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Research Article

The Design of a Wireless Network Home-Based Elderly Care System Based on Artificial Intelligence Technology and Its Impact on the Construction of the Social Security System

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Old age is the final stage in the life processes of a human being, and it is an age group comprising a segment of the oldest members of a population. During this phase of life, people need support and care. But in reality, due to changes in modern society, the elderly have to stay alone at home. Staying at old age homes is not possible for everyone. In current society, every member of the family has to work for a living and run the family. When this is the case, the elderly are left alone at home during the work hours of the other family members. In this research article, we are going to study the design of wireless network-based homes to ensure the safety and security of elderly people. Artificial intelligence (AI) is used to construct a safe and secure social system. In the current trend of smart homes, it is mandatory for people to install WSN-based home systems to take care of the elderly residents of their homes who stay alone for long periods of time. The home-based elderly care system is designed with the implementation of trending technologies like AI and WSN. The performance of the model is evaluated with the applied optimised neural network model and compared with the existing data summarization model. From the results, it can be seen that the proposed model has provided an accuracy of 98.89%, which is 4.77% higher than the proposed algorithm.

1. Introduction

In the upcoming years, artificial intelligence will have a significant impact on all aspects of our lives, from our interactions with AI (e.g., digital assistants and self-driving cars) to the way businesses and cities are planned and operated [1]. Because of its revolutionary and far-reaching implications, the risks associated with artificial intelligence (AI) are quite substantial. If the artificial intelligence Pandora's box is opened, there will be unintended and irrevocable implications for everyone involved. This is especially true for the elderly, who will enjoy the greatest benefits from advancements in artificial intelligence [2]. A diverse range of disciplines will be necessary in order to cope with the large array of concerns and challenges that will arise. It is expected that life expectancy will continue to climb throughout the majority of the world throughout the rest of the twenty-first century and beyond [3]. As we grow older, we have a tendency to become more concerned with our own degeneration and with the challenges that can only be resolved by professionals. As we grow older, our lives become more than a collection of medical records and pensions to be sifted through. Each of us has a job to do in our communities, our families, our schools, our communities, and the world at large, and we must all work together to fulfil that responsibility [4]. It is conceivable for our bodies to continue to function normally even though our health is deteriorating. Artificial intelligence (AI) has the potential to satisfy the needs of our ageing population while also integrating them into our social and physical environments [5]. Ageing as a form of dependency should not be restricted by an outdated conception of ageing. When developing apps for the elderly, it is critical to consider their needs as well as their ability to recover and grow. It is also critical to develop solutions that not only promote health but also

help to foster meaningful connections and methods of thriving-just as it is with the younger generation [6].

Older and disabled persons can benefit from an IoT-based home automation system. Additionally, this system architecture incorporates artificial intelligence (AI) as well as the cloud. They acquire an assistant to manage their home and their requirements, based on what they want them to do, as a result of this innovation. Remote control through tablet or smartphone is the primary use of wireless communication technology. Because NLP serves as an interface between humans and machines, it has a significant impact here. Users of NLP can command or request home equipment, even if the commands or requests of impaired people differ from presets. The Internet of Things (IoT), which is managed by artificial intelligence (AI) and stores data in the cloud, will help automate household controls including door monitoring, home appliance monitoring, and bed movement monitoring. AI is given complete authority over every aspect of the house. Voice control is used to perform all IoT operations, and all relevant data is sent to the cloud. Using a predictive engine, it is possible to make predictions that can be put to good use in the near future [7].

