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A Review on Quality Scanner Device for Radish and Carrot using Image Processing Technique

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Abstract: ***Agriculture is the backbone of the Indian economy and productivity. The market value obtained from them is immense and effect both the export and quality valuation . Although grading and quality can be analysed by humans it is still inaccurate, time intensive, unreliable, subjective, and also hard which can be easily influenced by surrounding. Hence, there is an ultimate need for intelligent classification for vegetables. This paper focuses on Developing an analysis device for Radish (Raphanus raphanistrum) and Carrot (Daucus carota subsp. sativus) which is an edible root vegetable grown in most parts of India. Radish and carrots are good sources of natural nitrates, minerals, calcium, and potassium. Thus, vegetables must be used as soon as possible to get a superior fresh character from them. External parameters such as size, shape, and quality factors of radish are important for finding out the total quality that is acceptable to the people. Various methods and algorithms are been put forwarded for the quality evaluation for the external defects present in it. Convolutional Neural Networks is the method used in image processing as this is more advantageous since it can learn special characteristics from images and by establish CNN for image classification where analyst have to gather the dataset. The requirement for doing this project is to have a computer and a python program for use the driver code. Image processing method is used for estimating quality of the particular food product efficiently in these days. This review paper examines current developments in methods for assessing food quality through image processing. The use of CNN (Convolutional Neural Networks) to identify characteristics of vegetables and its diseases through several built-in python libraries.***

Keywords: Quality Analysis, Image Processing, Grading, Non-Destructive, Agriculture.

I. INTRODUCTION

An approximate figure given by food and agricultural ministry states that roughly 40 percent of foods which are cultivated in India are fittrad away yearly due to disrupted food and ineffective supply chains management system. Around 1% of GDP is depleted in form of food waste which is given by Ministry of Agriculture [3]. Lack of untrained manpower and lack of acceptance of automation is the main reason for this back fall. Furthermore, inferior quality and misused supply chain transport is also one of the reasons. Conventional quality evaluation involves both the chemical and microbial evaluation [15]. The chemical evaluation implies finding the chemical constitution of food product which exist in it as natural or which is substitute to foods for increasing their nutritional composition. The goal of the microbiological study is to identify microorganisms that may be harmful to humans which is present in food products. It is frequently used as a key quality control technique [16]. The sensory evaluation is the most commonly used quality analysing method. The quality factors of food product are analysed which require testing of the food product manually by a specialist. it is a difficult task, when there is a bulk amount of food products to be analysed at a time. Low level of precision and repeatability of food evaluation are caused by a variety of variables, including the attitudes and perceptions of the experts [17]. Vegetables will continue to respire after harvest, so they will look fresh for a little while. Vegetable will eventually lose their freshness as the days go by. In addition to this, inadequate facilities for storage and delivery result in vegetable spoilage . Additionally, there is a potential that the secretions from one rotten fruit and vegetable could spread to the nearby fruits and vegetable and destroy the entire batch. Currently, computer vision has a wide range of uses in industries including food and agricultural, automotive, education, healthcare, etc. Applications for computer vision in agriculture [5].

II. LITERATURE REVIEW

Nowadays the fruit and vegetable industry has sustained due to the introduction of image processing methods and such methods has been successful in the non-destructive assessment of various food products.

Han S. EL-Mesery [9] states that there is an increasing concern on quality and safety of food in worldwide business. Non- invasive methods or non-destructive methods creates an esteemed value , especially in fruit and vegetable industries.

Non-destructive procedures are a component of high-quality controls and they complement the majority of existing approaches. In addition, consumers have a tendency to want more information about the items they buy nowadays as a result of their enhanced awareness.

The popularity of microprocessors, signal analysis techniques, and sensors has permitted new businesses to use these approaches. It took a lot of work to establish this strategy because there is a profitable demand in finding food and Agri product which are more uniform in grade and customer favourites [2].

Fruits and vegetables are evaluated for quality using both destructive and non-destructive methods. Destructive method of analysis determines how a procedure react under pressure till it fails. It's not suitable in fruit and vegetable industry, as it ruptures the fruit and vegetable tissue and is difficult to evaluate the whole lot at a time. Destructive testing is more expensive and generate waste. This testing is less efficient because Destructive testing is direct approach and does not provide accurate result.

If the testing is done by destructive method in large food manufacturing industry in order to analyse the hidden characteristics of the product, an analyst must destroy the various aspects of the product. Destructive method of analysis provides reliable result due to its manual process and material degradation procedure cost the manufacturer. Non-destructive analysis is similar to destructive analysis but it will not permanently damage any produce. This is based on physiological property which connects with certain quality factor of fruits and vegetables. Both internal and exterior characteristics of vegetables are very much important and internal attributes plays a major role in consumer selection of a particular food product.

