Design of Investment Project Monitoring and Prediction System Integrating LSTM Neural Network

Hong Zhou, Chengwu Yao[1,*], Heng Chen[2]

[1]Gansu Economic Research Institute, Lanzhou 730000, Gansu
[2]Gansu Target Information Technology Co., Ltd., Lanzhou 730000, Gansu
Correspondence Author

Abstract: ***The existing investment project management focuses on approval and supervision, lacking real-time monitoring and trend prediction. The economic prediction of artificial intelligence is more prominent than the traditional statistical measurement methods. This paper designs an investment project monitoring and prediction system for big data analysis monitoring of investment projects and prediction by long short-term memory network (LSTM), constructs an LSTM prediction model for investment projects, realizes real-time multi-dimensional analysis monitoring of investment project approval data and matter handling data, and intelligent prediction of investment project growth. Through the verification of 385,000 project data, the project monitoring is accurate and efficient, and the project growth prediction effect is relatively ideal, providing effective data and method support for investment development trend prediction and promoting investment and stabilizing growth, and helping to improve the investment management department's control and judgment of the macro economy and investment trends.***

Keywords: Investment project; Monitoring; LSTM network; Economic prediction.

1. INTRODUCTION

In Gansu Province, online approval and supervision of investment projects have been realized. A total of 184,000 investment projects have been approved online, and 201,000 project matters have been handled, which has strongly supported the all-round development of the province's economy and society. However, as the reform of "streamlining administration, delegating powers, improving regulation, and upgrading services" and the work of optimizing the business environment have entered a deeper stage, the existing monitoring and prediction capabilities of investment projects are increasingly unable to meet the requirements of high-quality development. There is an urgent need to build an intelligent monitoring and prediction system that can accurately monitor the current situation of investment and effectively predict future trends.

The development of artificial intelligence and big data technologies provides new ideas for solving this problem. As an important branch in the field of artificial intelligence, deep learning has shown significant advantages in dealing with complex non-linear problems and time series prediction. Ge and Wu (2023) conducted an empirical study on the adoption of ChatGPT for bug fixing among professional developers [1]. Gong et al. (2023) reviewed neural network lightweighting techniques [2]. Zhang and Shi (2026) optimized the thermal insulation performance of transport packaging boxes using a response surface algorithm [3]. Zhu et al. (2026) proposed a motion control method for flexible-joint robotic arms in warehouse sorting based on proximal policy optimization [4]. Yuan et al. (2025) developed a mixture-of-experts network for multi-modal fake news detection [5]. Gao et al. (2025) presented a hierarchical reasoning and LoRa-enhanced large model framework for root cause analysis in distributed systems [6]. Ya (2025) studied EDA technology and its application methodologies in digital circuit design [7]. Ma (2025) proposed a unified framework for congestion diagnosis and dynamic mitigation in complex networks [8]. Jin (2025) optimized order allocation algorithms for industrial internet platforms [9]. Miao (2026) explored the applications of big data technologies for enhanced network security analysis [10]. Wang (2025) enhanced YOLOv8 with multi-scale features for object detection in photovoltaic farm panoramic imagery [11]. Gao (2025) researched the international intelligent operation model of industrial electrical enterprises under the dual-track collaboration of digitalization and greening [12]. Gao (2026) proposed an intelligent operations and public relations collaborative management model for corporate image enhancement in smart manufacturing environments [13]. Zhang (2026) developed a hybrid LSTM-GARCH model integrating volatility factors from the US financial markets [14]. Han et al. (2026) devised a dual-scale model with collaborative reasoning and multi-feature fusion for robust AI-generated image detection [15]. Shen et al. (2026) constructed a survival risk prediction model for colorectal cancer patients based on graph convolutional networks and TCGA multi-omics

data integration [16]. Tian et al. (2025) introduced a business intelligence approach to ad recall using cross-attention multi-task learning for digital advertising [17]. Shen et al. (2025) applied the whale optimization algorithm to financial payment fraud detection [18]. Mao (2026) presented a clustering-based approach to image compression using the K-means algorithm [19]. Jie (2024) applied artificial intelligence technology to industrial defect detection [20].

