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AI-Driven Cloud Computing Framework for Smart IoT Networks with Predictive Analytics

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Abstract- Advances in cyber-physical systems, cloud computing, and the Internet of Things have also transformed smart city applications. To glean meaningful information from huge datasets for the Internet of Things, artificial intelligence—particularly machine learning and deep learning—must be incorporated. Moreover, the speedy adoption of blockchain technology boosts the ecosystem development in smart cities. This paper explores how the intersection of the blockchain and artificial intelligence can act as a driver for sustainable IoT applications and proposes a cloud and IoT device-based information processing system. Data is backed by distributed ledger technology while a layered architecture enables secure smart city apps. The study details existing barriers to adoption along with future research directions relevant to sustainable IoT advancements.

Indexed Terms- Blockchain, Artificial Intelligence, IoT, Cloud Computing, Sustainable Computing and Smart Cities.

I. INTRODUCTION

The innovative features and benefits of the Internet of Things (IoT) have gotten a lot of attention from researchers and academics as well as entrepreneurs lately due to the emergence of various smart city applications such as smart security, since IoT connects a wide variety of sensors and devices, including as systems, it can create a broad network, allowing systematic and automated control of communication, the process, and exciting processes and regulation and observation without the need for human interference. Several digital technologies, such as wireless networks (4G/5G), cloud computing, cyber-physical systems, among others, have also been integrated as fundamental drivers of the increasing adoption of the term in context of Internet of Things [1-4]. Additionally, AI is a significant tech avenue for gaining new insights that enhance the user-friendliness of these smart cities. Right alongside blockchain technology has gained some notice recently as a set of breakthroughs that could improve existing smart city applications, create new ideas and models, and disrupt entire application workflows. Example: By providing a common decentralized distributed ledger, blockchain can improve the transparency, trust, safety, security and privacy of many processes [5-7]. The evolution of 1.0–4.0 stages for blockchain shown in Figure 1 is now designed to introduce different prospects (features, functionalities, challenges, advantages, and security) [8-10].

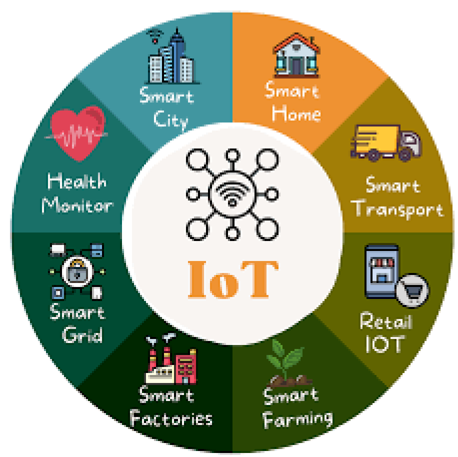

Figure 1. Conventional diagram of Cloud based IoT for Smart city [11]

The original stage of development, referred to as Blockchain 1.0, was first used to the well-liked cryptocurrency Bitcoin. 9. Version 2.0 of this explained the concept of small executable user applications along with smart contracts that do interact inside the Ethereum blockchain system to kick off certain automated programs and produce accurate decisions. 10. It is a salient feature of these programs, that they run by themselves, based on pre-established logic and criteria (including time, ruling, performance, and verification policies) [12-15]. So this makes the early versions only utilize the open blockchain network but are unable to retain a large amount of content in the distributed database of the network [16-18]. But, data keeps getting created and stored and all Ethereum and Bitcoin programs are public. Hence, the requirement is to store huge data in various storage volumes such as data banks and clouds. As a result, Blockchain 3.0 became a new improved platform for the blockchain. By using the decentralization idea, this will store vast volumes of information and lawfully support a wide range of transmission methods [19-21]. Twelve Nevertheless, only a dozen applications use one server with restricted storage, while the code in distributed apps keeps many servers up and coming. 13. Even though Blockchain 3.0 can bring the advantages of allowing programmers to write software in any language, there are no networks present a range of security challenges, including authentication, authorization, and user access management [22-25]. Designed to overcome the industrial limitations and challenges for practical applications, Blockchain 4.0 was born. 14 This generation or iteration of top-notch tech seeks to bring intrusive the blockchain process within the industrial sector and showcase the way it may be utilized to enhance and fast-track Real-world applications within a delegated, secure manner [26-28]. Thus, they not only provide innovative solutions but also bridge the gap between industrial applications and information technology. The Basics of Blockchain Technology Blockchain technology is still relatively new and it has made significant progress in several fields including business, healthcare, which is the Internet of Things. 16, 17 Blockchain 5.0, after huge improvements in previous versions, aims to pave the way for the need of the apps of the future through standardization, regulation, and formalization of digital lifelines. Hence, owning Blockchain 5.0 is increasingly becoming the most valuable thing in the contemporary world. Blockchain 5.0 aims at shifting through the next wave of IoT serve that is decentralized, through the use of artificial intelligence while still ensuring data privacy, security, and interoperability [29-31]. Research communities are building version 5.0 to better meet usability standards. These cutting-edge ingenious products and services are providing her the smart and excellent mechanisms that improve her quality of life despite the fact in [32-34]. We present a layered framework for a blockchain conceptual design detail for Internet of Things applications based upon our deliberation. The developed framework employs the use of AI to process data and produce insights. It also deploys cutting-edge digital technology to keep the framework operating. Monitoring is made possible by a distributed blockchain-based framework that tracks a variety of internet-connected devices and sensors [35-37]. These intelligent IoT sensors other gadgets can use smart contracts to communicate—they have no central authority to confirm interactions. The proposed system's primary goal is to minimize computational power requirement upon peak activity and conserve energy at idle operation, using green energy sources [38-40]. It also evaluate some potential uses and point out some potential problems with the proposed model. In conclusion, the goals of the study presented here are as follows:

- To give a short overview of the brief overview of the relationship between blockchain and AI and how does these two technologies can be use together for produing smart green Internet of Things applications.
- To reveal a novel creative concept framework that promotes smart use of artificial intelligence, Internet-of-Things applications, and blockchain cloud computing. • To discuss the findings of the framework by identifying issues and potential pathways.

