Microprocessors and Microsystems 80 (2021) 103579

Contents lists available at ScienceDirect

Microprocessors and Microsystems

journal homepage: www.elsevier.com/locate/micpro

Development of cultural tourism platform based on FPGA and convolutional neural network

Xinzhe Yin [a,b], Jinghua Li [a,*]

[a] School of International Business, Sichuan International Studies University, Chongqing, 400031, China
[b] The Research for International Business and Economy, Sichuan International Studies University, Chongqing, 400031, China

ARTICLE INFO

Keywords:
Data mining
Field programmable gate array (FPGA) using xilinx
Predictive Modeling
Association Analysis

ABSTRACT

Data mining can be described as a typical analysis of large datasets to investigate early unknown types, styles, and interpersonal relationships to generate the right decision information. It improves their markets and today to maintain control over whether these companies are forced into the data mining tools and technologies they use to develop and manage tourism products and services in the market. It is falling out of the favorable situation of the travel and tourism industry. Objective work is to provide and display its application in data mining and tourism. Advances in mobile technology provide an opportunity to obtain real-time information of travelers, such as time and space behavior, at the destination they visit. This study analyzed a large-scale mobile phone data set to capture the mobile phone traces of international tourists who visited South Korea. We adopt the trajectory data mining method to understand tourism activities' spatial structure in three different destinations. The research reveals tourist destinations and multiple "hot spots" (or popular areas) that interact spatially in these places through spatial cluster analysis and sequential pattern mining. Therefore, this article provides the planning of spatial model destinations to integrate important tourism influences, which is based on tourism design. The proposed system is modelled in Field Programmable Gate Array (FPGA) using Xilinx software.

1. Introduction

Nowadays, information can be reasonable and straightforward progressively. Information disclosure from a dynamic and exact forecast of various sources becomes extraordinarily and costly without a measurable data framework. This article provides a conceptual model of digital tourism systems and big data and data mining technologies that provide an overview of monitoring tourism sector processes from different sources. The essential issue is identified with the amount and nature of the information. These significantly affect the result of the information revelation measure. Specifically, the amount of data is tied to data mining technology's scalability, as the data is continuous and its changing nature is updated and modified. It uses statistics, math, machine learning and artificial intelligence techniques.

Its purpose is to mine the original classification, effective, convenient, and stable relationships and patterns with potential data. It has also been used wholly and intensively by marketing, financial institutions, retailers and manufacturers. Of course, data quality plays an important role. Therefore, all of the above issues can be affected negatively by the outcome of the knowledge discovery process and should be considered before and after the data analysis process. In any case, it also needs to consider statistical learning of how it has changed in the era of big data. The combination of data scientists in the tourism industry and modern statistical techniques have made the tourism economy prominent. The proposed advanced the travel industry framework underlines four territories of enthusiasm for various purposes: objective administration, R and D development, market investigation, and work market, explicitly to improve the travel industry the executives and the travel industry research.

2. Literature survey

The entire tourism industry is an essential strategy for promoting the tourism industry's development, which has received widespread academic attention. Big data was used to analyze messages and responses investigating the local media's overall differences in the tourism industry. Scholars provide new research perspectives in global information, big data, and tourism [1, 2]. Most dimensionality decrease plans are planned on the presumption that examples in every class follow a Gaussian circulation. Real-time data delivery, which lacks this attribute,

* Corresponding author.
E-mail address: lijinghua@sisu.edu.cn (J. Li).

https://doi.org/10.1016/j.micpro.2020.103579
Received 10 November 2020; Received in revised form 24 November 2020; Accepted 30 November 2020
Available online 3 December 2020

