Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

Internet of Things and Big Data: Transforming Business and Society Through Advanced Analytics

Fatimah Noor [1]

Abstract:

The convergence of the Internet of Things (IoT) and Big Data analytics is revolutionizing the way businesses operate and societies function. This paper delves into the transformative impact of these technologies, elucidating their synergy in generating actionable insights, enhancing operational efficiency, and fostering innovation. Through a comprehensive exploration of real-world applications, challenges, and opportunities, this research underscores the pivotal role of advanced analytics in harnessing the potential of IoT-generated data. As businesses and societies increasingly intertwine with digital ecosystems, understanding the intricate interplay between IoT and Big Data becomes imperative for sustainable growth, societal advancement, and informed decision-making.

Keywords: *Internet of Things, Big Data Analytics, Business Transformation, Societal Impact, Advanced Analytics, Operational Efficiency, Innovation.*

[1] **Department of Computer Science, University of Bristol, England**

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

1. Introduction

1.1 Background

In recent years, the rapid proliferation of interconnected devices and the exponential growth of data have ushered in a new era characterized by the Internet of Things (IoT) and Big Data analytics. The IoT paradigm encompasses a vast network of physical objects embedded with sensors, software, and other technologies, enabling seamless communication, data exchange, and intelligent decision-making. Concurrently, the advent of Big Data analytics has empowered organizations and societies to extract valuable insights from massive datasets, driving innovation, enhancing operational efficiency, and fostering informed decision-making. The convergence of IoT and Big Data represents a paradigm shift, transcending traditional boundaries and redefining the way businesses operate, societies function, and individuals interact with their environment [1]. This transformative synergy offers unprecedented opportunities to harness the potential of data-driven insights, optimize resource utilization, and address complex challenges across diverse domains, ranging from healthcare and manufacturing to transportation and urban development. However, the integration of IoT and Big Data also presents multifaceted challenges, including data privacy concerns, security vulnerabilities, and the need for robust infrastructure and analytical capabilities. As organizations and policymakers navigate this evolving landscape, understanding the intricacies of this convergence becomes imperative to unlock the full potential of IoT-generated data and realize the promise of a connected, intelligent, and sustainable future.

1.2 Objectives of the Study

The primary objective of this study is to explore the transformative impact of the Internet of Things and Big Data analytics on businesses and societies, elucidating their synergistic relationship, applications, challenges, and opportunities. Specifically, the study aims to:

1. Provide a comprehensive overview of the Internet of Things, encompassing its evolution, key components, technologies, applications, and societal implications.
2. Examine the foundations and advancements in Big Data analytics, highlighting its role in processing, analyzing, and deriving actionable insights from massive datasets generated by IoT devices.
3. Investigate the synergy between IoT and Big Data analytics, exploring how the integration of these technologies enhances operational efficiency, drives innovation, and fosters data-driven decision-making in various domains.
4. Evaluate real-world case studies and success stories, illustrating the transformative potential of IoT and Big Data analytics in diverse sectors, such as healthcare, manufacturing, transportation, and smart cities.
5. Discuss the societal impacts and considerations associated with the proliferation of IoT and Big Data, including ethical, privacy, security, and policy implications.
6. Identify future trends, challenges, and opportunities in the evolving landscape of

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

IoT and Big Data analytics, offering insights and recommendations for stakeholders, organizations, and policymakers.

2. The Internet of Things (IoT): An Overview

2.1 Definition and Evolution

The Internet of Things (IoT) refers to the network of interconnected devices, objects, and systems that communicate and exchange data with each other over the internet. These devices, equipped with sensors, software, and other technologies, collect and transmit data, enabling seamless integration and automation in various domains. The concept of IoT has evolved significantly over the years, transitioning from simple machine-to-machine communication to a sophisticated ecosystem encompassing a myriad of applications and technologies. The evolution of IoT can be attributed to advancements in wireless communication, sensor technology, cloud computing, and artificial intelligence, which have collectively contributed to its proliferation across industries and sectors [2], [3]. As IoT continues to evolve, it holds the promise of transforming businesses, enhancing operational efficiency, and driving innovation across diverse fields.

2.2 Key Components and Technologies

IoT comprises several key components and technologies that facilitate its functionality and interoperability:

- **Sensors and Actuators:** These are fundamental components that enable devices to gather data from their surroundings and perform actions, respectively. Sensors detect changes in their environment, such as temperature, motion, or light, while actuators execute specific actions based on received instructions.
- **Connectivity:** Connectivity solutions, including Wi-Fi, Bluetooth, Zigbee, and cellular networks, enable seamless communication between devices and facilitate data transmission over the internet.
- **Edge Computing:** Edge computing involves processing data closer to its source, i.e., the device itself or a local server, rather than relying solely on a centralized cloud server. This approach reduces latency, conserves bandwidth, and enhances real-time processing capabilities.
- **Cloud Platforms:** Cloud platforms provide the infrastructure and services required to store, manage, and analyze data generated by IoT devices. These platforms offer scalability, security, and advanced analytics capabilities, enabling organizations to derive actionable insights from vast amounts of data.
- **Security Mechanisms:** Given the interconnected nature of IoT devices, ensuring robust security is paramount. Technologies such as encryption, authentication protocols, and secure communication protocols are essential to safeguard data and protect against potential threats.

2.3 Applications and Use Cases

IoT has found applications across various sectors, revolutionizing industries and driving innovation in numerous use cases:

- **Smart Homes:** IoT-enabled devices, such as smart thermostats, lighting systems, and security cameras, enhance home automation, convenience, and energy efficiency. These devices can be controlled remotely via

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

smartphones or voice commands, offering personalized experiences and enhancing overall quality of life.

