Smart "set-up" area --mobile commercial market management system based on IOT and GIS

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Abstract: In order to explore the existing value of smart communities at a deeper level, improve the convenience of life of residents in smart communities, better serve residents, and help the development of the ground stall economy, the team is committed to constructing a small commercial mobile market under smart communities, improving the level of intelligence and precision of regional planning and management, realizing dynamic multi-dimensional supervision in the area, and fully exploring the potential of smart communities. The mobile commercial market management system is mainly composed of hardware and software: the hardware device has a booth positioning device and a space aircraft, and the software is divided into an intelligent management platform including the use of back-end planning and management booth personnel according to the object of use; The APP used by community managers to plan the optimal path and patrol and collect problems; The stall selection and positioning APP used by stall merchants; Consumers use the APP for viewing and feedback information. The stall positioning device has the functions of accurate positioning, trajectory query, electronic fence, vibration alarm, anti-demolition alarm and so on. Space vehicles have functions such as inspection, environmental detection and automatic planning. The intelligent management platform is a platform that integrates functions such as booth planning, booth merchant supervision, information processing and management, and equipment information management. The Inspector APP is mainly to provide the patrol management personnel with functions such as booth problem collection, patrol path planning, and booth problem handling. The stall merchant APP mainly provides merchants with functions such as booth valuation, map viewing, reservation, and navigation of optional stalls. The APP used by consumers is mainly to display business stalls for consumers, and consumers can make booth comments and stall business reports.

Keywords: smart communities, the ground stall economy, the mobile commercial market management system

1. Introduction

Under the background of the dual lanes of urban informatization and economic development, the Fifth Plenary Session of the 19th Central Committee pointed out that strengthening the construction of smart communities is an important way to achieve equalization and convenience of services for urban and rural residents. Smart community refers to the full use of the Internet of Things, cloud computing, mobile Internet and other new generation of information technology integrated applications, to provide community residents with a safe, comfortable and convenient modern and intelligent living environment So as to form a new form of management based on information, intelligent social management and service of the community. However, the existing smart communities have problems such as data integration and difficulties, inability to meet the diverse needs of residents, and difficulty in highlighting their value. The emergence of the stall economy, its own unique characteristics, can better meet the diversified needs of residents.

However, after the introduction of the stall economy into the smart community, the shortcomings of the mobile commercial market will be exposed, and a series of problems such as polluting the environment, blocking traffic and affecting the appearance of the city will emerge in the later stage, due

to the strong liquidity of the stalls and the large number of businesses, which also increases the management difficulty for community managers and government management departments. Therefore, in order to perfectly combine the smart community with the stall economy, and realize the standardization, standardization and greening of the stall economy on the basis of ensuring residents' employment and basic people's livelihood, government departments urgently need a management system or program that can better integrate the information of each smart community and properly solve the problem between urban law enforcement departments, vendors and consumers.

2. Introduction of products and solutions

2.1 System scheme design

The UAV relies on the Beidou system and LORA wireless communication technology, and the positioning device supports satellite and base station positioning, which can achieve high-precision positioning[1], so as to determine the remote collection and transmission of booth positioning information, and Alibaba Cloud IoT Platform realizes the data and information interaction between the booth positioning device and the user end. Computers and mobile terminals provide users with information and management.

