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RESEARCH ARTICLE

Application of metaverse technologies and artificial intelligence in smart cities

Archana Verma

Abstract

The metaverse has been the subject of a global trend in recent years. A network of connected, immersive digital areas where people can engage with computer-generated settings is called the metaverse. The realm of the metaverse possesses the potential to fundamentally change and alter smart cities—urban areas that aim to enhance citizen experiences by accelerating economic growth, modernizing government functions, enhancing accessibility, and promoting sustainability. In this article, we explore how utilizing the metaverse to power smart cities might spur substantial advancements and breakthroughs. The primary technologies that facilitate the metaverse are examined, along with the advantages of using this technology and its potential for smart city bids. We presented multiple instances and looked at the main opportunities that the metaverse provides for smart cities in order to show how the technology of the metaverse has helped and enriched a range of enterprises. Subsequently, five models of neural networks were chosen from the literature to be utilized in the air quality prediction process and evaluated based on accuracy. Therefore, the innovative model combination of ANN and DLR as an aid for decision-making and problem-solving can favorably regulate air pollution in order to handle environmental challenges.

Keywords: Metaverse, Artificial intelligence, Smart cities, Environment pollution.

Introduction

The Internet of Things (IoT) (Rose, K., Eldridge, S., & Chapin, L. 2015) and cyber-physical systems (CPS) (Baheti, R., & Gill, H. 2011) are key ideas in today's technological environment. The goal of the metaverse is to unite the actual and virtual worlds. The goal is to create a network of online communities that integrate several sectors, including services, employment, leisure, and retail, and where social elements are important. The idea of the metaverse is not new. Neal Stephenson offered a description of the metaverse in his 1992 novel "Snow Crash." The collection of diverse subjects that have gained popularity recently as a result of social and technological advancements is known as the metaverse (Ball, M. 2022). Applications that allow avatars to interact with digital things have been around for a while, especially in the gaming industry. The metaverse is becoming more concentrated as Web 3.0, which is replacing Web 2.0, integrates fundamental components like decentralization and openness from the ground up (Allam, Z., Sharifi, A., Bibri, S. E., Jones, D. S., & Krogstie, J.(2022). The interest of the economy is reflected in the massive quantities of money that governments and big businesses are investing in the creation of the metaverse. For instance, the Republic of Korea committed approximately 185 million US dollars in 2022 to develop a dependable metaverse infrastructure and environment for users and regional businesses. The COVID-19 epidemic has brought attention to the necessity of virtual applications, their relationship to the real world, and the potential that comes with living in the digital age. As a result, social transformation is playing a role in the creation of the metaverse. Originating in the 1990s, the term "Metaverse" is an amalgam of the terms "Meta" and "Verse" (Lenger, A. D. 2022). The metaverse is a futuristic vision of an immersive communal area where individuals can move around and establish connections with both the physical world as well as the metaverse. With a computer and a specific pair of glasses, users can access the metaverse. People feel as though they are in the actual world, even though it's simply a virtual one (Cui, H., Xu, Z., &

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Yao, C.2022, June). Furthermore, any real-world activity can be reproduced in the Metaverse (Huang, J., Sun, P., & Zhang, W. 2022, March). We are about to enter a whole new era of Internet-based Metaverse, thanks to the quick development of modern technology (Huang, J., Sun, P., & Zhang, W. 2022, March). The idea of the "metaverse" emphasizes how the actual and virtual worlds are integrated. Instead of being a straightforward technology, it is a revolutionary product that combines a number of cutting-edge technologies, including Artificial intelligence (AI) (Huynh-The, T., Pham, Q. V., Pham, X. Q., Nguyen, T. T., Han, Z., & Kim, D. S. 2023), fifth-generation (Njoku, J. N., Nwakanma, C. I., & Kim, D. S. 2022, October), digital twins (Far, S. B., & Rad, A. I. 2022), big data (Sun, J., Gan, W., Chen, Z., Li, J., & Yu, P. S. 2022), participatory technologies, computing in the cloud (Cai, Y., Llorca, J., Tulino, A. M., & Molisch, A. F. 2022, July).), fog computing (Dhelim, S., Kechadi, T., Chen, L., Aung, N., Ning, H., & Atzori, L. 2022), blockchain (Gadekallu, T. R., Huynh-The, T., Wang, W., Yenduri, G., Ranaweera, P., Pham, Q. V., ... & Liyanage, M. 2022), and cloud computing (Cai, Y., Llorca, J., Tulino, A. M., & Molisch, A. F. 2022, July).). Numerous changes will occur with the introduction of the metaverse.