Smart homes have emerged as a result of the incorporation of modern communication and information technology into the abode. In order to connect with the residents of a home and enhance their quality of life, these technologies enable the creation of smart home environments in which equipment and systems may communicate with one another and be controlled automatically. Security is a major problem when it comes to smart homes because of the open security back doors that are created by the people who live in them and the constant Internet connectivity they have [8]. Elderly and physically disabled people who have difficulty completing their work on their own can benefit from this work as an aid in making recommendations (AI). There should be no hesitation in laying out how artificial intelligence will benefit the elderly. This includes an explanation of why and how older people are important, as well as a description of the problem and how technology will be used to solve it for the benefit of older people [9]. According to recent research, the number of people over the age of 60 who appear in publicly available face data is severely underrepresented. Many databases do not include age-related metadata, which is unfortunate [10]. The collection and annotation of data sets that represent the diversity of the older population is a critical first step in producing fair and entertaining artificial intelligence experiences for the elderly (age, gender, ancestry, and disability). Invent tools and materials that can be used by individuals of all ages. A prevalent misconception about the elderly is that they are defined by their chronological age. This is incorrect. The physical, sensory, and mental capacities of people over the age of 65 are diverse, and they include everything from walking to driving [11]. Furthermore, their educational and technological backgrounds are extremely disparate. When developing artificial intelligence, it is critical to include people of different ages and socioeconomic backgrounds, particularly those who reside in rural or remote areas, in order to create products that meet the demands of a diverse variety of customers and users [12]. Take, for example, the situation of the elderly and people with disabilities as a point of reference. Disabilities in the elderly can be caused by age-related declines in sensory, motor, and cognitive function, although preexisting conditions may also play a role in this process. To be compliant with universally accepted accessibility requirements, artificial intelligence systems must be usable by a diverse spectrum of users, including people who have long-standing disabilities. When it comes to artificial intelligence, honesty is the best policy [13].

Furthermore, telemetry and error reporting can be used to keep tabs on the AI system's overall health and efficiency. When you are out with friends or family, remember to be considerate of the privacy of the elderly [14]. There are a plethora of options available for maintaining one's privacy [15]. The restriction of data collection and the deletion of data that is no longer required are both essential for protecting the privacy of the elderly. Instead of being a rote process, data collection and storage should be related to specific, actionable goals rather than being a routine task. Finally, when developing artificial intelligence systems, it is important to consider the privacy concerns of elderly individuals. Senior citizens should be able to control and monitor their artificial intelligence devices, as well as view what their caretakers are seeing when the situation calls for it [16]. On the other hand, older people should have access to user options that protect their privacy, such as the capacity to see what others who are watching them are seeing. The elderly are particularly concerned about online and in-home invasions of privacy. The use of artificial intelligence (AI) may jeopardise the privacy of an elderly person who lives alone [17]. Those over the age of sixty-five may be concerned about how their personal information is collected and used. Their right to privacy, as well as the length of time their data would be stored, may also be a concern. These issues necessitate the disclosure of information that has been carefully considered [18]. This study focused on designing a wireless network home-based elderly care system based on artificial intelligence technology and its impact on the construction of the social security system.

2. Proposed Architecture and Mathematical Model

Implementing the home-based elderly care system using various sensors in the home is used for monitoring the activities of the elderly. This process can be achieved with the support of intelligent wireless networks. The development of home-based elderly care will aid in the construction of the social security system. The basic sensors required for home-based elderly care are represented in Figure 1.

The applications of the wireless sensor network (WSN) for the home-based elderly care system are as follows:

(1) *Temperature Controller*. The wireless sensor network (WSN) keeps the temperature of the house on track which means the WSN takes control of the air conditioning, room heater, fans, etc. There is no need for