- **Healthcare:** IoT technologies are transforming healthcare delivery through remote patient monitoring, wearable devices, and smart medical devices. These solutions facilitate continuous monitoring of vital signs, early detection of health anomalies, and personalized patient care, thereby improving health outcomes and reducing healthcare costs.
- **Industrial IoT (IIoT):** In the industrial sector, IIoT enables the monitoring and optimization of manufacturing processes, predictive maintenance of machinery, and real-time inventory management. These capabilities enhance operational efficiency, minimize downtime, and drive productivity gains across the manufacturing value chain.
- **Smart Cities:** IoT plays a crucial role in the development of smart cities by enabling intelligent transportation systems, efficient energy management, and enhanced public safety through smart infrastructure and connected devices. These initiatives aim to create sustainable, livable, and resilient urban environments for residents and businesses alike [4].

3. Big Data Analytics: Foundations and Advancements

3.1 Definition and Characteristics of Big Data

Big Data, at its core, refers to the vast volumes of structured, semi-structured, and unstructured data that inundates organizations on a daily basis. The term is characterized by the three Vs: Volume, Velocity, and Variety.

- **Volume:** Big Data is massive in scale. Traditional data storage and management systems often struggle to handle the sheer volume of data generated from various sources, including social media, IoT devices, sensors, and more.
- **Velocity:** Data is generated at an unprecedented speed. Whether it's real-time stock market updates, social media posts, or sensor data from machinery, the velocity of data creation demands rapid processing and analysis capabilities.
- **Variety:** Data comes in diverse formats. From structured data in databases to unstructured data like text, images, and videos, the variety of data types poses challenges in terms of storage, processing, and analysis.

Additionally, two more Vs are increasingly recognized:

- **Veracity:** Refers to the quality and trustworthiness of the data. With the proliferation of data sources, ensuring data accuracy and reliability becomes crucial.
- **Value:** While not a defining characteristic, deriving actionable insights and value from Big Data is paramount. The ultimate goal is to transform raw data into meaningful information that can drive informed decision-making.

3.2 Analytics Techniques and Tools

To extract insights from Big Data, a myriad of analytics techniques and tools have been developed:

- **Descriptive Analytics:** Focuses on summarizing historical data to identify patterns, trends, and anomalies. Techniques include data visualization, dashboards, and reports.

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

- **Predictive Analytics:** Utilizes statistical algorithms and machine learning techniques to forecast future trends and outcomes based on historical data. It helps organizations anticipate changes and make proactive decisions.
- **Prescriptive Analytics:** Goes beyond predictions by recommending actions to optimize outcomes. It provides decision-makers with actionable insights and strategies to address specific challenges or capitalize on opportunities [5].

3.3 Big Data in Business and Society

Big Data has permeated every facet of modern business and society:

- **Business Insights:** Organizations leverage Big Data analytics to gain a deeper understanding of customer behaviors, preferences, and sentiments. It informs product development, marketing strategies, and customer engagement initiatives, driving competitive advantage and business growth.
- **Healthcare:** Big Data analytics enhances patient care by enabling personalized treatments, predicting disease outbreaks, and improving operational efficiencies in healthcare delivery.
- **Smart Cities:** Cities harness Big Data to optimize urban planning, enhance public services, and improve the quality of life for residents through data-driven initiatives in transportation, energy management, and public safety.
- **Social Impact:** Big Data analytics plays a pivotal role in addressing societal challenges, such as poverty alleviation, disaster response, and environmental conservation, by providing insights to inform policy-making and drive impactful interventions.

4. Synergy Between IoT and Big Data Analytics

4.1 Data Generation and Collection in IoT

The Internet of Things (IoT) is characterized by a vast network of interconnected devices, sensors, and systems that generate an unprecedented volume of data. These devices, ranging from smart thermostats to industrial machinery, continuously collect and transmit data related to their operational status, environment, and interactions. The data generation in IoT is not limited to structured information; it encompasses diverse data types, including text, images, and sensor readings.

The collection of data in IoT is facilitated through various communication protocols and technologies, such as Wi-Fi, Bluetooth, and cellular networks. Additionally, edge computing devices play a crucial role in preprocessing and filtering data at the source, ensuring that only relevant and valuable information is transmitted to centralized systems or cloud platforms for further analysis [6]. The proliferation of IoT devices and the exponential growth of data generation present both opportunities and challenges. While the abundance of data fuels advanced analytics and insights, it also necessitates robust data management, storage, and security mechanisms to harness the full potential of IoT-generated data effectively.

4.2 Integration and Processing of IoT Data

The integration and processing of IoT data involve aggregating, organizing, and

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

analyzing data from disparate sources to derive meaningful insights and actionable information. Given the heterogeneous nature of IoT devices and data formats, integration becomes a critical aspect of leveraging IoT data effectively.

Integration platforms and middleware solutions play a pivotal role in harmonizing data from various IoT devices and systems. These platforms facilitate seamless data flow, transformation, and normalization, ensuring consistency and compatibility across the data landscape. Furthermore, advanced data integration techniques, such as data virtualization and API-based integrations, enable real-time access and processing of IoT data, fostering agility and responsiveness in decision-making processes.

Once integrated, IoT data undergoes processing, where analytics algorithms and techniques are applied to uncover patterns, trends, and anomalies. This processing phase often leverages distributed computing frameworks, such as Apache Hadoop and Spark, to handle the massive scale and complexity of IoT data. By transforming raw data into actionable insights, organizations can optimize operations, enhance customer experiences, and drive innovation across various domains [7], [8].

