

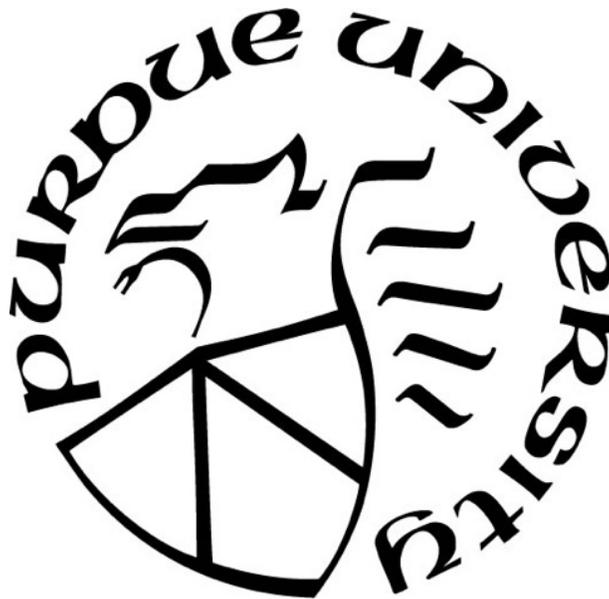
**A GROUP TRAVEL PLATFORM TO COOPERATIVELY MANAGE
TEAMWORK AND FACILITATE COMMUNICATION**

by
Xingyu Peng

A Thesis

*Submitted to the Faculty of Purdue University
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THE PURDUE UNIVERSITY GRADUATE SCHOOL
STATEMENT OF COMMITTEE APPROVAL

Dr. Cheryl Zhenyu Qian, Chair

Department of Visual and Performing Arts

Tong Jin Kim

Department of Visual and Performing Arts

Li Zhang

Department of Visual and Performing Arts

Approved by:

Dr. Harry Bulow

Head of the Graduate Program

TABLE OF CONTENTS

LIST OF TABLES.....	5
LIST OF FIGURES	6
ABSTRACT.....	9
CHAPTER 1. Introduction.....	11
CHAPTER 2. Literature Review	13
2.1 History of Travel.....	13
2.2 Impact of Travel.....	14
2.2.1 Impact for Society.....	14
2.2.2 Impact for Human Beings.....	17
2.3 Types of Travel.....	19
2.4 Problems of Travel.....	20
CHAPTER 3. Methodology.....	22
3.1 Methods of Research	22
3.2 Methods of Design.....	23
3.3 Methods of Evaluation.....	23
CHAPTER 4. Research.....	24
4.1 Market Research	24
4.1.1 Peer Product Analysis	24
4.1.2. Product Positioning Map.....	28
4.1.3. Main Competitors	30
4.2 User Study.....	34
4.2.1 Online Survey	34
4.2.2 User Interview.....	35
4.2.3 Field Research with Observational Study Method	36
4.2.4 User Persona and User Journey Map.....	38
4.2.5 Results.....	38
CHAPTER 5. DESIGN PROCESS	40

5.1 Brainstorming	40
5.1.1 Mobile App	40
5.1.2 Physical Device.....	42
5.2 Information Architecture	44
5.3 Wireframe	48
5.4 Visual Design.....	51
5.4.1 Design Guideline	51
5.4.2 Interface Design.....	56
5.5 Physical Device.....	69
CHAPTER 6. DESIGN EVALUATION.....	78
6.1 Paper Prototyping	78
6.2 Usability Testing.....	80
CHAPTER 7. CONCLUSION	89
REFERENCES	91
APPENDIX A. QUESTIONS OF ONLINE SURVEY.....	94
APPENDIX B. MATERIAL OF USABILITY TESTING.....	101
USABILITY TESTING TASKS SHEET.....	101
USABILITY TESTING QUESTION SHEET	104
USABILITY TESTING LIKERT SCALE.....	106

LIST OF TABLES

Table 1. Results of Field Research	37
Table 2. Results of User Study	39
Table 3. Ideas and Solutions	41
Table 4. Personal Info of Participants.....	82

LIST OF FIGURES

Figure 1. Number of International Tourist Arrivals Worldwide From (1996-2017).....	14
Figure 2. Total Contribution of Travel & Tourism to GDP.....	15
Figure 3. World: Total Contribution of Travel & Tourism to Employment.....	16
Figure 4. Categories of Travel Apps.....	24
Figure 5. Trip Advisor, Lonely Planet, Yelp	25
Figure 6. Tripit, Mafengwo, Qyer.....	26
Figure 7. Couchsurfing, Travel Pal, Booking.....	26
Figure 8. Trivago, Airbnb, Splitwise	27
Figure 9. Tricount, Packr, Packing List	27
Figure 10. Product Positioning Map.....	29
Figure 11. Features of the Main Competitors	30
Figure 12. Trip Advisor (mobile App).....	31
Figure 13. Trip Advisor (webpage)	31
Figure 14. Qyer	32
Figure 15. QyerPlan (mobile App)	33
Figure 16. QyerPlan Planning Platform (webpage).....	33
Figure 17. Survey Questions in Two Languages (Appendix A).....	35
Figure 18. Outcome of User Interview	36
Figure 19. User Persona.....	38
Figure 20. User Journey Map.....	39
Figure 21. Brainstorming.....	40
Figure 22. Functionality of the Physical Device.....	43
Figure 23. Information Architecture	45
Figure 24. Hierarchical Task Analysis of Making a Plan.....	47
Figure 25. Wireframe (Version 1)	48
Figure 26. Paper Prototyping	49
Figure 27. Wireframe (Version 2)	50
Figure 28. References of Color Palette.....	51

Figure 29. The Color Palette.....	52
Figure 30. Typography.....	53
Figure 31. Page Layout.....	54
Figure 32. Logo Design	55
Figure 33. The Main Menu.....	57
Figure 34. The Onboarding Process.....	58
Figure 35. The Planning Platform.....	59
Figure 36. The Process of Adding Places	60
Figure 37. The Checklists	61
Figure 38. The Tasks.....	62
Figure 39. The Accounting	63
Figure 40. The Smart Filter.....	64
Figure 41. The Budget Control Mode.....	65
Figure 42. Split Bills.....	66
Figure 43. The Group Chat	67
Figure 44. The Process of Separating Group	68
Figure 45. The Moodboard for Brainstorming	69
Figure 46. 3D Printed Mockups.....	70
Figure 47. Mockup Testing.....	70
Figure 48. Appearance Design.....	71
Figure 49. The Presentation of the Appearance Model	72
Figure 50. Instruction Manual (front page).....	73
Figure 51. Instruction Manual (back page).....	73
Figure 52. The Process of Connecting Physical Devices	74
Figure 53. The Emergency Call	75
Figure 54. The Aggregating Signal.....	76
Figure 55. The Notification of Group Chat	77
Figure 56. Result of the Time to Do the Task.....	83
Figure 57. Result of the Number of Times Need Assistance and Tips.....	84
Figure 58. Result of the Percentage of Task Completed	85
Figure 59. Result of the Likert Scale	86

Figure 60. Result of the Observed Problems	87
Figure 61. Recommendations	88

ABSTRACT

Author: Xingyu, Peng. MFA

Institution: Purdue University

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Title: A Group Travel Platform to Cooperatively Manage Teamwork and Facilitate Communication

Committee Chair: Cheryl Zhenyu Qian

This research aims to explore a new mobile application platform for group travel planning to improve the experience of communication and cooperation in teamwork. The inspiration was from my own travel experience. Being the leader or one of the people who managed the travel group during the past years, I realized that group travels have been full of fun. However, I also faced a variety of challenges at the stages of planning, preparing, managing, and accounting before travel, during travel, and after travel.

According to the literature review, some general problems of group travel were found out. Dealing with the problems in planning, scheduling, packing, communicating, and cooperating with travel partners, and financial issues are defined as the most general travel stressors for travelers. Therefore, travel relieves our living stress, meanwhile, brings new stressors from the other hand.

The research started off understanding the current market condition and main competitors through doing market research. Peer product analysis and product positioning map were done during the market research. Then the user study was conducted through an online survey, user interviews, and field research using observational study method. The design direction and target users of the research were defined afterward. The design process began with the brainstorming session, followed by going through App flow structuring, interface wireframing, and visual designing to come out with the mobile application – CooP, a group travel platform to cooperatively manage teamwork and facilitate communication.

Thus, a map-list alternating planning platform was developed for more efficient planning in CooP. Users can switch between the map view and the list view to plan the route. Besides, the group checklists, tasks distribution, and group account features were designed to facilitate teamwork in planning. Additionally, A group chat platform was hidden in every page corners to

improve group communication. The CooP can also split the group flexibly when different people want to visit different places separately. By connecting with physical devices, CooP can track the people for protection and safety.

The usability testing of the post-travel evaluation gathered some future improvements that can be achieved later. From the perspective of technology, AI technology can be better utilized in providing suggestions and recommendations voluntarily based on the user's data to enhance the efficiency and smoothness of the working experience. From the map perspective, providing a real route line between locations would be more preferred than the straight-line segments. The coop can recommend mid-way attractions for users to select. Overall, CooP achieved the goal of improving communication and cooperation in group travel planning. It innovated the traditional way of doing a group travel plan by combining different functions into CooP to create a multitasking platform which speeds up the process of planning.

Keywords: group travel, travel planning, schedule, tour, route, communication, cooperation, teamwork.

CHAPTER 1. INTRODUCTION

Started from the late 17th century, tourism developed rapidly on account of the revolution of transportation and the increase of economy. In 2018, 4 out of 5 recorded trips in the U.S. were counted for leisure purposes. In 2017, Americans spent \$718.4 billion on vacation, twice more than the business travel (\$317.2 billion).

The reasons why people travel are: to broaden their perspective, to build up relationships, to reflect their current life, to relieve stress and replenish vitality, and to practice rolling with the punches. We are living in a competitive and fast-paced world which imprisons us tightly in our fixed lifestyles. The American Institute of Stress reports that 77% of people in the U.S. are suffering physically and 73% mentally because of the prolonged stress in living (American Psychological Association, 2015). People have a desire to escape from their regular lifestyles and experience a new life.

Travel is beneficial for society macroscopically and the individuals microscopically. It is a consensus that the increase of economy pushes forward the tourism; while, tourism boosts the development of economy mutually. For human beings, travel benefits our physical body and spiritual fitness. Most people feel different, physically, and mentally after taking a trip. Travel can reduce the risk of heart disease (Gump & Matthews, 2000) and the seriousness of depression (Hartig, Catalano, Ong, & Syme, 2013).

However, without hesitating that travel brings people happiness and healthiness, there are still travel stress existed. According to surveys, people have to cope with problems in planning, scheduling, packing, communicating and cooperating with travel partners, and financial issues.

With these issues, 1/3 of people had experienced canceling or postponing their travel plans (Newsdesk, 2017).

The purpose of this research is to explore and improve the experience of group travel, especially at the planning stage. Three goals were set for the research:

- to explore a new mode of making a group travel plan
- to facilitate communication experience in making a group travel plan
- to improve cooperation experience in making a group travel plan

In the following chapters, the entire process of the thesis will be elaborated from the literature review to the post-design evaluation. Chapter 2 is the literature review section which describes the history, impact, types, and problems of travel detailedly. Chapter 3 contains all methods I utilized in the whole research and design process. Beginning from Chapter 4, it starts to go through the market research, user study, brainstorming, information architecture, wireframe, visual design, physical product design, and design evaluation. Last but not least, the conclusion chapter discusses a further plan to refine and improve the current system and product.

CHAPTER 2. LITERATURE REVIEW

2.1 History of Travel

When there was no travel existed, the reason human being moved from one place to another is survival. As seasons changed and resource exhausted, our ancestors have to migrate to another place for a more hospitable living environment. From 4850 B.C. to A.D. 300, human beings mostly traveled for the campaign. They expanded their territory by conquering neighboring tribes or countries. Around A.D. 300 (Empire Ear) when civilization rises, human beings started to focus more on commercial and religious activities via traveling (Gyr, n.d.; Mill, 1990). Along with the personal income increased, modern tourism derives from the United Kingdom, and was known as an educational journey (Grand Tour) of upper-class European elites from 17th to 18th (Towner, 1985; Towner & Wall, 1991; Zuelow, 2015).

The term *tourism*, which is formed from the word *tour*, officially came out in the world in 1881, is defined as travel for joy (“Tourism,” 2019). During the 18th-19th centuries, industrialization brings about the appearance of new transportation (*The Traveling Public and Tourism Promoters*, n.d.). The first craft was successfully invented in 1903 by the Wright brothers. After which, travel for leisure activities emerges in the new middle class (Singh, 2008). On July 5th 1841, Thomas Cook, a British businessman, sniffed a potential opportunity of tourism and established the first tour company, Thomas Cook & Son travel agency, in the world. In 1863, he created the first group tour by train, which was also called “Package Tour” because of providing meals and race tickets (Brendon, 1991).

2.2 Impact of Travel

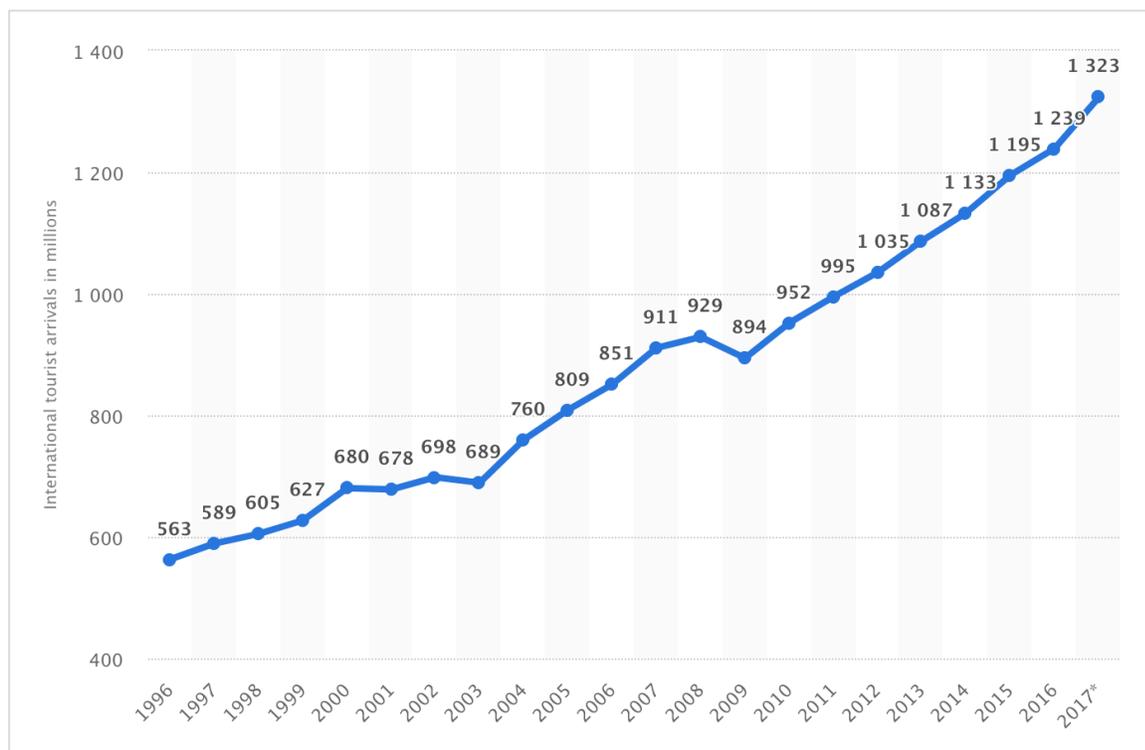


Figure 1. Number of International Tourist Arrivals Worldwide From (1996-2017)

The statistics above show the increase in the global tourist arrivals all over the world from 1996 to 2017 (Figure 1). Except for some periods that were impacted by the global economic crisis, the number of global tourist arrivals rises at a steady pace by years in general. The worldwide have a firm agreement with that a country's tourism industry stimulates its overall economic growth (Lee & Chang, 2008).

2.2.1 Impact for Society

According to the report of Travel's Impact on the U.S. Economy (2018), the travel industry has generated \$2.5 trillion economic outcomes and supported 15.7 million job positions across all industries of the U.S. Within this \$2.5 trillion output, only about half of which came

from the travel industry directly. The other half was generated from related manufacturing, finance and insurance, wholesale trade, professional services, health and social services, information, and others (Travel Impact and the U.S. Economy, 2018). The travel industry has been one of the keys to sustaining the economic growth of the U.S.

Economic Impact

Economic impacts of travel are always observed as positive and beneficial. David PT Harcombe summarized several primary benefits: increase the job opportunities and employment, simulate trade and economy, and promote the development of the isolated region (Harcombe, 1999; Mathieson & Wall, 1982).

According to “Travel & Tourism Economic Impact 2018 World”, the total contribution of travel and tourism to GDP (Figure 2) increases year by year from 2009 to 2018. It is about USD6,000bn in 2009 but increases to USD8,000bn in 2018. Moreover, by forecasting, the GDP will probably rise to nearly USD12,000bn in 2028.

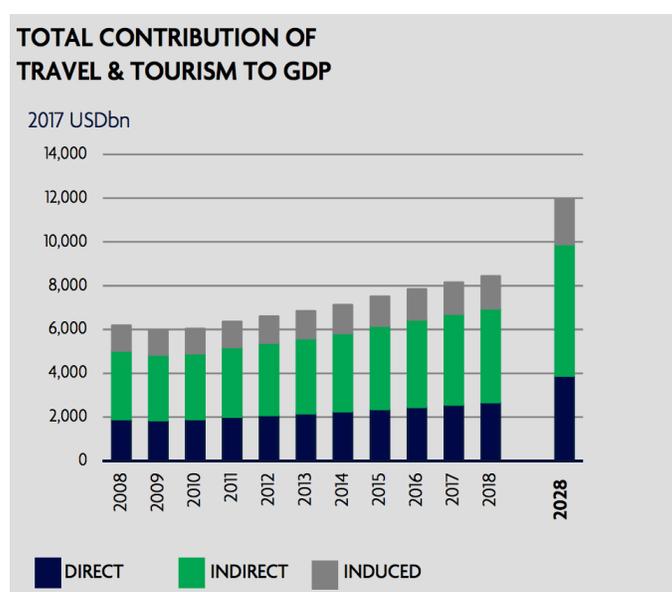


Figure 2. Total Contribution of Travel & Tourism to GDP

Travel and tourism also have made a significant contribution to employment. As the chart shows below, the number of jobs offered in the travel and tourism industry rises from 2017 to 2018, and it was predicted to even higher than 400,000,000 jobs by 2028 (Figure 3).

WORLD: TOTAL CONTRIBUTION OF TRAVEL & TOURISM TO EMPLOYMENT

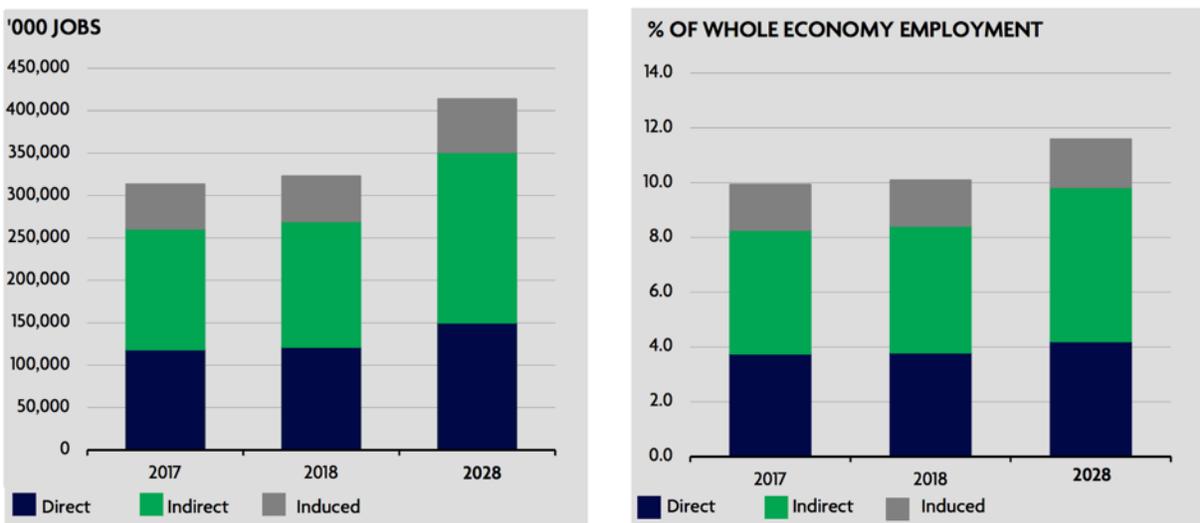


Figure 3. World: Total Contribution of Travel & Tourism to Employment

Sociocultural Impact

No matter wittingly or unwittingly, tourists always leave something in the community they visit, which make both social and cultural impacts for that place and its residents, even though for some isolated regions like mountain areas (Kariel & Kariel, 1982). Tourism can promote cross-cultural spread and fusion. Visitors experience and learn local culture from the place and bring it out to spread around the world. In the meantime, inhabitants accept foreign cultures from visitors come from different regions or countries. These cultures permeate and integrate with the local culture, make a excessive contribution to the local cultural diversity in religion, education, and other intangible cultural heritage.

2.2.2 Impact for Human Beings

From a microscopic view, travel benefits individuals as well. The whole environment of the society becomes more and more competitive and stressful. Most of the time, people live under considerable pressure of life. Travel, or say vacation, which can drag people out of their usual boring and repeating lives, and bring them a different and pleasant experience, is indispensable in the modern society (Richards, 1999). Observed by Hobson and Dietrich, leisure travel has been considered as a method to pursue both physical and psychological health by the public. People have accepted the fact that travel has become a new lifestyle to release stress coming from real lives (Hobson & Dietrich, 1995). Having a refreshment to escape from the daily trifles and take a dreamy journey makes a significant contribution to increasing people's well-being (Fritz & Sonnentag, 2006).

Physical Benefits

Travel benefits people's physical health. It seems that people all have the same feeling that their bodies are getting healthier after taking travel or vacation. This word has been verified by Gump and Matthews's research, which examined 12,388 middle-aged men with high-risked heart disease to find out the relationship between the frequency of traveling annually and the incidence rate of the disease. The result comes out that higher frequency of traveling does lower the risk of heart disease (Gump & Matthews, 2000).

Sands, J.D. also confirmed the physical benefits of travel in his study in 1981 (Sands, 1982). He recruited 112 senior (65-92 years old) female volunteers from the metropolitan area of Atlanta for this study. By asking and rating the stressfulness of some events they had

experienced on, he concluded that travel and vacation are beneficial to the intellectual functioning of women over 65 (Dolnicar, Yanamandram, & Cliff, 2012).

Physical health benefits are in doing physical activity like sports. During traveling, people have to exercise their bodies without circumstances. For instance, hiking is a comprehensive activity, which needs hikers to move every part of their bodies. By hiking, people can strengthen their lungs, build cardiovascular fitness, and maintain a healthier heart rate.

Psychological Benefits

Travel benefits people's mental health too. There was a research conducted in Netherland trying to find the importance of holiday trips for people who have mental problems. In the research, 11 people with mental illness were observed on two trips and interviewed deeply with their four psychiatric nurses. Ph.D. Pols and Kroon found from the research that patients were helped to participate into the community, relate to society, develop their skills, identify new perceptions, and maintain a balance of daily life by the trips (Pols & Kroon, 2007).

Researchers took thirty-nine tape-recorded interviews with people dwelled in Texas and Boston areas. Age of the participants was mostly 30-45 lived in the middle-class lifestyle. They found in the study that nine main motives direct people to a travel, seven among which were categorized in socio-psychological aspects which are to temporarily run away from a mediocre life, explore and assess themselves, relax and relieve, perceive more prestigious, enjoy a new and unusual lifestyle, enhance kinship relationships, and facilitate socio-interaction (Crompton, 1979).