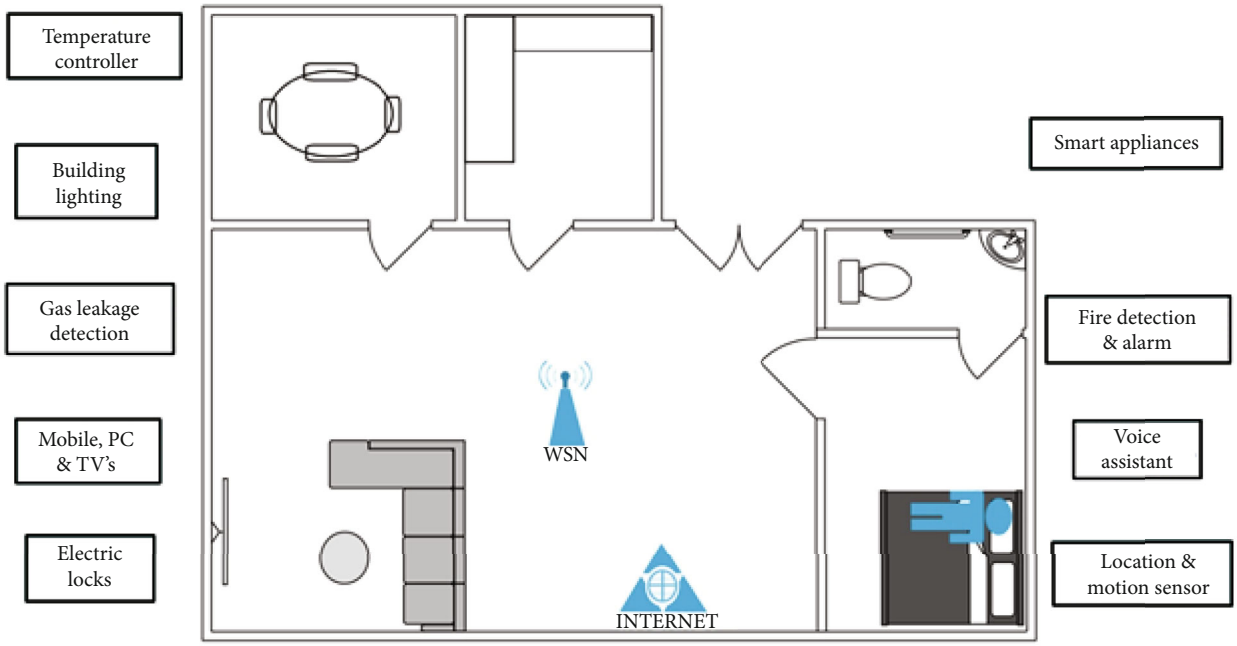

Figure 1: Architecture diagram of WSN home-based elderly care system.

human interference in controlling the temperature, often like the old method.

(2) *Building Lighting*. The building lighting is controlled based on the signals from the motion detection sensor. The AI controls the room's lighting, thus saving lots of energy. It also reduces the burden for the elderly. Even if the occupant forgets to switch off the lights or fan, AI will take care.

(3) *Gas Leakage Detection*. The gas leakage is also checked by AI. It gives an alarm if it detects any leakage. In advanced design, the gas valve design is automated and shuts off the valve based on sensor technology.

(4) *Mobile, PC, and TVs*. The mobiles, PC, and TV are connected to the home's wireless network. Thus, senior citizens can operate any of the above devices with the help of just mere voice commands.

(5) *Electric Locks*. The house is secured with the help of an electric lock. This lock is operated based on face detection and a biometric door camera system based on the design. There is no need to open and close the door manually; AI works with the help of sensor technology.

(6) *Smart Appliances*. Smart appliances are those of the home appliances connected to the AI. These home appliances also assist elderly people in their daily chores.

(7) *Fire Detection and Alarm*. The fire detection sensor detects fire and gives an alarm. It does not stop merely by giving alarm but extinguishes the fire by splashing water with the assistance of AI technology. This alarming is another primary security option, along with electric locks.

(8) *Voice Assistant*. The occupant can command the AI and control all kinds of tasks. The voice assistant plays a significant role in assisting elderly people never to feel alone.

(9) *Location and Motion Sensor*. Location and motion detection sensors are placed at multiple spots at the house for various applications like auto on/off lights and fans, heater/air conditioner, and open/close the doors. When the motion detector detects any abnormal activity of the occupant, it calls for medical assistance and related house members within seconds.

Thus, the design of a wireless network home-based elderly care system needs the hour technology to take proper care for the elderly people. By using AI technology, safety and security are assured for the occupant.

To design an engaging telemedicine infrastructure for elderly care in artificial intelligence and a data overview method for support for multiple scenarios, the method first evaluates and reconstructs its received data more by system but then stores the recreated reliable data into in the data base, enabling fast data summary of the results in a high concurrency circumstance. A wireless controller's data transformation technique is required to address the issue of data in different file types that must be given and analyzed. The method employs a centralized data template as well as transformation process restrictions to achieve

centralized management of disparate information from various sources, resulting in a uniform data support center for such system but also outer implementations. To address the problems may require of correlation coefficient data, its information system gives data for every component of the telecommunication platform based on the business specifications, using a standardized data structure but also strong and united storage management. It allows the free flow of strongly correlated data from multiple sources. The proposed method or technique first analyzes and reconstructs the supplied data by system but stores the regenerated reliable information in the database and allows fast data summary of the findings in a high concurrency situation. To address the issue of data in different file types that must be given and analyzed, a wireless controller's data transformation method is required. The technique makes use of a centralized data template and transformation process constraints is used to achieve centralized management of diverse data from various sources, resulting in such a uniform data support center for such systems as well as external implementations.

