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Research Article

Machine Learning-Based Intelligent Wireless Communication System for Solving Real-World Security Issues

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The intelligent wireless system focuses on integrating with the advanced technologies like machine learning and related approaches in order to enhance the performance, productivity, and output. The implementation of machine learning approaches is mainly applied in order to enhance the efficient communication system, enable creation of variable node locations, support collection of data and information, analyze the pattern, and forecast so as to provide better services to the end users. The efficiency of using these technologies tend to lower the cost and support in deploying the resources effectively. The wireless network system tends to enhance the bandwidth, and the application of novel machine learning approaches supports detection of unrelated data and information and enables analysis of latency at each part of the communication channel. The study involves critically analyzing the key determinants of machine learning approaches in supporting enhanced intelligent network communication in the industries. The researchers are aimed at gathering both primary data and secondary data for the study. The respondents are chosen in the industry so that they can provide better inputs and insights related to the area of research. The key determinants considered for the study are machine learning-influenced management of hotspots, identification of critical congestion points, spectrum availability, and management. The analysis is made using SPSS data analysis package based on which it is noted that all the factors make major influences towards the intelligent communication, and hence machine learning supports critically in enhancing the user experience effectively.

1. Introduction

The advent of machine learning approaches enables the business to learn, adapt, and grow in the dynamic environment. The wireless network is growing by leaps and bounds due to increase in needs and requirements from the customers, the individuals and businesses are now looking for more ways to stay connected 24 × 7, and hence the technology and communication industry needs to implement novel methods in order to prove required support, reduce latency issues, and enable provision of better and enhanced services at affordable cost. It has been stated that the machine learning tools enable the service providers to handle the information collected from different sources and support the analysis and recognition of the patterns from the raw data; moreover, the deep learning tools are gaining more attention as they support addition of better intelligence to the wireless network [1]. The machine learning systems apply complex algorithms and neural network systems for gaining brain-like features from the raw data, enable implementation of better programming for analyzing the current and future trends, support the service providers in meeting the requirements of the customers, deploy the resources effectively, address the latency and call drop issues, etc.

Furthermore, it can be stated that the machine learning approaches support the enhancement of the network dynamics covering distribution network channels, management of hotspots, identification of critical congestion points, spectrum availability and management, etc. These aspects enable in addressing the delay and latency issues and signal to noise ratio. Hence, researchers have stated that implementation of machine learning approaches supports in addressing the complex issues in the wireless communication, and the application of sophisticated algorithms enhances the wireless communication to be more intelligent and proactive so as to meet the growing needs and requirements [2].

In addition, machine learning methods can help improve network dynamics by spanning distribution network channels, managing access points, and detecting, accessing, and managing critical bottlenecks, reach, and so on. These aspects help solve law and order problems, activate the signal-to-noise ratio, and so on. The use of critical tools for machine learning enables the application of several areas of wireless communication, which include image enhancement, speech recognition, video quality processing, and security and protection against cyber threats, among others. Network researchers say that machine learning methods for effective decision making also support analysis of channel error aspects, develop resources efficiently, identify effective problems, manage networks, and provide protection against cyberattacks. With the increased research and development, more sophisticated machine learning tools are adopted for gathering large volume of data and analyzing them on a real-time basis for efficient processing and output [3]. Figure 1 shows the machine learning-influenced intelligent wireless communication.

Hence, the application of the machine learning techniques enables in addressing different plethora of data storage functions which helps in analyzing the data with more accuracy. The machine learning system enables sourcing the relevant data and information. The major merits of using machine learning are that it supports in automating the critical process in the wireless communication network, gathers data and information from different sources, and uses various algorithms in analyzing the data so as to measure the current and future pattern [5]. The researchers in communication networking have stated that the machine learning approaches for efficient decision-making process also support in analyzing the channel error aspects, deploying resources effectively, detecting the issues effectively, routing of networks, and protecting from cyberattacks. Moreover, it is noted that the machine learning approaches are stable and more persistent; the management can provide better and intelligent communication networks effectively [6].

