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Research Article

Addressing the Real World Problem of Managing Wireless Communication Systems Using Explainable AI-Based Models through Correlation Analysis

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In a general parlance, wireless communication tends to be investigated based on the available methods that support enhancing the optimized data link, especially the software-based methods. AI is mainly used to create and design efficient communication network systems and variable node locations. The major factors impacting wireless communications in the current context are enhanced channel frequency, efficiency of using the bandwidth, and modulation type. The software-defined ratio enables collecting the information and analyzing the overall signal-related components and processing them in real-time situations. This will support in detecting unnecessary information and identifying latency at each stage of communication. The study is intended to measure the influence of critical factors in enhancing the overall management of wireless communication systems through the application of AI technologies. The researchers used the questionnaire method in order to collect the data from the respondents and enable them to analyze the data using the SPSS data package.

1. Introduction

The advent of Internet communication has become a major aspect of the infrastructure. Business enterprises, governments, and individuals are now relying more on the Internet to enhance their communications, share information, and engage effectively to achieve their overall goals. The traditional model of wireless communication possesses more latency issues, an increase in infrastructure, and higher complexity in managing the radio frequency effectively [1]. However, with the implementation of artificial intelligence (AI) tools, organizations, innovators, and others are able to enhance communication through wireless communication. The implementation of artificial intelligence (AI) was also enhanced in addressing the latency issues, supporting enhanced communication without call drop, etc. [2]. The AI implements various sophisticated algorithms, thereby significantly enhancing the radio frequency parameters (RF), like the overall bandwidth, enhancing sensitivity, and monitoring the spectrum effectively. The growing needs for the usage of wireless communication between humans and machines are now focusing more on Internet-dependent and are expected to increase more in the coming years. Hence, in order to tackle the growing demand, future networks, system

and other related aspects need to be smarter and more automated.

The AI system possesses the capacity to analyze, forecast, and execute tasks in an efficient manner. The collected data can be stored for analyzing over time and therefore be used in predicting the future network requirements and thereby deploying the resources in resolving network challenges [3]. Hence, so as to increase the overall output and efficiency of the wireless network, the companies and their stakeholders are now focusing on using AI and other related aspects like planning, designing, and maintenance of the network system through AI technology. The research gap of the study is to reveal that the application of AI enables better connectivity ratio and coverage area, which can be enhanced using these tools. This results in addressing the variability of the communication. This study is focused on analyzing the key determinants of AI in enhancing wireless communication *n* the current context, the independent variables considered for the study are enhanced call admission rate, improved network accessibility, and reduced congestion during communication.

It has been stated that the overall performance of the wireless network is mainly based on efficient system design. These networks consider the different parameters that measure the overall performance of the network. As mobile phones and computers collide with the wireless network and internet-based packers, the approaches will support the overall integration of voice and data [4]. Traffic exhibits the overall fluctuations in time and space, which results in increasing energy waste. The wireless networks tend to face voice and data traffic volumes that are often provides a magnitude higher than what the individuals were facing previously [5]. It has been noted that wireless networks tend to face voice and data issues, which are often the reasons for call drops and other aspects. The implementation of AI supports enhancing the overall performance and output, managing the latency and forecasting the requirements in an efficient manner. Figure 1 shows the wireless communication supporting the SDR relay.

This work is more focused in using AI for better connection speeds and better coverage, which can be improved with the use of mentioned tools in Figure 1. This results in the management of communication variability. This study focuses on the analysis of the main factors for artificial intelligence to improve wireless communication in the current context. The independent variables considered in the study are improving call reception, improving network availability and reducing communication congestion. The growing demand for wireless communication between humans and machines is now more focused on Internet dependence and is expected to continue to grow in the coming years. Therefore, future networks, systems, and other related aspects need to be smarter and more automated to meet the growing needs.

