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A Literature Survey on Applications of 5G Technologies for Water Resource Management

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Abstract: ***Information and Communication Technology (ICT) has become the integral part of our everyday life. ICT has been playing vital and essential role in all modern and advance field. ICT covers computing, communication, information accessing, processing and transmitting the same with high security. In addition to increased network capacity requirements to handle a large number of devices running apps that need high data rates and always-on access, 5G can provide high speeds, low latency, and more capacity with the potential to change what we have experienced with our mobile device. This will be extremely beneficial to the emerging business models in the wireless network market that call for networks to be more open. The location, administration, and operation of upcoming 5G wireless networks will differ from those of present wireless networks due to new obstacles that call for new solutions and include revised planning. 5G wireless networks will have among their main goals the compliance provision of service-tailored networks to a wide range of services employing integrated cloud reserves and wireless and wired network assets, which may be offered by various infrastructure suppliers and/or operators.***
Keyword: 5G Technology, Water Resource Management, wireless/wired network, IoT, Communication.

I. INTRODUCTION

The "G" in 5G stands for "generation," while the number 5 represents the technological improvement (Generation). The first generation of wireless phone technology was 1G, and in the early 1990s, when businesses made it possible for users to transmit text messages between two cellular handsets, the technology was improved to 2G, which captivated the world. The world eventually transitioned to 3G, which gave people the freedom to make phone calls, send text messages, and access the internet at lightning speeds. Many of the features that were only feasible with third-generation wireless were improved with 4G. People could have phone conversations, send text messages, and browse the web with lightning speed. They could even download and upload enormous video files quickly and without any problems. Then, businesses enhanced 4G connectivity with LTE, an acronym for "long-term evolution." As the quickest and most reliable type of 4G, LTE began to compete in the market with other technologies like WiMax. Both approaches produced comparable results, but it was crucial to establish a standard that everyone could follow. By accelerating 4G technology even farther with LTE, the groundwork for 5G was laid. Ultra HD and 3D video download and upload will be made simpler with 5G. Thus, we can assert that there has been an increase in the pace of life [1].

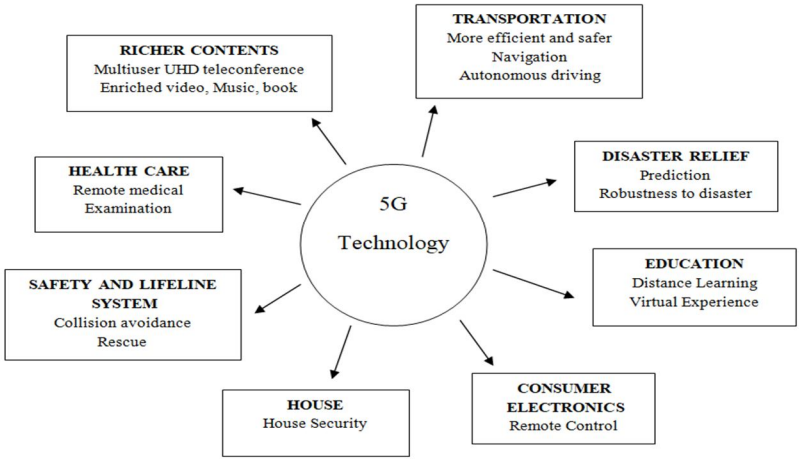

Figure 1: Example 5G Use Cases

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II. NETWORK COMMUNICATION

A. Wired Network

Any physical medium made up of a cable is referred to as being "wired," including the cables that combine twisted pair, fibre optics, and copper. The main purpose of a wired network is to transfer various electricity-based signals from one medium to another. A wired network uses one internet connection per cable. Data is shared across many devices that utilize the same idea of a wired network, even when just one device is connected to a single internet connection [3].

B. Wireless

A wireless network is a computer network that connects network nodes using wireless data links. Wireless networking allows companies, households, and communications networks to avoid the costly procedure of laying wires inside buildings or as a link between various equipment locations.

