MobileSync Web
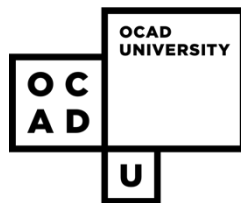
A study of user experiences for webpage interactions on computers

working with mobile technology

by

Chen Ji

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Abstract

With the development of mobile technology, smartphones have become a necessity in our daily lives. Various sensors and multi-touch screens of smartphones have contributed to a large amount of functional and excellent mobile applications and games. However, the support on interactive webpages is not sufficient. Since, in the most circumstances, smartphones are available when people use computers to browse webpages, I consider whether mobile technology might be effective to enhance the user experience when people browse webpages on computers and whether it has the potential to be a new way for web interactions. Through researches, mainly user testing, and analyzes, a project as a form of interactive webpage integrating mobile technology shows the potential needs of this combination. This project proposes a new way for people to browse interactive webpages which can lead user experiences, by use of mobile technology, to a new place.

Keywords: mobile sensors, multi-touch screens, web interactions, web design, mobile remote control, web synchronization on multiple displays, screen gestures control, motion gestures, user experiences on web, web app

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Chapter 1 - Introduction

The thesis aims to explore how mobile technology (multi-touch screen and sensors) might work for enhancing user experiences while browsing interactive webpages on computers. A study with use of mobile technology, as a project through a series of user testing and some other research methods, shows the value and impact for the development of web interactions.

1.1 Background

Firstly, a concern of this study comes from smartphones. It is widely acknowledged that smartphones have profoundly changed the way we live. Due to the revolutionary storm in the mobile industry in 2008 and 2009, smartphones now work as pocket computers, and the adoption rates are extremely high in major markets (Banga & Weinhold, 2014). The functions of smartphones are not simply limited to message texting, music playing, and contact information anymore. With the creation and development of mobile application stores, Apple has more than 900,000 apps in its store, and Android has around 700,000 (Banga & Weinhold). According to the statistics on statista.com (statista.com, 2015), Apple's digital distribution platform for mobile application – App Store has 20

different categories, namely: Games, Business, Education, Lifestyle, Entertainment, Utilities, Travel, Books, Health and Fitness, Music, etc. The new "App economy" leads smartphones to its age.

I watched a TV commercial that boasts a smartphone. In the commercial, books, maps, utilities, cash had been eliminating one by one, and a smartphone eventually turned out as the commercial product. In fact, this commercial tells a truth that smartphones do work as a magician. With our mobile phones, we can make phone calls, send / receive emails, buy online and pay bills, book tickets, navigate locations, check the weather forecast, manage bank accounts. It seems like everything can be dealt with on our mobiles. Moreover, an enormous advantage of mobiles is that they are of course portable. Smartphones can be put in clothing's pockets or handbags. Compared with laptops, smartphones can deal with so many things as laptops, but are more convenient than laptops to carry. A phenomenon now is becoming a trend that people often browse webpages on their phones during the time commuting on the way to offices or back home. A statistic shows that people have spent more time online with their mobiles than with their computers now (Oliveria, 2015). A study of testing user habit on mobiles has found that browsers of phones have been used on the move (Sahami Shirazi, Henze, Dingler, Kunze, &

Schmidt, 2013). In terms of web browsing on mobiles, it seems to have great potential to develop.

A topic I discuss further is user experiences of web interactions. Although the features of portable and versatile make mobile as a necessity, when it comes to webpages on the mobile platform, a drawback limits its development. The opposite of mobile phones' portable is their limited screen sizes. Regardless of how mobile technology develops, screen sizes and portable are the two sides of a coin. It is possible that a balance between screen sizes and portable will be found out one day; however, its user experience still cannot be compared with computer screens. On mobile websites, there are many sacrifices to solve mobile screen sizes' problem and responsive web design (which will be discussed later in this thesis) is one of the representatives as a solution of limited screen sizes and mobile friendly ("Rolling out the mobile-friendly update," 2015). Additionally, many companies of creating websites have weak support on mobile platforms. The content which is not optimized for mobiles is struggling in user experiences.

Concerning a scenario that people have both computer and mobile is quite common, my thought is whether it is possible to exploit mobiles to

improve user experiences on computers since mobile technology has been developed quite maturely. It is an intriguing topic for me because I am interested in web interactions and I have found that it is possible to take advantage of mobile technology and computer screen to enhance user experiences of websites.

1.2 Motivation

I had worked for digital agencies as a graphic designer and Flash animation designer for a few years in the advertisement industry. In my early career, I had seen plenty of intriguing and fantastic webpages made by Flash which had obsessed me. I have gotten a great passion on interactive webpages since then. However, in my personal opinion, when it has come to HTML5 age, the development of technology has not taken web interactions to a higher level. Although many interactive websites are very intriguing and creative, most of them are still conducted by mouse-based interactions, such as the parallax effect. In my opinion, there is a trend which seems to lead web interactions to a higher level.

Since televisions have become popular in our daily lives, electronic screens are increasingly important for our entertainment. Everyone

nowadays has more than one screen, from televisions to computer monitors to cell phone screens. There is an integration between different screens. For example, social media shares campaigns with television shows. Audiences can share their views on social media while they are watching the TV shows. Nintendo's Wii U is another example showing how two different type of media integrate as two screens working together. Wii U's tablet-like gamepad can act as a remote controller for the TV (Morris, 2012). Users are also able to read reviews on the gamepad and watch trailers on the gamepad as a 2nd screen. Nintendo believes that non-gaming entertainment on consoles to watch programs has been underestimated. I agree with this view. With the development of mobile technology, I believe it is the key that the mobile has the capability to extend more intriguing web interactions. Because mobiles have the multi-touch screen and various sensors. It can be as a second screen and enrich forms of interactions. Moreover, phones now become the entry for people to connect social networks. It is an advantage that interventions of mobiles in web browsing conduct a powerful dissemination. This is the reason I focus on this topic as my thesis project. This thesis is not trying to develop new technology in the technical section, but to utilize the existing technology to solve problems and enhance user experiences in the design section. In the book "research methods for product design",

the authors Alex Milton and Paul Rodgers indicate that "design research is not concerned with what exists but with what ought to be (2013)." From the aspect of user experience, I will consider how to use features of mobile, including its sensors and the multi-touch screen, to bring better user experiences to interactive webpages.

This study is not only a research project but also an opportunity to benefit the Internet. As the rise of technology and network companies, the user experience is the area being increasingly paid attention to. In some points of view, it is considered as a key factor in Apple's success, which the company really cares about the user experience (Bajarin, 2015). Apple boasts user satisfaction of using its products in the conferences every year. I believe that mobile technology will enrich web interactions tremendously, and excellent user experiences as the result can keep and attract users. With more attractive web interactions, websites will become more appealing as a sort of media with great potential. More specifically, a merchandise will become more compelling through rich dynamic effects. It can lead to a valid online purchase. Furthermore, as this study concerns both mobiles and computers, which are all digital devices, it provides a premium environment that can get data easily. Technology companies all know how crucial it is to learn from users. Through an

interactive website combining mobiles, user data can be collected automatically. Overall, my study of this thesis aims to detect the potential of a new way of web interactions working with mobile technology and see whether it can bring a better user experience and benefit e-business vendors and networking companies.

Chapter 2 – Literature Review

This chapter aims to explore the currently substantive findings and experimental tests in a scholar level. A brief review of HCI and mobile computing is involved. Also, the chapter contains a review of user experiences towards the web, and focuses on its value. Then, the development of interactions on mobiles is followed. Precisely, the chapter explores the gestures applied on multi-touch screens. There are investigations of existing interactions conducted by mobile sensors. Lastly, web design concerning mobile platforms is addressed.

2.1 HCI and Mobile Computing

HCI initially was considered with usability for those who wanted to use computers as tools in the late 1970s (Carroll & Kjeldskov, n.d.). In the 1980s, HCI was a small and focused specialty area. It was trying to establish what was then a heretical view of computing. Today, HCI grows rapidly. It became a big community, involving ubiquitous computing, sensor networks, and application infrastructures. Of these subareas, ubiquitous computing is considered as a frontier highly related to human habitats – cars, home appliances, clothing, and so on. The focus of HCI means to be enhancing human activity and experience.

Mobile computing becomes an interesting topic of research and design due to its enormous market potential and growth. While we are considering the terminology of mobile computing, we are discussing portability, miniaturization, connectivity, convergence, divergence, apps, and digital ecosystems (Carroll & Kjeldskov, n.d.). Prof. Kjeldskov explains these seven important waves as they provide a good overview of the legacy on which current mobile computing research and design is built. The era of focus on portability was about reducing the size of hardware to make the device physically moveable. Miniaturization was a further movement of processi9ng portable. Connectivity was about networks between devices and applications while users are in a wireless circumstance. Convergence was how PDAs, mobile phones, music players, cameras, games integrate into hybrid devices. Divergence conversely concentrated on specialized functionality. Apps is what we are all familiar with and continuing optimization. Lastly, the wave of digital ecosystems is how to gather apps to a system that can make the technology and interaction better.

2.2 User Experiences and the Web

Since the thesis project mainly addresses web interactions, the study starts from user experiences of web interactions. Why do user experiences matter? More specifically, in terms of the web, what can user experiences devote and how to consider user experiences while designers are conducting webpages?

