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Elevating English Translation Strategies of Children's Picture Books Through Deep Learning and Artificial Intelligence

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Deep learning, an artificial intelligence (AI) method, emerged shortly after the development of machine learning and other technologies. It enables machines to learn and interpret certain types of data in a large dataset, giving computers the ability to apply human-like thinking. In recent years, scholars have conducted in-depth research on deep learning and, subsequently, deep learning models have become widely used in the field of text emotion translation. However, few scholars have applied deep learning technology to the translation of children's picture books. The main goal of AI technology is to reduce the cost of human labor and enable humans to process transactions more efficiently. AI technology has been widely used in speech translation and the translation of sophisticated literary works. The application of AI technology to the translation of children's picture books has become the focus of current translation studies and computer science scholars. Firstly, this paper explains the concepts related to deep learning, artificial intelligence and translation of children's picture books. Then, in order to investigate the current status of the English translation of children's picture books, online questionnaires are distributed to translation writers, preschool and primary school teachers, and primary school students. The survey questionnaire given to translators comprised items related to the sales of translated picture books; the teachers' questionnaire pertained to the accuracy of the translation of picture books; and the survey of primary school students sought to determine whether they were interested in the content of the translated picture books. The statistical results obtained from the analysis of the survey data indicated that the sales of current English translations of children's picture books are not high, the translated content is not aligned with children's interests, and the translations themselves are not accurate. Finally, a targeted solution is designed based on the translation strategies that have been applied to translated children's books that have a high number of sales, the alignment of content with children's interests, and the application of AI deep learning technology to ensure that translations are accurate. According to the results of a second questionnaire survey of the same participants, the English translation of children's picture books, when combined with deep learning AI technology, is improved in terms of efficiency, accuracy, and other indicators.

Keywords: children's picture book; artificial intelligence; machine learning

1. INTRODUCTION

Deep learning is an algorithm that allows computers to learn the complex features of data by building hierarchical structures to fit models that mimic the work of the human brain [1]. Nowadays, with the maturity of research, deep learning has gradually developed into an algorithm system with artificial neural network algorithm as the core [2]. It also accelerates the development of AI-based mark detection technology [3]. The 21st century saw the advent of the big data era, in which the development of algorithm technology and AI represented by machine learning has made great strides and gained strength through data mining and algorithm improvements [4, 5]. At present, many industries and other sectors are actively implementing AI technology [6]. For example, artificial intelligence technologies such as intelligent

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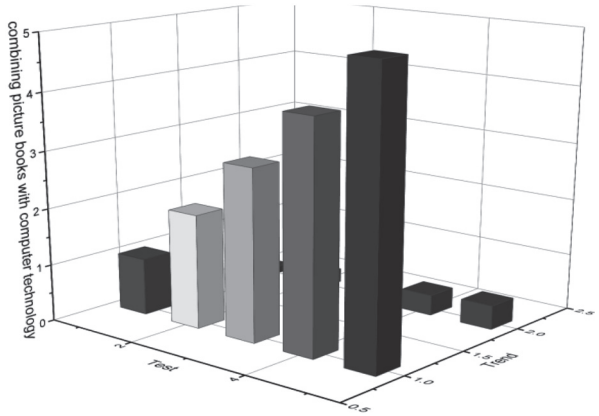

Figure 1 The trend of combining English translation of children's picture books with computer technology.

Table 1 Sales of translated picture books.

No.	Title of translated picture book	Annual sales
1	"The Little Prince"	190000
2	"Grimm's Fairy Tales"	900000
3	"Doraemon"	3000000

Table 2 Accuracy of picture book translation.

No.	Title of translated picture book	Translation accuracy ([0, 1])
1	"The Little Prince"	35%
2	"Grimm's Fairy Tales"	33%
3	"Doraemon"	29%

voice assistants, logistics robots, driverless cars, 5G mobile phones and networks are widely used in everyday activities [7]. Given the low population growth in recent years, it has become increasingly important to ensure that, from birth, children are given the best opportunities to learn. This has become the focus of the government, the public, teachers and scholars [8]. From birth, children are exposed to visual images and derive knowledge from what they see, which will have an impact on their perspective of the world, their thinking and mental state, and their perceptions of physical changes. Generally, children are curious about pictures and patterns; therefore, picture books are a means of visually displaying various elements of culture [9]. Combining picture books with children's education is also a current trend. In order to expose children to other cultures at an early age, the introduction into the domestic market of best-selling translated English picture books is the main way to achieve this. The various illustrations and connotations in the best-selling English picture books abroad will also provide favorable support for children's physical and psychological growth. Some excellent translated works also have the effect of establishing children's worldview, aesthetics and cognitive ability. Due to the late start of China's modern art and comics industry, the content of picture books produced locally has low output, low professional level and poor quality [10]. The introduction of picture books translated from English is still the main demand at present. To improve the quality, efficiency of English translations of children's picture books, accuracy and other indicators are also important for translators, parents, teachers and children themselves [11, 12]. The combination of English translations of children's picture books with computers has gradually become a trend, and institutions predict the future development of this trend as shown in Figure 1.

