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Design and Optimization of Tourism Information Management System Based on Artificial Intelligence

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ABSTRACT: This study aims to implement a tourism information management system based on the concept of Smart Tourism. As the people's living conditions have improved, the traditional model of tourism management failed to match the customers' demands, because it has some flaws such as low efficiency. Integrating AI with tourism management helps to meet clients' needs with smarter and more comfortable accommodations before, during, and after their trip. This study optimizes the artificial neural network (ANN) by utilizing long short-term memory (LSTM) to address its inherent faults, such as delayed convergence, easy oscillation, and falling into local minima. The experimental findings demonstrate that this algorithm achieves a recall rate of 99.6% and a prediction accuracy of 98.2%. This algorithm offers some useful recommendations for tourist management while avoiding the pitfalls of more conventional algorithms. In addition, this study extends the idea of "smart tourism" to particular forms of tourist informatization, which has the potential to boost the tourism industry's overall development level by facilitating structural upgrades and transformations.

Keywords: Tourism Information Management System, Smart Tourism, LSTM, ANN, Artificial Intelligence.

1. INTRODUCTION

Tourism Information Management System (TIMS) is a term that refers to a software application that presents travel information, order, and tracking. It helps the travel manager to scheme, detect, and inspect company travel operations. Online travel programs are a cost-effective way to market trips and activities online [1,2].

For the overarching goal of following the principles of software engineering design, this study primarily focuses on establishing a tourism management information system using AI technology [3]. One of the most crucial economic activities, tourism relies on competent management that understands the importance of human interaction, the value of human resources, the reliability of accounting methods, and the evidence they generate [4]. More and more individuals are taking advantage of vacation travel as a means to unwind and recharge now that people's living standards are rising and the economy is doing well [5,6]. Consequently, the demand for tourism will keep going up. For better adaptation to the present market condition, building a tourist management information system that satisfies needs and has inclusive functionalities is vital. The hospitality industry has extensively used information systems thanks to the meteoric rise in computing power. Information systems have the potential to be more efficient in tourist management when compared to more conventional, manual approaches [7,8].

Advances in computer processing power and hardware have led to the creation of artificial intelligence technology [9]. In addition to improving people's daily lives, artificial intelligence can eliminate even more manual labor. One of the many ways it has improved people's lives is by replacing humans in increasingly risky and complicated jobs [10,11]. The ability to interpret such complicated data very well is fundamental to artificial intelligence technology's ability to carry out these jobs. Artificial intelligence is necessary for tourism management to process the pertinent data of tourism management [12]. This will allow for the realization of tourism management's intelligence. An essential path for the astute evolution of tourist management is the integration of AI technology with the field. There is a high rate of mistake

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in the conventional manual management method [13]. Also, the hotel's satisfaction and occupancy rates will go up thanks to clever tourism management that caters to guests' individual wants for lodging. One benefit of AI technology is its enhanced ability to deal with high-dimensional and nonlinear data. AI finds correlations in complicated data using nonlinear functions. The foundation of AI technology is built on three of the most popular learning algorithms: supervised learning, unsupervised learning, and reinforcement learning [14]. In the realm of picture and speech recognition, supervised learning outperforms the other two approaches. ANNs and LSTM algorithms are examples of AI technologies that are widely used for feature extraction. There has been extensive usage of the Artificial Neural Network (ANN) approach in transportation and healthcare because of its superiority in extracting spatial aspects of data [15]. One area that has made extensive use of LSTM recurrent neural networks is voice recognition since these networks are able to process input pertaining to temporal elements more effectively. In order to promote online tourism, this study primarily employs ANN and LSTM algorithms [16]. The idea of serving users is central to the design of a tourist management system that meets the industry's actual demands]. In addition, we were able to achieve our goals of having an easy-to-understand interface, stable performance, minimal implementation cost, and accommodating a wide range of service tourist needs, as well as assisting tourist enterprises with decision-making [17].

Efficient operation, solid stability, reliability, security, and scalability are the hallmarks of an ideal system. In addition to enabling real-time online operation, the system constantly sets high requirements for timeliness and variety on its front page [18]. The safety of information exchanged within the tourist sector can be guaranteed by instituting data security standards, Including the security of data transmission, storage, and exchange. Because of the considerable non-linear link between effective factors and tourist attractions, traditional linear modelling methods cannot adequately explain them[19], for this reason, this study introduces LSTM to optimize ANN, to fit the non-linear relationship between tourist attractions and effective factors.