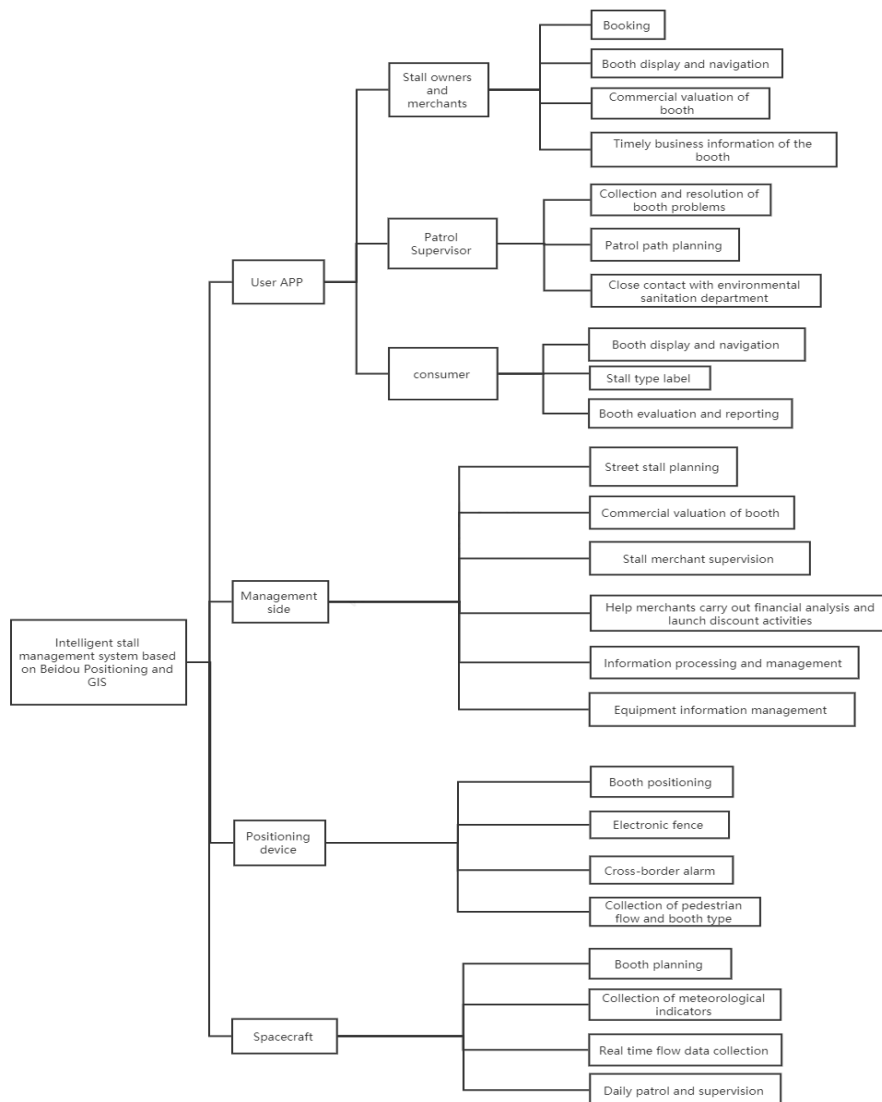### 2.2 The main functional design of the project

Figure 1: Functional design of smart stall management system.

The intelligent management system of the stall bar is mainly composed of hardware and software: the hardware device is the booth positioning device and the drone, and the software is divided into the intelligent management platform used by the background planning and management booth personnel, the inspection and collection problem APP designed for the inspection and management personnel, the commercial valuation and stall positioning APP used by the stall merchants, and the Consumers use the Consult and Feedback Information APP.

2.3 Core function algorithm design

2.3.1 Path planning

This project uses the improved Dijkstra algorithm for shortest path planning, using the greedy theory to split the original planning problem into several subproblems that are easy to solve the distance with the Dijkstra algorithm, first by finding the local shortest distance by separately comparing the subproblems, and finally finding the global shortest path of the original problem [2].
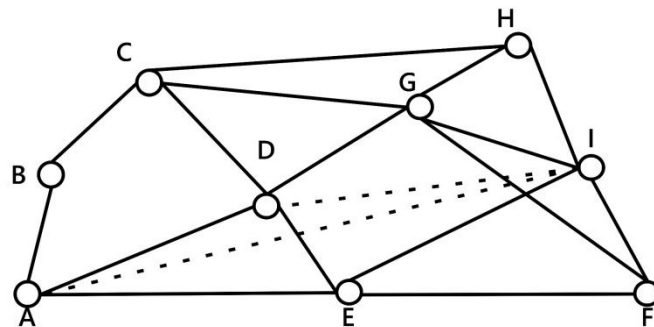
Figure 2: Schematic diagram of the improved algorithm.

2.3.2 Booth identification

This project can realize the automatic identification and evidence collection of vendors in the scope of smart community monitoring by using YOLOv3 algorithm[3] technology, effectively improving the efficiency of urban management departments and reducing labor costs.

The detection error of YOLOv3 through 15 iterations dropped from the original 5000 to about 25, and when the iterations were about 70 times, YOLOv3 was dropped The model with a small change in error has been basically trained. When fully iterated, the average error is displayed at 14.02, which can meet the actual demand.
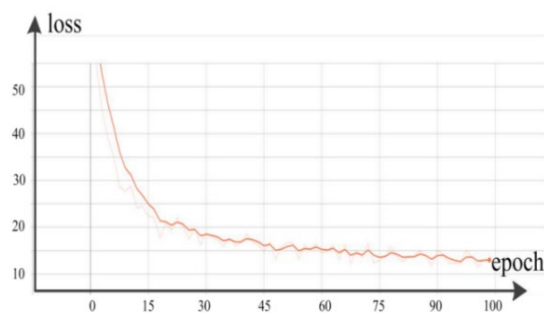
Figure 3: YOLOv3 Training Error and Number of Iterations.