Researchers have mentioned that the application of sophisticated hardware and software systems tends to enhance the advancement in communication. The enhanced capabilities of software-defined ratios are considered to be the critical aspects towards anticipated wireless devices, which will enhance the coupling of mobility. The overall

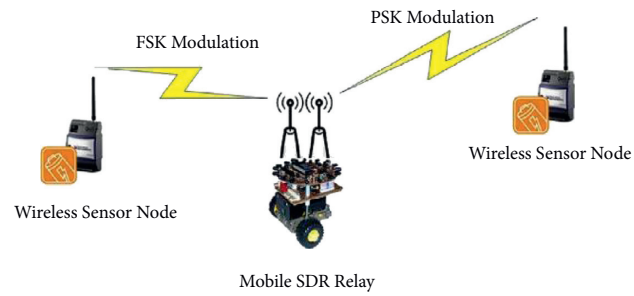

Figure 1: Wireless communication supporting the SDR relay [6].

scope of the networks and the communication management tend to impact the users, companies, and stakeholders to interact with different network communications while implementing the SDR and artificial neural networks [7]. The traditional hardware enables in making cross-functionality and needs to be modified only through the physical intervention. However with the implementation of AI technologies there can be enhancement to the wireless communication and constraints related to traditional channels have been reduced to a larger extent. Furthermore, AI supports reducing the overall operational cost, supporting flexibility, and enhancing the multiple waveform standards.

This study is more focused on the overall management of wireless communication systems using artificial intelligence-based tools. The application of new technologies and algorithms tends to enhance the overall accuracy and efficiency of wireless communication systems. The modifications of these systems tend to increase the overall potential based on the conditions and characteristics they support in realizing sustainable growth and development.

2. Review of Literature

Traffic fluctuates a lot in time and space, which leads to a waste of energy. During cramped events, voice and data traffic on mobile networks is often much higher than what you encounter daily. Despite the use of portable base stations to temporarily increase communication capacity and the use of free WIFI hotspots to free up Internet traffic from mobile base stations, congestion is still a major challenge for network operators. Designing an intelligent agent to manage the operation of the mobile network improves the overall quality of the service. A mobility management plan was proposed that includes a vague logic for a heterogeneous IP environment [8]. The proposed project uses a blurred inference method to process a metric decision for multiple transfers of multiple criteria. A vertical delivery decision algorithm is needed to decode the delivery. Although the plan registered improvements in system mobility, it never raised the issue of service availability. Locate a GSM mobile station using reference stations and ANNs based on radio signal strength measurements from several nearby base stations (antennas) and estimate the location of the mobile station using trained ANN models [9]. An improved version of the reverse propagation model (BP) multilevel perceptron (BP) that improves the positioning accuracy and elongation

of the primary MLP ANN model by introducing correction factors is derived from various references. For motion-based energy savings in functional 3G mobile networks, an approach based on the profile of the green cell infrastructure was proposed [10]. BS traffic and the approximate relationship between power and network were investigated at unloaded base stations. Collective learning applies to several servers that collect data and teach ML models together. It belongs to the general category of distributed learning but is specifically related to communication. (Table 1).

The structure and performance of collective learning also depend on artificial intelligence and communication itself. In the integrated architecture for artificial intelligence and wireless communication, the main issues are how to segment data and the separation of communication and computers, where data is mainly used to teach ML models, while the communication model is used to transfer data/parameters. Here we pay special attention to communication issues. The raw power calculation will provide an incentive for the development of artificial intelligence for some time to come [11]. New understandings, new discoveries, and innovations are strongly dependent on the computational performance of artificial intelligence. In addition, the success and promotion of artificial intelligence will require an infinite amount of data, the transmission and collection of which will depend on future wireless networks. Unfortunately, neither brute force nor infinite big data is viable. Therefore, we have identified nine challenges for 6G that are very critical, and we analyze them as follows. If there is no theoretical discovery in the related areas, we still have to search in the dark [12]. The interconnection of artificial intelligence and 6G wireless networks is expected to contribute to the development of new theories for the wireless networks of the future. At present, training models for artificial intelligence are based on the specific learning assumption that the environment (statistics for training data) is static, at least during the training period. But real-time communication scenarios, especially for mobile communications, are constantly changing. The basic functions of DL for wireless communication require extensive research. The challenge can potentially be solved by developing further learning and postlearning. The human prosthetic learning theory was proposed by cognitive psychologists over 40 years ago. Recently, the concept of prosthesis learning has been developed for classification [13].

