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Aspects of Artificial Intelligence in Agriculture, Healthcare and Education

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Abstract: AI applications have significantly evolved over the past few years and have found its applications in almost every business sector. AI is making a huge impact in all domains of the industry. Every industry looking to automate certain jobs through the use of intelligent machinery. This paper reviews the work of numerous researchers to get a brief overview about the current implementation of automation in agriculture. The aim of this paper is to identify gaps within the agricultural literature, and gaps in AI guidelines, that may need to be addressed. Moreover, Artificial Intelligence is now a reality in the Higher Education sector as we have started experimenting with the technology and reaping the benefits from the same. But this reality is marginal as there is still a long way to go for AI in the context of development and application in the Education sector. Healthcare organizations in different specialties are also getting more interested in how artificial intelligence can make accurate readings and results to several biological reports and thus gain a better diagnosis of the disease. The aim of this review is to keep track of new scientific accomplishments, to understand the availability of technologies, to appreciate the tremendous potential of AI in biomedicine, and to provide researchers in related fields with inspiration. New progress and breakthroughs will continue to push the frontier and widen the scope of AI applications, and fast developments are envisioned in the foreseeable future.
Keywords: Artificial Intelligence, Agriculture, Healthcare, Education

I. INTRODUCTION

Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the simplest to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception.

This paper will examine the social and ethical impacts of using artificial intelligence (AI) in several sectors. It will determine what some of the most prevailing challenges and impacts are known in the literature, and how this correlates with those mentioned in the domain of AI ethics and are being implemented into AI ethics guidelines. This shall be achieved by studying published articles and conference reports that focus on the societal or ethical impacts of AI in the various sectors, through a thematic analysis of the literature. While research on AI agriculture is still relatively new, this paper aims to map the debate and illustrate what the literature says in the context of social and ethical impacts. It aims to analyze these impacts and becomes the torchbearer for future research work.

II. AI APPLICATIONS IN AGRICULTURE

Agriculture and farming are one of the oldest and most important professions in the world. It plays an important role in the economic sector. The global population is expected to reach more than nine billion by 2050 which will require an increase in agricultural production by 70% to fulfil the demand. As the world population is increasing due to which land water and resources becoming insufficient to continue the demand-supply chain. So, we need a smarter approach and to become more efficient about how we farm and can be most productive. In this article, I will cover are challenges faced by farmers by using traditional methods of farming and how Artificial Intelligence is making a revolution in agriculture by replacing traditional methods by using more efficient methods and helping the world to become a better place. In many countries, including India, the farmers are dependent on monsoon for their cultivation. They primarily rely upon the predictions from numerous departments over the weather conditions, particularly rain-fed cultivation.

The AI technology will be helpful to predict the weather and other conditions associated with agriculture like land quality, groundwater, crop cycle, pest attack, etc. The accurate projection or prediction with the assistance of AI technology can cut back most of the concerns of the farmers.

With the advent of technology, there has been discovered a dramatic transformation in various of industries across the world [1]. Development in the agricultural sector will boost agricultural development, further leading toward rural transformation and eventually leading to structural transformation [2] [3]. At present in India Microsoft Corporation is working in Andhra Pradesh with 175 farmers with completely different services [57]. In India, most of the regions' farming depends upon rain or water availability. The 8 major steps farmers perform are crop selection, land preparation, seed selection, seed sowing, irrigation, crop growth, fertilizing, and harvesting. And all these steps are performed manually henceforth needing more human and animal labour. The work of [4]Jha et al., 2019 in relation to the AI software domain, encloses the connected relations between the various embedded systems and the AI technology articulate with the agricultural field, it gave a brief about the various applications of neural networks, ML in this sector for precision farming [5]. AI can be broken into two types of applications: AI software and AI robots. AI software is required for the working of AI robots, but AI robots are not (necessarily) essential for the functioning of AI software.

