

Copyright is owned by the Author of the thesis. Permission is given for a copy to be downloaded by an individual for the purpose of research and private study only. The thesis may not be reproduced elsewhere without the permission of the Author.

An evaluation of conversational interfaces for pedestrian navigation

A thesis presented in partial fulfilment of the requirements for the degree of

Master of Information Technology

Institute of Natural and Mathematical Sciences
Massey University, Albany
New Zealand

NATTAKAN LONGPRASERT
2017

An evaluation of conversational interfaces for pedestrian navigation

Abstract

The aim of this research was to compare the performance between the OsmAnd application and three types of conversational interface, to test whether the conversational interface is a more preferred navigation tool. We designed and tested four different navigation systems; the map with command interface, the conversational-only interface, the conversational with map interface, and the conversational with image interface. The research involved 100 participants who had different levels of experience when using navigation systems. Participants were divided into three groups and were given different navigation interfaces. This research was conducted with both quantitative and qualitative usability testing along a pre-defined route in Massey University campus, combined with a USE questionnaire to gain the user's feedback. The results indicated that both the OsmAnd and the conversational interface were good in different criteria. However, most participants preferred using the conversational interface more than the visual interface.

Key Words: conversational interface, pedestrian navigation system

Acknowledgments

I would like to thank many people who have supported me during my Masters thesis. I would like to thank my family and my partner for their support, love and understanding during my most difficult times. Without them I would not be myself now.

I would like to thank and express my gratitude to my supervisor Dr. Kristin Stock for her guidance and encouragement in many aspects of my Masters study. She has always been supportive, has answered all my questions and has cheered me up and re-built my confidence in difficult times.

I would like to thank Massey University for providing me the opportunity to complete this Masters thesis and enhance myself. I also thank Annette for providing me vouchers whenever I asked for them.

My thanks to all participants who helped me run the survey. Without them I would not have been able to finish my study.

I would like to thank my manager and colleagues in the Leaps and Bounds Early Learning Centre for giving me support and understanding during my study.

Lastly, I would like to thank all my friends who have cheered me up and helped me during my study. Especially, Frank who helped me to sort my coding out.

Dedication

My Father and Mother: Thanks for all your love and support you both have given me. I am so proud to be your daughter. Every time I feel down, I was thinking of both of you that made me want to move forward. Thanks for believing in me.

My Aunty Nee: Thanks for your big support and for guiding me about life and the importance of study. Without your support, I would not have been able to study overseas which I never expected to have this opportunity in my life.

My brother (Golf) and sister (Gift): Thanks both of you for being a lovely brother and sister. I am glad to be your big sister. Thanks, Golf for taking care of our parents and our sister while I am miles away.

My other half: Thanks for everything, Joey. Thanks for helping me settle down in Auckland. Thanks for your all support and always being by my side in my most difficult times. Thanks for wiping up my tears when I cried and for laughing with me when I was happy.

I love you all....

Contents

Abstract.....	2
Acknowledgments	3
Dedication	4
Chapter 1	10
Introduction.....	10
1.1 Background	11
1.1.1 The OsmAnd Map	11
1.1.2 The conversational interfaces	12
1.1.3 Advantages and disadvantages of using navigation systems	13
1.2 Aim and Objectives.....	14
1.3 Research questions.....	15
Chapter 2	16
Literature review	16
2.1 Existing navigation systems for vehicles	16
2.2 Existing navigation systems for pedestrians.....	19
2.3 Elements for improving navigation systems.....	21
2.4 Speech recognition technology.....	23
2.5 Existing speech interfaces in other fields	24
2.6 Existing speech interfaces with navigation systems.....	25
2.7 The conversational/dialog interfaces.....	26
2.8 The nature of conversation and conversational analysis	28
2.9 Summary.....	29
Chapter 3	30
Methodology	30
3.1 Usability Study Methodology.....	30
3.1.1 Pilot Study	30
3.1.2 Participants.....	31
3.1.3 Experimental Design.....	31
3.1.4 The questionnaire	33
3.1.5 Interview	34
3.2 User Evaluation Testing Protocol.....	35
3.3 Data collection Techniques.....	39
3.3.1 The observation (all recorded data)	39
Chapter 4	42
Prototype design.....	42
4.1 The Overview of the Design	42
4.2 Software components.....	44

4.2.1 Android studio.....	44
4.2.2 API.AI	44
4.3 Functionality.....	50
4.3.1 The conversational function.....	50
4.3.2 The map floating function	55
4.3.3 The image function	55
Chapter 5	57
Results	57
5.1 Participant characteristic analysis	57
5.2 Route analysis.....	59
5.2.1 The Overview of the route tracking	60
5.2.2 The map with command interface (Group A).....	61
5.2.3 The conversational interface (Group B)	63
5.2.4 The conversational with map interface (Group C).....	65
5.2.5 The conversational with images interface (Group D).....	66
5.2.6 The average distance for each location in different groups	67
5.2.7 The differences of the average for distance in different groups	68
5.2.8. Summary.....	68
5.3 Time-taken analysis	70
5.3.1 The average of time-taken analysis for each location.....	70
5.3.2 The differences of the average time-taken of each group	72
5.3.3 The difference in average time taken gender	73
5.3.4 Time taken analysis for different groups of navigation interface	75
5.3.5 Summary.....	75
5.4 The conversational analysis	76
5.4.1. Results of the user’s utterances for three groups of conversational interfaces in initiating moves	77
5.4.2 Results of the user’s utterances for three groups of conversational interfaces in response moves.....	78
5.4.3 Results of the user’s utterances for three groups of conversational interfaces in ready moves.....	79
5.4.4. Summary.....	80
5.5 Usability questionnaire analysis	80
5.5.1 The user’s attitude questions analysis.....	80
5.5.2 Effectiveness and Efficiency questions analysis	82
5.5.3 The average of USE questions analysis.....	88
5.5.4 The average and max and min of the total across all questions for each map	89
5.5.5 Future improvement questions analysis	92
5.6 Interview analysis.....	94
5.6.1 Summary.....	96
Chapter 6	97
Discussion and recommendations.....	97

