LinGo 灵购

——Be your third eye, for a warmer shopping experiment

1 Basic Information

1.1 Project Name

Our project is called **LinGo**, which contains the meanings of Linguistics and purchase (Go is the homophonic sound of "shopping" in Chinese). **LinGo** is designed to boost store efficiency and cut operational costs.

1.2 Team information

Name (Pinyin)	Name (Chinese)	Division of Labor
Xinhang Hu	胡鑫航	Project Manager/Backend Developer
Xinyu Hong	洪鑫裕	Backend Designer/Virtual Scene Builder
Zhiwei Lin	林之巍	Backend Designer/UX Designer
Yuting Sun	孙钰婷	Frontend Developer/UI Designer
Lanqi Fan	范岚琦	Backend Designer/QA Engineer

2 Problem Statement

2.1 Background

Witnessing a rapid growth in internet and multiple rounds of information revolution, the types of shops have differentiated into multiple variants, including offline supermarkets and online stores. For the public, the channels for purchasing are becoming more diverse.

However, there are several pain spots hidding beneath the surface prosperity. For example, solutions which can efficiently and universally shorten the time spent searching for goods are lacking. Meanwhile, foreign customers are more likely to encounter difficulties in understanding the local language on products.

2.1.1 Searching for goods in supermarkets

In a survey focusing on customer experience in stores, the author conducted a detailed assessment of customers' shopping experience using a *Likert 5-point scale*[1]. The result of this assessment shows that before the customers choose the stores, one of the most significant factors which influences their judgment is the shopping experience. Among those assessment data, one of the most vital point is the shopping guide service. In this regard, *Hefei Jiahufu Supermarket(R)*, as a traditional retailer, only outperforms *Yonghui Supermarket(N)*, which adopts the new retail format, in terms of customer satisfaction with its shopping guide service [1]. This reflects that under the current new retail form, department stores have some negligence in their guidance services, which undoubtedly affects the shopping experience of consumers.

	Promotional Activities /%	APP+ Home Service /%	Product Richness /%	Product Display /%	Payment Accuracy /%	Special Experience Projects /%	Shopping Guide Service /%
Yonghui (N)	88.46	80.16	91.69	84.77	84.61	87.08	62.94
Hema (R)	70.31	64.95	78.35	71.86	83.71	89.18	76.19
N-R	18.15	15.21	13.34	12.91	0.9	-2.1	-13.25

Figure 1 Comparison between Yonghui and Hema on service factors

Futhermore, as what *Luo Qian* and *Chen Junkun* proposed in 2019 [2], the consumers are gradually shifting their focus in consumption concepts from the cost-effectiveness of goods to the effcient and high-quality shopping experiences [2]. An excellent shopping experience will increase customer stickiness, indirectly boosting the foot traffic and sales of stores, which will be beneficial for their manegement.

From these serveys, it can be seen that optimizing the guidance services of stores in modern new retail forms can effectively enhance the shopping experience, thereby enabling shopping stores to seize more market share in competition.

2.1.2 Language Barrier on Foreigner Customers

In a survey conducted in Wuhan involving *150* international students, up to *50.9%* of the respondents indicated that they needed to translate the desired product names from English to Chinese before searching on *Taobao*, which is a online shopping platform in China. **Among them, approximately *35%* strongly believed that searching and reading in Chinese on *Taobao* was a major obstacle [3].** These undoubtedly pose hindrances for foreigners to engage

---

[1] Likert Five-Point Scale: It is a commonly used psychological measurement tool, proposed by American social psychologist Likert in 1932. It is a rating summative scale that measures respondents' attitudes, views, or beliefs towards a concept, thing, or phenomenon through a set of statements.

in normal consumption and shopping in China. According to data released by the *National Bureau of Statistics of China* in August *2024*, the average consumption per foreign visitor in the first seven months of *2024* was approximately *3,459* yuan, with an estimated direct economic contribution exceeding *100* billion yuan [4]. If the language barriers encountered by foreigners during offline shopping can be optimized, enhancing their shopping experience, it would be greatly beneficial for shopping stores in expanding their customer base and improving their reputation, especially those stores located in international cities.

Therefore, we tend to apply a **Multilingual Backend Intelligent Shopping Guide System Integrated with Artificial Intelligence Technology** to **Lingo**, which can strongly improve the shopping effenciency, optimize the experience of consumers and maintain the brand effect. We believe that it will become a new trend for the retail industry in the information age.