Various machine-driven computer-based systems are designed to determine some important parameters like weed detection, yield detection and crop quality, and many other techniques [6]. AI robots work comparatively autonomous on the farm to reap fruit and vegetables (such as peppers in the SWEEPER project), garden, scrape manure (LELY Robot), weeding robots (the Weed Wacker robot), drones to spray weeds and pesticides (ecorobotix), and robots that hoe and harvest (NAIO technologies' robots), and to measure crop health (agribotix) (examples taken from [7].

The use of (non-AI) robots in agriculture has been around for quite some time, with robot milking being used for almost two decades now. However, the work in agricultural AI robots is still relatively new. Agricultural robots are being employed in a wide variety of ways: crop scouting, pest and weed control, harvesting, spraying, pruning, milking, phenotyping, and sorting [8].

UAVs like drones are being enforced in agriculture for crop health monitoring, irrigation equipment monitoring, weed identification, herd and wildlife monitoring, and disaster management [9][10][11]. It is also applicable in precision agriculture, such as soil and field analysis [12], crop monitoring [13], crop height estimations [14], pesticide Spraying [15][16][17]. They are also being used to take aerial photographs and images of the farm and its surroundings. Drones are providing insights and mapping of the farm, which would not have been otherwise possible.

Artificial Intelligence (AI) has begun to play a major role in daily lives, extending our perceptions and ability to modify the environment around us [18][19][20]. [21] Plessen gave a method for harvest planning based on the coupling of crop assignment with vehicle routing is presented. [22] Savitha and Uma Maheshwari also developed the idea of an efficient and automated irrigation system by building remote sensors using the technology of Arduino which can increase production by up to 40%. Another system for automated irrigation was given by [23] Varatharajalu and Ramprabu. In this approach, different sensors were built for different purposes like the soil moisture sensor to detect the moisture content in the soil [24][25], the moisture sensor used for real-time irrigation system and developed crop coefficient curves for cotton crop to save irrigation water [26], the temperature sensor to detect the temperature, the pressure regulator sensor to maintain pressure and the molecular sensor for better crop growth.

AI is also being deployed in other types of robots, such as drones and self-driving tractors. It holds huge potential for farmers to be able to do other pursuits. AI is an alternative to several tasks typically assigned to agronomists and is also allowing farmers to streamline their documentation and administrative responsibilities. Companies, such as BASF, Monsanto, Bayer, Pioneer, and John Deere, are using the data retrieved from farms to provide tailored insights and recommendations to farmers, with the assistance of AI technologies which is surely an initiative of collaboration of AI in Agriculture.

A. Challenges And Future Scopes

In order to explore the vast scope of AI in agriculture, applications need to be more robust [27]. An essential aspect is the exorbitant cost of various cognitive solutions available in the market for farming. The solutions need to become more affordable to safeguard that the technology reaches the masses. An open-source platform would make the solutions more reasonable, causing rapid adoption and more access among the farmers. The technology will be useful in helping farmers with high-yielding and better seasonal crops at regular intervals. Farmers in India are majorly dependent on monsoons for cultivation. Also, the solutions need to become more affordable to ensure that the technology reaches the multitudes. AI systems also require a lot of data for training machines, to get accurate forecasting or predictions. Just in the case of a very large area of agricultural land, spatial data could be collected easily while getting temporal data is a challenge. Installation of digital cameras in the field whose output is converted to a digital signal, and is sent to the multiplexer through a wireless network such as Zigbee and hotspot would make it easier for monitoring and data recording. Crop-specific data could be obtained only once a year when the crops are grown. As the database takes time to mature, it involves a substantial amount of time to construct a robust AI machine-learning model. This is a major reason for the utilization of AI in agronomic products like seeds, fertilizer, and pesticides than that of on-field precision solutions.

