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Artificial Intelligence System for Effective Detection of Animal Intervention in Croplands

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Abstract: ***Animal intervention is significant intimidation to the potency of the crops, which influences food security and decreases the value to the farmers. This suggested model displays the growth of the Internet of Things and Machine learning technique-based resolutions to surmount this obstacle. Raspberry Pi commands the machine algorithm, which is interfaced with the ESP8266 Wireless Fidelity module, Pi-Camera, Speaker/Buzzer, and LED. Machine learning algorithms similar to Region-based Convolutional Neural Network and Single Shot Detection technology represents an essential function to identify the target in the pictures and classify the creatures. The experimentation exhibits that the Single Shot Detection algorithm exceeds than Region-based Convolutional Neural Network algorithm. Ultimately, the Twilio API interfaced software decimates the data to the farmers to take conclusive work in their farm territory.***

Keywords: Region-Based Convolutional Neural Network (R-CNN), Tensor Flow, Raspberry Pi, Internet of Things (IoT), Single Shot Detector (SSD)

I. INTRODUCTION

Farming is the nerve of the Indian economy, where an additional than 60% of the nation's community is directly or indirectly banks on this realm. Where they want to nourish this enormous boosting community year by year with the decreasing territory developing quantity. In near prospect, it is anticipated to have around 20% of nutrition products to get boosted within 5 years [1]. Even though an enormous quantity of the community is dangling on this category, they are however in uncertain to oversee their life in this sector. The justification for this may be inter and intra plantation field variability's such as due climate, seed selection, fertilization intakes, irrigation, etc [1].

Currently, one more crucial characteristic causing product casualty is an animal intrusion into the plantation field. The confrontation between the animal and planters is evolving widespread all over the province. That too in hill depot area and adjacent to the wilderness area have important issues and the planters undergo an enormous loss. To date, they use some conventional and recent techniques to withstand this issue like Shot Gun, the practice of electrified fastening mesh fence etc, but not up to the odds of protecting their harvests.

Also, few endeavours were strived to unravel this confrontation by using technology such as IoT and Machine learning, which is called AIoT i.e. Artificial Intelligence for the Infrastructure of Internet of Things. Our proposed criterion utilizes IoT and Machine learning theories founded a remedy to it.

IoT (Internet of Things) measures the Things that are related to it and carries the data across the network. The IoT technology allows the accumulation of real-time data from the field using Sensors and various electronic components [2]. In this work, we present the coordination of Pi Camera, LED, and Buzzer communicating with the cloud a new service in the domain. The external part adopted wireless technologies such as WiFi for collaborating with the data centre by a superior IoT gateway. Pi-Camera is used to capture real-time pictures in a land field 24×7 i.e., day and night. The cheap cost and ease of programming controller Raspberry Pi for coordination of tool-hardware parts and data assigned through ESP8266 WiFi module, which employs TCP/IP protocol [3].

Machine learning is a part of artificial intelligence applied for data interpretation to automate the scientific design building, which recognises the pattern and things to make a choice [4].

In the aforementioned work, a deep machine learning algorithm for object detection and classification model is equipped and examined. Twilio communication is the API interface software that is handled to communicate throughout globally by building its own/private system [5]. It is done to deliver the definitive information to the framers, which has control through the Raspberry Pi controller.

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II. RELATED WORKS

S. Giordano et al., [6] served and developed an IoT application for the security of products from animal intrusion in the harvest field. To receive or monitor the harvest patch, authors used wireless technologies such as 6LoWPAN, WiFi, and ZigBee with the venerable IoT gateway. An ultrasound repeller tool was produced to operate even in improper and complete darkness practising the solar panel along with LiPo batteries. To increase the effectiveness of this method used PIR (Passive Infrared) sensor, which needs the care of the frequency device and networking operation by sending a little size frame at a range of 50m. This communication occurs using the RIOT-OS software, when the creature is identified it delivers a sound of 120dB.