3 Solution Overview

This system will provide **intelligent shopping guide** service to customers, including product location queries, multi-language query functions with the support of AI technology. This system is also dedicated to providing foreigner-friendly alternatives to reduce language barriers.

3.1 Program Entry

QR codes will be used in conspicuous places in this store, such as the entrance or the side of display cabinets, making it convenient for customers to use the System at any time. When the mobile terminal uses a language other than Chinese, the system will provide with prompt the customer to **select a specified language and currency**. Also, the conversion between CNY and the selected currency based on the latest exchange rates of the day are provided.

3.2 Database Management

Considering that there are already many product information management systems in place, including product names, descriptions, inventory quantities, and its prices. To avoid the hassle of changing the database management system and improve the usage of existing data, we plan to **establish an additional database** to store new key-value pairs(Product location-product key; Product synonyms key).

In order to support multi-language query functions, AI will pre-input the synonyms of item to the new database while store employees are uploading product information.

3.3 Zoning and Positioning Design

According to the layout of a store, **display cabinets** will be divided into different areas by types, ensuring that customers can quickly find target products through LinGo. Before entering product information, store staff need to divide the areas of mall and number of the cabinets in each area to facilitate the product location code generation. Format of the product **location code** will be: **Product area + cabinet number + cabinnet layer number**. For example, an electric shaver in the electronics area might be represented as "**Electronics Area-E1-1**", indicating that a brand of shaver is located on the first layer of cabinnet **E1** in **the electronics area**. Each cabinet is marked on the store map, which can be easily seen in the app. By comparison, customers could find their orientation in the system quickly. This function is shown in Figure 5 and Figure 6.

3.4 Product Query

Customers can query accurately by entering the product name or location code, and the system will provide datailed product information (*If the name is entered, the location code will be returned. Conversely, if the location code is entered, the product information will be displayed*).

If there is no exact match for the product, system will suggest a **fuzzy search** to match **partial keywords**. If the match still fails, the system will compare with **synonyms key** added by AI in the database to improve the possibility of successfully searching.

3.5 Backend Management

System also provides store staff with a **visualized item system**, including the cabinet contents, and product stocks. By simply uploading the product data, the required associated data for faciliting above system can be automatically obtained, and combining with the data previously stored in the original database.