III. AI APPLICATION IN HEALTHCARE

A. *Medical Research*

AI has been involved in medicine since as early as the 1950s when physicians made the first attempts to improve their diagnoses using computer-aided programs ([28][29]). AI can be used to analyse and identify patterns in large and complex datasets faster and more precisely than has previously been possible [30]. It can also be used to search the scientific literature for relevant studies, and to combine different kinds of data; for example, to aid drug discovery [31]. The Institute of Cancer Research can SAR database that combines genetic and clinical data from patients with information from scientific research and uses AI to make predictions about new targets for cancer drugs [32]. Researchers have developed an AI 'robot scientist' called Eve which is designed to make the process of drug discovery faster and more economical [33]. AI systems used in healthcare could also be valuable for medical research by helping to match suitable patients to clinical studies [34].

Hao et al. [35] focus on text mining in medical research. As reported, text mining reveals new, previously unknown information by using a computer to automatically extract data from different text resources. Text mining methods can be regarded as an extension of data mining to text data. Text mining is playing a progressively pivotal role in processing medical information. Similarly, the studies by dos Santos et al. [36] focus on applying data mining and machine learning (ML) techniques to public health problems. Using data mining and ML techniques, it is possible to discover new evidence that otherwise would be hidden. These two studies are related to another topic: medical big data. According to Liao et al. [37], big data is simply referring to a great mass of digital data collected from various sources. In the medical field, we can obtain a vast amount of data (i.e., medical big data). Data mining and ML techniques can help deal with this information and provide helpful insights for physicians and patients. In healthcare, the most common place where machine learning is used is precision medicine. Precision medicine is predicting what treatment protocols will succeed for a given patient, and this is determined based on past medical records of patients [38]. This type of defining from previous learning will require training the model using huge datasets, and this approach is called supervised learning.

B. *Applications of AI in Hospitals*

1) *Medical Imaging:* Medical scans have been methodically collected and stored for some time and are readily available to train AI systems [39]. AI could reduce the cost and time involved in analyzing the scans, potentially allowing more scans to be taken for better treatment [40]. AI has shown remarkable results in detecting conditions such as pneumonia, breast and skin cancers, and eye diseases [41][42][43][44].
2) *Echocardiography:* The "Ultromics" system, trailed at John Radcliffe Hospital in Oxford, uses AI to analyze echocardiography scans that detect patterns of heartbeats and diagnose coronary heart disease.
3) *Screening for Neurological Conditions:* AI tools are being developed to analyze speech patterns to predict psychotic events and identify and monitor symptoms of neurological illnesses such as Parkinson's disease [45].
4) Surgery: Robotic tools controlled by AI have been used in research to carry out specific tasks in keyhole surgery, such as tying knots to close wounds [46].
5) *Dermatology:* Dermatology in healthcare majorly depends on imaging. Deep learning has significantly helped in image processing. There are three imaging types in dermatology, contextual images, micro images, and macro images. For each type of these image, remarkable progress has been made through deep learning. Convolutional neural networks have achieved a precision of 94% in the classification of skin cancer from skin lesions.

C. *Challenges And Drawbacks*

There are numerous challenges, and shortcomings associated with deep learning even though there is a lot of progress made in the healthcare sector. One of the essential factors for deep learning to perform is the amount of data. Multiple network parameters are required for a neural network; to achieve this, lots of data is needed. Generally, for any neural network, the number of parameters needed should be 10 times more than the number of samples. In the healthcare domain, we often do not get many patients willing to cooperate to provide data, to privacy concerns. Also understanding the inconsistency of diseases everyone is much more complicated than other fields in AI [47]. Another factor is, clinicians are quite slow in adapting to technological shifts and their relevance in the healthcare sector, and this needs to be enhanced. Other fields in AI like vision speech, language, etc., will have clean data and structured data, but the information from healthcare is ambiguous, noisy, and incomplete. So, it is quite tough to apply AI in the health sector compared to other fields. However, we are advancing in a good direction over the past few years.

IV. AI APPLICATION IN EDUCATION

A. Role of AI in Education

Artificial Intelligence (AI) is percolating into many aspects of our everyday lives, with common internet applications, smartphones, and even household appliances. Within education, AI is a quickly emerging field and there is a strong potential for AI to greatly expand and enhance teaching and learning in higher education [48]. In the Horizon Report 2020 report [49], AI is listed as one of six technologies with the potential for high impact in higher education.