Mukesh Mahajan et al., [7] operated on preserving the product in the farm arena from creatures such as buffaloes, bulls, goats, and birds practising a PIC microcontroller. The generated representation uses the motion sensor to recognise the mammals that are near to the crop field and the sensor flags the microcontroller to take proper steps by farmers. The PIR-based motion sensor is employed to identify the animals and the alarm is used to inform the farmers based on the microcontroller direction. Here scholars insist that this design bypasses the farmers tarrying for 24 hours in the land field.

III. PROPOSED METHODOLOGY

The product security from wild animals intervention is performed utilising the advanced model using IoT and Artificial Intelligence technologies as presented in Figure 1.

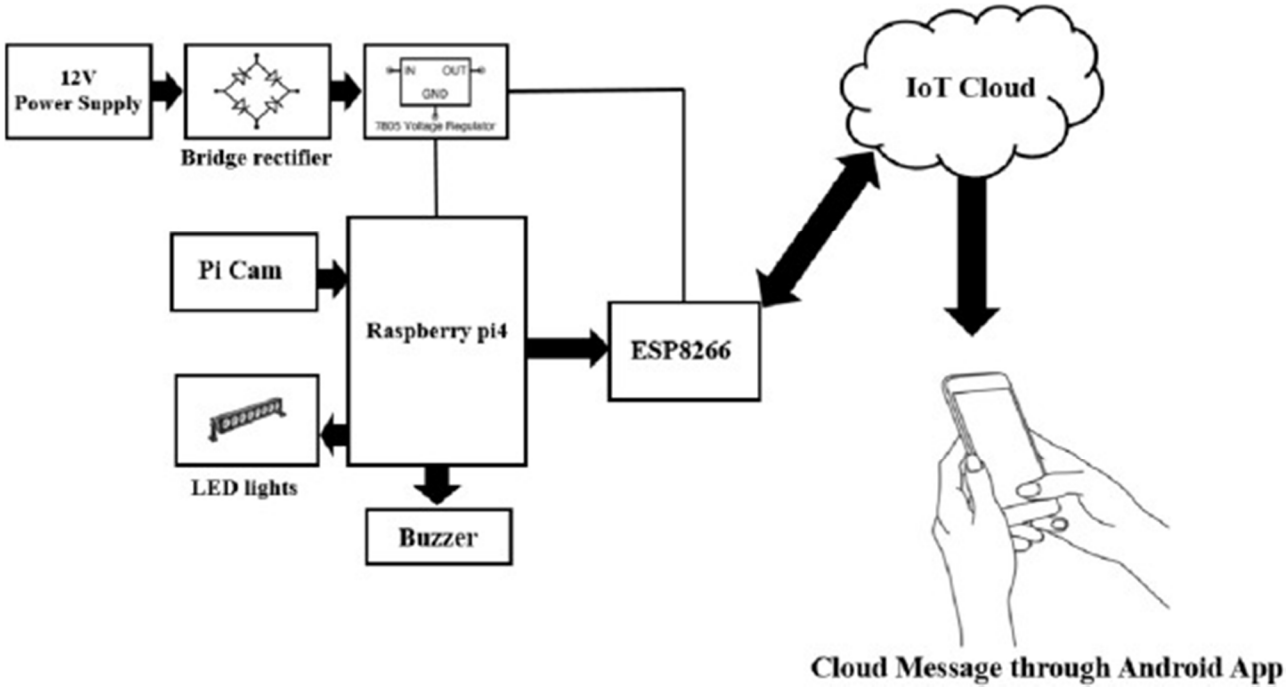

Fig 1: Block Diagram

The alternating current of 12V is changed over into a direct current of 5V through a bridge rectifier circuit and 7805 voltage regulator to work Raspberry pi. ESP8266 is interfaced with a Raspberry pi board to give firebase cloud availability to the framework. Raspberry pi4 is utilized to run an AI calculation. Pi cam is utilized to catch the interloper pictures entering the rural field. The pictures are then dissected by the AI calculation running on the Raspberry pi board and ends are drawn as a yield of the AI calculation. In the event that any peril is detected the Raspberry pi creates hints of various frequencies with the assistance of a ringer and an info signal is shipped off ESP8266 node MCU which is in correspondence with the firebase IoT cloud which sends messages to the rancher through the android application. On the off chance that the gatecrasher is recognized around evening time, the LED lights and signal are set off all the while to redirect the interloper from the field. The proposed model comprises of two sections as Hardware and Software. Raspberry pi behaves like a heart for the equipment part and it is interfaced with parts like a voltage regulator, Pi Camera, LED lights, WiFi, and Buzzer. The product part for the equipment is done through embedded C and for PC vision expectation utilized AI models like R-CNN and SSD for object location and predicts the creatures.