The purpose of this paper is to design and implement an investment project monitoring and prediction system integrating the LSTM neural network, making full use of the characteristics of LSTM in network modeling and prediction. Through in-depth mining and learning of the historical data of investment projects, accurate prediction of the number of investment projects is achieved, providing support for investment authorities to judge the investment situation, conduct economic regulation, and formulate policies, and realizing decision-making based on data, management based on data, and speaking with data.

2. RELATED THEORIES AND TECHNOLOGIES

2.1 Django Framework

Django is one of the mainstream Web frameworks for Python. By reducing repetitive code, it enables developers to focus on the key aspects of development and concentrate on writing application. Django provides a large number of tools out of the box, making the development process simpler and more efficient for quickly building complex and high-performance Web applications. Django adopts the MTV (Model-Template-View) architectural design, which is a variant of the MVC pattern, emphasizing the importance of templates in Web applications. The model is responsible for data processing and database interaction, mapping to the database by defining a series of data model classes. The view is responsible for business logic processing. View functions or classes receive HTTP requests, process data, and decide the response content to be returned to the user. The template provides a friendly way to define HTML and other format outputs, dynamically rendering the data provided by the view through variables and template tags. In a typical Django application, user requests are passed by Django's URL mapping mechanism to the corresponding view. The view processes business logic such as data operations, passes the data to the template, and the template generates an HTML page and responds back to the requester.

The high efficiency, security, and scalability of Django stem from its unique internal mechanisms. The Object Relational Mapping (ORM) enables developers to operate on data in the form of Python objects without directly writing SQL statements. The URL dispatching mechanism simply maps URLs to the corresponding view functions through the URLconf file. The pluggable middleware allows custom functions to be inserted at different stages of the request-response cycle. The form validation and generation mechanism simplifies the process of handling web forms. The multi-level caching mechanism significantly improves application performance. Django also provides security protection mechanisms such as Cross-Site Scripting (XSS) and Cross-Site Request Forgery (CSRF).

2.2 LSTM Neural Network

The Long Short-Term Memory (LSTM) network is a special structure of the Recurrent Neural Network (RNN). It can effectively overcome the problem of vanishing gradients in RNN, especially performing much better than RNN in tasks with long-distance dependencies. During the backpropagation of gradients, it will no longer be troubled by the problem of vanishing gradients and can accurately model data with short-term or long-term dependencies.

The core of LSTM lies in its internal cell state and gating mechanism, which endow LSTM with powerful modeling capabilities for long-term dependencies. The cell state enables LSTM to continuously store and transmit information in a sequence, thereby effectively retaining and accumulating long-term dependencies. The gating mechanism flexibly controls the reading, updating, and output of information through the input gate, forget gate, and output gate, ensuring that the model can capture short-term dynamic changes while fully understanding and utilizing long-term historical information. The cell state (C) is a continuously transmitting information channel, responsible for maintaining and transmitting information between time steps. The cell state can retain long-term dependencies and is not directly affected by the input gate, forget gate, and output gate. The forget gate, input gate, and output gate of the gating mechanism are based on the previous hidden state and the input at the current time step. The forget gate determines which information in the cell state should be discarded, with 1 indicating complete retention of information and 0 indicating complete forgetting of information. The calculation result of the input gate represents which new information should be added to the cell state. The output gate determines how to extract

useful information from the current cell state to generate the hidden state at the current time step, and this hidden state will be used for subsequent calculations or as the output of the model. The forget gate and the input gate combine to form the updated cell state. The output gate multiplies with the cell state (after passing through the tanh activation function), and the result is used as the hidden state at the current time step. The hidden state not only affects the LSTM unit at the next time step but is also the output of the model to the external world. LSTM achieves precise control of information through the gating mechanism, allowing the model to selectively retain, update, and read information when processing sequence data, making it suitable for tasks that need to consider long-distance dependencies in sequence data.

3. SYSTEM DESIGN

3.1 System Architecture Design

The system is based on the Django framework and adopts a three-layer architecture design, which consists of the application layer, business layer, and data layer from top to bottom. The application layer is responsible for direct interaction with users and undertakes key tasks such as interface display, function call, and request processing to ensure the usability and ease of use of the system. The business layer is the center of the entire system's logic processing, covering multiple important functions such as business rule definition, business process control, and service interface encapsulation. In the business layer, the system finely divides and implements complex business logics into modular and componentized forms, effectively ensuring the stability and maintainability of business processing. The data layer at the bottom includes a series of data-related processing tasks such as data access and operation, and data persistence. By closely cooperating with the upper-layer business logic, the data layer not only provides reliable data support but also ensures the security and consistency of data.