The concept of user experience has been regarded as "the experience the product creates for the people who use it in the real world"(Garrett, 2010). For easy understanding, a visualized example is made by Jesse James Garrett (2010) in his book "The elements of user experience". He descripts how awful a day could be if user experience had not been counted into our lives. In his example, a day is ruined by chain reactions. A detail was describing a coffeemaker -- it didn't make coffee and the reason is that you didn't notice the power is off. The reason you didn't notice it is that there is no light, no sound, no resistance can make you realize the coffeemaker was not working. This is a typical example how user experience was not involved. Garrett (2010) points out that either aesthetics or technology cannot fix the problem caused by user experience. When it comes to the web, regardless of the type of websites, Garrett defines that webpage is a self-service product. The aim

of user experiences is to improve efficiency. Through efficiency

improvement, it leads to satisfaction and productivity in some cases. To

get good user experiences, the designer has to be truly understand the

users. In his book, Garrett also mentions how important the user

experience design process is. It is to ensure that the designer fully

understands the users' expectations through the whole process. Garrett

provides a conceptual framework – five planes (namely, strategy, scope,

structure, skeleton and surface) – as the tool to solve user experience

problems.
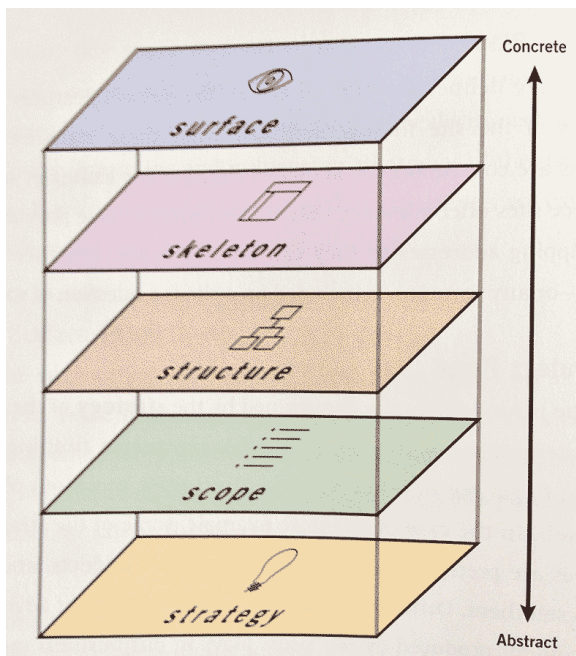
Figure 1: The five planes in the book "The Elements of User Experience" (2010)

As the figure shows above, the root plane, strategy, concerns user needs and product objectives. Business goals, brand identity, and success metrics are the aspects need to be considered in product objectives. For user needs, we need to differentiate target users in groups. Garrett (2010) lists measures -- namely, they are user segmentation, usability and user research, creating personas, and team roles and process -- to define who users are and what they need. Precisely, user testing is the most common way for user research. It allows users to test what have been produced. The scope plane is a stage when strategic objectives have been addressed and get ideas about what users want. On this plane, content requirements and functional specifications are essential. Also, a clean sense of priority of multiple objectives is required while sorting out the scope. After the scope has been addressed, it is time to move on to the next level – the structure plane, which is about to develop a conceptual structure. This level is a significant one since it is involved in the strategy and scope are sorted out; also, it is a fundamental structure for the upper levels. When it comes to website structure itself, the relationship of each page needs to be figured out and it gives shape to massive requirements from strategy and scope. On the skeleton plane, the structure is further refined. It is to identify specific aspects including interface, navigation, and information design. Garrett (2010) identifies that interface design is

the right interface elements for users to understand and use. To visually illustrate the concept, he shows how the elements of forms, including checkboxes, radio buttons, text fields, etc., work conducted by interface design. Navigation design is how the website constructs. Garrett lists several different navigation systems to interpret a good navigation design. Information design is to group and arrange the information elements in a way that help users understand easily. Last but not least, the surface plane, as its name, is the top level of the five planes model. It is a level that mainly concerns visual expressions, yet it still follows the rule of user experiences. For example, Garrett recommends using color and typography in a more effective way to conduct a brand identity.

A good user experience has the effect on customer loyalty, yet features and functions of websites do not have the same effect (Garrett, 2010). The user experience also conducts a term called return on investment or ROI. It is measured how many dollars of value you are getting back for every dollar you spend. In commerce sites, ROI is crucial and is effective to detect whether the user experience is qualified. By considering the five planes model, the website can achieve a good user experience, and that may lead to a successful business and satisfaction from users.

2.3 Mobile Interactions

Before exploring the combination of mobile sensors and web interactions, it is necessary to clarify the basic mobile interactions that modern smartphones have contained over these years.

2.3.1 Fundamental Interactions

In this section, mobile interactions based on multi-touch screen are addressed. Apple company has brought multi-touch technology and finger gesture interaction to the mass consumer market (Stößel & Blessing, 2010). Since Apple won multi-touch patent in 2007, the technology has been added to a variety of electronic devices, from smartphones, digital cameras, to digital photo albums, laptops, and even desktop computers. With touch screens or multi-touch screens becoming popular, people are familiarized with multi-finger interactions. However, the majority of gestures were performed with only one finger (the statistics showed in Stößel & Blessing's article is 82.9% of the younger users and 96% of the older users), and the rest was performed almost exclusively with two fingers. Only 0.7% in total were carried out with 3, 4 or 5 fingers. With all gestures being researched, limited gestures are mostly common. To summarize, these gestures are (with single finger)

tap, press, double tap, swipe, and (with two finger) pinch, spread, press

(an updated version "3D Touch" is included in the later part) and tap (this

is a gesture that press surface with one finger and briefly touch surface

with the second finger). Remarkably, swipe also has been labeled "slide",

"swipe", "flick", "fling" or "drag". Furthermore, among these most

common gestures, tap, swipe and pinch are used mostly frequently. In

the tests conducted by Stößel & Blessing (2010), a tap is used for

selecting a single object and taking a call, swipe is used for scrolling and

switching contents.

 In 2015, it is Apple company again that announced 3D Touch in iPhone

6S (Apple.com). It is described as the next generation of multi-touch. In

fact, at an earlier time, a similar function called Force Touch has been

involved into Apple's new MacBook trackpad and Apple Watch

(MacWorld UK, 2015). 3D Touch is a more sensitive version and included

in phones first time. With the incredibly advanced hardware technology, it

can achieve three main functions. The first one is quick actions. It allows

users to do some actions with a single press from the Home Screen. It

achieves faster and fewer steps without opening your app. The second

one called peek and pop. It utilizes a press and a deeper press to preview

and pop into content in the app. The last one called pressure sensitivity. It

is able to sense the pressure of press and give creative apps space to develop further functions. An example given by Apple is that the app can vary line thickness or give a brush a changing style. To foresee the future of 3D Touch, it is reported that Samsung is adding the feature to its cell phones in 2016 (Forbes, 2015).

2.3.2 Advanced Interactions

This section is about explorations of how researchers have utilized mobile technology and mobile sensors to achieve different and more advanced or experimental interactions. It is to study the existing researches and knowledge about mobile interaction utilization.

In a journal article called "user-defined motion gestures for mobile interaction" (Ruiz, Li & Lank, 2011), mobile sensors are tested for motion gestures. Testers use user-centered design as the approach getting the result from the users. It illustrates two primary input modalities: one is based on multi-touch screen, the other is based on sensors (accelerometers, gyroscopes, orientation sensors). Authors describe the gestures using the touch screen of the smartphones as surface gestures, and call the gestures with the device sensors, in three dimensions, by translating or rotating the devices as motion gestures.

In the tests, researchers try to switch the surface gestures to motion gestures. For example, it uses the gesture – place phone to ear as answering a call, or uses shake to go to home screen. To conduct an user-centered design, researchers start with getting comments from the participants. For instance, the answering call gesture is created according to the participants' comments: *The first motion I would be doing is picking it up [and] bringing it to my ear...The most natural thing for me would be bringing it to my ear.* However, the participants in the tests were all educated adults. Compared with Stößel and Blessing's tests, it is limited that the group did not cover the entire market.

Another journal article discusses scan and tilt encountering museum guides (Mantyjarvi, Paternò, Salvadoz, & Santoro, 2006). It aims to achieve a more natural interaction with mobile. The work combines multiple modalities – gestures, physical selection, location, graphical and voice. In particular, the physical selection is obtained by scanning RFID tags (since this journal article is published in 2006, this technology is outdated) associated with the artworks, and tilt gestures are used to control and navigate the user interface and multimedia information. The researchers considered the scenario of using the mobile devices before

they physically created the application. The first concept is motivated by a previous analysis of museum visitors and how they perceive the support of computer-based devices. The results clearly indicated that the users would not be interested in spending much time understanding how the electronic guide works, especially because they will probably not visit the museum again. On the other hand, the information usually provided by museums regarding artworks is rather limited, which raises the need for additional support to be dynamically activated when something interesting is found during the visit. For this purpose, it would be useful for visitors to have the possibility of pointing at the artwork of interest and controlling audio information with small hand gestures.

For guiding users in the museum, scan and tilt are used in the interaction. When a visitor enters a space, this is detected through the infrareds signals, and a map of the room is provided automatically. A visitor then scans the RFID tag associated with an object by physical selection, and the object is highlighted graphically on the room map. The information on a mobile device is associated with an object in the physical environment. Navigation among different pieces of information can be done by tilting horizontally. In alternative, users can use the tilt to identify or select different artworks in the room through simple horizontal tilts. Whenever a

new artwork is selected, then the corresponding icon in the room map is highlighted and its name is read. A vertical tilt must be performed in order to access the corresponding information. In general, the tilt interface follows a simple to learn pattern: horizontal tilts are used to navigate through different pieces of information at the same level, vertical tilt down events are used to access more detailed information.