The IoT enables in supporting the wireless communication in an efficient manner. It supports in real time accessing of the data and information which helps in enhancing efficiency in the wireless communication. It also helps in bringing more critical data and information to the surface in an efficient manner using IoT enable in minimizing the human efforts and enhance efficiencies. It also supports in saving more time and effort; however, there exist various security threats which will impact the performance and efficiencies.

In recent times, many industries and academicians have focused their attention on implementing the machine learning approaches for intelligent wireless communication. The term intelligent communication is more focused on realizing enhanced quality provisioning on the wireless communication network [7]. The proactive cache is applied in the network in order to gather the relevant data and support the target users in an efficient manner.

The study is confined in making a critical determinant of the intelligent wireless communication through the adoption of machine learning, and the major factors confined to the study are machine learning-influenced management of hotspots, identification of critical congestion points, spectrum availability, and management.

2. Review of Literature

While improving communication security in low power loss networking with limited devices, routing protocols such as RPL (Routing Protocol for Low Power Lossy Network) and special Mac protocols such as TSCH (Time Slotted Channel Hopping) are the default protocols. In short, RPL compiles routing paths easily and avoids routing loops by building a DODAG structure. In addition, the topology created for route management is constantly evolving over time, taking into account different network conditions and dimensions. With TSCH, different channels can be used and interference problems can be overcome. However, these protocols are based on local information received at each node. Therefore, there are still problems that are not directly captured and resolved by local information-based protocols [8].

Traditional communication techniques use the model-based processing method, which can fail if the mathematical model does not exist or is not aware of the area being studied. Modeless DRL algorithms can effectively solve these problems. In a dynamic scenario, the DRL can be customized based on the current scene [9]. Thus, the learned strategy can be adapted to a dynamic environment, which improves the adaptability of the communication network. For reliable wireless communication, the signal sent by the transmitter must be recognized correctly on the receiving side. A machine learning method is proposed for classifying signals in a real wireless environment. This task is considered similar to pattern recognition in that it classifies a modified signal as it passes through a wireless channel.

The deep learning models enable in addressing the critical issues which support in reducing the operational cost when compared with the traditional model. This helps in enhancing the service delivery and other critical aspects.