4.3 Real-time Analytics and Decision-making

Real-time analytics and decision-making represent a transformative capability enabled by the synergy between IoT and Big Data analytics. In the context of IoT, real-time analytics refers to the instantaneous processing and analysis of data as it is generated, allowing organizations to respond promptly to events, monitor operations in real-time, and implement proactive measures. Real-time analytics in IoT is facilitated by stream processing technologies, which enable continuous data ingestion, analysis, and actioning. These technologies, coupled with machine learning models and algorithms, empower organizations to detect anomalies, predict outcomes, and automate responses in real-time, thereby enhancing operational efficiency and agility.

The integration of real-time analytics with IoT data enables dynamic decision-making, where insights derived from real-time data analysis inform and influence operational strategies and actions. Whether it's optimizing supply chain logistics, managing smart city infrastructures, or enhancing healthcare services, real-time analytics empowers organizations to make informed decisions, mitigate risks, and capitalize on opportunities in a rapidly evolving digital landscape. In conclusion, the synergy between IoT and Big Data analytics, particularly in the realms of data generation, integration, and real-time analytics, is reshaping industries, driving innovation, and redefining the possibilities of data-driven decision-making in the interconnected world of the Internet of Things [9].

5. Transforming Business Through IoT and Big Data

5.1 Enhanced Operational Efficiency

The integration of IoT devices and Big Data analytics has significantly enhanced operational efficiency across various industries. By leveraging real-time data

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

collection and analysis, businesses can optimize processes, reduce downtime, and minimize wastage. For instance, in manufacturing, IoT-enabled sensors monitor equipment performance, predict maintenance needs, and streamline production workflows. Similarly, in logistics, real-time tracking and analytics enable route optimization, inventory management, and timely delivery, thereby reducing costs and enhancing customer satisfaction. Moreover, data-driven insights enable proactive decision-making, facilitating businesses to adapt swiftly to changing market dynamics and competitive pressures. Overall, enhanced operational efficiency through IoT and Big Data analytics translates into improved productivity, reduced operational costs, and a more agile business environment.

5.2 Data-driven Business Models and Strategies

The proliferation of IoT devices and the abundance of data they generate have catalyzed the emergence of data-driven business models and strategies. Organizations are leveraging advanced analytics to derive actionable insights from vast datasets, enabling them to create personalized customer experiences, develop innovative products and services, and unlock new revenue streams. For example, in the retail sector, IoT devices integrated with Big Data analytics facilitate personalized marketing campaigns, dynamic pricing strategies, and predictive inventory management. Likewise, in healthcare, wearable devices and remote monitoring systems enable proactive patient care, personalized treatment plans, and improved healthcare outcomes. By harnessing the power of IoT and Big Data, businesses can reimagine their value propositions, optimize resource allocation, and drive sustainable growth in an increasingly competitive landscape [10].

5.3 Case Studies: Success Stories and Lessons Learned

Several organizations have successfully leveraged IoT and Big Data analytics to transform their operations, drive innovation, and achieve strategic objectives. One notable example is General Electric (GE), which utilized IoT-enabled sensors and Big Data analytics to optimize the performance of its jet engines, resulting in significant fuel savings and enhanced reliability. Another success story is Amazon, which leverages IoT devices, machine learning algorithms, and Big Data analytics to personalize customer recommendations, optimize warehouse operations, and enhance the overall shopping experience. These case studies underscore the transformative potential of IoT and Big Data analytics across diverse industries and highlight the importance of strategic alignment, innovation, and continuous learning. Moreover, they offer valuable insights and lessons learned for organizations seeking to harness the power of IoT and Big Data to drive business transformation and achieve sustainable competitive advantage [11].

In summary, the convergence of IoT and Big Data analytics is reshaping the business landscape, enabling organizations to enhance operational efficiency, develop data-driven business models and strategies,

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

and drive innovation and growth. By embracing these technologies and adopting a strategic and innovative mindset, businesses can unlock new opportunities, optimize performance, and create value for stakeholders in an increasingly interconnected and data-driven world.

6. Societal Impacts and Considerations

6.1 IoT and the Digital Divide

The proliferation of the Internet of Things (IoT) has the potential to bridge gaps, connect remote regions, and democratize access to information and services. However, it also accentuates the digital divide, widening disparities between those with access to IoT technologies and those without.

Details: Many regions, particularly in developing countries, still lack adequate infrastructure and resources to fully harness the benefits of IoT. The digital divide is not merely about access to devices but encompasses factors such as affordability, digital literacy, and availability of reliable connectivity. As IoT applications become increasingly integrated into various sectors, including healthcare, education, and agriculture, addressing the digital divide becomes crucial to ensure inclusive growth and equitable opportunities for all [12].

6.2 Ethical and Privacy Concerns

The interconnected nature of IoT devices and the vast amount of data they generate raise significant ethical and privacy concerns. As devices collect and transmit sensitive information, ensuring data protection, consent, and ethical use becomes paramount.

Details: IoT devices often gather data without explicit user consent, leading to potential misuse or unauthorized access. Issues such as data breaches, surveillance, and profiling pose threats to individual privacy and autonomy. Moreover, the aggregation of data from multiple sources can create detailed profiles, raising questions about user anonymity and the potential for discrimination. Addressing these concerns requires robust data governance frameworks, transparent practices, and regulatory oversight to safeguard individual rights and uphold ethical standards in IoT deployments[13].

6.3 Societal Benefits and Challenges

The integration of IoT into societal frameworks offers a myriad of benefits, from enhancing efficiency and productivity to improving quality of life. However, realizing these benefits necessitates addressing associated challenges and ensuring that IoT deployments align with broader societal objectives.

Details: Societal benefits of IoT encompass areas such as healthcare, where remote monitoring and personalized treatments can revolutionize patient care. Additionally, smart cities leveraging IoT technologies can optimize resource allocation, reduce environmental impact, and enhance urban living. However, challenges such as infrastructure constraints, cybersecurity threats, and potential job displacement require careful consideration. Balancing the advantages of IoT with its societal implications entails collaborative efforts among stakeholders, encompassing policy-makers, industry leaders, and communities,

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

to foster a harmonious integration that prioritizes societal well-being and sustainable development [14].