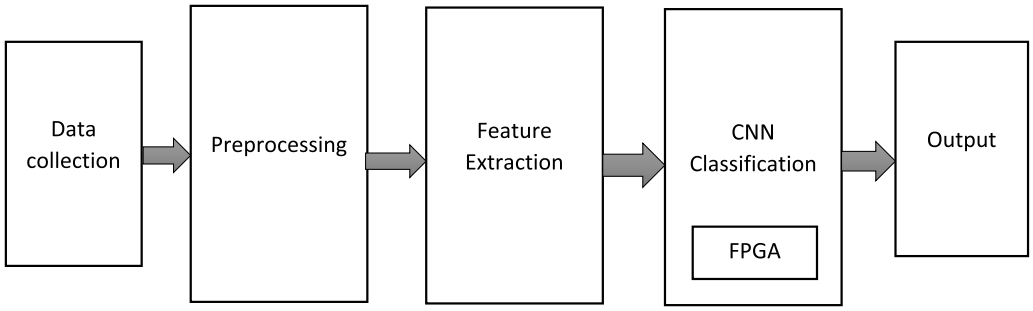

Fig. 1. Proposed Block Diagram.

cannot characterize different types of accurate measurement data uncertainty with good dimensionality reduction techniques [3, 4].

A survey to assess framework execution was chosen and explored by three specialists through a purposeful testing technique. A survey for assessment and framework fulfillment was directed by 400 travelers utilizing an irregular inspecting technique [5, 6]. In this work, text examination programming is utilized for word recurrence investigation, semantic organization investigation and notoriety examination to assess visitor perceptions of Beijing-Hangzhou Great Canal, including trait and cultural heritage perceptions [7, 8].

In this day and age, people are increasingly making purchasing decisions based on online reviews. However, in tourism and hotel management social networks, some astroturfing activities are organized by organizations to promote their products and services. Structured reviews can cause many problems for visitors who make decisions based on online-provided reviews [9, 10]. Taking the "Ginkgo Tourism Application" as an example. Design prototypes are based on competitive analysis to establish the structure and production function analysis of information systems [11, 12].

As people's income and consumption levels increase, tourism has become one of the essential consumption factors. Big data and informatization in the tourism industry have led to healthy and robust development [13, 14]. If it is moderately developed, it will provide expanded cultural exchange and national economic development. As a tool for internet applications that play a decisive role in the tourism industry's success and rational development, web development can pave the way for more development and success in this industry [15].

3. Materials and methods

This is a popular tourism model among foreign tourists in cultural tourism. Cultural tourism requires people to travel from one place to another. It must respect each other's culture by creating friendship, knowledge, and cultural appreciation of society's understanding. In this process, we need to consider maintaining the lowest environmental impact on people, culture and society. Network individuals can profit by social travel industry pay and business, prompting financial and social turn of events shown in Fig. 1.

Today, some products and services are characteristic of market competition worldwide. The importance of the part of the culture of products sold in one country is distinguished from that of competitors. This is a powerful creative economic line. It mostly tourists interested in understanding Thai culture from the United States and Europe. Through their historical heritage, they considered the architecture adopted by the product. People's cultural movements. This enables educational tourism to appreciate their religious beliefs and visits characterized by arts and cultural festivals, historic sites inherited by the community, mobile learning customs and beliefs.

3.1. Preprocessing

In huge information, the measure of information is gigantic, yet the organizations that hold this information are troubled to share it. Today, the Internet is the most significant wellspring of enormous information. More individuals are beginning to understand the estimation of enormous information, and more associations are preparing information as