This article is split into four parts based on the purpose of the article and the necessity of the article's structure. Each part has the next content, the first part is the introduction, in this part, an overview of the background, importance, and innovation of the research is presented). In the second part, we will find a comprehensive analysis of related works. The third part includes the algorithms applied, which are the Artificial Neural Network, the Long Short-Term Memory (LSTM) Algorithm, and finally the performance of our proposed Hybrid Model. Several experiments are conducted in the last part, to verify the effectiveness of the proposed technique and the enhanced algorithm.

2. RELATED WORK

The papers below illustrate a variety of sides of tourism behaviour like safety risks, trajectory prediction, tourism security, etc. Recognizing behavioural sides can enhance the use of smart tourism services to raise the success of the travel experience. The use of a variety of sensors of the Internet of Things through intelligence techniques is one method to get the required details about the actions of tourists in a smart city [20]. Table 1 provides details on different references that have related work in the field of tourism behaviour exploration. In this table we depended on the prediction accuracy and recall rates for ten papers, to clarify these rates for a variety of techniques in the smart tourism field, as well as we used two of these papers (which have used the same dataset) to make a comparison with our proposed model.

The first column implicates the serial number of references, the second column depicts the paper goal, the third column displays which methods were used, the 4th and 5th columns display recall rates and the prediction accuracy for the used methods, and the last column displays the dataset was used for each method.

Table 1. - Related works review

Ref.	Goal	Methods	Recall rate	accuracy	Dataset
[21]	The Prediction for Car Tourist Route	Bidirectional LSTM Neural Network	High recall rates	97.3%	Data made in the city of Saint Petersburg, Russia.
[22]	Tourism Information Management System	NN optimization Particle Swarm	96.11%	94.67%	particular place in Switzerland
[23]	Early Alert Information System for Tourist Safety	Long Short-Term Memory (LSTM)	High recall rates	Compared with the tourism safety early warning information	The experimental data in this paper are mainly for the analysis of the

				system based on the BP neural network, it has better accuracy and prediction ability	indicators of the scenic spot
[24]	Designing an intelligent tourism system	Deals with the combination of the Internet of Things and machine learning	92.6%	94.2%	Simulated datasets
[25]	Design a System for A Context-Aware Location Order.	Hierarchical LSTM Model	(94.2%	97.2%	The data collected from tourism in Jeju Island
[26]	The Prediction for Person Movement Traces of Short-Term Foreign Tourists	LSTM-Based Deep Learning Model	-	model always achieved a better accuracy than the baseline approaches	They used a real-world dataset including 7 months of unknown phone calls from tourists in Italy.
[27]	Security risk assessment of tourism management system	PSO-BP Neural Network	High of recall performance	97.3%	Tourist data of a location in Switzerland
[28]	Effective Tourism Using Tourist Vehicular Information	Neural Networks and Particle Swarm Optimization	-	99%	Jeju Island tourist data
[29]	smart tourism	CNN	-	85.08	AVA2 and ESITUR datasets
[30]	Cultural Tourist Management Information Systems	Data Mining	96.06%	91.65%	The data was collected on Facebook chat from 385 persons who had visited a tourist location in Maha Sarakham town.

3. METHODOLOGY

In this section, we present our proposed method for a Tourism Information Management System. This system focuses on network applications. The initial stage in developing a network management system is to determine the purpose of its applicability. A network management theme must be expressed clearly, different forms of material must be accommodated, and different resolutions must be accommodated; these are the typical functional requirements. Also, the database design is an upfront process because of the large number of databases used by this system.

This section divided into two parts: the first part is about presenting the implementation and testing environment and the data set used. The second part includes the algorithms that are used in our proposed model.

3.1. Implementation and Testing Environment

In this part, the details of the experimental setup are discussed, that is, we explain the operational environment for our work in full detail, in terms of the method of collecting and describing data and the structure of the model.

A system for intelligent tourist management is developed and implemented in this work primarily using ANN and LSTM algorithms.

3.1.1. Experiential Setup

The system is built in B/S mode, and the presentation layer's interface is implemented using a web browser. This layer primarily handles text, flash, photos, and other functions. In order to build and implement the system, data is sent to the programming model through the client browser's HTML form, URL, and Flash request realization. The system then offers J2EE realization. Experimental simulations are performed in this section to validate the system's practical application effect. Table 2 illustrates the parameter settings.