In order to improve infrastructure, update government services, increase accessibility, quicken economic growth, and enhance sustainability, smart cities use digital technologies as well as cutting-edge solutions (Yaqoob, I., Salah, K., Jayaraman, R., & Omar, M. 2023). Healthcare, administration of energy, supply chain, encompassing logistics, commerce and advertising, smart agriculture, smart housing, and transportation and finance are just a few of the segments of smart cities in which there is room for change in the metaverse.

Virtual worlds, including those with digital twins and avatars, can benefit greatly from the use of mathematical optimization, the theory of games, matching theory, artificial intelligence, reinforcement learning, especially graph theory. In metaverse-based smart cities, these strategies and methodologies can help with strategic interaction analysis, network structure modeling, pattern extraction from data, and resource allocation optimization. Their use can also improve the realism and usefulness of virtual environments, making metaverse-based smart cities' experiences more effective and immersive. More particular, the metaverse can improve everyday life, education, disaster preparedness, economic development, and urban planning and construction in smart cities (Wang, J., & Medvegy, G. 2022). It has the potential to create a metaverse market with lower emissions of carbon and pollution, as well as a virtual test ground for design and construction (Vidal-Tomás, D.2023). It can also offer new experiences and a way of life, as well as enhance transportation and forecast resource utilization. Enhancing the metaverse, resilience in cities, and evacuation skills can mimic municipal operations and disaster situations. In addition, because users can engage as virtual images to prevent real-world issues, adopting Smart cities' metaverses can make places more accessible and human connection for users (Zallio, M., & Clarkson, P. J. 2022). Residents in smart cities can anticipate changes, simulate issue-solving, and offer workable pre-treatment plans for the actual world thanks to a secure financial and cultural framework, deep user engagement, and virtual-real interactions enabled by the metaverse.

Literature Review

The capital market and industry's new favorite is the "metaverse" these days. A huge number of businesses are promising to move to the "metaverse" and an influx of funding. In the Internet sector, the "metaverse" has emerged as a new hotspot overnight. As "metaverse" technology continues to be in its infancy as a field, it is important to approach its implementation and any future developments with reason and practicality. As technology advances, so too will the application of the metaverse become more sophisticated. Initially, the primary application possibilities of "metaverse" technology will be in the areas of tourism, culture, and education, where users can receive immersive experience services. The primary use case for "metaverse" technology in the long future will most likely be to provide a platform for technological simulation for research and development (Fang, L. Z., & Shen, H. N. 2022). "Metaverse" technology will probably find extensive application in the long run in advanced exploratory research in the fields of biological sciences, sciences of material, technological sciences, marine fields of study, and earth and space science areas. The current industry forms can be improved via the "metaverse". The expansion and deployment of "metaverse" technological advances will undoubtedly bring a rebellion in the way that information technology is integrated with the economy and society, replacing "The Internet," "Big Data+," "Artificial Intelligence+," and "Metaverse+." Various variables need to be taken into consideration for the creation and dissemination of "metaverse" technology (Egliston, B., & Carter, M. 2022). Initially, in order to fully develop the "metaverse" scenario, a deeper examination of the "metaverse" scenarios for applications affecting service comprehensiveness and technology application substitution is required. User experience, social worth, economic value, and legal boundaries should not be disregarded without first determining what is necessary. Second, it's critical to support technical innovation. The "metaverse" that has emerged is a consequence of the evolution and application of information technology. Therefore, we should keep innovating in the areas of information understanding, data processing, and data modeling, which is the definition of software, along with associated technology fields such as artificial intelligence, scene illustration, virtual reality simulations, and information security. Furthermore, we aim to facilitate the full integration and utilization of pertinent technology inside the metaverse environment. Thirdly, in addition to their social value, "metaverse" technologies must consider the economic benefit of using actual scenarios and accounting for both short- and long-term inputs and outputs ratios (Wang, H., Ning, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., ... & Daneshmand, M. 2023)

