Research on the Development of Convoy Mobile App

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Abstract: With the progress of society and technology and the acceleration of people's life rhythm, nowadays, location-based services play an indispensable role in people's lives. For mobile users using mobile devices such as smartphones, location-based services are an integral part of life. Location-based services usually obtain the location information (geographic coordinates, or geographic coordinates) of mobile terminal users through the wireless communication network (such as GSM network, CDMA network) or external positioning (such as GPS) of mobile telecommunication operators. The accelerated pace of life also means more and more trips and transportation. In many cases, people would like to meet friends or family at a particular place. At the same time, they hope to observe each other's location and route during the journey and even hope to be able to chat by text or voice when they go to their destination together. The purpose of this project is to develop a map application program, which allows users to share real-time location, communication, and chats with friends or family members. Besides, if the user establishes a meeting place with friends, the application can make routes for the "travel together" people respectively, and the user can see the routes of friends on the map. This project collects useful insights and design ideas, and refers to and studies related applications to help the development of products in this project. In the future, more in-depth research can also be carried out to improve based on this project.

1. Introduction

With the development of the mobile communication industry, the number of users of smartphones has been dramatically boosted. How to further enhance the application value of mobile phones and develop new functions has become the hot spot of the mobile phone development industry. In the application of mobile phone functions, GPS technology has many applications and broad market prospects. Currently, mobile GPS plays a huge role in personal navigation and positioning. According to Berg Insight's report, mobile location services (LBS) will grow at a rate of 34% per year in the European market, reflecting the importance of LBS applications to mobile users[1]. GPS is not only the essential service provider for LSB but also the most effective positioning technology for navigation systems.

In the current market, Android, as the core of the Linux-based open-source mobile terminal application software platform[2], accounted for 85% of the global mobile phone market in 2016 . GPS applications based on the Android platform are also emerging, such as Google Maps, Android

Maps, Gaode Maps, and Baidu Maps. These mobile applications are personal positioning and can specify the route to the destination and transportation, including bus, driving, and walking. Also, these map software can provide information about destinations for users (e.g., Hotel), such as telephone, business hours, and other information, even including visitors' comments and pictures. Through the above information, users can get a preliminary understanding of the destination through the map software[3].

The above map software, their Application Programming Interface (API) are open source, Android developers can embed the map into the application through these open source APIs, and can also use JavaScript scripts for application development extension. In these development processes, developers can provide location services to users with map data without having to set up their map server. Based on these APIs, many developers have added many features based on the original navigation, such as real-time location sharing with friends. This function can not only achieve mutual positioning of friends but also can be used to locate the elderly and young children reducing the risk of loss and missing of vulnerable groups[4].

2. Literature Review

2.1 What is LBS?

Location-based service is a kind of service that can obtain the location information of mobile terminal users through the radio communication network of mobile telecom operators or external positioning, and provide corresponding services for users under the support of geographic information system platform. Although the concept of location-based services has not been proposed for a long time, it has a long history of development.

LBS first developed in the United States, originated from the global positioning system (GPS) deployed for military applications, and then began to be applied in the fields of mapping and vehicle tracking and positioning. After the popularization of GPS, a large number of applications with positioning as the core function came into being. It was not until the late 1990s that LBS and its related technologies received extensive attention and application.

2.2 Application of LBS in Games

After the continuous upgrading of smartphones, in some cases, smartphones have replaced personal computers. Smartphones have sensors, such as GPS, that collect and provide information about their surroundings, and hardware, such as cameras, that allow developers to develop immersive experiences. Location-based games such as Pokemon go are one way to provide such an experience. The most significant difference between these games and traditional computer games is that players need to move around in the real world to move to specific positions specified in the game, instead of completing the game through input devices such as keyboard and mouse[5].

Location-based games, such as Pokemon go, allow people with similar interests to meet in real life, and players can cooperate to complete the game. Players can see where they are in the real world and learn about the weather. In Pokemon Go, there is a game method called Raids, where players need to go to Gyms of a particular geographical location to beat and capture the different and powerful Pokemon it produces. Players can defeat the boss in Gyms alone or collaborate with other players. The in-game collaboration model also provides a platform for social interaction, facilitating online and real-life interactions with friends, family members, and even strangers. In addition to Raids patterns, PokemonGo game mode includes travel to different locations to find and catch pokemon, successfully promoted players to share information in real life and online. Pokemon GO is unique in the way it integrates display and virtual, allowing players to travel to public places

they would not usually go to, modify daily work and routes[6], and even talk to strangers such as other players to increase social skills.Besides PokemonGo, there are other location-based games, such as "BotFighters," "Songs of the North," " bean Yoshi," "Insectopia," the "Ingress." In the "Ingress", the players were divided into two camps; each faction of the players need to work together, to capture and expand the portal in the real world. Ingress players can communicate within the game and be able to track other players' locations and work together on missions. Although such games can improve social skills and increase physical activity, there are cultural differences, and online chatting in games can lead to discrimination, harassment, and bullying, especially among female gamers and other ethnic minorities. Also, players face security issues in the display world, such as being stalked and harassed.