Table 2. - simulation test environment requirements

System components	specifications
Hidden Layer	one
RAM	64 GN
CPU	4 nuclear
Operating System	Windows

3.1.2. Experiential Data

In this research, the TIMS of a particular place in Switzerland, a country that has elaborated to a specified degree in the field of tourism, is selected as the test subject. At first, this database is set using a script tool to remove indicators that have little impact on the security evaluation. As an outcome, 10,000 samples are stuck in the primary dataset, 2,000 of them have a compromised security evaluation as passive samples, 7,000 of the 10,000 have well security evaluation as certain samples, the rest 1,000 samples are unknown and anonymous or are used as experimental samples.

3.2. The Applied Algorithms

3.2.1. Artificial Neural Network

A large number of neurons with tuneable connection weights form an artificial neural network (ANN). More and more, it is being employed in areas such as intelligent control, system modelling, pattern recognition, and information processing due to its self-organizational and self-learning capabilities, distributed information storage, and large-scale parallel processing. There are two steps in the artificial neural network: sending the right signal forward and sending the wrong signal backward. As a standard multilayer prefeedback network, it may be trained multiple times by utilizing the backward propagation of the error [31]. The numerical values that represent the connection between neurons are termed weights. How well a neural network learns is dependent on the weights assigned to individual neurons. The weight between neurons fluctuates as artificial neural networks learn. To begin, the weights are chosen at random. The structure depicted in Figure 1 enables it to perform the abovementioned function. Its three distinct layers, the input, implicit, and output layers are readily apparent. The input layer nodes are fixed at the same time as the amount of data to be outputted. To find out what the middle, implicit layer is, actual experimental operation is required. After determining the implicit layer and calculating the results, the number of nodes in the output layer can be determined [32]. The data must be trained by first deciding how many nodes will be in each of the three layers; only then can the output data be mapped to the input data over a particular threshold. To find out what went wrong, must compare the expected and actual output numbers for the first time [33]. A second calculation of the actual output value is performed after the neural network's nodes undergo spontaneous adjustments and changes following direction propagation in cases where the inaccuracy is large. This uncertainty cycle is repeated until the mean square difference between the actual and desired output values falls within an acceptable range. This is done to train the neural network to employ its adaptive properties. The study aims to minimize errors and provide scientifically legitimate findings of management system safety evaluation by relying on the adaptive character of artificial neural networks, which is their major advantage compared to other approaches [34].

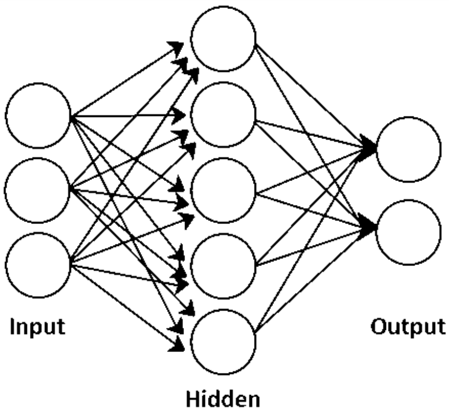

FIGURE 1. - Artificial Neural Network Algorithm

3.2.2. LSTM Algorithm

LSTM, an advanced form of Recurrent Neural Network, is crucial in deep learning for processing time series and sequential data. Designed by Hochreiter and Schmidhuber, LSTM effectively addresses ANN's limitations, particularly the vanishing gradient problem, making it superior for remembering long-term dependencies. This neural network can efficiently remember and change data because it combines complicated algorithms with gated cells [35]. Figure 2 displays the LSTM algorithm's computational process. Its distinctive gate structure allows it to memorize historical knowledge, setting it apart from ANN. This is also the explanation for its memorization capabilities regarding state history. It will take ANN output data in this investigation [36]. There is no pause in the process of using ANN and LSTM algorithms. The first step in tourism management is to use ANN to extract the spatial characteristics, and then use LSTM to recover the temporal aspects. Input, forget, and output gates make up the bulk of an LSTM algorithm's gate architecture [37]. Data altered by a reshape layer follows output from the ANN's output layer, which pertains to tourist management. Using sliding windows and stages, these data will be converted into labelled data. The reason behind this is that LSTM is likewise an algorithm for supervised learning [38].