C. Wireless 5G Technology: History and Benefits

Wireless communications systems employ radio frequencies, also known as "spectrums," to transfer data over the air.
The sole distinction is that 5G operates on higher, less crowded radio frequencies. This allows it to send more data at a much faster rate. These top bands are referred to as millimeter waves (mm waves). They were previously unutilized, but the authorities have recently made them available for licensing. They have generally gone unnoticed by the ordinary public due to the difficulty in utilizing them and the expensive expense of the necessary equipment.

TECHNOLOGIES/ FEATURE	1G	2G/2.5G	3G	4G	5G
Evolution	1970	1980	1990	2000	2010
Development	1984	1999	2002	2010	2015
Data Rate	2kbps	14.4 – 64 kbps	2 Mbps	2000 Mbps to 1 Gbps for low mobility	10 Gbps to 100 Gbps
Technology	AMPS	2G:GSM 2.5G: GPRS, EDGE	WCDMA, CDMA-2000	LTE, WiMax	MIMO, mm Waves
Technology behind	Analog Cellular Technology	Digital Cellular Technology	Broad bandwidth CDMA, IP Technology	Undefined IP and seamless Combination of broad brand. LAN/WAN/PAN/WLAN	Undefined IP and seamless Combination of broad brand. LAN/WAN/PAN/WLAN
Service	Voice	2G:Digital Voice, SMS 2.5G:Voice + Data	Integrated high quality audio, video and data	Dynamic information access, wearable devices	Dynamic information access, wearable devices with AI capabilities
Type of Switching	Circuit	2G:Circuit 2.5G:Circuit and Packets	Packets	Packets	Packets
Access System	FDMA	TDMA / CDMA	CDMA	CDMA	OFDM / BDMA
Core Network	PSTN	PSTM	Packet Network	Internet	Internet

Figure 2: 5G technology Development Ref: 2

III. 5G TECHNOLOGY

A revolution has occurred with 5G technology. The fifth generation of telecom networks has outpaced the market since the end of 2018 and will keep growing around the globe. A vast 5G IoT (Internet of Things) ecosystem with networks that can support communication needs for billions of linked objects will be unleashed elsewhere because of the technology's predicted rate of growth and the correct tradeoff between speed, latency, and cost [10].

5G technology is driven by 8 specification requirements

1) Up to 10Gbps data rate - > 10 to 100x speed improvement over 4G and 4.5G networks
2) 1-millisecond latency
3) 1000x bandwidth per unit area
4) Up to 100x number of connected devices per unit area (compared with 4G LTE)
5) 99.999% availability
6) 100% coverage
7) 90% reduction in network energy usage
8) Up to 10-year battery life for low power IoT device.