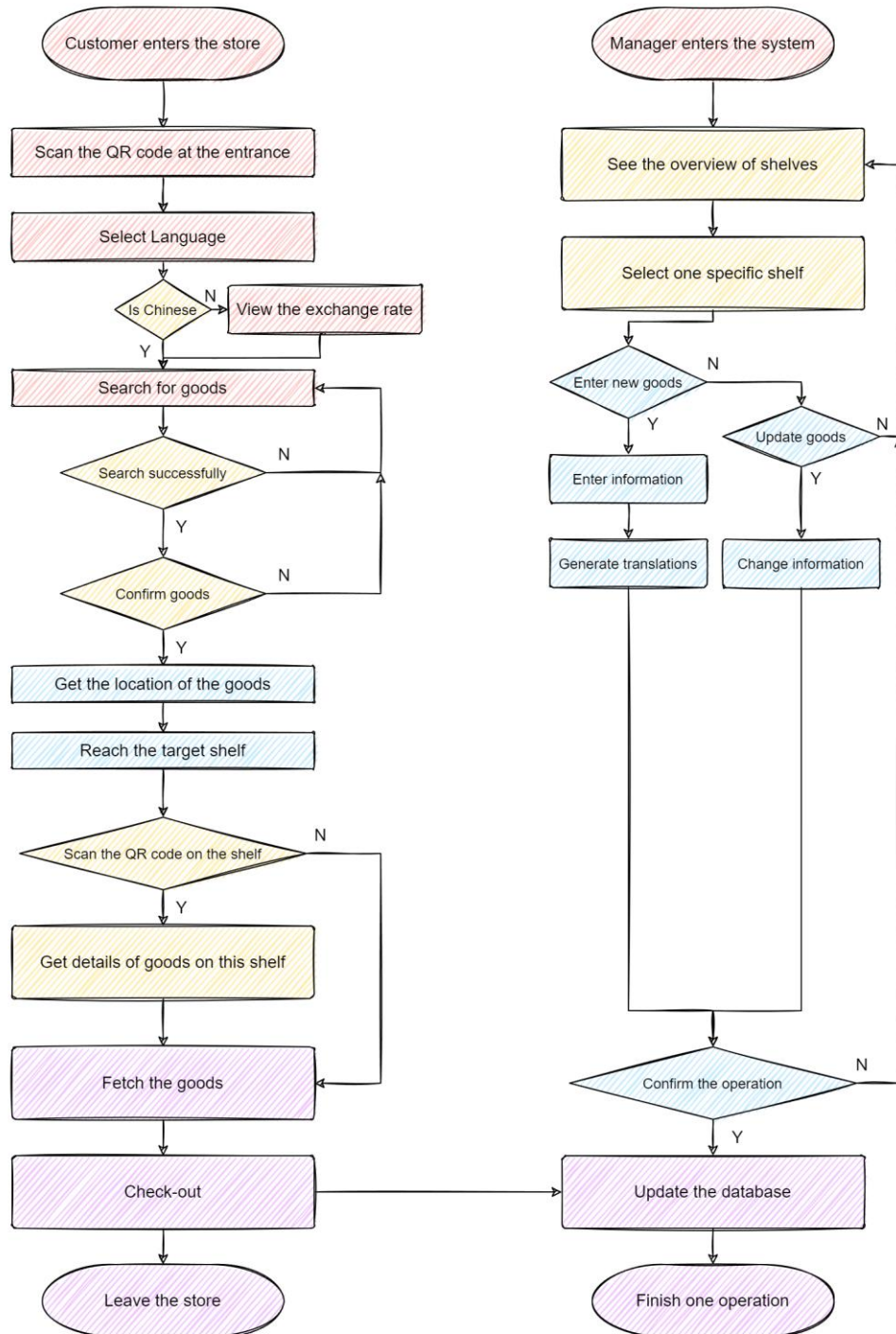# 4 Tech Stack

4.1 Flow Chart

Figure 2 The flow chart of LinGo shopping mode

This diagram illustrates the **basic process** for customers and managers to interact with our system.

For customers, they are able to search for the location of goods and get a guide to the cabinets. The product names translated through AI api and the information of the exchange rate also provide convenience for foreign customers.

For managers, they can access and modify the database as before. Meanwhile, they can receive translated product names easily within a few seconds.
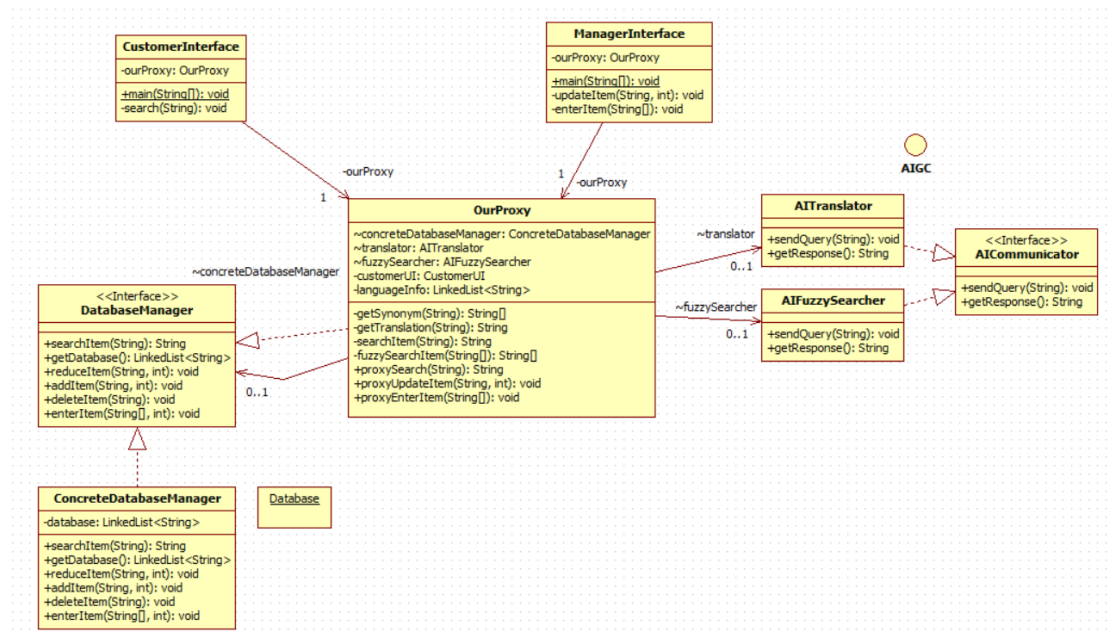
4.2 UML Analysis

Figure 3 UML Class Diagram

Regardless of the interaction between the platform layer and the application layer, the tentative kernel classes and their relationships are drawn in the UML class diagram.