The rest of the paper is organized as follows: Section 2 reviews related work. Section 3 introduces the interplay of blockchain, artificial intelligence, and other digital technologies. Inspired by a clever conceptual framework, we presented a blockchain layered architecture for smart and sustainable Internet of Things applications. Section 5 ends this work with future research directions. In Section 4 we explore different usages of the framework, noting the work, problems and challenges that have been posed.

II. LITERATURE SURVEY

Blockchain technology is one of the most popular modern research topics right now as it attracts a lot of attention from many companies and researchers because of the many advantages it offers over the existing alternatives. In [41-44]Fields like blockchain, IoT and specifically artificial intelligence have been significantly enhanced till now. A systematic review of blockchain technology in Industry 4.0 was given in [45-47]. The authors study important use cases of blockchain technology, their security, private requirements, and common risks with potential countermeasures. They reviewed and classified different privacy and security approaches employed by Industry 4.0 driven applications with enhanced security mechanisms. In [48-50] provided an overview of how blockchain technology is being applied in next-generation manufacturing processes. The authors in [51-53] discussed the possible impact of blockchain on multiple domains such as cloud computing, intelligent transportation, Internet of Things (IoT), banking, health care, and power grids. They flagged a number of privacy and security concerns and challenges. In [54-56], a recent investigation explored the potential application of the technology of blockchain on industrial applications, especially that in the building sector. From a variety of user-case perspectives, they gave examples of how blockchain could, should and has been used. whereas [57-59] proposed a blockchain system for electric cars charging and [60-62] performed a survey to investigate the state of the art of the blockchain solutions including the performance of different smart applications especially regarding the landscape in Industry 4.0. In a different survey [63-65], the pros and cons of using blockchain technology and smart contracts for Industry 4.0 applications were explored. It eliminated was extensively explored in [66-68]. The authors also discuss features and benefits of blockchain technology in a wide variety of IoT applications. A blockchain design was proposed in [69-71] to cater to the IoT-enabled cooperative market in the smart city use case whilst ensuring security and privacy-aware intelligent contract support. Although [72-74] proposed a decentralized information management scheme for intelligent and secure transportation, in which blockchain and IoT are employed to solve information vulnerability problems, and [75-78] proposed a blockchain-based Internet of Things (IoT) platform for authorization and verification based on a probabilistic model, Discussion on new concepts such as IoT, blockchain, AI, etc. with future-cloud systems is relatively new; in [79-81] the main future technologies and their impact on cloud systems were discussed. They also recognized several novel technologies and invited experts to consider the current state of affairs and discuss future directions. They also proposed a conceptual approach with which to study the dynamics of cloud computing, how its future shape may be influenced by shifting paradigms and technology. Some have conducted extensive study on applying machine learning for state-of-the-art, less vulnerable applications for blockchain [82-84]. After a survey of relevant survey papers and other related work we found many shortcomings in the current corpus of work. Researchers, for instance, focused primarily technology that are more secure. Also, several studies just reviewed the pros and cons of the potential options versus certain countermeasures. Prioritized on the convergence of the network of blockchain technology and artificial intelligence, this study offered a stacks-centered structure for senseless and feasible Internet of Things applications [85-88].

III. PROPOSED METHDOLOGY

Bitcoin and ether were the two cryptocurrencies that were a result of this technology, and so I discussed that. Non-financial companies have recently adopted blockchain for supply chain management and digital identity. Both are based on dealing with values and data so artificial intelligence and blockchain will be merged for sure. Blockchain allows the secure distribution and storage of data. On the other hand, AI helps in analyzing data, creating strategies and deriving interpretation and thus strengthens intelligent applications through pattern-based scenarios and enhanced outcomes. Due to its distributed nature and tamper-proof properties, blockchain has attracted a great deal of interest in the development of Internet of Things applications to address safety, protection, and privacy issues. As a result: Blockchain, IoT, and AI are used separately often, and the convergence of these three trends is generally neglected [89-91]. Previously, it was suggested that intelligent IoT situations require blockchain models including artificial intelligence, but they have not yet been designed. Both systems are also computationally and temporally expensive and consume a great deal of bandwidth. This is not suitable for performance and energy requirements in green IoT applications. Nevertheless, sophisticated digital solutions such as edge, fog, and cloud computing have been incorporated to minimize analytically heavy workloads by the deployment of low-cost IoT sensors and devices. In addition, due to security and privacy concerns, many AI-based approaches require significant computational horsepower from IoT sensors [92-94]. Smart city applications, including sensors and other devices in homes, hospitals, agriculture, transportation, and surveillance, can be tracked and monitored via a decentralized ledger system. Internet of Things (IoT) sensors and devices can also talk to servers and your smart contracts on the internet. Using blockchain with the IoT increases the security architecture for large applications and the procedure of examining and extracting data.