3. Hardware design and implementation

3.1 Functional design

3.1.1 Functional design of positioning device

Based on the STM32F103 development board, it integrates GPS/BDS dual-mode positioning technology, BC20 IoT development module, terminal display and management module, etc., design and production of a positioning device. Its main functions include business positioning, electronic fencing,

and cross-border alarm.

3.1.2 Functional design of space vehicles

Based on the Beidou system and LORA wireless communication technology, combined with the multi-party data acquisition device at the UAV end, a multi-party real-time information acquisition system is designed, which can detect CO_2, SO, and O_3 and other gas data, video and image information, and can collect and process data at the same time.

3.1.3 Handler design

The MQTT protocol allows the hardware to connect to the cloud platform, in which the publisher and subscriber are clients, the message broker is the server, and the message publisher can also be the subscriber.

Figure 4: Communication Flow.

Open the BC20 chip configuration, by sending AT instructions can test whether the hardware is working properly, the following are some common AT instructions.

3.2 Hardware design and assembly

3.2.1 Positioning device design and assembly

3.2.1.1 Positioning device design ideas

BeiDou positioning device based on "specification + management" as the design concept, mainly by the microcontroller core control module, Beidou module, alarm module three modules, after the merchant carries the positioning device, through the GPRS wireless network will transmit the location information to the host computer display terminal, combined with the Beidou positioning technology, the management personnel can view the position of the business booth at the terminal, Manage and deal with problems with merchants in real time and in a timely manner.

3.2.1.2 Assembly of positioning devices

Considering the practicality and convenience of the device, we will encapsulate the functional device into a PP plastic box, and install the booth number, real-name certification, and project logo on the surface, indicating that the booth merchant has been certified, and the consumption can be guaranteed, and the transaction collection code is pasted on the surface to facilitate the merchant to collect.
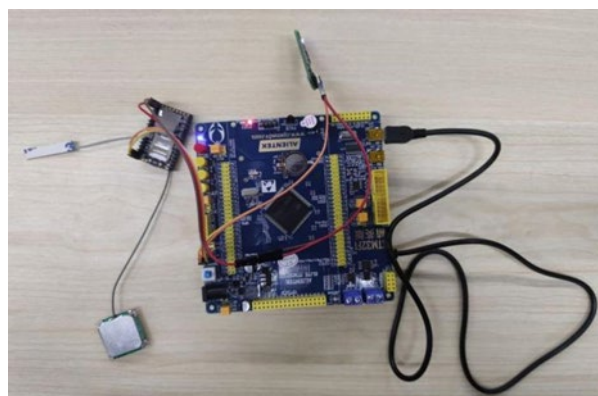

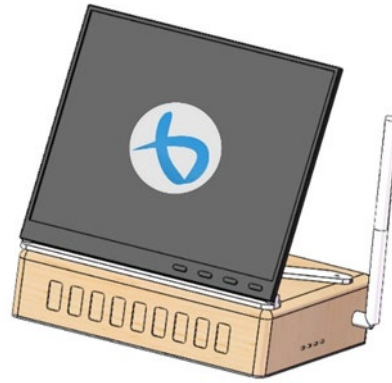*Figure 5: Positioning terminal circuit integrated physical diagram.*

Figure 6: Device Product Design Drawing.

3.2.2 Space vehicle design and selection

3.2.2.1 Space vehicle design

Based on the Beidou system vigorously promoted by China, with the design concept of "intelligent management", the space vehicle mainly has five modules: meteorological data acquisition device, video image acquisition device, data processing device, data storage device and communication device. After the data processing device analyzes and processes from the meteorological data acquisition device and the video image acquisition device, it is stored in the data storage device, and the information of the data storage device can be transmitted to the management platform after the UAV flight and displayed on the platform.

3.2.2.2 Space vehicle assembly

The meteorological data acquisition device, data pre-processing device, video image acquisition device, flight attitude detection device, navigation and positioning device and other parts of the module are assembled and debugged to obtain the space vehicle, and the uninterrupted real-time transmission of data is realized through LORA communication and Beidou short message function as an auxiliary transmission means to ensure the improvement of work efficiency.