6.1 The problem with the noisy environment.....	98
6.2 The problem with OsmAnd’s commands	98
6.3 Recommendations	99
6.4 Answering the research questions	100
Chapter 7	102
Conclusion	102
Chapter 8	103
Reference	103
Chapter 9	113
Appendices.....	113
Appendix A: Lists of example questions.....	113
Appendix B: User instructions for the OsmAnd application.....	114
Appendix C: The consent form.....	115
Appendix D: The questionnaire Group A	118
Appendix E: the questionnaire Group B, C, and D	126
Appendix F: Interview questions.....	134
Appendix G: The structure of the experiment	135
Appendix H: The brochure	137
Appendix I: The average of USE questions calculation by SPSS.....	138
Appendix J: Categories of the user’s utterances.....	142

List of figures

Figure 1 The OsmAnd application	11
Figure 2 The conversational interface.....	12
Figure 3 Voice Recognition based on the speaker.....	24
Figure 4 The conversational analysis process	28
Figure 5 The participant is testing the interface	32
Figure 6 OsMoDroid.....	39
Figure 7 Stopwatch	40
Figure 8 Voice Memos	40
Figure 9 The conversational interface.....	42
Figure 10 Overview of the Design.....	43
Figure 11 The API.AI process.....	44
Figure 12 API.AI (Agents)	45
Figure 13 The route from the starting point to destination	45
Figure 14 Api.ai (API keys).....	46
Figure 15 Api.ai (Intents)	46
Figure 16 Api.ai (Entities)	47
Figure 17 API.AI (An example of entity).....	48
Figure 18 API.AI (The entity's process)	48
Figure 19 Api.ai (Contexts)	49
Figure 20 API.AI (Responses from the system)	49
Figure 21 Coding with ACCESS_TOKEN keys	50
Figure 22 Coding with each waypoint.....	51
Figure 23 The conversational with map interface	55
Figure 24 The conversational with image interface.....	56
Figure 25 The graph of age of four groups.....	58
Figure 26 The graph of experiences of four groups.....	58
Figure 27 The overall of the route tracking.....	60
Figure 28 The route results of group A.....	61
Figure 29 The route that many participants in Group A got lost (First point).....	62
Figure 30 The route between the book shop and The Sir Neil Waters Lecture Theatres	62
Figure 31 The route that many participants in Group A got lost (Second point).....	63
Figure 32 The route results of Group B.....	63
Figure 33 The area that most participants were suffered from wind	64
Figure 34 The route results of Group C.....	65
Figure 35 The route results of group D.....	66
Figure 36 The average distance for each location in different groups.....	67
Figure 37 The graph of the time-taken analysis for each location	70
Figure 38 The different in average time-taken for gender.....	73
Figure 39 The difference in average time-taken for age	73
Figure 40 The difference in average time-taken for experience with navigation	74
Figure 41 The graph of time-taken (Max & Min) for different groups of navigation interface	75
Figure 42 The graph of the user's utterances for three groups of conversational interface (The starting sentences).....	77
Figure 43 The graph of the user's utterances for three groups of conversational interface (the middle conversation sentences).....	78

Figure 44 The graph of the user's utterances for three groups of conversational interface	79
Figure 45 The results of P2.1	82
Figure 46 The results of P2.5	83
Figure 47 The results of P2.2	83
Figure 48 The results of P2.3	84
Figure 49 The results of P2.4	84
Figure 50 The results of P2.6	85
Figure 51 The results of P2.10	86
Figure 52 The results of P2.11	86
Figure 53 The results of P2.12	87
Figure 54 The results of P2.13	87
Figure 55 The results of P2.14	88
Figure 56 The average of USE questions analysis	88
Figure 57 Mean and max and min of the total across all questions for Group A.....	89
Figure 58 Mean and max and min of the total across all questions for Group B.....	90
Figure 59 Mean and max and min of the total across all questions for Group C.....	90
Figure 60 Mean and max and min of the total across all questions for Group D.....	90

List of tables

Table 1 Four groups of participants	31
Table 2 The selection criteria for user study	35
Table 3 The experiment's step	37
Table 4 The average distance between each location in different groups	67
Table 5 The different of the average for distance in different groups	68
Table 6 The mean time-taken of four groups.....	71
Table 7 The differences of the average time-taken of different groups.....	72
Table 8 The average response figures across all the questions for four interfaces.....	91
Table 9 The average response figures across all the questions for Three conversational interfaces.....	91
Table 10 Types of questions created by participants.....	94