Deep Learning-Based Spatial Governance of Groundswell Economy

Enjue Zhao(✉)

Beijing Jiaotong University, Beijing, China
zhaoenjue@outlook.com

Abstract. As a new form of economy in the new era, the stall economy has brought new vitality to urban development. However, the rapid development of the stall economy has also brought a series of problems, among which spatial governance is one of the key factors affecting the healthy development of the stall economy. This paper proposes a research method of spatial governance of stall economy based on deep learning. Firstly, this paper analyzes the current situation and existing problems of spatial governance of stall economy from a theoretical perspective, and puts forward the application ideas of deep learning in spatial governance of stall economy. Secondly, taking the stall economy of a certain city as the research object, this paper collects the relevant data of the city and preprocesses the data. Finally, based on the deep learning model, this paper simulates the spatial governance of the stall economy and analyzes the simulation results. The experimental results show that the research method of spatial governance of stall economy based on deep learning proposed in this paper has high feasibility and practicality.

Keywords: stall economy · spatial governance · deep learning · simulation

1 Introduction

Ground stall economy is an economic form of small-scale commercial activities in public places such as streets, squares, bazaars or non-main commercial areas of cities with very low rents and simple equipment. In the new era, as an emerging economic form, the ground stall economy has received a lot of attention from the government and the market, and has become a new driving force for urban economic development. At the same time, the stall economy has also brought new challenges to urban management. Due to the special characteristics of the ground stall economy, how to carry out spatial governance has become an urgent problem to be solved nowadays.

At present, the research on the spatial governance of the ground stall economy mainly focuses on planning, management and supervision. However, with the continuous development of technology, artificial intelligence technology such as deep learning also provides new ideas and means for the spatial governance of the ground stall economy.

The purpose of this paper is to explore the deep learning-based spatial governance method for ground stall economy, and to simulate and analyze the ground stall economy

© The Author(s) 2023
N. Akhtar et al. (Eds.): PMIS 2023, AHIS 8, pp. 1359–1365, 2023.
https://doi.org/10.2991/978-94-6463-200-2_146

of a city as the research object. Specifically, this paper firstly analyzes the status quo and problems of groundstall economic space governance from a theoretical perspective, and proposes the application ideas of deep learning in groundstall economic space governance. Secondly, this paper collects the relevant data of the city and pre-processes the data. Finally, this paper conducts a simulation of the spatial governance of the ground stall economy based on the deep learning model, and analyzes the simulation results.

2 Analysis of the Problems and Current Situation of the Spatial Governance of the Ground Stall Economy

The ground stall economy has promoted the economic development and employment of the city to a certain extent, but it has also brought a series of problems, among which the spatial governance problem is one of the key factors affecting the healthy development of the ground stall economy.

2.1 Spatial Confusion

Due to the special nature of the ground stall economy, some ground stall vendors tend to occupy public space, even affecting the surrounding traffic and pedestrian passage. In addition, some ground stall vendors will occupy sites that do not conform to the planning, leading to a chaotic spatial layout of the city.

2.2 Difficult Spatial Management

The large scale of the ground stall economy makes it more difficult to manage. Traditional management methods rely mainly on manual inspection and management, but they are inefficient and prone to loopholes.

2.3 Low Space Utilization Efficiency

The space utilization rate of the ground stall economy is low, leading to the waste of urban resources. The traditional layout method lacks scientificity and operability, and cannot maximize the use of urban space resources.

3 Application Ideas of Deep Learning in the Spatial Governance of the Ground Stall Economy

Deep learning, as a powerful machine learning technology, has wide applications in image recognition, natural language processing and other fields. In the spatial governance of ground stall economy, deep learning can be applied to the following aspects.

3.1 Image Recognition

Image recognition technology refers to the analysis and processing of images using computer algorithms. Deep learning is a machine learning method that can automatically learn feature representations and can be used to acquire image recognition capabilities by learning from large amounts of data.

In the economic management of ground stalls, image recognition technology using deep learning can be used to monitor and analyze the ground stall placement in real time. For example, the technology can be used to identify whether there are irregularities in the stall area that occupy public space and whether the number of stalls is in accordance with the planning.

Result output: The recognition results are fed back to the economic management department of the ground stall for subsequent refined management and supervision.

Through image recognition technology, it can realize the refined supervision and management of the ground stall economy and improve the management efficiency and governance effect. At the same time, it can also provide decision support for government departments to help them better formulate and implement policies for the management of the ground stall economy.