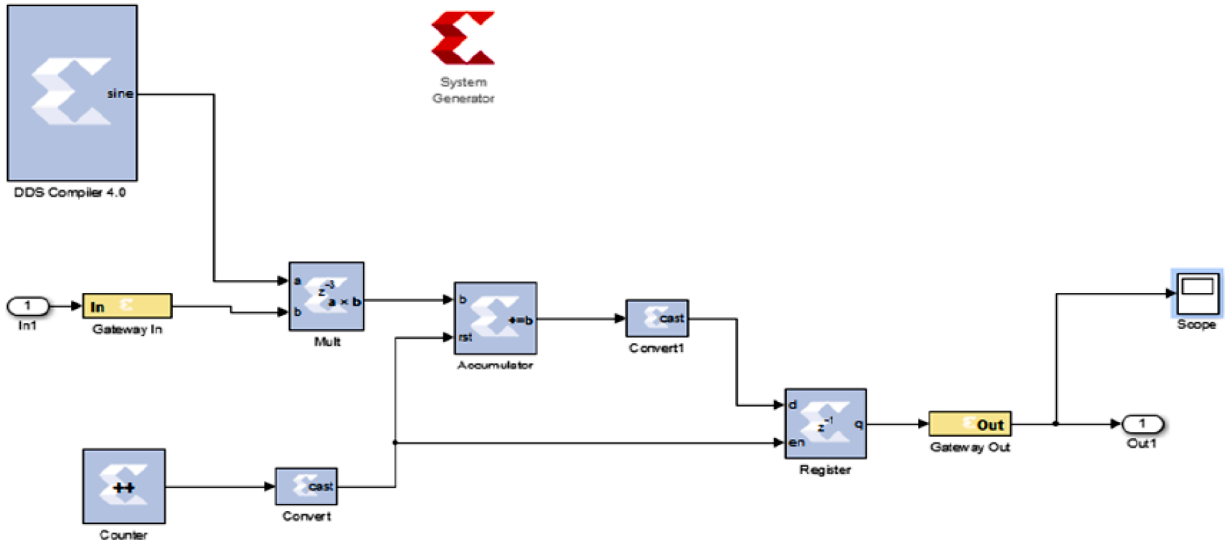

Fig. 2. Data preprocessing FPGA circuit.

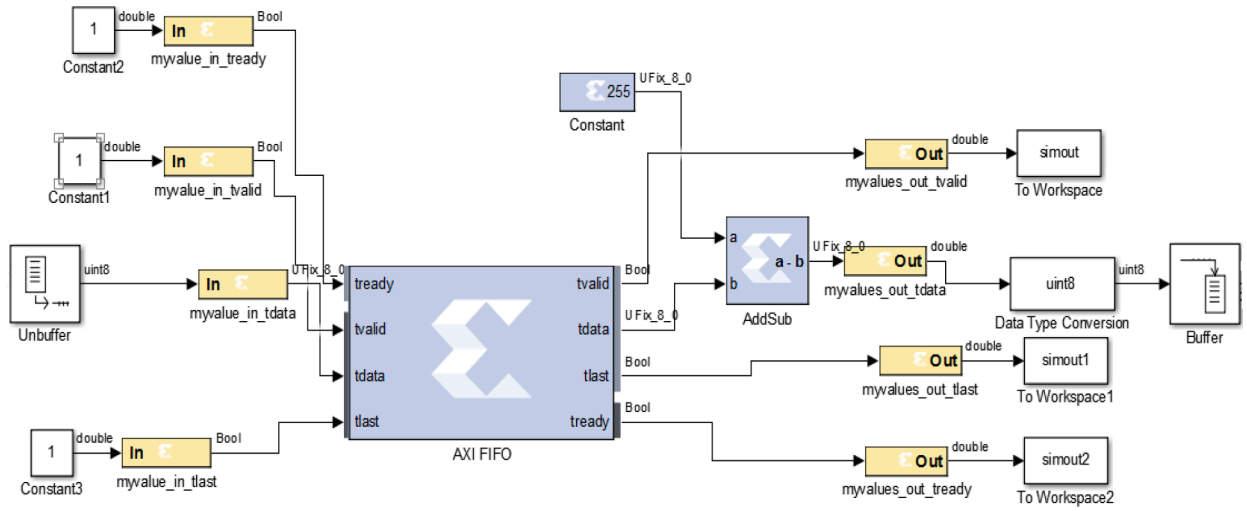

Fig. 3. Feature extraction FPGA circuit.

to their most significant resource. Subsequently, you have to get authorization before you can get this information. For regular money related establishments, they need to pay for it. Likewise, it is harder to get convenience information. It is hard to acquire information from different fields, not to mention partnered organizations and exploration establishments. The frameworks between divisions are autonomous and not associated. It is difficult for companies to manipulate data effectively because the data is not systematic, consistent and reliable. Big data technology's strategic importance is not to store large amounts of data but to specialize in meaningful data. The main goal of big data applications is to find correlations in irrelevant data. This requires an understanding of the industry and data processing capabilities of both parties and a professional analyst.

The present large information applications in the travel industry organizations are essentially information mining ideas. Regarding the travel industry, the executive's office, all the information they require during the travel industry preparing and all the information produced in the travel industry exercises are data generated by a detailed analysis of tourism management and destination promotion activities and then trusted. Provides highly relevant tourism policy guidance, facilitates industrial transformation and upgrades that further improve efficiency, and preprocess data shown in Fig. 2.