During the elderly care consultation, its doctor can interact with the patient via multimedia devices while also accessing the patient's chronological medical information and indeed the hospital information streamed. It is represented by Equation (1).

$$S_m = \sqrt{\sum \frac{S \times D_n}{K_m \times g} + \sum \frac{S \times D_n}{D_t}}, \tag{1}$$

where S is the requirement home-based elderly care system based on, D_n is the expense of consultancy, D_t signifies the social security servicing operational, and K_m is the proportion of total rate where the free flow of g is strongly correlated data from multiple sources.

The elderly care contribution of retaining resources is based upon the fact that its costs of retaining reserve funds have now risen in relation to the resources in organization. Its own proportion seems to be the correlated data from the multiple of the following Equation (2).

$$\mathrm{SE} = \sum_{\mathrm{x}} \frac{S}{F} \times D_n + \sum_{m=1}^{g} \left(\frac{F}{2} + Q_m \right) \times g \times K_m, \tag{2}$$

where SE stands for elderly care maximum number of concurrent users. F stands for the magnitude of the delivery portion, and Q_m stands for the implementation of safety margin representing Equation (3).

$$\mathrm{SE} = \sqrt{\frac{\sum_x (1-F) \times D_n \times S}{g \times (h + K \times (1-F))}}. \tag{3}$$

h denotes an alternative consultancy. $\sum_x (1-F) \times D_n \times S$ is the optimal amplitude of a small transaction in terms of maximizing enterprise value. K is the effective rate of statistical inventory production.

$$\mathrm{SE} = \sum_{n}^{m} \frac{S}{F} \times D_n + \sum_{m}^{v} \left(\frac{F}{2} + Q_m \right) \times v \times S, \tag{4}$$

$$\mathrm{SE} = \sum_{n}^{m} \frac{S}{F} \times D_n + \sqrt{\frac{\sum \left[(1-F) \times D_n^{\$} + D_n^{*} \right] \times S}{v \times \left(h + K^{*} + K^{\$} \times (1-F) \right)}}. \tag{5}$$

In Equations (4) and (5), there is evolving of the inventory level and revenue costs of developing the stock levels, in which $D_n^{\$}$ represents the revenue distance of developing speed levels, D_n^{*} signifies tractor trailer of evolving inventory actual distance concurrent number levels, $K^{\$}$ reflects the marginal minimum distance of the inventory levels, and K^{*} stands for the effective maximum distance.

The executive can effectively collect the information of specialists but also serve users through scheme but also meet the requirement for clear dialogue and is represented in the following Equations (6) and (7).

$$\mathrm{SE} = \sum_{n} \frac{S}{F} \times D_n^{\$} + \frac{S}{F} \times D_n^{*} + \sum_{y} \left(\frac{F}{2} + Q_m \right) \times v \times K^{\$}, \tag{6}$$

$$\mathrm{SE} = \sum_{n} \frac{S}{F} \times D_n^{\$} + \frac{S}{F} \times D_n^{*} + \sum \left(\frac{F}{2} + Q_m \right) \times v \times K^{*}. \tag{7}$$

Distinctions in Equation (8), Q_m distribution home-based elderly care system based on reliability have such a considerable effect on T^2 various consultancy of safety systems that suppliers are considered necessary to provide.

$$Q_m = \sum_{n}^{m} \sqrt{T^2 \times \ln \frac{\sum D \times F \times T \times v \times \sqrt{2\pi}}{S \times D_{nm}}}, \tag{8}$$

in which T seems to be the transfer utilization standard error as well as D_{nm} is the expense from not needing stock level reserves is given in the following Equation (9).

$$T = \sum_{i=1}^{m} S_i \times \sum_{i=1}^{K} (K_i - K)^2 + \sum D \times F \times T \times v \times \sqrt{2\pi}. \tag{9}$$

In the above equation, S_i seems to be the estimated likelihood of occurrence of the specific Equation (10) circumstance based on statistics.

$$T = \sum \sqrt{D} = \sqrt{\sum_{i=1}^{m} S_i \times (K_i - K)^2} + \sum_{y} \left(\frac{F}{2} + Q_y \right) \times v \times K^{\$}. \tag{10}$$

To achieve centralized management of disparate information from various sources, a unified data support centre