Overall, living in this competitive and highly-stressful society, travel has always been an effective choice to release the stress and replenish the vitality. Through traveling, the stress

hormone of our body, which called cortisol can be reduced, and which helps us maintain good mental health.

2.3 Types of Travel

As Nesbit mentioned in his research “The Art of Forecasting Domestic Air Travel: A Survey Assessment and Overview,” there are four types of travel: solo business travel, group business travel, friends or families visiting travel, and holiday vacation travel (Nesbit, 1973). Solo travel and group travel are fundamental travel styles. Solo travel has many advantages. Travelers can make all decisions and do whatever you prefer without compromising with your partners; you have more chance to make new friends during the trip by communicating with strangers; you can totally meditate, reflect, and relax by your own. However, for group travel, it is safer than solo travel. Group travel is much cheaper too because you can share a large amount of accommodation and transportation fee. Group ticket of some attractions is lower than individual charge as well. Besides, teamwork is inevitable in group travel. People have to work with each other to accomplish the trip, which can improve their communication skills and cooperation skills.

A study of the American Sociological Association (Hartig et al., 2013) demonstrated that group vacation, a shared activity, can reduce people’s stress and depression via communicating and cooperating in a pleasant circumstance. They aggregated data of monthly dispensation of antidepressants in Sweden for 147 months and compared it with fluctuation in the number of vacationing workers. It came out that when the number of vacationing workers increased, the monthly dispensation of antidepressants descended logarithmically (Hartig et al., 2013).

Group travel compels people to spend time with each other, which increases the opportunity of psychological linkup. The anxiety and distress accumulated in real lives lessen during travel.

2.4 Problems of Travel

Even though travel brings people happiness and satisfaction, it is a consensus that taking a trip stands for coping with troubles and stressors.

A statistic study conducted by Travel Agent Central in 2018 shows that 51% of participants admit that they feel more stressful nowadays than in the past, which causes 1/3 of them to cancel or postpone their plans. Below are some detailed results of this study:

- Information overload has been a severe problem of 67% participants while planning.
- 41% feel stressed and have troubles scheduling the trip.
- 67% of people have experience arguing with their travel companions. 25% of them are even worse to break up with their companions after the travel.
- Also, 61% of people concerned with the financial problem; 49% have trouble dealing with packing; 48% responded that it is difficult to satisfied everyone. (Newsdesk, 2017)

Another exploratory research about travel stress focuses on physical stress as well as psychological stress people have during the whole travel activities. 110 samples were collected from U.S. residents who just took a vacation recently. The data exposes that:

- Planning stage is the most stressful part of travel. It engenders stressors at a higher level than the actual travel process.
- Financial budget, packing, schedule arrangement, and itinerary development are the top stressors of the planning stage.

- Weather, traffic, flight, and route are considered as the most stressful factors during the travel stage.
- International travel planning (32.2%) is more stressful than domestic travel planning (17.2%).
- Plan with the spouse (34.3%) is more stressful than plan solo travel (17.5%)(Crotts & Zehrer, 2012).

While travel is relieving stress from living, work, or study aspects, meanwhile, creating new stressors itself to make people stressful in another perspective. There are still a lot of existed problems in travel, waiting for us to identify and solve.

CHAPTER 3. METHODOLOGY

This chapter lists out all methods used in the whole process of this research of study briefly. It includes methods in the research stage, design stage, and evaluation stage.

3.1 Methods of Research

My preliminary research consisted of the Market Research and User Study.

The Market Research was for having a deep understanding of the current market condition and main competitors. It begins with a comprehensive Peer Product Analysis of all travel-related Apps. Then, the Product Positioning Map categorizes all Apps in the strength and number of feature aspects for finding the potential exploring field. From the findings of the Positioning Map, four most famous Apps were selected to do in-depth research in their main features.

The User Study was composed by an Online Survey, User Interviews, a Field Research, a Persona, and a User Journey Map. The wide range of Online Survey was undertaken bilingual in both China and the United States. After identifying the initial problems and get more familiar with the masses, four people who had more experience about group travel were selected from the online survey and considered as my typical target users to do the in-depth Interviews. The interview questions were more specific and detailed. Accidentally at that time, I was doing group travel with five other graduate students. Therefore, I conducted as well as participated in a Field Research using the observational study method. Main problems and pain points were summarized to build the Persona and User Journey Map afterward.

3.2 Methods of Design

Affinity Diagram was employed to brainstorm and organize solutions for the pain points. After consideration, several most severe problems were selected to be the main features of the new App.

Information Architecture (IA chart) and Hierarchical Task Analysis (HTA chart) are critical in building a sound logic and fluency of the App flow. Information Architecture is a scientific method to organize and structure the content of the system, including mobile applications, websites, and other social media platforms (“Information Architecture. Basics for Designers.,” 2017). Hierarchical Task Analysis originated from human factors, is a structured, objective approach to describe users’ performance of tasks (Peter, 2010). The overall App was structured by the IA chart, and the HTA chart was for coming up with all involved tasks and smoothing the way of doing a travel plan.

3.3 Methods of Evaluation

During the whole design process, two rounds of evaluation were conducted. Paper prototyping was utilized to test the original wireframe firstly. It helps the overall App flow to be more intuitive and fluent. Besides, an interactive high-fidelity prototype was developed for usability testing at the end of the research.

CHAPTER 4. RESEARCH

4.1 Market Research

4.1.1 Peer Product Analysis

There are thousands of travel-related applications in online digital stores. By reviewing most of the Apps, I categorized them into four types: Transportation, Information, Reservation, and Planning (Figure 4). Under each category, there are sub-categories. For instance, the Reservation underneath has Accommodation, Restaurant, and Tour & Activity. As is known to all, Booking, Trivago and Airbnb are Apps people commonly use to book accommodations. Yelp is frequently used to find and reserve a restaurant. Except for booking accommodation, Airbnb also has new services to recruit visitors for a tour or activity.

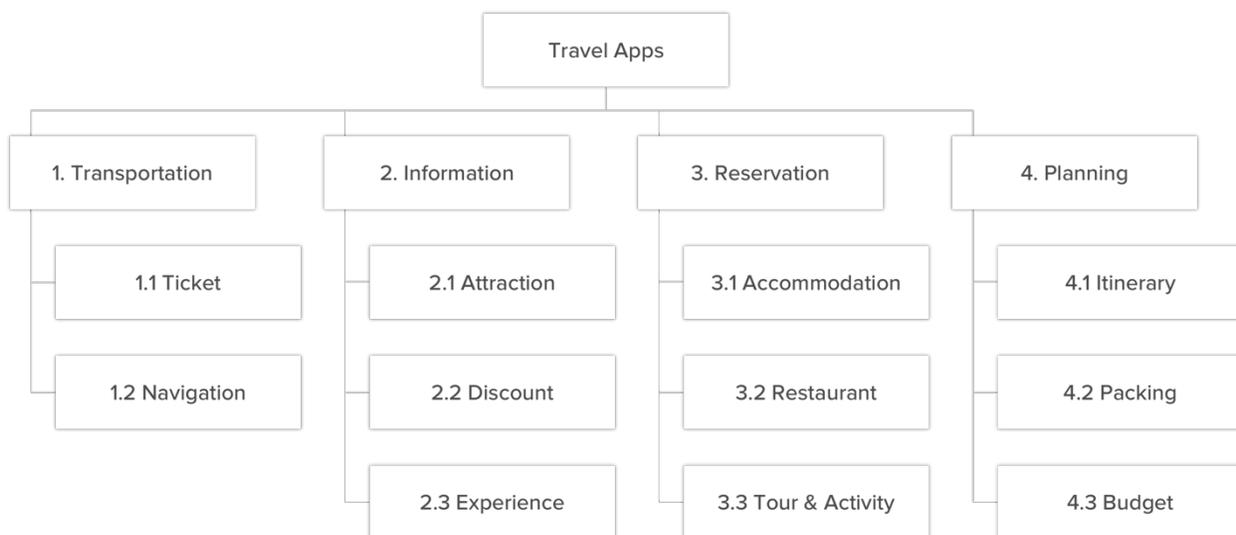


Figure 4. Categories of Travel Apps

According to the taxonomy above, the below figures (Figure 5 to Figure 9) present an overall review of corresponding Apps.

App Interface	Trip Advisor	Lonely Planet	Yelp
Description	Resource Database/ Planning Find the lowest airfare, best hotels, great restaurants and fun things to do	Resource Database Guidelines of worldwide famous cities including offline maps, must-see sights, neighborhood guides and audio phrasebooks	Resource Database Discover local services and activities around your area
Main Feature	<ol style="list-style-type: none"> 1. Compare prices from hotel booking sites and find the lowest one (hotel) 2. Show reviews, opinions and candid photos by travelers; discover cool things to do in any destination (visiting) 3. Explore restaurants and reserve tables online (food) 4. Compare airfares and find great deals (transportation) 5. Add own reviews and photos (feedback) 6. Download maps (navigation) 7. Schedule your travel plan 	<ol style="list-style-type: none"> 1. Navigate: download offline maps; neighborhood maps 2. Visiting: recommend must-see sights 3. Language: speak like a local with phrasebooks in 18 languages 4. Transportation 5. City guide including see, eat, sleep, shop, drink, play 	<p>Restaurant:</p> <ol style="list-style-type: none"> 1. Find the newest and hottest local restaurant near you 2. make reservations 3. order delivery or pickup 4. filter restaurant search results by price, location, open now... <p>Businesses, services & professionals:</p> <ol style="list-style-type: none"> 1. Discover great local businesses 2. Find great deals 3. Read millions of reviews
Other platforms	Website	Website, book	Website, iWatch (Message)
Pros and cons	<p>Pros:</p> <ol style="list-style-type: none"> 1. It has very rich resource of hotels, flights, restaurants, attractions and so on. 2. "My Trips" feature can help users easily organize things they want to do. 3. Users can share reviews and photos with each other. <p>Cons:</p> <ol style="list-style-type: none"> 1. "My Trips" feature just helps users to list up tasks but not perfect enough to help them schedule the plan detailedly. 2. "My Trips" feature is not closely related to the very main feature. 	<p>Pros:</p> <ol style="list-style-type: none"> 1. Information is very organized and systematical with a city-based structure. Inside each city "booklet", there is more detailed information about attractions, restaurants, hotels, stores, and other services about local stuff. 2. Information can be used by downloading offline maps when there is no signal. 3. It has a currency converter for users reference. <p>Cons:</p> <ol style="list-style-type: none"> 1. Some important navigate icons are not showing clear enough. 2. The database is just about some famous cities. Other cities are excluded in this App. 3. It provides users optional choices of surrounding. 	<p>Pros:</p> <ol style="list-style-type: none"> 1. It has a smart filter that can narrow down to very detailed requirement accurately. 2. Features are more based on food which is very focused. 3. Its database about local is very rich. <p>Cons:</p> <ol style="list-style-type: none"> 1. Reservation cannot be done by App. 2. The App provides individual locations that cannot connect with each other to make a plan.

Figure 5. Trip Advisor, Lonely Planet, Yelp

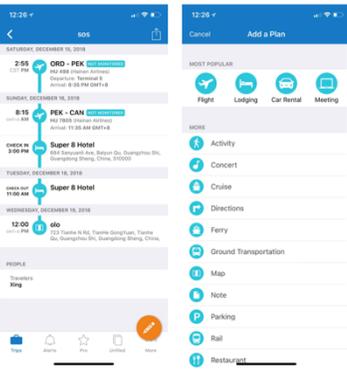
	TripIt	Mafengwo (马蜂窝)	Qyer (穷游)
App Interface			
Description	Help you organize your travel plan detailedly by inputting information	Rich database of places and attractions, experience sharing from both official Mafengwo and customers, do travel plan	Rich database of places and attractions, experience sharing from customers, do travel plan (comparing to Mafengwo, Qyer is better at saving money)
Main Feature	<ol style="list-style-type: none"> Forward travel confirmations to create a travel schedule Instantly create master trip itineraries Access important information, even when you are offline Discover nearby restaurants, parking, ATMs & more Find available transportation options Get real-time flight alerts throughout your trip Easily navigate your way around the airport 	<ol style="list-style-type: none"> Recommend plenty of travel diaries and strategies from other users Provide detailed info about locations (attractions, hotels, restaurants, Q&A, shopping areas, recommended visiting routes, and etc.) Write travel diary Shop in online store Do travel plan 	<ol style="list-style-type: none"> Recommend plenty of travel diaries and strategies from other users Provide detailed info about locations (attractions, hotels, restaurants, Q&A, shopping areas, recommended visiting routes, and etc.) Write travel diary Shop in online store Do travel plan (use another App)
Other platforms	Watch (Message)	Website	Website
Pros and cons	<p>Pros:</p> <ol style="list-style-type: none"> By inputting some critical information, the App itself can extract more detailed information from internet.(e.g. Enter airline and flight number to get departure/arriving time and cities as well) Have an alert feature to remind users in advance. The App helps you list up all tasks by timeline automatically. <p>Cons:</p> <ol style="list-style-type: none"> Except the timeline connection, there is no other connection between tasks.(e.g. distance, public transportation) All tasks have to add time which is not flexible to adjust the plan. No database about surroundings or local provided. 	<p>Pros:</p> <ol style="list-style-type: none"> Very hug resource database and customer system. It can run by itself using customers' experience sharing. Real-time sharing <p>Cons:</p> <ol style="list-style-type: none"> Weak planning feature Too many information in App (information overload) 	<p>Pros:</p> <ol style="list-style-type: none"> Very hug resource database and customer system. It can run by itself using customers' experience sharing. Real-time sharing <p>Cons:</p> <ol style="list-style-type: none"> Weak planning feature Too many information in App (information overload)

Figure 6. Tripit, Mafengwo, Qyer

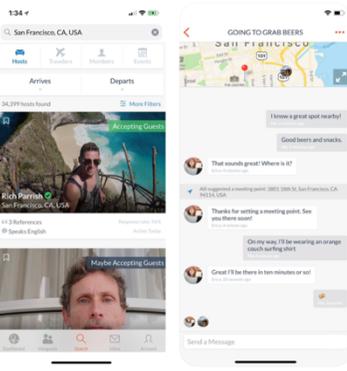
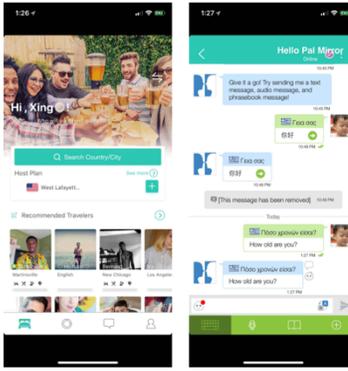
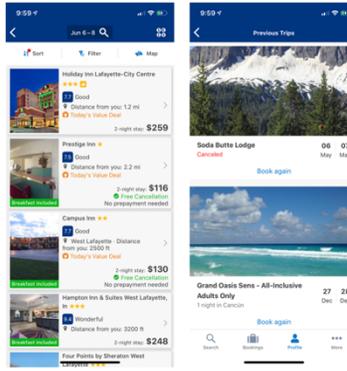
	Couchsurfing	Travel Pal	Booking
App Interface			
Description	Stay with locals, make travel friends, host travelers coming to your hometown, or plan and manage trip itinerary.	Meet people from all over the world as a traveler or a host (local).	Book hotels
Main Feature	<ol style="list-style-type: none"> Handouts: chat with other users (or nearby), receive messages Travel: create upcoming travel for local hosts to understand your needs and find you directly Events: host events for other users to participate in; find nearby events to participate in Host: meet and serve for travelers as a host 	<ol style="list-style-type: none"> Share travel stories Share moments (like Wechat) Chat with other users (translation) Recommend hosts/travelers Recommend travel partners/neighbly travelers 	<ol style="list-style-type: none"> World leader in booking accommodations Get paperless confirmation Easily make changes to bookings Find deals in every destination Hug database of hotels, apartments and more
Other platforms	Website	Website	Website
Pros and cons	<p>Pros:</p> <ol style="list-style-type: none"> By hanging out with local people, users can visit the place in-depth. It can create activity to recruit people who are interested in as well. <p>Cons:</p> <ol style="list-style-type: none"> With both travel and host side, the interface is not designed clearly enough(compares to "Travel Pal") Trust and safety are fatal issues of this App. 	<p>Pros:</p> <ol style="list-style-type: none"> By hanging out with local people, users can visit the place in-depth. The App is organized well by switching between host side and guest side. "Moments" feature can get users closer to each other. <p>Cons:</p> <ol style="list-style-type: none"> It is limited to offer and find an accommodation without other activities. Trust and safety are fatal issues of this App. 	

Figure 7. Couchsurfing, Travel Pal, Booking

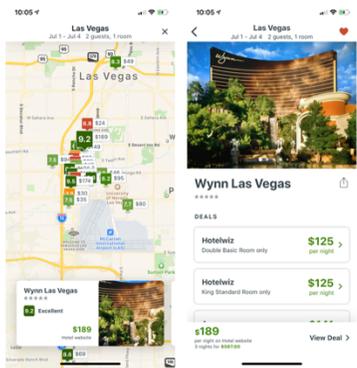
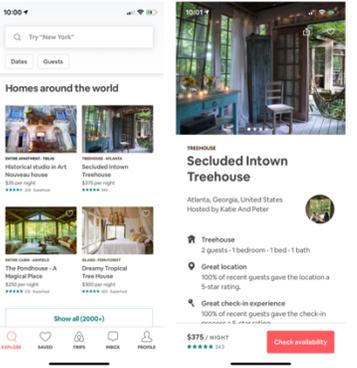
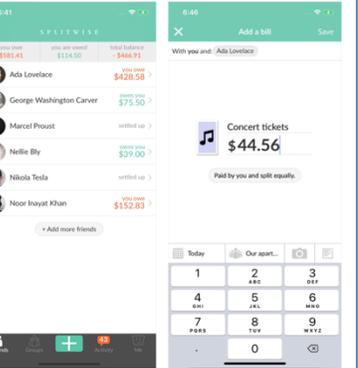
App Interface	Trivago	Airbnb	Splitwise
			
	Hotel	Hotel/ Tours	Accounting
Description	Book hotels	Book local B&B, tours and tickets (all based on local)	To share bills and IOUs and make sure that everyone gets paid back
Main Feature	<ol style="list-style-type: none"> Find the great prices worldwide Travel for cheap with last minute discounts and holiday deals on hotels 	<ol style="list-style-type: none"> Book local B&B Book local travel experience Book local activity tickets 	<ol style="list-style-type: none"> Keep track of apartment bills, group trips, random IOUs Everyone can log in, see their balances, and add new expenses Get push notifications with every updates, or just when important bills are due (US only) settle up instantly with PayPal and Venmo
Other platforms	Website	Website	

Figure 8. Trivago, Airbnb, Splitwise

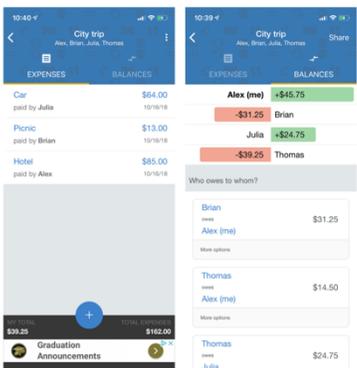
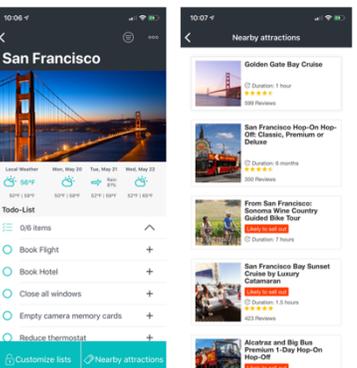
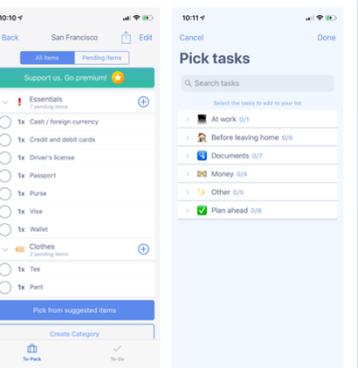
App Interface	Tricount	Packr	Packing List
			
	Accounting	Packing, to-do-list	Packing, to-do-list
Description	Share expenses with others	Smart packing list	Smart packing list
Main Feature	<ol style="list-style-type: none"> Record and view expenses and total costs See who owes to whom Divide expenses any way you like Pull down to stay in sync 	<ol style="list-style-type: none"> Generate initial packing list based on travel period and destination Nearby attractions recommendations Share packing list to other people 	<ol style="list-style-type: none"> Create and manage own categories Stop forgetting things and get organized Add notes to your tasks & items

Figure 9. Tricount, Packr, Packing List

Trip Advisor, Lonely Planet, Mafengwo (China) and Qyer (China) are famous Apps in either China or the United States to get the information of attractions on the way. However, with Trip Advisor, Mafengwo, and Qyer, users can also book flight and accommodation. Booking is

focusing on hotel booking from the beginning to now, while Airbnb started to explore new services for users participating in local tours and activities. Tripit can be connected to the user's email for syncing confirmation emails of booking transportation and accommodation to auto create a travel itinerary. For independent travel planning, only Trip Advisor and Qyer have this feature involved. Besides, there are some Apps working on specific aspects of planning separately, such as packing, accounting, and splitting bills.

4.1.2. Product Positioning Map

“Positioning maps are diagrams drawn to illustrate the customer perception of the business” offering based on price, quality, or other product benefits and how the perception compares against the competitors.” (“What is a positioning map in marketing?” n.d.) By taking advantage of the traditional positioning map, I customized a new style based on the information wanted. Considering the properties of group travel, I set up four main aspects: which are Database, Booking, Planning, and Accounting. The X-axis represents the number of features, and the Y-axis represents the overall strength of the App (Figure 10).

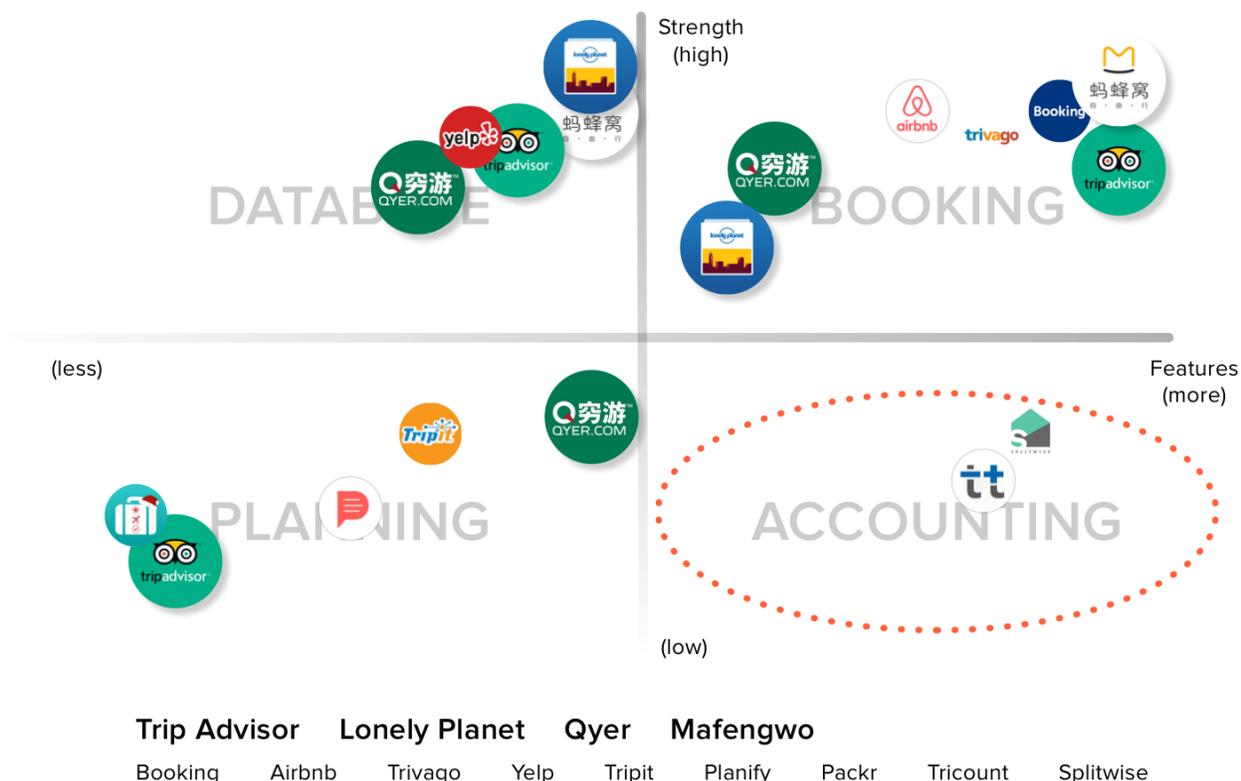


Figure 10. Product Positioning Map

Trip Advisor, Lonely Planet, Mafengwo, and Qyer are the Top 4 highly developed Apps which have the most number of features. Trip Advisor and Qyer cover three features except for financial management. Mafengwo and Lonely Planet are more professional at providing datasets of attractions and accommodations than other apps. Other Apps only specialize in one or two features. Accounting is the area lack of attention by the travel App market and has a great potential to be exploited.