In this article, the solution for a mobile museum guide considerably extends interaction towards more natural ways of interacting with the environment. Related approaches which focus on scan modality, such as, exploit similar ideas, but our solution offers a greater degree of freedom for users to move around and more control in obtaining information only when they want and without overloading the visual channel by having to graphically browse the application. Some future work is also planned for the algorithm that manages tilt events, in order to support dynamic angle thresholds to allow for a more natural interaction with the device. The use of combined axis movement (i.e. 'up' and 'right' at the same time) also opens up new interaction possibilities which could further improve the interaction richness between the user and the application.

There is another article exploring how to control remote event by using mobile gestures (Torunski, El Saddik, & Petriu, 2011). It is similar to the above examples – achieve gesture recognition by using smartphone' orientation sensors. It tries to use smartphones as a remote controller, and use wrist rotation as gesture recognitions. It is notable that the tests got results in the conclusion which shows some people like it but some strongly dislike because some gesture recognition interfered with their normal hand gestures.

There is a study from University of Toronto -- utilizing synchronization across multiple devices, from televisions to computers, from tablets to mobiles. The study conducted by Stephanie Santosa and Daniel Wigdor (2013) is an exploration of multi-device workflows in distributed workspaces. The study shares several common points with my thesis – by using cross-device, sync technology, testing for interaction improvement. Yet it covers a wider range of electronic devices and it focuses on productivity (specifically, workspaces are distributed by multiple devices). Instead of focusing on web interaction, it aims to test cross-device workflows and to understand how people work within ubiquitous computing. There are two points in their found related to my study. First, through their tests, they found that the trend people using

different devices to distribute works based on device specialization is increasing. People are getting used to using more than one device in one task. Second, they identify an issue with interaction design which the user experience of the interaction is not smooth and often exists as an obstacle to productivity.

2.4 Web design on mobiles

This section is a review of existing principles how to design a webpage when mobile platforms are involved, and how to design a mobile interface based on consideration of user experiences.

For a web design on the mobile platform, the responsive design must be highlighted as a technique in the first place. It is the responsive design that as a major strategy and solution when the webpage needs to be fitted on both mobile and computer platforms. It is about the existing solution countering limited screen resolution, particular mobile screens. Responsive web design is the most common way to approach the issue. It is a way that uses flexible and fluid layouts that adapt to almost any screen (De Graeve, 2011). In McNeil's book "Mobile web – designer's idea book" (2013), he clarifies that responsive design was once separated

as two approaches: one was fluid as responsive, the other called adaptive design. Fluid or responsive means that the layout of webpages is flexible and fully fits the available space. Adaptive design, on the contrary, uses multiple fixed-width layout in order to optimize the various devices' screen sizes. The term adaptive seems to be falling out of usage since most of the industry use both of the approaches as responsive design. Responsive design, anyhow, now becomes the term which we describe the way we design the webpage's layout responsively fitting for various devices' screen sizes.

In another book called "Mobile design pattern gallery", the author Neil (2014) illustrates how to design mobile interfaces with a great user experience in details. As a recently published book, it is a useful guide in terms of mobile design. The book covers the elements of the mobile user interface including navigation, forms, tables, search, tools and charts. it also lists the anti-patterns which are proved as failure to conduct a good user experience. The book is an excellent complement as a reference when mobile interface design is involved in some cases.
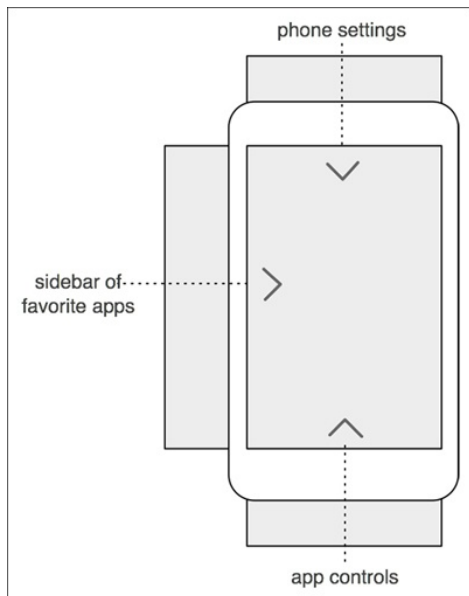
Figure 2: A picture about how to utilize the screen edges in the book "Mobile design pattern gallery"(2014)

In the chapter introducing "navigation on mobile", the most common forms of navigation have been listed. Compared with responsive design, mobile interface design is diffident. The forms, such as side drawer, cards, and dashboard are designed specifically for mobile devices. The design also considers gestures. For instance, for the cards which is one of the forms of the mobile navigation, the swiping gesture is considered to be effective. Users do know using swiping gesture when they visually see a cards navigation on their mobiles.

Chapter 3 – Research Approach

In this chapter, primary and secondary thesis questions are addressed.
The research methods are listed to explain the processing of the study.
"Research as prototype" (Dow et al., 2012) is the main research approach
which the study provides iterative experiments and reflections in tests.

3.1 Research Questions

This research study mainly focuses on:

Primary question:

- How might mobile technology work for enhancing user
  experiences while browsing interactive webpages on
  computers?

Secondary questions:

- Could interventions of mobile technology be beneficial for some
  specific types of websites?
- How do the combinations of mobile technology and interactive
  webpages on computers add value or impact the development
  of the Internet?

3.2 Research Methods

Since the study has a major portion of design and experiments, the processing is similar to product design which they both focus on the design process and have visual outputs as results. The research methods I have used in this research study include: observing people, asking questions, searching for information, making and testing ideas, and ultimately generating solutions to problems (Milton & Rodgers, 2013). Before doing prototypes, a field research at the first stage is a logical way to explore and consider the elements and usability ahead. In the contents of this chapter, I introduce the methods I have used, before I proceed to iterative experiments. Also, as my testing proceeds, feedback from testers and a couple of other methods are involved for helping the improvement of prototypes. The methods listed below have all been described in the book "research methods for product design" by Alex Milton and Paul Rodgers (2013) which I used as a reference.

3.2.1 Observations

Scenarios:

This is a method to research, imagine, sketch and simulate the product in a correlative environment at the background stage. It tests for potential

problems and usability of the product. In the next chapter, I explore a couple of most common scenarios where the thesis project can be utilized in a real world in details.

Sketching:

Sketching is a useful method within the design process. With rough sketching, it can build up a visual output of ideas quickly. It is helpful to evaluate the product and to estimate the problems.

Competitor product analysis:

This method helps to get related to the topic but unofficial, non-academic online resources. For my study, this method is especially useful since plenty of web interactions exist not in an academic form. Although my thesis project is not an exactly physical product, this method is still appropriate. Considering that my study is not brand-new, existing cases are important for me to analyse. How are these existing cases related to my study? Could I improve some of them or integrate them into a further development? The analysis in details is followed in the next chapter.

3.2.2 Surveys

Questionnaires:

Although this is a quite common method when approaches in other researches, in my study, the method is significant to make sure there is a target market. It also is a way to learn user habit while they are using mobiles or computers to browse websites.

Interviews:

To differ from the methods above, I have used this method to get users' feedback after I have done any experiments. During the interviewing, users test my prototype or mock-up and give me feedback. At the same time, I ask users questions based on their operations and feedback.

Be your customer:

This method is also used during the testing stage. As the method's name, I test my prototypes on my own. I evaluate the result based on my personal experience. I use this method when I approach some minimal tests and the circumstance which unable to get interviewers.

Chapter 4 – Field Research

As an early stage of the study, research is considered and required to get ready for the design progress. In this chapter, I use scenarios, sketching, competitor product analysis and questionnaires which have been introduced above as field research to approach the evaluation. The outcomes are used in the design process in the next chapter.

4.1 Scenarios

By using this research method, I try to ask a critical question which is whether this study only works in theory. More precisely, web interactions have existed for a long run. Would the change of user habits on web browsing be challenged and be difficult to apply in practice? Consider where suits the web interactions are essential since it involves how big the scope can be applied in the real world. The requirements of applying this sort of web interactions are three items: mobiles, computers, and the network environments. As an analysis in the introduction chapter already explained why mobile is a necessity, a consideration of scenarios only requires the network or Wi-Fi, and computers. At home is the most common scenario where people use computers to browse websites and place their smartphones on tables beside them. This is a scenario where

the web interactions can perfectly work. Then, to consider the scenarios

needs to categorize different groups of people. For college students, they

may use laptops to browse websites during the break. This probably is

not a perfect scenario because it depends on different individuals. For

white collars, though, chairs, tables, computers and the Internet are

standard. The scenario perfectly works as well.

Figure 3: A computer and a mobile are the bases for the web interactions

For people who stay at home or work at an office, web interactions with

mobile technology can work perfectly. Some other scenarios including

campus, coffee shops, and hotels may also be able to apply. To sum up, this study has wide application prospects in practice.

4.2 Sketching

Since sketching continues through the design process, this section is added in details in chapter five.

4.3 Competitor product analysis

In this section, I explore some existing cases which conduct websites by using mobile synchronization. The aim of this section is to scan the area where academic materials and journal articles cannot be covered. The case study is highly related to my thesis project and has magnificent effects on my research.