2. QUESTIONNAIRE SURVEY AND ANALYSIS

In order to investigate the current status of English translations of children's picture books, 1,200 questionnaires were distributed to a total of 50 translators, preschool and primary school teachers, and primary school students. The surveys of the adults related to the accuracy of the translation of picture books, while the survey of primary school students sought to determine whether they were interested in the content of the translated picture books. The volume of sales of translated picture books can provide financial support for the writer's subsequent creation, which indirectly determines the translation quality of picture books. Table 1 shows the statistics obtained from the questionnaire for the sales of translated picture books.

The accuracy of a picture book translation indicates its alignment with the original work. The closer it is to the original text, the more it conveys the intended meaning of the work. The more accurate the translation, the higher the quality of teachers' teaching. Table 2 shows the accuracy of picture book translation according to the questionnaire survey.

If the translated content of picture books is from the perspective of children, it will increase children's interest in reading, indirectly increase the sales of picture books, improve the efficiency of children's reading of picture books, and

Table 3 The degree of alignment between the translated content of picture books and children's interests.

No.	Title of translated picture book	Degree of alignment with children's interests ([0, 1])
1	"The Little Prince"	19%
2	"Grimm's Fairy Tales"	25%
3	"Doraemon"	21%

Table 4 The use of new technologies for picture book translations.

No.	Technology used in the translation process	New technology usage rate
1	Artificial Intelligence	34%
2	Deep Learning	28%
3	Other technologies	26%

Table 5 The reliability and validity of the English translation survey of children's picture books.

	reliability	validity
value	Alpha = 0.81	KMO = 0.89

accelerate children's acquisition of new knowledge. Table 3 shows the degree of alignment between the translated content of picture books and children's interests, according to the survey data.

The combination of picture book translation with deep learning and artificial intelligence technology is important given the current era of intelligent technology. The survey of relevant translators regarding the application of deep learning and artificial intelligence technology to picture book translations yielded the results shown in Table 4.

The validity and credibility of the questionnaire items is vital to the survey, allowing valid conclusions to be drawn from the questionnaire data. The Cronbach's Alpha and KMO test were applied to determine the reliability and validity of the questionnaire items. The results are within the established parameters. The Alpha and KMO values are shown in Table 5.

3. PROBLEMS EXISTING IN ENGLISH TRANSLATION OF CHILDREN'S PICTURE BOOKS

3.1 Sales of Translated Picture Books are Not High

Children's picture books and the publishing of children's literature in China are highly regulated. Permission to publish English translations of children's picture books is obtained from foreign writers or publishing houses, in order to prevent copyright disputes [13]. Royalties from the sale of translator's picture books go to the publishing houses and translators [14]. Expanding the domestic market of children's picture books, and promoting their sales are two ways to ensure the healthy mental and physical development of children, and expose them to other cultures as soon as possible [15]. The questionnaire data and the interviews with picture book translators revealed that picture book translators generally have low sales of their works [16]. Hence, their income from picture book translations is not sufficient to support them; hence, picture book translations are a sideline for many translators. As a result of other commitments, translators do not devote enough time to children's picture books, resulting in poor quality translations. Also, many children favour literature that is created locally. The best-sellers continue to compress the market space for foreign translated picture books [17].