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IV. HARDWARE USED

The equipment section examines the associated factors in the selection of the components for ranch field standard monitoring to edit protection.

A. *Processor*

Raspberry Pi 4 controller unit is coordinated with Broadcom BCM2711 and Quad-core Cortex-72 processor which works for 64-bit SoC (System-on-Chip). This controller works for a voltage of 5V and discusses effectively with other connectivity like ESP8266, Pi camera, and so forth It gives a bunch of universally useful information/yield pins to have control over electronic components for actual figuring for IoT innovation, additionally the writing computer programs is simple and the expense is low.

B. *Pi Camera*

Pi Camera V2 module is 8-megapixel specially crafted board that is equipped with an adaptable ribbon link, making it viable with Raspberry Pi. The camera module takes pictures in two versions for example Standard version and the NoIR version. The Standard version; is intended to catch pictures in typical light and the NoIR version; is intended to catch pictures in dim light utilizing the infrared light source.

C. *WiFi Module*

ESP8266 WiFi module permits the Raspberry Pi controller to connect with WiFi network utilizing TCP/IP (Transmission Control Protocol/Internet Protocol) connection. It works for a recurrence of 2.4GHz utilizing the sequential communication UART to send and get information. Two broadly useful pins, for example, GPIO0 and GPIO2 are utilized to choose to communicate/get for sequential info/yield purposes, which are connected to ground and VCC.

D. *Force*

A 12V Lead-acid battery is utilized for the force supply of electronic components connected in the equipment part, which consists of 6 cells connected in series each delivering 2.1V. The lead-acid battery can't produce the actual force, where it stores power got from another hotspot for this it is known as a capacity battery. For instance here the 12V battery can supply a current of 10mA for a duration of 12.5 hours, in any case if consumption of current diminished means duration can be expanded.

V. SYSTEM MODEL

A. *R-CNN*

R-CNN approach here utilized for the object detection utilizes deep models as displayed in Figure 2. The R-CNN is composed of four principle parts such as selective search, pre-trained CNN, category prediction, and bounding box prediction. For the info pictures, selective search is applied to select numerous excellent proposed regions, which are in various scales and different sizes and shapes. In the middle of the selective search and yield, pre trained CNN is placed. Pretrained CNN works on forwarding computation to extract the features for yield, which gather input as required by the network through the proposed region. For object classification, various Support Vector Machines were trained utilizing each proposed region of the two features and labeled category. Then, at that point for the ground truth bounding box prediction linear regression model is trained utilizing each proposed region of the two features and labeled bounding box hardware part and it is interfaced with components like a voltage regulator, Pi Camera, LED lights, WiFi, and Buzzer. The software part for the hardware is done through embedded C and for computer vision prediction utilized machine learning models like R-CNN and SSD for object detection and predicts the creatures.

B. *SSD Model*

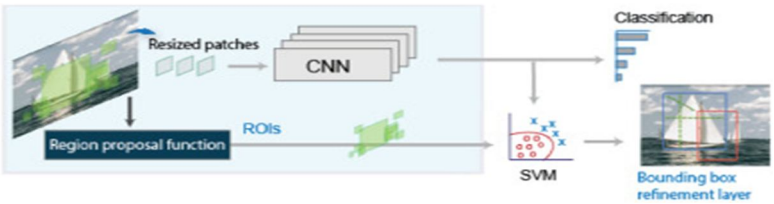

Figure 2. Object detection using R-CNN detector architecture

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Single Shot Multibox Detection (SSD) model consists series of components like a base network block and several multiscale feature blocks a displayed in Figure 3. In original pictures, features are extracted utilizing the base network block dependent on the deep Convolutional neural network. Here to detect the little objects in the original pictures more anchor boxes are generated utilizing the feature map. Several multiscale feature blocks are utilized to reduce the size. The multiscale feature blocks detect objects of different sizes dependent on the predicted bounding boxes and anchor boxes.