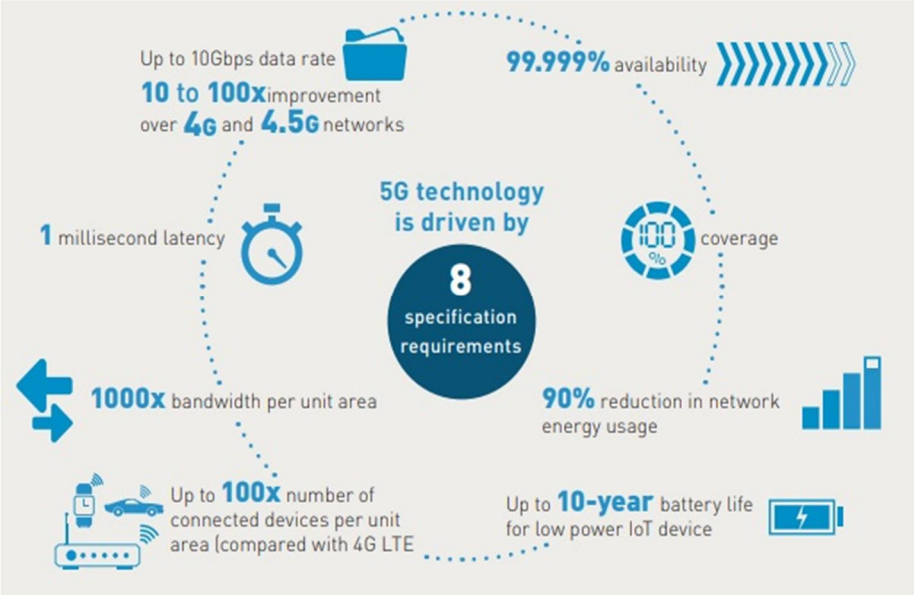

Figure 3: 5G technology specification requirements Ref: 11

IV. LITERATURE SURVEY

There are many research studies and related work that has been carried out by researchers and stakeholder groups for water resource management using 5G technologies that prove the need for technologies for better management and policy design.

KhushneetKour et al. [1] This research paper provides a detailed assessment of the basic requirements of 5th-generation wireless cellular communication systems, which are described in terms of data rate, spectrum efficiency, latency, capacity, energy efficiency, and quality of service. The 5G wireless network architecture, massive MIMO technology, network function virtualization (NFV) cloud, and device-to-device communication are all covered in detail in this article. Some short-range communication technologies, such as Wi-Fi, small cells, visible light communication (VLC), and millimetre wave communication (MVC) technologies, have been explained in terms of better quality in the future and increased data rates for the inside users, while at the same time reducing the pressure from the outside base station. It has also been discussed how certain key emerging technologies, such as large-scale MIMO and Device-to-Device (D2D) communication in fastidious intervention management, full-duplex radios, millimetre wave communication (MVC), and cloud technologies generally with radio access networks, spectrum allocation with cognitive radio, and software-defined networks, can help with legitimate daily needs.

Sk. Saddam Hussain et al. [2] According to the study report, 5G would deliver high speed and capacity with no loss of performance regardless of where the mobile station travels, even if a large number of mobile users are connected to the network at the same time. Massive MIMO is a future technology that will help satisfy 5G requirements. Because of the limitations of frequency and time, TDMA, FDMA, and other multiple access techniques may not be ideal for delivering acceptable capacity efficiency. As a result, in order to enhance capacity, we need to use a new technique called Beam Division Multiple Access in Massive MIMO. Channel estimation is a crucial issue in massive MIMO in order to achieve a low bit error rate. Massive MIMO increases system capacity tenfold and improves energy efficiency by a factor of 100. Because the cost of 5G infrastructure will be high, one method to save costs is to minimize processing at the transmitter and receiver, which may be accomplished with an appropriate antenna selection algorithm.

Manjurul H. Khan et al. [4] in this research paper cover the introduction to 5G technologies, key principles of 5G, benefits of 5G technology, applications, and wireless network design for 5G wireless technologies. The market currently provides new 5G technology at reasonable prices with higher peak speeds and improved dependability than predecessors. Fifth-generation technology and the most recent mobile operating system provide tremendous data capacities, infinite call volumes, and limitless data broadcasts. In comparison to 4G, the fifth generation should vastly enhance things and provide the globe with new services and benefits. Fifth-generation technology must be more advanced and infinite in terms of global connection.

Ankit Patkar [5] The main motivation of this paper is the need for more bandwidth and less latency. While latency is mostly influenced by the processing speed of each node that the data flows through, performance is the actual data transmission rate. When creating new mobile technology, factors including stability, channel interference, connection, scalability, energy efficiency, and compatibility with older networks are also taken into consideration, in addition to performance-related performance gains. 5G is expected to improve not only the data transfer speed of mobile networks but also the scalability, connectivity, and energy efficiency of the network. And last but not least, a greener planet will require network nodes that use less energy. The following are the key components of the 5G description, in that order: high dependability, low latency, high performance, higher scalability, and mobile technologies with small consumption.