7. Future Trends and Opportunities

7.1 Advancements in IoT Technologies

The future of IoT technologies promises unprecedented advancements, driven by continuous innovation and research. One of the key trends is the proliferation of edge computing, enabling data processing closer to the data source, thereby reducing latency and enhancing real-time analytics capabilities. This shift towards edge computing is complemented by the development of more sophisticated sensors and actuators, facilitating enhanced data collection and interaction within IoT ecosystems. Furthermore, the integration of artificial intelligence (AI) and machine learning (ML) with IoT devices is set to redefine the capabilities of connected systems. AI-driven IoT applications will enable predictive analytics, anomaly detection, and autonomous decision-making, paving the way for more intelligent and adaptive IoT solutions.

The convergence of IoT with other emerging technologies, such as 5G networks and blockchain, will also shape the future landscape. 5G's high-speed, low-latency connectivity will unlock new possibilities for IoT deployments, particularly in sectors requiring real-time communication and high data throughput. Meanwhile, blockchain technology offers enhanced security and transparency, addressing critical concerns related to data privacy, integrity, and trust within IoT infrastructures. Advancements in IoT technologies will continue to drive innovation across industries, fostering a more interconnected, intelligent, and efficient world [15], [16].

7.2 Evolving Landscape of Big Data Analytics

The evolution of Big Data analytics is characterized by the convergence of diverse data sources, enhanced processing capabilities, and the integration of advanced analytics techniques. As data volumes continue to grow exponentially, there is a growing emphasis on scalable and distributed computing frameworks, such as Apache Spark and Hadoop, to handle complex data processing tasks efficiently.

Moreover, the adoption of real-time analytics and streaming data processing frameworks, like Apache Kafka and Flink, is becoming increasingly prevalent, enabling organizations to derive actionable insights from data in real-time. This shift towards real-time analytics is driven by the need for timely decision-making, especially in dynamic and rapidly changing environments. The evolution of Big Data analytics is also marked by the growing importance of data governance, quality, and ethics. As organizations rely more on data-driven insights, ensuring data privacy, security, and compliance with regulations becomes paramount. This necessitates the development of robust data governance frameworks and the adoption of ethical data practices.

Furthermore, the integration of AI and ML algorithms within Big Data analytics platforms is revolutionizing data analysis capabilities, enabling more accurate predictions, personalized recommendations,

Journal Of Environmental Sciences And Technology
Volume No: 02 Issue No: 02 (2023)

and automated decision-making processes. In conclusion, the evolving landscape of Big Data analytics is characterized by advancements in technology, growing emphasis on real-time analytics, and increasing focus on data governance and ethics, shaping the future of data-driven decision-making [17].

7.3 Implications for Business, Society, and Policy-making

The convergence of IoT and Big Data analytics has profound implications for business, society, and policy-making. From a business perspective, the integration of IoT devices and advanced analytics enables organizations to gain deeper insights into customer behavior, optimize operations, and drive innovation. This, in turn, facilitates the development of new business models, products, and services, fostering competitive advantage and growth [18].

Moreover, the transformational impact of IoT and Big Data extends beyond businesses, influencing various aspects of society, including healthcare, transportation, energy, and urban planning. IoT-enabled smart cities, for instance, leverage data-driven insights to enhance sustainability, efficiency, and quality of life for residents, while IoT applications in healthcare enable remote monitoring, personalized treatment, and improved patient outcomes. However, the proliferation of IoT devices and the vast amounts of data generated also raise significant challenges and considerations related to data privacy, security, and ethical implications. As such, there is a growing need for comprehensive policies and regulations to govern the collection, storage, processing, and sharing of IoT-generated data, safeguarding individual rights and ensuring responsible use of technology [19].

Furthermore, policy-makers and regulators play a crucial role in fostering an enabling environment for IoT and Big Data innovation, balancing the benefits of technological advancements with potential risks and challenges. This includes promoting data literacy, establishing data governance frameworks, and addressing ethical and privacy concerns through appropriate legislation and standards [20].

8. Conclusion

8.1 Key Insights and Findings

Throughout this research, several pivotal insights have emerged regarding the transformative potential of the Internet of Things (IoT) and Big Data analytics. Firstly, the integration of IoT devices across various sectors has led to an unprecedented surge in data generation, offering a wealth of opportunities for businesses to derive actionable insights. Secondly, Big Data analytics serves as a cornerstone in unlocking the value of IoT-generated data, facilitating enhanced decision-making, operational efficiency, and innovation. Moreover, the synergy between IoT and Big Data has catalyzed advancements in real-time analytics, predictive modeling, and personalized experiences. However, it is imperative to acknowledge the challenges posed by data privacy, security concerns, and the digital divide, necessitating collaborative efforts to address these issues.

8.2 Recommendations for Stakeholders

For businesses and policymakers, embracing a strategic approach towards harnessing the

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

potential of IoT and Big Data analytics is crucial. Firstly, organizations should prioritize investments in robust data infrastructure, ensuring scalability, security, and interoperability of IoT devices and systems. Secondly, fostering a culture of data-driven decision-making and promoting data literacy across all organizational levels can amplify the benefits derived from analytics. Furthermore, stakeholders should engage in collaborative partnerships, fostering interdisciplinary research and knowledge sharing to navigate the evolving landscape of IoT and Big Data. Addressing ethical considerations, advocating for data privacy regulations, and promoting inclusivity in digital adoption are paramount to ensuring sustainable growth and societal advancement.