Diplomatic-cover

http://www.diplomatic-cover.com/

The website is a good example illustrating how mobiles work with web interactions. In this website, it utilizes the mobile as a remoter and replacing the mouse. However, the mobile has only two functions

towards web interactions. One is to select a subject, the other is to scroll

the webpage by tap the up or down button. Therefore, the user

experience is not quite good due to the limited utilization of mobile
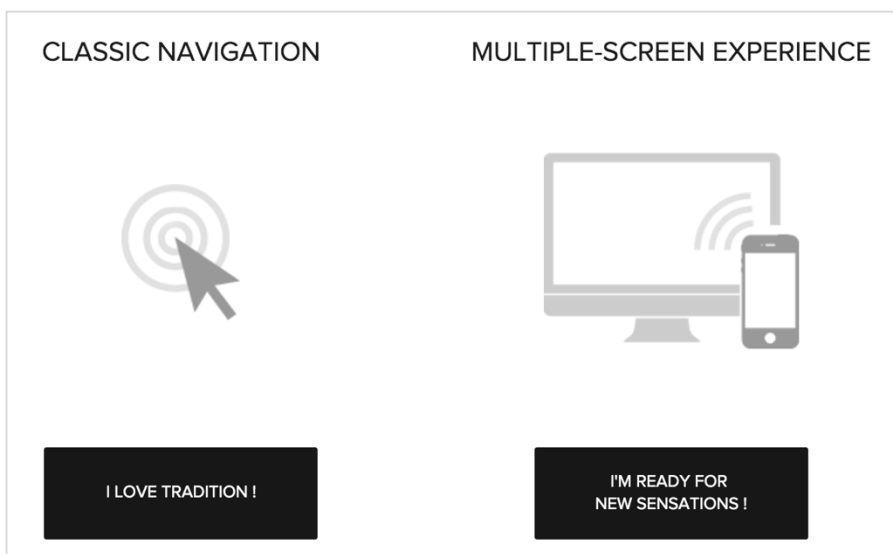
interactions.

Figure 4: A selectable interface of two experience modes at the beginning
(http://www.diplomatic-cover.com/)
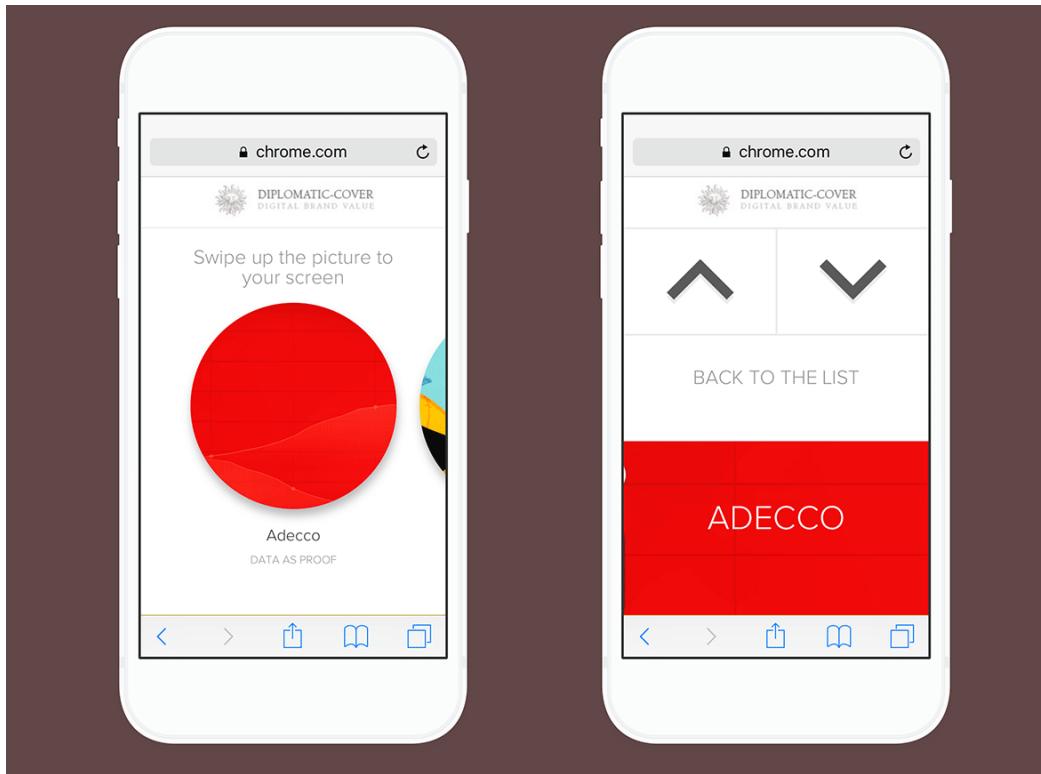
Figure 5: Interfaces of two functions work on the mobile platform (http://www.diplomatic-cover.com/)

Just A Reflektor

http://www.justareflektor.com/

It is a conceptual website using video stream and the webcam on computers and the mobile's flashlight for interactions. I have to say this is a unique website since I had never seen a similar one before.

*Figure 6: A screenshot from the website on the computer platform
(http://www.justareflektor.com/)*

The website basically was a music video, and users could use their

phones to interact with the video. On the computer platform, the MV was

rendering a blur effect that the video did not play in a usual way. On the

mobile platform, the website would require using users' flashlight. While

users were using phones to light the screen through flash light, the part

which shined by phones played the video in the normal way. The principal

of the interaction was that It utilized the mobile's flashlight and used

computer's webcam to detect the light. According to the light position,

the correlative position on the computer screen showed the normal

content.

Figure 7: A detection of flash light from the webcam and a rendered effect of the video (http://www.justareflektor.com/)

This is a very creative way of using mobile and web interactions. However, Chrome and Safari are not supporting to use the webcam anymore. It seems to avoid privacy and security issues. Therefore, the interaction of using mobile's flashlight and the webcam is not available now. Anyway, as a case study, the website shows the existing example how the use of camera and flashlight can enrich the user experiences of web interactions.

Super Sync Sports!

https://chrome.com/supersyncsports/

It is another experimental website for Chrome experience. This project is created by Google London. By using the mobile screen as a second screen, and utilizing multi-touch screen which also means it replaces mouse as a remote controller, the website allows you and your friends (maximum is 4) to complete synchronously in athletic games, namely running, swimming and cycling.
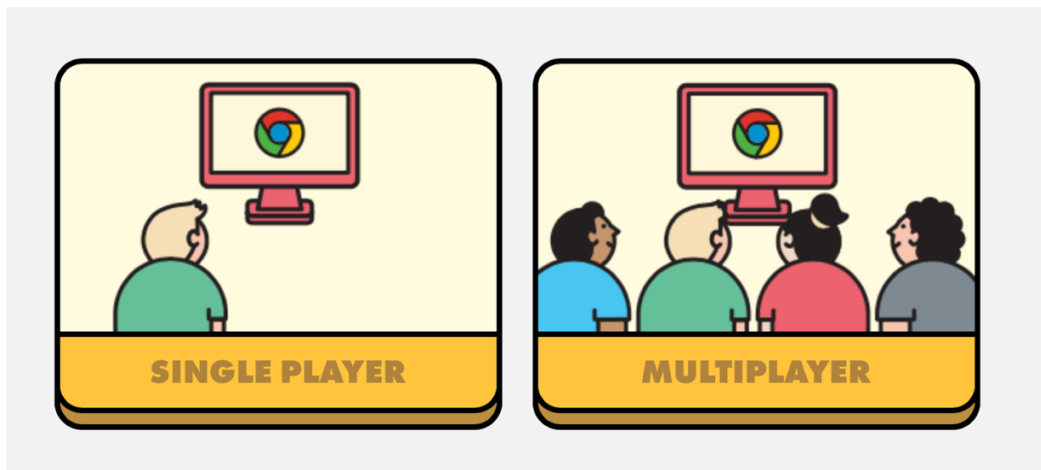
Figure 8: The interface to choose single player or multiplayer (https://chrome.com/supersyncsports/)

The website has excellent aesthetics and graphic style. With smooth frame by frame animation, the user experience is quite relaxing. The website has three main parts: entry, select a character, play games.