2.3 Comparison between Products

2.3.1 Google Map and Baidu Map

With the development of society, the demand for information from the public has increased, and the importance of geographic information services has become increasingly prominent. The rise of the Internet and the rapid development of its technology have provided a new form of geographic information services -Internet (electronic) maps. The information and search services provided by such maps bring convenience to people's work and life and create a broader market. In this section, two major map software will be compared -- Baidu map and Google Map

Although Baidu map has many advantages in use compared to Google Maps, its disadvantages cannot be ignored. Compared with Baidu map, Google Maps has two modes, map and satellite image, which can better understand the landscape information. Its ranging function is calculated based on the route trajectory, not the straight line distance. The trajectory map is more intuitive, which has more practical reference significance, and the global map of Google Maps is more comprehensive than Baidu Map. In addition, Google Maps is very rich in extensions, including Google Earth and 3D Street View.

2.3.2 "Find My Friends" and "Zenly"

The "Find My Friends" app is automatically installed on the iPhone, iPad, or iPod touch products with iOS 9 or higher version. With this app, user can share their real-time location with family or friends. When in use, the user can send an application to their friends or family members, the other party has the right to refuse. If the request is agreed, the two parties can share the location. Users who use the "Find My Friends" app can turn off the "Share my location" function directly in the app interface if you wish to stop sharing your location. Alternatively, log in to the Apple user's own iCloud.com account and open "Find My Friends", select "Me" and uncheck "Share my location." Users of Apple products can use the "Find My Friends" app on any iPhone, iPad, iPod touch or Apple Watch they have, but only one iOS device and any paired Apple Watch cellular network models can send the user's location to its followers. If the user has logged in to "Find My Friend" on multiple devices, they can use the settings to select any device for location sharing. Only when a friend requests to view the user's location, the user's location information will be sent through the device, and the system will not periodically transmit the user's location information.

3. Research Methodology

3.1 Study Design & Plan

In the initial interview, the researcher will introduce the background and goal of the project to

participants before the beginning. Participants were then asked to rate the mapping software they had used and ask what features they wanted to add to the most frequently used mapping software. Researcher develops the first step, the initial prototype, based on feedback from participants in the first interview. In the second interview, participants will use the prototype built based on the feedback from the first interview and complete some tasks. After the user completes the task, they will be asked to evaluate thet ext, graphics, and maneuverability of the prototype. The researcher will improve the opinions of the participants collected in this interview and start to develop the software to be built in the project. In the final third interview, the researcher will let participants use the developed products. Again, participants will conduct an evaluation, but the evaluation will focus more on practicality and functionality. Once again, the researcher makes final changes to the software based on feedback from the participants.

3.2 Participants

According to data from the Pew Research Center, in the United States, Americans with mobile phones are up to 96%, and Americans with smartphones account for 81% (as figure 1 shown). Nowadays, smartphones have become the principal means for Americans to surf the Internet at home. About one-fifth of American adults are "smartphone-only" Internet users. After categorizing all users with smartphones, it is known that smartphone users aged 18 to 29 and 30 to 39 are up to 96% and 92% respectively (as figure 2 shown). According to the survey of China's smartphone map application, among users who use China's local map software - Baidu map, users between 15 and 35 account for 56.79%. This phenomenon shows that young people have become mainstream people using map software.
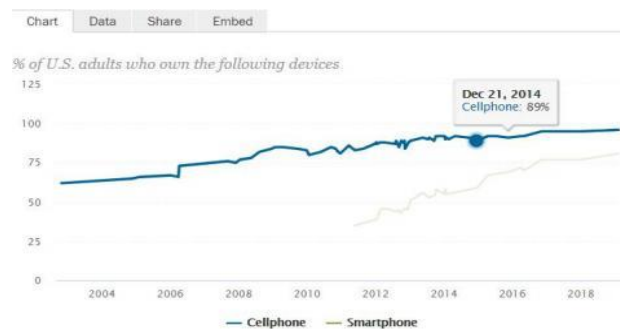

Figure 1: Adults who own a cellphone or smartphone

% of U.S. adults who own the following devices

	Any cellphone	Smartphone	Cellphone, but not smartphone
Total	96%	81%	15%
Men	98%	84%	14%
Women	95%	79%	16%
Ages 18-29	99%	96%	4%
30-49	99%	92%	6%
50-64	95%	79%	17%
65+	91%	53%	39%