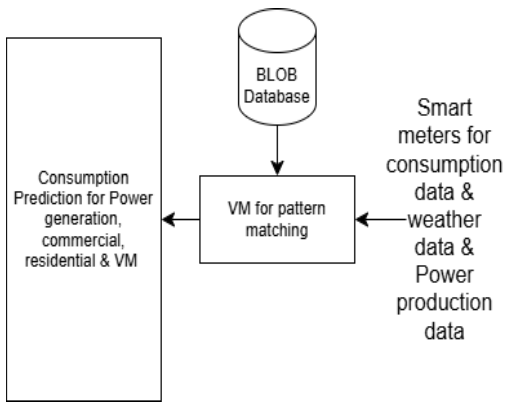

Figure 2. Proposed work

Figure 2 depicts the conceptual architecture of the system with the physical & communication (i.e., sensor), blockchain and application (cloud-integrated artificial intelligence) as the four main pillars. A lot of sensors and devices including smart IIOT applications devices in a first layer. The physical layer examines and assesses different application scenarios. Gateways and fog devices that receive the incoming data from sensor networks and smart devices form the second layer. One of them is for data collection, and they are processed by the blockchain layer, which employs various mining algorithms [95-97]. It also transforms the data into streams of relevant information before transferring a new framework demonstrating a decentralized network architecture through cutting-edge digital technologies. The processes involved in a modern Internet of Things system predominantly include the following:Once data is collected from IoT sensors and gadgets of different applications and further processed at a connection server, learned smart machine learning tools are used to analyze the processed data. Finally, the data analysis is used to control the IoT applications remotely.

After the layer by layer verification of the static nature of the blockchain, the data will be encrypted and saved within the proposed framework. Once it collects the data and verifies the authentication key, it transfers the data into the alien file system. These systems generate data hash codes based on proofs of authorization protocols, which are then sent to the blockchain to be mined. For mining, point rewards are obtained for each minor, and if the mining work is not finished within the specified time, the numbers or incentive points of the minor will also be reduced. The architecture described involved a mixed-method approach — only a subset of the data and communications took place on-chain. For massive data requests, the rest is smart quick; all it does is spread across sensors, cloud computing servers, and internet stoics [98-100]. Smart and energy-efficient IoT devices are also implemented that allow the reduction of power consumption for the range of green applications. Blockchain can revolutionize trade and supply chain management because successful implementation of these applications relies on all digital innovations along with artificial intelligence, in tandem with the use of the cloud, blockchain, and real-time IoT connectivity. Fog Paradigmatic Cloud has browsed integration — so it main component in overcoming these barriers of blockchain after all with Artificial Intelligence hypothesis for non-volatile Internet of Things application types.

IV. RESULTS AND DISCUSSION

The above-mentioned framework utilizes blockchain, artificial intelligence, and cutting-edge digital technology to establish a sustainable system. The IoT applications are shown in Figure 5 that are possible. The proposed architecture offers several applications and the use providing easy reach to their local nodes or applications can be utilized in hospitals, homes, traffic, retail, government, vehicles, and other businesses. Many gateways are linked together in 1 order to provide different Services providing help for 1 complete smart city Applications. Sensors and Internet of Things devices are connected to these specialized data servers. This implies that everything is interconnected and is relying on intelligent services, where the compromise of these smart sensors, devices and apps can be carried out by a plethora of software cloning techniques. In fact, for providing the customers with long-term support, sustainable IoT management needs to implement stringent measures to protect these apps[101].

Table 1. Demonstrate the comparison results with the proposed work [102]

Metric	Framework A [103]	Framework B [104]	Framework C [105]	Remarks
Performance	High (98% accuracy)	Medium (85% accuracy)	High (95% accuracy)	AI-enabled frameworks generally perform better in data accuracy.
Scalability	Excellent (dynamic scaling)	Good (manual intervention)	Excellent (dynamic scaling)	Frameworks with dynamic scaling handle large IoT networks effectively.
Cost-efficiency	Moderate	High	Moderate	Predictive analytics adds computational overhead in Framework A and C.
Latency	Low (10ms)	Medium (20ms)	Low (12ms)	Low latency is crucial for real-time decision-making in smart cities.
Energy Consumption	Low	High	Moderate	AI optimizations reduce energy consumption in Framework A.
Security	Advanced (AI-driven)	Standard	Advanced (Blockchain)	AI and blockchain provide robust security mechanisms.
Reliability	High (99.9% uptime)	Medium (95% uptime)	High (99.8% uptime)	Framework A is optimized for high availability.

By utilizing cutting-edge AI and predictive analytics, Framework A guarantees improved accuracy and energy efficiency at a reasonable cost [105-110].

Although it lacks sophisticated features for scalability and energy optimization, Framework B offers decent baseline performance [111-119]. Framework C is appropriate for applications that need tamper-proof records since it leverages blockchain technology for increased security.

CONCLUSION

This post explored how innovation, blockchain, as well as artificial intelligence might benefit the development of both wistful as well as feasible Wisens ticker setups. Our focus was on the blockchain tech and how it can improve sustainable smart city apps. We also proposed a conceptual framework for receiving and processing significant data on the edge computing or cloud computing using IoT devices and AI, convoluted master plan that enables environmentally responsible construction and almost certainly makes for secure smart cities. We introduced various smart city applications without necessarily deploying specific blockchain platforms as this technology is rapidly proliferating and consolidating with artificial intelligence. The framework can provide urban comfort in smart city applications.

