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Use of Blockchain Technology in the Fashion Industry: Analysis of How Blockchain Technology Can Be Used to Improve Transparency, Traceability, and Sustainability in the Fashion Supply Chain

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Abstract: ***Aim: The aim of this study was to investigate the use of blockchain technology in the fashion industry and to analyze its potential to improve transparency, traceability, and sustainability in the supply chain.***
Methodology: The study was based on a self-administered questionnaire, which was completed by 200 participants involved in the fashion industry. Descriptive statistics and correlation techniques were used to analyze the data and to test the main hypotheses of the study.
Originality/Value: This study adds to the growing body of research on the use of blockchain technology in the supply chain and provides valuable insights into the potential benefits and challenges of implementing blockchain technology in the fashion industry. The study also highlights the role that blockchain can play in improving transparency, traceability, and sustainability in the supply chain.
Findings: The results of the study suggest that the use of blockchain technology can lead to a significant increase in transparency in the fashion industry, as well as a significant improvement in traceability and sustainability. The results provide evidence of the potential of blockchain technology to improve the overall accountability and performance of the fashion industry, and highlight the need for further research and investment in this area.
Keywords: Blockchain, Transparency, Traceability, Sustainability etc.

I. INTRODUCTION

The fashion sector is worth billions of dollars, yet it faces difficulties in areas such as supply chain sustainability, traceability, and transparency. The global and intricate nature of the fashion industry's supply chain contributes to problems including counterfeiting, worker exploitation, and environmental damage (Rab et al., 2020).

These issues may be resolved with the use of blockchain technology, which offers a trustworthy and transparent method of tracking products and guarantees that all parties involved have access to the same data (Liu et al., 2020). Using this technology, a decentralised, immutable ledger of information can be created, which can then be used to track products from the point of origin all the way through to the final consumer (Leone, 2021). This has the potential to enhance product visibility and traceability, making it simpler to verify that goods are produced in a responsible manner. Using this paper as a springboard, we want to learn more about blockchain's potential in the fashion industry and how it may be put to use to improve supply chain transparency, traceability, and sustainability. To better understand the potential benefits and obstacles of using blockchain in the fashion sector, we will explore existing research and case studies. The paper will also address the possible influence that blockchain could have on the fashion industry as a whole, and it will identify key stakeholders and their involvement in the adoption of blockchain technology. Fashion remains among of its globe's greatest market segments, contributing approximately 5% of world exports but producing an estimated €300,100m in 2018 (statista.com, 2018). (Morgan, 2015). Having 69 million folks working throughout this product lifecycle, the sector employs 10.0% of its nation's workforce (Fashion United, 2018). World Fashion Agenda but also A Boston Consulting Group (2017) anticipate projected worldwide garment demand would climb over 70%, from 69 million tonnes currently to 102 million tonnes throughout 2035, its equal as greater nearly 400 billion T-shirts, according its internal investigation.

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With this magnitude, this was hardly surprise since global fabric industry is crucial to our world's marketplace (Giljum, Dittrich, Lieber, & Lutter, 2014). Blockchain technology was developing considered among its quickest developing innovations, changing nearly each sector's growth. Confidentiality, openness, plus provenance constitute just a few of the many compelling arguments for widespread adoption of such technologies. That technologies provides enabled practically each business to modernize and advance. Blockchain is actively disrupting the way established methods work and establishing new avenues for reliable yet sustainable growth (Burstall, 2017).

Blockchain technology, featuring important qualities besides as decentralisation, data integrity, agreement, and so on, offers tremendous capacity help improve the exciting clothing sector by providing an additional level of safety plus confidence towards it (Wang, 2020). One of the most serious issues confronting the fashion business is the proliferation of fake goods on the marketplace. These counterfeit goods get an adverse influence upon this company image but also worth. Blockchain offers the potential to preserve but also tamper resistant credentials while also establishing credibility in the fashion sector (Global Fashion Agenda & The Boston Consulting Group, 2017). Notwithstanding the tech's increasing appeal increasing curiosity, however less understood about its actual position for implementation for utilisation inside this design but also textiles industries (Morgan, 2015).