Figure 2: Distribution of mobile phone users

Therefore, in the selection of the participants, the researcher referred to the above data, and selected the 20-30-year-old smartphone map software user group in the school and the society, because people in this age group have similar cognitive and technical skills. The selected participants are in the 20-30 age range, and smartphones have become the primary means of their

daily online access. Besides, map software is installed on their mobile phones, and they are used to searching using the map software installed on their mobile phones when they travel. Another reason for selecting and interviewing young people is that they will be exposed to different mapping software in their daily life. After comparison, they will decide which one they prefer. Precisely because they will compare different software, they will have a clearer understanding of the characteristics of different map software and can provide more feedback in the interview, so that the interview can go on smoothly.

4. Results and Findings from Interview

4.1 Feedback from Interview

After the interview of the participants on the mobile map application, the participants gave answers based on their daily use of mobile map software and other similar software (for details, please refer to the appendix). Through the interview, it can be found that the map software used by all participants in daily life is Google map. Although participants had other similar mapping apps on their phones, Google was the most frequently used mapping app in the UK, which reflected Google's unassailable position in the mobile map application market. In the interview with participant K2, he explained that the reason why he downloaded Google map was that Google map ranked the highest in the iOS APP Store, which once again confirmed the propagation degree of Google map and its considerable number of users. Compared with paper maps, all participants agreed that the advantages of electronic maps lie in the ability to locate in real-time, search for a particular destination to understand it, and even can drive to the destination with the help of electronic maps. Navigation functions significantly reduce the error rate of drivers when driving.

4.2 Determine Functions of Software

Through the above analysis of interview feedback, the developer re-plan the functions of the software to be developed. In the first interview, all users questioned the real-time sharing function of location, and they all felt that this function violated the privacy of users to some extent. They consider that if a close friend or family member can observe their location in real-time, they will not be able to do specific personal things. So in future projects, developers will abandon the real-time sharing of friends' locations. The privacy of users will be highly valued in the development of this project because privacy is considered as a personality right, which is defined as "the most extensive right and the most cherished right of civilized people". Privacy, which can be defined as the "right to privacy" from outside interference, is attracting more and more attention. Based on predecessors, modern scholars have gradually expanded the connotation of privacy, including information privacy, space privacy, and self-determination privacy. Privacy, it is generally agreed, involves at least two interests: the security of one's life from unlawful interference and the protection of personal information from disclosure. Privacy, as a kind of personal right, indicates that individuals can independently decide personal affairs in a self-centered circle, and others cannot get beyond it.

4.3 Prototyping Interview

As for the feedback from the first interview about software functions, after careful analysis, the developer will start the preliminary design of the prototype, mainly for the user interface, because the prototype does not have any function and can only realize page hopping. In designing, developers will focus on the usability of software in advance, that is, the degree to which users use software functions in the actual operation. A highly available system will satisfy the following

conditions:

In the actual prototype design, the developers set the background color of the user Login interface and user registration interface to light blue, and displayed the "Login" and "Sign in" buttons in dark brown to achieve the promary keys in the highlighted interface. The first interface was set to light blue because most people regard blue as their favorite color (as shown in figure 3), so blue is considered the safest color in the world. In many cases, convincing people to use our products is critical. Blue is used by technology companies such as Dell, IBM, and Alipay to convey a sense of trust. Blue can be seen in patients with color weakness (such as the common red-green color blindness) and is significantly superior to other colors such as green and red (as shown in figure 4). When entering the main interface of user operation, the display background of the whole user interface will be the map interface, and there will be buttons with precise meanings on the map interface, so that users who use this software for the first time can directly understand the functions represented by each button.
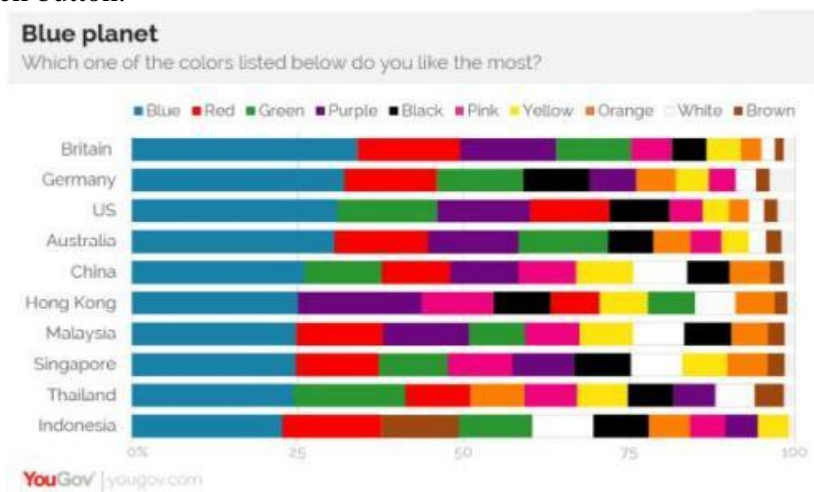