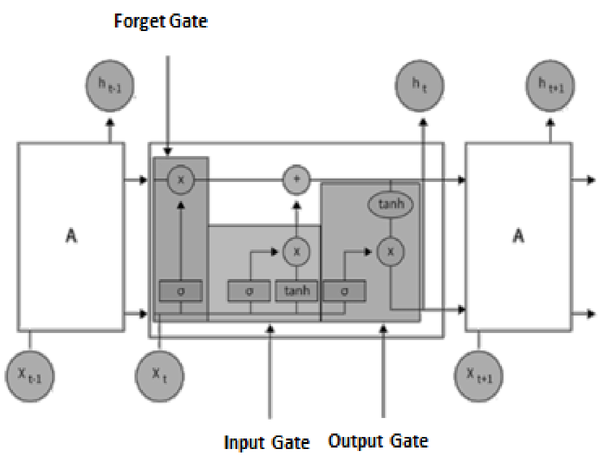

FIGURE 2. - LSTM Algorithm architecture

3.2.3. Performance of Hybrid Model

In order to create and execute the Intelligent Tourist Management Information System, this research primarily employs ANN and LSTM algorithms.

To achieve an equilibrium between the simulation and prediction accuracy of the proposed algorithm, this article uses a three-layer ANN with a single hidden layer as its topological structure. This is because over-fitting of real-world difficulties becomes more common with more hidden layers. While the input layer's node count represents the data's dimension, the number of prediction indexes represents the output layer's node count. What defines the function of a network is the activation function of its neurons. The major purpose of this is to execute functional transformation for both the input/output, as well as to control the activation of the input to output, to turn the input with an infinite range into an output with a limited domain. The S-type function is utilized in this work. The output of an ANN can be expressed as:

$$Y(X_n) = \sum_{i=1}^{1} W_i \Phi(X_n, r_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In the formula, Wi represents the weight between the nodes in the hidden layer and the output layer; Φ represents the ANN function, while ri is the center of the ANN function. Here is the definition of the ANN function:

$$\Phi(x) = \exp\left(\frac{\|x - c_i\|^2}{\delta_i^2}\right) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(2)$$

In this case, δi presents the radial basis's radius and ci for the response function's center. The optimal dimension for the three-layer ANN utilized in this paper is:

$$D = m \times n + n \times k + n + k \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(3)$$

Pass the input layer's threshold vector on to the hidden layer by setting it as:

$$A_1 = [a_{11}, a_{12}, a_{13}, \ldots, a_{1n}]^T \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Before the output layer is called, set the threshold vector as follows:

$$A_2 = [a_{21}, a_{22}, a_{23}, \ldots, a_{2k}]^T \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Using the mean square of errors as a basis to adjust the weights and thresholds in ANN and set the encoding on particle dimensions:

$$x = [IW_{11}, \ldots, IW_{mn} LV_{11}, \ldots, LV_{nk} a_{11}, \ldots, a_{1n} a_{21}, \ldots, a_{2k}] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(6)$$

The NN algorithms are the ones from which the LSTM algorithm is derived. The LSTM method's foundational idea for memorization of past state information is shown in equation (7). By impacting data about the present state, historical state knowledge makes the memory of past states a reality. In order to facilitate the retrieval of past knowledge, both historical and present state data will be assigned relative weights. You can think of equation 8 as the general form of equation (8). The LSTM structure requires the temporal feature information shown in equation (8). equation (9) provides specific temporal information to LSTM:

$$y(r) = f(X(r) \bullet W + y(r-1) \bullet V + b) \ \ldots\ldots\ldots\ldots(7)$$
$$\widetilde{C}(r) = f(W \bullet x(r) + V \bullet y(r-1)) \ \ldots\ldots\ldots\ldots\ldots\ldots.(8)$$
$$C(r) = C(r-1) + \widetilde{C}(r) \ \ldots\ldots\ldots\ldots\ldots..(9)$$

Not only can the input gate regulate the quantity of data being sent, but it can also regulate the properties of both past and present state data. Inputting all the state data, both historical and current, into the network will result in more than just an excess of parameters. As a result, feature extraction becomes subpar. As shown in equations (10) and (11), the input gate follows a computation process. Depending on the weight, it can transmit along selective state information (both historical and current):

$$C(r) = C(r-1) + g_{in} \bullet \widetilde{C}(r) \ \ldots\ldots\ldots\ldots(10)$$
$$C(r) = C(r-1) + g_{in} \otimes \widetilde{C}(r) \ \ldots\ldots\ldots..(11)$$

As illustrated in equation (12), the LSTM forget gate is calculated in a certain way. The LSTM will be inundated with data once all the forget gates are opened. According to the weight, which is defined by the feature's importance, the forgetting gate will selectively input features from previous state data. according to the size of the weight:

$$C(r) = g_{forget}C(r-1) + g_{in} \otimes \tilde{C}(r) \quad \text{............(12)}$$