To address the need for sustainable, the increasing number of design businesses is creating new goods utilizing recycled materials. For example, H&M's new collection Conscious Exclusive is created for progressive manner, with most items made from environmentally friendly resources. A clothing line, is declared the globe 's greatest purchaser of textile for its sixth year running plus one amongst its largest global purchasers of greater sustainability ingredients with the affixed green tags, signifying either at least 40% sustainability procurement or 30% recovered cotton were utilised (Sajja, 2021). A successful capitalism is currently a highly difficult and demanding endeavour. To develop profitable but also long-lasting client interactions, a transptracearent network is required. Businesses were becoming acclimated to technological world and incorporating it into their operating hours. These research concentrates on textiles as well as related sectors. This entire product was chosen because of this demand need provenance, which has arisen as a critical method enabling multi-site and multi-tier manufacturing. Meanwhile, oversupply that excess inventory are important challenges mostly in apparel industry. 87% of the aggregated fibre utilized in garments is either burned or dumped in such a garbage (Caldarelli, 2021). H&M, for example, been implicated in a TV investigation report for burning 60 tonnes donated reviewing since 2013. Burberry were found to have incinerated £28 million in excess products in 2018 (Wang, 2020). According to claims, Nike Company Urban Outfitters have wrecked deliberately created problems in order to preserve customisation but also prevent cheap prices. Chain of custody improves identify exactly and caters to customer demands for cleanliness but also performance measurement.

This even solves the prevalent ills of data asymmetry and low exposure, as well as practicing good purchasing practises by successful outcome legitimacy (Bullon et al 2020). Its usage of Blockchain (tracking but also identifying function) enables business design but also textiles industries to regulate but also oversee various items throughout industry phase from manufacturing to its final user's buy (Elmessiry 2018). In terms of the production line, this following absence comprehensive distribution network traceability is created a financial but also societal concern, as businesses might possess little data on the parts or ingredients utilised to manufacture their goods. Concerns about legitimacy may occur as a result of the production of sustainability apparels. Blockchain, as one of its greatest hopeful apps, confront fashion's distribution network inadequacies by allowing fashion companies to monitor one‘s goods from its unprocessed components to its end good or service: presuming trustable data is entered into the system at its origin, a certain identical data would then attain its in shop consumer without whatever potential of explanation. Any company without complete trust can deliver their advertised sustainable way items having reduced atmospheric value. These actual substances are emitted may cause ecological harm or pollution (Burstall, 2017). Nevertheless, such issues may be resolved mostly in big analytics era, whereby content laser rangefinders were established by leveraging modern cloud computing enabling data exchange.

Amongst modern data systems, Blockchain is a cutting-edge solution for allowing traceability. Blockchain comprises a computer ledger made up of data chunks that are all interconnected to one another. Every activity but also activity in Blockchain-based traceability solutions is visible so may both traced but also accessed via many users at whichever moment. Cheap clothing creates a trace, contributing to increased contamination plus wastage. As a result, the garment sector needs environmentally textiles, ethically manufacturing, but a recycling method. In this case, technologies would act as a trigger (Caldarelli, 2021). This impact from technologies would become such a stone, causing waves mostly in fashion market never only internally and moreover externally. Furthermore, due to Block chain’s advanced encryption, every information is irrevocably yet forever preserved. As a result, essential entities may communicate information alongside one another fear of losing confidence or legitimacy. For a consequence, Blockchain is found widespread use in practise (Wang, 2020).

A. *Objectives*

1) To examine the use of Blockchain technology in fashion industry.
2) To determine transparency, traceability, and sustainability in fashion supply chain through Blockchain technology.

II. LITERATURE REVIEW AND HYPOTHESIS BUILDING

It is difficult to trace the origin and authenticity of fashion products due to the industry's complicated and worldwide supply chain, which involves various stakeholders. As a tool to address these difficulties and promote transparency, traceability, and sustainability, the application of blockchain technology in the fashion industry is being studied.