Figure 7: Space vehicle integration diagram.

4. Software design and implementation

4.1 Management end function design and implementation

4.1.1 Stall planning module

Table 1: Booth types summarized.

Booth model	Booth category		
Small stalls	Snack class	Repair class	Talent class
Medium-sized stalls	Agricultural and sideline products	Apparel class	Entertainment
Large stalls	Department stores	BBQ class	
Reference booth reference length: small stall 0-4m; Medium size stall 5-6m; Large stalls 7-9m			

Managers can plan stalls by booking stalls at merchants and the number of historical stalls. In order

to solve the problem of cluttering the types of stalls. According to the market research results, the common stalls are classified, the types of booth services are clarified, and the correlation degree analysis is carried out through the survey results, and the booth categories are divided into three categories: large, medium, and small, which are convenient for managers to plan and choose from stall merchants.

4.1.2 Booth and merchant supervision modules

Monitor the behavior of merchants through surveillance video (drones can also be called to patrol), and use the booth identification function to lock the stalls around the community for targeted supervision and improve staff management efficiency.

4.1.3 Information processing and management module

The management platform provides regional traffic analysis data for the merchant APP, including weather, human flow, time period and other information, so as to assist the booth valuation function of the merchant APP, and set up the corresponding hierarchical payment system according to the booth valuation results to achieve hierarchical management.

Based on the supervision of business behavior in the supervision module, if a business violates the law is found, a series of information inquiries can be made through the information processing and management module, combined with the basic information of the business, the booth information, the historical stall of the merchant and the illegal information to provide multi-faceted information for the manager's decision-making, so that the manager can make a comprehensive decision.

4.2 User-side function design and implementation

The user terminal is divided into three kinds of APP according to the use of the object: inspection supervisor, consumer and merchant. The main functions of the APP used by the inspection supervisor include inspection path planning, booth problem collection, booth problem handling, and stall navigation; The main functions of the APP used by consumers include booth comments and reports, business information browsing, and stall navigation; The main functions of the merchant APP include real-name authentication, booth selection, device connection, information reception, financial analysis, and store exposure.

4.2.1 Patrol regulators

Path inspection: Using the above improved Dijkstra algorithm to find the shortest multi-point inspection path, select several stalls around the universities in Shuangliu District starting from the Shuangliu District Urban Management Bureau, and find the path shown on the green line[5]. By comparing the map data, it is found that this route is indeed the shortest route, and the time to find it is also very short, which is suitable for the route planning of the actual patrol.

Problem collection: In the inspection process, the Beidou satellite will be used to track and record the path of the inspectors in real time, and when the inspectors find the booth problem during the inspection, the Beidou positioning function that comes with the mobile phone will be used to report the location of the inspectors and provide location proof while uploading relevant certification materials.

4.2.2 Consumer

Booth comments and reports: In order to enliven the economic market, increase user participation, and safeguard consumer rights, we have set up booth evaluation and reporting options on the Consumer Stalls Bar APP. If consumers encounter counterfeit and shoddy products, food safety problems, etc., they can report and feedback to the management department through the APP, and the management department will fine the merchant and reduce the credit value after the investigation and verification of the situation, and the serious situation will be suspended for rectification or pulled into the blacklist of the application booth[6]. Through the form of mass supervision and verification by the management department, the merchants are driven to improve the quality and service level of the booths. The introduction of the review mechanism can enable other consumers to use evaluation and scoring as consumption references and quickly dock consumption targets.

Booth inquiry and stall navigation: Consumers can search through APP, view the information of the booth merchants on the booth map on APP, understand the types of stalls, business items, and navigate the booth through the Beidou satellite after locking the target, so as to quickly complete the process of consumption.