Non-destructive analysis is non-invasive, rapid and suitable for instantaneous analysis so this non-invasive analysis is emerging as highly efficient means of analysing the quality of the material [6]. In today's post-harvest and processing of agricultural products, assessing the quantity and quality of agricultural products without causing any harm and reducing food waste has a significant place. For fresh fruit and vegetables, non-destructive procedures with a focus on quality value have become increasingly important and prevalent in recent years [9].

NDM was established with the goal of concentrating on developing the best systems required to assess the quality of food and agricultural products, which have improved the standards needed to categorise the grade of food quality in a particular product that can be sold according to the grade in the market. The aim of non-destructive evaluation approaches is "on the structure, mechanical, physical, and chemical properties of food". The best method for food processing processes is the use of non-invasive measurement [20]. Common non-invasive (non- destructive) evaluation techniques that include "machine vision, near-infrared spectroscopy, hyperspectral imaging, electronic noses, ultrasonic measurement, and acoustic emission tests". According to scientists, food primarily consists of water, carbs, fats, and proteins. The methods of processing frequently change as the chemical structure of the agricultural product changes [8].

"Colour, size, form, texture, and quantity of flaws" are the three primary components of a fresh inspection. Carrot and radish defects or damage typically result from rotting, bruising, scabs, fungal development, injury, disease, etc. After these vegetables are harvested, proper care should be given [22].

A. Radish (Raphanus statives')

The Radish, Raphanus sativus L., comes from Central and Western China and India and is a member of the Brassicaceae or Cruciferae family [23]. It is both diuretic and revitalising. Radish is used to treat persistent diarrhoea, insomnia, and neurological headache. Radish is also beneficial for bladder and piles problems. For the purpose of making culinary and lighting products as well as for the industrial extraction high amount of protein from radish leaves, radish seeds may be a good source of non-drying fatty oil [25].

Because of its specialised structure (hypocotyls), which can store starch and other substances, its similar resemblance to actual roots, and its home in the ground, the radish is classified as a root [19]. While the majority of European and Asian crops have white flesh, the surface colour of radish can range from white in Asia to red in Europe, to purple green, and even black [18]. A plenty of indigenous recipes are made out of radish which gives great health benefits. They taste best when eaten fresh, can be prepared in salads and sandwiches in slices, or can be consumed whole and dipped in houmous as a nutritious snack [12]. They are frequently used in cooking to give meals the greatest peppery as well as for pungent flavour. Mooli Subzi, Radish Dry Vegetable. White Radish is used in South Indian "Radish Sambhar, Mooli ka Salad, Radish, Cucumber, and Curd Dip, Indian Theplas, Parathas, Mooli Thepla, Radish Nachni Roti, Mullangi Sambar, and Bhatia Kadhi". Radish comes in a wide range of varieties such as black radish, daikon radish, horse radish, and watermelon radish. Radishes can be prepared in different ways, including pickling, roasting, and can be used in sandwiches also. Radish have a very large amount of nutritional value and it provide wide range of elements that can have a significant impact on human health.

B. Radish Diseases

Radish *(Raphanus sativus L.*) have a significant issue with storage decay, which makes it difficult to keep this produce fresh and increase its postharvest shelf life at both low and high temperatures. Radishes are susceptible to postharvest and storage degradation caused by a number of fungi, however Alternaria and Fusarium species are the most frequent infections when the vegetable is individually wrapped in food packaging film for storage. High moisture content and low temperatures can control the softening and weight loss, which are mostly caused by the loss of water. Bruises are caused by collisions during post harvesting and transportation; when produce is harvested by hand, the chance of this damage is typically lower. Additionally, spongy look is a change that might happen during harvesting and persist during post-harvesting. Chilling damage and cavities are the physiological changes that happen most often. Temperatures of -0.7℃ cause freezing. In severe conditions, the roots gets weak, dry out, and become brittle. The cavities, which might appear before or after the harvesting and become more frequent during storage, are signs of senescence. Low temperatures lessen its occurrence.