The adoption of blockchain technology in the fashion sector can promote transparency by offering a secure, tamper-proof information ledger that is accessible to all parties. This can contain information about the product's origin and legitimacy, as well as information about labour methods and environmental impact (Rahman, 2011). In the diamond sector, for instance, blockchain technology has been utilised to give consumers with information on the origin and authenticity of gems, and the same may be applied to other products in the fashion industry. In addition to enhancing traceability, blockchain technology may provide a comprehensive record of the entire supply chain, from raw materials to the final consumer (Rab et al., 2020). This enables stakeholders to trace items and verify that they are produced ethically and sustainably. In the food business, for example, blockchain-based traceability systems have been built to track food products from the farm to the table; the same might be applied to the fashion industry (Cartney-Morley, 2020).In addition to enhancing transparency and traceability, blockchain technology has the potential to promote ethical and sustainable supply chain practices, hence enhancing sustainability. For instance, blockchain-based systems can be used to monitor the carbon footprint of items and track the use of sustainable materials, such as organic cotton or recycled polyester (Elan, 2020). This information can be used to recognise businesses that are promoting sustainability and to inspire other businesses to adopt more sustainable practices.The literature analysis demonstrates that blockchain technology has the potential to improve supply chain transparency, traceability, and sustainability and to address many of the difficulties facing the fashion sector. However, blockchain technology adoption in the fashion sector is still in its infancy, and additional research is required to properly comprehend its benefits and drawbacks. Additionally, it is essential to evaluate the role of key stakeholders, such as customers, producers, and merchants, in the adoption of blockchain technology and to ensure that the technology is accessible and user-friendly for all parties (Chernozhukov et al., 2021).

A. *Hypothesis*

H_1: the use of blockchain technology will result in a significant increase in transparency.
H_2: Traceability will rise significantly as a result of the adoption of blockchain technology.
H_3: The application of blockchain technology will significantly improve sustainability.

III. METHODOLOGY/ DESIGN

A questionnaire was used to collect data from two hundred people. Manufacturers, retailers, and end-users were among the fashion industry's target demographics for this study to provide a balanced representation of the fashion supply chain's many moving parts. The survey asked respondents to share their thoughts and experiences with blockchain technology as it relates to the fashion industry in response to a series of questions. The questions were organised to test the study's three major hypotheses (Feng et al., 2020). The goals of the survey were to gauge respondents' opinions on blockchain technology and their familiarity with its application in the fashion sector. We used a Likert scale, with options ranging from "strongly disagree" to "strongly agree," to gather responses since we wanted them to be impartial and simple to interpret. Manufacturers, retailers, and consumers all had a role in the research's intended audience for the fashion sector (Hutchins et al., 2020). The research set out to discover what effect blockchain may have on transparency, traceability, and sustainability in the fashion industry's supply chain, as well as the possible benefits and drawbacks of deploying blockchain technology in the fashion business. The study's findings were supposed to shed light on blockchain's potential to revolutionise the fashion industry and direct further study in this field. Descriptive statistics and correlation methods were used to analyse the questionnaire data and get insight into the participants' perceptions on blockchain technology's potential in the fashion industry. Descriptive statistics were used to summarise and characterise the data, and they included measures of central tendency, like mean and median, and measures of variability, like standard deviation and range (Haischer et al., 2020). Such measures were used to summarise the key aspects of the data set and provide insight into its overall structure. This research used correlation methods to examine the links between the variables in order to further explore the possible connection between blockchain technology and the study's three major assumptions.

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A. Analysis/ Findings

Statistical tests and descriptive statistics are used to examine the online survey data. Analyzing the correlation between variables is part of the statistical test. In addition, the demographic information is reflected in the frequency tables. Descriptive statistics were calculated using the mean of responses for four variables: blockchain use, transparency, traceability, and sustainability.

1) Demographics

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	174	87.0	87.0	87.0
	Female	26	13.0	13.0	100.0
	Total	200	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	26 to 35	55	27.5	27.5	27.5
	36 to 45	58	29.0	29.0	56.5
	46 to 55	87	43.5	43.5	100.0
	Total	200	100.0	100.0	

Education level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bachelor	62	31.0	51.7	51.7
	Master	28	14.0	23.3	75.0
	Above Master	30	15.0	25.0	100.0
	Total	120	60.0	100.0	
Missing	System	80	40.0		
Total		200	100.0		

Working Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	6 to 10 years	32	16.0	26.7	26.7
	11 to 15 years	58	29.0	48.3	75.0
	Above 15 years	30	15.0	25.0	100.0
	Total	120	60.0	100.0	
Missing	System	80	40.0		
Total		200	100.0		

Do you think that blockchain solutions address fashion's supply chain deficiencies by giving fashion brands the ability to track their products?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	75	37.5	37.5	37.5
	No	125	62.5	62.5	100.0
	Total	200	100.0	100.0	

Do you think that blockchain has the potential to become the single source of truth for the fashion supply?