For tourism companies, they gradually need to analyze and mine massive amounts of information to control and deal with their work. For instance, lodgings make more exact suggestions and allure travel items and administrations depending on client attributes and inclinations. Touring spots can manage a superior progression of travelers. Travel services can all the more effectively coordinate data assets and grow more focused on and customized travel items. When it comes to customer management, tourism companies should discard these data rather than strengthening the assortment of client data and thoughtfulness regarding the gathering of client information.

3.2. *Feature extraction*

In the association, the purpose is to decide where to go for standard variables. This is a tool for finding groups or patterns in groups of items. For example, market analysis refers to the generated probabilistic dissertation. For example, tourists visit Nepal, with a probability of 0.66, if also visit Indian technology. It's easy to know that such statements (rules) are sensitive. Also, good organizations are expected to have forecasted. However, many uses of association analysis are exploration only to understand better data set grouping and patterns. Association rules can be extended to include more complex applications and useful for project construction discounts and promotion decisions and cross-selling and other related analyses. For example, you can capture a time series. To enhance online purchases, online travel agencies can attempt to isolate an array of online purchases that may not provide network navigation. Clustering is a search technique in which attempts to discover natural groups in the data are shown in Fig. 3.

A feature is typically used for market segmentation and determines cluster configuration files for different segments. Separating the market and the qualities of the various sections see how such an association can help decide the techniques and correspondences that can arrive at the

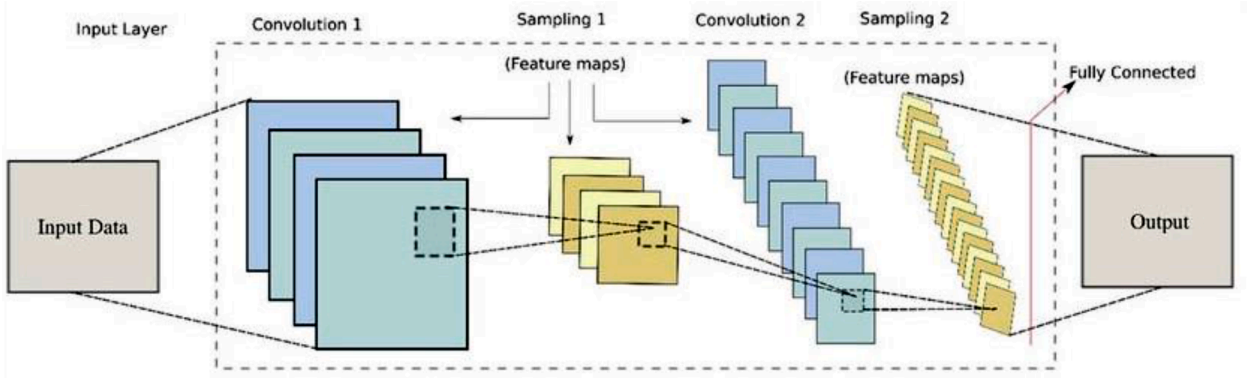

Fig. 4. CNN Structure.