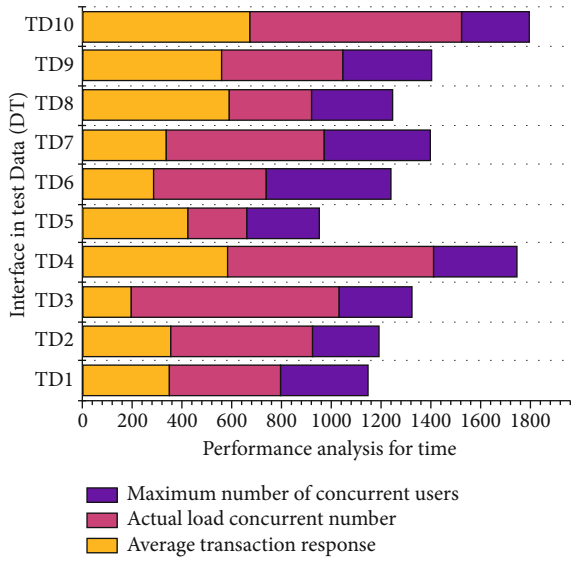

Figure 2: Performance analysis for test statistics elderly care construction of the social security system.

and external implementations has been employed in following the Equation (11).

$$L_2 = \frac{\sum_{i=1}^{m} S_i(K_{1i} - K_1) \times (K_{2i} - K_2)}{\sum_{i=1} T_1 \times T_2}, \tag{11}$$

where L_2 is the correlation value between minimum and maximum, T_1 denotes support for multiple scenarios, T_2 denotes the wireless controller's data transformation technique is required to address the issue of data in different file types, and K_1 signifies the sampling error for the distributor. The standard error for the second supplier is denoted by K_2. T_1 is the possibility of creating of prospective rates. T_s is the possibility of creating employs a centralized data template as well as transformation process restrictions to achieve centralized management of disparate information from various sources following Equation (12).

$$T_S = \sum_{n}^{m} \sqrt{T_n^2 + T_m^2 \times T_n \times Q_m \times L_{nm}} + \sum_{i=1}^{m} S_i \times (K_i - K)^2, \tag{12}$$

in which T_S is the whole standard error, T_m^2, T_n^2 seems to be the standard error of its first way to solve, Q_m is indeed the standard error of the standard alternative, and nm are the coefficient vectors between data distributions. The assessments that could be implemented anyway for the improvement WSN with AI techniques and advancement of the information system would have been defined.

$$T_S = \sum_{n}^{m} \sqrt{L_1 < L_2 <. \cdots \cdots < L_n}. \tag{13}$$

In Equation (13), in which P_1 did come once $P_{2,}$ it appears to come before P_3, etc. The necessity in a predefined P would

Table 1: Result analysis for test statistics elderly care construction of the social security system.

Test data	Test statistics elderly care construction (%)	Social security system (%)	Accuracy (%)
TD1	67.76	76.89	92.45
TD2	73.65	69.45	94.21
TD3	65.34	83.54	89.56
TD4	89.23	76.45	90.12
TD5	91,34	86.45	95.67
TD6	88.23	90.4	97.45
TD7	79.23	91.3	93.54
TD8	76.6	89.45	96.12
TD9	84.65	81.34	89.34
TD10	90.23	89.34	95.34

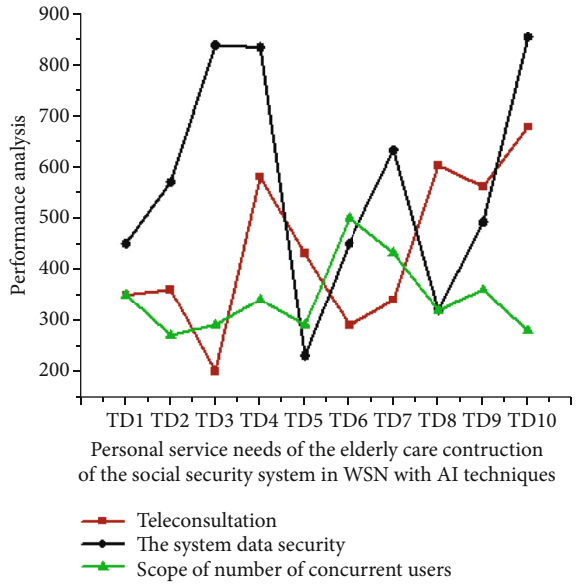

Figure 3: Types of personal service needs of the elderly care construction of the social security system in WSN with AI techniques.