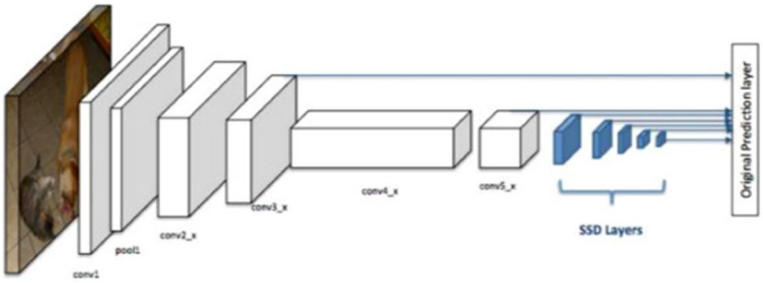

Figure 3. Object detection using SSD detector architecture

C. Tensor Flow

Tensor Flow library is an open-source library created by Google, which is utilized to assemble a mathematical calculation for the profound machine learning model. It offers different degrees of deliberation to construct and prepare models utilizing API (Application Program Interface). While preparing the huge machine learning undertakings, it utilized the circulated procedure to prepare the model on various preparing on the distinctive equipment arrangements. This execution takes into consideration prompt emphasis and debugging, which makes it more adaptable.

D. Twilio

Twilio is utilized for correspondence capacities utilizing its web API like settle on and get telephone decisions and instant messages worldwide. Here the Twilio is associated with electronic parts, which are called Cellular IoT availability.

VI. METHODOLOGY

The Power supply of 12V is utilized here, which rectifies it to 5V utilizing the bridge rectifier i.e., changing over from alternating current into direct current utilizing the LM7805IC. Raspberry pi controller fills in as a heart for the proposed equipment part with the interconnected electronic parts fueled by a battery of 12V. The controller and other associated parts in the equipment part work for a voltage of 5V, so here regulator is utilized for stepping down the voltage. To screen the field routinely, the Pi camera module is associated with the controller, which communicates with Pi utilizing the MIPI camera serial interface protocol. The Pi camera is controlled utilizing the Python code and the see transparent by setting an alpha level to 200. Pictures were caught at regular intervals, where postpone time gives the camera sensor to detect the light levels around the field. The Raspberry Pi communicates with the ESP8266 module through predefined AT commands, UART, and indicated Baud rate. Indeed, even the computerized reasoning put together machine learning calculation works with respect to the Raspberry Pi. Pictures caught are investigated utilizing deep machine learning procedure as displayed in Figure 4.