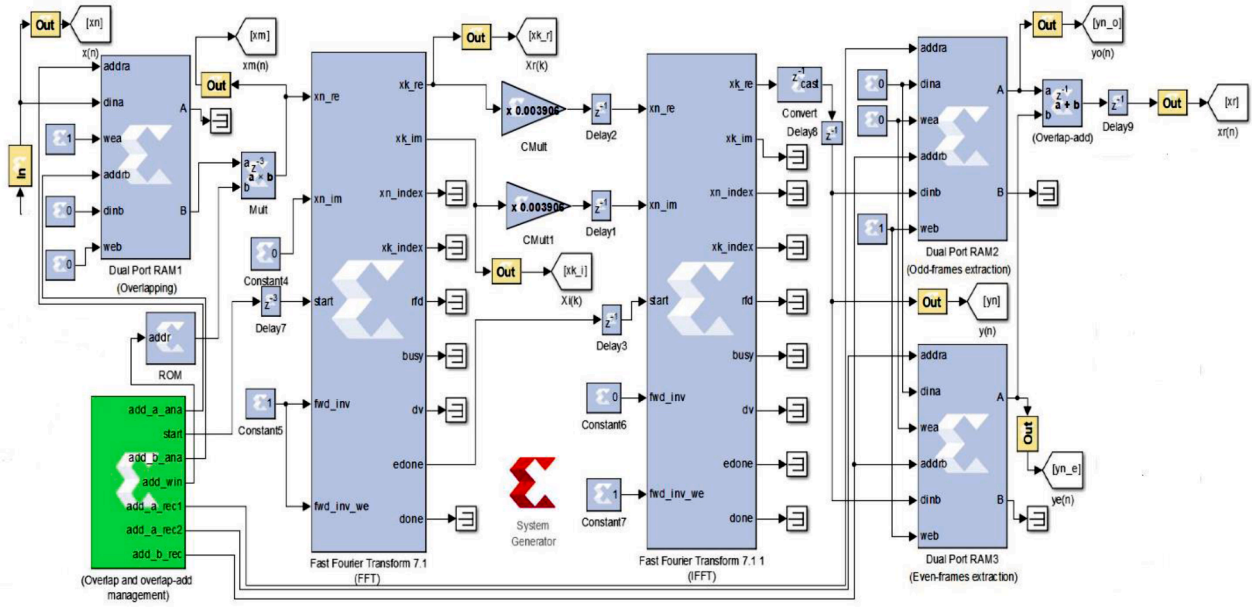

Fig. 5. FPGA based data classification.

objective fragment. The travel industry is one of the primary clients of data innovation. Advances in data innovation offer assistance and offices and impact how they are appropriated and advanced. It also affects the interaction of the organizational structure between the customer and the service provider. Travelers find places where they use the internet and communication technologies to meet their needs and expectations.

3.3. Classification convolutional neural network (CNN)

Data mining is primarily a common and essential application that involves predictive models that can be further divided into two categories. Classification means that the target variable is essentially a qualitative prediction. Estimates, on the other hand, essentially refer to quantitative predictions of target variables. Predictive modeling attempts typically predict the objective variable based on one or more input variables. For example, various relapse can foresee the measure of movement spending dependent on pay, age and sex. Neural organizations can likewise be utilized for prescient demonstrating. They are often very good at simulating complex relationships in the data. Neural networks are later modeled on the human brain, which can be understood as a highly connected network of neurons.

The CNN structure has appeared in Fig. 4. It very well may be utilized for prescient demonstrating as well. They partition the common selective sentiment and detail bunches dependent on the specific info variable level with the most grounded connection with the objective variable. The result can be spoken to through a CNN-like structure, a conservative understanding of graphical information. Clear decision-making rules can also represent the final product. It is easy to understand and use these two expressions. CNN's can simulate fairly complex relationships. All regressions, neural networks and CNN models are built together, after which a competitive model is evaluated to determine the final model.

3.3.1. FPGA

The most promising solution to this problem is that a simple microcontroller cannot run it, but it can be implemented very efficiently in an FPGA and uses parallel processing. In the first step, we evaluated an algorithm that utilized simulation performance on a standard PC. It implements an 8-bit microcontroller on the sensor interface for this purpose and sends the PC's measurement data. Data processing performed by the PC (which will be done later by the FPGA) and return the results of this analysis (in our case, prediction of future values of the parameters) will be displayed on the back microcontroller analysis displayed. At the moment, we are working hard to implement the algorithm on the FPGA. FPGA hardware implementations seem to be most suitable for building highly distributed parallel computing systems. However, sensor and display work mode management and interface management are still performed using microcontrollers because they allow quick corrections. In contrast, methods and neural networks require much of the computation done through parallel processing in the FPGA domain.

Therefore, Fig. 5 gives the modular structure of statistical merit processing is for the parallel processing paradigm. It is developing local distributed processing equipment and control equipment for this purpose. These processing units are implemented in the FPGA (e.g., using a high-level description language such as VHDL for FPGA synthesis). The last building block execution speed and force utilization plan must be additionally thought of and advanced during the period.

Table 1
Proposed FPGA Implementation.

Measurement	*SVM*	*FUZZY*	*CNN*
Power supply (w)	*24*	*19*	*8*
latches	*365*	*493*	*516*
Slice	*241*	*377*	*458*

Table 2
Comparison Proposed system Performance.