The LSTM method's output gate can be found using equation (13) as a reference. Features pertaining to the data about the present condition will be output via the output gate. A gate structure is necessary for this to be controlled effectively. Not only can it guarantee accurate historical data output, but it can also guarantee that data parameters won't be too big:

$$y(r) = g_{out} \otimes f(C(r)) \quad \text{..........(13)}$$

Oversee and fix the Internet tourist network using the HTML page of the system. It is via the presentation layer that the client and logical interface are shown. Both the users and the connection between the system are embodied in the presentation layer. After receiving a request from the client, the presentation layer transmits the data, mostly through the business layer, and displays the results. Openness, extensibility, adaptability, efficiency, and stability are the guiding principles of data exchange interface design. The data exchange interface features its hierarchical authority management mechanism, effectively encrypts data during transmission, and securely authenticates data and storage for other data exchange application systems. To create a tourist management system that satisfies the real demands of tourism management, this study employs the principle of serving users. Furthermore, we have achieved our goals of Assist tourist enterprises with decision-making by providing a solid functionality, a user-friendly interface, a reasonable installation cost, and the ability to meet a variety of service tourism demands.

4. RESULTS AND DISCUSSION

This section reviews our study results and provides their full analysis and explanation. In Section 4.1, we utilize recall rates. In Section 4.2, we presented prediction accuracy to evaluate the performance of the model in comparisons with other models.

Emulation experiences are utilized to check the achievement of the LSTM Artificial neural network algorithm. The proposed algorithm was designed to carry out perfectly through an indefinite iterations number by using the dataset from the tourism management system of a Switzerland place aforementioned. At last, the finest standardization fault is acquired, and the best model performance when this amount is less.

For input layer to the hidden layer conversion, we use the Ansig function, and for the hidden layer to output layer conversion, we use the Purelin function. There is a limit of 1000 steps for training. Figure 3 displays the outcomes of the training.

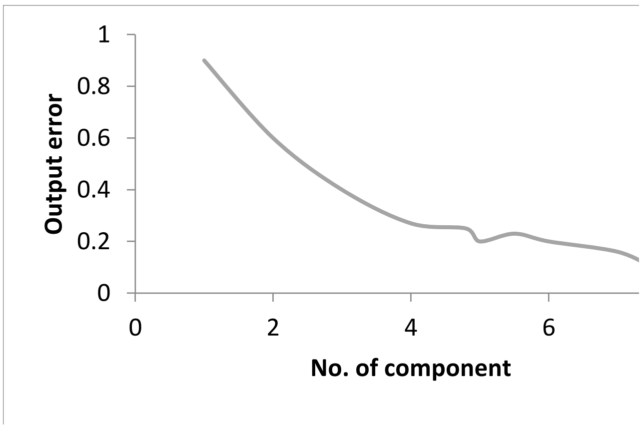

FIGURE 3. - The results of training in our proposed algorithms

We utilize prediction accuracy and recall rates to evaluate the performance of the model. Within the framework of our proposed technique objectives, this section reviews our study results and provides their full analysis and explanation.

4.1 Recall rates

To prove the excellence and effectiveness of our technique, we compared our results with another technology [14,19]. These are the Particle Swarm-Optimize Neural Network (PSO) algorithm [14], and PSO-BP Neural Network which used the same dataset as we mentioned in previous paragraph, as well as the Traditional Artificial Neural Network. Depending on table 3 we can see that previous methods recorded recall rates are less than our proposed method, which is obtained a recall rate of 99.6%.

Table 3. - comparison between different methods in term of recall

Techniques	Recall rate
Traditional Neural Network	84.0%
PSO and NN [14]	96.11%
PSO-BP Neural Network [19]	Always high
LSTM optimization ANN	99.6%

In Figure 4, we compared the recall rates of our proposed method (LSTM optimization ANN) with another two methods. Our algorithm outperforms the comparison algorithm and has the highest recall rate.