Although the connexion of the application of AI in Education (AIEd) is ceaselessly increasing, [50] Renz et al. noted that there are only a few examples in the current discourse that have already enforced AIED successfully and sustainably in higher education.

B. Aspects of AI in Education

Artificial Intelligence is the new electricity [51]. The VDE Tec Report 2018, with 1.350 German companies and universities, is calling for a strong offensive for innovation initiatives for AI as a key technology in digital transformation. According to the Horizon Report 2020 report [48], AI is listed as one of six technologies considering the potential for a vast impact on higher education. Agreeing with the survey results, 73% of the VDE-related companies and universities call for adapting Higher Education in the field of AI and restructuring educational methods [53] to meet the industry 4.0 needs. AI is a crucial technology for the digital revolution. In addition, Machine Learning is only possible if big datasets are available. This can be mapped for almost all sectors of digitization, making Big Data a sufficient condition for ML and AI applications in the education sector.

Given the volume and pace of technical innovation, the necessity for AI-based continuous education at the workplace is exceedingly high. AI assists professors in identifying the drivers of students' performance [54] and their weaknesses, adopting a personalized student model based on the knowledge level, adaptive learning systems, using AI to provide predictive models, and furthermore monitoring students' progress over the course of study.

According to Gartner, [55] the implications of AI in Education are Intelligent Things (an assortment of internet-connected technologies and devices), Digital Twin / Learner model (a digital illustration of what is going on within the learners' brain), Cognitive Technologies, Blending the virtual and real worlds to create an immersive digitally enhanced and connected environment, Immersive Experience with Augmented Reality/Virtual Reality, Conversational Platforms. In 1950, Skinner [56] inaugurated the first teaching machine based on stimuli, response, and rewarding of the correct response. The most important models of programmed Instruction are linear programs [56] and branched programs [57]. They offered the personalized learning scenario for answering through the chapters relevant to the theme in question, depending on the student's learning behaviour e.g., interactive book, Skinner model, and interactive video, N.A. Crowder model.

Figure-1 shows an example of our personalized learning scenario that is embedded in Learn Management System (LMS) Moodle at DIT. For Mathematics and Business Informatics courses, they developed an adaptive self-assessment with personalized answers for the chapter that needs to be conducted after self-evaluation.

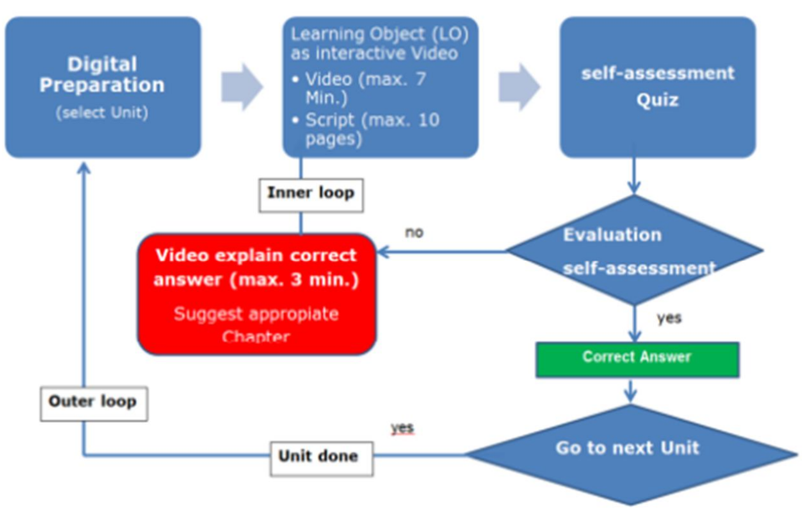

Fig.1 Personalized learning scenario

Now it is valid to ask how AI practically advances higher education in the field would.