The first part is an entry of synchronization of mobiles and computers. It adopts verified code to synchronize mobiles and computers. The guide

on this page is worth to be learned that the graphic is clear and simple. It

allows users to understand how to achieve synchronization efficiently.
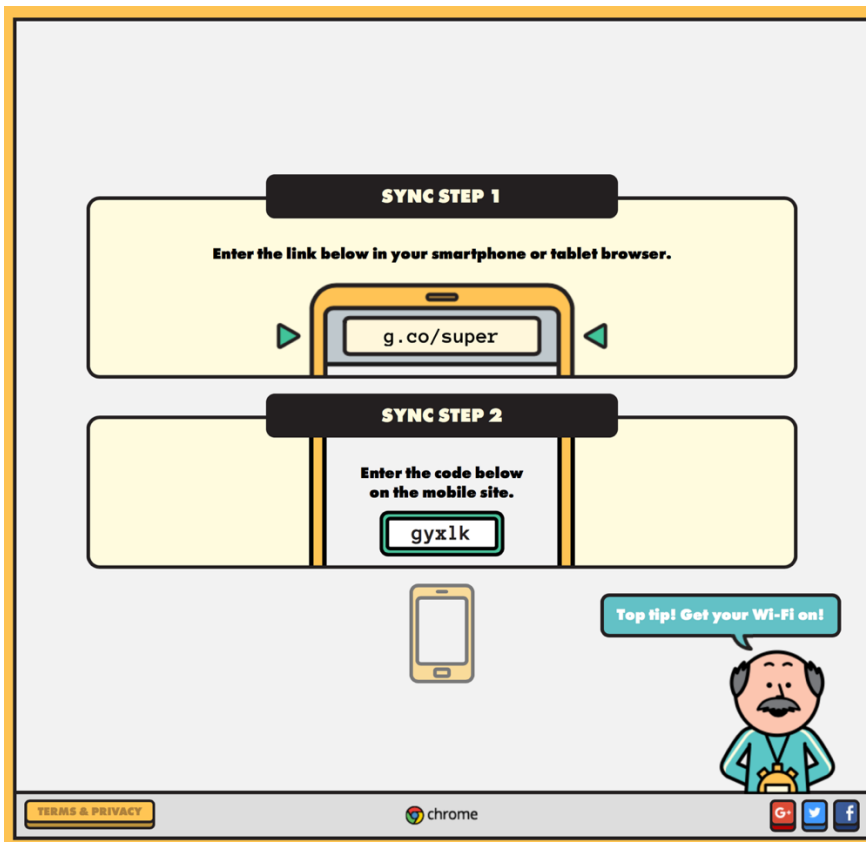
Figure 9: The entry page of Super Sync Sport!
(https://chrome.com/supersyncsports/)

A detail is worth to be mentioned here. It is another example of good user

experience. While users are using their mouse, the tip will appear. The

coach character and his action are fully detailed.
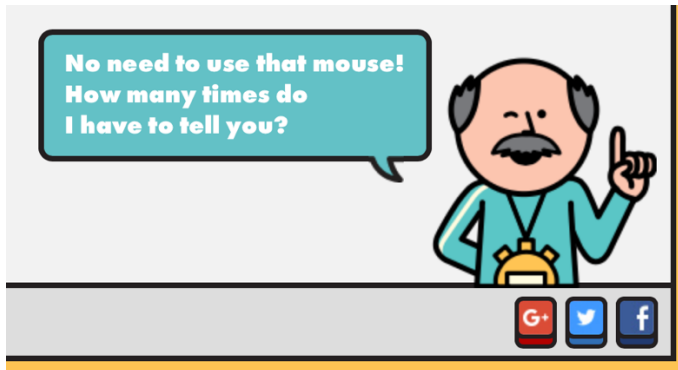
Figure 10: The detail of a tip in Super Sync Sport!
(https://chrome.com/supersyncsports/)

The second part of the website is character selection. Users pick

characters by using the mobile phone as a controller and computer

monitor as the main screen.
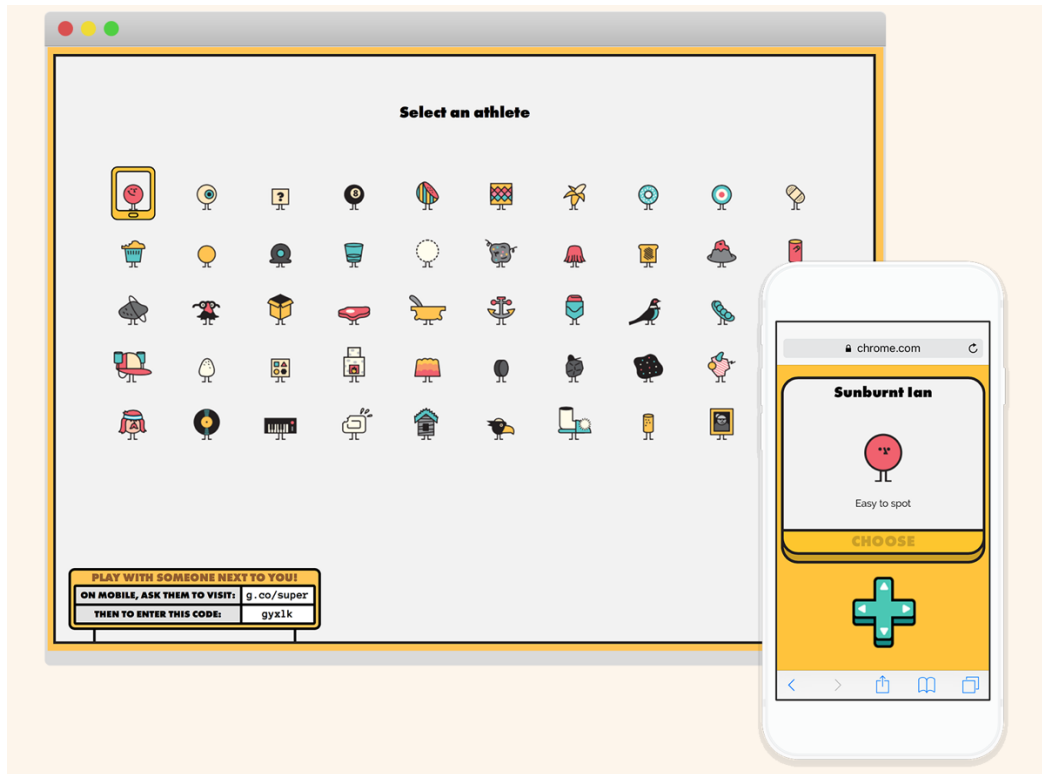
Figure 11: Pick a character in Super Sync Sport!
(https://chrome.com/supersyncsports/)

The last main part of this website is the competition. In this section,

mobile works only as a remoter so that users can focus on the computer

display. On smartphones, the multi-touch gesture is utilized. To

manipulate the athlete on the monitor, users need to follow the gesture

guide on the smartphone.

Racer: A Chrome Experiment – use multiple mobile devices

https://www.chrome.com/racer

This is another experimental website produced by Chrome teams. The idea of the project is to use multiple mobile devices to create a race competition. A race supports up to five screens. Moreover, there is no any extra app or extension required in order to experience the race. A difference between this project and others listed above is that this project has synchronization only on mobile devices. It is not an interactive website combining computers and mobiles in practice.
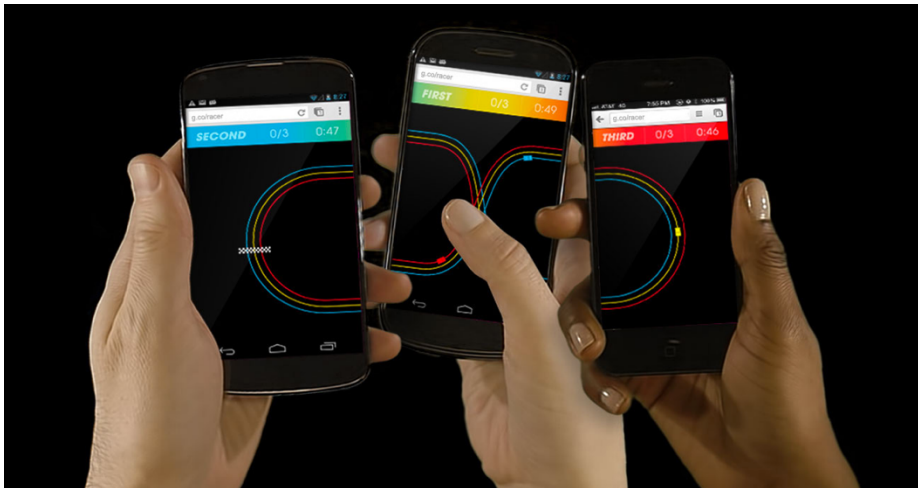
Figure 12: The user interface in this project (https://www.chrome.com/racer)

4.4 Questionnaires

In this section, several important questions towards my study are addressed. The full result of the questionnaires can be found in the appendix. A group whose age between 16 to 40 is the target for this

survey since the range covers the majority who browses webpages often.

It is notable that almost nobody is familiar with this study which conducts

web interactions by using mobile technology and synchronization.

4.5 Outcomes

This chapter aims to explore the field concerning my study through a

series of research methods. Through an observation of "scenarios", it is

pleased to find out that there are plenty of scenarios satisfy the condition

of using the interactions. According to "competitor products analysis",

the interactions conducted by using mobiles and computer

synchronizations are still at the experimental stage. Also, some of the

experiences from the case study are referred to my design in the next

chapter. The result from "questionnaires" shows people are unfamiliar

with the topic of this study. Moreover, the feedback shows the

interactions for (commercial) websites are vacant.

The methods "interviews" and "be your guest" are involved in the user

testing section in the next chapter.

Chapter 5 – Design Process

This chapter illustrates how the design processing develops in the iterative cycles of experiments and research methods. The first section is the preparation before I had enough technology ability and experience to create prototypes. In this section, I review the key technology I have used in my prototypes. In the iterative design research process, I have used testing, interviews, be your customer, and evaluation and selection of research methods. However, all the results of tests did not take digital immigrants who are not familiar with digital devices into consideration. The target of this study had not covered the whole groups of people.

5.1 Preparation and learning

To shape interactive websites with mobile technology, front-end technologies (mainly HTML5, CSS3 & JavaScript) need to be commanded. Since I have no background in front-end programming, I had to do a lot of studying to be able to program for web interactions and mobile technology.

There is a large amount of resources available online. More importantly, I am grateful that I gained many bits of helps from Professor Tom Barker

and my classmate Hart Sturgeon-Reed. I had learned elementary

knowledge of HTML5 and CSS3 through online resources first. Then, with

Prof. Barker's guide (Barker, 2015), I had learned jQuery, web

technologies on mobile, and use of mobile's sensors.