Integrating the digital and real worlds is crucial, and the metaverse is essential for this (Yang, Q., Zhao, Y., Huang, H., Xiong, Z., Kang, J., & Zheng, Z. 2022). It provides engaging virtual reality experiences that are appealing to a variety of sectors. In addition to having a significant influence on smart city growth development, speeding up the widespread implementation of the metaverse may effectively assist the fusion of the virtual and physical worlds. Instead then being a single technology, the metaverse is a combination of several technologies used in various contexts (Ball, M. 2022). These Metaverse technologies may accelerate smart city development. Adopting Metaverse technology in smart cities makes them more competitive in the long run by providing essential frameworks for digital leadership and the expansion of the online economy (Vishkaei, B. M. 2022). The three main categories of smart city operations are project delivery, data aggregation, and data sources. To comprehend the role these technologies, play more fully play in the metaverse and smart cities, it is helpful to focus specifically on the interaction between IoT and the following major technologies while studying their connectivity. Consequently, we present how both these innovations and IoT are related. Metaverse technology can be a powerful tool in empowering and supporting smart cities through these processes. We explore these technologies' effects on and contributions to the metaverse's growth in the context that follows.

Methodology

Rising metaverse technologies that contribute to pollution and greenhouse gas emissions include Blockchains, AI models, augmented reality (AR), and enhanced communication are examples of technologies that require a lot of computational horsepower and bandwidth (Jolliffe, I. T., & Cadima, J. 2016). Moreover, driving up energy demand is the need for high-quality photographs. Training a single AI model is projected to produce 284 tonnes of carbon dioxide, a very large amount according to current research from the University of the State of Massachusetts (Bengio, Y., Courville, A., & Vincent, P. 2013). The growing use of cloud-based virtual reality computing, online gaming, and high-resolution picture processing can lead to a large rise in carbon dioxide emissions (Catalano, M., Galatioto, F., Bell, M., Namdeo, A., & Bergantino, A. S. 2016). In summary, there is considerable energy consumption associated with the technologies linked to the metaverse. Reducing the energy usage of metaverse technology requires the development of creative solutions, such as new calculating techniques.

When it comes to predicting air toxicity, the majority of environmental scientists lean toward adopting Artificial Neural Networks (ANN). Numerous studies have been conducted on the subject of nature, covering the various aspects of toxins, their emission, dissemination, and effects (Reddy, V., Yedavalli, P., Mohanty, S., & Nakhat, U. 2018). Particulate matter (PM) accumulations have been forecasted on a daily average using the ANN technique, which is based on regulations and widely accepted air quality criteria related to meteorological variables.

This study examined a selection of five of the most popular neural network models, drawing on prior research in the field (Sahoo, L., Praharaj, B. B., & Sahoo, M. K. 2021). The following neural networks have been chosen: Deep learning regularization (DLR), artificial neural networks (ANN), least squares support vector machines (LSVM), ANN with genetic algorithm (ANNGA), and deep belief network model (DBN).

Out of the collection of the most widely used models from the literature, Figure 1 presents the choice of the best model for predicting air pollution. The models listed below are utilized for cross-validation, interpolation, and data refining.

Artificial neural network (ANN) model

When it comes to predicting air quality, ANNs are thought of as statistical models (Zhao, H., Zhang, J., Wang, K., Bai, Z., & Liu, A. 2010, December). The ANNs are further separated into multi-layer perceptron (MLP) and radial basis function networks (RBF) based on their composition and principles of operation. All connected feed-forward models make up MLP. Four contaminants (CO, NO, SO_2, and NO_2), comfort, and five neurons make up the structure's input layer variables (Tair, RH, and Vair). To further enhance the functionality of the ANN, the ANN model also has a single surreptitious layer made up of several neurons. From the output layer, the most recent predicted result is obtained. The number of neurons used in the structure's output layer is comparable to the