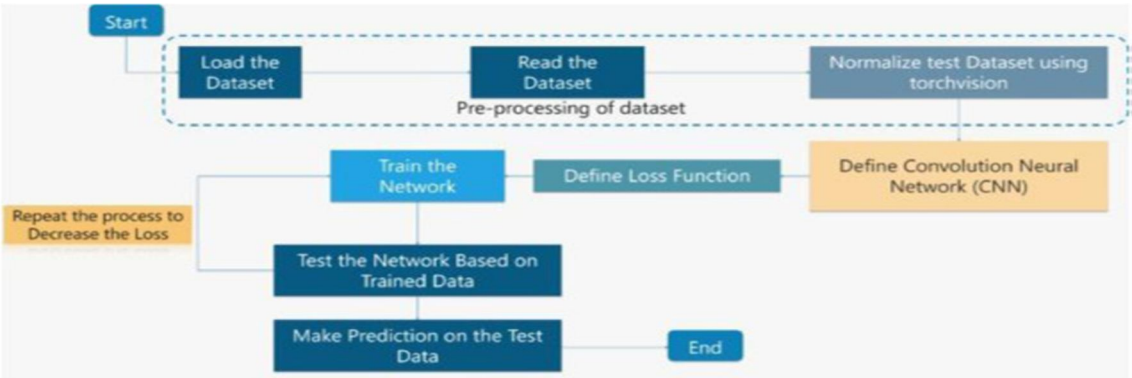

Figure 4. Training and testing process flow in machine learning algorithm

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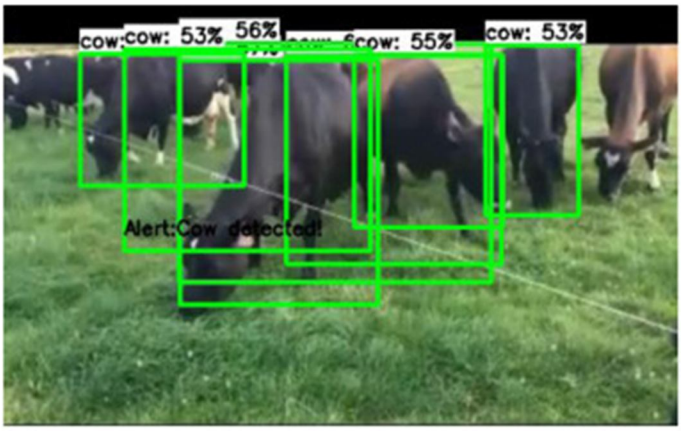
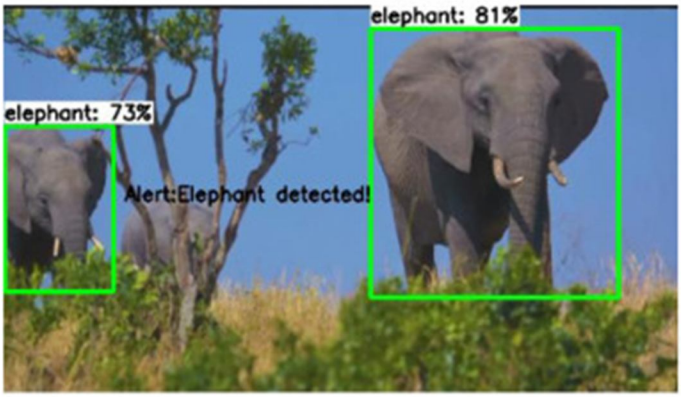
VII. RESULTS

We directed experimentation by shifting preparing datasets for the recognition of creatures and classification purposes. R-CNN algorithm generates locales utilizing particular inquiry and concentrates around 2000 areas in each picture. Computation time will be a lot higher in light of its cycle in making an expectation, which is around 40-50 seconds. SSD algorithm deals with spine model and SSD head contains pre-prepared picture classification network as a featured organization. Here we have utilized 4×4 lattices for distinguishing the articles in the locale of the picture. Table 2 shows the forecast for the algorithm, SSD outstands in anticipating and characterizing the creatures contrasted with R-CNN, and furthermore, computation time will be extremely less.



(a)



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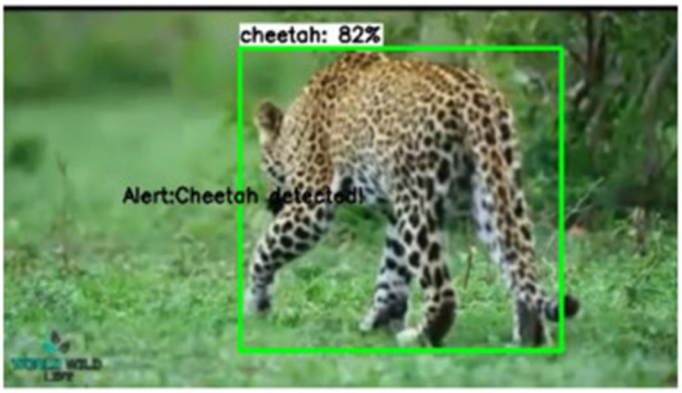

(c)

Figure 5. Training and testing process flow in machine learning algorithm

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VIII. CONCLUSION

Crop insurance from animal interruption is significant for the fruitful cultivation of the harvests and this should be possible with the IoT and Machine learning innovation. This paper talks about different methods like Raspberry Pi processor, WiFi module, R-CNN, SSD, and Twilio. SSD algorithm execution is better contrasted with the R-CNN algorithm with computation time, precision and effectiveness. In future work, an App-based model can be created to make it greater portability and easy to use.

