Design and Development of Map Vertical Social Platform Based on LBS

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Abstract. In recent years, vertical social communication among strangers characterized by anonymization and personalization is becoming a new approach to social communication in mobile Internet era. This paper developed a map vertical social platform based on LBS technology and Retrofit network framework in an attempt to solve such problems as the slow shift from online to offline social activities and barriers to communication between strangers . The platform implements real-time map display by connecting to the Golden Map SDK, uses C/S three-tier structure as the system architecture, SQL Server database to store and manage data, MVVM as the backend framework, and constructs four modules of map social, social activities and recommendation, group chat and user center based on the social needs of young people, which effectively meets the anonymous social needs of strangers.

Keywords: Map vertical social interaction; LBS; Android development; C/S Three-tier.

1. Introduction

In recent years, with the rapid development of spatial positioning technology and mobile network technology, the use of the Internet has begun to change from traditional fixed terminals to mobile terminals such as smartphones and tablet PCs. In this context, Location Based Services (LBS) has gradually emerged and matured. Currently, Android and iOS dominate the mobile terminal operating system market. Android is favored by users and cell phone manufacturers for its free, open, personalized and barrier-free communication between applications [1-2]. Positioning System (GPS) and Cellular Mobile Communication (CMCC) technologies [3].

Currently, users' demand for personalized and anonymous social networking is growing,.The youth-oriented social group urgently needs an app that can quickly transform online socializing into offline socializing [4], and can view and join nearby activities based on different interests via maps anytime and anywhere. Jie Gu [5] had developed a simple social platform on Android platform using LBS technology. Liang Chenxia, Wang Yanhui et al [6] have also implemented similar APPs on Android platform using LBS and other technologies, but all the above studies have certain defects and cannot meet the daily use. In this context, based on the Android platform and LBS technology, this paper designs an APP-"You&I"-that can meet the needs of young people for vertical social networking based on the shortcomings of the current social platform. "You&I" is an LBS-based map-based vertical social platform, using the map as a social carrier, users can screen and view activities initiated nearby on the map in real time and participate in them, aiming to connect young people with the same interests, vitality and social power in the same city, and close the social distance of strangers. It aims to connect young people with the same interests, energy and social power in the same city, and bring strangers closer together.

2. System design and key technologies and methods

2.1. System design

2.1.1 Overall frame design

The system uses a Client/Server (C/S) three-tier architecture, as shown in Figure 1. It contains three layers: the representation layer (APP client), the business logic layer (server) and the data storage layer (database) [7].

1) Representation layer: It is the user interface of the whole system and is responsible for the interaction between the user and the system, which is mainly realized by the Android APP client.The APP client realizes the basic system data input and output by using the Graphic User Interface (GUI), feeds the user's operation at the APP side to the server for processing, and Receive the data from the server after processing.

2) Business logic layer: also called intermediate layer, it is responsible for realizing specific business logic and transmitting data and requests with the representation layer through data interface, and this system uses Tencent cloud server to realize the corresponding functions. By accepting requests from APP clients, the server performs logical processing of data in the corresponding database already available in the platform and returns the results to APP clients, thus realizing the functions of the software [8].

3) Data storage layer: responsible for the storage, access and modification of all information in the system, this system realizes the relevant operations by using SQL Server database to store several data tables such as user tables, etc. By accepting requests from the server, the database quickly performs operations such as querying and modifying the information stored in the database, and feeds the results back to the server.