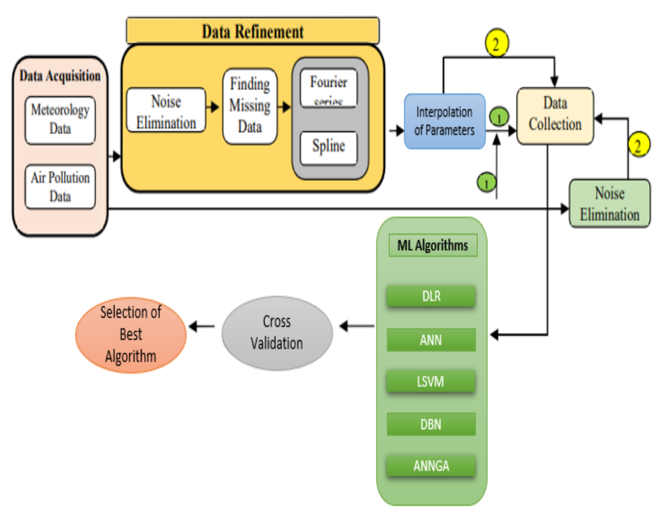

Figure 1: The best model to predict air pollution

number of variables in the output data (the anticipated data). In this model, the output variables used were SO_2, NO, CO, and NO_2. Using a neural network with a feed-forward structure to forecast air quality was used to create the structure.

ANN with genetic algorithm (ANNGA)

An approach to heuristic optimization known as the evolutionary algorithm looks for a final solution among the population of possible solutions based on an evaluation of the nature of the problem. Said another way, the use of neural networks in conjunction with genetic algorithms would increase accuracy and efficiency (speed at which improved answers can be reached). Through the genetic algorithm's training and testing phases, the fundamental ANN behavior was optimized in this investigation. The objective function is Z = fit_nn (w), where the input is the number of errors to be minimized and the output is the starting weights to be generated. The ANN's starting weights are chosen via the Genetic Algorithm.

The training test concludes after 20 epochs, at which point network data that was not used for training is reviewed, and the statistical index is used to test the results. With the purpose of air quality forecasting, this model selects a subset of the real set of components. The ANN model is also available in the genetic algorithm–ANN model (Li, X., Peng, L., Hu, Y., Shao, J., & Chi, T. 2016), which is an enhanced version.

Deep learning regularization (DLR)

In order to reduce the error, the DLR model fits a structure into the specified training set without overfitting and prevents overfitting (Ip, W. F., Vong, C. M., Yang, J. Y., & Wong, P. K. 2010, August). The models' performance on the unseen data can be improved by using this strategy. By penalizing the node weight matrices, deep learning regularization works. Several of the weight matrices are probably close to zero because of the high coefficient of regularization. With a little underfitting of the training dataset, a straightforward, linear neural network can be created by applying regularization. A greater regularization coefficient value is the unfavorable outcome of underfitting. In order to create a well-fitting model, the greater regularization coefficient value must be explained.

D. Least squares support vector machines (LSVM)

Based on the concept of statistical learning, the Least Squares Support Vector Machines (LS-SVM) model is utilized for regression and time series estimation (Kang, G. K., Gao, J. Z., Chiao, S., Lu, S., & Xie, G. 2018). The majority of the MLP method's shortcomings can be eliminated with this strategy, leading to more genuine results.

Deep Belief Network Model (DBN)

One multi-layered generative graphics model with hidden variables (also known as "hidden units") is the deep belief

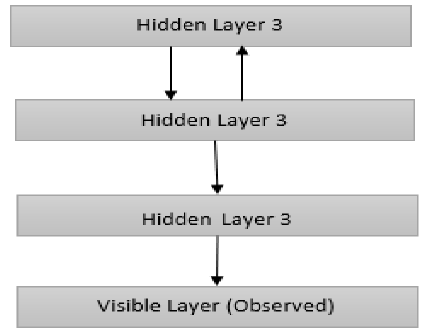

Figure 2: Deep belief networks (DBNs)

network model (DBN)(34). In this paradigm, interconnections exist between units inside each layer but not between the levels themselves. It is possible to determine how to computationally regenerate the origins of the data when the DBN model is automatically built utilizing the collection of models. Figure 2 displays deep belief networks (DBNs) with distinct layers. The DBN must be trained under supervision in order to complete the following step of development, which is categorization.