4.2.1 Database Manager and Concrete Database Manager

Considering the cost for stores to switch from original database system to a brand new system, the previous system in our design is preserved and abstracted as an interface with a concrete manager. The datas in the database is saved as a private linked-list named *database*. The whole database can be fetched by the function *+getDatabase()*.

The other functions in this part are comparatively fundamental, including changing the database (*+addItem()*, *+reduceItem()*, *+enterItem()*, *+deleteItem()*) and searching for specific item *+searchItem()*.

4.2.2 AICommunicator, AITranslator and AIFuzzySearcher

This pattern takes the responsibility to connect with AI api (like *openAI* or *xinghuo*). Both AI Translator and AI Fuzzy Searcher are designed to send prompts to AI (**+*sendQuery()***) and receive the responses (**+*getResponse()***). However, there is a slight difference between them. **AI Translator** transforms the Chinese word into a prompt and receives its foreign language name *(in this proposal, we just focus on English to make the system easier to understand)*, while **AI Fuzzy Searcher** transforms any word into a prompt and receives five possible synonyms.

To achieve these operations, we decide to use the Large Language Model (LLM) provided by *QianFan ModelBuilder*. And the prompt is written as

> "Assuming you are a supermarket consumer planning to search for product information by searching for _____, but cannot find it accurately, please generate five keywords for fuzzy search. Remember to strictly follow the following principles: 1. Only output keywords without any explanation. 2. If there are no such words, output the input information"

Through the **local consult** in our PC and the **backend *OneAPI***, we typed in a name Toothpaste, and then successfully received five synonyms in Chinese. The details are shown in Figure 4 and Figure 5.

This attempt shows the feasibility for generative AI to support our translation module and fuzzy search method.

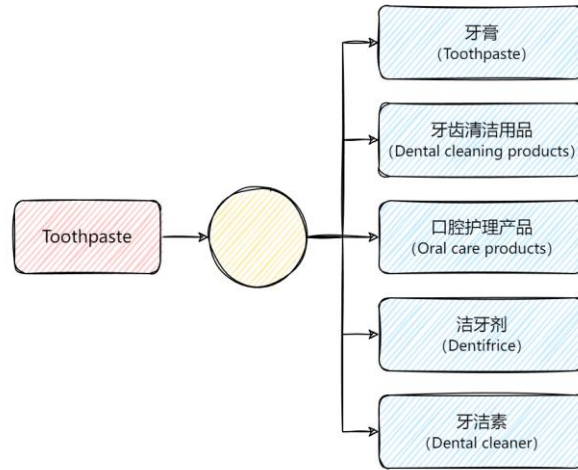Figure 4 Screenshot of the console

Figure 5 Illustration of the operation in Figure 3

4.2.3 Our Proxy

This is our kernal class, which plays the significant role of a proxy among user, AI api and the original database.

The proxy runs *+proxySearch()*, which contains *-searchItem()* and *-fuzzySearch()* when searching for goods. If *-searchItem()* returns nothing, *-fuzzySearch()* will be invoked.

When updating the information of existing goods, *+proxyUpdateItem()* is invoked and it lets the original database manager to do corresponding operations. And *+proxyEnterItem()* is used for adding new goods.

In addition, when a new item is entered through *+proxyEnterItem()*, the proxy invokes *-getTranslation()* and then saves the key-value pair EnglishName-ChineseName into linked-list *languageInfo* (which is needed to replace the English words with Chinese words when the users search in English). And the fuzzy search *-fuzzySearch()* requires the *String* variable from *-getSynonyms()*.

4.2.4 Customer Interface

This is a class contains a main method. For each customer, an unique proxy will be allocated to him/her. The customer can interact with it through *-search()*.

4.2.5 Manager Interface

This is a class contains a main method too. For the manager of a store, he/she can update their goods or enter/delete their goods through higher-level functions *-updateItem()* and *-enterItem()*.

5 Budget

5.1 Cabinet Numbering and Zoning Costs

Supermarkets need additional investment to label cabinets and partitions for digital management, increasing the initial investment costs.

Assuming that each person can install *100* cabinet tags per day, the entire installation process requires 50 man-days, the daily labor cost of about ¥*80* per person per day. The cost of each project is about *50 * 80 = 4000* yuan **(1)**.