8.3 Final Thoughts on the Future Outlook

As we navigate the intricacies of an increasingly interconnected world, the fusion of IoT and Big Data analytics is poised to redefine the boundaries of innovation, reshaping industries, and societies alike. The proliferation of smart devices, coupled with advancements in data analytics techniques, heralds a future where predictive insights, automation, and personalized experiences become ubiquitous. However, the journey ahead is fraught with challenges, necessitating a concerted effort from stakeholders across sectors to foster a responsible, inclusive, and ethical digital ecosystem. Embracing a proactive stance, fostering innovation, and prioritizing the well-being of individuals and communities will be pivotal in shaping a future where IoT and Big Data analytics coalesce to create a more resilient, efficient, and equitable world.

References

[1] K. Rathor, K. Patil, M. S. Sai Tarun, S. Nikam, D. Patel and S. Ranjit, "A Novel and Efficient Method to Detect the Face Coverings to Ensurethe Safety using Comparison Analysis," 2022 International Conference on Edge Computing and Applications (ICECAA), Tamilnadu, India, 2022, pp. 1664-1667, doi: 10.1109/ICECAA55415.2022.9936392.

[2] Manjunath C R, Ketan Rathor, Nandini Kulkarni, Prashant Pandurang Patil, Manoj S. Patil, & Jasdeep Singh. (2022). Cloud Based DDOS Attack Detection Using Machine Learning Architectures: Understanding the Potential for Scientific Applications. International Journal of Intelligent Systems and Applications in Engineering, 10(2s), 268 –. Retrieved from https://www.ijisae.org/index.php/IJISAE/article/view/2398

[3] Wu, Y. (2023). Integrating Generative AI in Education: How ChatGPT Brings Challenges for Future Learning and Teaching. Journal of Advanced Research in Education, 2(4), 6-10.

[4] K. Rathor, S. Vidya, M. Jeeva, M. Karthivel, S. N. Ghate and V. Malathy, "Intelligent System for ATM Fraud Detection System using C-LSTM Approach," 2023 4th International Conference on Electronics and Sustainable Communication Systems (ICESC), Coimbatore, India, 2023, pp. 1439-1444, doi: 10.1109/ICESC57686.2023.10193398.

[5] Kumar, K. Rathor, S. Vaddi, D. Patel, P. Vanjarapu and M. Maddi, "ECG Based

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

Early Heart Attack Prediction Using Neural Networks," 2022 3rd International Conference on Electronics and Sustainable Communication Systems (ICESC), Coimbatore, India, 2022, pp. 1080-1083, doi: 10.1109/ICESC54411.2022.9885448.

[6] K. Rathor, S. Lenka, K. A. Pandya, B. S. Gokulakrishna, S. S. Ananthan and Z. T. Khan, "A Detailed View on industrial Safety and Health Analytics using Machine Learning Hybrid Ensemble Techniques," 2022 International Conference on Edge Computing and Applications (ICECAA), Tamilnadu, India, 2022, pp. 1166-1169, doi: 10.1109/ICECAA55415.2022.9936474.

[7] K. Rathor, S. Chandre, A. Thillaivanan, M. Naga Raju, V. Sikka and K. Singh, "Archimedes Optimization with Enhanced Deep Learning based Recommendation System for Drug Supply Chain Management," 2023 2nd International Conference on Smart Technologies and Systems for Next Generation Computing (ICSTSN), Villupuram, India, 2023, pp. 1-6, doi: 10.1109/ICSTSN57873.2023.10151666.

[8] Ketan Rathor, "Impact of using Artificial Intelligence-Based Chatgpt Technology for Achieving Sustainable Supply Chain Management Practices in Selected Industries ," International Journal of Computer Trends and Technology, vol. 71, no. 3, pp. 34-40, 2023.
Crossref, **https://doi.org/10.14445/22312803/IJCTT-V71I3P106**

[9] "Table of Contents," 2023 2nd International Conference on Smart Technologies and Systems for Next Generation Computing (ICSTSN), Villupuram, India, 2023, pp. i-iii, doi: 10.1109/ICSTSN57873.2023.10151517.

[10] "Table of Contents," 2023 Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS), Trichy, India, 2023, pp. i-xix, doi: 10.1109/ICAISS58487.2023.10250541.

[11] K. Rathor, A. Mandawat, K. A. Pandya, B. Teja, F. Khan and Z. T. Khan, "Management of Shipment Content using Novel Practices of Supply Chain Management and Big Data Analytics," 2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS), Trichy, India, 2022, pp. 884-887, doi: 10.1109/ICAISS55157.2022.10011003.

[12] S. Rama Krishna, K. Rathor, J. Ranga, A. Soni, S. D and A. K. N, "Artificial Intelligence Integrated with Big Data Analytics for Enhanced Marketing," 2023 International Conference on Inventive Computation Technologies (ICICT), Lalitpur, Nepal, 2023, pp. 1073-1077, doi: 10.1109/ICICT57646.2023.10134043.

[13] M. A. Gandhi, V. Karimli Maharram, G. Raja, S. P. Sellapaandi, K. Rathor and K. Singh, "A Novel Method for Exploring the Store Sales Forecasting using Fuzzy Pruning LS-SVM Approach," 2023 2nd International Conference on Edge Computing and Applications (ICECAA), Namakkal, India, 2023, pp. 537-543, doi: 10.1109/ICECAA58104.2023.10212292.

[14] K. Rathor, J. Kaur, U. A. Nayak, S. Kaliappan, R. Maranan and V. Kalpana, "Technological Evaluation and Software Bug Training using Genetic Algorithm and Time Convolution Neural Network (GA-TCN)," 2023 Second International

Conference on Augmented Intelligence and Sustainable Systems (ICAISS), Trichy, India, 2023, pp. 7-12, doi: 10.1109/ICAISS58487.2023.10250760.