3. Methodology

The critical objective of the study is to apprehend the critical determinants of the overall management of wireless communication systems using artificial intelligence-based tools. The researchers intend to apply descriptive design as it enables us to understand and appreciate the role of AI in enhancing the overall management of wireless communication. There is an increased investment in enhancing the technological advancement in information and communication aspects; hence, researchers need to understand the current nature of using AI in enhancing the overall management of wireless communication [14]. The researchers also intend to source the data through a primary source which is through the use of a questionnaire. The information will be collected from the respondents who are chosen through the convenience sampling method [15]. The researchers have selected nearly 144 respondents for the study; the study uses a 5-point Likert scale for preparing the closed-ended questionnaire.

The study applies quantitative research design, which will enable the research to quantify the data effectively using the Likert scale. The data are then used to make effective statistical analysis and interpretation, which will enable in supporting the research aim effectively. The quantitative research approach is also useful in making critical arguments and judgments based on the analysis and interpretation.

Furthermore, the researchers have used secondary data sources to understand the various literature conducted in the area of the study and provide an overall outlook related to the topic in a more comprehensive manner. The major determinants of the study are that AI-influenced enhanced call admission rate, improved network accessibility, and reduced congestion during communication [16], whereas the dependent variable is the overall management of wireless communication. The researchers use the IBM SPSS data analysis package to perform the detailed analysis.

4. Research Assumptions

H1: there is no major association between the AI-influenced enhanced call admission rate and the overall management of wireless communication.

H2: there is no major association between the AI-based improved network accessibility and the overall management of wireless communication.

H3: there is no major association between the reduced congestion during communication through AI and the overall management of wireless communication.

5. Data Analysis

This part of the task is involved in performing detailed data analysis based on the information collected by the researchers; the major analysis covers percentage rate analysis, correlation analysis, and chi-square test analysis.

5.1. Percentage Rate Analysis. The above Table 2 shows that 38.9% of the respondents have strongly agreed to the statement that AI supportive in wireless communication and nearly 36% of the respondents have agreed to it. Hence, it can be stated that AI is highly influential in enhancing the wireless communication network. Furthermore, 6.3% of the respondents were neutral and the remaining was disagreeing to the statement. This has been shown graphically in Figure 2.

The above Table 3 states that 38.2% of the respondents have strongly agreed with the statement that AI supports the efficacy of the bandwidth in wireless systems. Another 34.7% of the respondents have agreed with the statement. However, 7.6% were neutral and the remaining was disagreeing with the statement. This has been shown graphically in Figure 3.

Table 1: Literature survey.

Author	Applications	Features
Hussain et. al. [4]	Conventional hardware	They are mainly limited to support only one category of the network. With the increase in communication, the world needs more advanced features.
Ghasemiyeh et. al. [5]	Software defined ratio	SDR supports in reducing the manufacturing cost and enables effective wireless communication.
Worasucheep [6]	Network management	The role of SDR in network management is immense and support in the implementation of advanced cognitive radio network.
Weng et. al. [7]	Artificial intelligence	AI supports in delivering better value at affordable cost. Moreover, AI enables in scalability and sustainability of the operations.

Table 2: AI supportive in wireless communication.

AI supportive in wireless communication	Frequency	In %
Strongly disagree	12	8.3
Disagree	14	9.7
Neutral	9	6.3
Agree	53	36.8
Strongly agree	56	38.9
Total	144	100

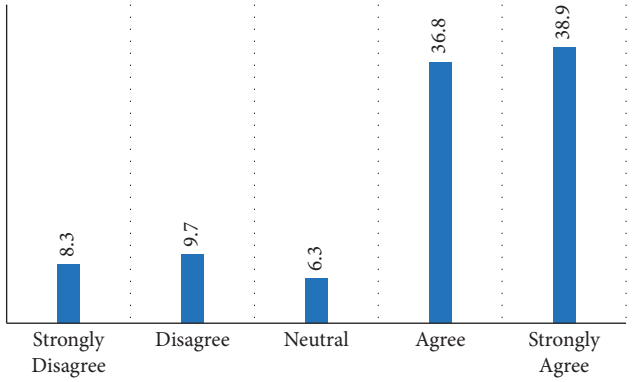

Figure 2: Chart representing that AI supportive in wireless communication.