Although I had spent a lot of time on learning front-end development and

sometimes it was frustrating to get stuck with some problems, it was

fulfilling and important because these technological accumulations show

great effects on my experiments and prototypes.

5.2 Sketching

2.5 Dimension

To Add perspective feature into the user interface of mobile navigation

system was a concept which was originally from a thesis supervision with

my primary advisor Prof. Barker. He advised a concept of 2.5D, which

means a perspective between real three-dimension and flat. It is to utilize

the mobile's accelerometer and cover the shortage of mobile's screen

size. Prof. Barker mentioned a navigation system which could apply 2.5D.

I applied his concept and created a sketch about how this navigation

system could be possibly working.
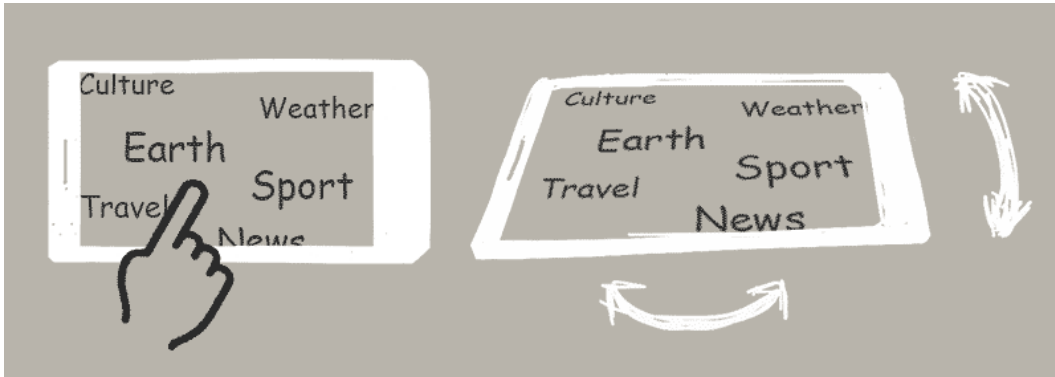
Figure 13: A sketch of the idea

Mobile as a remote controller

The idea was got from my literature review and case study. There is an
article introducing an application which utilizes mobile sensors as a
remoter to control the PowerPoint. It used mobile's rotation to control the
play of slides, yet it has drawbacks (I explain in the literature review
chapter specifically). What I was supposed to do is to overcome the
drawbacks. Considering that mobile screens are more accurate and
easier to control than the sensor like tilt, I wanted to take advantage of
mobile screens and make the mobile as a remoter for webpages.
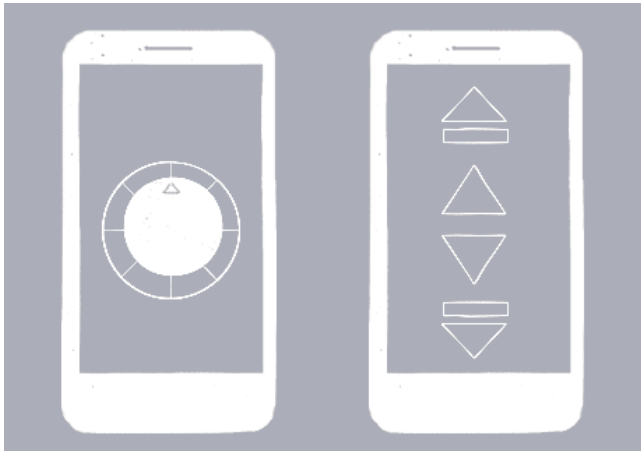
Figure 14: Two different layouts for using mobile as a remoter

Mobile screen as a second screen

This idea also utilizes mobile screens. Instead of using the multi-touch

feature, this is to take advantage of the screen itself. It is to apply the

mobile as a part of the content on the computer's webpage. The content

has to be different and depends on the creativity how the two screens

interact with each other relying on the data synchronization.
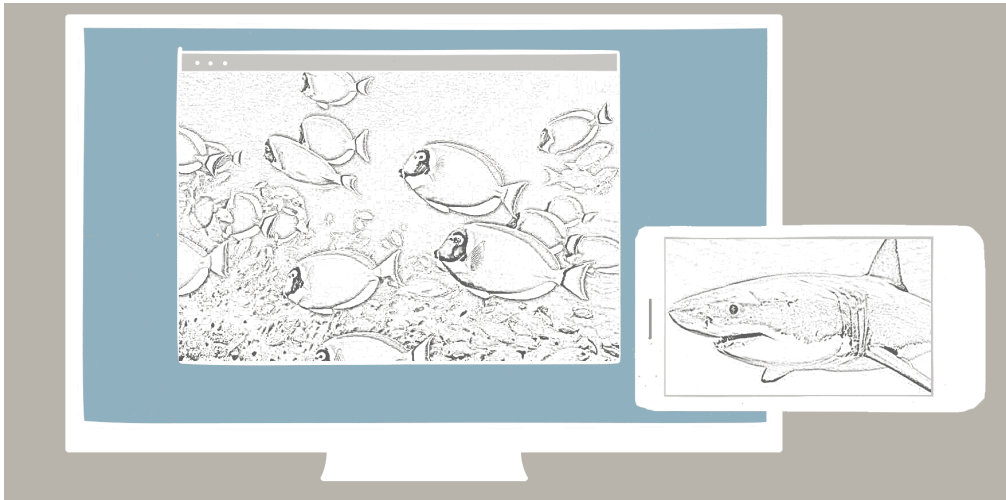
Figure 15: A sketch utilizing the mobile screen as a second screen

5.3 Tests before Prototype #1

Before I did the iterative tests, the final effect of this prototype had not

been determined. The idea was to get a developed design through

prototyping from the iterative experiments. Every experiment proposed

the possibilities and limitations of a design idea in the simplest and most

efficient way (Lim, Stolterman & Tenenberg, 2008). Then, through

reflections and selections, try and update experiments.

About the targets selected for the following tests, they are the major

group of the Internet users, age between 16 to 40. It is a consideration

based on the analysis of "scenarios" which the group meets the

condition.

5.3.1 Test 1 + 2 -- Synchronization

After all, I had rough knowledge about front-end technologies, yet had no idea about how to synchronize computers and mobiles. Fortunat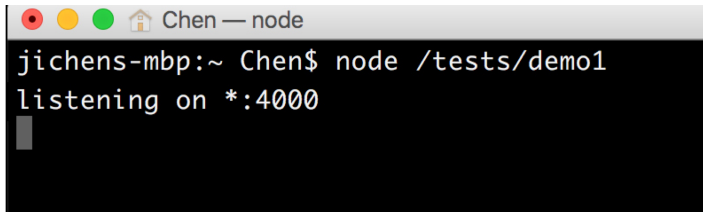ely, it did not take too long for me to figure out the solution. In the thesis colloquium of our faculty, Hart heard my presentation about my project and recommend me socket.io to achieve synchronization between computers and mobiles.

Although socket.io came out as an appropriate solution, it is really a challenge since it is brand-new for me since it is based on node.js which I had no any knowledge as well. On its official website, there is only a tutorial to teach how to create a chat application that server can be created on a local computer so that no server is required and multiple users are able to connect and communicate with each other on the chatting panel. Besides, the resources and examples are limited online. There are several examples which I can gain online synchronize webpages both on mobiles and computers in real-time. At the first step, I focused on the function that with a tap on hyperlinks on the mobile screen, both mobile and computer jump to the correlative pages. The experiment functionally and technically worked.