[15] Hollings, Sam & Torabi, Fatemeh & Abbas, Asad. (2023). Striking a Balance: Ensuring Ethical Considerations in the Integration of AI in Education.

[16] Ahmad, Nawaz & Abbas, Asad. (2023). Catalyzing Change: The Impact of Interdisciplinary Approaches on AI Education. 10.13140/RG.2.2.30094.13123..

[17] Williams, S., Hardy, C., & Nitschke, P. (2019). Configuring the Internet of Things (IoT): A review and implications for big data analytics.

[18] Ahmed, E., Yaqoob, I., Hashem, I. A. T., Khan, I., Ahmed, A. I. A., Imran, M., & Vasilakos, A. V. (2017). The role of big data analytics in Internet of Things. Computer Networks, 129, 459-471.

[19] Ahmad, Sumrine & Abbas, Asad. (2023). Guardians of the Digital Realm: Interplay between Machine Learning, Artificial Intelligence, and Cyber security.

[20] Riggins, F. J., & Wamba, S. F. (2015, January). Research directions on the adoption, usage, and impact of the internet of things through the use of big data analytics. In 2015 48th Hawaii international conference on system sciences (pp. 1531-1540). IEEE.

[21]

[22] Liang, J., Wang, R., Liu, X., Yang, L., Zhou, Y., Cao, B., & Zhao, K. (2021, July). Effects of Link Disruption on Licklider Transmission Protocol for Mars Communications. In *International Conference on Wireless and Satellite Systems* (pp. 98-108). Cham: Springer International Publishing.

[23] Liang, J., Liu, X., Wang, R., Yang, L., Li, X., Tang, C., & Zhao, K. (2023). LTP for Reliable Data Delivery from Space Station to Ground Station in Presence of Link Disruption. *IEEE Aerospace and Electronic Systems Magazine*.

[24] Arif, H., Kumar, A., Fahad, M., & Hussain, H. K. (2023). Future Horizons: AI-Enhanced Threat Detection in Cloud Environments: Unveiling Opportunities for Research. *International Journal of Multidisciplinary Sciences and Arts*, *2*(2), 242-251.

[25] Kumar, A., Fahad, M., Arif, H., & Hussain, H. K. (2023). Synergies of AI and Smart Technology: Revolutionizing Cancer Medicine, Vaccine Development, and Patient Care. *International Journal of Social, Humanities and Life Sciences*, *1*(1), 10-18.

[26] Yang, L., Liang, J., Wang, R., Liu, X., De Sanctis, M., Burleigh, S. C., & Zhao, K. (2023). A Study of Licklider Transmission Protocol in Deep-Space Communications in Presence of Link Disruptions. *IEEE Transactions on Aerospace and Electronic Systems*.

[27] Yang, L., Wang, R., Liang, J., Zhou, Y., Zhao, K., & Liu, X. (2022). Acknowledgment Mechanisms for Reliable File Transfer Over Highly Asymmetric Deep-Space Channels. *IEEE Aerospace and Electronic Systems Magazine*, *37*(9), 42-51.

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

[28] Zhou, Y., Wang, R., Yang, L., Liang, J., Burleigh, S. C., & Zhao, K. (2022). A Study of Transmission Overhead of a Hybrid Bundle Retransmission Approach for Deep-Space Communications. *IEEE Transactions on Aerospace and Electronic Systems*, *58*(5), 3824-3839.

[29] Fahad, M., Airf, H., Kumar, A., & Hussain, H. K. (2023). Securing Against APTs: Advancements in Detection and Mitigation. *BIN: Bulletin Of Informatics*, *1*(2).

[30] Kumar, A., Fahad, M., Arif, H., & Hussain, H. K. (2023). Navigating the Uncharted Waters: Exploring Challenges and Opportunities in Block chain-Enabled Cloud Computing for Future Research. *BULLET: Jurnal Multidisiplin Ilmu*, *2*(6), 1297-1305.

[31] Yang, L., Wang, R., Liu, X., Zhou, Y., Liang, J., & Zhao, K. (2021, July). An Experimental Analysis of Checkpoint Timer of Licklider Transmission Protocol for Deep-Space Communications. In *2021 IEEE 8th International Conference on Space Mission Challenges for Information Technology (SMC-IT)* (pp. 100-106). IEEE.

[32] Zhou, Y., Wang, R., Liu, X., Yang, L., Liang, J., & Zhao, K. (2021, July). Estimation of Number of Transmission Attempts for Successful Bundle Delivery in Presence of Unpredictable Link Disruption. In *2021 IEEE 8th International Conference on Space Mission Challenges for Information Technology (SMC-IT)* (pp. 93-99). IEEE.

[33] Liang, J. (2023). *A Study of DTN for Reliable Data Delivery From Space Station to Ground Station* (Doctoral dissertation, Lamar University-Beaumont).

[34] Tinggi, M., Jakpar, S., Chin, T. B., & Shaikh, J. M. (2011). Customers? Confidence and trust towards privacy policy: a conceptual research of hotel revenue management. *International Journal of Revenue Management*, *5*(4), 350-368.

[35] Alappatt, M., Sheikh, J. M., & Krishnan, A. (2010). Progress billing method of accounting for long-term construction contracts. *Journal of Modern Accounting and Auditing*, *6*(11), 41.

[36] Krishnan, A., Chan, K. M., Jayaprakash, J. C. M., Shaikh, J. M., & Isa, A. H. B. M. (2008). Measurement of performance at institutions of higher learning: the balanced score card approach. *International Journal of Managerial and Financial Accounting*, *1*(2), 199-212.