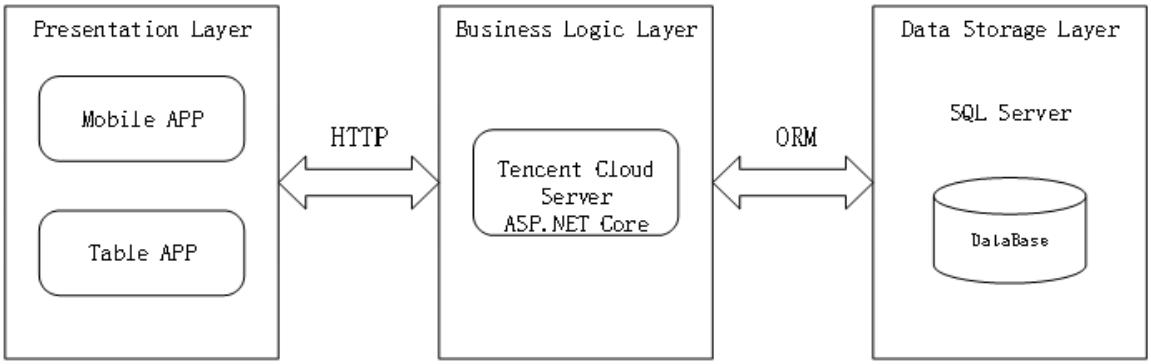


Figure. 1 System Overall Framework Diagram

2.1.2 Functional module design

The system is mainly divided into four modules: map social, activity and recommendation, activity group chat and user center, each module contains several sub-functions, and the division of each module and function is shown in Figure 2.

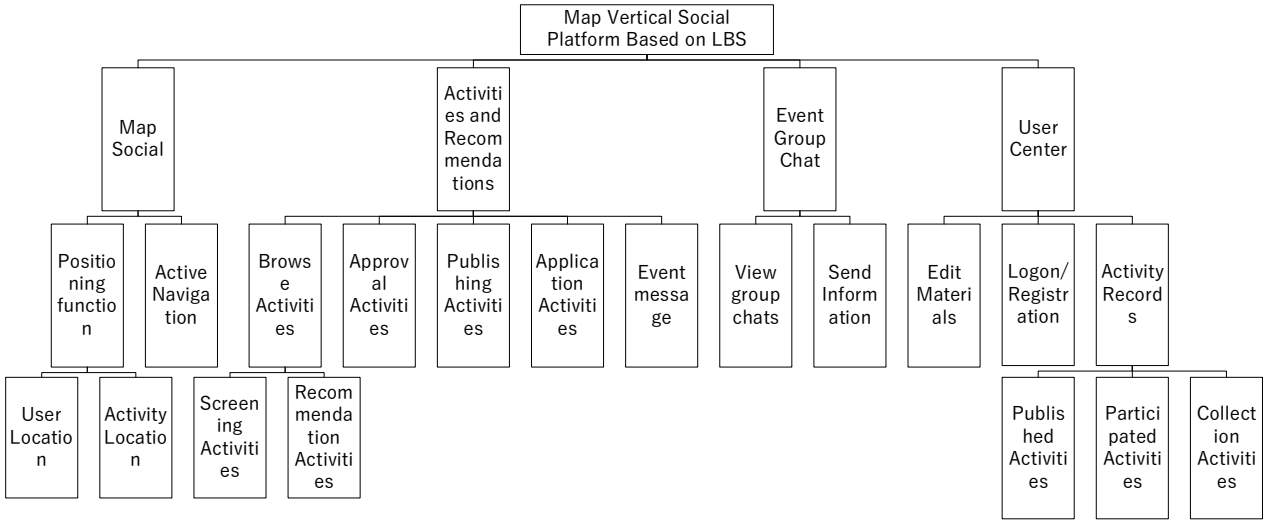


Figure. 2 System Module Structure Diagram

1) Map Social

①Location function: By using the phone's built-in GPS to obtain the user's current geographic location in real time, and display the positioning of nearby activities according to the user's current location.

②Activity navigation: Users can click on the activities they are interested in to navigate, and the system will automatically evaluate and display the route to match.

2) Activities and recommendations

①Browse activities: Users can filter the activities they are interested in by different interest tags; the system will recommend activities that users may be interested in based on their history of participating in activities and the personalized tags they fill in through the recommendation algorithm, so that users can easily understand and participate in the activities they are interested in.

②Publish activities: Users can click the publish button to initiate activities by themselves by filling in the form information.

③Join the event: Users can click on the event details page to learn more about the event and sign up for the event.

④Activity Message: Users can fill in and post a message under the detail page of the activity they want to know about.

⑤Approve the activity: The applied activity can be successfully participated after the activity initiator agrees to it.