4.1.3. Main Competitors



Figure 11. Features of the Main Competitors

1. Trip Advisor

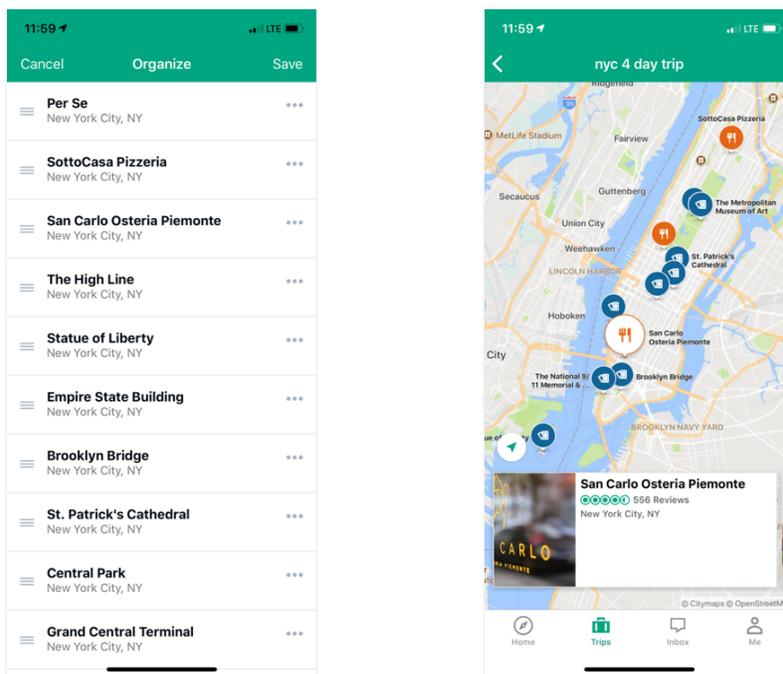


Figure 12. Trip Advisor (mobile App)

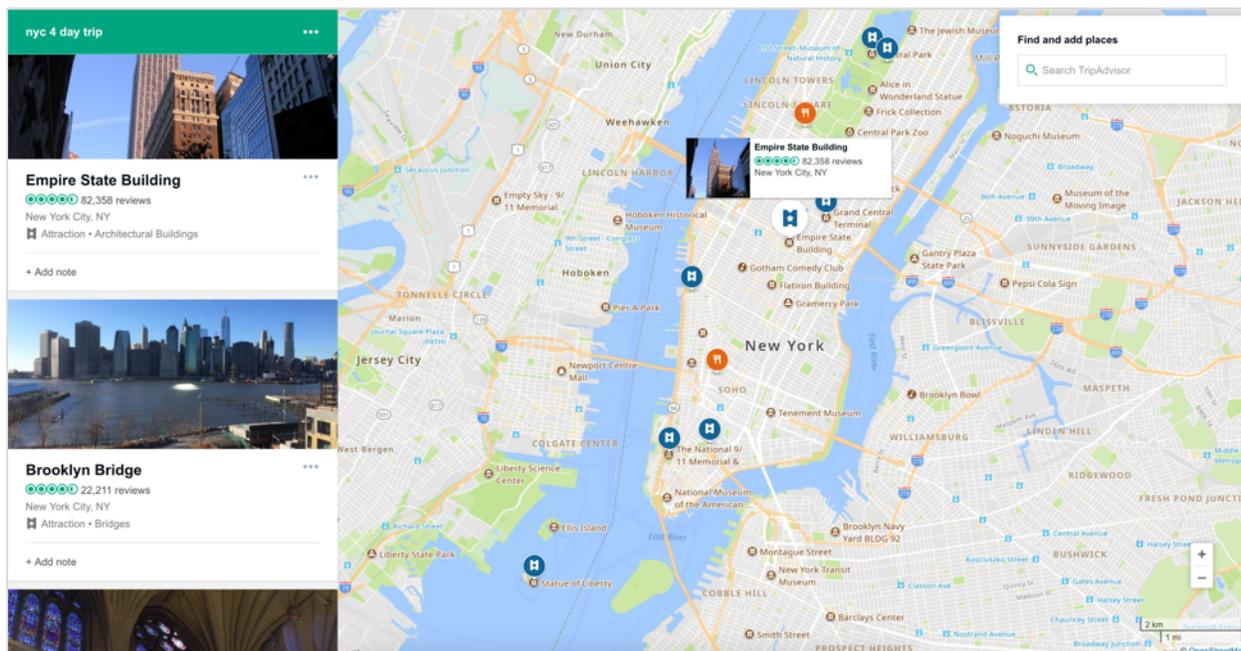


Figure 13. Trip Advisor (webpage)

Trip Advisor is a well-known travel App in the U.S. market which can do multitask. The most powerful feature is its database of attractions and places. Beyond that, it can customize a tour map on both mobile App and webpage quickly by tagging interesting items in the database into a specific folder. The result comes out are a sequence of items and a corresponding tour map. Users can easily view the location of all the places they collected on the map. New members can also be invited to the plan via email or message. However, the disadvantage is that this platform does not provide any detailed information for users in the planning aspect precisely. It can not do further schedule such as distributing places in different days and arrange them into a sequence. The only function it has is to collect places together and review as a map.

2. Qyer and QyerPlan

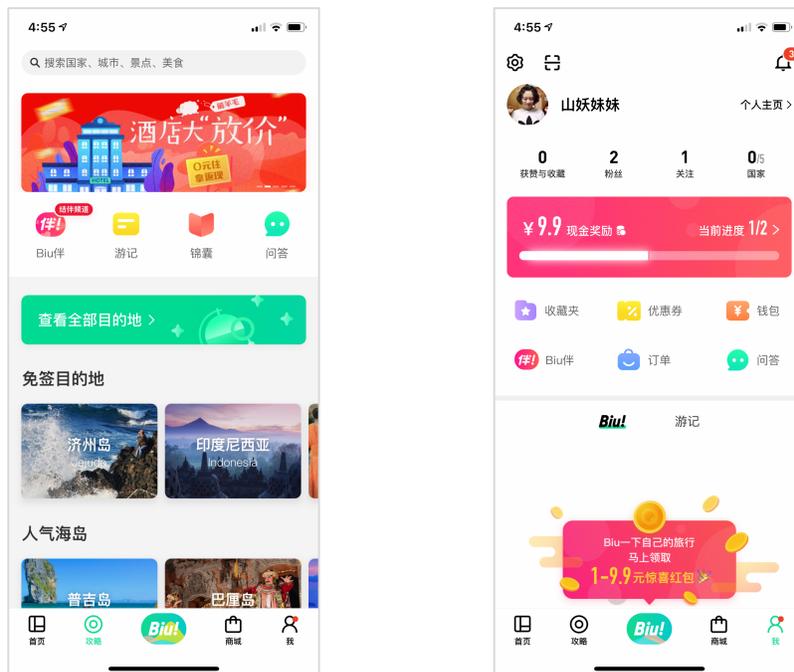


Figure 14. Qyer

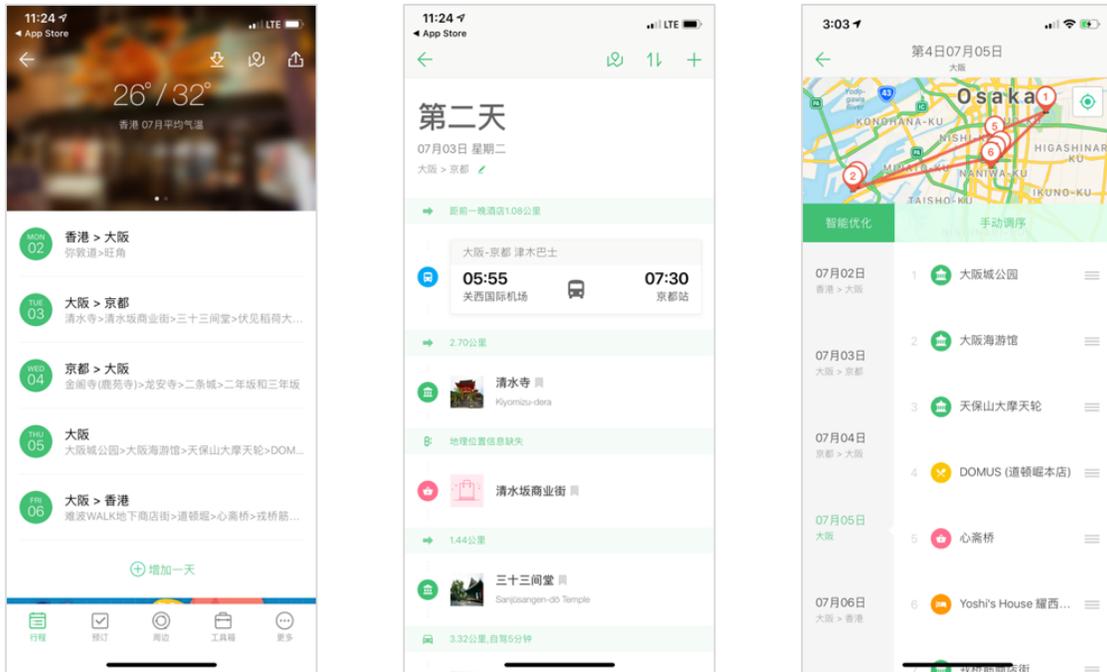


Figure 15. QyerPlan (mobile App)

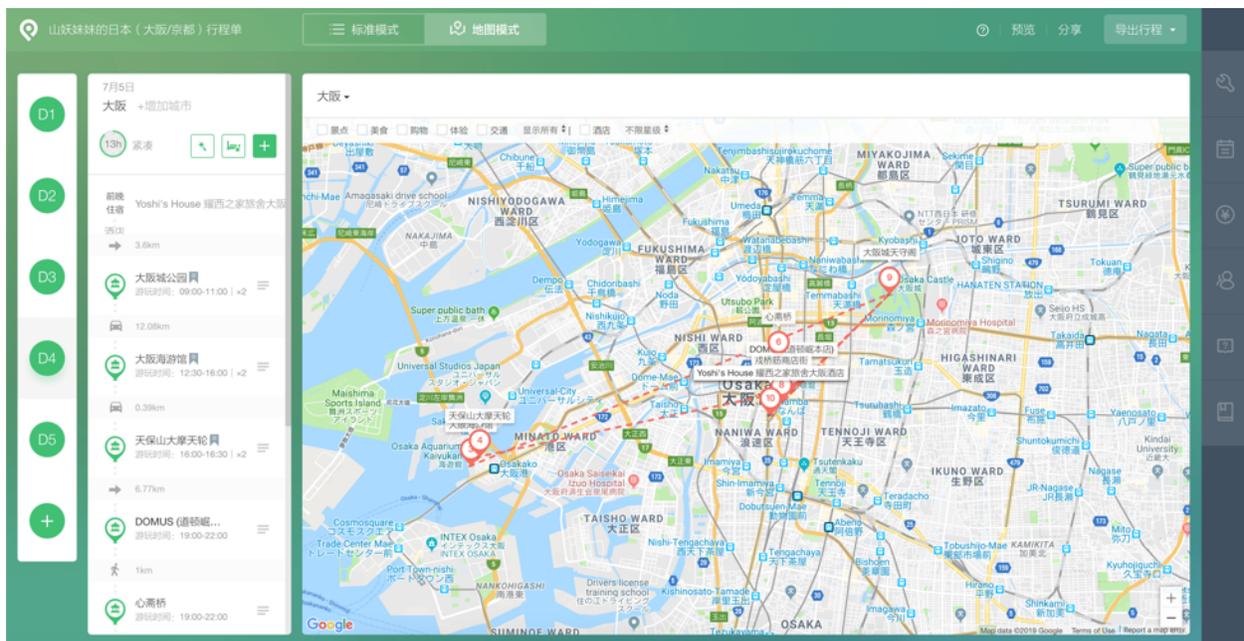


Figure 16. QyerPlan Planning Platform (webpage)

Qyer (Figure 14) is one of the most popular travel Apps in China. It is famous for its powerful functionality in the trip planning feature, a side-App called QyerPlan (Figure 15). QyerPlan also has a webpage platform (Figure 16). Comparing to Trip Advisor, users can do more detailed step-by-step travel plans by the platform. You can distribute attractions on different days and arrange their sequence. The system even helps users figure out the distance and traffic time between places.

4.2 User Study

In consideration of creating a user-centered design, which focuses on the user itself and their real needs, a framework was built starting from a broad scope of view into small and specific areas. An online survey was conducted in the first place to collect general opinions and problems from the masses. Then outcomes of the survey lead me to implement more detailed user interviews. The field research was to put the researcher personally on the environment with prepared goals and assignments. Lastly, by combining pain points from the user's perspective and the researcher's experience, persona, and journey map of target users can be defined more comprehensively.

4.2.1 Online Survey

The inspiration for choosing this topic initially came out of my own experience of group travel. However, other people's experiences are more significant for this research. I started with a bilingual online survey with 24 questions asked about communication and cooperation problems in three different travel stages (planning, traveling, post-travel). 60 respondents have been selected as reliable samples after filtering.

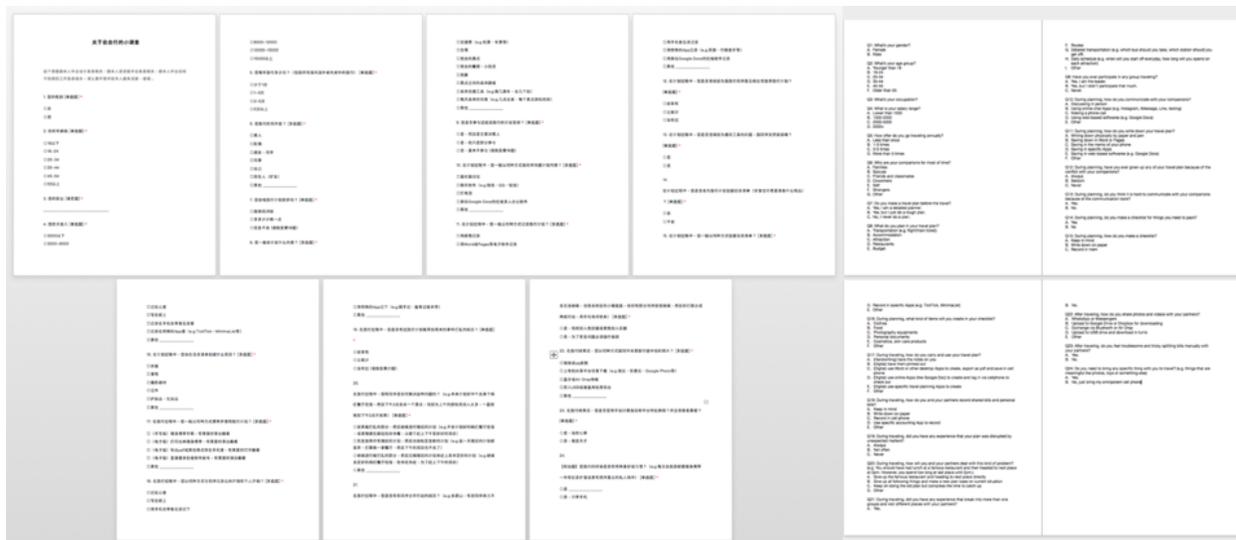


Figure 17. Survey Questions in Two Languages (Appendix A)

In the results:

- 83.33% of people use a non-App tool such as handwriting, Word, Google Doc, to record their plans.
- 55 out of 60 had experience disrupted by unexpected events in the trip.
- 1/3 of users had ideas to hang around separately.
- 28.33% saved paper receipts during the trip, while others recorded digital receipts by mobile phones.

(Appendix A shows detailed questions of the online survey.)

4.2.2 User Interview

Some prominent point of views were distilled from the result of the survey and referred by the next-step user interview. Four participants who are more experienced and have critical thinking in group travel problems were selected from the respondents of the survey. They are of

different ages, with different nationalities and education background, and are doing different types of jobs.

Each interview proceeded about 30-45 minutes long. Interviewees were asked a few open-ended questions and talking about their group travel experience detailedly. Summary of the result is as below (Figure 18).

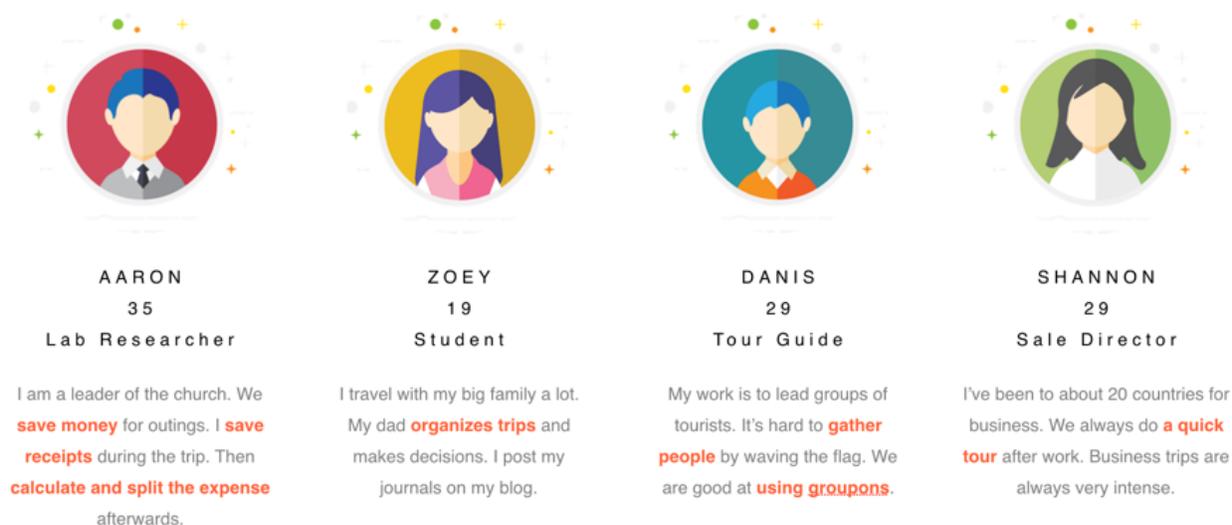


Figure 18. Comparison Table of User Interviews

4.2.3 Field Research with Observational Study Method

Field research is a UX method used to put researchers personally in the environment to collect data outside of the laboratory, library, or workplace settings. The results are persuasive and closer to the users' real needs.

By Prepared with common pain points and insights from the previous online survey and user interview, a field research was conducted using the observational study method. I led a group of 6 people to have a five-day road trip around northern Michigan area. I participated in as a role of a leader as well as an observer to organize the whole group and record all actions and events that happened during the trip. The results are listed in the table below.

Table 1. Results of Field Research

		ASPECTS				
PAIN POINTS		Planning	Packing	Teamwork	Billing	
STAGES	Formation	1. We had difficulty in starting planning at the very beginning.	1. We found people brought the same things which can be shared during the trip (such as hair dryer, cellphone charger, shampoo, tooth paste).	We did not assign tasks appropriately so that some people did not do anything for the trip while some others take responsibility for everything.		
		2. After we found some other's itineraries, we did not know how to take those as a reference and reuse them as ours.	2. I forgot to bring some things useful for the trip while packing (selfie stick).			
		3. We used the group chat feature in WeChat to communicate as a team. We jumped between WeChat and Trip Advisor to communicate and plan.				
		4. After we collected all the places we were interested in, we did not know how to connect them.				
	Execution	There were some emergent situations that we could not follow our original plan and searched for an alternative backup plan to make it up.			Some people did not have clear roles and tasks to take charge of during the trip.	1. I paid all shared bills during the whole trip and got my credit card maxed out.
						2. I kept all the receipts during the trip for splitting the bills later.
	Completion					I spent more than an hour to sort out all receipts, organized, recorded, and then split evenly for individuals.

4.2.4 User Persona and User Journey Map

The target users are defined as millennials who are extroverted, enjoy leading and helping other people in teamwork. They should be detailed planners and always keep things in order.

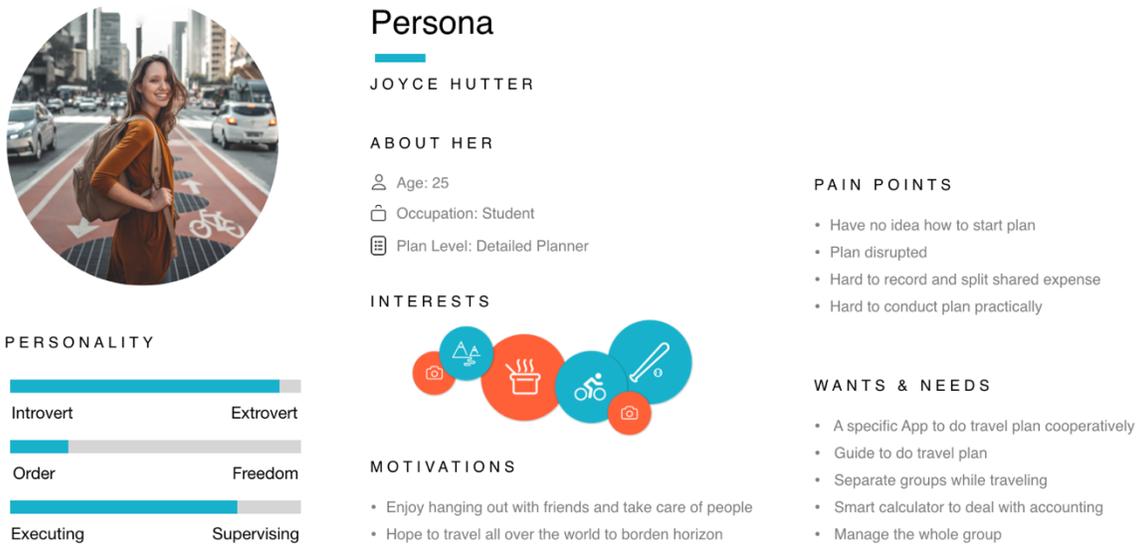


Figure 19. User Persona

4.2.5 Results

Results of the user study are categorized into pain points in four aspects as Planning, Preparing, Accounting, and Managing in the table below.