3.2 Functional Module Design

1) Total Data Monitoring. Classify, count, and sort the data of project approvals and matter handling. For suspected abnormal projects, manual processing is carried out after tracing back to the basic data. The monitoring scope mainly includes general investment projects, special project libraries, and approval matters. The investment project monitoring cross-analyzes attributes such as project approval and preparation type, approval region and agency, coding date, approval and preparation date, national standard industry classification, development and reform department industry classification, project catalog, start and completion dates, etc., as well as special project library identifiers such as the Yellow River Strategy, ecological industry, foreign loans, and private capital promotion. The value range is the number of projects and investment amount. The analysis results are presented in forms such as tables and heatmaps for easy calculation and information extraction. The approval matter monitoring cross-analyzes attributes such as project approval level, approval authority, region, matter name, matter status, application, receipt, acceptance, and completion dates. The value range is the matter handling volume, and the analysis results are presented in forms such as tables and heatmaps.

2) Special Project Library Monitoring. Mainly monitor special projects such as reserve projects, Yellow River Strategy projects, key investment projects, and major preliminary projects. The reserve project monitoring analyzes attributes such as reserve project type, attributes, location, industry, investment, preliminary work situation, construction nature, and auxiliary identifiers. The Yellow River Strategy project monitoring analyzes attributes such as Yellow River Strategy project type, location, industry, investment, start and resume work situation, responsible person, in-charge leader, and auxiliary identifiers. The key investment project monitoring analyzes attributes such as the proposed start and completion dates, type, attributes, location, industry, investment, preliminary work situation, start and resume work situation, responsible person, in-charge leader, and auxiliary identifiers of key investment projects. The major preliminary project monitoring analyzes attributes such as the preliminary work situation, type, attributes, industry, investment responsible person, in-charge leader, and auxiliary identifiers of major preliminary projects.

3) Investment Project Prediction. To achieve accurate prediction and efficient automated processing of the future trends of investment projects, an investment project prediction model based on the LSTM network is constructed. This model is based on the investment project approval data since October 2015, fully considering the time series characteristics of the training set and test set and the impact of the sample length, and taking them as key parameters into the model construction process. In the specific implementation of the model, the selection and setting of the loss function are optimized to ensure that while the model learns the laws of historical data, it can accurately capture the complex dynamic relationships between various dimension indicators of investment projects and

effectively prevent the occurrence of overfitting or underfitting phenomena, enabling the model to have strong generalization ability and scientifically and reasonably predict the future trends of investment projects. The model processing process is functionalized, and a user interface is developed to achieve automated investment project prediction.

3.3 LSTM Prediction Model Construction

1) Data preprocessing. The data of this system comes from the analysis database of the Gansu Investment Project Online Approval and Supervision Platform, and the data is updated in real time during the project approval process. As of March 2024, there are 184,000 projects in the database. Considering the stability of the project quantity and the business requirements of monthly prediction, etc., this system converts daily data into monthly data, a total of 102 months from October 2015 to March 2024. The training set and the test set are divided in a ratio of 90%, with 91 months in the training set and 11 months in the test set. Both the data features and the prediction target are the number of investment projects.

2) Model implementation. This paper builds an LSTM model based on the deep learning framework of Keras. Keras is a deep learning interface library at the model level, mainly responsible for core functions such as model construction, training, and prediction. Keras has excellent encapsulation characteristics, which can conveniently and efficiently build network models required for various experiments, greatly improving the experimental efficiency. For the complex tensor operations involved in the underlying layer of deep learning, Keras relies on backend engines such as Theano or Tensorflow to provide computing support and does not directly handle them itself.

3) Model evaluation method. The root mean square error (RMSE) and mean absolute percentage error (MAPE) commonly used in time series are used to evaluate the model performance. RMSE evaluates the performance of the model by calculating the square of the difference between the predicted value and the actual value, taking the average, and then taking the square root. The formula is as follows:

$$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i - y_i)^2} \tag{1}$$

Where: y_i represents the true value of the i -th sample; y_i represents the predicted value of the i -th sample, and n represents the number of samples.