Technique	*SVM*	*FUZZY*	*CNN*
Accuracy (%)	89.8%	91.5%	98.7%
Sensitivity (%)	71%	76%	97.3%
Specificity (%)	70%	76%	89%

4. Result and analysis

The proposed Convolutional Neural Network (CNN) is developed to monitor the environment process. The proposed system is implemented

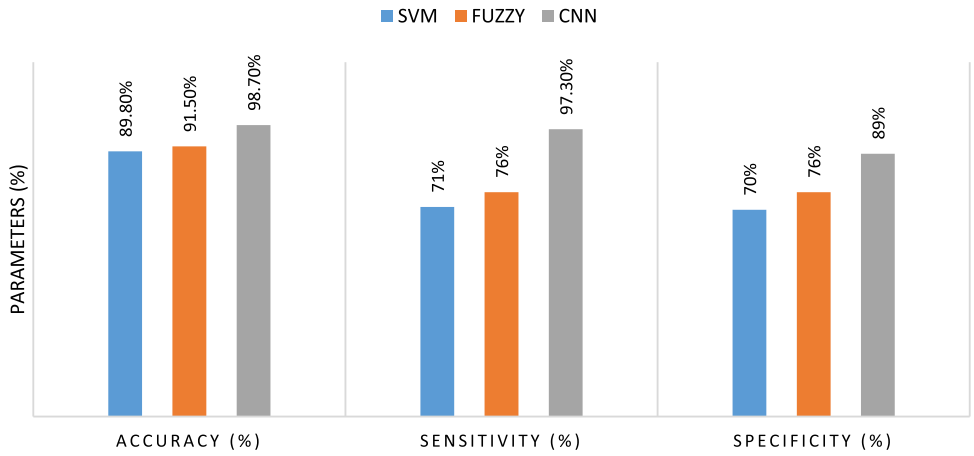

Fig. 6. Comparison of proposed CNN system.

Table 3
Error Rejection Rate.

Technique	*ERR (%)*
SVM	10.2%
FUZZY	8.5%
CNN	1.3%

with help of the FPGA Tool and Xilinx software.

The proposed Convolutional Neural Network (CNN) based data mining work is actualized on the Vertex-2Pro FPGA parameter are shown in table 1.

Table 2 shows the sensitivity, accuracy, and specificity of the proposed Convolutional Neural Network (CNN) strategy is higher than the other existing framework like SVM and Fuzzy. The correlation graph is given below.

Fig. 6 gives the performance examination of the proposed Convolutional Neural Network (CNN) with the standard technique. Compared with traditional SVM and FUZZY methods, the proposed Convolutional Neural Network (CNN) method delivered significant results for every working condition.

Table 3 gives the error rejection ratio of the Convolutional Neural Network (CNN) system.

Fig. 7 gives the proposed Convolutional Neural Network (CNN) system Error Rejection Rate.

5. Conclusion

This has a significant impact on the travel industry, but the effect is still a mistake in its infancy. A few offices and organizations are now utilizing extensive information dependent on testing and creation, and numerous individuals have not yet made any move in such a manner. The survey conducted in this report should not be disputed by all companies on the premise that big data has great potential to change the industry. The critical point is that the potential is small, at least real. Maintaining a one-on-one relationship with a customer can be difficult in some areas, but this is not a real trip. Travel General Purpose; Transactions with the subject individuals are often made with customers. Accordingly, building a client situated information stage is essential for experts inside this reach. Enormous information examination makes way for different open doors for present-day information on the travel industry's turn of events. Different parts of the neural network layer focus on various features, and this model achieved better results than other CNN models based on FPGA Xilinx software.

Declaration of Competing Interest

We declare that we do not have any commercial or associative interest that represents a conflict of interest in connection with the work submitted.