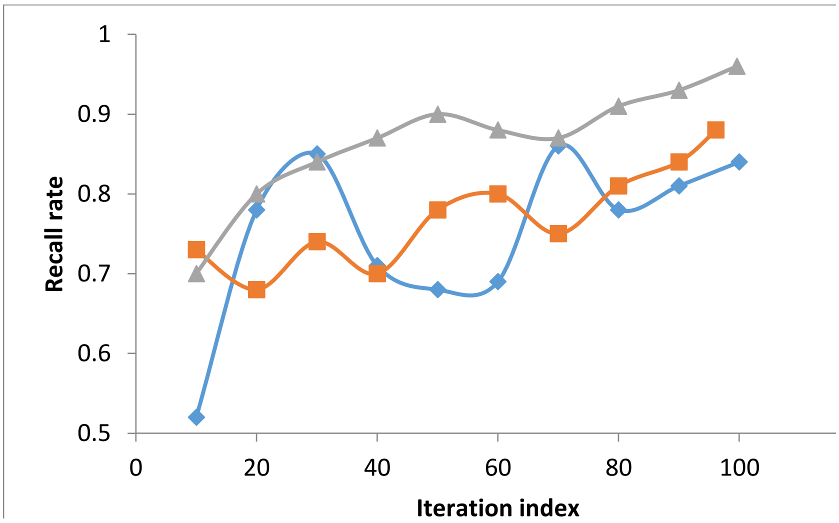

FIGURE 4. - The differing recall among different algorithms

4.2 prediction accuracy

The performance is assessed by comparing the prediction results obtained from three independent models that were used to forecast the test set, which are Traditional Artificial Neural Network, and a model used the Particle Swarm-Optimize Neural Network (PSO) algorithm [14], as well as PSO-BP Neural Network [19] as shown in table 1 which used the same dataset as we mentioned in previous paragraph.

Table 4. - Comparison between different methods in term of Prediction accuracy

Techniques	Prediction accuracy
Traditional Neural Network	79.3%
PSO and NN [14]	94.67%
PSO-BP Neural Network [19]	97.3%
LSTM optimization ANN	98.2%

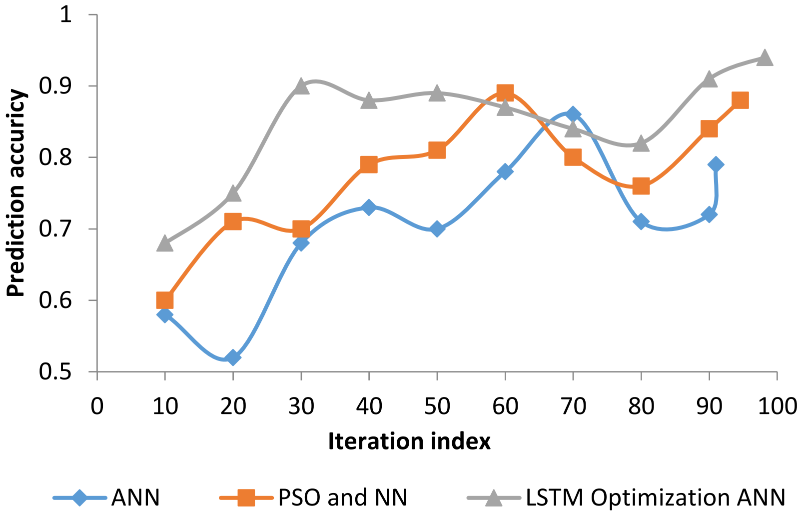

FIGURE 5. - The differing predictions for different algorithms

Depending on the table 4, we can see that all previous methods record prediction accuracy less than our proposed method, which is obtained 98.2% for a prediction accuracy. Figure 5 displays the results of various models' prediction accuracy tests.

This paper's technology also has a short response time, which allows it to be very efficient. This data proves that the system described in the paper performs better than the competition. It has potential uses in the field of tourist data management.

5. CONCLUSION

Thanks to the proliferation of powerful computers, the tourism industry has grown at a dizzying rate, and even the most conventional forms of tourism have seen profound transformations. Consequently, a highly available, extensible, and easily maintained tourism management information system is necessary. By nonlinearly reducing the inertia factor, the optimization performance of the LSTM is enhanced, and this paper uses the LSTM to optimize ANN. The system offers comprehensive support, covering everything from system setup to statistical category reports and analysis of tourism resource management by management people. In addition to managing user registration, it sorts users into groups based on their data, keeps track of their clicks on distinct lines for different categories, and rearranges route information to make search results more accurate and personalized. For all these, the proposed system approves its ability to greatly improve the tourist experience. The model and method presented in this study were tested in a number of trials to ensure their efficacy. A recall rate of 99.6% and a prediction accuracy of 98.2% were achieved by this strategy in testing. Concurrently, this research considers one of the artificial intelligent applications under the concept of “smart tourism" via the lens of targeted tourism informatization, which might contribute to the tourism industry's general level of development and structural upgrading.