be a computational set of intensity training U of element measures P_i, which will be represented as in Equation (14).

$$S = \sum_{n}^{m} \{S_i\}, i = 1, 2, 3, .. \cdots n. \tag{14}$$

The aggregated scheme efficiency measurement might be represented as a complicated effectiveness metric in the form of a system of linear Equations (15).

$$Q = \sum_{i=1}^{n} S_1 L_1 + S_2 L_2 + \cdots + S_n L_n = \sum_{i=1}^{n} S_i L_i. \tag{15}$$

The effectiveness of a policy is simply a component Q that contains n performance parameters that seem to be

Table 2: Result personal service needs of the elderly care construction of the social security system in WSN with AI techniques.

Personal service needs of the elderly care	Mean	Standard deviation	Test data (1 to 10)	Training/testing	Accuracy
Teleconsultation	65.78	76.43	91.78	93.76	94.10
The system data security	87.34	86.98	89.34	92.56	92.53
Number of concurrent user	79.98	87.34	75.89	94.43	93.54

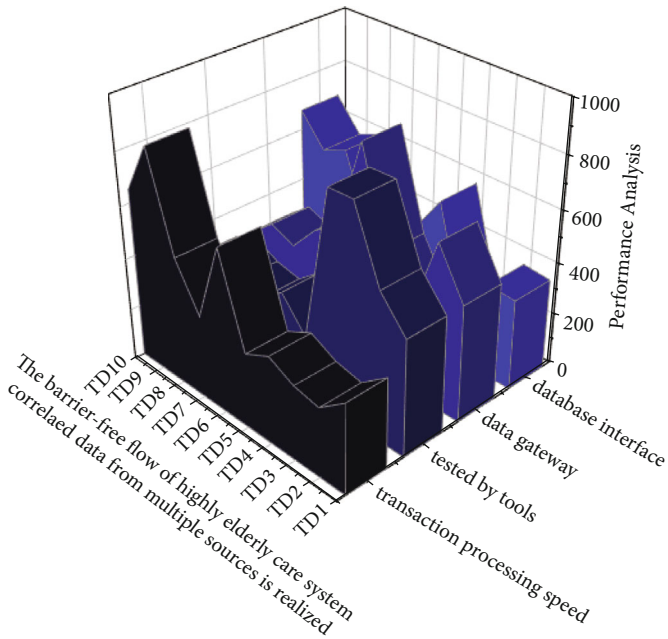

Figure 4: Analysis for elderly care system based the barrier-free flow of highly correlated data from multiple sources is realized.

Table 3: Result analysis for elderly care system based the barrier-free flow of highly correlated data from multiple sources is realized.

Barrier-free flow of highly correlated data	Training (%)	Testing (%)	Overall accuracy (%)
Interface	92.45	84.64	86.89
Data gateway	85.34	92.45	89.12
Tested by tools	87.65	83.89	84.56
Transaction processing speed	91.67	92.84	91.75

incremental to its evaluation metrics L_i. The teleconsultation interface is very simple but rather friendly, which is much more convenient for consumers and gives them with the positive experience but also needs to meet about their specifications to be used. The teleconsultation service's security and privacy are improved, as is the recognition of access controls. The focus of procedure of users from different protections is also distinct, which helps to ensure the system's security.

3. Experimental Results and Discussion

Home-based elderly care has to be extended toward the construction of a social security system for the elderly. The analysis for this process is depicted in Figure 2. The performance

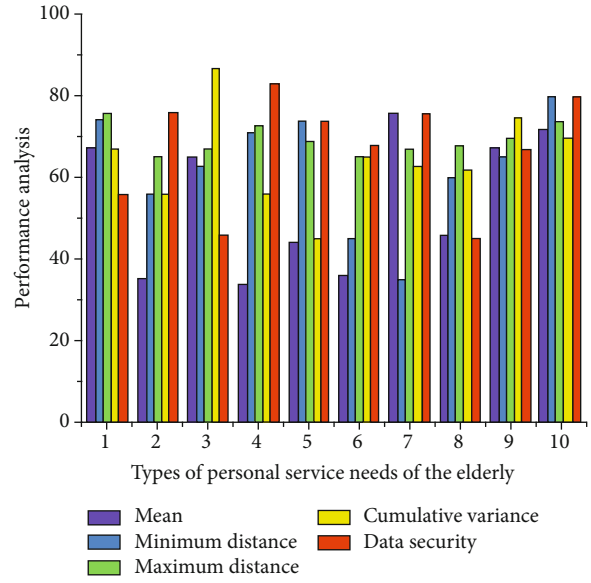

Figure 5: Performance analysis for the test and train in teleconsultation of elderly care system on the construction of the social security system.