NaseerHwaidiAlkhazaali et al. [6] the main key objective of this research paper is mobile communication through 5G technology. The world's current research on mobile communication using 5G technology has made significant advancements towards 5G technology in several work methodologies, including software and hardware. Like earlier iterations of communication technologies, 4G technology incorporates a number of standards under a single roof. Despite the fact that 4G is currently adequate, in five or 10 years it will undoubtedly be unable to meet the needs of any new applications that emerge during that time. 5G will increase the data rate, reduce end-to-end latency, and improve coverage. Improved coverage, lower end-to-end latency, and higher data rates are all expected with 5G. Since they are acknowledged as one of the technology components of the developing 5G architecture, these characteristics are crucial for many applications connected to the IoT and D2D. The primary contribution of this study is its discussion of the essential features of mobile communication enabled by 5G (fifth-generation) technology, which is seen as being consumer-oriented. Mobile consumers have been given high priority in 5G technology above other groups. Using mobile devices at a very high bandwidth is 5G technology. A technology as highly appreciated as 5G has never been experienced by the customer. 5G technologies include a wide range of complex characteristics, making 5G the most dominant technology in the near future.

Lin Ding et al. [7] In this research paper, it is discussed how human activities interfere with river flow and cause ecological and environmental problems to vary degrees. River health assessments have become a requirement for maintaining river health and restoring the river environment. Based on a thorough examination of the actual issues confronting the Futuan River Basin in Rizhao City According to the study's findings, the Futuan River's hydrological indicator has a score of 0.43 for hydrological vertical connectivity, making it the element with the most influence over the indicator. Chemical oxygen demand and ammonia nitrogen are the primary influencing elements of the Futuan River's water quality indicators, with scores of 0.7 and 0.74, respectively. Several non-engineering actions must be implemented in order to make good, efficient, and high-quality use of water resources. It suggests how the Futuan River in Rizhao City could be managed and restored. The disadvantage is that it is influenced by the river's intricate and diverse physical features. It is evaluated using scoring, so there is some subjectivity involved. Remote sensing and satellite data should thus be widely used to allow for a more objective assessment of river health. We identify indicators that can be quantitatively calculated to create a long-term monitoring system for rivers, allowing for a standardized and objective river health assessment. This is used in conjunction with 5G wireless communication.

HainieMeng et al. [8] based on the paper, solving key technologies in intelligent agricultural production in a 5G environment can not only effectively improve modern agricultural technology but also meet the needs of agricultural information, which is a collaborative innovation combining digital agriculture and traditional agricultural research. It is currently advanced and exploratory, but the research's practicability needs to be improved. With the further development and application of 5G technology, this research will be supported by more intelligent technologies and data processing technologies, which are expected to be more widely applied in the fields of agricultural practical technology promotion and scientific research.

Arun Kumar et al. [9] base their study article on the revolutionary developments in technology and communication technologies that have entered our daily lives. As a result, everyday growth is being seen in the amount of data traffic on the Internet. For these gadgets to receive limitless, continuous, and content-rich services, fifth-generation (5G) network technology has evolved. In comparison to 4G networks, 5G networks can deliver greater data speeds, reduced latency, and improved Quality of Service (QoS). The article assesses several wireless network generations. Also, it looks into several difficulties with the development of 5G networks and potential uses for these networks.

AbdelmadjidSaad et al. [10] have provided an overview of contemporary research on the critical water management issue in agriculture, which is being pushed by cutting-edge technology. The literature has been evaluated for a number of recent investigations. They include a range of issues related to the use of water in agriculture, such as water pollution, irrigation, recycling, and animal drinking water. The research community has looked into these possibilities while taking into account contemporary water management and monitoring methods depending on cutting-edge technologies like the Internet of Things (IoT), Wireless Sensor Network (WSN), and cloud computing. Such innovations emerge as a solution to get around the limitations of conventional methods and improve water exploitation.