		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	**Yes**	**116**	**58.0**	**58.0**	**58.0**
	No	**84**	**42.0**	**42.0**	**100.0**
	Total	**200**	**100.0**	**100.0**	

This study involved 200 participants who looked at the application of blockchain technology in the fashion industry. According to the frequency table, 13% of participants were women and 87% of participants were men. If there are observable variations between men's and women's viewpoints or experiences in the fashion industry, this gender distribution may have an influence on the study's conclusions. In future investigations, it is crucial to gather more demographic information and assess how gender influences the results. The results of the study show that the participants were primarily middle-aged, with a diversity of ages. The participants' educational background was also noted; 31% had a bachelor's degree, and 15% had a degree higher than a master's. However, incomplete data resulted from 40% of the participants failing to give information on their schooling. It was also highlighted that 15% of the participants had more than 15 years of professional experience in the fashion industry. 42% of participants do not think that blockchain has the capacity to completely replace existing information sources in the fashion supply chain, while 58% do.

2) Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Usage of blockchain	200	4.00	5.00	4.2500	.31432
Transparency	200	4.00	5.00	4.3670	.33477
Traceability	200	3.20	5.00	4.2590	.34367
Sustainability	200	3.20	5.00	4.3300	.41420
Valid N (listwise)	200				

The descriptive data provide the industry-wide average score for blockchain adoption, transparency, traceability, and sustainability. The average rating for blockchain usage is 4.25 (out of 5), and the standard deviation is.31432. This suggests that blockchain technology is often used at a moderate level in the fashion business. The standard deviation of.31432 indicates that there is some variation in the industry's use of blockchain, nevertheless. The average transparency rating is 4.367 (out of 5), with a.33477 standard deviation. This shows that, generally speaking, there is a high level of operational openness in the fashion sector. The standard deviation of.33477, however, indicates that there is some variation in the degree of transparency within the sector. The average traceability score is 4.259 (out of 5), with a.34367 standard deviation. This suggests that the supply chain traceability in the fashion business is often on the modest side (Betsch et al., 2020). The industry's level of traceability appears to vary, as indicated by the standard deviation of.34367. The sustainability score has a mean of 4.33 (out of 5) and a standard deviation of.41420. This shows that the fashion sector, as a whole, operates with a high degree of sustainability. The industry's degree of sustainability appears to vary, nevertheless, given the standard deviation of.41420.

3) Correlation

Correlations

		Usage of blockchain	Transparency	Traceability	Sustainability
Usage of blockchain	Pearson Correlation	1	.677**	.041	-.106
	Sig. (2-tailed)		.000	.560	.136
	N	200	200	200	200
Transparency	Pearson Correlation	.677**	1	.209**	-.146*
	Sig. (2-tailed)	.000		.003	.039
	N	200	200	200	200
Traceability	Pearson Correlation	.041	.209**	1	.329**
	Sig. (2-tailed)	.560	.003		.000
	N	200	200	200	200
Sustainability	Pearson Correlation	-.106	-.146*	.329**	1
	Sig. (2-tailed)	.136	.039	.000	
	N	200	200	200	200

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

The research examined the connections between the use of blockchain technology and factors including supply chain visibility, transparency, and environmental friendliness. The Pearson correlation coefficient was used to assess the robustness and direction of the linear connection between the variables. This study found strong evidence of a favourable correlation between blockchain technology adoption and supply chain transparency in the apparel industry. In a similar vein, there found a weak positive linear link between transparency and traceability in the fashion industry's supply chain. The findings also showed a weakly positive linear link between traceability and sustainability in the fashion supply chain, suggesting that the two improve together as traceability increases (Ardan et al., 2020). However, the research did find a weakly negative linear relationship between blockchain technology use and sustainability in the fashion supply chain. This suggests that sustainability may worsen with more blockchain technology adoption (Bhattarai, 2020). However, this link was not significant at the.05 level of significance. These results illuminate the interplay between blockchain technology and the many components of the fashion supply chain.