Let's say that one supermarket has *5,000* cabinets, each one needs a label. There are two design schemes for labels, one is QR code, and the other is Radio Frequency Identification (RFID) labels.

a. **Using QR code tags** (cost about ¥*0.1* ~ ¥*0.5*)

   The cost of printing tags: *5000 * 0.3 = 1500* yuan **(2)**

b. **The use of RFID tags** (cost about ¥*0.5* ~ ¥*1.5*)

   The cost of making RFID tags: *5000 * 1 = 5000* yuan **(3)**

Through (1), (2) and (3), the total estimated cost can be

   1500 + 4000 = 5500 yuan (using QR code tags).

   5000 + 4000 = 9000 yuan (using RFID tags).

5.2 AI Cost

The accuracy of the recommendation and translation of the related words of the trade name needs to rely on powerful AI algorithms and data training to avoid misleading customers. The usage and maintenance of AI models in supermarkets require certain costs.

Assuming that there are *50,000* items in the store. And *1,000* new or updated items are added or updated every day (*2%* of the database).

Prompt descriptions: about *260* characters (*40* Tokens) on average.

Multi-language translation (*6* languages: Chinese, English, Russian, French, Spanish, Arabic): *25 × 6 = 150* Tokens.

Total number of Tokens per item: *40 + 150 + 25 = 210* Tokens.

Input Tokens: about *40* tokens.

Output Tokens: about *175* Tokens.

According to the Baidu Qianfan model, **input** costs *¥0.03 per 1,000 tokens*, while **output** costs *¥0.09 per 1,000 tokens*.

The cost of each item: *40 / 1,000 * 0.03 + 175 / 1000 * 0.09 = ¥0.01695*

Initial data processing (*50,000* products): *5,000 * ¥0.01695 = ¥847.5*

Daily product update cost: *1,000 * ¥0.01695 = ¥16.95*

Monthly product update cost (*30* days): *¥16.95 × 30 = ¥508.5*

Annual renewal cost (*365* days): *¥16.95 × 365 = ¥6,186.75*

5.3 Data Input and Maintenance

Merchants need to update product data regularly to ensure the accuracy and timeliness of the information in the system, so there will be some additional labor costs.

6 Except Outcomes

6.1 Forms of Output

Development and delivery of a multilingual back-end intelligent shopping guide system with integrated AI technology.

System features:

1. Multi-language text content.

2. Product location display.

3. Product information display.

4. Product exchange rate display.

5. Combined with AI intelligent search

6.2 Expected Results

6.2.1 Enhance User Experience

Provide customers with a more convenient intelligent shopping guide service, and effectively solve the language barrier through multi-language support.

6.2.2 Business Value

Through the guides from our system LinGo, not only the reliance on manual shopping guides, but the labor cost of shopping guide service can be reduced, and the overall operational efficiency can be enhanced.

6.2.3 Coverage Crowd

1. **Ordinary customers:** LinGo is applicable to general consumers by helping them find their targets faster and providing a warm shopping experience.

2. **Social phobic customers:** Especially those who avoid communication with staff and tend to shop on their own. LinGo eliminates the need to interact with staff by providing self-service shopping guides to enhance shopping comfort.

3. **Multi-language customers:** The service covers a variety of international languages to meet the needs of customers with different language backgrounds and provide a convenient shopping experience for foreign customers.

6.3 Success Indicators

1. User Satisfaction ≥ *90%*.

2. Multi-language coverage rate ≥ *95%*.

3. System response speed ≤ *5* seconds.

6.4 Measurement Methods

1. User behavior data analysis (click rate, conversion rate, etc.).

2. Regular collection of user feedback (questionnaires and evaluations).

3. Test coverage and actual use analysis of multi-language functions.
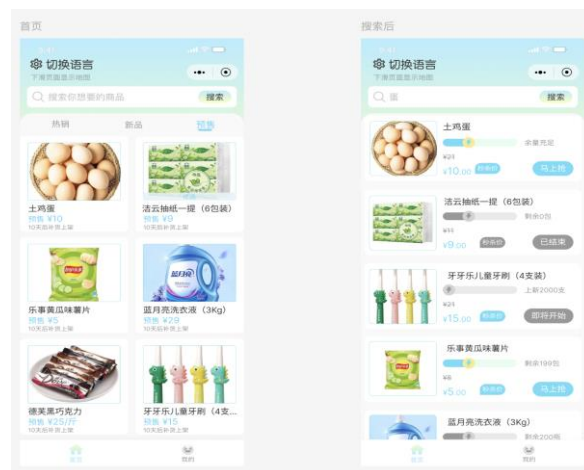
6.5 Expected UI