Results and Discussion

The graph shows the five neural network models that were simulated using the MATLAB program.

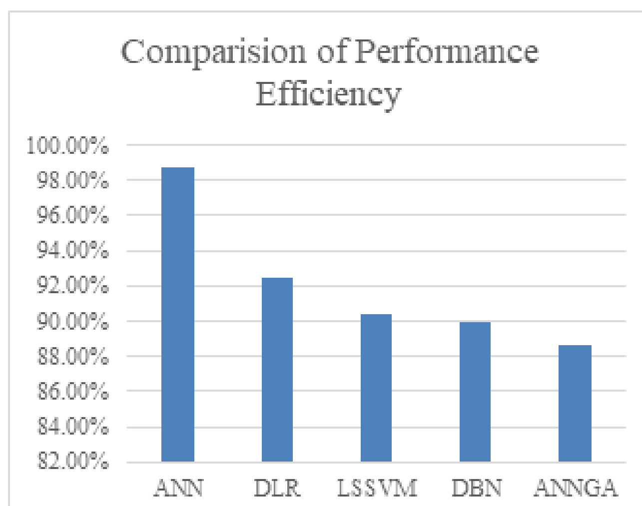

Figure 3: Comparing the performance and efficiency of seven models

Table 1: Comparison of performance efficiency

ML model	*Accuracy (%)*
ANN	98.80
DLR	92.50
LSSVM	90.40
DBN	90.00
ANNGA	88.60

Table 2: Accuracy comparison of various ML models

Epochs	*Accuracy*				
	ANN	*DLR*	*LS-SVM*	*DBN*	*ANNGA*
1	97.5042	89.1612	88.244	87.246	84.4126
2	97.086	89.6462	87.4281	86.624	83.4246
3	97.8082	89.1808	87.86	87.162	83.2048
4	97.8608	89.2142	88.1436	86.8465	83.6286

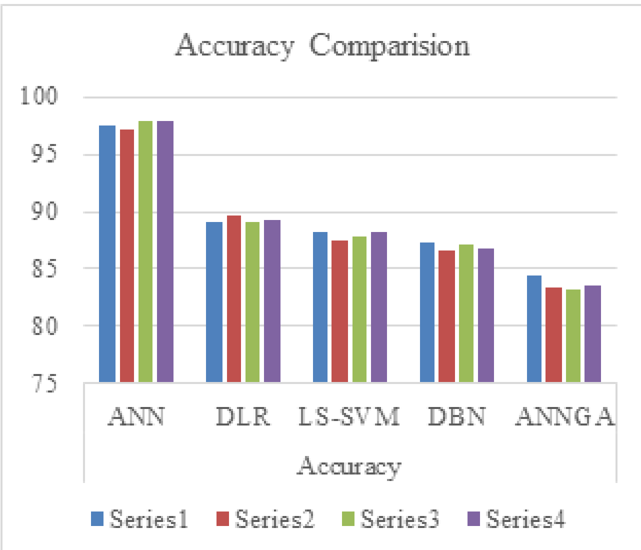

Figure 4: Accuracy of various models with time periods

One eight information layers: the input level, one hidden layer, and one layer for output eight data are all present in the ANN model. In line with this, it shows algorithmic details, progress, and charts. Three distinct graphs—training performance, training state, and regression—are produced by using the plots menus. Figure 3 illustrates that, when compared to the other four models for air pollution index prediction, ANN exhibits the highest efficiency in terms of percentage. A comparison of the effectiveness of various machine learning models is presented in Table 1.

Table 2 presents the accuracy numbers derived from the simulation for five distinct models. As a result, ANN and DLR models are suitable for analyzing and predicting air quality. Figure 4 depicts the accuracy and time periods for a variety of machine learning models.