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```
npm install --save express@4.10.2
```

Figure 16: Terminal is required to initialize app.

Figure 17: To make the HTTP server listen on different ports.

However, the effect I needed was to display different contents on different devices. To solve this technical problem, I had spent quite a long time figuring out how to play around with socket.io. After many exhausting tests, also with Hart's help, I eventually managed to synchronize webpages both on mobiles and computers in real-time, and different devices can display different contents.

User testing and feedback

This was a simple test which I allowed participants to use their mobile phones to achieve the hyperlink synchronization from both the computer and mobile. The contents showed on two screens were slightly different so that they can realize it can achieve synchronization and showing different contents. Three participants were involved in this test. I observed

whether they can successfully achieve web synchronization by using their own mobiles. Also, I observed whether they can find out the difference between two webpages on the respective platforms. The result was positive. The comments from participants are generally positive as well. They felt that it was cool that they can use mobiles to control the website on the computer.

Analysis

At this stage, the user experience was too simple to get an objective and comprehensive feedback, yet it was important for me to get how users felt the study object at the first touch. The next step was to add different sensors into my tests and make them works.

5.3.2 Test 3 - 5 – Accelerometer and navigation

Tilt is important for mobiles to sense a three-dimension gesture. Initially, I didn't expect that figuring out how it works would be an easy job. Fortunately, I had had a demo of using accelerometer when I had learned mobile technology by Prof. Barker's guide (Barker, 2015). A next question would be what kind of interactive effects computers can achieve. Firstly, I had tried to utilize the sensor in the navigation system I sketched before.

With mobile's rotation and remote communication by socket.io, it worked

functionally. Then, I had tried to utilize mobile's rotation to achieve

webpage's scrolling. It was kind like replacing the mouse's wheel. It

functionally worked as well.
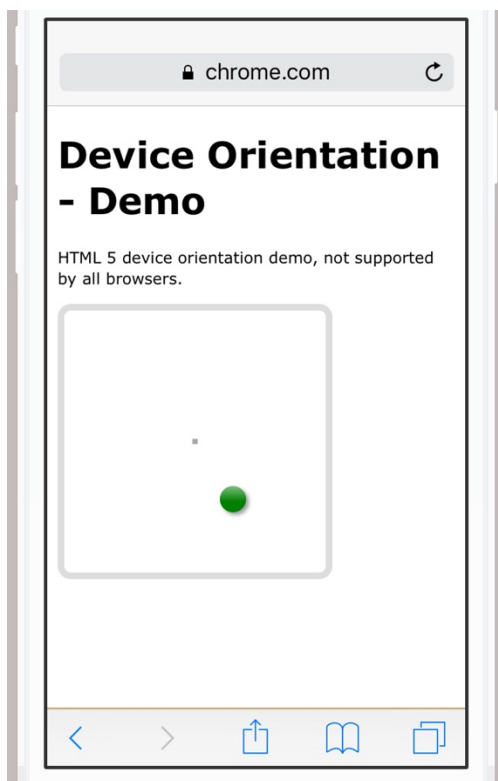
Figure 18: refer the source code which detects the mobile's tilt from Prof. Tom
Barker's book (Barker, 2015)
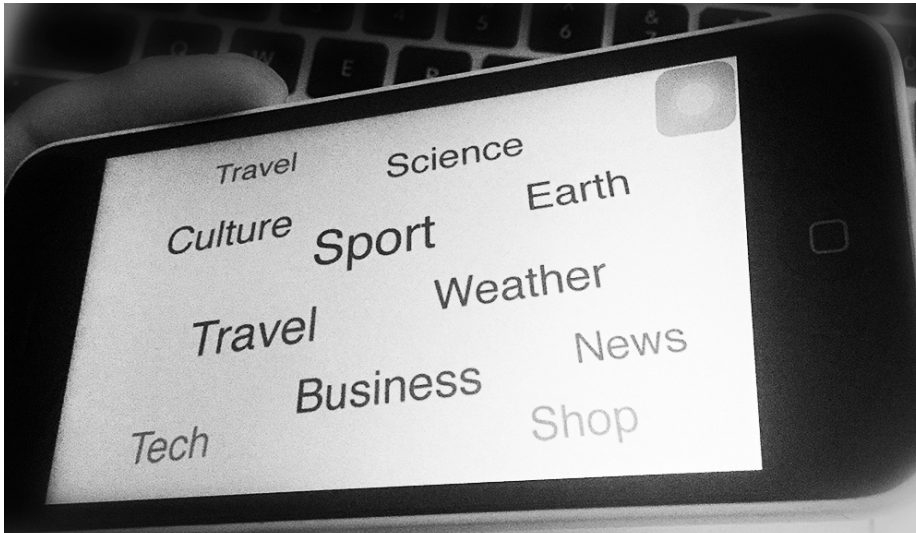
Figure 19: A navigation system utilized the tilt sensor.

User testing and feedback

I observed users' operations towards this navigation system. Three participants were involved in this test. However, when I did the test with participants, they felt the navigation system was not quite helpful and they felt confused in some moments. Their feedback was that it would be easier if improve the user experience of the navigation system on computer's web than on a remote control system.

Two participants shared a common thought which the tilt sensor could be applied in games since some games utilizing tilt are interesting.

Analysis

The navigation system I tried to create is not suitable because the user experience is not fluent. Users have to figure out how the system works and it costs time. For a common website, users already get used to using the regular form of navigation, and the application of the navigation system which using the mobile tilt and screen could be complex for users. The advantage of the function of tilt is to create something intriguing not practical. By the end of the test, I was still thinking how computers can reflect mobile's rotation and to achieve what kind of interactions.

5.3.3 Test 6 + 7 – Mobile as a remoter

These tests are considered to use mobile as a second screen and a controller. It has potential that mobiles can be a second screen while interacting with computers. In these tests, I had tried to use the mobile screen as a drawing board firstly. It is a common thought that consider mobile screen as a touchpad, like touchpads on MacBook; also, drawing things through mobile screens is more accurate than by dragging the mouse. However, considering the scenarios, it has its limitations. One way it works I can imagine is for the online conference. Mobile drawing is handier for a meeting to tag or mark on a shared webpage. Beyond that,

mobile drawing is not quite useful. Additionally, it is limited by mobile screen size. For more accurate drawing, a bigger, more professional screen, is required. An example to prove this view would be iPad Pro.

Besides using mobiles as a drawing board, I tried another way which considers mobile as a remoter panel. To visualize this concept, you can imagine mobiles as TV controllers. By pressing different buttons, the website can jump to correlated pages. A simple test I did is to achieve page scrolling. As the figure showed below, once you press "next" or "prev", the webpage automatically scrolls to next or previous section. "Top" and "bottom" is to scroll the top and bottom of the webpage.
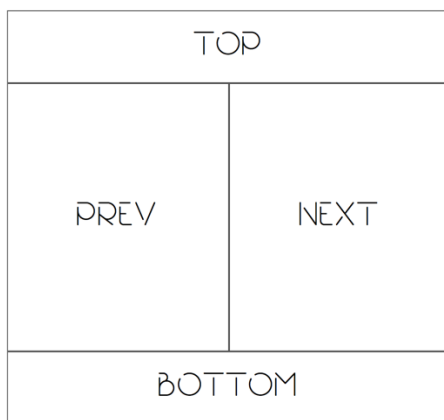

Figure 20: The interface of using mobile as a remoter.

User testing and feedback

Four participants were involved in this test. I observed their actions

whether they understand the interaction during the experience. Two

participants felt the use of mobile as a remoter is cool, but others felt it

was useless. The people who felt cool thought it was fresh to manipulate

webpage scrolling in this way. However, two testers had no sense

towards this experiment. They thought the function was not practical at

all. They prefer using mouse or touchpad for webpage scrolling rather

than using mobile as a remoter.

Analysis

The result is acceptable since it is a simple application how to use the

mobile as a remoter. The interaction of webpage scrolling is not intriguing

and creative, and it is not the only way to use the mobile as a remoter. A

further developed project concerning how the mobile as a remoter could

be playful needs to be considered at this stage.

5.3.4 Test 8 - 11 – Augment Reality & CSS 3D

I had spent a lot of time on studying how to apply augment reality and

CSS 3D to webpages. Unfortunately, the major browsers such as Chrome

and Firefox are not supporting the use of camera anymore. It became the

biggest barrier to achieving augment reality. An alternative plan to enhance the user experience of viewing was to use panorama photos. However, the source codes are complicated in this case. I was unable to combine the effect with node.js.

5.3.5 Test 12 + 13 – Shake + hidden contents

Another mobile sensor I tested for the interaction was the sense of shake. Since shake is an unusual way to manipulate in our regular mobile use, I wanted to try the possibility whether it could integrate to web interactions. The code for mobile shaking is available online. Therefore, I had not encountered difficulty while I was trying to approach the shake effect. For the user testing, I decided to use a shake animation effect on webpages so that users can get a response from their shaking action.

User testing and feedback

For this user testing, I showed five participants how it works and let them try it by themselves. The feedback of this user testing was quite like the remoter one. Some people felt it was intriguing but others felt it was not practical.

Analysis

Although the test was still a simple version how the function works and users' feedback is limited due to the limited interactions, I can assess that the study of mobile and web interactions is not suitable to apply for any websites. It has advantages on campaign sites which need fancy and flowery interactive effects.

5.3.6 Test 14 – Video & keyframes

I also explored the possibility how mobile could interact with videos. The inspiration was from the case study – Reflektor. I utilized the key frames of videos in this case. It can achieve interactions once the computer detected the keyframe where I added a tag. For the user testing, I combined the key frame function to mobile synchronization.

User testing and feedback

Eight participants were involved in this test. I showed them how it works and asked them for comments. Many participants thought this function could be useful in some cases. Prof. Barker thought this could be playful as well. They thought that the function which utilized two screens could

create many possibilities which depend on what type of webpages been applied.

Analysis

This function was the one got the most active comments. I agreed with the feedback concerning its potential. Again, nevertheless, it relies on the creativity how to execute the brilliant animation and interaction effects on websites.

5.4 Prototype #1

After accumulated some experiences on interactions between mobiles and the web, I got started producing the first prototype. Since I had no idea of what kind of theme I wanted to create at the moment, I created a conceptual webpage which combines some of the functions I achieved in the former tests. The aim of the user testing was to allow users getting a general idea of this study overall.

Figure 21: The index of the prototype on the computer and mobile platforms.

The index of the computer platform was designed to be empty so that

users can focus only on mobile's index page. I used different color

patterns for each section I wanted to use for tests.

Figure 22: An interface of the prototype on the computer platform.

Since there is no practical content, I just simply used an empty block with color patterns.