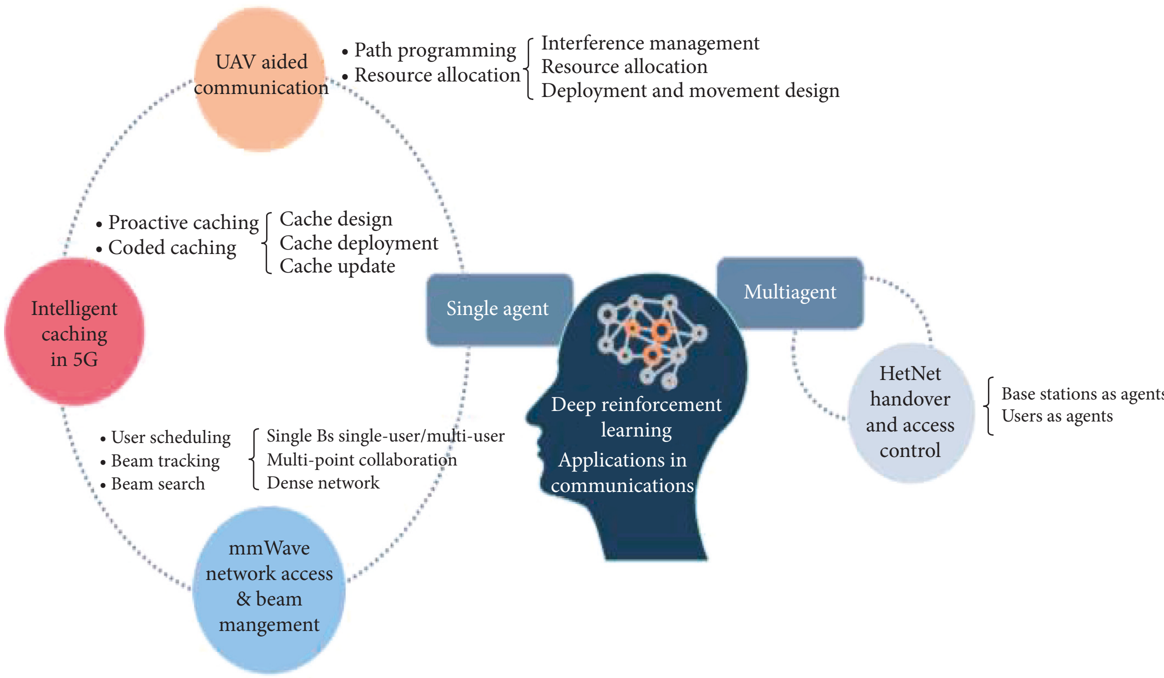

Figure 1: Machine learning-influenced intelligent wireless communication [4].

It can be stated that the DL methods support in auxiliary learning which automatically enhances the algorithms.

The network conditions change over time and vary greatly from environment to environment. Because of this, it is difficult to predict the future state of the network. Although various bit rate matching algorithms have been proposed for high-quality video streaming, they are not sufficient and much remains to be done [10]. Several studies have suggested the use of machine learning techniques for video streaming services. It recommends the system implemented by the server, learns the critical features, and makes the best bit rate and CDN decision for the stream user to optimize QoE. Auxiliary learning was also used to automatically generate the best ABR algorithm, taking into account the video bandwidth, buffer level, and bit rate. It offers a machine learning solution for channel selection to overcome a bad environment. Using ML technology, the system predicts the number of expected transfer attempts. Use the following attributes as input: RSSI, number of transmission attempts, reason for each failed attempt, and performance data such as RSSI and LQI of the most recently received packet. It selects the best channel from the output, and a channel with a small number of expected transmission attempts is considered to be the best [11]. However, there are still disturbances on the wireless channel, which reduces the accuracy of the estimate [12]. To solve the problem, the project used seven different machine learning techniques on two different architectures to find the algorithm with the smallest errors and compare performance. On the test bench, the subject had a handheld sensor that he needed to find on the wireless sensor network.

3. Methodology

The researchers apply the quantitative research methodology approach in order to perform the study; the main purpose of the study is more confined in understanding the key role of machine learning approaches in enhancing the efficiency of intelligent wireless communication [13]. The researchers intend to use the questionnaire method in order to collect the data from the respondents; nearly 165 responses were received and these data were then measured quantitatively using the Likert scale for analysis and interpretation [14].

The researchers also use secondary data source in order to understand the past literature performed in the area of study and also to understand the various determinants of machine learning approaches in influencing the intelligent wireless communication in the current economic environment [15, 16]. Many researchers have stated that the traditional communication system does not support the diversified applicators which the end users are now looking for, and hence implementing novel machine learning methods supports the enhancement of the overall speed and coverage efficiently [17].

The proposed model tend to support influencing the related hotspots which enhances intelligent wireless communication. Also, the congestion points are addressed effectively so as to provide better services and manage the demand effectively. Also, the model is focused in measuring the spectrum availability and overall management for rendering better services to the end users.

The researchers use IBM SPSS package in order to analyze the data, and the major analysis involves basic descriptive analysis, regression analysis, and analysis of variance (ANOVA).

4. Research Questions

Is there any influence of machine learning influenced management of hotspots and impact on intelligent wireless communication?

Is there impact of machine learning on identification of critical congestion points and intelligent wireless communication?

Will there be a positive association between spectrum availability and management and impact on intelligent wireless communication?

5. Data Analysis and Interpretation

This section involves presenting the critical data analysis of the data collated by the respondents for the study, and the researchers use main analysis like descriptive analysis, regression analysis, and ANOVA for the study.