Table 3: Efficacy of bandwidth.

Efficacy of bandwidth	Frequency	In %
Strongly disagree	15	10.4
Disagree	13	9
Neutral	11	7.6
Agree	50	34.7
Strongly agree	55	38.2
Total	144	100

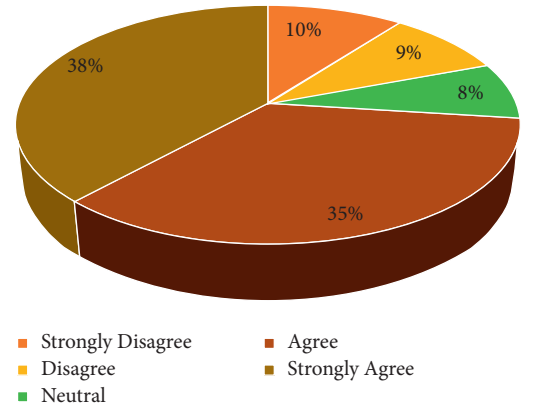

Figure 3: Chart representing the efficacy of bandwidth.

5.2. Correlation Analysis. The second part of the analysis is involved in presenting the critical nature of the relationship between the independent variables.

Correlation analysis is one of the useful statistical tools to measure the overall association between the variables. In the study, the researchers considered three key independent variables, viz., risk management, areas of enhancing financial performance, and managing the cash and its relationship towards the dependent variable, enhancing financial decision making.

For the overall analysis from Table 4, it is noted that the coefficient of correlation analysis lies between +0.823 and +0.888, which shows that there is a higher positive correlation between the variables. On the other hand, the overall comparison between the independent variables and dependent variable shows that the highest correlation lies between improved network accessibility and overall management of wireless communication with the value of +0.868. The variables enhanced call admission rate and overall management of wireless communication is +0.858, and the remaining variable reduced congestion during communication and overall management of wireless communication is +0.823.

5.3. Chi-Square Test Analysis. The last step in the data analysis is to test the hypothesis using chi-square analysis.

Hypothesis 1. Null: there is no major association between the AI-influenced enhanced call admission rate and the overall management of wireless communication.

Based on the above analysis in Table 5, it is noted that the *P* value is 0.001, which is less than the significance value, hence an alternate hypothesis is considered. Hence, there is a major association between the AI-influenced enhanced call admission rate and the overall management of wireless communication.

Hypothesis 2. Null: there is no major association between the AI-based improved network accessibility and the overall management of wireless communication.

Based on the above analysis from Table 6, it is noted that the *P* value is 0.001, which is less than the significance value, hence an alternate hypothesis is considered. Hence, there is a major association between the AI-based improved network accessibility and the overall management of wireless communication.

Table 4: Correlation analysis.

Analysis of correlation	Enhanced call admission rate	Improved network accessibility	Reduced congestion during communication	Overall management of wireless communication
Enhanced call admission rate	1	0.888	0.823	0.858
Improved network accessibility	0.888	1	0.858	0.868
Reduced congestion during communication	0.823	0.858	1	0.823
Overall management of wireless communication	0.858	0.868	0.823	1

Table 5: Chi-square analysis between AI-influenced enhanced call admission rate and the overall management of wireless communication.

Chi-square test	Value	df	*P* val.
Chi-square data	296.812a	16	0.001
L ratio	210.318	16	0.001
Linear-by-Linear	105.308	1	0.001

Table 6: Chi-square analysis between AI-based improved network accessibility and the overall management of wireless communication.