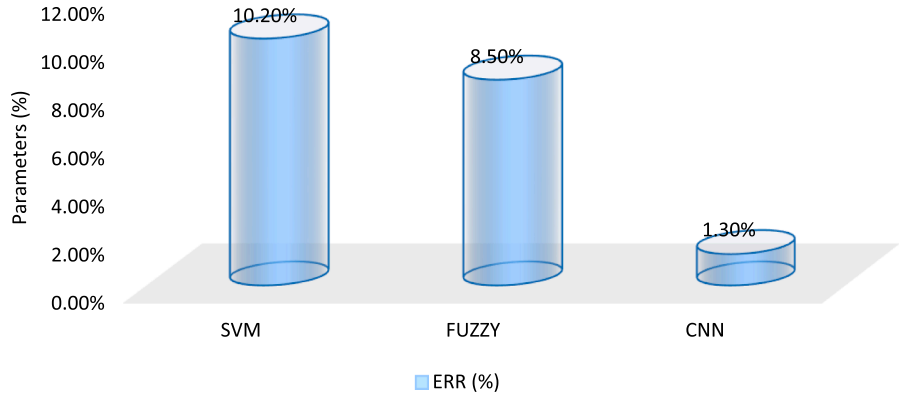

Fig. 7. Average EER.

Reference

[1] W.A.N.G. CHAO, G.U.O. NA, Differences in regional media responses to China's holistic tourism: big data analysis based on newspaper text, in: IEEE Access, 2020.
[2] Ives Gutierriz, Vanessa, The importance of using the QR code in tourism in portugal, in: Conference on Information Systems and Technologies, 2020.
[3] Rajalakshmi Dinakaran, Efficient pattern matching for uncertain time series data with optimal sampling and dimensionality reduction, in: Microprocessors and Microsystems, 2020.
[4] Tomas Figliolia, Andreas, An FPGA multiprocessor architecture for Bayesian online changepoint detection using stochastic computation, in: Microprocessors and Microsystems, 2020.
[5] Achaporn Paingruthai, Cultural tourism web service via augmented reality for public relations in Prachuapkhirikhan province, in: Technology Innovation Management and Engineering Science International Conference, 2019.
[6] Xia ling, Feihu chen, The development trend of Tibetan decorative art and boudoir architecture integration and cultural tourism under the background of big data, in: International Conference on Mechanical, Control and Computer Engineering, 2019.
[7] S.H.I. Kaijing, Z.H.A.N.G. Ying, Study on Tourists' perception of the grand canal cultural heritage based on network travels, in: International Conference on Big Data Computing Service and Applications, 2019.
[8] Yongzhi Wang, Research on evaluation method of tourism quality of characteristic towns in southwest minority areas based on ORA network data analysis, in: International Conference on Robots & Intelligent System, 2019.
[9] Noora Alallaq, Muhmmad, Detecting suspicious social a stroturfing groups in tourism social networks, in: International Conference on Behavioral, Economic, and Socio-Cultural Computing, 2018.
[10] Alfian Nara Weking, Stefanus Ndala, Analysis of mobile application smart religious tourism, in: International Conference on Information Technology, Information Systems and Electrical Engineering, 2018.
[11] Zhang Lili, Shen Peiying, User experience based urban tourism app interface design, in: International Conference on High Performance Computing and Communications, 2018.
[12] Jerry Chun-Wei, Shifeng Ren, EHAUPM: efficient high average-utility pattern mining with tighter upper-bounds, in: IEEE Access, 2017.
[13] Hongwei Yin, Ye Zhu, The influence of big data and informatization on tourism industry, in: International Conference on Behavioral, Economic, Socio-Cultural Computing, 2017.
[14] Jun Yuan, Yanhong Liu, Research on tourism development of cultural and creative industry park based on the network text analysis, in: International Conference on Information Management, 2017.
[15] Sanaz Shafiee, Ali Rajabzadeh, Big data in tourism industry, in: International Conference on E-commerce in Developing Countries: Focusing on e-Tourism, 2016.

Xinzhe Yin, male, 03/04/1980; School of International business, Sichuan International Studies University, Zhuangzhi Road, Lieshimu, Shapingba District, Chongqing, PR China; PHD; Associate professor; Regional economy, industrial economy, tourism economy and planning.

Jinghua Li, female, 03/10/1986, School of International business, Sichuan International Studies University, Zhuangzhi Road, Lieshimu, Shapingba District, Chongqing, PR China; Master; Assistant Lecturer; Tourism economy and planning, tourism management.