5.1. Descriptive Analysis. From the analysis shown in Table 1, it is noted that 36.4% of the respondents have stated that ML approaches are highly important to the statement that ML enable in enhancing the accuracy of intelligent wireless systems. Furthermore, additional 37.6% have mentioned it as important statement; hence, it is in correlation with the previous study performed which stated that ML supports in enhancing the accuracy and speed of wireless communications [15]. Moreover, 10.3% of the respondents have been neutral to the statement, 5.5% have disagreed, and 10.3% have strongly disagreed to the statement. The support of AI in wireless communication is shown in Figure 2.

Form the analysis in Table 2, it is noted that 41.2% of the respondents have stated that ML supports in deploying resources and 35.2% have mentioned it as important. Hence, this is in line with the previous studies. The support of AI in deploying resources is shown in Figure 3.

5.2. Regression Analysis. The next section involves performing multilinear regression analysis; this enables the analysis of nature of relationship between independent variables and dependent variable.

From the analysis in Table 3, it is noted that R squared is 0.734, which is more than 0.600, and hence the model is best fit. The p value of all the independent variables is less than 0.05; hence, there is a significant association between the variables.

5.3. Regression Equation. The regression equation is framed as Y (intelligent wireless communication) = $0.134 + 0.347 \times$ management of hotspots $+ 0.353 \times$ critical congestion points $+ 0.201 \times$ spectrum availability and management.

Table 1: ML results in better accuracy.

Machine learning enables better accuracy	Frequency	Percent
Not at all important	17	10.3
Less important	9	5.5
Neutral	17	10.3
Important	62	37.6
Highly important	60	36.4
Total	165	100

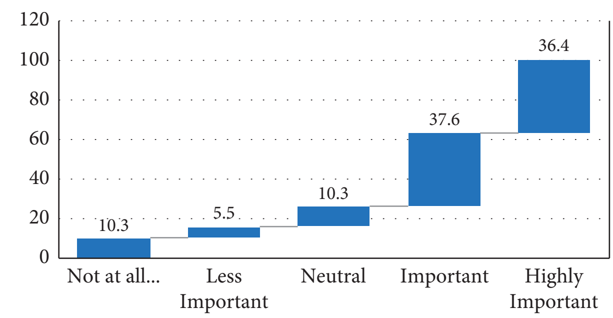

Figure 2: Chart representing that AI is supportive in wireless communication.

Table 2: ML supports in deploying resources.

Supports in deploying resources	Frequency	Percent
Not at all important	14	8.5
Less important	21	12.7
Neutral	4	2.4
Important	58	35.2
Highly important	68	41.2
Total	165	100

5.4. ANOVA. The third stage of analysis is measuring the analysis of variance to understand the research questions.

5.4.1. RQ 1. Is there any influence of machine learning-influenced management of hotspots and impact on intelligent wireless communication?

From the analysis in Table 4, it is noted that the P value is 0.001 which is less than 0.05, and hence it can be stated that there is a significant association between intelligent wireless communication and management of hotspots.

5.4.2. RQ 2. Is there impact of machine learning on identification of critical congestion points and intelligent wireless communication?

From the analysis in Table 5, it is noted that the P value is 0.001 which is less than 0.05, and hence it can be stated that there is a significant association between intelligent wireless communication and critical congestion points.

5.4.3. RQ 3. Will there be a positive association between spectrum availability and management and impact on intelligent wireless communication?

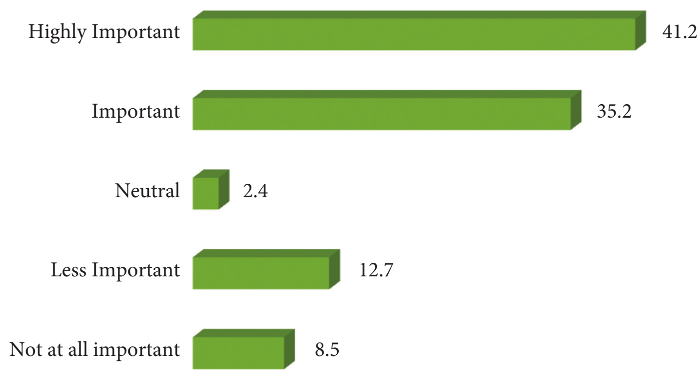

FIGURE 3: Machine learning supports in deploying resources.