There are a few directions for Artificial intelligence (AI) in education to probably transform its future forever:

1) AI can automate rudimentary activities in learning, like classification and grading.
2) AI systems can tailor educational programs to the student's needs. This is possible with current advanced systems and programs.
3) AI-powered courses let students and teachers could provide useful comments for others to benefit from and share experiences.
4) AI systems change the way to find information and interact with it. These types of intelligent systems play a key role in the way we interact with information in our personal and professional lives. Over the past few decades, AI systems have noticeably changed the way we interact with information. With more integrated technology, future students may have substantially advanced experiences in searching for facts than today's students.
5) AI systems can point out the areas that require enhancement in the study courses because this type of system helps students to improve and comply with gaps that are evident in the present educational curriculum. It helps to ensure that all students build the same conceptual foundations: instead of waiting for the teacher to listen, students get instant feedback that helps them understand the concept and reminds them about its practical application.
6) AI systems can reduce the efforts and uncertainty of trial-and-error methods. AI systems can provide students with a way to learn in a relatively free environment, especially when AI teachers can offer better and prompt solutions for improvement. In fact, AI systems are the ideal form to support this type of learning because these systems themselves often learn through the trial-and-error method.
7) The data supported by AI, can change the admission process of schools.
8) AI systems can transform the teachers' role. AI would give flexibility to students to learn remotely and heedlessly of school hours, same would be the case for teachers. [57].
9) AI systems will give students the flexibility to learn regardless of location, who teach them, and the manner of gaining basic skills.

C. Challenges and Future Scope

Tech giants like Google, Microsoft, Netflix Facebook are trying to develop new data-based learning programs that enable new didactic tools in public institutions through these business-driven companies (Rittelmeyer, 2017). These tech lords are investing intensively in the development of AI-based teaching and learning solutions inevitably raise the question of whether educational institutions are ready to implement such data-driven technology in their teaching and learning programs (Ifenthaler & Yau, 2019). Answering these and similar questions is challenging due to the unstructured market, lack of evidence, and topic-specific complexity [58]. Moreover, although the market for educational technology (EdTech) is predicted to grow worldwide to $8 trillion, the market is growing much more slowly than other markets with the dynamics of digital transformation. A major reason for this is the number and complexity of decision-makers—educators, teachers, traditional textbook publishers, and politicians, to name a few—who are involved in the market (EdTechXGlobal Report, 2016). In addition, the definition of EdTech has changed over the years. While 10 years ago, the mere provision of classrooms with computers was referred to as EdTech, today, EdTech refers to many start-ups and other organizations working to transform education and quality using technology. In the context of this work, we follow the definition of EdTech as "the digitization of educational services and business models" by software companies that provide technology solutions for schools, colleges, or businesses. As a result, the educational landscape is increasingly influenced by business-driven companies, such as the big tech lords, SMEs, or start-ups. Thus, technological developments like AI, Machine Learning (ML), and Learning Analytics (LA) inevitably find their way into teaching and learning methods and require the development of digital, data-based business models.

One of the areas in education is using machine learning technologies in adaptive learning, using it allows us to determine the possibilities of making an individual educational path for each student. In this area, the study has just begun, so the study of the problem is quite pertinent and claims more attention[59].

Established, most AI-based systems are trained with humongous quantities of data, but mainly with data from past observations that are irrelevant in the world where data varies every day, which limits their capability for predicting future scenarios and for driving radical innovations. Such radical innovations are fundamental in many cases to transform higher education, especially in engineering fields, to adapt to the hasty pace of technological progress. Consequently, input from educators is needed (and will probably always be), even if aided by AI tools. Today's students are different from those of yesterday and will be different from those of tomorrow.

The generations change, their contexts are conditional, and the educational models must be updated. In addition, in the engineering programs, each year the planning is updated in relation to contents, and what was studied years ago is a small part of the current plan. Modern technologies, new discoveries, and techniques make academic planning quite unusual. Due to these incessant changes, AI applications will not be effective enough if they are based only on the data of a single professor or a limited dataset. Data is referred to as, "the oil of the future"[61], and the creation of educational networks to share data will allow algorithms to get better trained with high student diversity. This wide data collection will reduce mistakes and adapt more quickly to social, technological, or educational trends.