Figure 3: Favorite color of people of different countries

Figure 4: Comparison of normal vision and red-green weak vision

In other features of the application, such as chatting with friends and viewing a list of friends, the color of the title bar is set to gray, and the font color is set to black. After a user searches for a destination, the user interface displays the location of the destination and gives three options: Route, Start, Convoy. If the user clicks on "Route," the prototype shows the user options for "drive", "walk," and "bus." When a user clicks "Convoy," the page jumps to friend list, allowing the user to choose whom they will travel with. After that, the itinerary of users and their friends, as well as their location and estimated time to reach their destination, will be marked on the map interface. During the journey, users can click on their friends' avatars to view the navigation page from their friends' perspective. In the co-trip page, user can achieve the same function as clicking the "Start" button - enter the navigation page.

After designing the prototype, the developers invited participants to re-evaluate the prototype and asked them to give feedback on how they felt about using it. For the overall user interface, K2 thinks that the overall user interface is straightforward and gives users a refreshing feeling. The login button of the user login interface is very eye-catching, but the background color of the interface reduces the visibility of text at the bottom and hides the registration button to some extent. The selection of ICONS for other functions of the interface is very reasonable, which can make users who use this prototype know the corresponding functions of each icon. The text inside the icon is concise and clear, which does not cause any difficulty for the user to understand. The user can easily understand the corresponding function from the text contained in the key. Other participants also gave similar feedback.

5. Develop the software

The product development of this project is based on the existing Google map API. By using the Google map API, developers can use the map data in the Google map server without having to build their own map server. In addition to the Google maps API, the developers used another API for this project -- FireBase. FireBase is a platform for building mobile applications, providing real-time data storage and synchronization, user authentication and other functions. With the framework loaded by Firebase, developers of mobile and web applications can easily build apps without having to build servers and infrastructure. The above two development platforms belong to Google, therefore, the developer applied for a Google account before the formal development of the project, and created corresponding applications on both platforms and obtained corresponding API keys.

5.1 Functions Design

Before the software was officially developed, the developers created initial requirements for the software to be developed for the project and will combine these requirements for the product development phase. Demand will be divided into the following categories:
1) Functional requirements -- the functions the product should have.
2) User requirements -- relevant characteristics of target users.
3) Usability requirements - usability related requirements.
4) Data requirements - dimensions and other related data.
Next, the designer describes each requirement and classifies the requirements into the following categories:
1) "must" requirements: play a critical role in designing the system
2) "should" requirements: included in system design
3) "can" requirements: may be added as the design progresses
4) "expected" requirements: the designer will carefully consider whether to add them into the system design in future development.
After classifying the requirements, the developer created a list of requirements and put them in the appendix.In this section, developers will only describe the development of Functional requirements listed in the requirements list: adding friends, positioning, making routes, navigation, Convoy.

5.2. Real Machine Test

After completing the preliminary development of the software, the developers will test the main functions mentioned above, and record the errors caused by the corresponding operation of the software and the problems not found in the development.

When testing the login function, developers found that users can register as long as the inputted mailbox address conforms to the format, and the system will not distinguish whether the mailbox address is valid or reasonable. Users can not upload their avatars when they register. Every registered user can only use a unified default avatar. If two users fill in the same account name when they register, it will be difficult for users to distinguish in the list of friends. When a user registers for a new account, the system does not require the user to enter a second password for password confirmation. Based on this problem, the developer added the key of "display password" in the password input field of the registration page. Users can click on this button when entering password in the registration stage. The system will display the password entered by users in plain text instead of cipher text. The developers did not detect any problems with the other login method, Google. In the testing phase of adding friend function, the results of the system are consistent with expectations. Users will not send friend applications when adding friends and the system will automatically set both sides as friends without the passive user authorization.

6. Conclusion

In conclusion, this project focuses on meeting the needs of users to travel together, and develops high availability products based on Google Maps API and FireBase API. In the literature review section, the developer discusses what is address-based service, introduces the application of address-based service in the field of science and technology, and compares the functionality and usability of some software with map function on the market. Subsequently, through interviews with participants, the developer understands the actual needs of users, adjusts the expected project objectives, and determines the functional development to be completed in the actual project development.

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