TABLE 3: Regression analysis.

Regression	*B*	*t*	*P* value
(Constant)	0.134	0.721	0.472
Management of hotspots	0.347	3.344	0.001
Critical congestion points	0.353	3.635	0.001
Spectrum availability and management	0.201	2.131	0.035
R	0.857		
R squared	0.734		
Adj. *R* squared	0.729		

TABLE 4: ANOVA between intelligent wireless communication and management of hotspots.

Intelligent wireless communication and management of hotspots					
ANOVA	SS	df	Mean square	*F*	Sig.
Between groups	176.625	4	44.156	124.054	0.001
Within groups	56.951	160	0.356		
Total	233.576	164			

TABLE 5: ANOVA between intelligent wireless communication and critical congestion points.

Intelligent wireless communication and critical congestion points					
ANOVA	SS	df	Mean square	*F*	Sig.
Between groups	174.01	4	43.503	116.853	0.001
Within groups	59.566	160	0.372		
Total	233.576	164			

From the analysis in Table 6, it is noted that the *P* value is 0.001 which is less than 0.05, and hence it can be stated that there is a significant association between intelligent wireless communication and spectrum availability and management.

6. Findings and Discussion

The application of methods for machine learning aims primarily to develop an efficient communication system, create variable node locations, support data and information collection, model analysis, and forecast the delivery of better services [18]. Efficient use of these technologies reduces costs and promotes efficient use of resources. Wireless networking system strives to improve bandwidth; implementation of new methods of machine learning supports the detection of

TABLE 6: ANOVA between intelligent wireless communication and critical congestion points.

Intelligent wireless communication and spectrum availability and management					
ANOVA	SS	df	Mean square	*F*	Sig.
Between groups	175.941	4	43.985	122.107	0.001
Within groups	57.635	160	0.36		
Total	233.576	164			

irrelevant data and information and can analyze latency in any part of the communication channel [19].

The major focus of the paper is towards addressing the application of critical intelligent wireless communication in addressing the real-world problems. The main aspect of the paper is to use the statistical tools for enhancing the usage of these models in an effective manner. Wireless networks are evolving exponentially as customer needs and requirements increase, and individuals and companies are now looking for more ways to stay in touch around the clock, so the technology and communications industry must adopt new methods to prove necessary and reducing latency. It has been argued that machine learning tools allow service providers to manage information collected from various sources, which helps to analyze and identify samples of raw data. In addition, deep learning tools are getting more and more attention as they allow better intelligence to be added to the wireless network. Machine learning systems use complex algorithms and neural network systems from raw data to raw brain functions. These future trends help service providers meet customer needs by efficiently developing features, managing latency and loss issues, and much more.

7. Conclusion

The use of critical tools for machine learning enables the application of several areas of wireless communication, which include image enhancement, speech recognition, video quality processing, security, and protection against cyber threats, among others. With the increase in research and development, more sophisticated tools for machine learning are used to collect and analyze large amounts of data in real time for efficient processing and manufacturing. The machine learning system allows the users to find relevant data and information. It was considered that the main advantages of using machine learning are that it supports the automation of critical processes in the wireless communication network, the collection of data and information from different sources, and the use of different algorithms. Network researchers say that machine learning methods for effective decision making also support analysis of channel error aspects, develop resources efficiently, identify effective problems, manage networks, and provide protection against cyberattacks. It should also be noted that machine learning approaches are more stable and sustainable, and management can effectively provide better and smarter communication networks.

The future scope of the study involves applying other digital technologies like automation, robotics, deep learning, and other related tools in enhancing the wireless communication, and the research can also focus on using various statistical tools to measure the effectiveness of the applications. Also, the researchers can use other critical determinants in order to validate the findings.

The research has some limitations, for example, the time available was short, the respondents who provided the answers may be biased, and the research was confined only to the wireless network system [20].

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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