MAPE calculates the average of the absolute percentage deviations between the predicted value and the true value. The formula is as follows:

$$MAPE = \frac{100\%}{n}\sum_{i=1}^{n}\left|\frac{y_i - y_i}{y_i}\right| \tag{2}$$

MAPE effectively eliminates the influence of data scale, enabling accurate prediction performance evaluation between datasets with different scales or fluctuation characteristics, and is suitable for evaluating and comparing the prediction accuracies of datasets with significantly different scales or fluctuation amplitudes.

4. EMPIRICAL ANALYSIS AND RESULT DISCUSSION

4.1 Monitoring of Investment Projects

From the data of investment projects in Gansu Province monitored by the system in the past five years, it can be seen that from 2019 to 2023, the investment projects in Gansu Province generally showed an increasing trend, as shown in Figure 1. Looking at it by quarter, from the first quarter to the second quarter is the rapid growth period of investment projects; the third and fourth quarters are the implementation periods of the projects, and the number of newly reported projects decreased compared with the previous two quarters. However, the number of investment projects continued to grow from the first quarter to the fourth quarter of 2023, showing strong investment momentum.

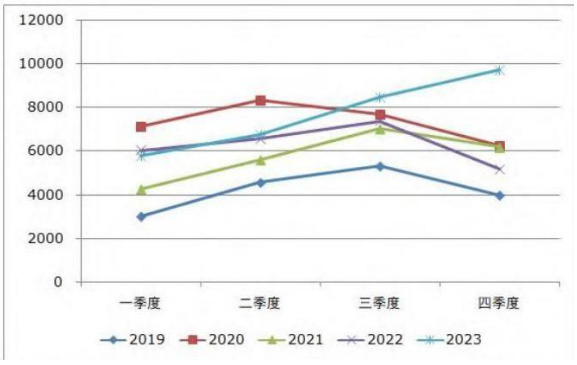

Figure 1: Monitoring of the Number of Investment Projects in Gansu Province from 2019 to 2023

The situation of project approval matters is basically the same as the quarterly trend of the number of investment projects. However, the project approval matters in 2020 and 2021 decreased significantly compared with 2019. The main reason is that the number of approvals in the implementation stage after the matters in the project establishment stage were handled was small in this stage, that is, a large number of projects were not implemented. The situation improved significantly from 2022 to 2023, and the number of project approval matters increased significantly.

From the monitoring results, from January to December 2023, both the number and investment amount of investment projects in Gansu Province remained at a high level. In the first quarter, both the number and investment amount of projects showed an obvious growth trend; they remained flat in the second and third quarters; there was another significant growth in the third quarter.

4.2 Investment Project Prediction

The model proposed in this paper is used to predict the number of investment projects in Gansu Province from November 2023 to March 2024. The actual and predicted values are shown in Table 1.

Table 1: Comparison of Actual and Predicted Values of the Number of Investment Projects

Monthly	2023-11	2023-12	2024-01	2024-02	2024-03
Actual value	4290	2095	1903	1741	2349
Predicted value	2399	2796	2196	2175	2127

The root mean square error (RMSE) of the model for predicting the number of investment projects is 937.012 4, and the mean absolute percentage error (MAPE) is 0.254 6.

5. CONCLUSION

This paper designs and implements an investment project monitoring and prediction system integrating the LSTM neural network. Based on the existing information technology achievements of investment projects, this paper realizes the unified aggregation, analysis, application and in-depth service of information resources through business process sorting, system integration, aggregation and integration. By using big data analysis methods, it realizes the real-time monitoring of the number and amount of investment projects, and conducts in-depth data mining and refined comparative analysis on the investment distribution in different years, industries and regions, providing strong data support for the optimization of investment strategies and resource allocation. A prediction model for the number of investment projects based on the LSTM network is constructed, and through the prediction of the number of investment projects from November 2023 to March 2024, good results are achieved, providing effective data and method support for the prediction of investment development trends and the promotion of investment and stable growth. The system effectively realizes the real-time monitoring and intelligent prediction of investment projects in Gansu Province, and has important application value in the field of government investment decision-making and regulation. At the same time, further research and improvement are needed in terms of the accuracy rate of system prediction and other aspects.

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