Table 4: A comparison result analysis for existing system elderly care system.

Parameter	Average transaction response	Actual load concurrent number	Maximum number of concurrent users	Overall accuracy
Minimum distance	350	673	680	92.56
Maximum distance	478	530	540	89.43
Mean	530	350	380	91.34
Data security	420	423	450	93.45

Table 5: Comparison result with existing system.

Algorithm	Elderly care system construction of the social security	Average transaction speed	Testing/training (%)	Accuracy (%)
Optimised neural network algorithm	92.56	80.53	95.68	98.89
Existing method: data summarization method	89.34	72.45	91.34	94.12

analysis is done in relation to time and the number of interfaces in the test data.

The metric utilized was maximum number of concurrent users, actual load concurrent number, and average transaction responses. According to Table 1, it can be observed that the values obtained during simulation for the analysis metrics are fluctuating throughout the processes.

Next to the registration for the social security number is made, an analysis of the services required by the elderly is given in Figure 3. The metrics used for analysis are teleconsultation, system data security, and the scope of the number of concurrent users. In emergency circumstances, elderly individuals can be given options through wireless networking to make teleconsultations with their doctors for medication. This process is numerically given in Table 2. From the table, it can be observed that the teleconsultation has received a higher level of accuracy than the on-demand basis, with a 94.10% accuracy rate. Though the mean, standard deviation, training, and testing values are higher in the concurrent user, it has failed to achieve higher accuracy than the teleconsultation. This teleconsultation reduces transportation costs and time spent on travel. The data security is also minimal compared to the other two services.

The next type of analysis involves the barrier-free flow of highly correlated data from multiple sensors fixed in the home and is depicted in Figure 4. The metrics utilized for analysis are interface, data gateway, tested by tools, and transaction processing speed. The interface includes the type of intelligent device, like mobile phones and tablets. A data gateway plays a significant role in the secured data transfer between people or between people and devices. This process is achieved through cloud services, where the elderly can get reliable data transfer and answers to their queries on-time. Mobile applications or some automated system can be installed in the home to perform necessary actions. The numerical results of the process are displayed in Table 3. The data transfer must be fast enough to get an instant response to the issues that the elderly person is coming across. After training the system with neural networking, the system can be tested for accuracy. With these processes, transaction accuracy is higher with 91.5%, whereas the interface and the data gateway have only reached average results of 86.95% and 89.12%, respectively.

The final performance is based on the test and train of the teleconsultation of elderly care system is given in Figure 5. The metrics utilized were mean, minimum distance, maximum distance, cumulative variance, and data security, and the numerical data is given in Table 4.

The comparison results between the proposed optimised neural network algorithm and the existing data summarization method are presented in Table 5. The analysis takes into account metrics such as elderly care, social security number, and average transaction speed, as well as the algorithm's accuracy. The accuracy obtained with the proposed model is 98.89%, which is higher in comparison to the existing system.

4. Conclusions

A safe and secure social system is built using artificial intelligence (AI). Implementing WSN-based home systems is a must in today's trend toward smart homes for anyone who has elderly relatives living alone for extended periods of time. Modern technologies like artificial intelligence (AI) and wide-area wireless networks (WSNs) are being used to create a home-based elderly care system. With the optimised neural network model in use, the model's performance is assessed and compared to that of the previously used data analysis model. In this study, the results proved that the proposed model is 4.77 percent more accurate than the existing algorithm. For future research, it is highly recommended to implement deep learning approach for evaluation the performance of equipped sensors.

Data Availability

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

Conflicts of Interest

The author declares that there is no conflict of interest.

References

[1] C. T. Kulik, S. Ryan, S. Harper, and G. George, "Aging populations and management," *The Academy of Management Journal*, vol. 57, no. 4, pp. 929–935, 2014.