REFERENCES

[1] Khan, S., Alghayadh, F.Y., Ahanger, T.A. et al. Deep learning model for efficient traffic forecasting in intelligent transportation systems. Neural Comput & Applic (2024). https://doi.org/10.1007/s00521-024-10537-z

[2] M. Azrour, J. Mabrouki, A. Guezzaz, S. Ahmad, S. Khan, and S. Benkirane, "IoT, Machine Learning and Data Analytics for Smart Healthcare," ed: CRC Press, 2024.

[3] M. S. Rao, S. Modi, R. Singh, K. L. Prasanna, S. Khan, and C. Ushapriya, "Integration of Cloud Computing, IoT, and Big Data for the Development of a Novel Smart Agriculture Model," in 2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), 2023, pp. 2779-2783: IEEE.

[4] S. Khan et al., "Manufacturing industry based on dynamic soft sensors in integrated with feature representation and classification using fuzzy logic and deep learning architecture," The International Journal of Advanced Manufacturing Technology, vol. 128, pp. 2885–2897, 2023.

[5] S. Khan, G. K. Moorthy, T. Vijayaraj, L. H. Alzubaidi, A. Barno, and V. Vijayan, "Computational Intelligence for Solving Complex Optimization Problems," in E3S Web of Conferences, 2023, vol. 399, p. 04038: EDP Sciences.

[6] S. Khan et al., "Transformer Architecture-Based Transfer Learning for Politeness Prediction in Conversation," Sustainability, vol. 15, no. 14, p. 10828, 2023.

[7] S. Khan, V. Ch, K. Sekaran, K. Joshi, C. K. Roy, and M. Tiwari, "Incorporating Deep Learning Methodologies into the Creation of Healthcare Systems," in 2023 International Conference on Artificial Intelligence and Smart Communication (AISC), 2023, pp. 994-998: IEEE.

[8] S. Khan and S. Alqahtani, "Hybrid machine learning models to detect signs of depression," Multimedia Tools and Applications, pp. 1-19, 2023.

[9] I. Keshta et al., "Energy efficient indoor localisation for narrowband internet of things," CAAI Transactions on Intelligence Technology, 2023.

[10] M. J. Antony, B. P. Sankaralingam, S. Khan, A. Almjally, N. A. Almujally, and R. K. Mahendran, "Brain–Computer Interface: The HOL–SSA Decomposition and Two-Phase Classification on the HGD EEG Data," Diagnostics, vol. 13, no. 17, p. 2852, 2023.

[11] Eldosoky, Mahmoud A., Jian Ping Li, Amin Ul Haq, Fanyu Zeng, Mao Xu, Shakir Khan, and Inayat Khan. "WallNet: Hierarchical Visual Attention-Based Model for Putty Bulge Terminal Points Detection." The Visual Computer (2024): 1-16.

[12] S. Khan, "Study Factors for Student Performance Applying Data Mining Regression Model Approach," International Journal of Computer Science Network Security, vol. 21, no. 2, pp. 188-192, 2021.

[13] S. Khan and M. Alshara, "Development of Arabic evaluations in information retrieval," International Journal of Advanced Applied Sciences, vol. 6, no. 12, pp. 92-98, 2019.

[14] S. Khan and M. Alshara, "Fuzzy Data Mining Utilization to Classify Kids with Autism," International Journal of Computer Science Network Security, vol. 19, no. 2, pp. 147-154, 2019.

[15] S. Khan and M. F. AlAjmi, "A Review on Security Concerns in Cloud Computing and their Solutions," International Journal of Computer Science Network Security, vol. 19, no. 2, p. 10, 2019.

[16] S. Khan, A. S. Al-Mogren, and M. F. AlAjmi, "Using cloud computing to improve network operations and management," presented at the 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW), 2015.

[17] M. F. AlAjmi, S. Khan, and A. Sharma, "Collaborative learning outline for mobile environment," in 2014 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT), 2014, pp. 429-434: IEEE.

[18] Saif, Sohail, et al. "A secure data transmission framework for IoT enabled healthcare." Heliyon 10.16 (2024).

[19] Jian, Wang, et al. "Feature elimination and stacking framework for accurate heart disease detection in IoT healthcare systems using clinical data." Frontiers in Medicine 11 (2024): 1362397.

[20] Sreekumar, Das, S., Debata, B.R., Gopalan, R., Khan, S. (2024). Diabetes Prediction: A Comparison Between Generalized Linear Model and Machine Learning. In: Acharjya, D.P., Ma, K. (eds) Computational Intelligence in Healthcare Informatics. Studies in Computational Intelligence, vol 1132. Springer, Singapore. https://doi.org/10.1007/978-981-99-8853-2_4

[21] Khan, S., Serajuddin, M., Hasan, Z., Alvi, S.A.M., Ayub, R., Sharma, A. (2025). Natural Language Generation (NLG) with Reinforcement Learning (RL). In: Dev, A., Sharma, A., Agrawal, S.S., Rani, R. (eds) Artificial Intelligence and Speech Technology. AIST 2023. Communications in Computer and Information Science, vol 2268. Springer, Cham. https://doi.org/10.1007/978-3-031-75167-7_25

[22] S. Khan, P. Sharma, K. R. Prasad, S. D, M. Serajuddin and R. Ayub, "The Implementation of Machine Learning in the Development of Sustainable Supply Chains," 2023 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), Gautam Buddha Nagar, India, 2023, pp. 292-296, doi: 10.1109/UPCON59197.2023.10434528.