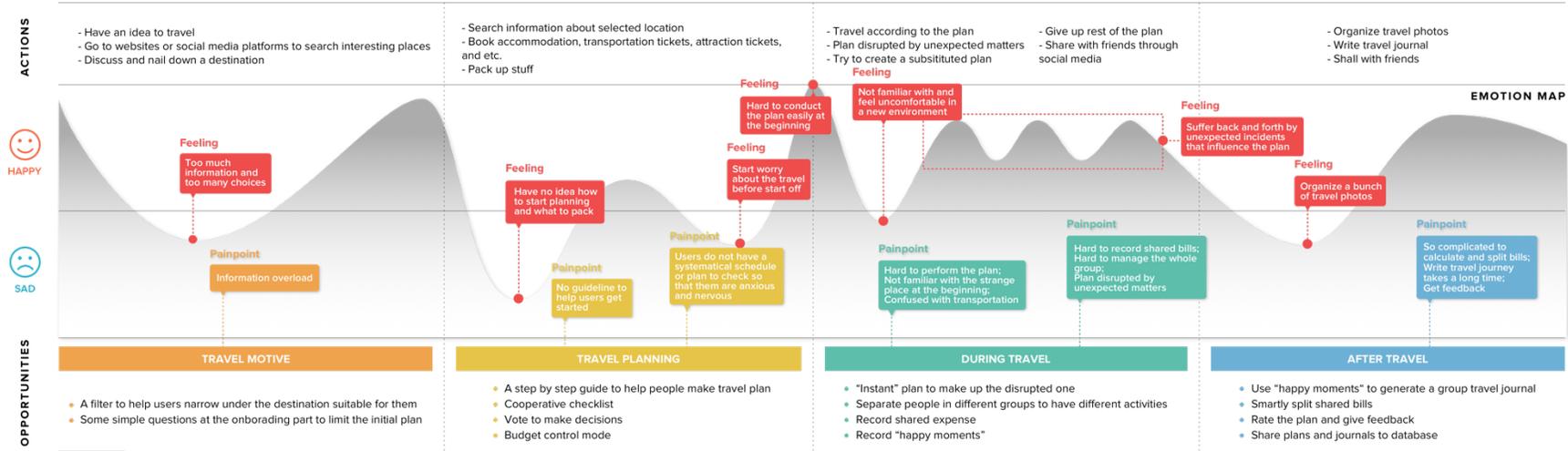


Figure 20. User Journey Map

Table 2. Results of User Study

PAIN POINTS			
Planning	Preparing	Accounting	Managing
1. Hard to work cooperatively without meeting each other in person 2. Have no idea how to start a plan 3. To do a quick plan instantly	1. People bring the same stuff which can be shared 2. Hard to distribute tasks and responsibility 3. Leaders do all the work	1. So inconvenient to save all physical receipts during the trip 2. Hard to record down people who share the bills by phone 3. Afterward calculate is complicated and time-consuming	1. Hard to deal with the condition if some people want to go separately. 2. Hard to gather and organize the group effectively

CHAPTER 5. DESIGN PROCESS

5.1 Brainstorming

5.1.1 Mobile App

Affinity diagram was employed in brainstorming to explore more potential features and functions. It was separated into three stages, pre-travel, travel, post-travel, and five aspects, planning, checklist, teamwork, billing, and others (Figure 21).

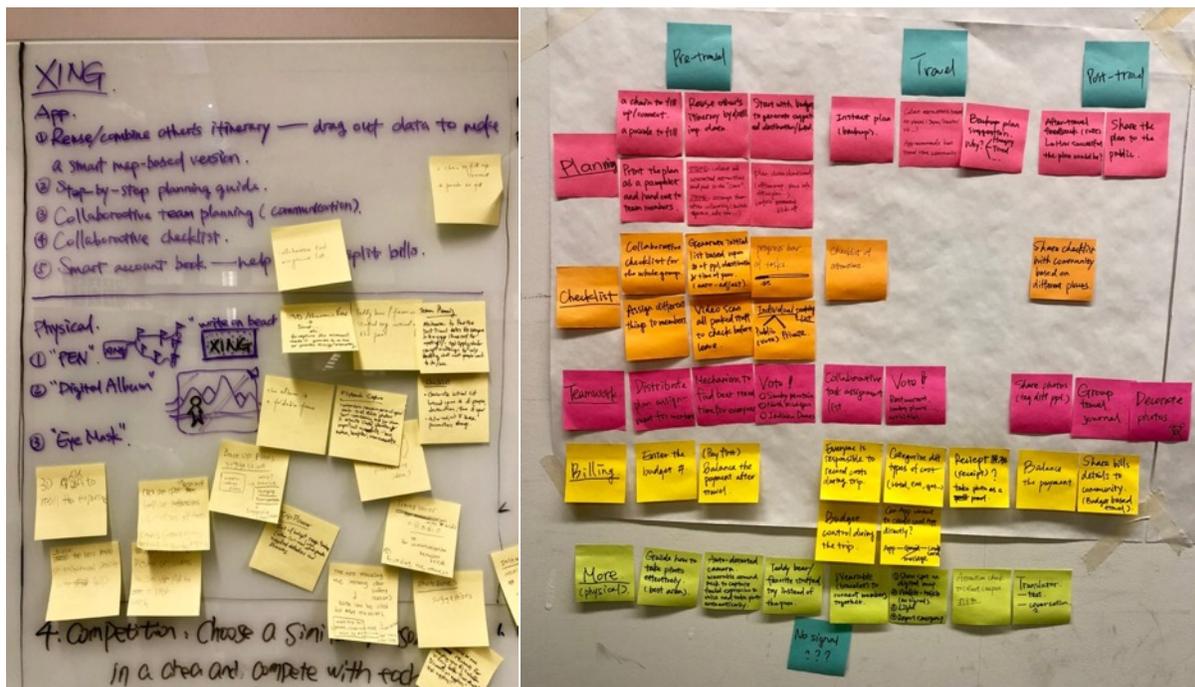


Figure 21. Brainstorming

By combining the pain points from user study and new ideas I brainstormed, solutions of them in five main aspects are summarized below (). All solutions are sorted under different aspects.

Table 3. Ideas and Solutions

SOLUTIONS			
1. Do travel plan cooperatively —— improve teamwork	2. Help start planning —— instruction	3. Make up a disrupted plan —— instant plan	4. Deal with shared bills —— record and split bills
<p>1. Hard to work cooperatively without meeting each other in person</p> <p>2. Have no idea how to start a plan</p> <p>3. To do a quick plan instantly</p>	<p>1. People bring the same stuff which can be shared with each other</p> <p>2. Hard to distribute tasks and responsibility</p> <p>3. Leaders do all the work</p>	<p>1. So inconvenient to save all physical receipts during the trip</p> <p>2. Hard to record down people who share the bills by phone</p> <p>3. Afterward calculate is complicated and time-consuming</p>	<p>1. Hard to deal with the condition if some people want to go separately.</p> <p>2. Hard to gather and organize the group effectively</p>

5.1.2 Physical Device

The idea of the physical device is to coordinate with the digital App and enhance the overall functionality. Although using a mobile phone is the fastest way to do communication, it is inconvenient to take it out of the pocket all the time during traveling. Therefore, the function of the physical device was defined to help leader organize and manage the team, meanwhile, take the place of the mobile phone under some certain situations to conduct simple communication and information exchange.

It is a set of devices consisted of a digital whistle for the leader and five breastpin-style buttons for the group members. A charging box is accompanying with the devices to pack them up as well as charge them all together. All devices use a cell phone signal at the regular time. While they are at the middle of nowhere without cell phone service, the battery volume can support three chances to send an emergency call towards the satellite per charge. Then other people can receive the lost team member's location and find him/her back.

There is some small difference between the features of the leader's whistle and the member's button (Figure 22). For the digital whistle, it can send out signals to the whole group by blow it in for rounding people up. For the button, it can receive gathering signals from the leader. They both can receive group chat notifications when someone just sent a group message in Coop.

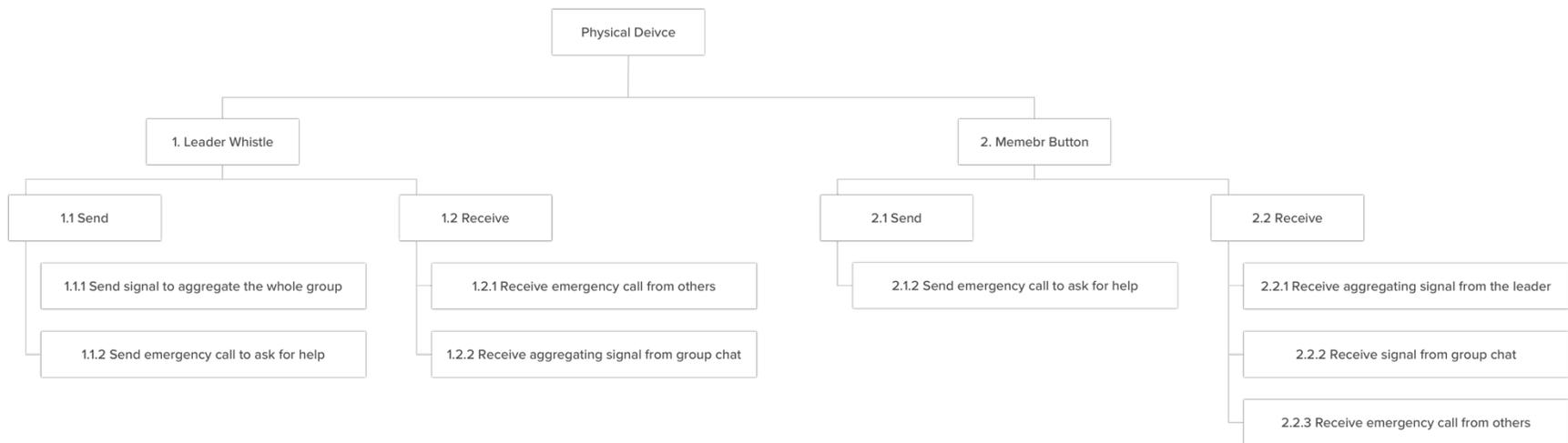


Figure 22. Functionality of the Physical Device

5.2 Information Architecture

Places, Plan, Ongoing, Archive, Device are the five main features on the home page (Figure 23).

Places provide attraction database for users. It has basic attraction information, travel plans, and itineraries shared by other users, and group discounts and coupons recommendations. Users can reuse other people's plans or itineraries to customize into their own, which can save much time to start from scratch.

The plan has a comprehensive and multitasking team planning platform. It can do travel plan by switching between the list and the map, create both group and personal checklist, distribute roles and tasks for the team, manage the account in both group and self aspects

Ongoing is similar to the Plan platform but has an extra feature of separating the big group into small ones as well as track all members' location and condition.

Archive contains all user's history, such as the history of plans, trips, bills, and collection of interesting things.

Device page is used to connect and control the physical devices along with the digital App features. Users can also adjust the group chat notification toggle to turn on or off the function.

Besides, there is another significant feature – the group chat platform always floating up at the side of every page as a hidden button. It can be pulled out at anytime conveniently. On this platform, users can not only chat with their team members but also put forward a poll for the whole group to vote and exchange opinions.

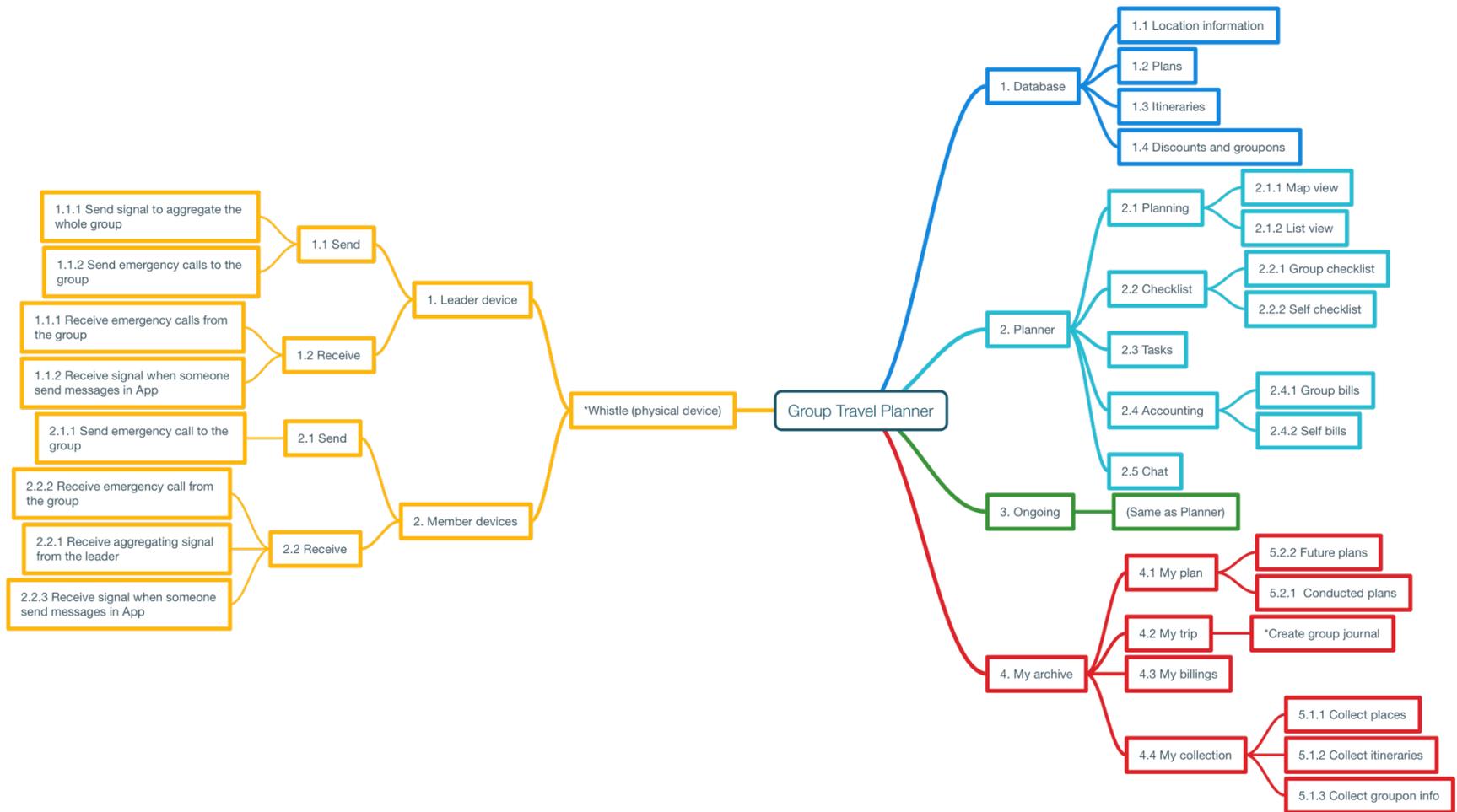


Figure 23. Information Architecture

In terms of creating a group travel plan, there are three ways to create an initial travel plan – planning from scratch, reusing the plan or itinerary resource from App’s database, and generating from a collection folder. Users are required to go through a simple six-step onboarding process created by the App to generate an initial plan. The six steps are: to name the trip, to select the dates, to choose the daily duration, to add partners, to select a general destination, and to add some attractions.

After users go through all questions in the onboarding process, the App will generate a plan intelligently to help them arrange the itinerary by considering about all detailed information of attractions, such as weather condition, open hours, distance and traffic time between each other, suggested duration. Moreover, users can still have total freedom to adjust and customize their itinerary afterward.

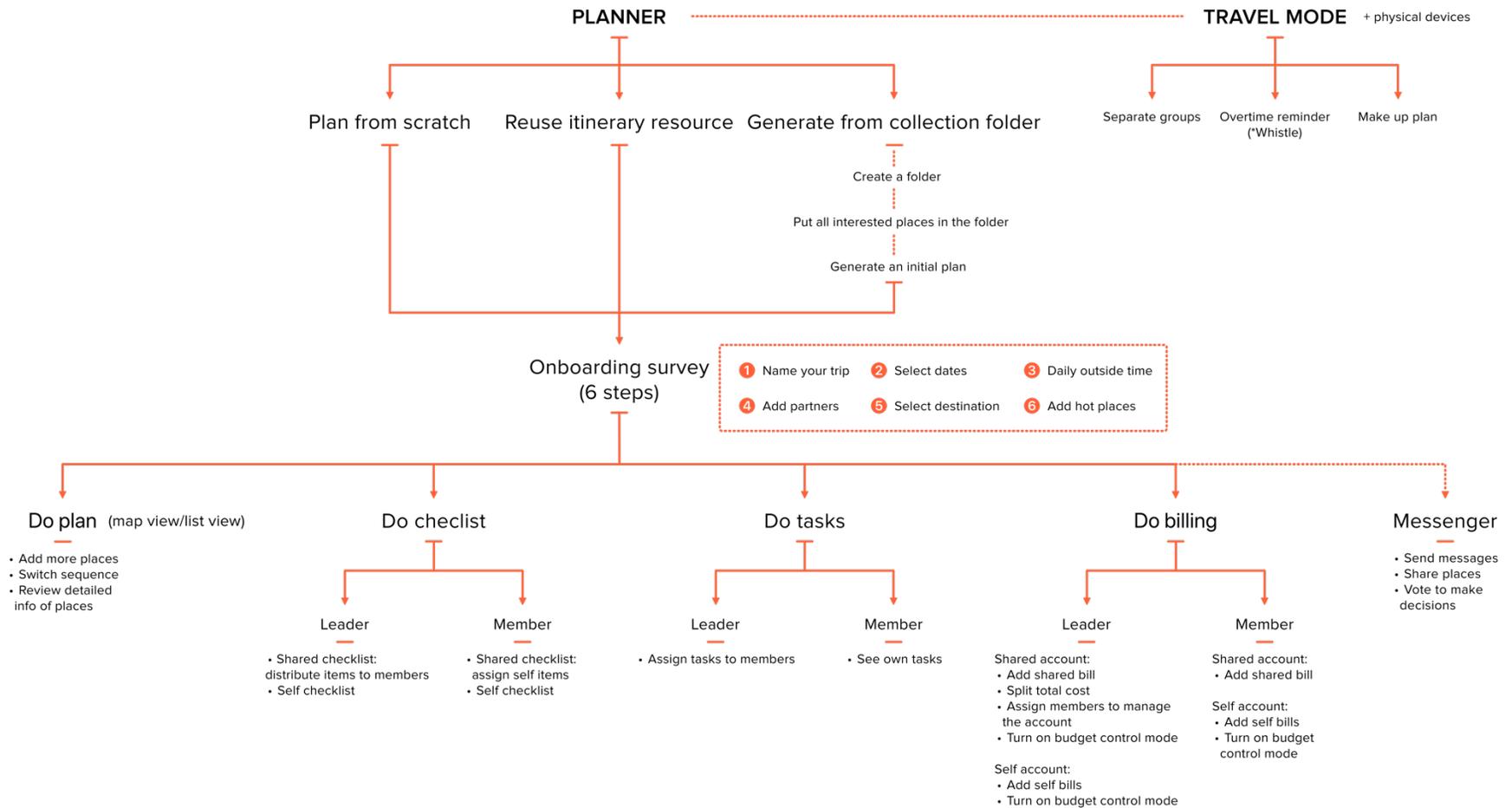


Figure 24. Hierarchical Task Analysis of Making a Plan

5.3 Wireframe

The first version of the wireframe (Figure 25) contains the main features and major pages. A rough usability testing was conducted with this version of wireframe to test the All flow fluency by means of paper prototyping method.

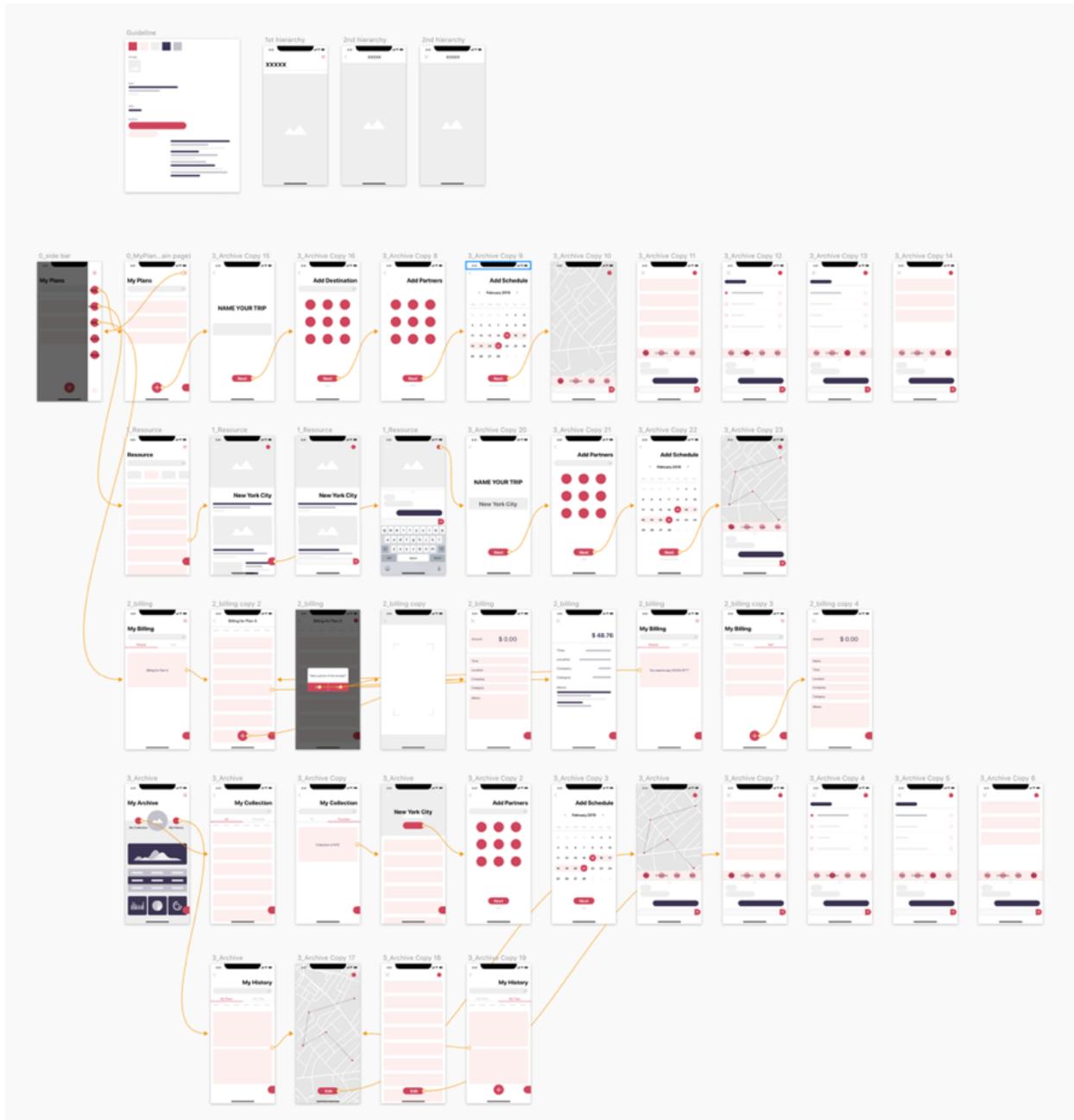


Figure 25. Wireframe (Version 1)

The test contains six parts to test on different features – onboarding process, checklist, task, accounting, new places adding, and group chatting . (More detailed information about the paper prototyping testing will be elaborated in CHAPTER 6. DESIGN EVALUATION, 6.1 Paper Prototyping.)



Figure 26. Paper Prototyping

The second version of wireframe was developed out of the first version (Figure 27). It specifies the whole working flow for completing the main features. All functions in each page are marked out below pages.