3.2 The Translation Content is Not Well-Aligned with Children's Interests

Although children's picture books appeal to children generally, most children still seek picture books of specific interest. However, if the book is not interesting and engaging, they will give up reading it halfway through or earlier [18]. If a book is interesting, it will have more appeal and will have an important impact on children's reading of picture books [19]. The analysis of the questionnaire data found that there is still a poor alignment between children's interests and the content of English translations of picture books. Consequently, children do not focus on the reading, are less motivated to persist, and learn little from their reading experience [20]. The main issue associated with the aforementioned problems is the quality of the translation itself. The questionnaire data also revealed that, currently, there is very little use of technology for the translation process [21]. In the current era of data science, children's interests and needs need to be considered on order to conduct a comprehensive analysis of picture book translation strategies. Combining with the actual needs of the children, it is necessary to first obtain the demand data of children. Since the translators do not have the technical ability, they can only use on-site investigation or translation based on their own understanding. In fact, it is still necessary to quickly ascertain the actual needs of children when readings picture books. It is important for translators to know how to use tools offered by deep learning and artificial intelligence. Obviously, translators do not have the ability to use deep learning or artificial intelligence technology, and those with the required

expertise are also less willing to undertake the translation of children's English picture books. Such talents are all engaged in other industries, which is one of the reasons why the translated content is not strongly aligned with children's actual interests.

3.3 Inaccurate Translation Results

Inaccurate translation will lead to a huge difference between the translated rendering of the text and the original meaning. The questionnaire data indicated that the current English translations of children's picture books are generally inaccurate. For example, some picture book translations contain content related to the translator's own experience, and do not convey the meaning intended by the original author. In addition, most translations of picture books indicate that the translators have an inadequate understanding of the culture of the original author, which leads to the content being misunderstood. This makes it more difficult for children to understand the text when reading, and to grasp the themes and storyline even after reading the entire book.

4. ENGLISH TRANSLATION STRATEGY OF CHILDREN'S PICTURE BOOKS BASED ON DEEP LEARNING AND ARTIFICIAL INTELLIGENCE

4.1 Comprehensively Learn and Use the Translation Strategies of Similar Picture Books with High Sales

Deep learning technology enables computers to mimic human-like self-learning behavior. After the training library and code are written, deep learning can operate automatically, independent of human intervention. As long as the dynamic update of the training library can be ensured, the subjects undertaking the learning can continue to improve. In deep learning, RNN, long and short-term memory methods and CNN algorithms are the mainstream applications recognized by scholars today. Among them, CNN is usually a three-layer structure, with the convolution layer being the key structure. In this process, the corresponding convolution value feature matrix is obtained by inputting the corresponding key parameters. The CNN algorithm combined with some text-classification models can achieve effective object classification. RNN does not belong to a feedforward neural network structure similar to CNN. Its key feature is that it can memorize information, and combine the memory to obtain key semantics. Usually, the memory ability of RNN is used to solve continuous problems. Its formula as shown in (1)–(5).

$$Q(y \le y_0) = 1 - G^{-y_0/\mu} \tag{1}$$

$$V3 = A - \frac{A_2}{A_1 + A_2} \times i \tag{2}$$

$$H = Q + T + \frac{\frac{\sum_{i=1}^{N} B_i}{2} - D_{m-1}}{B_m} \times d \tag{3}$$

$$M = \frac{O_1 f_1 + P_2 f_2 + \cdots + V f_k}{f_1 + f_2 + \cdots + f_k} = \frac{\sum_{i=1}^{k} x_i V_i}{V} \tag{4}$$

$$H = \frac{n}{\frac{1}{x_1} + \frac{1}{x_2} + \cdots + \frac{1}{x}} = \frac{Z}{\sum_{i=1}^{n} C} \tag{5}$$

According to the formula, the variables can be captured by the set parameters, indicating the unique memory ability of RNN. However, in the case where the training involves content with greater memory requirements, RNN will have a training dilemma. Therefore, the short-term memory method can overcome the shortcomings of RNN. This method combines the special gate structure of neurons to help the method maintain memory, and has a good ability to memorize the data before and after the learning and training process. By combining RNN with the long-term memory method, the training model can have independent learning ability. In order to solve the current problem of low sales of English translation works of children's picture books, we can start from a business perspective and combine deep learning algorithms to learn the translation methods of other best-selling translation works. First, we use CNN technology to classify and filter all children's picture books on the market, and then learn the translation methods of these works through the RNN algorithm. Finally, we combine the long and short-term memory methods to translate English works of children's picture books. This will increase the sales of subsequent English translations of children's picture books, increase the income of children's picture book translators, and allow children's picture book translators to have more time to think about the translation content, thereby ending the current endless cycle of poor picture book translations. After applying the translation strategy combined with deep learning technology to the subjects who participated in the questionnaire, the feedback found that the sales of English translations of children's picture books have increased significantly, as shown in Figure 2.