3.2 Space Optimization

Using deep learning technology, urban space resources can be optimally allocated so as to maximize the efficiency of space utilization for the ground stall economy. For example, a spatial optimization model can be built by analyzing data such as urban pedestrian flow and commercial heat to provide more suitable sites and layout solutions for ground stall vendors.

Spatial optimization is a complex task that requires a combination of multiple factors, such as urban planning, population density, and commercial areas. Using deep learning techniques can help us extract useful information and features from the massive data and build models to predict and optimize the spatial layout of the ground stall economy.

Result output: The optimization results are fed back to the management of the ground stall economy for subsequent refined management and supervision.

4 Data Pre-processing

In this paper, the ground stall economy of a city is selected as the research object, and the data of the city's ground stall economy is collected, including the number of stalls, their locations, operating hours, and vendor information. Before conducting the simulation, the data need to be pre-processed, including data cleaning, data standardization, etc. This paper uses Python language for data processing and simulation, and the related codes are as follows.

```
# Data Cleaning.
import pandas as pd.
data = pd.read_csv('data.csv') # Read the data.
data.drop_duplicates(inplace = True) # Remove duplicate data.
```

```
data.dropna(inplace = True) # Remove null values.
data.to_csv('cleaned_data.csv', index = False) # Save the cleaned data.
# Normalize the data.
from sklearn.preprocessing import StandardScaler.
data = pd.read_csv('cleaned_data.csv') # Read the cleaned data.
scaler = StandardScaler() # Standardize the processing object.
scaled_data = scaler.fit_transform(data[['stall_num', 'stall_time']]) # standardized_processing.
scaled_data = pd.DataFrame(scaled_data, columns = ['stall_num_scaled', 'stall_time_scaled']) # Convert to DataFrame format.
data = pd.concat([data, scaled_data], axis = 1) # Splice data.
data.to_csv('scaled_data.csv', index = False) # Save the normalized data.
```

5 Deep Learning Model Design and Simulation

In the specific spatial governance model of ground stall economy, we adopt convolutional neural network (CNN) as the image recognition model, through image acquisition and processing of the ground stall stall situation, and use convolutional neural network to recognize and classify the image.

Convolutional neural network is a deep learning model which has a wide range of applications in the field of image processing and computer vision. In the study of spatial governance of the ground stall economy, convolutional neural network is used to identify and classify images of the stalls of the ground stall economy, which can accurately determine whether there are irregularities in the stall area occupying public space and whether the number of stalls is in accordance with the planning. Through image recognition technology, it can realize the fine supervision and management of the ground stall economy and improve the management efficiency and governance effect.

Let the input image be $x \in R^{H \times W \times C}$, where H, W and C denote the height, width and number of channels of the image, respectively. The convolutional layer of this model uses F convolutional kernels $\omega \in R^{k \times k \times C \times F}$ of size $k \times k$, where C denotes the number of channels and F denotes the number of convolutional kernels. The bias term is $b \in R^F$. The output of the i-th convolutional layer is

$$h_i = \sigma\left(\sum_{j=1}^{C} \omega_{i,j} * x_j + b_i\right)$$

where * denotes the convolution operation and σ denotes the activation function, and the ReLU activation function is used in this model. The pooling layer of the model uses maximum pooling to reduce the feature dimensionality by using the maximum value within the pooling window of each 2X2 as the output. The fully connected layer of the model adopts a multilayer perceptron (MLP) structure to connect all features to the output layer and finally output the governing result.

In this paper, a convolutional neural network (CNN)-based image recognition model is used to simulate the spatial governance of the ground stall economy. Specifically, the model first acquires and processes images of the ground stall economy.

The model first acquires and processes the images of the stalls, then uses convolutional neural network to recognize and classify the images, and finally outputs the governance results of the stall economy.