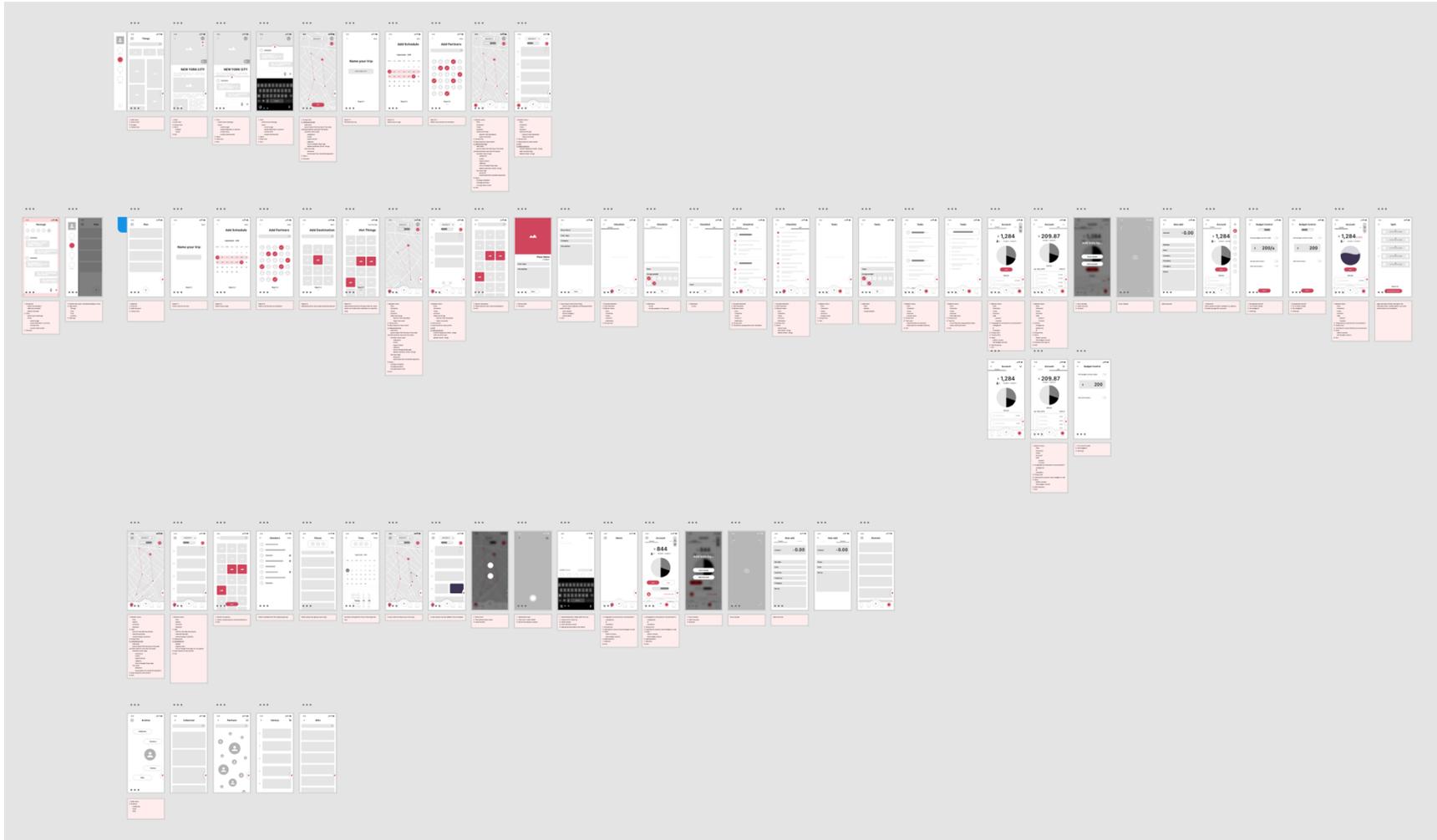


Figure 27. Wireframe (Version 2)

5.4 Visual Design

The first step of designing a user interface is to define a set of UI guidelines. Including which has the definition of the color palette, typography, button style, and page layout.

5.4.1 Design Guideline

1. Color

Take **Mafengwo**, **Airbnb**, **Trip Advisor**, **Yelp** and **Qyer** as references, they all use pure white with very light gray as the main colors of the background; they use a set of monochromatic color as their primary colors, with the addition of secondary colors in different hues. Yelp and Qyer have very fancy icon design in various colors. Mafengwo and Qyer are unique for using gradient colors to rich the plain interface.

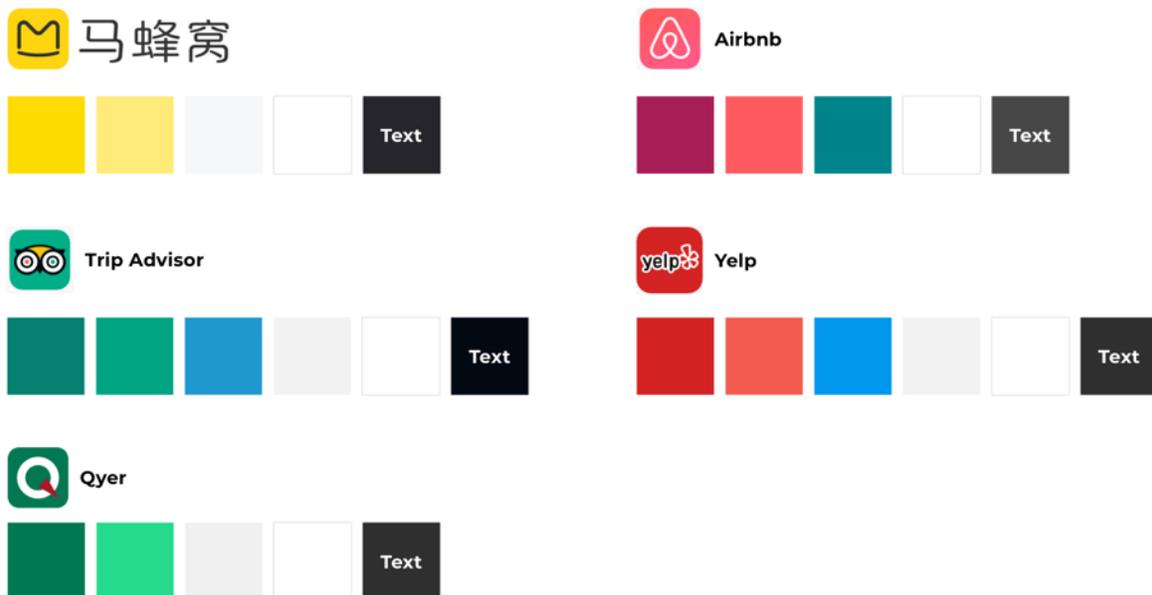


Figure 28. References of Color Palette

Blue and green are colors for nature represent freedom, relaxation, and freshness. As CooP is an App for traveling, a greenish blue has been selected to be the most primary color. Combined with a dark blue and a bright orange color for highlighting, here comes out the color palette of CooP. By taking advantage of the gradient color strategy, the logo of CooP uses a gradient color made of two primary colors. For the secondary colors, they were all adjusted on hues, values, and saturation in order to fit with the primary colors.

Primary color



Secondary color



Gradient color



Figure 29. The Color Palettes

2. Typography

Open Sans, Montserrat, Playfair Display, Roboto and Proxima Nova are popular fonts for mobile Apps on trends in these years. Montserrat is a transformation of sans-serif typefaces which shows relaxation and playfulness (Figure 30).

Typeface

Aa

Montserrat Regular
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890!@#%&*()_+<>?{}|\

Aa

Montserrat SemiBold
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890!@#%&*()_+<>?{}|\

Aa

Montserrat Medium
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
1234567890!@#%&*()_+<>?{}|\

Heading

HEADING 1
font-size: 30px / font-weight: SemiBold

A quick brown fox jumps over a lazy dog.

HEADING 2
font-size: 24px / font-weight: SemiBold

A quick brown fox jumps over a lazy dog.

HEADING 3
font-size: 21px / font-weight: Medium

A quick brown fox jumps over a lazy dog.

HEADING 4
font-size: 17px / font-weight: Medium

A quick brown fox jumps over a lazy dog.

TEXT 1
font-size: 18px / font-weight: Regular

A quick brown fox jumps over a lazy dog.

TEXT 2
font-size: 13px / font-weight: Regular

A quick brown fox jumps over a lazy dog.

TEXT 3
font-size: 11px / font-weight: Regular

A quick brown fox jumps over a lazy dog.

TEXT 4
font-size: 10px / font-weight: Regular

A quick brown fox jumps over a lazy dog.

Montserrat Regular 10
Montserrat Regular 11
Montserrat Regular 13
Montserrat Regular 15
Montserrat Regular 17
Montserrat Regular 21

Montserrat Regular 10
Montserrat Regular 11
Montserrat Regular 13
Montserrat Regular 15
Montserrat Regular 17
Montserrat Regular 21

Montserrat Semibold 10
Montserrat Semibold 11
Montserrat Semibold 13
Montserrat Semibold 15
Montserrat Semibold 17
Montserrat Semibold 21

Montserrat Bold 10
Montserrat Bold 11
Montserrat Bold 13
Montserrat Bold 15
Montserrat Bold 17
Montserrat Bold 21

Montserrat Regular 10
Montserrat Regular 11
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Montserrat Regular 13
Montserrat Regular 15
Montserrat Regular 17
Montserrat Regular 21

Montserrat Semibold 10
Montserrat Semibold 11
Montserrat Semibold 13
Montserrat Semibold 15
Montserrat Semibold 17
Montserrat Semibold 21

Montserrat Bold 10
Montserrat Bold 11
Montserrat Bold 13
Montserrat Bold 15
Montserrat Bold 17
Montserrat Bold 21

Figure 30. Typography

4. Logo Design

The logo of Coop is composed of a location symbol in a gradient blue color, and a rotated "C" shape represents the "C" of Coop (Figure 32).

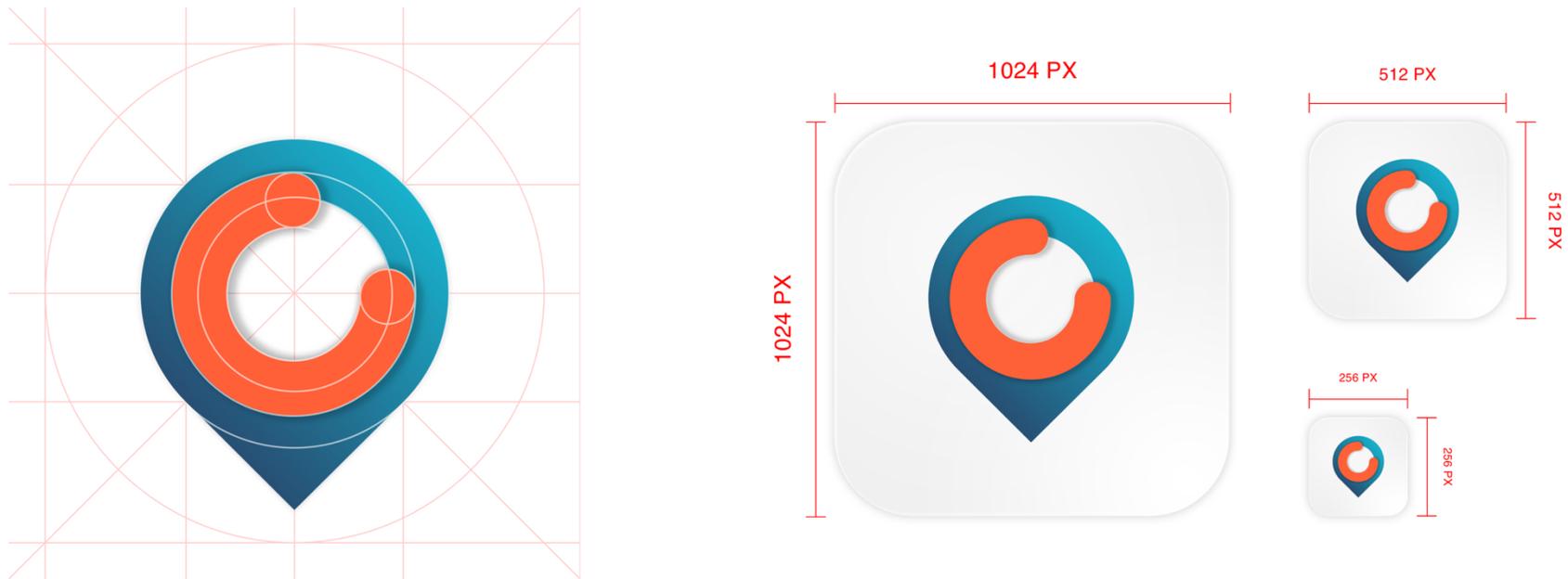


Figure 32. Logo Design

1. Main Menu

The main menu is hidden in a sidebar at the left of the page. A layer of drop shadow is added underneath the main page to sink the layer of the menu (Figure 34).

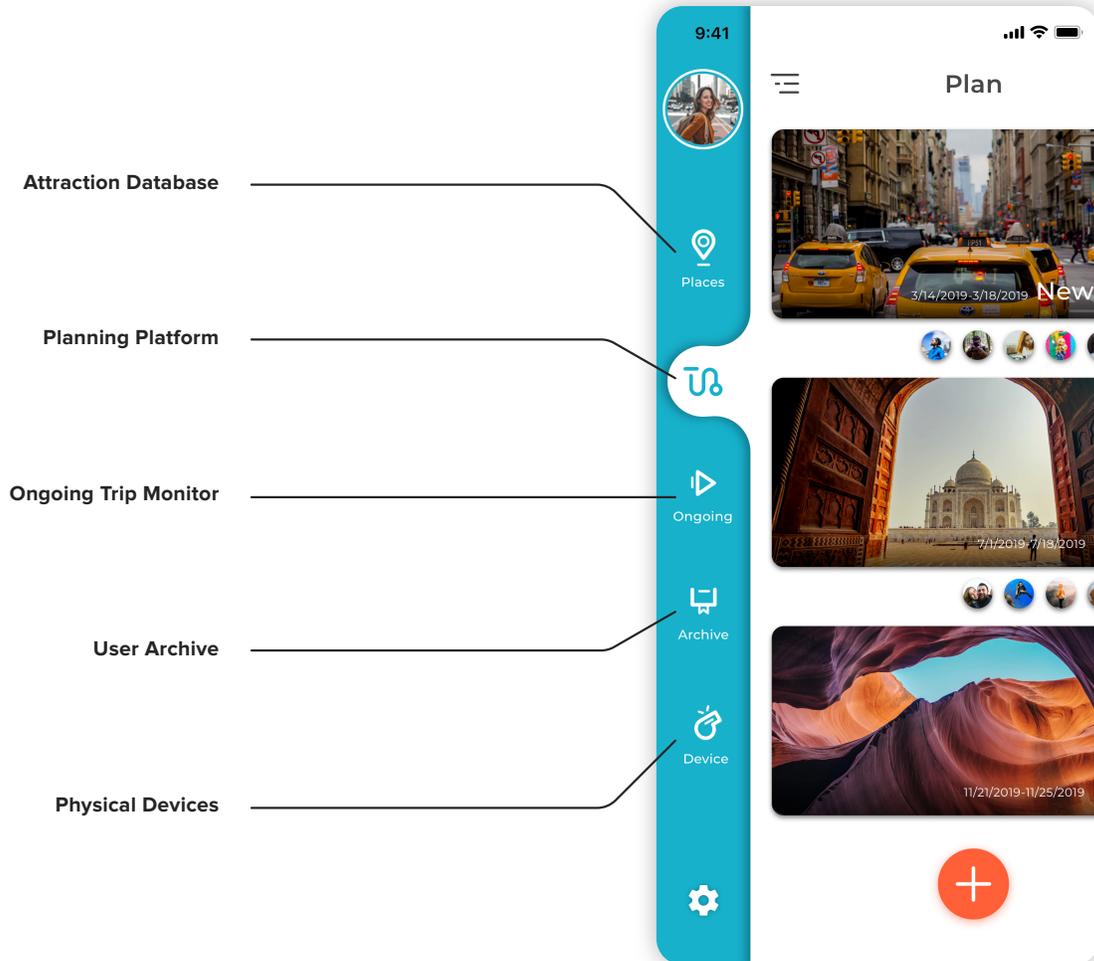


Figure 34. The Main Menu

2. Onboarding Process

To initiate a new plan, users are required to go through a six-step onboarding process. By asking users the basic information of the trip, the system can calculate and customize the most reasonable plan for users according to distance, traffic, open hours, suggested duration, and all other referable data. The process is Name Your Trip, Select Dates, Daily Duration, Add Partners, Add Destination, and Hot Places.

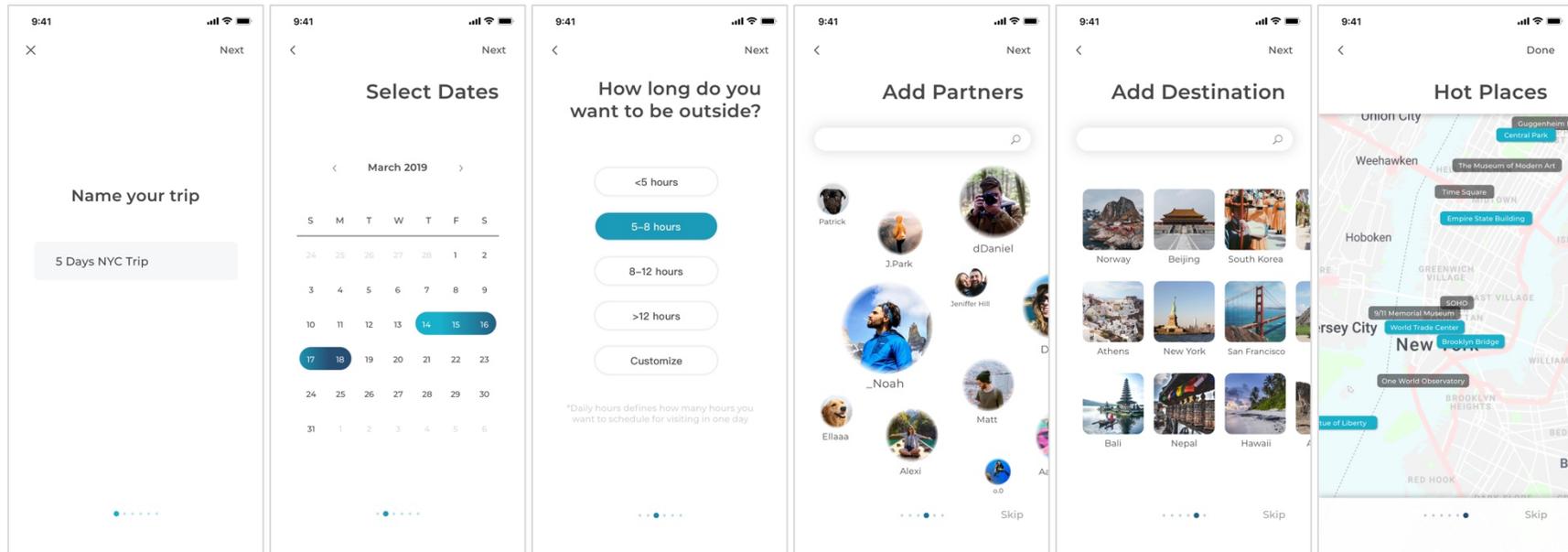


Figure 35. The Onboarding Process

3. Planning Platform

This is a multitasking planner consisted of an interactive map platform and a detailed list platform. Users can switch between the map and the list view to plan a better route.

Map View and List view

In the map view, users can overview all the routes of the plan. By clicking the attraction cards at the bottom, users can get into the attraction page and get more detailed information about the attraction. In the list view, detailed information about suggested duration and traffic condition are provided. It also has notifications to remind users of over-scheduled duty.

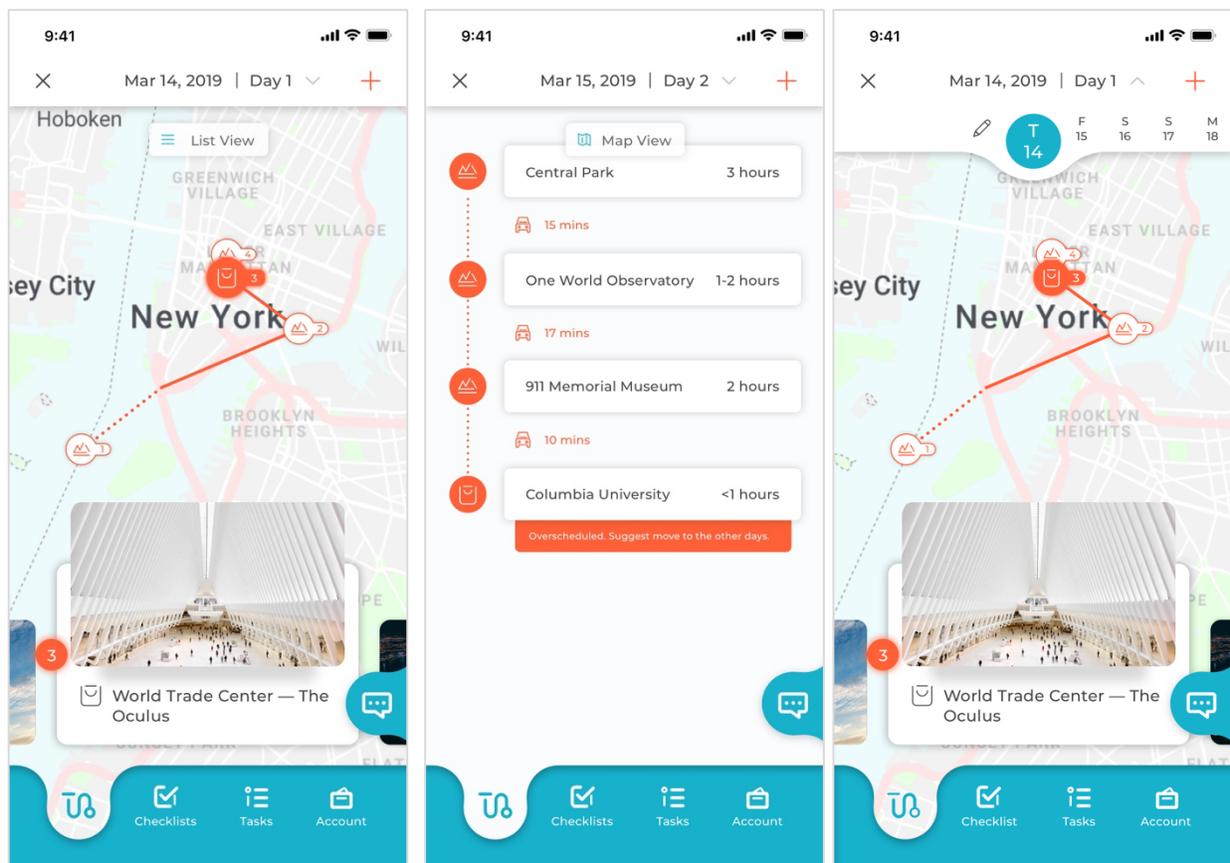


Figure 36. The Planning Platform

Add Places

Users are free to add new places at any time just by clicking the “+” button at the right top corner. They can get into the attraction and view its detailed information. If the total estimated time of the day is beyond the daily duration preset in the initial onboarding question, they will be notified an over-scheduled duty signal.