6.5.1 Customer UI

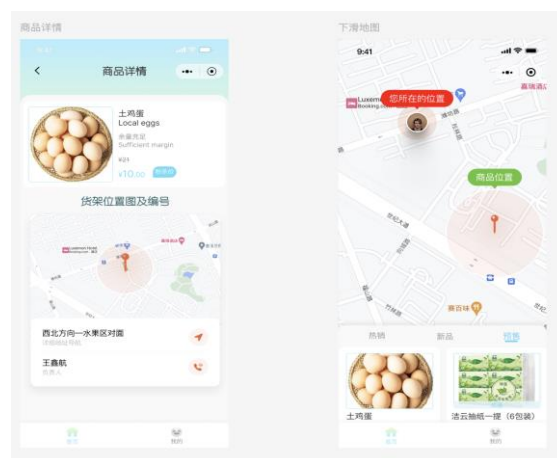Figure 6 Customer searching goods

Figure 7 Customer get the details of an item

6.5.2 Manager UI

Figure 8 Manager gets the overview of all the cabinets

Figure 9 Manager updating the data in one item

6.6 Risk Management

6.6.1 Technical Risks

1. **Insufficient accuracy of AI algorithms:** Inaccurate translation or wrong recommendation of related words may lead to customers' misunderstanding of the products, thus causing disappointment among them.

2. **System performance bottlenecks:** high concurrent user searches may lead to corresponding system delays or crashes.

6.6.2 Data Risks

1. **Data quality issues:** Incorrect entry of product data and untimely updating may lead to inaccurate final results, which in turn seriously affects user experience.

2. **Data security and privacy:** Leakage of user search records or merchant data may bring privacy and legal risks.

3. **Data volume and storage costs:** As product and translation data accumulate, storage costs may increase significantly, which impacts the whole performance of LinGo.

6.6.3 Market Risks

1. **User acceptance:** Customers may distrust the advertisements or may not be accustomed to using our system.

2. **Market competition pressure**: Other stores or e-commerce platforms may be back to launch a similar function system to seize the market.

3. **Long return period:** The development and deployment the new system could take a long time to see any economic benefits, which leads to a potential financial pressure.

7 References

[1] S. Bowen, H. Qiliang, and W. Feng, "Comparative Study of Customer Experience in Supermarket Formats under the Background of New Retail: Based on Hierarchical Principal Component Analysis," Journal of Baoding University, vol. 32, no. 05, pp. 68-72, September 2019, doi: https://doi.org/10.13747/j.cnki.bdxyxb.2019.05.009.

[2] L. Qian, C. Junkun, "Research on the influencing factors of customer consumption intention under new retail formats: based on the perspective of customer experience," Economic Research Guide, vol. 08, pp. 116-121+151, Mar 2019, Available: https://kns.cnki.net/kcms2/article/abstract?v=WStw-PbchozTKElLmm6kCU_9LWrauk31dkziGspdZ2zdSu-trqeBGXWXbAGLhRQ1VR-oEJFinw_3MeAmFSMxy09_Ttb1AnvS2xXQnpn-2wAH9o0QP8-0Kzh-fkup-8YsGeSPF8AtHKxyN7Sc1ushsqFUw-TXgYqcG8N4j3__PRL2ozSHyuJk_Q==&uniplatform=NZKPT&language=CHS

[3] J. Salimu Abushiri and M. Nuran Ally, "Exploring Foreigners' Online Shopping Experience in China: A Case of Taobao," Feb. 2014, Available: https://kns.cnki.net/kcms2/article/abstract?v=WStw-PbchoxFegs-vEQyH3UxBzH1RBzsgCyqxn_WVSiXk7ad7G6cvsLvb3ViM6UeJT9AzJjPPmvzdoSo299Yhttz769lvIVVkR1jyKinWNrZI7BinUQbjxXH4NTUlPBEwe87ZxUtRBZIKIoCX2wEdOAajUFErnQLLrkKigaL8grmZFWXaNT3KQ==&uniplatform=NZKPT&language=CHS

[4] L. Qilong, "Official: The average daily consumption of foreigners in China is 3459 yuan, and the inbound tourism market is booming," China Net, Aug. 19, 2024. https://news.china.com/socialgd/10000169/20240819/47062941.html