In this paper, Keras deep learning framework is used to build the model, and the related code is as follows.

```
# Model Design.
from keras.models import Sequential.
from keras.layers import Conv2D, MaxPooling2D, Dropout, Flatten, Dense.
model = Sequential().
model.add(Conv2D(filters = 32, kernel_size = (3, 3), activation = 'relu', input_shape = (224, 224, 3))).
model.add(MaxPooling2D(pool_size = (2, 2))).
model.add(Conv2D(filters = 64, kernel_size = (3, 3), activation = 'relu')).
model.add(MaxPooling2D(pool_size = (2, 2))).
model.add(Conv2D(filters = 128, kernel_size = (3, 3), activation = 'relu')).
model.add(MaxPooling2D(pool_size = (2, 2))).
model.add(Dropout(0.25)).
model.add(Flatten()).
model.add(Dense(128, activation = 'relu')).
model.add(Dropout(0.5)).
model.add(Dense(1, activation = 'sigmoid')).
model.compile(loss = 'binary_crossentropy', optimizer = 'adam', metrics = ['accuracy']).
# Model Training.
from keras.preprocessing.image import ImageDataGenerator.
train_datagen = ImageDataGenerator(rescale = 1./255, shear_range = 0.2, zoom_range = 0.2, horizontal_flip = True).
test_datagen = ImageDataGenerator(rescale = 1./255).
train_generator = train_datagen.flow_from_directory('train', target_size = (224, 224), batch_size = 32, class_mode = 'binary').
validation_generator = test_datagen.flow_from_directory('validation', target_size = (224, 224), batch_size = 32, class_mode = 'binary').
model.fit_generator(train_generator,
steps_per_epoch = 2000,
epochs = 50,
validation_data = validation_generator, validation_steps = 800).
```

In the simulation process, this paper adopts image recognition technology to monitor and identify the stall situation of the ground stall economy, and carries out the spatial governance of the ground stall economy according to the output of the model. The simulation results show that the spatial governance method of ground stall economy based on deep learning has high feasibility and practicality.

6 Conclusion

In this paper, a research method of spatial governance of ground stall economy based on deep learning is proposed to realize the fine regulation and management of ground stall economy through the technical means of image recognition, spatial optimization and risk prediction. In this paper, a convolutional neural network-based image recognition model is constructed using the Keras deep learning framework to monitor and analyze the stall situation of the ground stall economy in real time and achieve better simulation results. The study shows that deep learning technology has a wide application prospect in the spatial governance of the ground stall economy, providing urban management and economic development with New ideas and tools.

This paper is only a preliminary exploration of the deep learning-based spatial governance method for the ground stall economy, and further in-depth research and practice are needed in the future. For example, it can combine map information, social media data and other multi-source data to monitor and manage the ground stall economy in an all-round way, and improve the management efficiency and governance effect of the ground stall economy. In addition, the application of deep learning technology in other urban governance fields can be explored to provide more scientific basis and technical support for urban governance and development.

References

1. Yang JQ, Ma JC. Research on the spatial governance of ground stall economy[J]. Journal of Urban Planning, 2021, 15(3): 56-63.
2. Goodfellow I, Bengio Y, Courville A. Deep learning[M]. MIT Press, 2016.
3. He K, Zhang X, Ren S, et al. Deep residual learning for image recognition[C]//Proceedings of the IEEE conference on computer vision and pattern recognition. 2016: 770–778.
4. LeCun Y, Bengio Y, Hinton G. Deep learning[J]. nature, 2015, 521(7553): 436–444.
5. Xie Baojian, Li Jiuling. Construction of spatial governance system in Guangdong-Hong Kong-Macao Greater Bay Area [J/OL]. Reform and Strategy:1–11[2023–03–21]. http://kns.cnki.net/kcms/detail/45.1006.C.20230307.1850.002.html
6. Wang Miao, Yang Meizi, Yang Xudong, Cai Cai, Wu Shang, Ding Yanjie. Research and application of key technologies for mega-city space governance [J]. Beijing Survey and Mapping,2022,36(12):1619-1623.
7. Tang Jier, Bao Jiawang, Huang Yi. Exploration of intelligent community renewal and renovation from the perspective of spatial governance: the case of Changshou Road Street in Putuo District, Shanghai[J]. Residential Science and Technology,2022,42(12):24-29.
8. Du Zhiyue. Research on the effectiveness of global cyberspace governance mechanism[D]. Shanghai Normal University, 2022. DOI:https://doi.org/10.27312/d.cnki.gshsu.2022.001736.
9. Liu Dongxu. Study on urban and community regeneration planning of Jijiang Peninsula, Jiangjin District, Chongqing from the perspective of spatial governance[D]. Chongqing University, 2021.
10. Zhang Zhongkai. Research on passive traffic detection methods in cyberspace governance [D]. Shandong University, 2021.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.