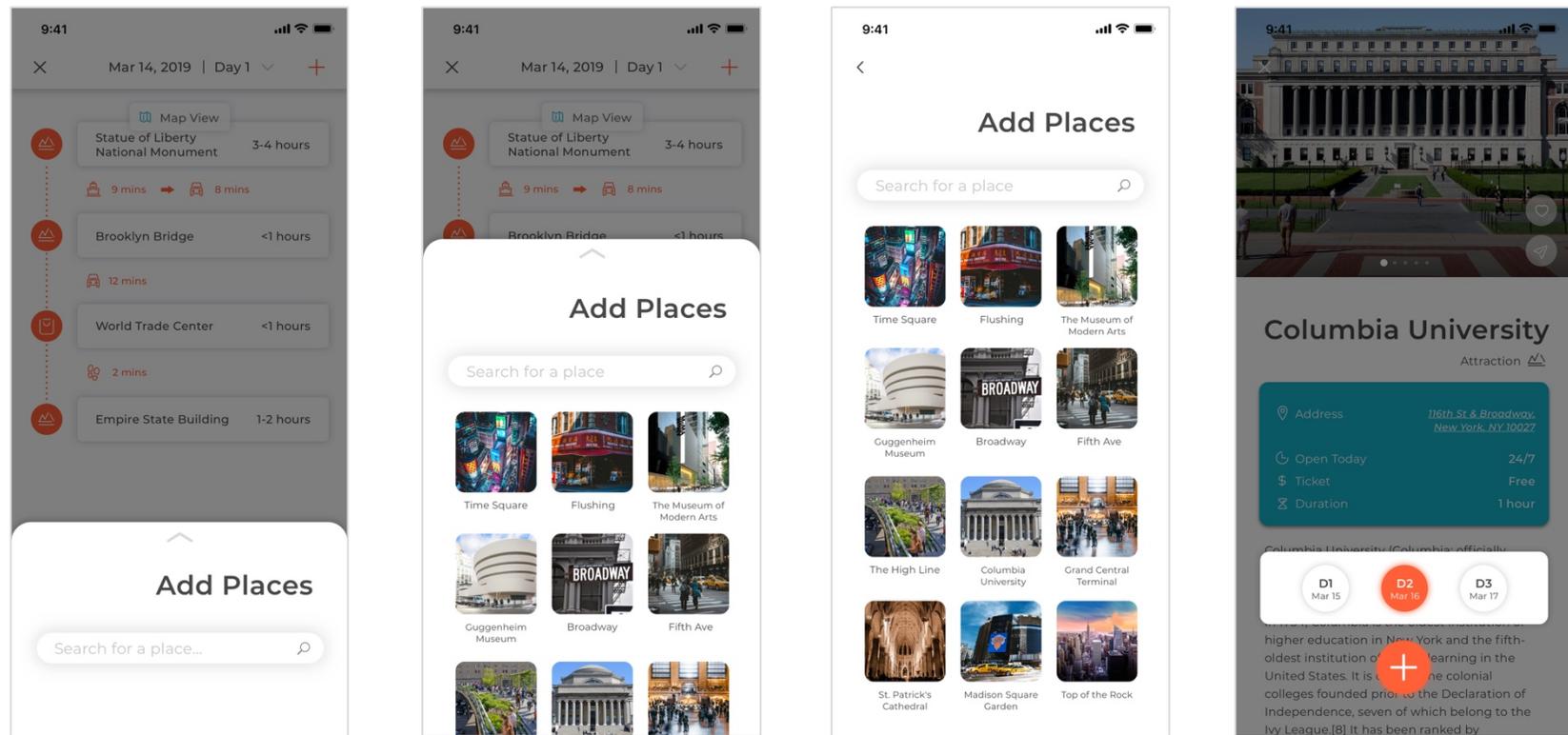


Figure 37. The Process of Adding Places

4. Checklists

Users can do both group checklist cooperatively and self-checklist privately. Every member has access to help build the group checklist by assigning items to their partners. They also can see each other's packing progress at their sides of App.

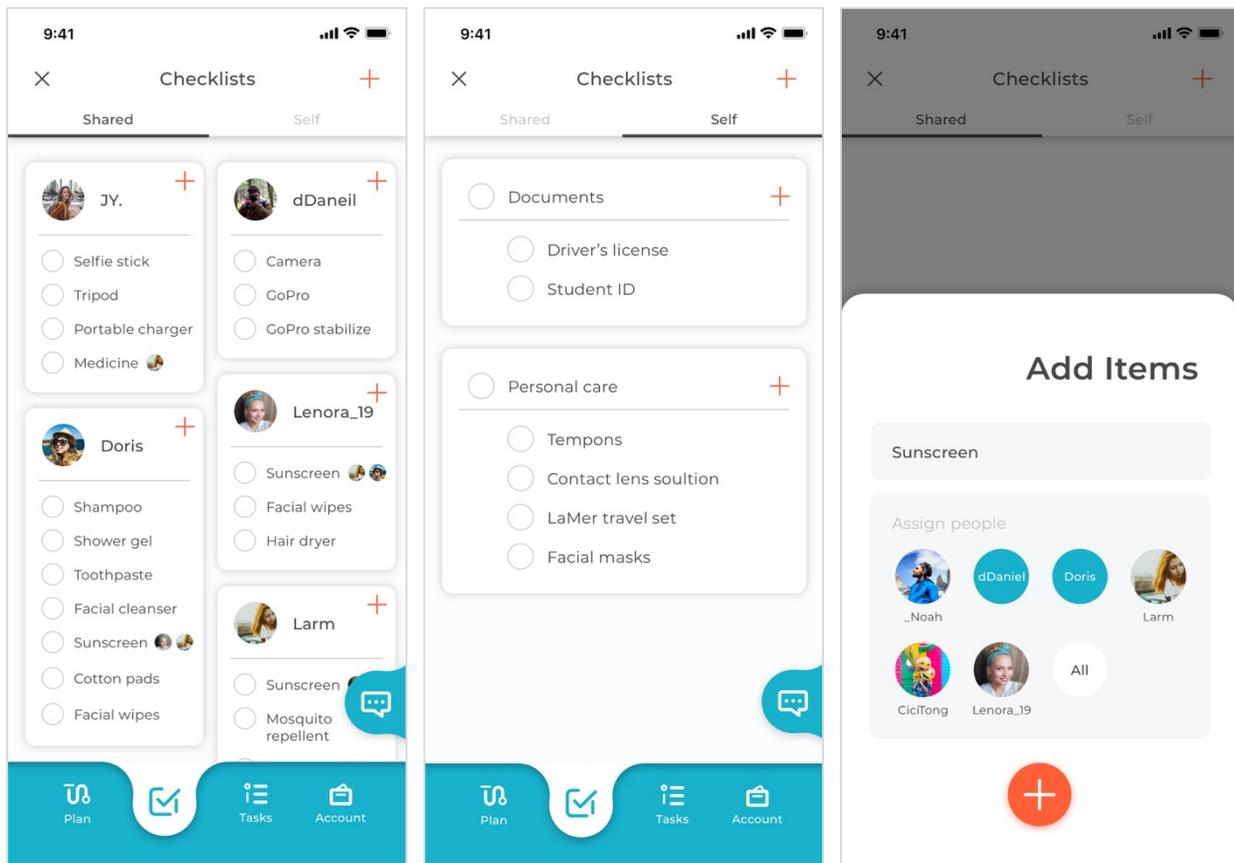


Figure 38. The Checklists

5. Tasks

CooP separates the Tasks feature into the leader version and member version. In the leader version, the group leader can assign roles and main responsibility to members. In the

member version, the group members can only see the role/title they have been assigned and detailed responsibility description.

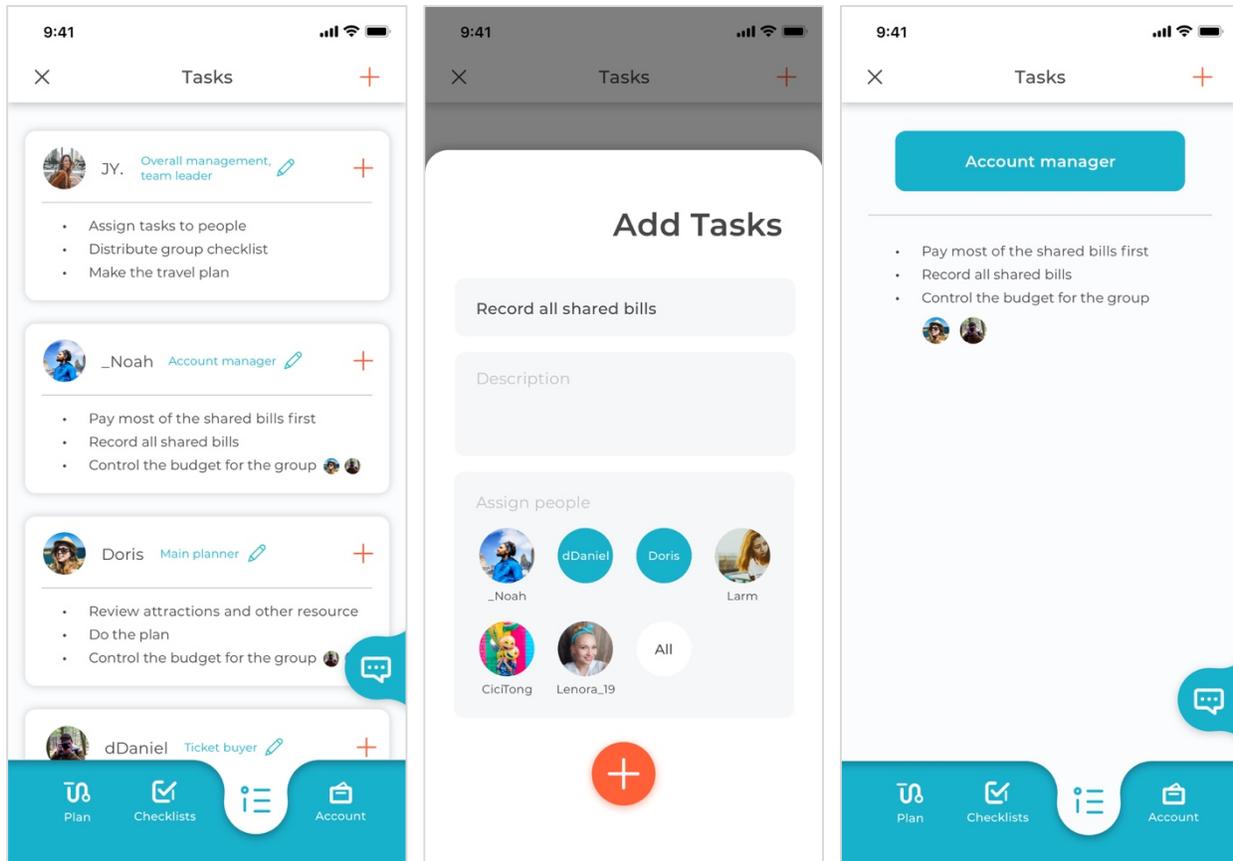


Figure 39. The Tasks

6. Accounting

Record Bills

By taking a photo of the receipt, artificial intelligence technology can recognize and extract the keywords out of the printed receipt, such as the store name, location, time, and total amount of consumption, to fill up the form automatically. The recorder only needs to select people involving in.

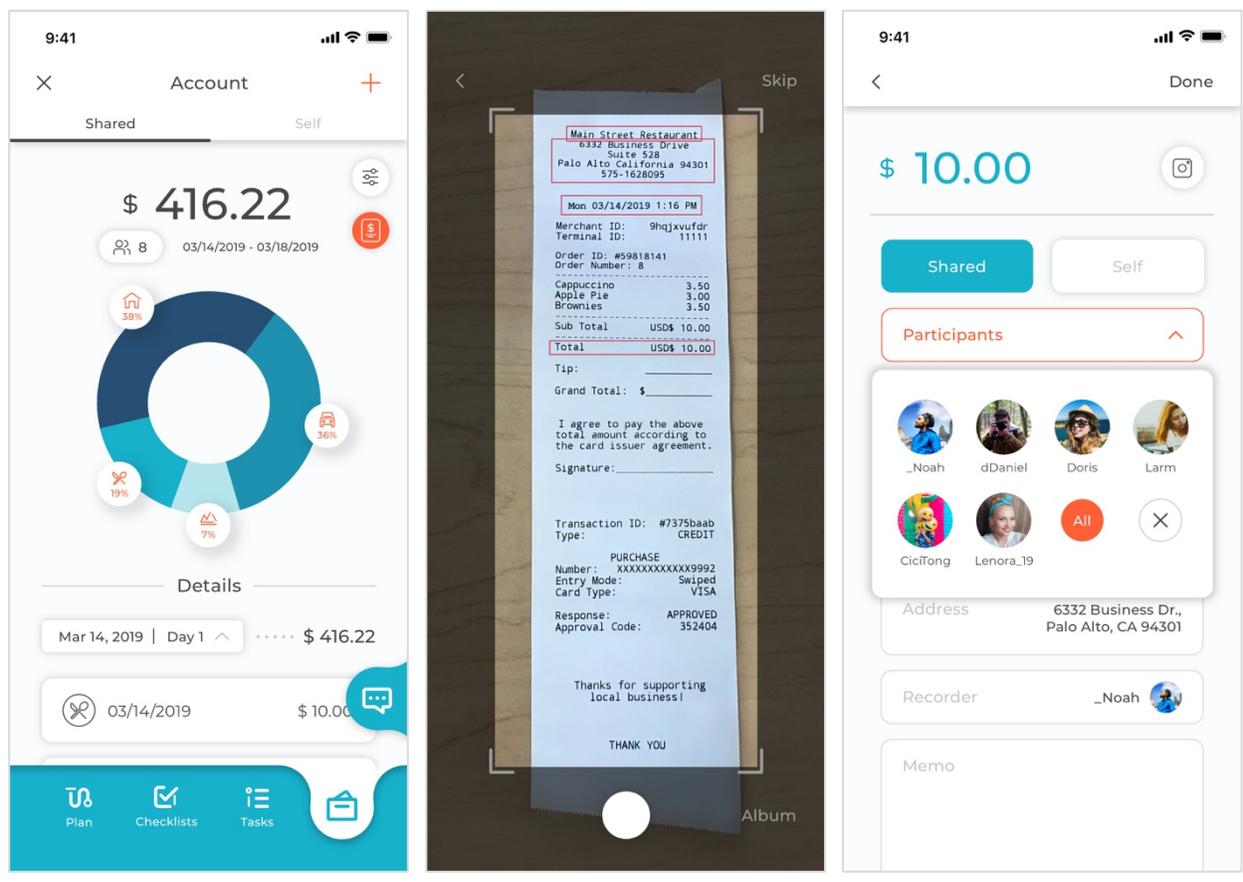


Figure 40. The Accounting

Smart Filter

By clicking a certain section of expense in the chart, this category of expense can be sorted out from all bills below. Users can also change the date to see the expense of different days.

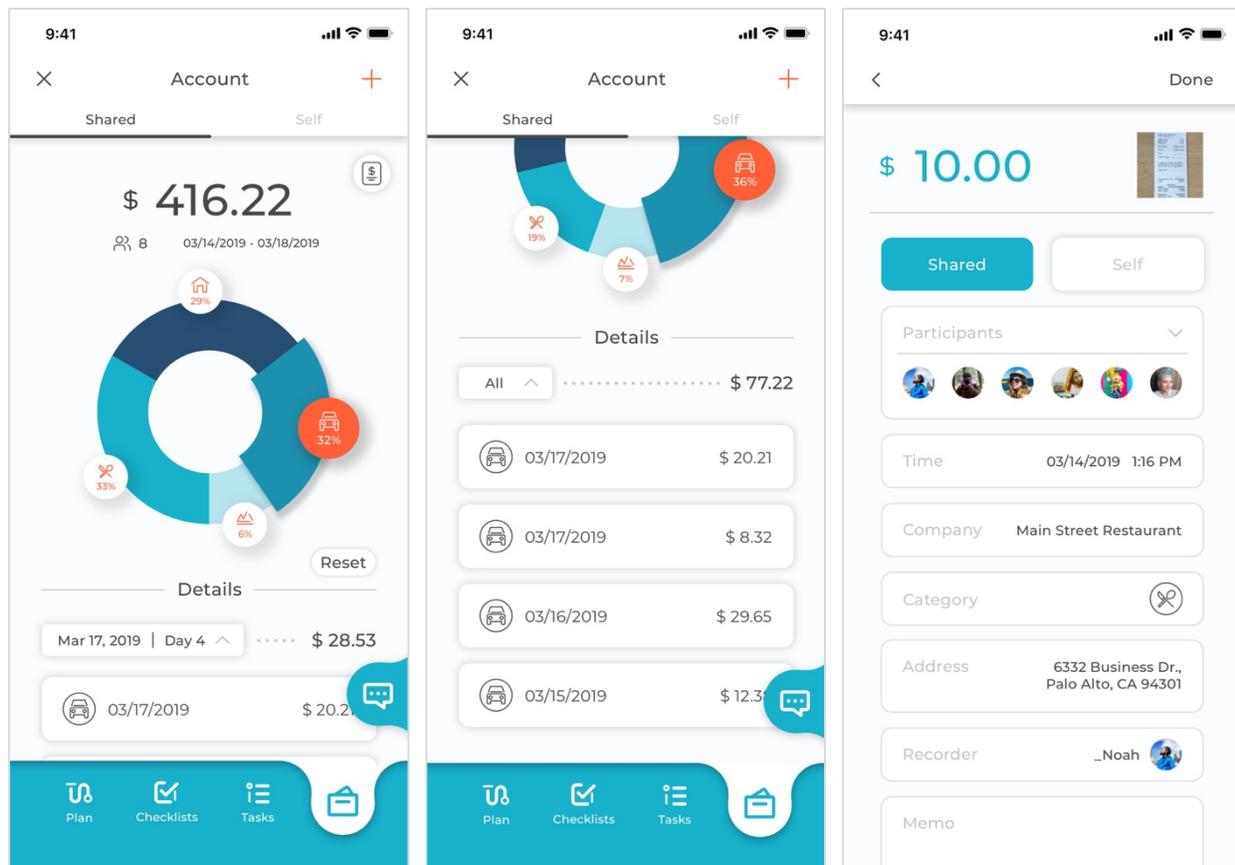


Figure 41. The Smart Filter

Budget Control Mode

For groups who have a strained financial condition, they can set up the budget control mode to help manage and save the expenditure. If the account runs a deficit, CooP will pop up a notification as a reminder.

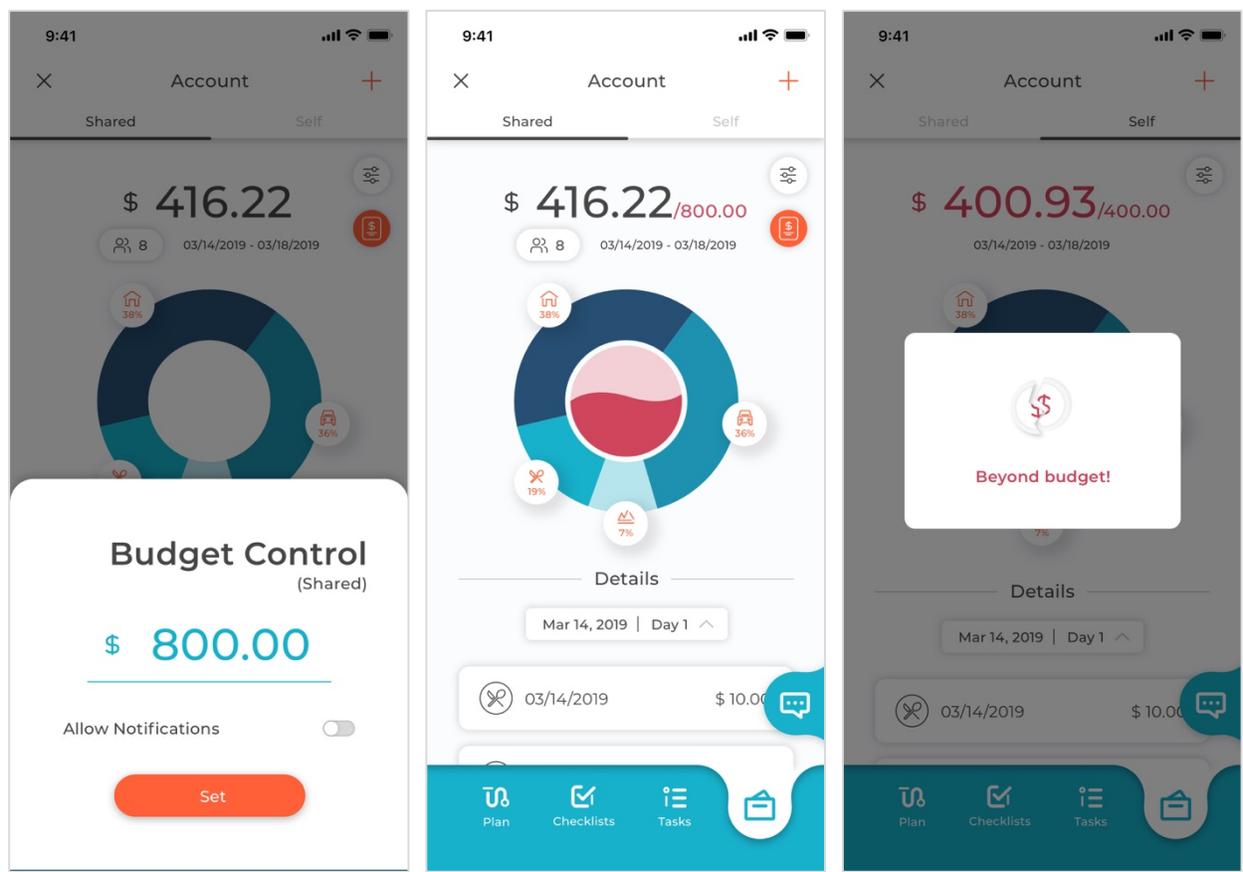


Figure 42. The Budget Control Mode

Split Bills

CooP helps users split bills automatically and gives the balance for each person, respectively. There are two ways to pay the bill: add debit or credit card in CooP; or pay in other ways manually and come back to confirm the payment.

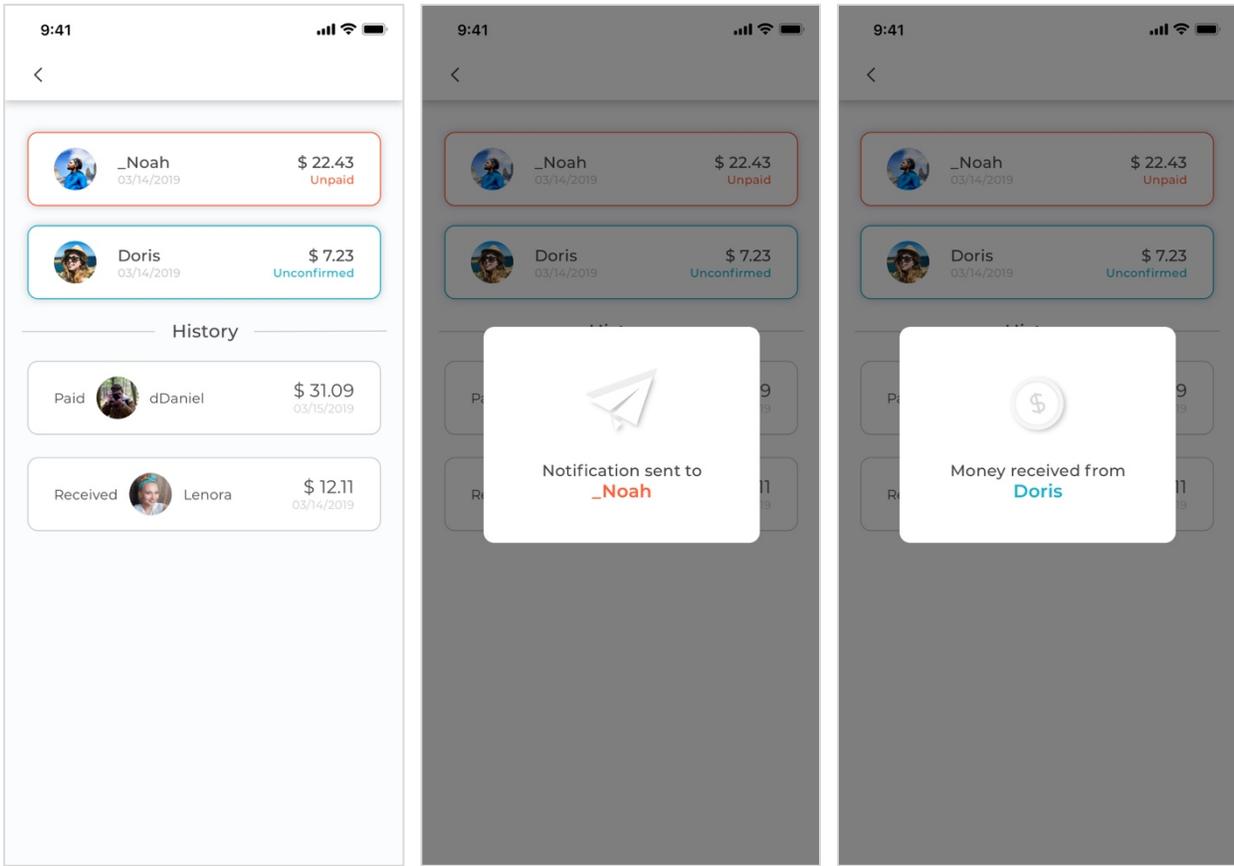


Figure 43. Split Bills

7. Group Chat

Group Chat stays at the right side of every page as a floating button to pull out the chat window easily. To receive other people’s opinion, users can put forward a poll and let the group members vote.