Chi-square test	Value	df	*P* val.
Chi-square data	291.110a	16	0.001
L ratio	198.319	16	0.001
Linear-by-Linear	107.721	1	0.001

Table 7: Chi-square analysis between the reduced congestion during communication through AI and the overall management of wireless communication.

Chi-square test	Value	df	*P* val.
Chi-square data	298.677a	16	0.001
L ratio	186.064	16	0.001
Linear-by-Linear	96.969	1	0.001

Table 8: Hypothesis.

Hypothesis	Decision
H1: there is a major association between the AI-influenced enhanced call admission rate and the overall management of wireless communication.	Accept
H2: there is a major association between the AI-based improved network accessibility and the overall management of wireless communication.	Accept
H3: there is a major association between the reduced congestion during communication through AI and the overall management of wireless communication.	Accept

Hypothesis 3. Null: there is no major association between the reduced congestion during communication through AI and the overall management of wireless communication.

Based on the above analysis from Table 7, it is noted that the p value is 0.001, which is less than the significance value. Hence alternate hypothesis is considered. Hence, there is reduced congestion during communication through AI and overall management of wireless communication.

Therefore, the statement of hypothesis is stated as (Table 8).

6. Findings and Discussion

The traditional wireless communication model presents more latency problems, requires larger infrastructure, and more sophisticated radio frequency management. But with the help of artificial intelligence (AI) tools, organizations, innovators, and others can improve communication through wireless communication [17]. The use of artificial intelligence (AI) also solved latent problems, supported better communication without interrupting calls, and more. AI implements a variety of advanced algorithms to significantly improve radio frequency (RF) parameters such as full bandwidth, sensitivity, and efficient spectrum control [18]. The AI system can analyze, predict and perform the work efficiently. Collected data can be stored over time for analysis so that it can be used to predict future network requirements and thus develop the capacity to handle network challenges. Therefore, in order to increase the overall performance and efficiency of the wireless network, companies and their stakeholders are now focusing on using artificial intelligence and other related aspects such as designing, constructing, and maintaining network systems [19]. Mobile phones and computers will collide with wireless networks and Internet-

based packaging software, methods that will support global voice and data integration. Traffic fluctuates globally in time and space, which leads to increased energy waste. Wireless networks often have more voice and data traffic than people have encountered before. It has been noticed that the wireless network often has voice and data problems, which are often the cause of call interruptions and other aspects.

7. Conclusion

Improved software-defined reporting capabilities are critical aspects of wireless devices designed to improve mobility connectivity. The general scope of network and communication management usually influences users, companies, and stakeholders to interact with different network communications when implementing SDRs and artificial neural networks. In general, wireless communication is based on available methods that support data link optimization, especially software-based methods.

Based on the overall analysis, it can be stated that AI is immensely useful in enhancing wireless communication, as the world is transforming into a digital community, the telecommunication providers need to find ways to enhance the performance and output. AI is mainly used to create and design an efficient communication network system and change the location of nodes. In today's environment, the most important factors affecting wireless communication are best channel frequency, bandwidth efficiency, and configuration type. Software-defined reporting enables information collection and real-time analysis and processing of all signal-related data. This helps to identify unnecessary information and latency at all stages of communication.

Data Availability

The data used in this study will be made available from the author on request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

[1] S. Mullainathan and J. Spiess, "Machine learning: an applied econometric approach," *The Journal of Economic Perspectives*, vol. 31, no. 2, pp. 87–106, 2017.

[2] A. Mishra, D. Irwin, P. Shenoy, J. Kurose, and T. Zhu, "Smartcharge: cutting the electricity bill in smart homes with energy storage," in *Proceedings of the 3rd International Conference on Future Energy Systems: Where Energy, Computing and Communication Meet*, p. 29, IEEE, Madrid, 9 May 2012.

[3] M. Kampouridis and F. E. B. Otero, "Heuristic procedures for improving the predictability of a genetic programming financial forecasting algorithm," *Soft Computing*, vol. 21, no. 2, pp. 295–310, 2017.