Mohsen Attaran [11] This article investigated the critical roles that 5G plays in the development of several industries, such as IoT, the auto industry and smart vehicles, manufacturing and smart factories, smart grids and smart cities, and healthcare. It covered how 5G is important for tackling the myriad issues that various manufacturing businesses confront in this rapidly evolving environment, as well as for the expanding digitalization of industry. This article concluded by outlining the key role that 5G plays in enabling the widespread adoption of essential communications services as well as in advancing the digitalization and automation of industrial processes and practices for Industry 4.0.

Stephen Ojo et al. [12] In this research paper, the role of 5G technology in the detection of accidents and the effective frameworks to communicate to the appropriate rescue personnel have been reviewed. Although other studies have recommended additional cohesive frameworks, the focus of this study is the Internet of Things and 5G. Accident detection and communication would be more dependable and efficient thanks to the framework, which combines OneM2M, eCalls, MIMO, UAV, and the integration of mobile broadband. The 5G network uses the Ultra High Spectrum Band (UHSB), a new generation of technology. It is an innovation that communicates between the positions of vehicles and the temperature of high-quality connections using the pedestrians-vehicles-roads-cloud model. Since safety is the top priority for road transportation, it is crucial for intelligent transportation systems since it enables information sharing and incident prediction. This research investigates how to reduce the number of fatalities and injuries by detecting accidents using 5G technology, Multiple-Inputs Multiple-Outputs (MIMO) wireless, and integrated mobile broadband systems. Yet, while advancements in wireless technology over the ensuing years may move us closer to a world without accidents, they won't necessarily result in a complete cessation of accidents and fatalities.

Mr. Vinayak Pujariet al. [13] This paper is based on the fifth generation of mobile technology, or 5G. The way that mobile devices may be used at extremely high bandwidth has changed thanks to 5G mobile technology. Such high-value technology has never been continuously experienced by users before. Mobile users today are well versed in cell phone (mobile) technology. The 5G technologies comprise every form of cutting-edge architecture that will make 5G mobile technology the most potent and in high demand in the near future. To get broadband internet, a person can connect their laptop to their 5G mobile device. With 5G technology, you can get a camera, an MP3 player, a huge phone memory, an audio player, and much more. Piconets and Bluetooth technologies have become incredibly entertaining for kids.

AbdelmadjidSaad [14] The vital water management issue in agriculture, driven by cutting-edge technologies, is covered in this paper's assessment of current studies. The literature has been evaluated for a number of recent investigations. They cover a wide range of issues related to the use of water in agriculture, including water pollution, irrigation, recycling, pipeline leaks, and cattle drinking water. The research community has looked into these approaches while taking into account contemporary methods for water management and monitoring that rely on cutting-edge technologies like the Internet of Things (IoT), wireless sensor networks (WSN), and cloud computing. In order to improve water extraction and get beyond the limitations of conventional methods, such technologies are developed. They explored several pertinent open problems after their examination of the current literature, which led to the identification of potential future research areas. The efforts that are anticipated in the near future are focused on the development of novel, clever ideas and technologies for effective water management and monitoring in the agricultural sector.

Preeti R. Ashtikar et al. [15] The Internet of Things (IoT) is rapidly becoming an innovative and easy way to access physical objects or devices that are connected through the internet. IoT can access any devices that have built-in sensors and unique address identifiers and have the ability to collect and transfer data without any human intervention. Using IOT, we can control devices from anywhere efficiently and safely.

V. CONCLUSION

The Advance ICT techniques, along with 5G technologies and IoT give the excellent solution to collect, process, and analyze the water resource data without visiting the sites. In this literature survey, we found that many researchers have applied/suggested 5G technology for water resource management. The high-speed, reliable data transmission through 5G as it pertains to water resources may help tremendously to potentially improve the management of water resources.