3) Activity group chat

①View group chat: The group chat will be created automatically after the activity promoter agrees to the applied activity, and the user can view the information of other people participating in the current activity and the previous chats in the group chat.

②Send message: Users can input and send messages in the group chat, and the message records will be synchronized in real time.

4) User Center

①Edit Profile: Users can edit their account nickname, email address, modify avatar, personality signature, personality tag, birthday and other basic personal information.

②Login/Registration: Users can login to their existing accounts or register new accounts through email.

③Activity record: Users can view all the activities they have posted, participated in and collected in the past.

2.1.3 Database design

In order to realize the basic functions of this system, information such as users and activities need to be stored. This system uses SQL Server database to store data and designs database tables according to the functional requirements of the system. The database tables of this system contain user table, activity table, activity application form group chat message table, comment table and so on. Among them, the user table is used to store the user id, location, basic information and other data of the user, as shown in Table 1. In order to avoid the situation of renaming, this system uses user id as the unique id of each account, which is convenient for user retrieval.

Table. 1 User Table

Parameter Name	Type	Explain	Can It Be Empty
id	int	User Unique ID	NO
username	nvarchar(50)	User Name	NO
password	nvarchar(50)	User Password	NO
email	nvarchar(50)	User Email	NO
avatar	nvarchar(50)	User Head portrait	NO
sex	nvarchar(10)	User Gender	YES
age	int	User Age	YES
hobby	nvarchar(50)	User Hobby	YES
brief	nvarchar(100)	User Introduce	YES
x	float	Location Latitude	YES
y	float	Location Longitude	YES
location	nvarchar(100)	Location Address Name	YES

The activity table is used to store the basic information of the initiated activity, such as activity id, latitude and longitude, activity description, etc., as shown in Table 2.

Table. 2 Activity Table

Parameter Name	Type	Explain	Can It Be Empty
id	int	Activity Unique ID	NO
userid	int	Creator ID	NO
title	nvarchar(50)	ActivityTitle	NO
x	float	Location Latitude	NO
y	float	Location Longitude	NO
type	int	Activity Type ID	NO
location	nvarchar(100)	Address Name	NO
introduction	nvarchar(100)	Activity Introduce	NO
maxnumber	int	Maximum Number	NO
curnumber	int	Current Number	NO
starttime	smalldatetime	Activity Start Time	NO
endtime	smalldatetime	Activity End Time	NO

2.2. Key technologies and methods

2.2.1 LBS service

Most of the functions of this system are based on LBS technology, which contains a variety of information technologies such as location information, spatial positioning, Internet, mobile communication, etc., so that users can access the corresponding services through spatial positioning. The system uses LBS technology for the following two main functions: one is to display the user's current location and the activities that exist around it in real time on the map; the other is to navigate according to the user's location and the location of the activities.

Currently, there are many open map service development interfaces on the market, and this system selects Gaode Map SDK to realize LBS service. It provides accurate positioning service, navigation function based on road conditions and accurate map display, and is free for developers to use, which can well meet the development needs of this system. In summary, this system uses the Gaode Map SDK to realize the functions of real-time map display, user activity positioning and navigation [9].

2.2.2 Back-end development

This system uses Tencent Cloud as the back-end server, which has the advantages of low cost, good stability, perfect ecology and high security, and is suitable for the development of this system.

SQL Server is one of the most widely used relational database management systems, which is easy to use and scalable, and can be adapted to different versions of Windows environment, so SQL Server is chosen to store and manage user and activity data. To simplify the development and use of database, this system introduces Entity Framework Core as an ORM (Object Relational Mapping) model, which enables developers to handle data in an object-oriented way by mapping application entity objects and data in a relational database.

The back-end of the system is developed using ASP.NET Core framework, which is a cross-platform high-performance open source framework with modularity, testability, and dependency injection to quickly build the API (Application Program Interface) required by the system.

2.2.3 Front-end development

The front-end of the system adopts Material Design language, which can make different cell phones and tablets get a consistent look and feel and use experience.

For network request, the system uses Retrofit framework to implement Android network request, the APP application layer initiates the network request, Retrofit configures the request parameters through annotations, and then transmits the network request to the server through OkHttp; after data processing, the server returns the response data to the application layer through Retrofit, and then refreshes the interface and returns the result to the user. After data processing, the server returns the response data to the application layer through Retrofit, and then gives the result back to the user through interface refresh.