B. Regression Analysis

A statistical technique called regression analysis is used to look at how one or more independent variables and a dependent variable are related. The use of blockchain technology and the three variables of transparency, traceability, and sustainability in the fashion sector were examined in this study using regression analysis.

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.677[a]	.458	.455	.24710

a. Predictors: (Constant), Usage of blockchain

ANOVAa

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	10.213	1	10.213	167.273	.000[b]
	Residual	12.089	198	.061		
	Total	22.302	199			

a. Dependent Variable: Transparency

b. Predictors: (Constant), Usage of blockchain

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	1.304	.237		5.490	.000	.835	1.772
	Usage of blockchain	.721	.056	.677	12.933	.000	.611	.831

a. Dependent Variable: Transparency

The model summary reveals that the R-squared value of the model is 0.458, which indicates that the use of blockchain technology can account for 45.8% of the variability in transparency. The F-value of 167.273 is significant (p0.001) according to the ANOVA table, which suggests that the use of blockchain technology has a considerable influence on the transparency of the fashion sector. The constant is 1.304, and the use of blockchain technology has a coefficient of 0.721, according to the coefficients table. Accordingly, there is a 0.721 improvement in transparency for every unit increase in the use of blockchain technology.

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IV. CONCLUSION

The research conducted in this study provides an in-depth analysis of the use of blockchain technology in the fashion industry, and its potential to improve transparency, traceability, and sustainability in the fashion supply chain. The results of the survey indicate that there are significant challenges in the fashion industry supply chain, including a lack of transparency, inefficient traceability, and unsustainable practices. However, the survey results also suggest that blockchain technology has the potential to significantly address these challenges, by improving transparency, enhancing traceability, and increasing sustainability. Despite the potential benefits of blockchain technology, the results of the survey also revealed several barriers and challenges to its implementation in the fashion industry, including the need for significant investment, a lack of understanding, and resistance to change from industry stakeholders.

A. Practical Implications

The results of this study have important implications for the fashion industry and for further investigation into blockchain technology's potential applications in the supply chain. The paper highlights the role that blockchain technology may play in boosting supply chain transparency, traceability, and sustainability, and provides important insights into the possible benefits and barriers of using blockchain technology in the fashion business.

The research found that a significant increase in fashion sector transparency may be achieved via the use of blockchain technology. The results show that blockchain may improve supply chain visibility and accountability by providing a secure and transparent record of transactions and information. As a result, this may make the fashion industry a safer place, improve the quality of products, and inspire trust in the brand (Leone, 2021).

Another noteworthy outcome of the study is that the deployment of blockchain technology may significantly enhance supply chain traceability. The findings indicate that blockchain can offer a safe and permanent record of information regarding the origin and travel of a product, hence enhancing the supply chain's overall transparency and accountability (Li et al., 2020). In turn, this can lower the likelihood of counterfeiting and increase customer trust in the genuineness of items.

B. Limitations

Since just 200 people were included in the study, its results may not be generalizable to the whole fashion business. Therefore, it is possible that the findings of this study cannot be applied without qualification to other groups or contexts. For instance, the findings might not be representative of the opinions and experiences of people in other nations or regions, or of those working in different areas of the fashion business, such as designers, manufacturers, or merchants. There is also the possibility of selection bias because the sample was collected using a self-administered questionnaire; respondents who were more invested in the issue or who had more strongly held ideas may have been more inclined to fill out the survey (Elan, 2020).

One limitation of the research is that it relied on self-reported data, which might suffer from social desirability bias and other forms of measurement error. One possible reason is that people were coached to have positive attitudes about blockchain technology even if they weren't universally shared (Betsch et al., 2020). Potentially affecting the reliability and validity of the study's results.

