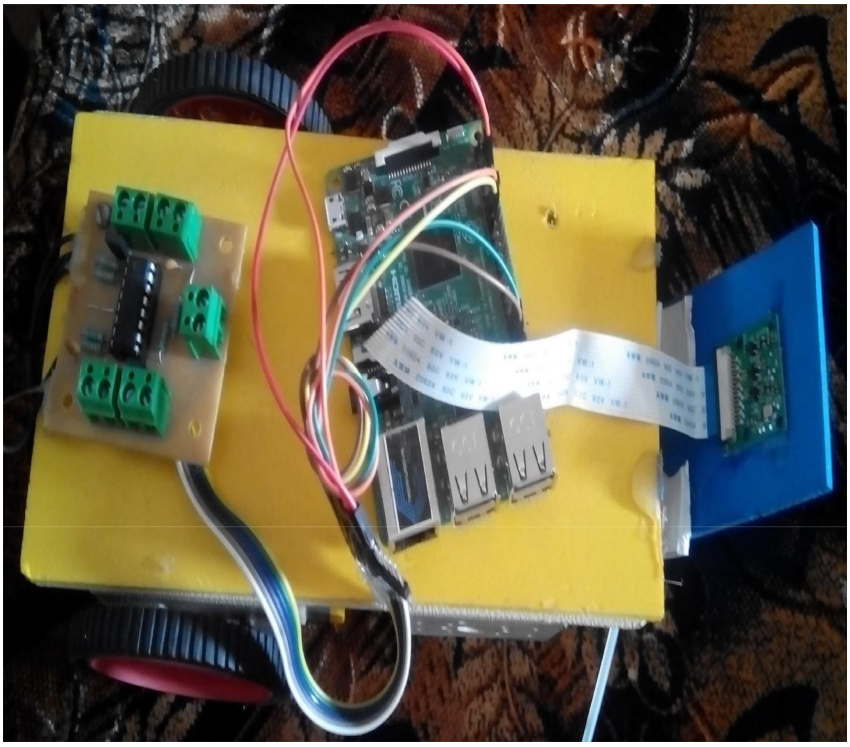

Fig. 9. Robotic Module

Existing product 1	Existing product 2	Proposed model
• Combat drones are remote-controlled by human pilots. • They can fly autonomously, but do not fire autonomously, but rather by a trained human operator.	• A sentry gun is a gun that is automatically aimed and fired at targets that are detected by sensors. • This helps for detecting and destroying short range incoming missiles and enemy aircraft first, used on naval assets, and land-based defenses	• An autonomous warfare robot is trained to monitor the area on itself automatically. The robot moves with direction sense of its own on land. • The sensor fusion helps it to detect fire and act as a fire alert system. Along with fire, it helps to detect ferrous substances.

Fig. 10. Table of comparison with existing product

The paper focus on making automated advancement in the field of military surveillance. It uses the robot which is trained to survive in the battle field to monitor the area on itself automatically. The robot moves with direction sense of its own. For making it completely autonomous the algorithm of back propagation is successfully implemented. The sensor

fusion helps to detect fire and act as a fire alert system. The feature to detect metal helps to detect ferrous substances, therefore acts like a metal detector. Thus the above mentioned comparison table fulfills the goal of providing effective warfare surveillance and protection.

IV. SUMMARY AND CONCLUSIONS

A military field is an open ground of challenges. But tech-no logical advancements are stretched far and wide, including the Warfield. The system is a collaboration of features of autonomous path detection, metal detection, fire detection and security surveillance. The proposed work focuses on fusion of different sensor that functions towards the robot movement and actuation. Different challenges of fire, ferrous substances and intruder detection mechanism are successfully achieved by this work. Thus the proposed System fulfills goal of providing effective warfare surveillance and protection.

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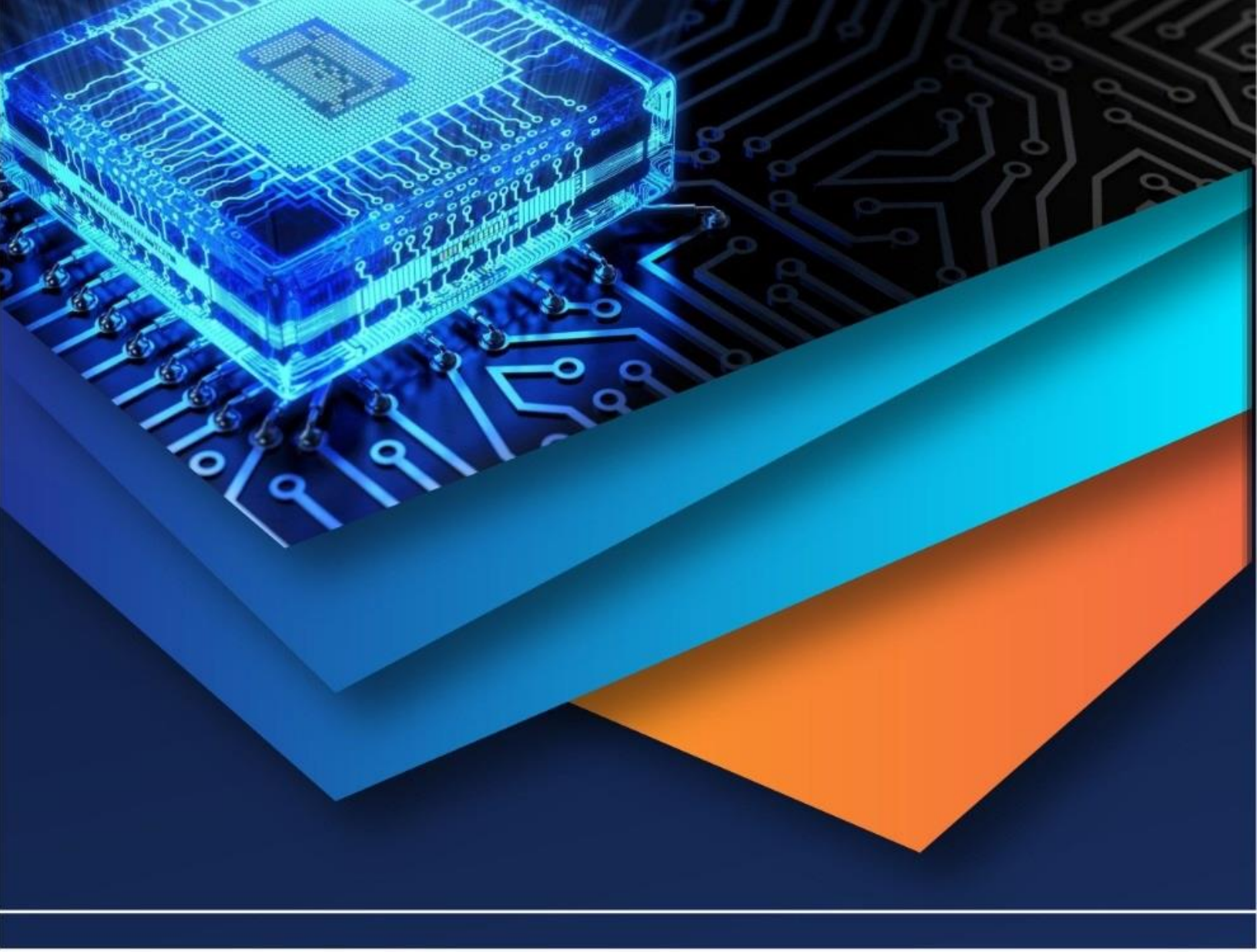

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