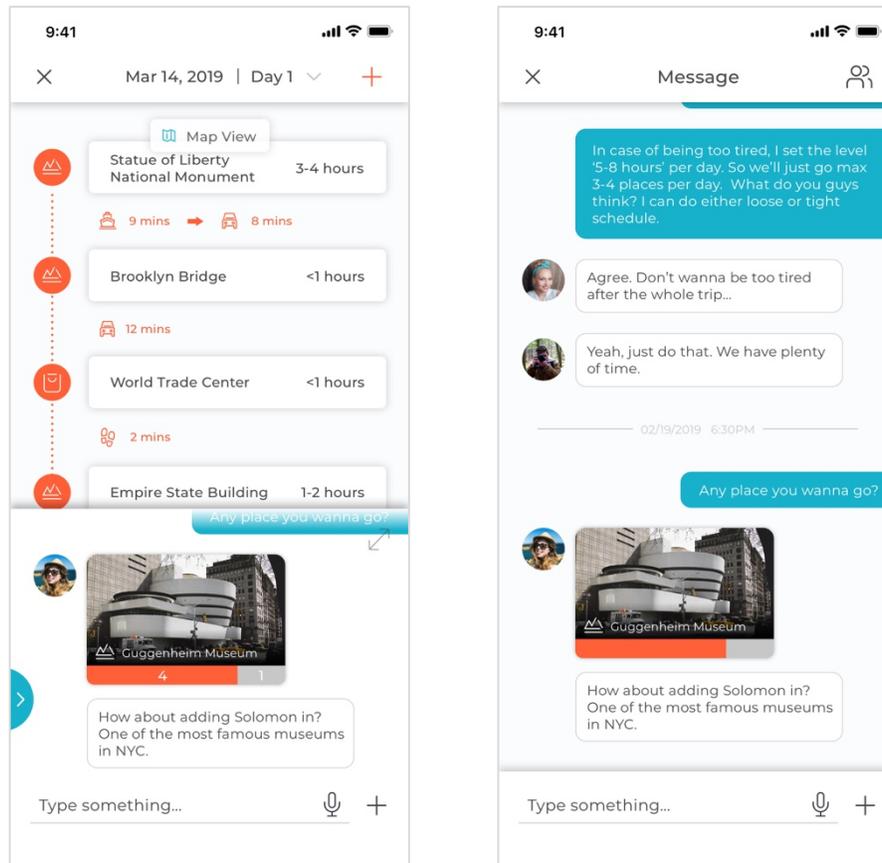


Figure 44. The Group Chat

8. Separate Group (Ongoing trip)

To separate a group is a function in the Ongoing feature. Except for making a group plan, Coop can improve the way people conduct the plan. It happens during the trip frequently that some of the members want to go their own ways. For instance, the majority of the group plans to go to the metropolitan museum while some of the others want to go shopping and search for good local restaurants. In this case, Coop can separate a group of people of the whole team and follow their track automatically with their physical devices connected.

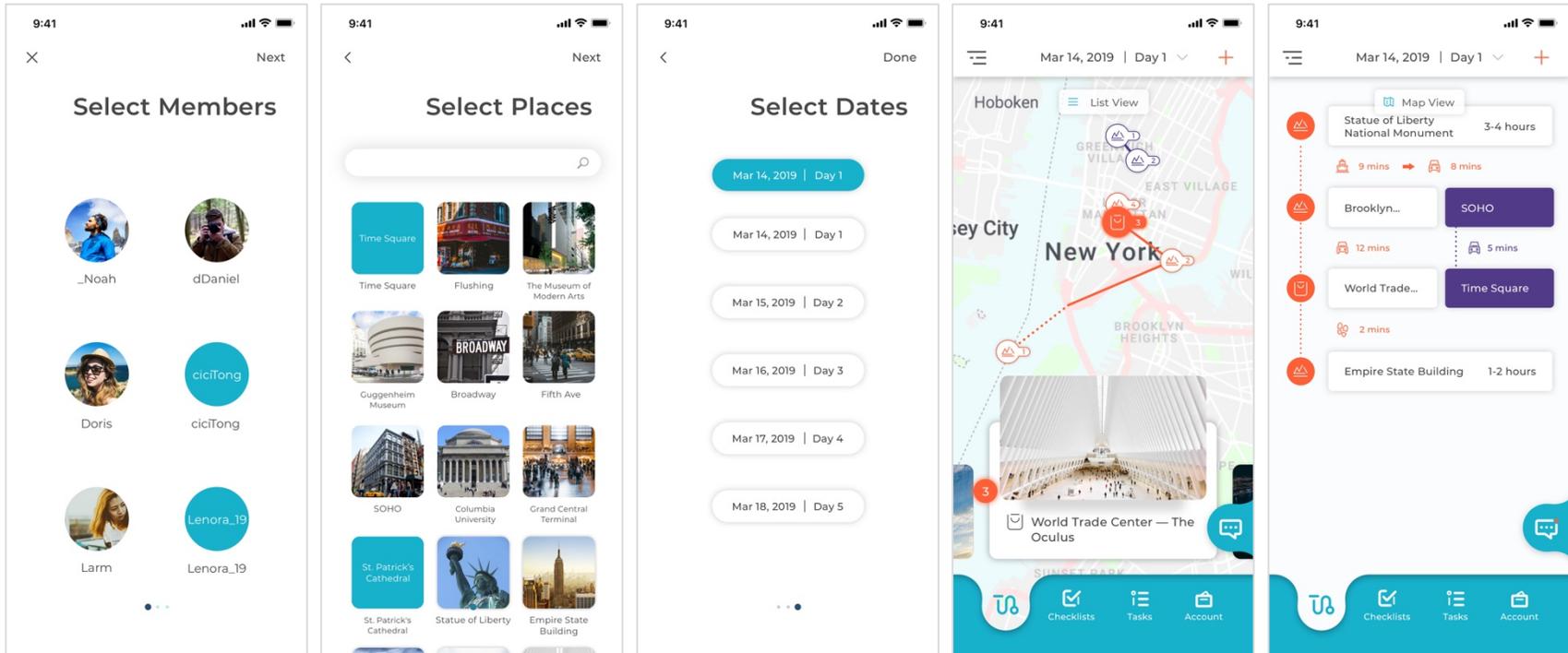


Figure 45. The Process of Dividing the Group

5.5 Physical Device

The tactility of physical products often cannot be replaced by digital products. When the users are exposed to a strange environment when traveling, having a whistle, and a button to communicate with group members can provide secure and comfort feelings. The form of the whistle and the button come from a set of mood board before the sketching phase. Some keywords were generated from the board, including durable, robust, portable, and reliable. Giving users a reliable feeling was the priority when brainstorming. While obtaining the modern look, the devices have to make the user feel like they will work in any types of environmental conditions and terrains. Therefore, many geometric shapes were used. Being approachable is one of the most important things. When an emergency occurred, the users have to quickly locate the right button to activate the right function.



Figure 46. The Moodboard for Brainstorming

3D Printed mockups helped speeding up the process. One of the key insights from the button printed model was that the location and size of the emergency button are confusing. Many testers were not sure where the button is when it is on the bottom side of the device. However, when it is placed on top, people were complaining about it is being too obnoxious and unnecessary. The final form landed itself with a button located on the top of the device which smoothly blends into the rest of the body.



Figure 47. 3D Printed Mockups



Figure 48. Mockup Testing



Figure 50. The Presentation of the Appearance Model

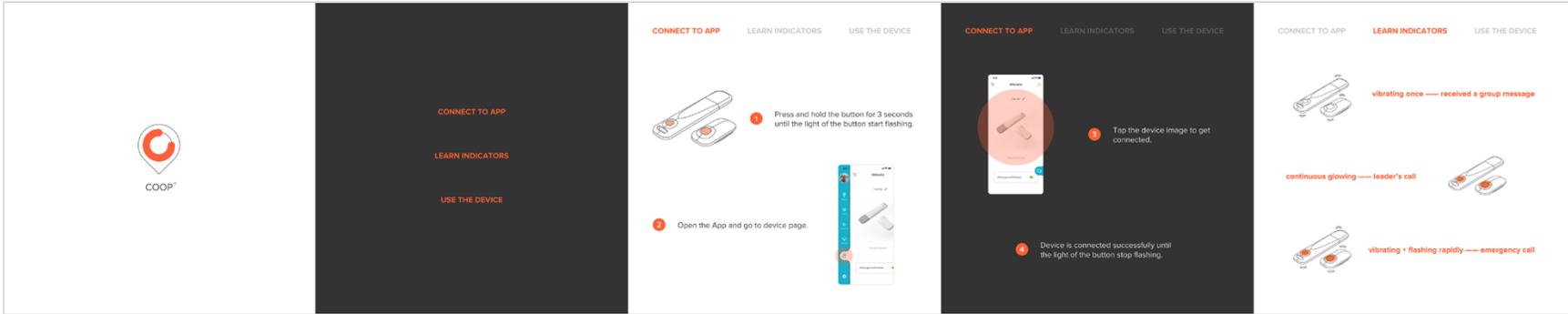


Figure 51. Instruction Manual (front page)

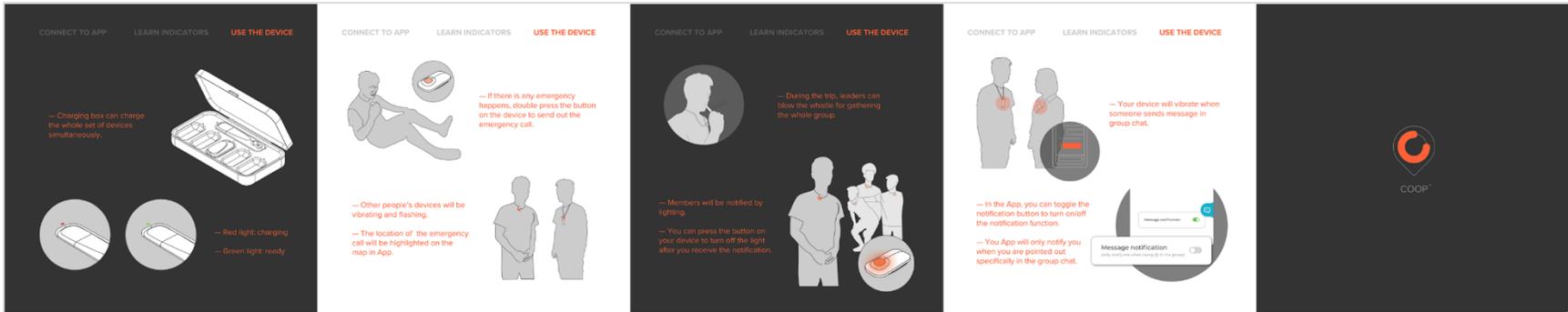


Figure 52. Instruction Manual (back page)

CooP can track people on the map with the devices connected. The separate group will be shown up as glowing points in a different color on the map (Figure 53).

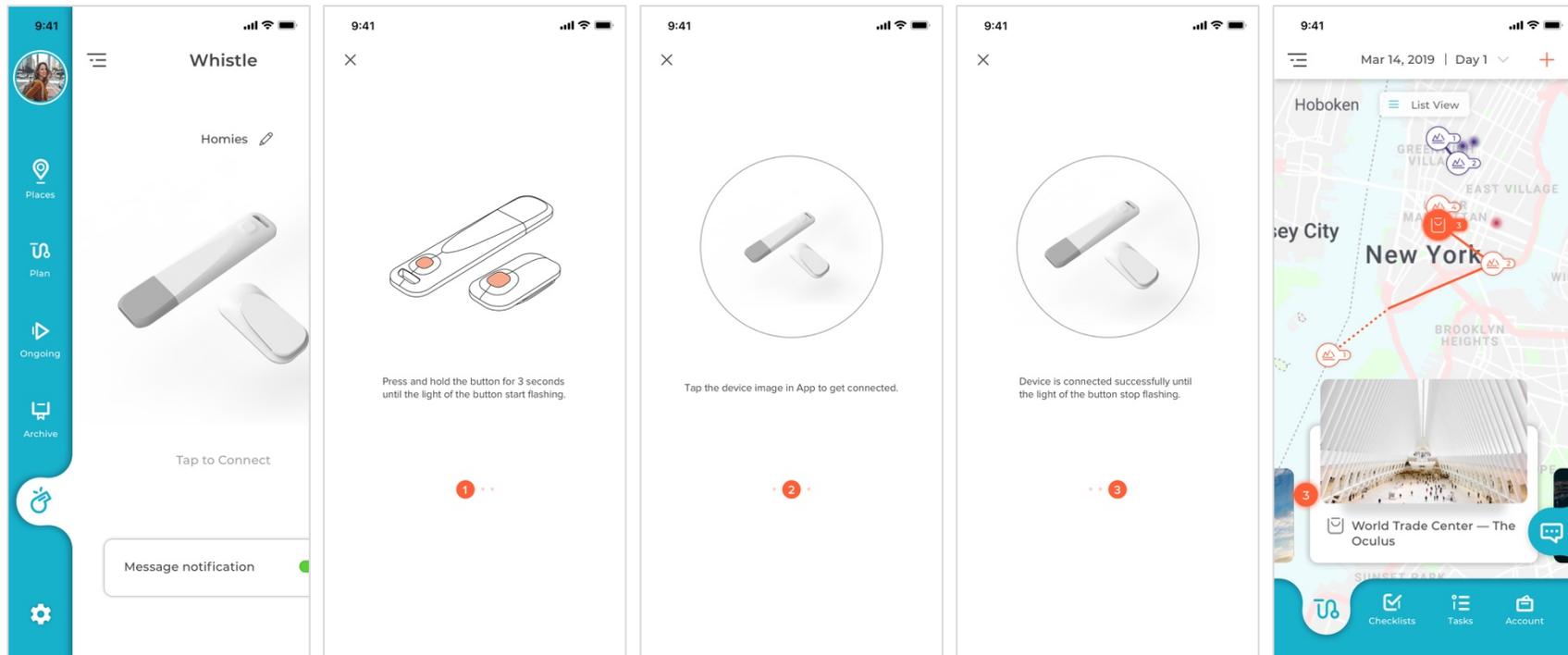


Figure 53. The Process of Connecting Physical Devices

Usage

- (Figure 54) If there is any emergency happened, double press the button on the device to send out the emergency call. Other people's devices will be vibrating and flashing. The location of the emergency call will be highlighted on the map in Coop.

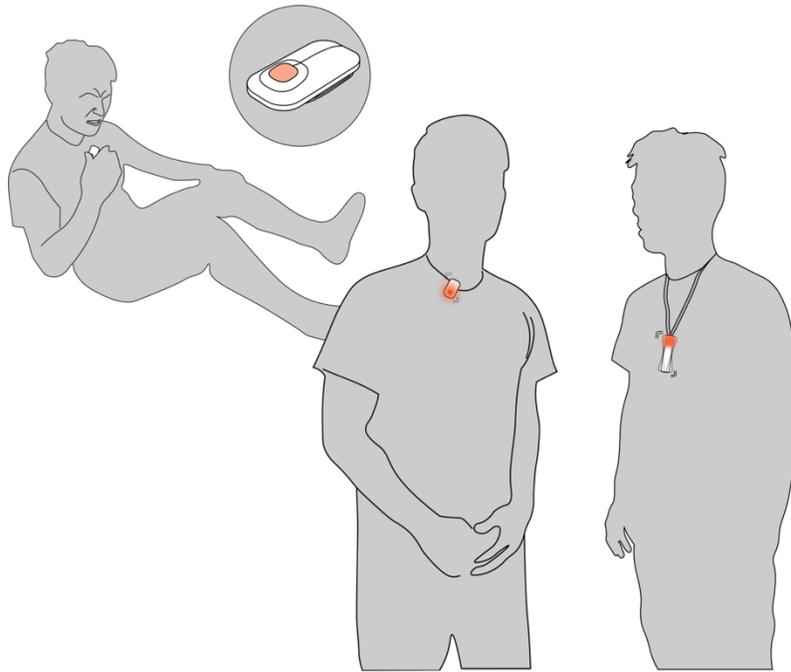


Figure 54. The Emergency Call

- (Figure 55) During the trip, leaders can blow the whistle in for gathering the whole group. Members will be notified by flashing light. Press the button on the device to turn off the light after receiving the notification.

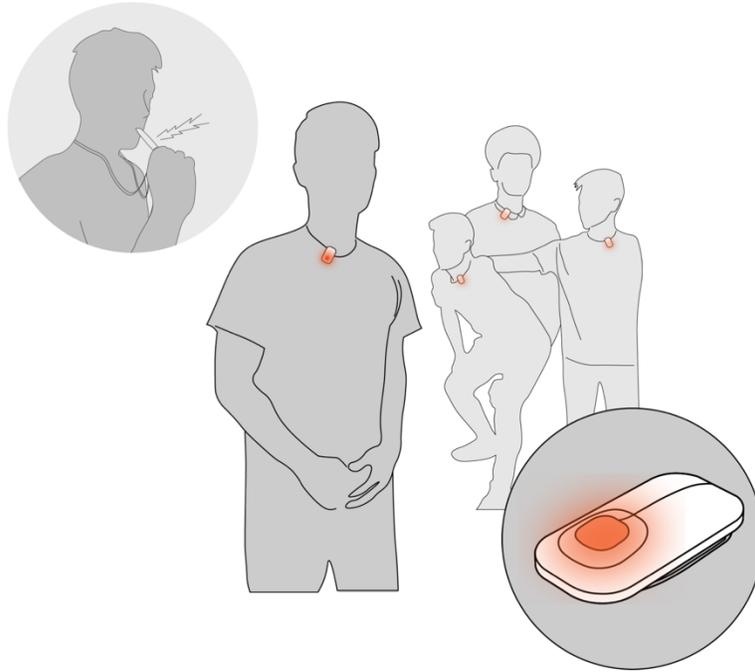


Figure 55. The Aggregating Signal

- (Figure 56) The device will vibrate when someone sends a message in the group chat. In CooP, you can toggle the notification button to turn on/off the notification function. CooP will only notify you when you are explicitly tagged in the group chat.

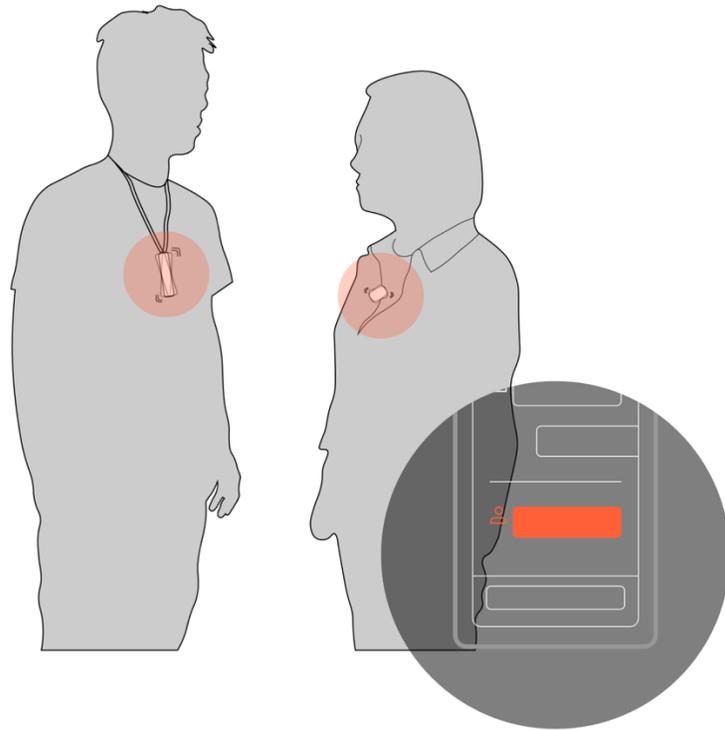


Figure 56. The Notification of Group Chat

CHAPTER 6. DESIGN EVALUATION

6.1 Paper Prototyping

Comparing to high-fidelity prototype built by Principle or Framer, the paper prototype is cheaper, faster, and also, more comfortable to annotate. Participants can just mark on paper directly by handwriting. It is more appropriate to be utilized in unofficial testing, or say pre-testing.

Before exploring the second version of the wireframe, three people were asked to do rough testing using the printed paper prototypes of the first version of the wireframe (Figure 57). The test has seven segments: onboarding questions, build a checklist, assign tasks, manage the account, add new places, group chat, and separate group. By moving forward a printed iPhone X frame through the primary process of these segments, participants roughly experienced the flow of each feature (Figure 58). I let the participants mark down the issues they found on the paper prototypes directly. Meanwhile, I observed, talked with them, and recorded the significant issues.



Figure 57. Paper Prototypes



Figure 58. Paper Prototype Testing

6.2 Usability Testing

Usability testing is an evaluation method in user-centered interaction design to test a product on live users and to get the most intuitive feedback. There are five main types of usability testing: moderated usability testing, unmoderated remote usability testing, beta testing, survey, and A/B testing. The researcher chose to use the moderated usability testing method to evaluate CoopP.

1. Introduction

CoopP is a planning App for group travel. It has its own attraction database and resources. Users can do planning, checklists, tasks, and accounting cooperatively in CoopP. While traveling, it can also improve the way users conduct the plan. CoopP is dedicating to provide a better and smooth experience of group travel planning.

2. Executive Summary

The usability testing was implemented in three experienced people separately at random places such as a library, studio, or user's home. The whole test consisted of seven separate segments of different features. Participants were arranged to manipulate high-fidelity prototypes in the smartphone. Each session took approximately 40 minutes. There are three goals of this usability testing: to assess CoopP on live users practically; whether it is successfully helpful for users or not; and what further can CoopP to be improved.

The usability testing started with a brief introduction of CoopP and a description of what participants will do in the test. Then, the task list and the question sheet were given out to them. Participants were told how to do the test and how to fill up the form. When they were doing the

test, they were observed and recorded simultaneously. After each task, they were asked to explain and discuss the details about the task. Lastly, after they finished all tasks, they were asked to do a post-test satisfaction scale of the overall user experience.

3. Participants

Three participants were recruited who have rich experience in group travel. The tests were scheduled separately, and they all completed the testing successfully.

Participant A is a young freelance photographer who travels around the whole world to take amazing pictures. She mostly does small group travels with three to five photographing enthusiasts.

Participant B is a visiting scholar at Purdue University who has traveled to so many different countries with friends and is planning to explore more places in the United States. He organized a small group of hikers back in China three years ago. He is a Ph.D. majoring in interaction design, and he was able to provide more professional suggestions during the testing.

Participant C was one of my classmates, who also was majored in interaction design. He and his wife have a lot of travel experience. He also gave many suggestions from a professional's point of view.

Table 4. Personal Info of Participants

Participant	Gender	Age	Job	Times of travel per year	Leadership-driven
A	Female	25	Freelance photographer	3-5	No
B	Male	30	Visiting scholar	3-5	Yes
C	Male	29	Student	2-3	Yes

4. Results

Quantitative Data

It shows in the table that Task 1 and 5 are relatively complicated and take participants longer time to complete (Figure 59). Participants have confusions on Task 3 and 5 and need help to continue the test (Figure 60). These confusions obstruct them to complete the test (Figure 61).