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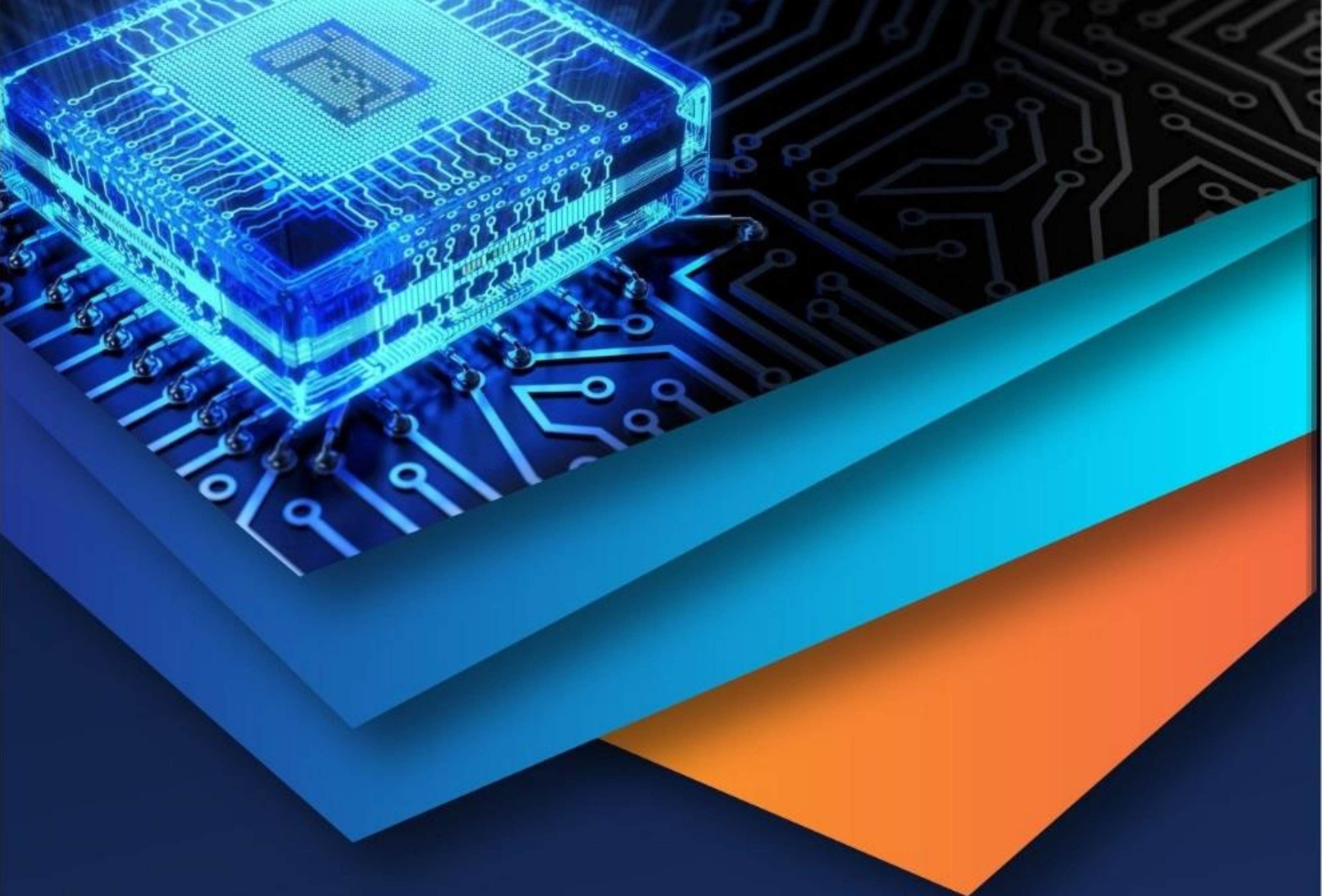

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