Conclusion

The utilization of the metaverse in smart city applications can enhance government services, infrastructure, accessibility, revenue generation, and sustainability, as we covered in this article. Healthcare, management of energy, transport, smart homelands, supply chains and shipping, travel, sales, and finance are just a few of the areas where smart cities can undergo revolutionary variations cheers to the metaverse. In order to demonstrate how metaverse technology can realize all of its possibilities for smart cities, we talked about its enabling technologies and benefits. In order to demonstrate how metaverse technology has aided and enhanced a variety of businesses, we presented multiple case studies and examined the major prospects that the metaverse presents for smart cities. After that, a group of five neural network models for predicting air quality were chosen from the literature and assessed according to accuracy. About 98.8% of the models were accurate, with the ANN model being the most accurate at 92.5%, the LSVM model at 90.4%, the DBN model at 90%, and the ANNGA model at 88.6%. ANN is the most appropriate model when compared to the other models, as can be seen from the results. In terms of accurately predicting air quality, the ANN algorithm outperformed the other six algorithms, according to the model simulation findings. In order to manage environmental difficulties, air pollution can, therefore, be favorably regulated through the creative model integration of ANN and DLR as a tool for decision-making and problem-solving.

References

Allam, Z., Sharifi, A., Bibri, S. E., Jones, D. S., & Krogstie, J. (2022). The metaverse as a virtual form of smart cities: Opportunities and challenges for environmental, economic, and social sustainability in urban futures. Smart Cities, 5(3), 771-801.

Baheti, R., & Gill, H. (2011). Cyber-physical systems. *The impact of control technology*, *12*(1), 161-166.

Ball, M. (2022). The metaverse: and how it will revolutionize everything. Liveright Publishing.

Bengio, Y., Courville, A., & Vincent, P. (2013). Representation learning: A review and new perspectives. *IEEE transactions on pattern analysis and machine intelligence*, *35*(8), 1798-1828.

Cai, Y., Llorca, J., Tulino, A. M., & Molisch, A. F. (2022, July). Compute- and data-intensive networks: The key to the metaverse. In *2022 1st international conference on 6G networking (6GNet)* (pp. 1-8). IEEE.

Catalano, M., Galatioto, F., Bell, M., Namdeo, A., & Bergantino, A. S. (2016). Improving the prediction of air pollution peak episodes generated by urban transport networks. *Environmental science & policy*, *60*, 69-83.

Cui, H., Xu, Z., & Yao, C. (2022, June). Will the Metaverse be the Future of the Internet?. In *2022 8th International Conference on Humanities and Social Science Research (ICHSSR 2022)* (pp. 2165-2170). Atlantis Press.

Dhelim, S., Kechadi, T., Chen, L., Aung, N., Ning, H., & Atzori, L. (2022). Edge-enabled metaverse: The convergence of metaverse and mobile edge computing. *arXiv preprint arXiv:2205.02764*.

Egliston, B., & Carter, M. (2022). Oculus imaginaries: The promises and perils of Facebook's virtual reality. *New Media & Society*, *24*(1), 70-89.

Fang, L. Z., & Shen, H. N. (2022). Conceptualizing metaverse: A perspective from technology and civilization. *Review of Industrial Economics*, *1*, 5-19.

Far, S. B., & Rad, A. I. (2022). Applying digital twins in metaverse: User interface, security and privacy challenges. *Journal of Metaverse*, *2*(1), 8-15.

Gadekallu, T. R., Huynh-The, T., Wang, W., Yenduri, G., Ranaweera, P., Pham, Q. V., ... & Liyanage, M. (2022). Blockchain for the metaverse: A review. *arXiv preprint arXiv:2203.09738*.

Huang, J., Sun, P., & Zhang, W. (2022, March). Analysis of the Future Prospects for the Metaverse. In *2022 7th international conference on financial innovation and economic development (ICFIED 2022)* (pp. 1899-1904). Atlantis Press.

Huynh-The, T., Pham, Q. V., Pham, X. Q., Nguyen, T. T., Han, Z., & Kim, D. S. (2023). Artificial intelligence for the metaverse: A survey. *Engineering Applications of Artificial Intelligence*, *117*, 105581.