TIME TO DO THE TASK

	Participant A	Participant B	Participant C	Average
Task 1	2.13	2.82	3.67	2.87 (2'52")
Task 2	1.88	1.35	1.50	1.58 (1'35")
Task 3	0.67	1.70	1.42	1.26 (1'16")
Task 4	1.23	1.78	1.27	1.43 (1'26")
Task 5	2.62	3.37	3.23	3.07 (3'04")
Task 6	0.50	1.17	0.47	0.71 (0'43")
Task 7	0.85	1.33	0.90	1.03 (1'02")

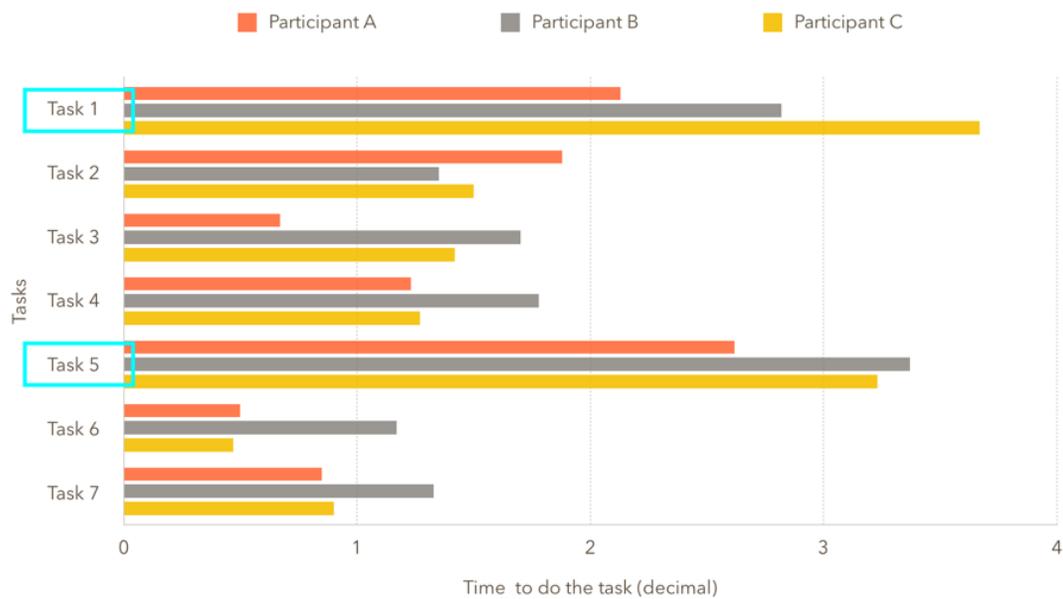


Figure 59. Result of the Time to Do the Task

NUMBER OF TIMES NEED ASSISTANCE AND TIPS

	Participant A	Participant B	Participant C	Average
Task 1	0	0	0	0
Task 2	1	0	0	0.33
Task 3	1	1	1	3
Task 4	0	0	0	0
Task 5	1	1	1	3
Task 6	1	0	0	0.33
Task 7	0	0	0	0

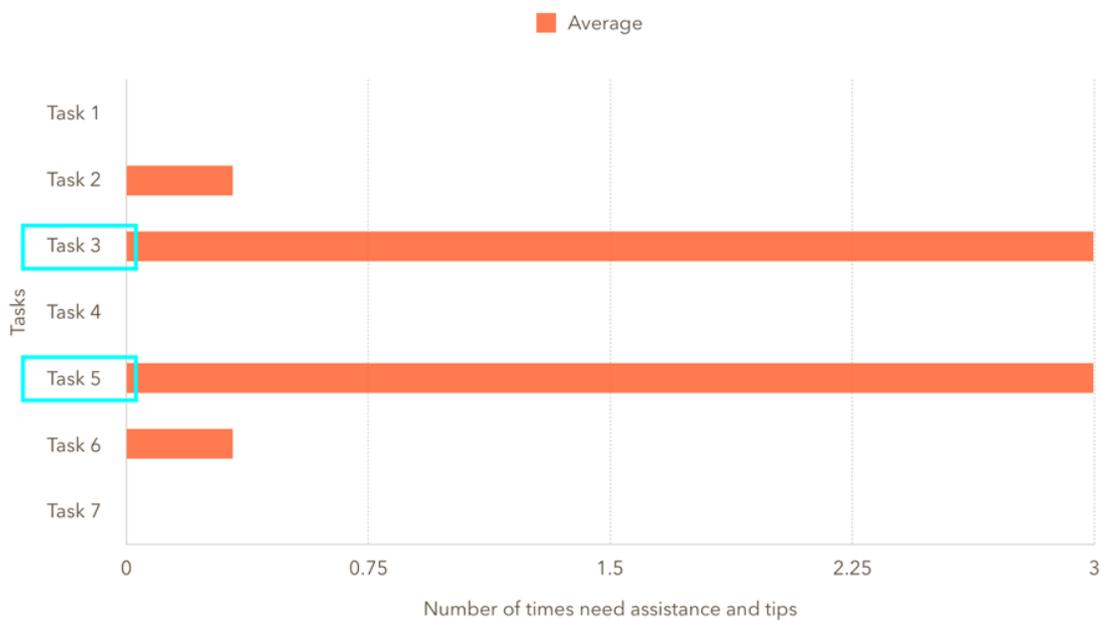


Figure 60. Result of the Number of Times Need Assistance and Tips

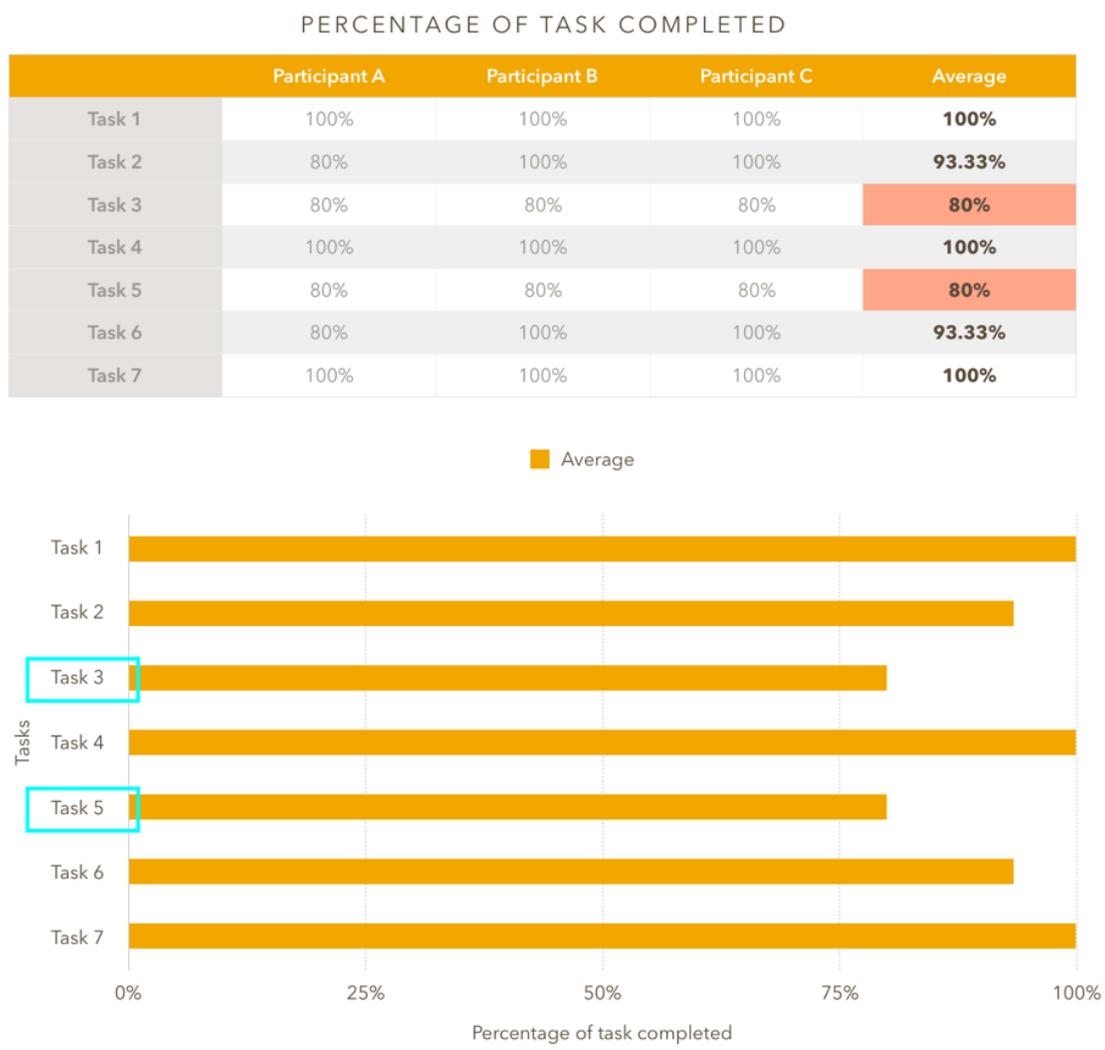


Figure 61. Result of the Percentage of Task Completed

Based on the result of the Likert Scale (Figure 62), it would be fair to say that Coop is not easy to manipulate App. User needs to be well instructed for the first time using this App. They may memorize the usage afterward. The overall App design is maintaining at a high rating level, but the font size needs to be adjusted for better readability experience.

LIKERT SCALE

	Participant A	Participant B	Participant C	Average
Learnability (ease of learning)				
1. It is easy for me to get started with CoopP.	5	4	4	4.33
2. I feel confident and easy to use CoopP without any instruction or help.	4	4	3	3.67
Memorizability (ease of memory)				
3. I can memorize the features and usage of CoopP in next time using.	4	4	5	4.33
Efficiency (speed of manipulation)				
4. I can complete the tasks efficiently using CoopP.	4	4	5	4.33
5. I think CoopP is useful and helpful to solve the overall group planning problems.	5	5	5	5
Aesthetics (visual design)				
6. I like the interface design of CoopP.	5	5	4	4.67
7. I like the color scheme of CoopP.	5	5	5	5
8. The font type/size is easy to read.	4	3	5	4
9. The icons/labels are understandable.	5	4	4	4.33
Aesthetics (visual design)				
10. All pages are going consistent logically.	4	5	4	4.33
11. I think the idea of going through an onboarding process is helpful to start a group travel planning.	5	5	5	5
12. I think it is helpful to plan and communicate simultaneously.	5	4	5	4.67
13. I like the format of the platform switching between map view and list view, and at the same time communicating with the group.	5	5	4	4.67
14. I feel helpful using CoopP to manage a group if I was a leader.	5	5	4	4.67

Figure 62. Result of the Likert Scale

The table below (Figure 63) gives information about all problems from both participants brought forward and observed.

Qualitative Data

OBSERVED PROBLEMS

	Participant A	Participant B	Participant C
Task 1	<ol style="list-style-type: none"> 1. Size of some profile's shapes are too small 2. Hard to switch features by side bar 	<ol style="list-style-type: none"> 1. Have confusion between page indicators and cross-pages (sweep left and right or sweep to the next page) 2. Can't get the idea of the bubble design 	<ol style="list-style-type: none"> 1. Hard to hit "Next" button by one-hand manipulate 2. Name suggestion according to data reviewed (AI technology) 3. Need pictures of hot places because not familiar with the destination 4. Name of the location in the map is too small
Task 2	<ol style="list-style-type: none"> 1. Font size of attraction name is too small 2. Hard to switch between attractions 	<ol style="list-style-type: none"> 1. Hard to realize the "+" button's place because all important information are placed at the bottom half part of the page. 	
Task 3	<ol style="list-style-type: none"> 1. Vote feature is ambiguous and hard to find 2. Want to drag up for expanding group chat into full screen 	<ol style="list-style-type: none"> 1. Can't complete the task of "Vote" feature 	<ol style="list-style-type: none"> 1. Can't complete the task of "Vote" feature
Task 4	<ol style="list-style-type: none"> 1. Hit "+" in the guide illustration by mistake 	<ol style="list-style-type: none"> 1. Graphic confusion of "+" in the illustration 2. Use "Done" button instead of "+" to complete the task 	
Task 5	<ol style="list-style-type: none"> 1. Hard to find "Bills" button 2. Hard to find "Budget control" button 	<ol style="list-style-type: none"> 1. "Reset" button is too small 2. "Bills" button is too ambiguous 	<ol style="list-style-type: none"> 1. Hard to find "Bills" button 2. Hard to find "Budget control" button
Task 6			
Task 7			

Figure 63. Result of the Observed Problems

5. Recommendations

Some sever problems from different tasks were filtered out and figured out by preliminary solutions (Figure 64).

RECOMMONDATIONS

Solution	Justification	Task	Severity
Redesign the page of selecting partners, change another way to visualize the data.	Participants could not read the small bubbles clearly. They didn't get the idea why I design profiles into bubble shapes.	1	Average
Give name suggestions at the very beginning according to user's recent read history.	Take advantage of AI technology to voluntarily give users recommendations.	1	Average
Add pop-up image of hot places after name be clicked.	In case that some users have no idea with the destination they plan to go.	1	High
Use the real route in map to show the mid-way places suggestion.	If some users are not familiar with the destination, App can provide them more information voluntarily.	2	High
Redesign the "Vote" feature.	All participants cannot find out the feature which is too ambiguous.	3	High
Use "Done" instead of "+" when complete adding items.	To increase the consistency of the linguistics. Use "+" to start adding an item and use "Done" to complete an adding which make more sense linguistically.	4	Average
Redesign Bill and Budget Control buttons in the account page.	All participants had a hard time finding the Bill and Budget Control buttons.	5	High
Enlarge the "Reset" button,	Button too small.	5	Low

Figure 64. Recommendations

CHAPTER 7. CONCLUSION

The purpose of this research is to explore a new mobile application platform for group travel planning to improve the experience of team communication and cooperation. By reviewing related literature and conducting preliminary research, the existing problems and potential opportunities of planning and traveling were found. Solutions were generated during the brainstorming phase: to design a mobile application assisted with a set of physical devices.

This App has a map-list alternating planning platform to help users plan the route from both visualized and literalized perspectives. When facing a difficulty to initiate a travel plan from the scratch, rich attraction information, qualified plans and itineraries are ready for utilizing in the database. Teamwork facilitation was realized in doing group checklists, distributing roles and assignments, and managing shared bills cooperatively. A group chat platform was also provided to enhance the communication experience hidden in every page corner of CooP. If there is any different opinion arises during the trip to cause the group taken apart, it can be implemented by splitting a small group of people and tracking them with the physical devices connected. The physical devices can help the leader aggregate the group and ensure the safety issue of the whole group.

Although CooP can solve problems in team communication and cooperation, there were still some issues found in the usability testing:

- Technology – to utilize more AI technology such as machine learning to provide users information voluntarily. CooP is more likely to let users plan by themselves. If there is a condition that users know nothing about the destination, it could be a challenge for them to plan all by themselves. With AI technology, information can be recommended by

identifying things users browsed and are interested in. In this case, users can work more efficiently and smoothly. Moreover, Coop will be not just a tool to plan the route, but more like a real guide during the planning.

- Map – to visualize the original route on the map instead of a straight line linked up to the locations. The functionality of the interactive map can be improved. By using the original route, Coop can provide mid-way attractions to give users more selections.
- Communication – to explore more features in the Group Chat platform to improve team communication. As it mentioned above, the user can put forward polls to collect opinions of the group. However, the group chat can be used to aggregate people along with the physical devices as well. Here is a thought that when the scheduled visiting time of an attraction is over, Coop will reminder people in the group chat to move on to next attraction. People can vote to decide if they prefer to move on or stay at this attraction a little bit longer.

The design of Coop is already exhibited at Patti and Rusty Ruff Gallery and Radio Flyer, Chicago Show successfully. It achieved a lot in creating a new way to make the group travel plan. However, further refinement is still needed which will focus on the recommendations of usability testing and the issues mentioned above. AI technology will be used more comprehensively in Coop to offer more related information. The route planned in map will be the real routes instead of straight-lines so that Coop can provide mid-way attractions for users. More features will be explored and added in the group chat to improve the way of communication.

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APPENDIX A. QUESTIONS OF ONLINE SURVEY

Q1: What's your gender?

- A. Female
- B. Male

Q2: What's your age group?

- A. Younger than 18
- B. 18-24
- C. 25-34
- D. 35-44
- E. 45-55
- F. Older than 55

Q3: What's your occupation?

Q4: What is your salary range?

- A. Lower than 1000
- B. 1000-2000
- C. 2000-5000
- D. 5000+

Q5: How often do you go traveling annually?

- A. Less than once
- B. 1-3 times
- C. 3-5 times
- D. More than 5 times

Q6: Who are your companions for most of time?

- A. Families
- B. Spouse
- C. Friends and classmates
- D. Coworkers
- E. Self
- F. Strangers
- G. Other

Q7: Do you make a travel plan before the travel?

- A. Yes, I am a detailed planner.
- B. Yes, but I just do a rough plan.
- C. No, I never do a plan.

Q8: What do you plan in your travel plan?

- A. Transportation (e.g. flight/train ticket)
- B. Accommodation

- C. Attraction
- D. Restaurants
- E. Budget
- F. Routes
- G. Detailed transportation (e.g. which bus should you take, which station should you get off)
- H. Daily schedule (e.g. when will you start off everyday, how long will you spend on each attraction)
- I. Other

Q9: Have you ever participate in any group traveling?

- A. Yes, I am the leader.
- B. Yes, but I didn't participate that much.
- C. Never.

Q10: During planning, how do you communicate with your companions?

- A. Discussing in person
- B. Using online chat Apps (e.g. Instagram, iMessage, Line, texting)
- C. Making a phone call
- D. Using web-based softwares (e.g. Google Docs)
- E. Other

Q11: During planning, how do you write down your travel plan?

- A. Writing down physically by paper and pen
- B. Saving down in Word or Pages
- C. Saving in the memo of your phone
- D. Saving in specific Apps
- E. Saving in web-based softwares (e.g. Google Docs)
- F. Other

Q12: During planning, have you ever given up any of your travel plan because of the conflict with your companions?

- A. Always
- B. Seldom
- C. Never

Q13: During planning, do you think it is hard to communicate with your companions because of the communication tools?

- A. Yes.
- B. No.

Q14: During planning, do you make a checklist for things you need to pack?

- A. Yes
- B. No

Q15: During planning, how do you make a checklist?

- A. Keep in mind
- B. Write down on paper
- C. Record in mem
- D. Record in specific Apps (e.g. TickTick, MinimaList)
- E. Other

Q16: During planning, what kind of items will you create in your checklist?

- A. Clothes
- B. Food
- C. Photography equipments
- D. Personal documents
- E. Cosmetics, skin care products
- F. Other

Q17: During traveling, how do you carry and use your travel plan?

- A. (Handwriting) have the notes on you
- B. (Digital) have them printed out
- C. (Digital) use Word or other desktop Apps to create, export as pdf and save in cell phone
- D. (Digital) use online Apps (like Google Doc) to create and log in via cellphone to check out
- E. (Digital) use specific travel planning Apps to create
- F. Other

Q18: During traveling, how do you and your partners record shared bills and personal bills?

- A. Keep in mind
- B. Write down on paper
- C. Record in cell phone
- D. Use specific accounting App to record
- E. Other

Q19: During traveling, did you have any experience that your plan was disrupted by unexpected matters?

- A. Always
- B. Not often
- C. Never

Q20: During traveling, how will you and your partners deal with this kind of problem? (e.g. You should have had lunch at a famous restaurant and then headed to next place at 2pm. However, you spend too long at last place until 2pm.)

- A. Give up the famous restaurant and heading to next place directly
- B. Give up all following things and make a new plan base on current situation
- C. Keep on doing the old plan but compress the time to catch up
- D. Other

Q21: During traveling, did you have any experience that break into more than one groups and visit different places with your partners?

- A. Yes.
- B. No.

Q22: After traveling, how do you share photos and videos with your partners?

- A. WhatsApp or Messengers
- B. Upload to Google Drive or Dropbox for downloading
- C. Exchange via Bluetooth or Air Drop
- D. Upload to USB drive and download in turns
- E. Other

Q23: After traveling, do you feel troublesome and tricky splitting bills manually with your partners?

- A. Yes.
- B. No.

Q24: Do you need to bring any specific thing with you to travel? (e.g. things that are meaningful like photos, toys or something else)

- A. Yes.
- B. No, just bring my omnipotent cell phone

APPENDIX B. MATERIAL OF USABILITY TESTING

USABILITY TESTING TASKS SHEET

1. Onboarding

1.1. Go to Plan page

1.2. Add a new plan

1.2.1. Name the trip

1.2.2. Select date period (March 15th-17th, 2019)

1.2.3. Select (5-8 hours) to be outside

1.2.4. Select partners (_Noah, dDaniel, Doris, ciciTong, Lenora_19, Larm) in order

1.2.5. Select (New York) as the destination

1.2.6. Select (Empire State Building - SOHO - Brooklyn Bridge - Statue of Liberty - Central Park) as the hot places

2. Add new places

2.1. Go to the next attraction

2.2. Get in and check out the attraction information

2.3. Exit the attraction information page

2.4. Click add button

2.5. Select Columbia University

2.6. Add it to the day 2

2.7. Switch to list view

3. Group chat

- 3.1. Pull out Group Chat
- 3.2. Expand to full screen
- 3.3. Vote the location
- 3.4. Get into the location info and add to plan

4. Checklists and Tasks

- 4.1. Go to the Checklist
- 4.2. Add an item in the shared checklist
- 4.3. Name the item
- 4.4. Select partners (Doris, Larm, Lenora)
- 4.5. Go to self-checklist
- 4.6. Go to the Tasks
- 4.7. Add a task to members
- 4.8. Name the task
- 4.9. Select partners (_Noah, Doris)

5. Manage the account as a leader

- 5.1. Go to the account
- 5.2. Add a new bill
 - 5.2.1. Take a photo
 - 5.2.2. Assign participants to all
 - 5.2.3. Save the bill

5.3. Confirm the bill

5.3.1. Go to Bills

5.3.2. Enter my bills

5.3.3. Confirm payment of _Noah

5.3.4. Click blank area to exit

5.4. Go back to main page of account

5.5. Tap transportation expense in the chart

5.6. Tap reset

5.7. Set budget control

5.7.1. Input budget number

5.7.2. Turn on the notification toggle

5.7.3. Set budget

6. Checkout the account as a member

6.1. Go to my bill page

6.2. Confirm Doris received bill

6.3. Check out self-account

7. Split a group during traveling

7.1. Click add button

7.2. Assign ciciTong and Lenora_19

7.3. Select Time Square and St.Patrick's Cathedral

7.4. Select 16th/day 2

USABILITY TESTING QUESTION SHEET

Usability Testing Question Sheet of CooP (for both participant and observer)							
Personal Information							
Participant:	Gender:	Age:	Vocation:	Date:			
Quantitative Data							
	Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7
Time to do the task							
Number of times need assistance and tips							
Percentage of task completed							
Qualitative Data							
Please talk about Task 1							

Please talk about Task 2	
Please talk about Task 3	
Please talk about Task 4	
Please talk about Task 5	
Please talk about Task 6	
Please talk about Task 7	

USABILITY TESTING LIKERT SCALE

Post-test Likert Scale of Coop (for participant)					
Personal Information					
Participant:	Gender:	Age:	Vocation:	Date:	
Satisfaction Rate (1=disagree, 5=agree)					
	1	2	3	4	5
Learnability (ease of learning)					
1. It is easy for me to get started with Coop.					
2. I feel confident and easy to use Coop without any instruction or help.					
Memorizability (ease of memory)					
3. I can memorize the features and usage of Coop in next time using.					
Efficiency (speed of manipulation)					
4. I can complete the tasks efficiently using Coop.					
5. I think Coop is useful and helpful to solve the overall group planning problems.					

Aesthetics (visual design)					
6. I like the interface design of Coop.					
7. I like the color scheme of Coop.					
8. The font type/size is easy to read.					
9. The icons/labels are understandable.					
User Experience (App flow)					
10. All pages are going consistent logically.					
11. I think the idea of going through an onboarding process is helpful to start a group travel planning.					
12. I think it is helpful to plan and communicate simultaneously.					
13. I like the format of the platform switching between map view and list view, and at the same time communicating with the group.					
14. I feel helpful using Coop to manage a group if I am a leader.					

15. Anything else to complement?	
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