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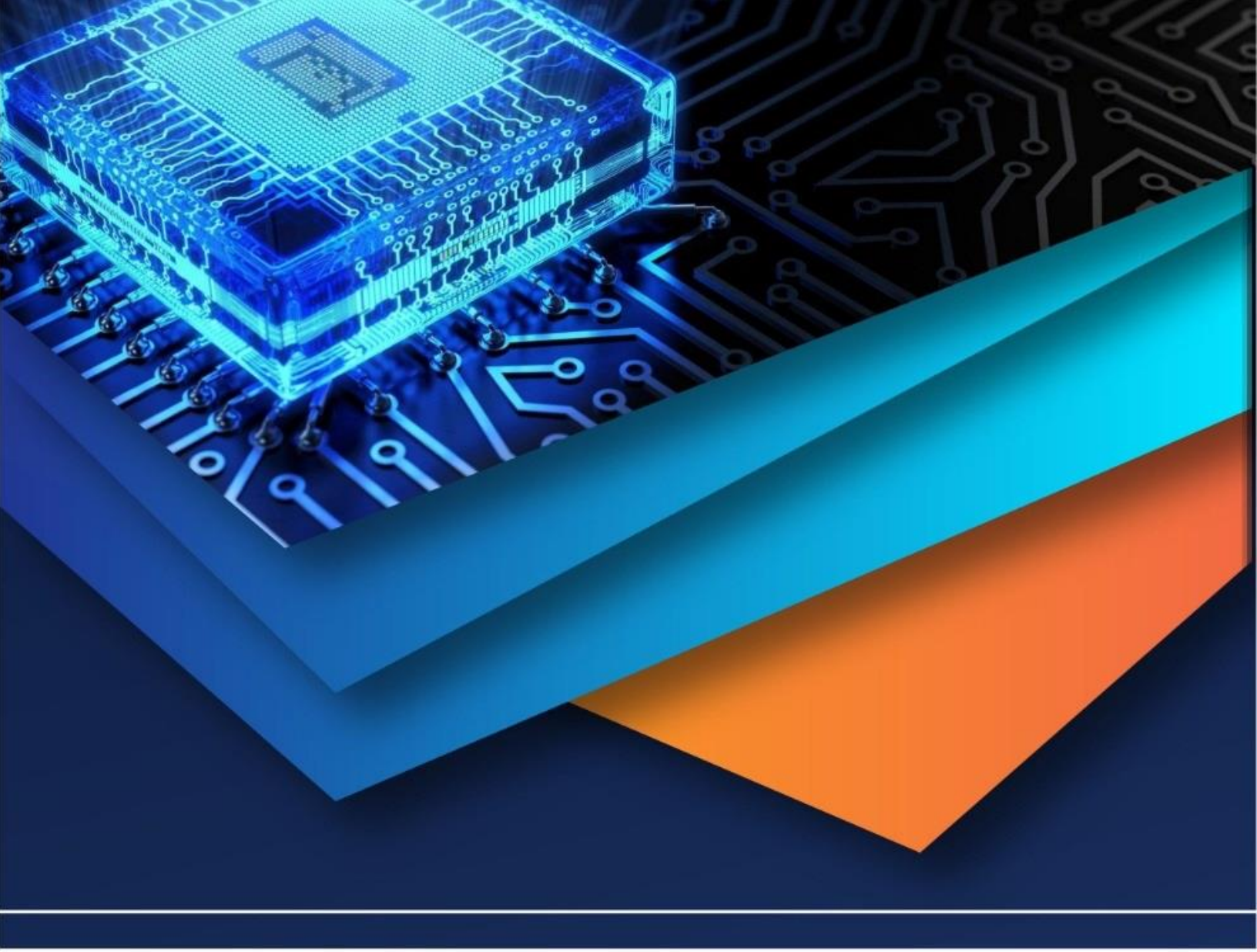

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