REFERENCES

[1] Gretzel, U.; Sigala, M.; Xiang, Z.; Koo, C. Smart tourism: Foundations and developments. Electron. Mark. 2015, 25, 179–188.

[2] Korzun, D.; Balandina, E.; Kashevnik, A.; Balandin, S.; Viola, F. Ambient Intelligence Services in IoT Environments: Emerging Research and Opportunities; IGI Global: Hershey, PA, USA 2019.

[3] Ogirima, Sanni Abubakar Omuya, Tolulope Reuben Awode, and Olajide Olusegun Adeosun. "Online computerized hotel management system." J. Comput. Biosci. Eng., ISSN (2014): 2348-7321.

[4] Mikhailov, S.; Kashevnik, A. Tourist Behaviour Analysis Based on Digital Pattern of Life—An Approach and Case Study. Future Internet 2020, 12, 165.

[5] Wint Wah Loon, Haymar Aung, Hlaing Htake, and Khaung Tin, “Learning the Requirements Engineering Process of the Online Hotel Reservation System” International Journal of Emerging Research in Management &Technology ISSN: 2278-9359 Volume-7, Issue-8, 2018.

[6] Abdulkadhim, Ekhlas Ghaleb, Sanaa Hammad Dhahi, and Meeras Salman Al-Shemarry. "Review on various image protection methods." Journal of Al-Qadisiyah for Computer Science and Mathematics 15.4 (2023): 41-47.
[7] Hayder, Muqdad Abdulraheem, and Ekhlas Ghaleb Abdulkadhim. "Enhance a Cloud-Based Distance Learning Computing Management System (LCMS)." Intelligent Systems and Networks: Selected Articles from ICISN 2021, Vietnam. Springer Singapore, 2021.
[8] J. Du, “Research on intelligent tourism information system based on data mining algorithm,” Mobile Information Systems, vol. 2021, Article ID 5727788, 10 pages, 2021.
[9] Gui, Z.; Sun, Y.; Yang, L.; Peng, D.; Li, F.; Wu, H.; Guo, C.; Guo, W.; Gong, J. LSI-LSTM: An attention-aware LSTM for real-time driving destination prediction by considering location semantics and location importance of trajectory points. Neurocomputing 2021, 440, 72–88.
[10] Choi, S.; Kim, J.; Yeo, H. Attention-based Recurrent Neural Network for Urban Vehicle Trajectory Prediction. Procedia Comput. Sci. 2019, 151, 327–334.
[11] Urner, J.; Bucher, D.; Yang, J.; Jonietz, D. Assessing the influence of spatio-temporal context for next place prediction using different machine learning approaches. ISPRS Int. J. Geo-Inf. 2018, 7, 166.
[12] Rezaei, Sajad, et al. "Online impulse buying of tourism products: The role of web site personality, utilitarian and hedonic web browsing." Journal of Hospitality and Tourism Technology 7.1 (2016): 60-83.
[13] S. Bai and F. Han, “Tourist behavior recognition through scenic spot image retrieval based on image processing,” Traitement du Signal, vol. 37, no. 4, pp. 619–626, 2020.
[14] Intelligence and Neuroscience, Computational. "Retracted:: Optimization Algorithm of Tourism Security Early Warning Information System Based on Long Short-Term Memory (LSTM)." (2023).
[15] Alzubaidi, Asia Mahdi Naser, and Elham Mohammed Thabit A. Alsaadi. "LPCNN: convolutional neural network for link prediction based on network structured features." TELKOMNIKA (Telecommunication Computing Electronics and Control) 20.6 (2022): 1214-1224.
[16] Hu, S.; Gao, S.; Wu, L.; Xu, Y.; Zhang, Z.; Cui, H.; Gong, X. Urban function classification at road segment level using taxi trajectory data: A graph convolutional neural network approach. Comput. Environ. Urban Syst. 2021, 87, 101619.
[17] Pierdicca, Roberto, Marina Paolanti, and Emanuele Frontoni. "eTourism: ICT and its role for tourism management." Journal of Hospitality and Tourism Technology 10.1 (2019): 90-106.
[18] Chen, X.; Zhou, L. Design and implementation of an intelligent system for tourist routes recommendation based on Hadoop. In Proceedings of the 2015 6th IEEE International Conference on Software Engineering and Service Science, Beijing, China, 18–20 October 2015.
[19] Yuan, F.C. Intelligent forecasting of inbound tourist arrivals by social networking analysis. Phys. Stat. Mech. Appl. 2020, 558, 124944.
[20] Hochreiter, S.; Schmidhuber, J. Long Short-Term Memory. Neural Comput. 1997, 9, 1735–1780.
[21] Mikhailov, Sergei, and Alexey Kashevnik. "Car tourist trajectory prediction based on bidirectional lstm neural network." Electronics 10.12 (2021): 1390.
[22] Gao, Xuan, et al. "Tourism Information Management System Using Neural Networks Driven by Particle Swarm Model." Computational Intelligence and Neuroscience 2022 (2022).
[23] Feng, Lei, and Yukai Hao. "Optimization algorithm of tourism security early warning information system based on long short-term memory (LSTM)." Computational Intelligence and Neuroscience 2021 (2021).
[24] Ma, Hui. "Development of a smart tourism service system based on the Internet of Things and machine learning." The Journal of Supercomputing (2023): 1-21.
[25] Shafqat, Wafa, and Yung-Cheol Byun. "A context-aware location recommendation system for tourists using hierarchical LSTM model." Sustainability 12.10 (2020): 4107.
[26] Crivellari, Alessandro, and Euro Beinat. "LSTM-based deep learning model for predicting individual mobility traces of short-term foreign tourists." Sustainability 12.1 (2020): 349.
[27] Song, Jingqing, and Han Xu. "Safety Risk Evaluation of Tourism Management System Based on PSO-BP Neural Network." Wireless Communications and Mobile Computing 2023 (2023).
[28] Malik, Sehrish, and DoHyeun Kim. "Optimal travel route recommendation mechanism based on neural networks and particle swarm optimization for efficient tourism using tourist vehicular data." Sustainability 11.12 (2019): 3357.
[29] Kleinlein, Ricardo, et al. "Predicting image aesthetics for intelligent tourism information systems." Electronics 8.6 (2019): 671.
[30] Yuensuk, Thanet, et al. "Information Systems for Cultural Tourism Management Using Text Analytics and Data Mining Techniques." Int. J. Interact. Mob. Technol. 16.9 (2022): 146-163..
[31] Zhang, X.; Zhao, Z.; Zheng, Y.; Li, J. Prediction of Taxi Destinations Using a Novel Data Embedding Method and Ensemble Learning. IEEE Trans. Intell. Trans. Syst. 2019, 1–11.
[32] Kanjanasupawan, Jaruwan, et al. "Prediction of tourist behaviour: Tourist visiting places by adapting convolutional long short-term deep learning." 2019 International Conference on System Science and Engineering (ICSSE). IEEE, 2019.