4.2 Translating Picture Book Content Based on Children's Interests

Given the current misalignment between English translations of picture books and children's specific interests, we designed an interest translation model combined with deep learning technology to improve the translated text. The two main steps are: firstly, ascertain the interests of children, and then translate the text. The model has two functions. The first function point is the collection of children's interests. It uses the pre-trained model engine to take the data generated by children in social media and daily activities as input, and combines CNN and LSTM to perform key tasks. Interest feature captures, through further comprehensive processing of interest features, combined with Softmax function to print interest points. The second function point is to complete the translation of picture book content that reflects children's interests. This function point requires the transformation of the convolutional neural network and the long and short-term memory method. This process combines the translation

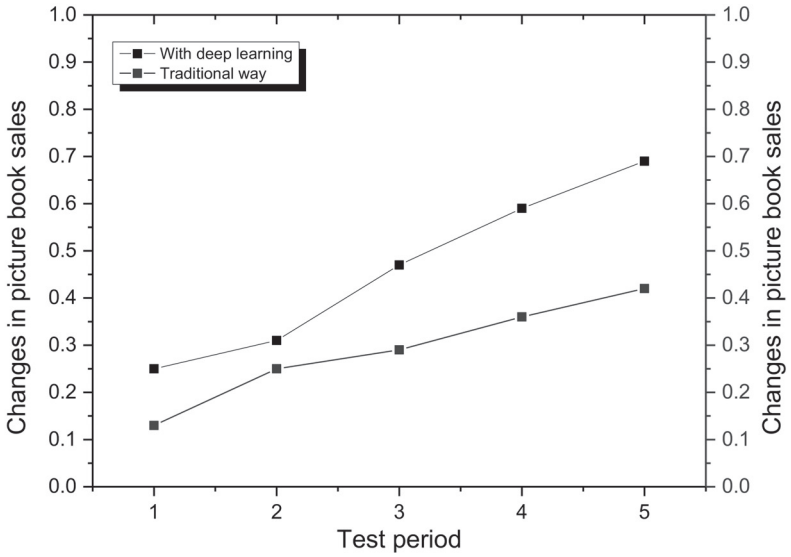

Figure 2 Changes in sales of English translations of children's picture books after applying deep learning strategies.

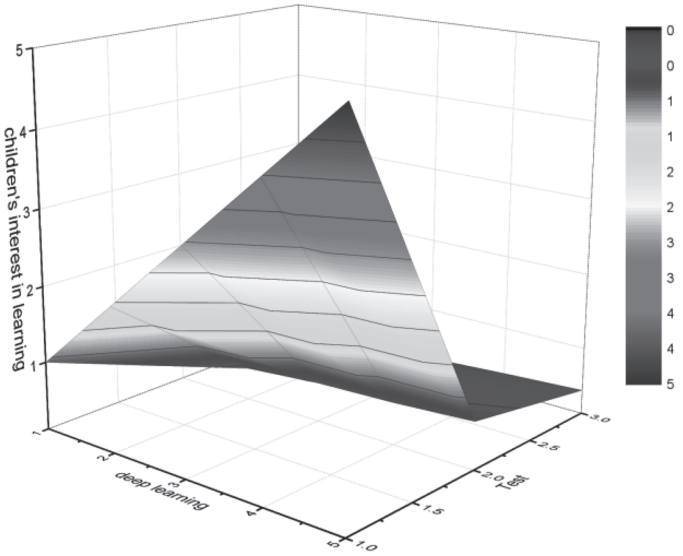

Figure 3 Children's picture book reading interest before and after applying deep learning technology.

strategy and control points after the convolutional neural network acquires the interest points, and when the long-short-term memory method acquires the translation path, the key points in the translation method are applied, and the interest points and the translation method are used together. Ultimately, this ensures that children's interests and picture book content translation are aligned, at the same time reducing the training difficulty of deep learning models. After applying the translation strategy combined with deep learning technology to the subjects who participated in the questionnaire, the feedback found that children's reading interest has been effectively improved. This is shown in Figure 3.