[23] Khan, S., Khari, M. & Azrour, M. IoT in retail and e-commerce. Electron Commer Res (2023). https://doi.org/10.1007/s10660-023-09785-3

[24] Halder, P., Hassan, M.M., Rahman, A.K.Z.R., Akter, L., Ahmed, A.S., Khan, S., Chatterjee, S., Raihan, M.: Prospects and setbacks for migrating towards 5G wireless access in developing Bangladesh: A comparative study. J. Eng. 2023, e12319 (2023). https://doi.org/10.1049/tje2.12319

[25] Alotaibi, Reemiah Muneer, and Shakir Khan. "Big Data and Predictive Data Analytics in the Smes Industry Using Machine Learning Approach." 2023 6th International Conference on Contemporary Computing and Informatics (IC3I). Vol. 6. IEEE, 2023.

[26] Alfaifi, Asma Abdulsalam, and Shakir Gayour Khan. "Utilizing data from Twitter to explore the UX of “Madrasati” as a Saudi e-learning platform compelled by the pandemic." Arab Gulf Journal of Scientific Research 39.3 (2021).

[27] Xiang Li, Wang Zhou, Amin Ul Haq, Shakir Khan, LDPMF: Local differential privacy enhanced matrix factorization for advanced recommendation, Knowledge-Based Systems, Volume 309, 2025, 112892, ISSN 0950-7051, https://doi.org/10.1016/j.knosys.2024.112892.

[28] Jian, Wang, et al. "SA-Bi-LSTM: Self Attention With Bi-Directional LSTM based Intelligent Model for Accurate Fake News

Detection to ensured information integrity on social media platforms." IEEE Access (2024).

[29] Sharma, Chirag, et al. "Lightweight Security for IoT." Journal of Intelligent & Fuzzy Systems Preprint (2023): 1-17.

[30] Akram, Abeeda, et al. "On Layout Optimization of Wireless Sensor Network Using Meta-Heuristic Approach." Comput. Syst. Sci. Eng. 46.3 (2023): 3685-3701.

[31] Shakir, Khan, and Alotaibi Reemiah Muneer. "A novel thresholding for prediction analytics with machine learning techniques." International Journal of Computer Science & Network Security 23.1 (2023): 33-40.

[32] Tayyab, Moeen, et al. "Recognition of Visual Arabic Scripting News Ticker From Broadcast Stream." IEEE Access 10 (2022): 59189-59204.

[33] Khan, Shakir. "Business Intelligence Aspect for Emotions and Sentiments Analysis." 2022 First International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT). IEEE, 2022.

[34] AlSuwaidan, Lulwah, et al. "Swarm Intelligence Algorithms for Optimal Scheduling for Cloud-Based Fuzzy Systems." Mathematical Problems in Engineering 2022.1 (2022): 4255835.

[35] Sultan Ahmad, Sudan Jha, Abubaker E. M. Eljialy and Shakir Khan, “A Systematic Review on e-Wastage Frameworks” International Journal of Advanced Computer Science and Applications(IJACSA), 12(12), 2021. http://dx.doi.org/10.14569/IJACSA.2021.0121287

[36] Khan, Shakir, and Mohammed Ali Alshara. "Adopting Open Source Software for Integrated Library System and Digital Library Automation." International Journal of Computer Science and Network Security 20.9 (2020): 158-165.

[37] Khan, Shakir, and Amani Alfaifi. "Modeling of coronavirus behavior to predict it’s spread." International Journal of Advanced Computer Science and Applications 11.5 (2020): 394-399.

[38] Khan, Shakir. "Modern Internet of Things as a challenge for higher education." International Journal of Computer Science and Network Security 18.12 (2018): 34-41.

[39] Khan, Shakir, and M. Alajmi. "The Role Of Open Source Technology In Development Of E-Learning Education." Edulearn17 Proceedings. IATED, 2017.

[40] AlAjmi, M., and Shakir Khan. "Part of Ajax And Openajax In Cutting Edge Rich Application Advancement For E-Learning." INTED2015 Proceedings. IATED, 2015.

[41] Sattar, Kamran, et al. "Social networking in medical schools: Medical student’s viewpoint." Biomed Res 27.4 (2016): 1378-84.

[42] AlAjmi, Mohamed F., Shakir Khan, and Abdulkadir Alaydarous. "Data Protection Control and Learning Conducted Via Electronic Media IE Internet." International Journal of Advanced Computer Science and Applications 5.11 (2014).

[43] Khan, Shakir, et al. "Keeping Data on Clouds: Cloud Computing Significance." International Journal of Engineering & Science Research 3.2 (2013): 2321-2327.

[44] AlAjmi, Mohammed, and Shakir Khan. "Data Mining–Based, Service Oriented Architecture (SOA) In E-Learning." Iceri2012 Proceedings. IATED, 2012.

[45] AlAjmi, M., and Shakir Khan. "The Utility of New Technologies in Enhancing Learning Vigilance in Educationally Poor Populations." EDULEARN12 Proceedings. IATED, 2012.

[46] AlAjmi, Mohamed F., and Shakir Khan. "Effective Use of Web 2.0 Tools Complex Pharmatical Skills Teaching And Learning." ICERI2011, 3rd International Conference on Education and New Learning Technologies, Spain. 2011.

[47] Alajmi, M., and S. Khan. "EFFECTIVE USE OF WEB 2.0 TOOLS IN PHARMACY STUDENTS'CLINICAL SKILLS PRACTICE

DURING FIELD TRAINING." iceri2011 proceedings. IATED, 2011.

[48] Khan, Shakir, Mohammed AlAjmi, and Arun Sharma. "Safety Measures Investigation in Moodle LMS." Special Issue of International Journal of Computer Applications (2012).