Radishes are susceptible to parasite infections after harvest. The two most prevalent illnesses are bacterial black spot and powdery mildew, which are both brought on by the fungus Peronospora (caused by *Xanthomonas vesicatoria*)

C. Carrot (Daucus carota)

In the Apiaceae family of herbaceous plants, the carrot (*Daucus carota*) is an edible taproot. It is often a biennial plant. Common forms of roots come in a variety of morphologies, from spherical to lengthy, with blunt to pointy bottom ends. White, yellow, and purple flesh variants are also known in addition to those with orange-coloured roots. It is a cool climate crop which is grown in subtropic as well as temperate climate zone. Carrot is mostly used as an edible produce for millions of people all over the world. Carrot are good source of calcium, potassium, mineral and natural nitrates. Carrots are also good source of carotenoids, vitamins, dietary fibres and antioxidants. Carrots are very much popular for its abundant nutrient. Quality analysis of carrot based on the product quality is most basic and important operation. In tradition method quality evaluation of carrot is done manually and its expensive and is time consuming with low performance. Carrot is mostly used in salads and halwa, sambar. Vegetable biriyani , roasted carrot, carrot curry, glazed carrot, carrot smash, carrot juice, carrot supe and carrot poriyal.

Now a days, fruits and vegetables industry has sustained due to the introduction of image processing method and such method had been successful in non-destructive assessment of variety of the particular food item. Fruits and vegetables are graded according to their quality Deep learning is established by complete convolutional network, deep learning in food safety and quality assessment, deep learning in food process monitoring and packaging, deep learning in foreign object detecting etc. after harvest. So, in order to gain the best fresh quality, carrot must be utilised as soon as possible. To increase the effectiveness of grading and sorting as well as for automatic detection [10].

D. Carrot Diseases

During the cultivation of carrot large variety of diseases are been detected which results in the reduction of yield and market value. The majority of carrot diseases are brought on by organisms like mycoplasma, which cause “stunting, yellowing, bronzing of the leaves, sterility, and yellowing of the leaves that look like aster petals, common scab, dark root rot, cavity spot, rubbery brown rot, heat canker”[13]. Carrots are damaged by various microorganism. Due to nature of the carrot, the spoilage is brought about by different microbes and microorganisms which is a significant element that restricts the carrot production. To provide best quality of carrot to the market, fruits and vegetable industry update the innovations like image processing of carrot.

E. Need For Intelligent Quality analysing system

Automation in food processing without a concern significantly increases efficiency, quality and productive development of the country using computer vision, image processing is utilized to automatically detect and identify plant disease such as colour, texture and shape. Food quality can be further developed by quality examination using computer vision [11].

F. Convolutional Neural Network

Image recognition has lately used deep learning. The term "deep learning" refers to algorithms that tackle complicated problems using a deep architecture. The most distinctive aspect is that training allows superior visual features for recognition to spontaneously separate. The convolutional neural network and one technique that fully satisfies the requirements of the deep learning methodology is CNN.

CNN is made up of a number of layers, including convolutional, nonlinear, pooling (down-sampling), completely connected, and the final result. For picture identification tasks like the Large-Scale Visual Recognition Challenge, CNN is currently the best method available [1].

Numerous important developments in imaging technology have been sparked by the rapid growth of both hardware and software frameworks. Researchers have developed a number of non-contact techniques recently for the evaluation or inspection of food and beverage goods, mostly addressing the drawbacks of conventional procedures like human inspection. [24]. This made a shallow interest towards change to computerized image handling by which machines are prepared to classify predefined dataset of food classes within a particular food dataset.

G. Computer Vision

Machine vision is an engineering technology which consolidates mechanics, optical instrumentation, electromagnetic detecting, digital video and image processing technology. The recent progression of computer technology, machine vision system has been applied in different industrial applications principally the food handling industry. The capability of computer vision is to mimic the video and graphic information which is typically caught by human eyes and to screen and handle existing data image information, which can work with technician to rapidly capture sensitive indicators during the process of data entry, data incorporation, data analysis and labelling [4]. Many researchers conducted studies on utilization of deep learning in food handling, quality assessment. The recognition steps of conventional deep learning are to gather huge number of datasets and there after this information are used to train a network model, and next the training model is used for detection and recognition of food images.

At the ongoing stage, the quality has been evaluated generally by hand, analysing the products individually or testing huge batches which is actually tedious and conflicting. The assessment is performed by a labour force trained to detect defects, colours, sizes or peculiar highlights, and characterize the product in its relevant category. The massive variability that can introduce this kind of products with regards to colours, textures or various sorts of imperfections, hinders their classification, being machine vision, a valid volition to automize this task. In particular, food processing sectors a machine vision framework can gather a series of parameters such as size, weight, shape, texture and colour of the food and numerous details that cannot be observed by the human eye, fully intent on checking and controlling food handling methods. By this way we can defeat human blunders brought about by repetitive works which can be avoided [7].

H. Image Processing

Image Processing produces new pictures in based on existing pictures, by this the objective of bringing out and enhancing the characters from the district of interest. Image Processing contains low level processing, mid/Moderate-level processing and high-level processing which is also undeniable level handling [5].