For front-end and back-end data transmission, the system adopts FastJson library to realize the parsing and packaging of JSON format data, which is a lightweight data exchange format and can realize faster and more convenient data transmission by converting the data to be transmitted into JSON data.

For image loading and processing, the system uses Gilde library to realize smooth image list scrolling effect, and to get good APP experience by speeding up image decoding speed and reducing the resource pressure brought by decoding images.

2.2.4 Recommendation algorithm

This system uses content-based recommendation as the recommendation algorithm for activities. By collecting the tags of users' historical participation activities and the personalized tags filled by users themselves, we learn to calculate users' preferred interests, and based on this, we calculate the similarity between users and each item in the set of items to be recommended, and then sort and recommend them to the users according to the similarity calculation results. Since the data of this system are mainly low-dimensional data and need more accurate results, we compare several distance calculation formulas and finally use Euclidean Metric to calculate the similarity, which has the advantages of easy understanding and simple calculation, and the formula for calculating the distance between two points in n-dimensional space is shown in equation (1) [10-12].

$$d(x,y) = \sqrt{\sum_{i=i}^{n}(x_i - y_i)^2} \tag{1}$$

Among them, x and y are two points in an n-dimensional Euclidean space, whose coordinates can be expressed as a point set. Take x as an example, it can be expressed as $(x_1,x_2,\ldots,x_n)$, where x_i (i=1,2...,n) is the ith coordinate of the real number x.

When the Euclidean distance is used to express the similarity, it is generally statuted to between (0,1] in order to make it more representative of the similarity, as shown in the conversion equation (2). The final result ranges between (0,1], and the larger the value, the smaller the d(x,y), i.e., the closer the distance, the greater the similarity.

$$sim(x,y) = \frac{1}{1+d(x,y)} \quad (2)$$

3. Results

3.1. System development environment

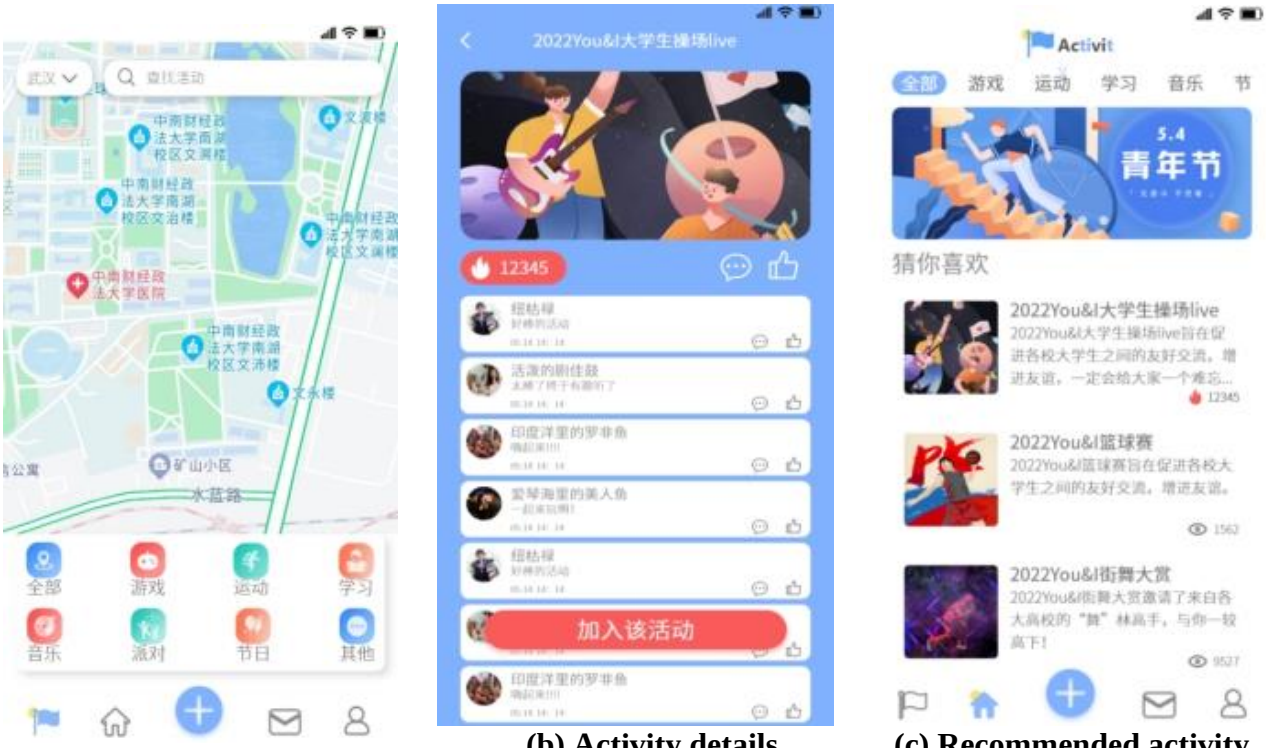
The system is developed based on Android platform, the main languages used are C# and Java, the specific development environment is shown in Table 3.