[49] Khan, Shakir, and Arun Sharma. "Moodle Based LMS and Open Source Software (OSS) Efficiency in E-Learning." International Journal of Computer Science & Engineering Technology 3.4 (2012): 50-60.

[50] AlAjmi, Mohamed F., Arun Sharma Head, and Shakir Khan. "Growing cloud computing efficiency." International Journal of Advanced Computer Science and Applications (IJACSA) 3.5 (2012).

[51] AlAjmi, Mohamed F., Shakir Khan, and Arun Sharma. "Studying data mining and data warehousing with different e-learning system." International Journal of Advanced Computer Science and Applications 4.1 (2013).

[52] Xiang Li, Wang Zhou, Amin Ul Haq, Shakir Khan, LDPMF: Local differential privacy enhanced matrix factorization for advanced recommendation, Knowledge-Based Systems, Volume 309, 2025, 112892, ISSN 0950-7051, https://doi.org/10.1016/j.knosys.2024.112892.

[53] Khan, S., Alghayadh, F.Y., Ahanger, T.A. et al. Deep learning model for efficient traffic forecasting in intelligent transportation systems. Neural Comput & Applic (2024). https://doi.org/10.1007/s00521-024-10537-z

[54] Saif, Sohail, et al. "A secure data transmission framework for IoT enabled healthcare." Heliyon 10.16 (2024).

[55] Veluri, Rahul Chiranjeevi, et al. "Modified M-RCNN approach for abandoned object detection in public places." Expert Systems 42.2 (2025): e13648.

[56] Jian, Wang, et al. "Feature elimination and stacking framework for accurate heart disease detection in IoT healthcare systems using clinical data." Frontiers in Medicine 11 (2024): 1362397.

[57] Jian, Wang, et al. "SA-Bi-LSTM: Self Attention With Bi-Directional LSTM based Intelligent Model for Accurate Fake News Detection to ensured information integrity on social media platforms." IEEE Access (2024).

[58] S. Khan and S. Alqahtani, "Hybrid machine learning models to detect signs of depression," Multimedia Tools and Applications, pp. 1-19, 2023.

[59] Eldosoky, Mahmoud A., Jian Ping Li, Amin Ul Haq, Fanyu Zeng, Mao Xu, Shakir Khan, and Inayat Khan. "WallNet: Hierarchical Visual Attention-Based Model for Putty Bulge Terminal Points Detection." The Visual Computer (2024): 1-16.

[60] Saboor, Abdus, et al. "DDFC: deep learning approach for deep feature extraction and classification of brain tumors using magnetic resonance imaging in E-healthcare system." Scientific Reports 14.1 (2024): 6425.

[61] M. Azrour, J. Mabrouki, A. Guezzaz, S. Ahmad, S. Khan, and S. Benkirane, "IoT, Machine Learning and Data Analytics for Smart Healthcare," ed: CRC Press, 2024.

[62] Sreekumar, Das, S., Debata, B.R., Gopalan, R., Khan, S. (2024). Diabetes Prediction: A Comparison Between Generalized Linear Model and Machine Learning. In: Acharjya, D.P., Ma, K. (eds) Computational Intelligence in Healthcare Informatics. Studies in Computational Intelligence, vol 1132. Springer, Singapore. https://doi.org/10.1007/978-981-99-8853-2_4

[63] Khan, S., Serajuddin, M., Hasan, Z., Alvi, S.A.M., Ayub, R., Sharma, A. (2025). Natural Language Generation (NLG) with Reinforcement Learning (RL). In: Dev, A., Sharma, A., Agrawal, S.S., Rani, R. (eds) Artificial Intelligence and Speech Technology. AIST 2023. Communications in Computer and Information Science, vol 2268. Springer, Cham. https://doi.org/10.1007/978-3-031-75167-7_25

[64] I. Keshta et al., "Energy efficient indoor localisation for narrowband internet of things," CAAI Transactions on Intelligence Technology, 2023.

[65] Khan, S., Khari, M. & Azrour, M. IoT in retail and e-commerce. Electron Commer Res (2023). https://doi.org/10.1007/s10660-023-09785-3

[66] Halder, P., Hassan, M.M., Rahman, A.K.Z.R., Akter, L., Ahmed, A.S., Khan, S., Chatterjee, S., Raihan, M.: Prospects and setbacks for migrating towards 5G wireless access in developing Bangladesh: A comparative study. J. Eng. 2023, e12319 (2023). https://doi.org/10.1049/tje2.12319

[67] S. Khan et al., "Manufacturing industry based on dynamic soft sensors in integrated with feature representation and classification using fuzzy logic and deep learning architecture," The International Journal of Advanced Manufacturing Technology, vol. 128, pp. 2885–2897, 2023.

[68] Alotaibi, Reemiah Muneer, and Shakir Khan. "Big Data and Predictive Data Analytics in the Smes Industry Using Machine Learning Approach." 2023 6th International Conference on Contemporary Computing and Informatics (IC3I). Vol. 6. IEEE, 2023.

[69] M. J. Antony, B. P. Sankaralingam, S. Khan, A. Almjally, N. A. Almujally, and R. K. Mahendran, "Brain–Computer Interface: The HOL–SSA Decomposition and Two-Phase Classification on the HGD EEG Data," Diagnostics, vol. 13, no. 17, p. 2852, 2023.

[70] Yousef, Rammah, et al. "Bridged-U-Net-ASPP-EVO and deep learning optimization for brain tumor segmentation." Diagnostics 13.16 (2023): 2633.