Low level handling is utilized to pre-process image [21] While imaging the items, both image detecting gadgets can be at the same time used to educe images of test sample and convert them into advanced digital forms, which can be obtained by the system. The image which is obtained might be defective due to lot of cause including inappropriate lighting, imperceptible distance or low resolution of the imaging gadget, unsteady and variable viewfinder, and other different characteristics.

Moderate/Mid-level handling have three cycle image division or segmentation, image portrayal, and image depiction (Shih, 2010). Image segmentation is perhaps of the most fundamental and pivotal move toward Image handling and processing, since it generally decides if the Image investigation centres around the Main objective (Food). The primary capability of Image segmenting is to isolate the objective from other undesirable image information, in this manner helping in decreasing the computational expense and work force in resulting Image analysis, while also improves the accuracy.

High Level Processing basically incorporates two stages: Image recognition and Image interpretation that is understanding. Here, Statistics/profound deep learning techniques are usually embraced to characterize the objective, which is based on application of interest. Neural networks and the most profitable fuzzy logic strategies have been evolving all over the planet and to a great extent applied to the food producing industry. Professor Kashyapa (2016) [14] proposed a best machine vision-based framework which assists with eliminating the calyx from strawberries with greater ease of access.

III. PROPOSED METHODOLOGY

A Device setup arrangement is built by ESP32 cam and a Gas sensor. ESP32-CAM is a complete featured and advanced microcontroller with a coordinated camcorder/Integrated Camera and micro-SD card attachment slot.

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It's cheap and Open effectively, and is ideally suited for IoT gadgets requiring a camera with cutting edge capabilities like Image Tracking and recognition. Gas sensors which are otherwise called gas detectors are electronic gadgets which distinguish and recognize various kinds of gasses. They are normally used to distinguish poisonous/ toxic or explosive gasses and furthermore used to measure gas concentration. Agricultural gas sensors are broadly used to screen and identify poisonous gasses tracked down food production and food quality control. Food and beverage makers and processors produce perilous or harmful gasses in many stages, including the processing of food, waste, and by-products and the preservation of food until it is opened.

Fig. 1 Gas Sensor

Fig. 2 ESP-32 Cam

A. Components

1) Node MCU
2) ESP32CAM
3) MQ-135
4) OLED Display
5) TP4056battery charging circuit
6) Lithium-ion battery(3.7V)
7) Boost converter
8) Toggle Switch
9) Push button

Their images and values are collected by the microcontroller and the sensor values sent to the system to perform convolution neural network which analyse the image of carrot or radish and the final result is sent to the mobile application through IoT cloud and more over the sensor collects the gas value and the data further viewed by the same application and the device has an inbuilt lithium-ion battery with protection board which has a capability to cut off once the battery charged full. The sensor reading are captured and displayed using inbuilt OLED display.

B. Procedure for Image Processing

Image Acquisition is the initial step of image handling or processing in which camera is utilized for capturing pictures of radish in computerized structure / digital form and stored in any advanced digital media. Image Pre-processing is a part eliminates noise, smoothen the image additionally perform resizing of radish images. RGB images are changed over completely to grey pictures likewise the contrast of image is expanded to an ideal level

Image Segmentation is utilized for partitioning and isolating an image into different parts which are desirable. Feature Extraction is for Acquiring features like colour tone, surface texture and shape which helps in diminishing resources to portray large dataset information before classification of image.

Image Characterization is the part examines mathematical property of image features including organizing its data into categories. It utilizes neural network which performs training and classification of vegetables and fruit diseases