Ip, W. F., Vong, C. M., Yang, J. Y., & Wong, P. K. (2010, August). Least squares support vector prediction for daily atmospheric pollutant level. In *2010 IEEE/ACIS 9th International Conference on Computer and Information Science* (pp. 23-28). IEEE.

Jolliffe, I. T., & Cadima, J. (2016). Principal component analysis: a review and recent developments. *Philosophical transactions of the royal society A: Mathematical, Physical and Engineering Sciences*, *374*(2065), 20150202.

Kang, G. K., Gao, J. Z., Chiao, S., Lu, S., & Xie, G. (2018). Air quality prediction: Big data and machine learning approaches. *Int. J. Environ. Sci. Dev*, *9*(1), 8-16.

Lenger, A. D. (2022). Digital transformation in the digital world the metaverse: the new era on the internet. In *Handbook of research on digital transformation management and tools* (pp. 199-217). IGI Global.

Li, X., Peng, L., Hu, Y., Shao, J., & Chi, T. (2016). Deep learning architecture for air quality predictions. *Environmental Science and Pollution Research*, *23*, 22408-22417.

Njoku, J. N., Nwakanma, C. I., & Kim, D. S. (2022, October). The role of 5g wireless communication system in the metaverse. In *2022 27th Asia Pacific Conference on Communications (APCC)* (pp. 290-294). IEEE.

Rahman, P. A., Panchenko, A. A., & Safarov, A. M. (2017, October). Using neural networks for prediction of air pollution index in industrial city. In *IOP Conference Series: Earth and Environmental Science* (Vol. 87, No. 4, p. 042016). IOP Publishing.

Reddy, V., Yedavalli, P., Mohanty, S., & Nakhat, U. (2018). Deep air: forecasting air pollution in Beijing, China. *Environmental Science*, *1564*.

Rose, K., Eldridge, S., & Chapin, L. (2015). The internet of things: An overview. *The internet society (ISOC)*, *80*(15), 1-53.

Sahoo, L., Praharaj, B. B., & Sahoo, M. K. (2021). Air Quality Prediction Using Artificial Neural Network. In *Soft Computing Techniques and Applications: Proceeding of the International Conference on Computing and Communication (IC3 2020)* (pp. 31-37). Springer Singapore.

Sun, J., Gan, W., Chen, Z., Li, J., & Yu, P. S. (2022). Big data meets metaverse: A survey. *arXiv preprint arXiv:2210.16282*.

Vidal-Tomás, D. (2023). The illusion of the metaverse and meta-economy. *International Review of Financial Analysis*, *86*, 102560.

Vishkaei, B. M. (2022). Metaverse: A new platform for circular smart cities. In *Cases on Circular Economy in Practice* (pp. 51-69). IGI Global.

Wang, H., Ning, H., Lin, Y., Wang, W., Dhelim, S., Farha, F., ... & Daneshmand, M. (2023). A survey on the metaverse: The state-of-the-art, technologies, applications, and challenges. *IEEE Internet of Things Journal*, *10*(16), 14671-14688.

Wang, J., & Medvegy, G. (2022). Exploration of the future of the metaverse and smart cities.

Yang, Q., Zhao, Y., Huang, H., Xiong, Z., Kang, J., & Zheng, Z. (2022). Fusing blockchain and AI with metaverse: A survey. *IEEE Open Journal of the Computer Society*, *3*, 122-136.

Yaqoob, I., Salah, K., Jayaraman, R., & Omar, M. (2023). Metaverse applications in smart cities: Enabling technologies, opportunities, challenges, and future directions. *Internet of Things*, 100884.

Zallio, M., & Clarkson, P. J. (2022). Designing the metaverse: A study on inclusion, diversity, equity, accessibility and safety for digital immersive environments. *Telematics and Informatics*, *75*, 101909.

Zhao, H., Zhang, J., Wang, K., Bai, Z., & Liu, A. (2010, December). A GA-ANN model for air quality predicting. In *2010 International Computer Symposium (ICS2010)* (pp. 693-699). IEEE.