4.3 Using AI Technology to Make Translation More Accurate

AI technology is based on machine learning, similar to deep learning. It can also be applied to machine translation. The current research frontiers of scholars are mainly machine translation technology combined with neural networks. In order to solve the problems of low accuracy and poor quality in the current English translations of children's picture books, a machine translation method combined with neural network technology is introduced. This method needs to first refer to a large number of translation dictionaries and geographic and cultural data of various countries, and establish a model corresponding to accurate translation through the learning of dictionaries and cultural data, so as to achieve better learning effects and continuously improve translation accuracy. Since the open-source model is highly consistent with the translation accuracy requirements of this current study, the open source NMT artificial neural model is directly used to train the existing data. It was found that after combining this model, the English translation of children's picture books can more accurately combine the translation of the context of the pictures, and can also combine the local cultural characteristics of the original author of the work, which

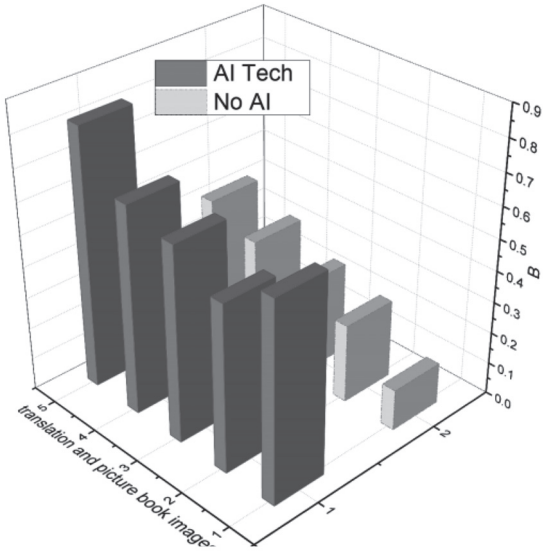

Figure 4 Changes in the fit between translation context and picture book images when applying AI technology.

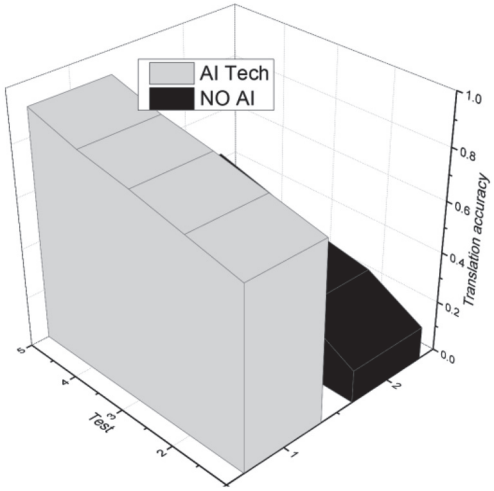

Figure 5 Changes in translation accuracy when applying AI technology.

resolves the problem of translation accuracy. After applying the translation strategy combined with AI technology to the questionnaire participants, the feedback obtained is that the English translation of children's picture books combined with AI technology has greatly improved the combination of context and picture book illustrations compared with the traditional method, as shown in Figure 4.

After applying the AI neural network to related research objects, it was found that the overall translation accuracy had been greatly improved, as shown in Figure 5.

5. CONCLUSION

Deep Learning technology has achieved outstanding results in various industries. For example, the learning of home layout by sweeping robots is achieved by means of deep learning technology. China's focus on AI technology and algorithms is intended to further its economic development and enhance people's lives. The application of deep learning and artificial intelligence technology to the field of children's picture book translation is in line with the government's policies, but there is still a lack of interdisciplinary talents and established translation standards. In this study, deep learning is combined with AI technology to design an efficient strategy for the translation into English of children's picture books. First of all, the current situation of English translations of children's picture books is revealed by means of a questionnaire survey, and then combined with the questionnaire data, the problems associated with the English translation of children's picture books are summarized, and targeted solutions are designed to address them. In the second interview conducted with participants, it was found that the proposed English translation strategy yielded better results in many aspects than the traditional strategy.

Data Availability Statement

The datasets used and/or analyzed for the current study are available from the author on reasonable request.

Conflicts of Interest

The author declares that this study is free of conflict of interest.