Table. 3 System Development Environment

Operating System	Windows 11
Development Tool	Visual Studio 2022+Microsoft SQL Server Managerment Studio 18+Android Studio
Running Environment	Android 3.0 and above
Database Server	Tencent Cloud Lightweight Application Server 4 Core 8G 10M
Debugging Device	AVD+MCE16
Map API	AMAP Android SDK V6.0.0

3.2. Client side implementation

The system uses Adobe illustrator tool to design the prototype of the system interface, and implements the functions of map social, activity recommendation, and view activity according to the drawn prototype, and the interface of the prototype implementation part is shown in Figure 3. After users open the system and complete the login operation, they will automatically jump to the map social interface, where they can view the activities launched nearby, as shown in Figure 3(a). Users can click on the activity they are interested in to jump to the activity details interface, where they can view the specific content, time, location, initiator and other information of the activity and leave comments on the page, as shown in Figure 3(b). Users can also apply to join the activity and chat with the activity initiator after the activity is approved. . When users need to filter the nearby activities or view recommended activities, they can sort nearby activities by clicking the Recommended button in the bottom navigation bar, as shown in Figure 3(c). Users can also click other buttons in the bottom navigation bar to jump to the corresponding function.



(a) Map social interface **(b) Activity details interface** **(c) Recommended activity interface**

Figure. 3 Main Interface

3.3. System Operation Analysis

In October 2022, "You&I" App was officially tested in a small scale within the Central South University for Nationalities (CSUN), and the download link for Android was opened, and the number of downloads reached 1,687. After a period of promotion and use, as of January 12, 2023, the total number of registered users reached 1,159, 1,352 activities were published, with an average of 12 activities published per day, 26 activities participated by users on average, and the peak number of online users reached 586, which shows that the platform has good usability, concurrency and reliability, and has also lowered the threshold of anonymous This shows that the platform has good usability, concurrency and reliability, and also reduces the threshold of anonymous socialization among young people to a certain extent, and brings young people closer to each other.

4. Conclusions

In this paper, we design and implement a map-based vertical social platform "You&I" based on Android platform and LBS technology to meet the needs of contemporary young people for anonymous vertical social networking. The software is developed with C/S three-layer structure, using tools such as Gaode Map API, ASP.NET Core framework, Retrofit framework, FastJson library, etc. The functional modules and database of the system are designed and implemented, and recommendation algorithms are added to recommend activities of interest according to the needs of different users. Users can use the Android client to socialize on the map, initiate and participate in activities, and chat in activity groups, which can quickly transform online socializing into offline socializing and close the social distance of young people in the same city. After a period of trial run, the system also meets expectations and no hidden system security and operation problems were found.

The system also has some limitations, and there is still room for further improvement in the implementation method, such as how to protect users' information from illegal theft, how to ensure the security and authenticity of users' offline friendships, and so on. The combination of map and

vertical social can make the social way of contemporary young people more colorful and meet the needs of more young people socially, which is a field that deserves more investment.

Acknowledgments

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