[4] A. J. Hussain, D. Al-Jumeily, H. Al-Askar, and N. Radi, "Regularized dynamic self-organized neural network inspired by the immune algorithm for financial time series prediction," *Neurocomputing*, vol. 188, pp. 23–30, 2016.

[5] R. Ghasemiyeh, R. Moghdani, and S. S. Sana, "A hybrid artificial neural network with metaheuristic algorithms for predicting stock price," *Cybernetics & Systems*, vol. 48, no. 4, pp. 365–392, 2017.

[6] C. Worasucheep, "Forecasting currency exchange rates with an Artificial Bee Colony-optimized neural network," in *Proceedings of the 2015 IEEE Congress on Evolutionary Computation (CEC)*, pp. 3319–3326, IEEE, Sendai, Japan, 25 May 2015.

[7] B. Weng, L. Lu, X. Wang, F. M. Megahed, and W. Martinez, "Predicting short-term stock prices using ensemble methods and online data sources," *Expert Systems with Applications*, vol. 112, pp. 258–273, 2018.

[8] S. Tirunillai and G. J. Tellis, "Mining marketing meaning from online chatter: strategic brand analysis of big data using latent dirichlet allocation," *Journal of Marketing Research*, vol. 51, no. 4, pp. 463–479, 2014.

[9] A. Jain, A. K. Yadav, and Y. Shrivastava, N. R. Nayak, S. Kumar, D. Gupta, and A. Suri, Modelling and optimization of different quality characteristics in electric discharge drilling of titanium alloy sheet" Material Today Proceedings," vol. 21, p. 1680, 2019.

[10] M. Naved and M. Soni, "Network mining techniques to analyze the risk of the occupational accident via bayesian network," *International Journal of System Assurance Engineering and Management*, vol. 1, no. 1, pp. 01–09, 2022.

[11] A. Jain and A. Kumar Pandey, "Modeling and optimizing of different quality characteristics in electrical discharge drilling of titanium alloy (Grade-5) sheet," *Materials Today Proceedings*, vol. 18, pp. 182–191, 2019.

[12] D. Ushakov, L. Cherkasova, and K. Shatila, "Environmental management system and its impact on productivity," *IOP Conference Series: Earth and Environmental Science*, vol. 937, no. 2, p. 022037, Article ID 022037, 2021.

[13] A. Piepenbrink and E. Nurmammadov, "Topics in the literature of transition economies and emerging markets," *Scientometrics*, vol. 102, no. 3, pp. 2107–2130, 2015.

[14] K. Mahajan, U. Garg, and M. Shabaz, "CPIDM: a clustering-based profound iterating deep learning model for HSI segmentation," in *Wireless Communications and Mobile Computing*, V. Shanmuganathan, Ed., vol. 2021, , pp. 1–12, Hindawi Limited, 2021.

[15] S. Oprea, "Informatics solutions for electricity consumption optimization," in *2015 16th IEEE International Symposium on Computational Intelligence and Informatics (CINTI)*, pp. 193–198, IEEE, 2015.

[16] A. Jain and A. K. Pandey, "Multiple quality optimizations in electrical discharge drilling of mild steel," *Sheet" Material Today Proceedings*, vol. 8, pp. 7252–7261, 2019.

[17] S. Sanober, I. Alam, S. Pande et al., "An enhanced secure deep learning algorithm for fraud detection in wireless communication," in *Wireless Communications and Mobile Computing*, V. SHANMUGANATHAN, Ed., vol. 2021, , pp. 1–14, Hindawi Limited, 2021.

[18] V. Panwar, D. K. Sharma, K. V. P. Kumar, A. Jain, and C. Thakar, "Experimental investigations and optimization of surface roughness in turning of EN 36 alloy steel using response surface methodology and genetic algorithm" Materials Today," *Proceedings*, vol. 46, 2021.

[19] W. Xu, Z. Zhang, D. Gong, and X. Guan, "Neural network model for the risk prediction in cold chain logistics," *International Journal of Multimedia and Ubiquitous Engineering*, vol. 9, no. 8, pp. 111–124, 2014.