Furthermore, this study used cross-sectional data, which precludes any sort of causal conclusion. Since there may be more factors at play, the study's findings cannot be utilised to demonstrate a causal link between blockchain technology's adoption and the three primary hypotheses (Ardan et al., 2020). To determine causes and consequences and offer a fuller picture of how blockchain technology is influencing the fashion industry, further studies with experimental or longitudinal designs are required.

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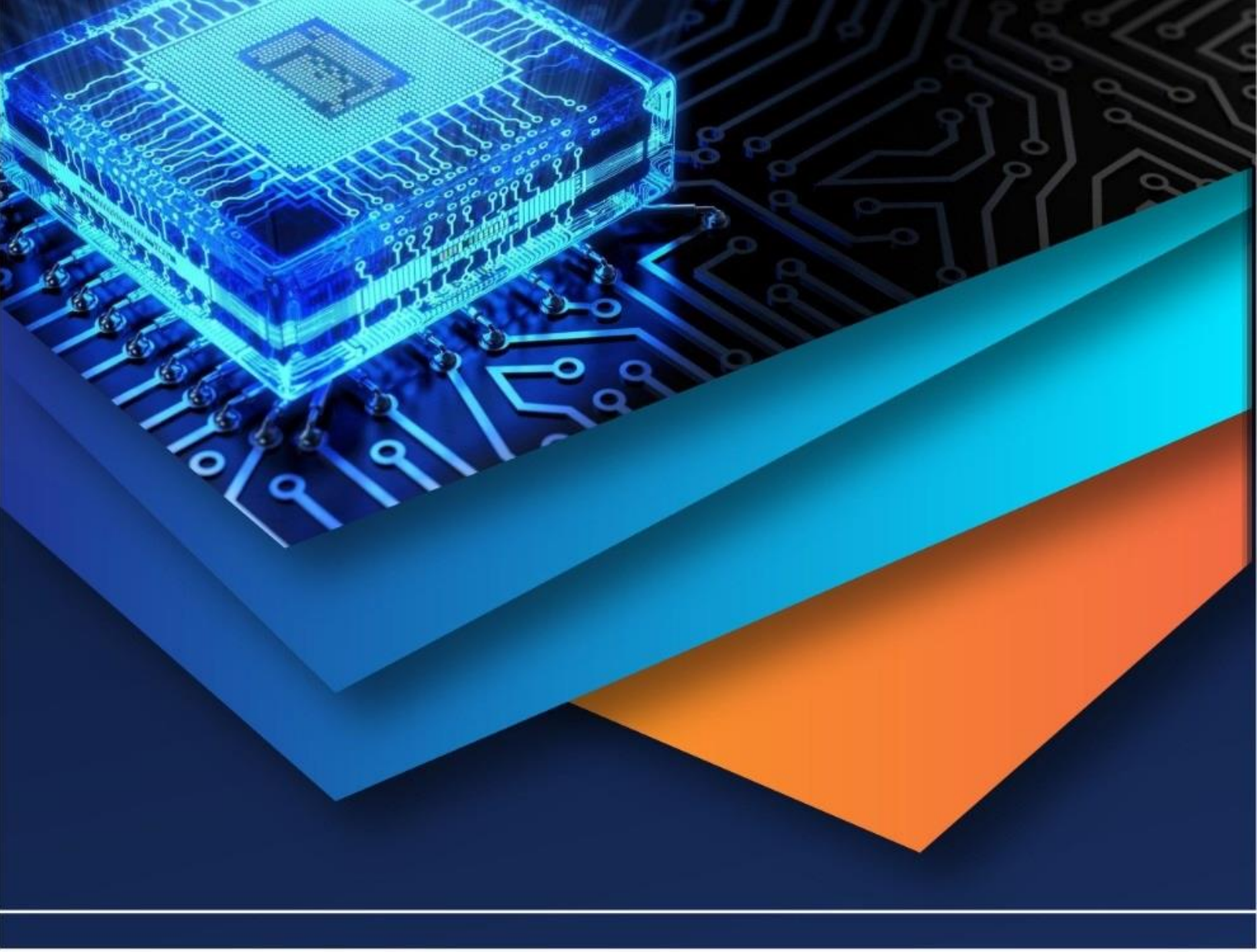
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