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# Sentiment Analysis of Animated Online Education Texts Using Long Short-Term Memory Networks in the Context of the Internet of Things

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**ABSTRACT** This work aims to introduce Long Short-Term Memory (LSTM) under the Internet of Things (IoT) context to enhance the accuracy and granularity of sentiment analysis in animated online education texts. It employs a multimodal data collection approach and uses IoT technology to gather multimodal textual data from students engaged in animated online education. The data includes students' feedback texts, emotional texts, written texts, and verbal expressions during animated online education. Subsequently, a model named Information Block Bidirectional Long-Short term Memory (IB-BiLSTM) is designed and utilized to construct a sentiment classification model for animated online education texts. Experimental results demonstrate that the model achieves an accuracy of 93.92% and an F1-score of 90.34% for sentiment classification in animated online education texts and the loss function converges to around 0.14. This model effectively captures the emotional changes and evolution during students' learning process. Thus, the proposed model holds significant potential and practical significance for enhancing animated online education's personalization and emotional engagement. It provides valuable insights and guidance for the intelligent development of the education field.

**INDEX TERMS** Internet of Things, Long Short-Term Memory network, text sentiment analysis, animation online education, multimodal data

## I. INTRODUCTION

### A. RESEARCH BACKGROUND AND MOTIVATIONS

With the rapid progress of the internet and mobile technology, animation online education has become an essential trend in modern education. In the early stages of online education, the emphasis was primarily on text and images. However, with the advancement of multimedia technology, animation, as a multimedia form, has gradually been incorporated into the field of education. Animation, as a multimedia form, offers vivid and intuitive ways of expression, capturing students' attention and providing rich visual and auditory experiences (Inangil et al., 2022; Sepp et al., 2022; Aisah et al., 2022). By combining storytelling, images, sound, and interactive elements, animation online education creates a more engaging and enjoyable learning environment for students (Feeley et al., 2023). Animations

offer the advantage of a multimedia format that conveys information vividly. They can capture students' attention and provide rich visual and auditory stimuli. By combining visual imagery, storytelling, sound effects, and interactive elements, animation online education creates an engaging and stimulating learning environment (Baglama et al., 2022; Namestovski & Kovari, 2022). Through the integration of these elements, students can immerse themselves in captivating and enjoyable learning experiences, enhancing their understanding and retention of subject matter (Mohd Azmi et al., 2023). However, accurately analyzing and understanding students' emotions and feedback in animation online education remain challenging tasks. Understanding students' emotional states during learning is crucial for educators and educational platforms.

Sentiment analysis provides educators with powerful assistance, enabling them to gain deeper insights into students and formulate more precise teaching strategies, thus enhancing teaching quality, learning outcomes, and student satisfaction. For instance, educators can introduce more challenging content for emotionally excited students. For emotionally confused students, educators can offer additional supporting materials and explanations. The value of such information and insights lies in providing tangible support for the intelligent development of the education sector and personalized learning, contributing to the creation of a higher-quality educational experience (Guo, 2022; Shelke et al., 2022; Aslam et al., 2022). The application of Internet of Things (IoT) technology can provide more data sources for sentiment analysis in animation online education. Various sensors and devices are connected to collect multimodal data generated by students during the learning process. These data can offer a more comprehensive and diverse input for sentiment analysis, resulting in more accurate and comprehensive analysis outcomes (Dahou et al., 2023; Pei et al., 2023). Long Short-Term Memory (LSTM) is a deep learning (DL) model suitable for handling sequential data. When performing sentiment analysis for animation online education, LSTM models can effectively capture the temporal correlation and long-range dependencies within text sequences (Rani et al., 2022; Peng et al., 2022; Abdelhamid et al., 2022). As a result, they provide valuable information and insights to educators, helping them better understand students' learning needs, optimize teaching strategies, and provide personalized learning experiences.

## **B. RESEARCH OBJECTIVES**

This work aims to enhance text sentiment classification in online animation education by utilizing IoT technology to gather multimodal data and employing an Information Block Bidirectional LSTM (IB-BiLSTM) algorithm. This work utilizes IoT technology to collect multimodal data generated by students during animation online education. Additionally, it designs an algorithmic model called IB-BiLSTM to better capture the text's temporal correlation and long-range dependencies. Moreover, it integrates multimodal data with the sentiment analysis algorithm to enhance the accuracy and effectiveness of sentiment classification. The research contribution is evident in improving sentiment classification accuracy, facilitating personalization and emotional engagement in online animation education, and providing substantial support for the intelligent development of the education sector.

The overall research structure is as follows. Section 1 is the introduction. In this section, the background and gaps in sentiment analysis in the field of animation online education are presented, leading to the research motivation and objectives. Section 2 is the literature review. This section provides a comprehensive review and analysis of

the existing research on text sentiment analysis and the application of DL algorithms in this context. Section 3 is methodology. This section designs the IB-BiLSTM algorithmic model and constructs the sentiment classification model for animation online education based on IB-BiLSTM. Section 4 is experimental design and performance analysis. The performance of the constructed model is discussed, analyzed, and then compared with previous research to demonstrate the value of this work. Section 5 is the conclusion. It summarizes the main research findings, points out the limitations, and provides suggestions for further research.

## **II. LITERATURE REVIEW**

### **A. CURRENT RESEARCH STATUS OF TEXT SENTIMENT ANALYSIS IN THE FIELD OF EDUCATION**

As a significant research area within the field of natural language processing, sentiment analysis holds extensive applications in the realm of education. It can automatically recognize and understand positive, negative, neutral and other emotional information from text, and plays a vital role in educational fields such as social media monitoring and user feedback analysis. Thanks to the dedicated efforts of numerous researchers, sentiment analysis has made notable advancements in the realm of education. Chen & Du (2023) proposed a method based on DL and IoT to predict the evolution of public sentiment during public emergencies. Bhuvaneshwari et al. (2022) utilized a Bi-LSTM self-attention CNN model for sentiment analysis of user comments, showing favorable results in sentiment analysis. Ghosh & Ahammed (2022) investigated the influence of sentiment analysis on feedback loops among different types of movies. The findings demonstrate that sentiment analysis can impact the feedback loop between movie genres. Yenikar et al. (2022) introduced a machine learning model based on semantic correlations that improved the accuracy of sentiment analysis. El-Ansari & Beni-Hssane (2023) conducted sentiment analysis on the application of personalized chatbots in e-commerce, achieving personalized services based on sentiment analysis. This further demonstrated the value of sentiment analysis in providing intelligent and emotionally-driven services in the education sector.

In conclusion, sentiment analysis of text, as a crucial research area within the education sector, has introduced various techniques and methods to offer educators an effective means to comprehend student emotions and feedback. As a result, it has provided a more intelligent and personalized support system for educational endeavors.

### **B. RESEARCH ON THE CURRENT SITUATION OF DATA COLLECTION AND THE APPLICATION OF DL IN THE BACKGROUND OF IOT**

The rapid development of IoT technology has provided a wealth of sensor data and multimodal data to various fields.