[33] Ma, Y.; Zhu, X.; Zhang, S.; Yang, R.; Wang, W.; Manocha, D. TrafficPredict: Trajectory Prediction for Heterogeneous Traffic-Agents. In Proceedings of the Thirty-Third AAAI Conference on Artificial Intelligence (AAAI-19), Honolulu, HI, USA, 27 January–1 February 2019.
[34] Lim, C.; Kim, K.J.; Maglio, P.P. Smart cities with big data: Reference models, challenges, and considerations. Cities 2018, 82, 86–99.
[35] Huang, X.; Li, M.; Zhang, J.; Zhang, L.; Zhang, H.; Yan, S. Tourists' spatial-temporal behavior patterns in theme parks: A case study of Ocean Park Hong Kong. J. Destin. Mark. Manag. 2020, 15, 100411.
[36] Z. Yixing, S. Wang, W. Xu, F. Carlos, and F. Yongcun, "Novel feedback-Bayesian BP neural network combined with extended Kalman filtering for the battery state-of-charge estimation," International Journal of Electrochemical Science, vol. 16, no. 6, article 210624, 2021
[37] R. Li Yu, Z. Tao, X. S. Ne et al., "Application of the collision mathematical model based on a BP neural network in railway vehicles," Proceedings of the Institution of Mechanical Engineers, Part F: Journal of Rail and Rapid Transit, vol. 235, no. 6, pp. 713–725, 2021.
[38] S. Du, H. Zhang, H. Xu, J. Yang, and O. Tu, "To make the travel healthier: A new tourism personalized route recommendation algorithm," Journal of Ambient Intelligence and Humanized Computing, vol. 10, no. 9, pp. 3551–3562, 2018