[2] S. Majumder, T. Mondal, and M. J. Deen, "Wearable sensors for remote health monitoring," *Sensors*, vol. 17, no. 1, p. 45, 2017.

[3] M. J. Deen, "Information and communications technologies for elderly ubiquitous healthcare in a smart home," *Personal and Ubiquitous Computing*, vol. 19, no. 3-4, pp. 573–599, 2015.

[4] N. Agoulmine, M. J. Deen, J.-S. Lee, and M. Meyyappan, "*U-health smart home*," *IEEE Nanotechnology Magazine*, vol. 5, no. 3, pp. 6–11, 2011.

[5] J. Van Hoof, G. Demiris, and E. J. Wouters, *Handbook of Smart Homes, Health Care and Well-Being*, Springer, Basel, Switzerland, 2017.

[6] A. Pantelopoulos and N. Bourbakis, "A survey on wearable sensor-based systems for health monitoring and prognosis," *IEEE Transactions on Systems, Man, and Cybernetics. Part C (Applications and Reviews)*, vol. 40, no. 1, pp. 1–12, 2009.

[7] L. M. Gladence, V. M. Anu, R. Rathna, and E. Brumancia, "Recommender system for home automation using IoT and artificial intelligence," *Journal of Ambient Intelligence and Humanized Computing*, vol. 30, pp. 1–9, 2020.

[8] L. M. Gladence, V. M. Anu, S. Revathy, and P. Jeyanthi, "Security management in smart home environment," *Soft Computing*, vol. 29, pp. 1–9, 2021.

[9] S. H. Shah, A. Iqbal, and S. S. A. Shah, "Remote health monitoring through an integration of wireless sensor networks, mobile phones amp; cloud computing technologies," in *2013 IEEE Global Humanitarian Technology Conference (GHTC)*, pp. 401–405, San Jose, CA, USA, October 2013.

[10] C. Chen and C. Pomalaza-Raez, "Design and evaluation of a wireless body sensor system for smart home health monitoring," in *GLOBECOM 2009-2009 IEEE Global Telecommunications Conference*, pp. 1–6, Honolulu, HI, USA, November 4 December 2009.

[11] Y.-J. Park and H.-S. Cho, "Transmission of ECG data with the patch-type ECG sensor system using Bluetooth Low Energy," in *2013 International Conference on ICT Convergence (ICTC)*, vol. 14–16, pp. 289–294, Jeju, October 2013.

[12] C. Rotariu, A. Pasarica, H. Costin, F. Adochiei, and R. Ciobotariu, "Telemedicine system for remote blood pressure and heart rate monitoring," in *2011 E-Health and Bioengineering Conference (EHB)*, pp. 1–4, Iasi, Romania, November 2011.

[13] S. Ullah, H. Higgins, B. Braem et al., "A comprehensive survey of wireless body area networks," *Journal of Medical Systems*, vol. 36, no. 3, pp. 1065–1094, 2012.

[14] B. Latré, B. Braem, I. Moerman, C. Blondia, and P. Demeester, "A survey on wireless body area networks," *Wireless Networks*, vol. 17, pp. 1–18, 2011.

[15] S. Movassaghi, M. Abolhasan, J. Lipman, D. Smith, and A. Jamalipour, "Wireless body area networks: a survey," *IEEE Communications Surveys & Tutorials*, vol. 16, no. 3, pp. 1658–1686, 2014.

[16] M. Hadjem, O. Salem, F. N. Abdesselam, and A. Mehaoua, "Early detection of myocardial infarction using WBAN," in *2013 IEEE 15th International Conference on e-Health Networking, Applications and Services (Healthcom 2013)*, pp. 135–139, Lisbon, Portugal, October 2013.

[17] N. S. Shivakumar and M. Sasikala, "Design of vital sign monitor based on wireless sensor networks and telemedicine technology," in *2014 International Conference on Green Computing Communication and Electrical Engineering (ICGCCEE)*, vol. 6–8, pp. 1–5, Coimbatore, India, March 2014.

[18] K. Takei, W. Honda, S. Harada, T. Arie, and S. Akita, "Toward flexible and wearable human-interactive health-monitoring devices," *Advanced Healthcare Materials*, vol. 4, no. 4, pp. 487–500, 2015.