[37] Al-Takhayneh, S. K., Karaki, W., Chang, B. L., & Shaikh, J. M. (2022). Teachers' psychological resistance to digital innovation in jordanian entrepreneurship and business schools: Moderation of teachers' psychology and attitude toward educational technologies. *Frontiers in Psychology*, *13*, 1004078.

[38] Mamun, M. A., & Shaikh, J. M. (2018). Reinventing strategic corporate social responsibility. *Journal of*

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

Economic & Management Perspectives, *12*(2), 499-512.

[39] Mwansa, S., Shaikh, J., & Mubanga, P. (2020). Special economic zones: An evaluation of Lusaka south-multi facility economic zone. *Journal of Social and Political Sciences*, *3*(2).

[40] Rani, N. S. A., Hamit, N., Das, C. A., & Shaikh, J. M. (2011). Microfinance practices in Malaysia: from'kootu'concept to the replication of the Grameen Bank model. *Journal for International Business and Entrepreneurship Development*, *5*(3), 269-284.

[41] Yuan, X., Kaewsaeng-On, R., Jin, S., Anuar, M. M., Shaikh, J. M., & Mehmood, S. (2022). Time lagged investigation of entrepreneurship school innovation climate and students motivational outcomes: Moderating role of students' attitude toward technology. *Frontiers in Psychology*, *13*, 979562.

[42] Shamil, M. M. M., & Junaid, M. S. (2012). Determinants of corporate sustainability adoption in firms. In *2nd International Conference on Management. Langkawi, Malaysia*.

[43] Ali Ahmed, H. J., & Shaikh, J. M. (2008). Dividend policy choice: do earnings or investment opportunities matter?. *Afro-Asian Journal of Finance and Accounting*, *1*(2), 151-161.

[44] Odhigu, F. O., Yahya, A., Rani, N. S. A., & Shaikh, J. M. (2012). Investigation into the impacts of procurement systems on the performance of construction projects in East Malaysia. *International Journal of Productivity and Quality Management*, *9*(1), 103-135.

[45] Shaikh, J. M. (2010). Reviewing ABC for effective managerial and financial accounting decision making in corporate entities. In *Allied Academies International Conference. Academy of Accounting and Financial Studies. Proceedings* (Vol. 15, No. 1, p. 47). Jordan Whitney Enterprises, Inc.

[46] Ali Ahmed, H. J., Shaikh, J. M., & Isa, A. H. (2009). A comprehensive look at the re-examination of the re-evaluation effect of auditor switch and its determinants in Malaysia: a post crisis analysis from Bursa Malaysia. *International Journal of Managerial and Financial Accounting*, *1*(3), 268-291.

[47] Abdullah, A., Khadaroo, I., & Shaikh, J. (2017). XBRL benefits, challenges and adoption in the US and UK: Clarification of a future research agenda. In *World Sustainable Development Outlook 2007* (pp. 181-188). Routledge.

[48] Tinggi, M., Jakpar, S., Tiong, O. C., & Shaikh, J. M. (2014). Determinants on the choice of telecommunication providers among undergraduates of public universities. *International Journal of Business Information Systems*, *15*(1), 43-64.

[49] Jasmon, A., & Shaikh, J. M. (2004). UNDERREPORTING INCOME: SHOULD FINANCIAL INSTITUTIONS DISCLOSE CUSTOMERS'INCOME TO TAX

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

AUTHORITIES?. *JOURNAL OF INTERNATIONAL TAXATION*, *15*(8), 36-43.

[50] Mwansa, S., Shaikh, J. M., & Mubanga, P. (2020). Investing in the Lusaka South Multi Facility Economic Zone. *Advances in Social Sciences Research Journal*, *7*(7), 974-990.

[51] Junaid, M. S., & Dinh Thi, B. L. (2017). Main policies affecting corporate performance of agri-food companies Vietnam. *Academy of Accounting and Financial Studies Journal*, *21*(2).

[52] Sheikh, M. J. (2015, November). Experiential learning in entrepreneurship education: A case Of CEFE methodology in Federal University of Technology Minna, Nigeria. Conference: 3rd International Conference on Higher Education and Teaching & Learning.

[53] Chafjiri, M. B., & Mahmoudabadi, A. (2018). Developing a conceptual model for applying the principles of crisis management for risk reduction on electronic banking. *American Journal of Computer Science and Technology*, *1*(1), 31-38.

[54] Lynn, L. Y. H., Evans, J., Shaikh, J., & Sadique, M. S. (2014). Do Family-Controlled Malaysian Firms Create Wealth for Investors in the Context of Corporate Acquisitions. *Capital Market Review*, *22*(1&2), 1-26.

[55] Shamil, M. M. M., Shaikh, J. M., Ho, P. L., & Krishnan, A. (2012). The Relationship between Corporate Sustainability and Corporate Financial Performance: A Conceptual Review. In *Proceedings of USM-AUT International Conference 2012 Sustainable Economic Development: Policies and Strategies* (Vol. 167, p. 401). School of Social Sciences, Universiti Sains Malaysia.

[56] Chafjiri, M. B., & Mahmoudabadi, A. (2018). Developing a conceptual model for applying the principles of crisis management for risk reduction on electronic banking. *American Journal of Computer Science and Technology*, *1*(1), 31-38.

[57] Lynn, L. Y. H., & Shaikh, J. M. (2010). Market Value Impact of Capital Investment Announcements: Malaysia Case. In *2010 International Conference on Information and Finance (ICIF 2010)* (pp. 306-310). Institute of Electrical and Electronics Engineers, Inc..

[58] Shaikh, J. (2010). Risk Assessment: Strategic Planning and Challenges while Auditing. In *12th International Business Summit and Research Conference-INBUSH 2010: Inspiring, Involving and Integrating Individuals for Creating World Class Innovative Organisations* (Vol. 2, No. 2, pp. 10-27). Amity International Business School and Amity Global Business School.