[71] Saurabh, et al. 'Lightweight Security for IoT'. 1 Jan. 2023: 5423 – 5439.

[72] Khan, Shakir, et al. "Transformer Architecture-Based Transfer Learning for Politeness Prediction in Conversation." Sustainability 15.14 (2023): 10828.

[73] M. S. Rao, S. Modi, R. Singh, K. L. Prasanna, S. Khan, and C. Ushapriya, "Integration of Cloud Computing, IoT, and Big Data for the Development of a Novel Smart Agriculture Model," in 2023 3rd International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE), 2023, pp. 2779-2783: IEEE.

[74] Akram, Abeeda, et al. "On Layout Optimization of Wireless Sensor Network Using Meta-Heuristic Approach." Comput. Syst. Sci. Eng. 46.3 (2023): 3685-3701.

[75] S. Khan, V. Ch, K. Sekaran, K. Joshi, C. K. Roy, and M. Tiwari, "Incorporating Deep Learning Methodologies into the Creation of Healthcare Systems," in 2023 International Conference on Artificial Intelligence and Smart Communication (AISC), 2023, pp. 994-998: IEEE.

[76] S. Khan, G. K. Moorthy, T. Vijayaraj, L. H. Alzubaidi, A. Barno, and V. Vijayan, "Computational Intelligence for Solving Complex Optimization Problems," in E3S Web of Conferences, 2023, vol. 399, p. 04038: EDP Sciences.

[77] Shakir, Khan, and Alotaibi Reemiah Muneer. "A novel thresholding for prediction analytics with machine learning techniques." International Journal of Computer Science & Network Security 23.1 (2023): 33-40.

[78] Alfaifi, Asma Abdulsalam, and Shakir Gayour Khan. "Utilizing data from Twitter to explore the UX of "Madrasati" as a Saudi e-learning platform compelled by the pandemic." Arab Gulf Journal of Scientific Research 39.3 (2021).

[79] AlSuwaidan, Lulwah, et al. "Swarm Intelligence Algorithms for Optimal Scheduling for Cloud-Based Fuzzy Systems." Mathematical Problems in Engineering 2022.1 (2022): 4255835.

[80] Sultan Ahmad, Sudan Jha, Abubaker E. M. Eljialy and Shakir Khan, "A Systematic Review on e-Wastage Frameworks" International Journal of Advanced Computer Science and Applications (IJACSA), 12(12), 2021.

[81] Khan, Shakir. "Visual Data Analysis and Simulation Prediction for COVID-19 in Saudi Arabia Using SEIR Prediction Model." International Journal of Online & Biomedical Engineering 17.8 (2021).

[82] Khan, Shakir, and Mohammed Altayar. "Industrial internet of things: Investigation of the applications, issues, and challenges." Int. J. Adv. Appl. Sci 8.1 (2021): 104-113.

[83] S. Khan, "Study Factors for Student Performance Applying Data Mining Regression Model Approach," International Journal of Computer Science Network Security, vol. 21, no. 2, pp. 188-192, 2021.

[84] Khan, Shakir, and Amani Alfaifi. "Modeling of coronavirus behavior to predict it's spread." International Journal of Advanced Computer Science and Applications 11.5 (2020): 394-399.

[85] S. Khan and M. Alshara, "Development of Arabic evaluations in information retrieval," International Journal of Advanced Applied Sciences, vol. 6, no. 12, pp. 92-98, 2019.

[86] S. Khan and M. Alshara, "Fuzzy Data Mining Utilization to Classify Kids with Autism," International Journal of Computer Science Network Security, vol. 19, no. 2, pp. 147-154, 2019.

[87] S. Khan and M. F. AlAjmi, "A Review on Security Concerns in Cloud Computing and their Solutions," International Journal of Computer Science Network Security, vol. 19, no. 2, p. 10, 2019.

[88] Khan, Shakir. "Modern Internet of Things as a challenge for higher education." International Journal of Computer Science and Network Security 18.12 (2018): 34-41.

[89] S. Khan, A. S. Al-Mogren, and M. F. AlAjmi, "Using cloud computing to improve network operations and management," presented at the 5th National Symposium on Information Technology: Towards New Smart World (NSITNSW), 2015.

[90] AlAjmi, Mohamed F., and Shakir Khan. "Effective Use of Web 2.0 Tools Complex Pharmatical Skills Teaching And Learning." ICERI2011, 3rd International Conference on Education and New Learning Technologies, Spain. 2011.

[91] M. F. AlAjmi, S. Khan, and A. Sharma, "Collaborative learning outline for mobile environment," in 2014 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT), 2014, pp. 429-434: IEEE.

[92] S. Khan, P. Sharma, K. R. Prasad, S. D, M. Serajuddin and R. Ayub, "The Implementation of Machine Learning in the Development of Sustainable Supply Chains," 2023 10th IEEE Uttar Pradesh Section International Conference on Electrical, Electronics and Computer Engineering (UPCON), Gautam Buddha Nagar, India, 2023, pp. 292-296, doi: 10.1109/UPCON59197.2023.10434528.

[93] Tayyab, Moeen, et al. "Recognition of Visual Arabic Scripting News Ticker From Broadcast Stream." IEEE Access 10 (2022): 59189-59204.

[94] Khan, Shakir. "Business Intelligence Aspect for Emotions and Sentiments Analysis." 2022 First International Conference on Electrical, Electronics, Information and Communication Technologies (ICEEICT). IEEE, 2022.