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REFERENCES

1. Keith, J. A., McKone, J. R., Snyder, J. D., & Tang, M. H. (2022). Deeper learning in electrocatalysis: realizing opportunities and addressing challenges. Current Opinion in Chemical Engineering, 36:100824. https://doi.org/10.1016/j.coche.2022.100824
2. Puyol Anton, E., Ruijsink, B., Piechnik, S. K., Neubauer, S., Petersen, S. E., Razavi, R. et al. (2021). Fairness in AI: are deep learning-based CMR segmentation algorithms biased?. European Heart Journal, 42(Supplement1): ehab724-3055. https://doi.org/10.1093/eurheartj/ehab724.3055
3. Singh, M., Kumar, R., & Chana, I. (2021). Machine translation systems for Indian languages: review of modelling techniques, challenges, open issues and future research directions. Archives of Computational Methods in Engineering, 28(4), 2165-2193. https://doi.org/10.1007/s11831-020-09449-7
4. Ji, H. G., Oh, S. Y., Kim, J., Choi, S., & Park, E. (2022). Integrating deep learning and machine translation for understanding unrefined languages. Computers, Materials and Continua, 70(1), 669-678. https://doi.org/10.32604/cmc.2022.019521
5. Chen, C. (2024). Design of intelligent education decision support system based on big data analysis. Engineering Intelligent Systems, 30(4): 289-298.
6. Yu, J. L., Ma, X. L., & Qu, Z. G. (2022). English translation model based on intelligent recognition and deep learning. Wireless Communications and Mobile Computing, 2022: 3079775. https://doi.org/10.1155/2022/3079775
7. Silva, R., Junior, J. M., Almeida, L., Gonçalves, D., Zamboni, P., Fernandes, V., et al. (2022). Line-based deep learning method for tree branch detection from digital images. International Journal of Applied Earth Observation and Geoinformation, 110: 102759. https://doi.org/10.1016/j.jag.2022.102759
8. Xu, X. Y., & Yang, Z. H. (2022). The use of deep learning and AIoT technology in loan word translation. International Journal of Grid and Utility Computing, 13(1), 49-56. https://doi.org/10.1504/IJGUC.2022.121427
9. Sun, W., Goto, Y., Yamamoto, T., & Hitomi, K. (2022). Deep learning model for 3D profiling of high-aspect-ratio features using high-voltage CD-SEM. Japanese Journal of Applied Physics, 61(SD): SD1036. https://doi.org/10.35848/1347-4065/ac6306
10. Shao, H. C., Wang, J., Bai, T., Chun, J., Park, J. C., Jiang, S., et al. (2022). Real-time liver tumor localization via a single x-ray projection using deep graph neural network-assisted biomechanical modeling. Physics in Medicine and Biology, 67(11): 115009. https://doi.org/10.1088/1361-6560/ac6b7b
11. Deckert, M. (2020). Tracing complex translation choices. Libri et Liberi: Journal of Research on Children's Literature and Culture, 9(1), 189-191.
12. Sun, X. (2024). A clustering analysis of students' English scores after targeted improvement. Engineering Intelligent Systems, 32 no. 2, pp. 89-93.
13. Wang, A., & Ren, N. (2018). Research on the translation of sound and rhythm in children's picturebooks. IPPTA: Quarterly Journal of Indian Pulp and Paper Technical Association, 30(5), 389-395.
14. Chang, C. W., Gao, Y., Wang, T. H., Lei, Y., Wang, Q., Pan, S., et al. (2022). Dual-energy CT based mass density and relative stopping power estimation for proton therapy using physics-informed deep learning. Physics in Medicine and Biology, 67(11): 115010. https://doi.org/10.1088/1361-6560/ac6ebc
15. Yoo, K. S. (2020). Emerging trends in Korean-diaspora and translated Korean picture books. The Reading Teacher, 73(4): 399-404. https://doi.org/10.1002/trtr.1872
16. Li, M. X. (2015). A tentative study on the development of children's picture books and Chinese translation versions. Educational Research International, 4(1), 30-41.
17. Shi, C. L. (2021). Research on intelligent language translation system based on deep learning algorithm. Soft Computing. 26(16): 7509-7518. https://doi.org/10.21203/rs.3.rs-899180/v1
18. Pratama, A. D. Y. (2020). Translation of children's picture book. Retorika: Jurnal Ilmu Bahasa, 5(2), 168-176. https://doi.org/10.22225/jr.5.2.1355.168-176
19. Zakaria, F. F., Warip, M. N. M., Ehkan, P., Mustapa, M., & Ilyas, M. Z. (2021). Deep-learning assisting cerebral palsy patient handgrip task translation. Journal of Physics: Conference Series, 1962(1): 012047. https://doi.org/10.1088/1742-6596/1962/1/012047
20. Zang, L. R., Xin, B. J., & Deng, N. (2022). Identification of wool and cashmere fibers based on multiscale geometric analysis. The Journal of the Textile Institute, 113(6): 1001-1008. https://doi.org/10.1080/00405000.2021.1914399
21. Zhang, M., Li, X. J., Xu, S. H., & Meng, X. Y. (2022). Fault pattern recognition of rolling bearing based on smoothness prior approach and dual-input depth spatial-temporal fusion. Measurement Science and Technology, 33(8): 085022. https://doi.org/10.1088/1361-6501/ac60d4