[59] Shaikh, J. M. (2008). Hewlett-Packard Co.(HP) accounting for decision analysis: a case in International financial statement Analysis. *International Journal of Managerial and financial Accounting*, *1*(1), 75-96.

[60] Jasmon, A., & Shaikh, J. M. (2003). A PRACTITIONER'S GUIDE TO

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

GROUP RELIEF. *JOURNAL OF INTERNATIONAL TAXATION*, *14*(1), 46-54.

[61] Kangwa, D., Mwale, J. T., & Shaikh, J. M. (2020). Co-Evolutionary Dynamics Of Financial Inclusion Of Generation Z In A Sub-Saharan Digital Financial Ecosystem. *Copernican Journal of Finance & Accounting*, *9*(4), 27-50.

[62] ZUBAIRU, U. M., SAKARIYAU, O. B., & JUNAID, M. S. (2015). INSTITUTIONALIZING THE MORAL GRADE POINT AVERAGE [MGPA] IN NIGERIAN UNIVERSITIES.

[63] Shaikh, J., & Evans, J. (2013). CORPORATE ACQUISITIONS OF MALAYSIAN FAMILYCONTROLLED FIRMS. *All rights reserved. No part of this publication may be reproduced, distributed, stored in a database or retrieval system, or transmitted, in any form or by any means, electronics, mechanical, graphic, recording or otherwise, without the prior written permission of Universiti Malaysia Sabah, except as permitted by Act 332, Malaysian Copyright Act of 1987. Permission of rights is subjected to royalty or honorarium payment.*, *7*, 474.

[64] Jasmon, A., & Shaikh, J. M. (2001). How to maximize group loss relief. *Int'l Tax Rev.*, *13*, 39.

[65] SHAMIL, M., SHAIKH, J., HO, P., & KRISHNAN, A. External Pressures. *Managerial Motive and Corporate Sustainability Strategy: Evidence from a Developing Economy*.

[66] Bhasin, M. L., & Shaikh, J. M. (2012). Corporate governance through an audit committee: an empirical study. *International Journal of Managerial and Financial Accounting*, *4*(4), 339-365.

[67] Ahmed, H. J. A., Lee, T. L., & Shaikh, J. M. (2011). An investigation on asset allocation and performance measurement for unit trust funds in Malaysia using multifactor model: a post crisis period analysis. *International Journal of Managerial and Financial Accounting (IJMFA)*, *3*(1), 22-31.

[68] Wang, Q., Azam, S., Murtza, M. H., Shaikh, J. M., & Rasheed, M. I. (2023). Social media addiction and employee sleep: implications for performance and wellbeing in the hospitality industry. *Kybernetes*.

[69] Jasmon, A., & Shaikh, J. M. (2003). Tax strategies to discourage thin capitalization. *Journal of International Taxation*, *14*(4), 36-44.

[70] Shaikh, J. M., & Mamun, M. A. (2021). Impact of Globalization Versus Annual Reporting: A Case. *American Journal of Computer Science and Technology*, *4*(3), 46-54.

[71] M. Shamil, M., M. Shaikh, J., Ho, P. L., & Krishnan, A. (2014). The influence of board characteristics on sustainability reporting: Empirical evidence from Sri Lankan firms. *Asian Review of Accounting*, *22*(2), 78-97.

[72] Shaikh, J. M., Islam, M. R., & Karim, A. M. Creative Accounting Practice: Curse Or Blessing–A Perception Gap Analysis Among

Journal Of Environmental Sciences And Technology

Volume No: 02 Issue No: 02 (2023)

Auditors And Accountants Of Listed Companies In Bangladesh.

[73] Shamil, M. M., Gooneratne, D. W., Gunathilaka, D., & Shaikh, J. M. (2023). The effect of board characteristics on tax aggressiveness: the case of listed entities in Sri Lanka. *Journal of Accounting in Emerging Economies*, (ahead-of-print).

[74] Shaikh, I. M., Alsharief, A., Amin, H., Noordin, K., & Shaikh, J. (2023). Inspiring academic confidence in university students: perceived digital experience as a source of self-efficacy. *On the Horizon: The International Journal of Learning Futures*, *31*(2), 110-122.

[75] Shaikh, J. M. (2023). Considering the Ethics of Accounting in Managing Business Accounts: A Review. *TESS Res Econ Bus*, *2*(1), 115.

[76] Naruddin, F., & Shaikh, J. M. (2022). The Effect of Stress on Organizational Commitment, Job Performance, and Audit Quality of Auditors in Brunei.

[77] Izzaty, D. N., Shaikh, J. M., & Talha, M. (2023). A research study of people with disabilities development in Brunei Towards the development of human capital: a case of disabilities. *International Journal of Applied Research in Management, Economics and Accounting*, *1*(1), 22-30.

[78] Tin Hla, D., Hassan, A., & Shaikh, J. (2013). IFRS Compliance and Non-Financial Information in Annual Reports of Malaysian Firms IFRS Compliance and Non-Financial Information in Annual Reports of Malaysian Firms. *The IUP journal of accounting research and audit*, *12*, 7-24.

[79] Yeo, T. S., Abdul Rani, N. S., & Shaikh, J. (2010). Impacts of SMEs Character in The Loan Approval Stage. In *Conference Proceeding*. Institute of Electrical and Electronics Engineers, Inc..

[80] Papa, M., Sensini, L., Kar, B., Pradhan, N. C., Farquad, M. A. H., Zhu, Y., ... & Mazı, F. Research Journal of Finance and Accounting.

[81] Shaikh, J. M., & Linh, D. T. B. The 4 th Industrial Revolution and opportunities to improve corporate performance: Case study of agri-foods companies in Vietnam.