[95] Khan, Shakir, and Mohammed Ali Alshara. "Adopting Open Source Software for Integrated Library System and Digital Library Automation." International Journal of Computer Science and Network Security 20.9 (2020): 158-165.

[96] Khan, Shakir, and M. Alajmi. "The Role Of Open Source Technology In Development Of E-Learning Education." Edulearn17 Proceedings. IATED, 2017.

[97] AlAjmi, M., and Shakir Khan. "Part of Ajax And Openajax In Cutting Edge Rich Application Advancement For E-Learning." INTED2015 Proceedings. IATED, 2015.

[98] Sattar, Kamran, et al. "Social networking in medical schools: Medical student's viewpoint." Biomed Res 27.4 (2016): 1378-84.

[99] AlAjmi, Mohamed F., Shakir Khan, and Abdulkadir Alaydarous. "Data Protection Control and Learning Conducted Via Electronic Media IE Internet." International Journal of Advanced Computer Science and Applications 5.11 (2014).

[100] Khan, Shakir, et al. "Keeping Data on Clouds: Cloud Computing Significance." International

Journal of Engineering & Science Research 3.2 (2013): 2321-2327.

[101] AlAjmi, Mohammed, and Shakir Khan. "Data Mining–Based, Service Oriented Architecture (SOA) In E-Learning." Iceri2012 Proceedings. IATED, 2012.

[102] AlAjmi, M., and Shakir Khan. "The Utility of New Technologies in Enhancing Learning Vigilance in Educationally Poor Populations." EDULEARN12 Proceedings. IATED, 2012.

[103] Alajmi, M., and S. Khan. "EFFECTIVE USE OF WEB 2.0 TOOLS IN PHARMACY STUDENTS'CLINICAL SKILLS PRACTICE DURING FIELD TRAINING." iceri2011 proceedings. IATED, 2011.

[104] Khan, Shakir, Mohammed AlAjmi, and Arun Sharma. "Safety Measures Investigation in Moodle LMS." Special Issue of International Journal of Computer Applications (2012).

[105] Khan, Shakir, and Arun Sharma. "Moodle Based LMS and Open Source Software (OSS) Efficiency in E-Learning." International Journal of Computer Science & Engineering Technology 3.4 (2012): 50-60.

[106] AlAjmi, Mohamed F., Arun Sharma Head, and Shakir Khan. "Growing cloud computing efficiency." International Journal of Advanced Computer Science and Applications (IJACSA) 3.5 (2012).

[107] AlAjmi, Mohamed F., Shakir Khan, and Arun Sharma. "Studying data mining and data warehousing with different e-learning system." International Journal of Advanced Computer Science and Applications 4.1 (2013).

[108] Khan, Shakir. "Data visualization to explore the countries dataset for pattern creation." *International Journal of Online & Biomedical Engineering* 17.13 (2021).

[109] AlAjmi, Mohamed Fahad, Shakir Khan, and Abu Sarwar Zamani. "Using instructive data mining methods to revise the impact of virtual classroom in e-learning." *International Journal of Advanced Science and Technology* 45.9 (2012): 125-134.

[110] Khan, Shakir. "Artificial intelligence virtual assistants (Chatbots) are innovative investigators." *IJCSNS* 20.2 (2020).

[111] Parisa, S.K. and Banerjee, S. 2024. AI-Enabled Cloud Security Solutions: A Comparative Review of Traditional vs. Next-Generation Approaches. International Journal of Statistical Computation and Simulation. 16, 1 (Jan. 2024).

[112] Somnath Banerjee. Intelligent Cloud Systems: AI-Driven Enhancements in Scalability and Predictive Resource Management. International Journal of Advanced Research in Science, Communication and Technology, 2024, pp.266 - 276. ⟨10.48175/ijarsct-22840⟩. ⟨hal-04901380⟩

[113] Banerjee, S., Whig, P. and Parisa, S.K. 2024. Cybersecurity in Multi-Cloud Environments for Retail: An AI-Based Threat Detection and Response Framework. Transaction on Recent Developments in Industrial IoT. 16, 16 (Oct. 2024).

[114] Banerjee, S., Whig, P. and Parisa, S.K. 2024. Leveraging AI for Personalization and Cybersecurity in Retail Chains: Balancing Customer Experience and Data Protection. Transactions on Recent Developments in Artificial Intelligence and Machine Learning. 16, 16 (Aug. 2024).

[115] Somnath Banerjee. Neural Architecture Search Based Deepfake Detection Model using YOLO. International Journal of Advanced Research in Science, Communication and Technology, 2025, 5 (1), pp.375 - 383. ⟨10.48175/ijarsct-22938⟩. ⟨hal-04901372⟩

[116] Banerjee, S. and Parisa, S.K. 2024. Enhancing Explainability in Deep Learning Models Using Hybrid Attention Mechanisms. American Journal of AI & Innovation. 6, 6 (Nov. 2024).

[117] Banerjee, S. and Parisa, S.K. 2023. AI-Driven Predictive Analytics for Healthcare: A Machine Learning Approach to Early Disease Detection. American Journal of AI & Innovation. 5, 5 (Oct. 2023).

[118] Parisa, S.K. and Banerjee, S. 2022. Ethical Challenges in AI: A Framework for Fair and Bias-Free Machine Learning Models.

American Journal of AI & Innovation. 4, 4 (Aug. 2022).

[119] Banerjee, S. and Parisa, S.K. 2021. Blockchain-Integrated AI for Secure and Transparent Data Sharing in Smart Cities. American Journal of AI & Innovation. 3, 3 (Aug. 2021).