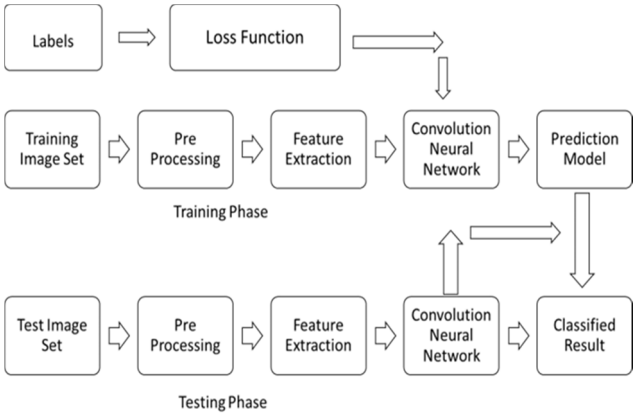

Fig. 3 Block Diagram

IV. CONCLUSIONS

This review paper highlights the use of developing a system for Quality analysis of Carrot and Radish. This is a Novel and non-invasive method done by image processing and computer vision innovation in the field of food industry, horticulture agriculture. The most important quality characteristics of agricultural products are size, variety, shape, surface and imperfection and these data could be collected by Scanning Technology through image processing. To change manual investigation of food products computer vision method is used efficiently which provide authentic characteristic approach, equitable and non-destructive rating. This device is more feasible to operate and can also applied in Industrial Conveyors. The computer vision-based quality review contains four essential and significant stages, which acquisition, segmentation, division, extraction lastly classification. Monitoring is easy as it has both device (OLED) and a computer display. Therefore, this enables in achieving real-time data through cloud reducing time and increasing efficiency. classification will be more robust if more characters and features are added including circumference, form and shape recognition.

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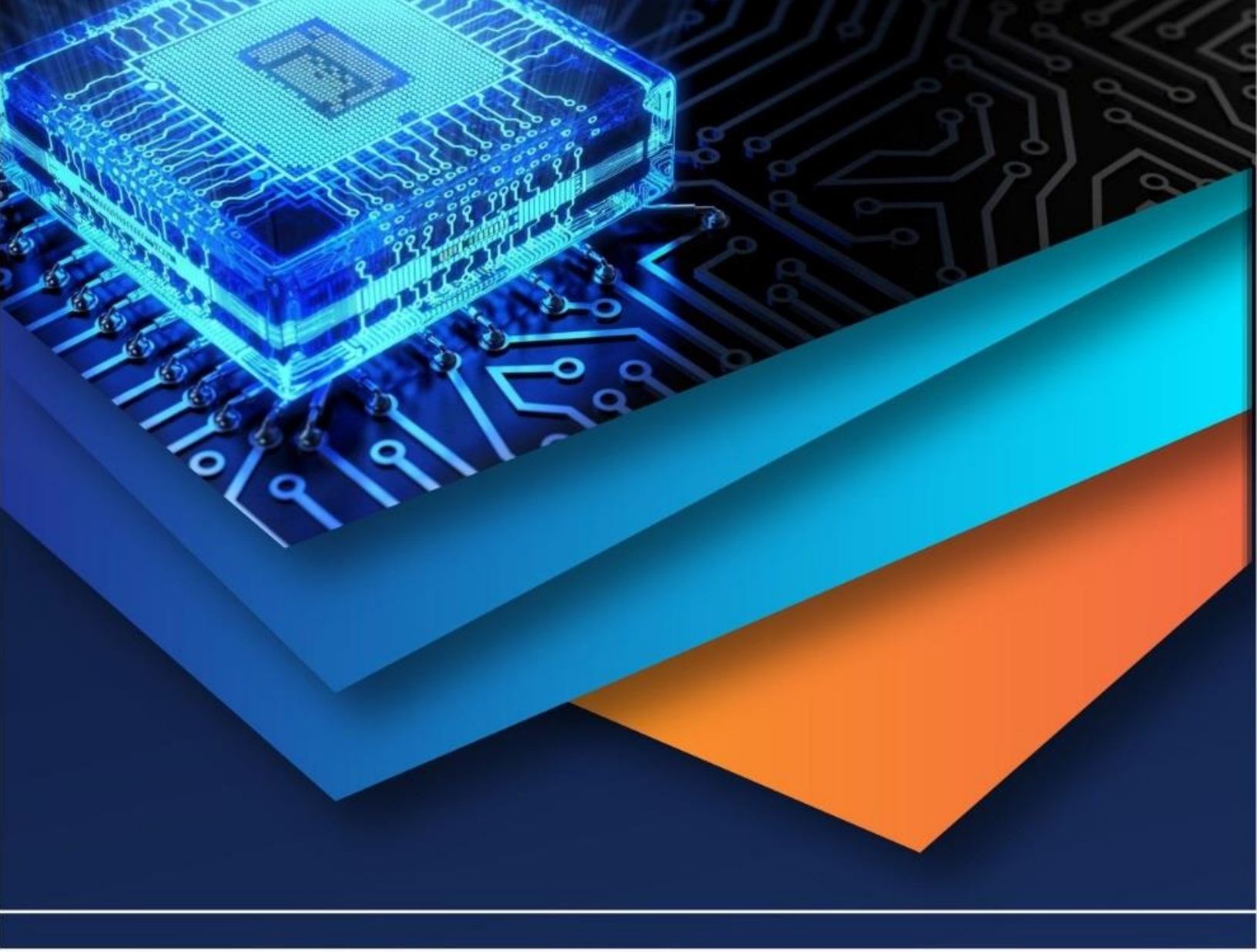

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