4.2.3 Stallholders

Real-name authentication: In view of the frequent occurrence of food safety, clean chaos, counterfeit and shoddy products, it is difficult for managers to trace the source, and it is difficult to protect consumer rights. The project introduces a real-name authentication mechanism for merchants to settle in the merchant APP, and conducts a comprehensive assessment of the merchant according to the credit and historical background information of the business, and can only apply for the booth if it meets the requirements. Real-name authentication fundamentally solves the problem of businesses deceiving consumers, and consumers have a channel to protect their rights.
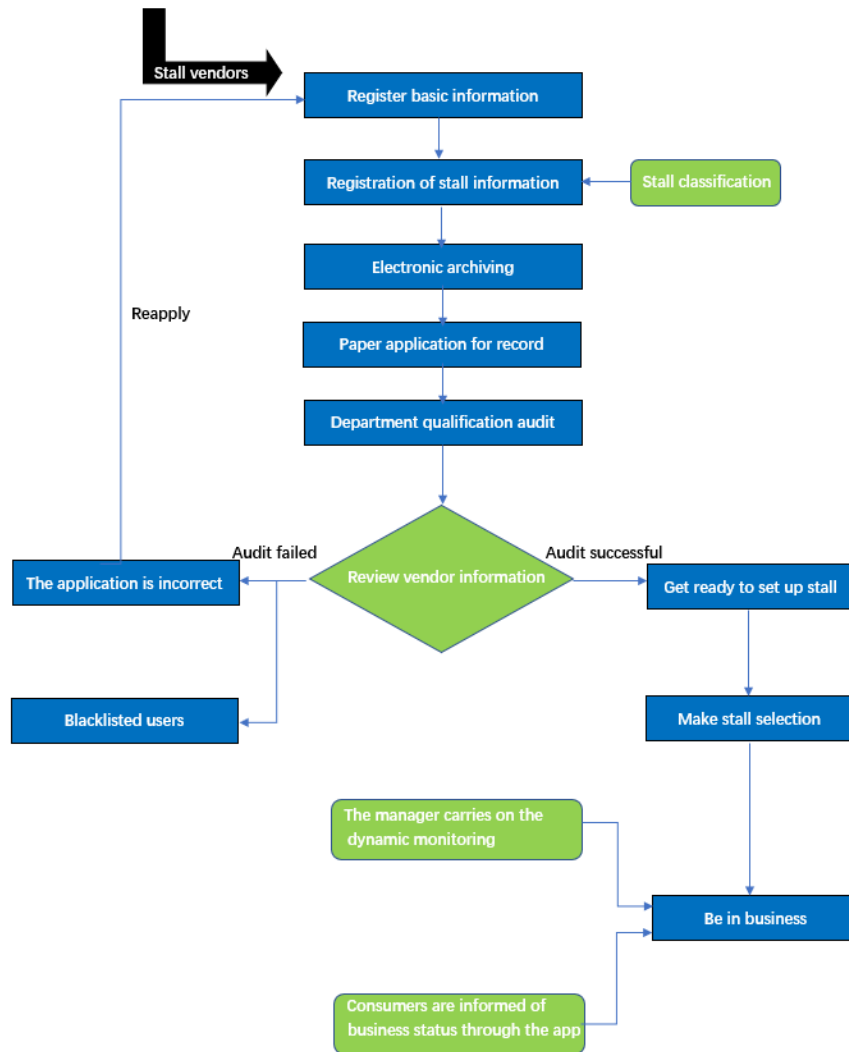

Figure 8: Merchant real-name authentication process.

Booth selection: The merchant APP can call Baidu Map and Baidu Weather's API to obtain the street stall map developed by the management platform. Booth merchants can select the target booth, and merchants can assist in selecting specific booths according to the booth valuation results and charges. Among them, the booth valuation results are obtained by the regional traffic analysis data (including the weather, human traffic, time period and other information of the day), and the valuation results and corresponding charging information are displayed to the merchant in descending order, and the higher the booth valuation order, the higher the fee. Merchants make their own decisions on the selection of a specific booth based on factors such as the intended stall area, their own booth type, booth valuation results and charging conditions.

Information Reception: Information reception includes notification of the connection of the positioning device, notification of the administrator to the stall owner, weather forecast, precautions before and after the stall, and so on.

Financial analysis: Merchants through the self-built database, of which the consumption data of the merchant APP cash register system as the main data source of the database, the daily consumption data of consumers is collected and precipitated, and valuable consumption data is fed back to the database through the selection of data, so that the management platform can conduct a deeper interpretation and analysis of the consumption data and feedback to the merchant.

Shop exposure: First of all, through the analysis of the business district near the stall, the competitive advantage of the merchants in the business circle is explored. Secondly, through the self-built database, the consumption data of the cash register is analyzed through the processing and analysis of the data to form a consumer portrait. The platform uses big data analysis to accurately push store information to consumers through decentralized algorithms.

5. Conclusion

The product introduces the stall economy into the smart community, helps the construction of the smart community on the basis of solving the existing problems of the stall economy, and at the same time drives the economic development and carries out a new type of stall economic management to better improve the business quality and protect the rights of consumers, which has good market prospects.

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