VI. ACKNOWLEDGMENT

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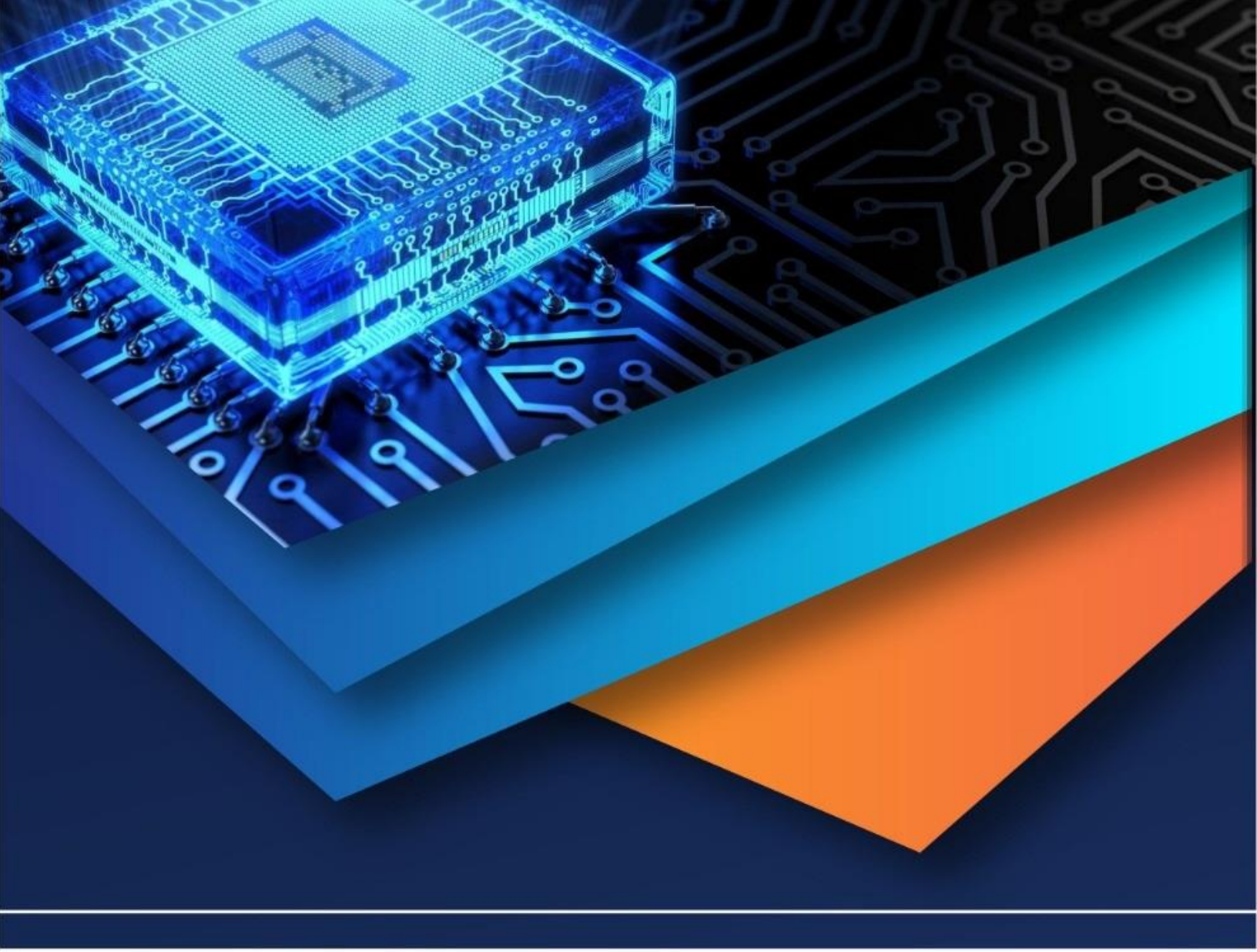

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