User testing and feedback

Ten testers were involved in this test. I divided the testers into two groups. One group was showed the interaction and asked feedback while the other group was asked to try without any guide. All testers in "try it on your own" group managed to achieve all the interactions which was

great. The aim was to see whether the interactions I created were user-friendly. The feedback of this prototype was positive overall. However, users still did not get the core of this study since their suggestions focus on practical function instead of intriguing interactions. A critical comment from "thesis stage 3" advisor Prof. David McIntosh was that the prototype was a technology-oriented prototype. The user experience was limited since it was not a completed website. It would be getting more comments when design and real content are involved.

Analysis

I realized that this study highly relies on creativity after the user testing although the technology is important as well. It was certain that a design-oriented prototype was urgent for a further user testing.

5.4.1 Test 15 + 16 – Gestures & Hammer.JS

These two tests are for utilizing gestures on mobile screens. It is crucial for mobile interactions which manipulate mobiles through hands gestures. There is is a JavaScript library called Hammer.js, which supports the most common single and multi-touch gestures. It is not difficult to use, even for a front-end development learner at the beginning level like me.
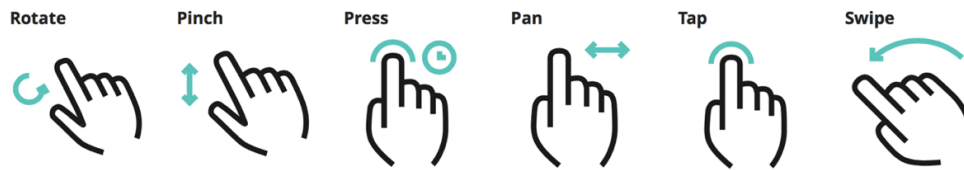
Figure 23: The gestures supported by Hammer.js

After managed to use Hammer.js in gesture controls, I had tried to use swipe gestures to achieve scrolling effects on webpages on computer screens. According to the reflection of the first prototype, some participants wanted the similar scrolling effect like Mac's touchpad instead of the effect which is "tap-to-scroll". They felt that "swipe-to-scroll" is more natural.

I skipped the user testing for this test since this was created by the reflection and it was prepared for the second version of the prototype. Also, these two tests end up with the tests oriented by technology. The following tests and prototypes switch to design-oriented.

5.6 Prototype #2

This prototype starts to switch from technology-oriented to design-oriented and tend to polish up the design of webpages. Since I had done

the tests for mobile sensors and multi-touch screens, I was able to combine these features into a completed project. The first question when I approach this prototype was, in so many themes, I can utilize as a topic for this project, how to choose a proper one. Eventually, it came out with the theme of introducing the view of Alberta. There are several considerations with this theme: firstly, it is a topic about nature. I tend to express that there is no conflict between nature and technology although technology is occupying our lives. The user experience is trying to the make the thing more nature and comfortable for users. Also, for a prompt project, this topic contains valid and abundant photo resources.

The design of the beginning of this website is kind like a mobile unlock action. I learn it from mobile interactions. The purpose of this interaction is to make users realize the basic interactive way of combining mobiles and computers. The parallax feature is also used in this interaction. It is notable that the workload behind this simple interaction is really huge. From getting idea with what I tend to do, to draw sketches for the layout, to look for image resources, to design the layout, to extract proper image size and format from source file, to produce front-end development (including HTML, CSS, JavaScript coding for layout, parallax effect and synchronization interaction), to polish up the interaction.
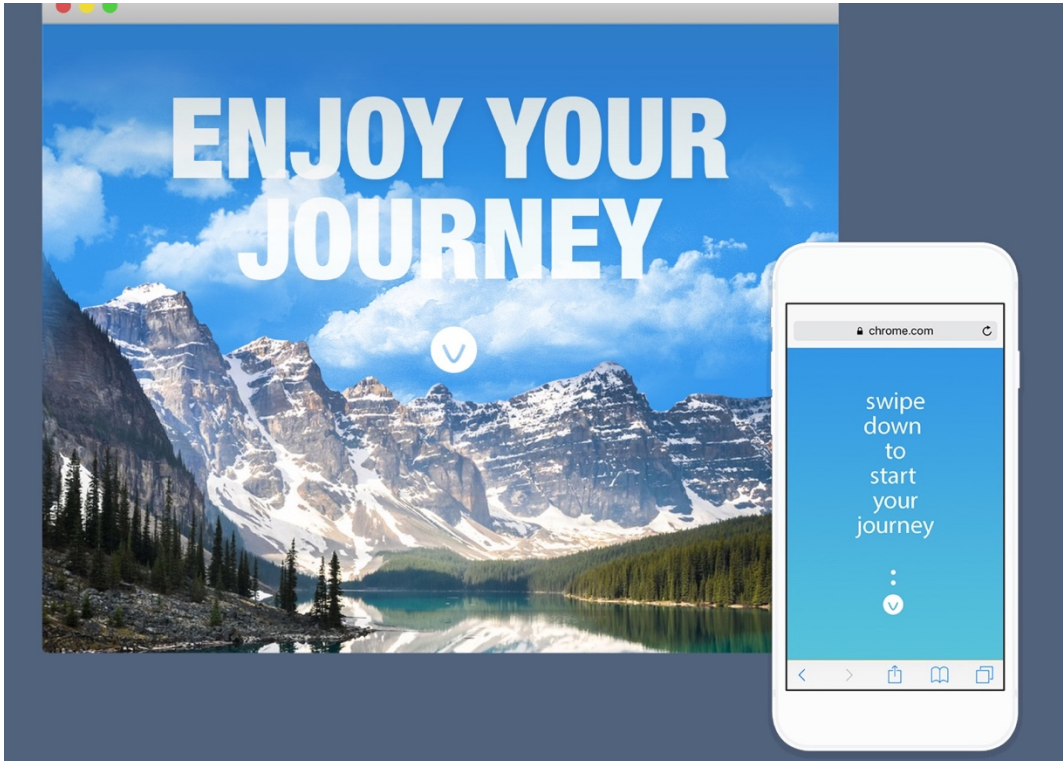
Figure 24 & 25: The beginning interaction of the index – browsing the content by using a swipe gesture to scroll down.

User testing and feedback

For this user test, I choose a mixed group combining new testers and old testers who did the tests before. Up to more than 20 participants were involved. All testers were able to use mobile and web interactions by themselves without guides which was good. However, a general and critical problem was, they felt that the interactions of the prototype were not practical. Their feedback was, for common webpages, although mobiles can functionally replace the mouse or touchpad, people get used to using the mouse and they do not want to use their phones to do the same thing. For the user experience, new testers felt that using mobile to interact with the web is fresh. Old testers had comments on the possibility of other forms of interactions with sensors and themes.

For the participants who tested this prototype, I also handed out a questionnaire. The result of a vital question is satisfying. There is one key question which focuses on which one is the best way as user experience for the web. The entire result of the questionnaire can be found in the appendix.

Which one is the best among 3 different ways of web user experiences?			
Traditional web	Mobile web	Web on PC with mobile tech	Not Sure
5	4	9	1

Table 1: The statistic from the questionnaire

Analysis

Although the reflection that concentrated on the practical effect of this kind of interactions was not ideal, it was not unexpected. The aim of this study is to create new user experiences on web interactions. As for its practical, it was not my primary concern initially. A conclusion I got from this prototype and user testing is that mobile and web interactions heavily rely on creativity. Creative interactions have the ability to attract users and that is a high requirement for web creators. Also, a found in this test was how the switch can be manipulated between the mobile screen as a gestural input of a screen framing. Since this needs a large amount of tests, the question will be explored in the future directions.

Chapter 6 – Conclusion

This chapter considers whether the research questions were addressed through the iterative experiments and the user testing. The chapter also focuses on the drawbacks of the research direction found during the process of research and the possible solutions encountering the problems. Lastly, the lacks of this study and future exploration are included in this chapter.

6.1 Reflection

Through the study in the last chapter -- design process and the chapter four -- field research, given the conclusion from the research and the experiments, now it is able to answer the three research questions. Based on my prototypes and user testing, it is able to answer the primary research question: how might mobile technology work for enhancing user experiences while browsing interactive webpages on computers? By utilizing mobile sensors and multi-touch screens, it is no doubt that mobile technology has the potential and the ability to enhance user experiences of web interactions based on a computer browsing environment. Although it can functionally work as a mouse or touchpad, I do not expect it replaces mouse at all. Its various interaction ways are

flowery complement based on the existing hardware and technology. According to the feedback from participants, they feel that many interactions with mobile technology on web experiences are fresh and intriguing. Either compared with traditional way surfing webs on computers by using the mouse or the touchpad, or websites particularly made for mobiles, the user experience on web interactions of combining mobile technology and computers is better. The vote I did for prototype stage two shows that the majority approves this new way to conduct web interactions. There is no sufficient proof to answer the secondary question which is: could interventions of mobile technology be beneficial for some specific types of websites? Google Chrome team as the pioneer of this field has developed quite a lot intriguing and conceptual websites based on HTML and mobile technology. There are many innovations prove that the combination of mobile technology and computer web is worth to explore. The research question was supposed to be addressed in my design process and iterative experiments; However, plenty of works are required to prove where is the comfort zone for web interactions with mobile technology. The following sections, challenges, and future directions, focus on this concern in details. Through my user testing and questionnaires, I address the research question: how do the combinations of mobile technology and interactive webpages on

computers add value or impact the development of the Internet? The

result from participants shows the web interaction with mobile technology

has potential. In a scale of the whole Internet environment, the market is

always looking for innovations and growth points. The web itself is

attractive because it can combine with e-commerce to sell the

merchandise and create revenues. Through the research, the form

combining mobiles and computers is acceptable for the mass. The

fundamental factor of its success is that people are already familiar with

how to manipulate the web and mobile phones. There is no barrier to

obstruct the mobile and computer web interactions. Moreover, when we

compare web interactions with virtual reality (VR) or augment reality (AR)

technology, we found that the technologies are both playful and they

show great potential in the future. However, no matter how advanced VR

or AR has developed, web interactions with mobile technology are

handier since the experience is not required any additional devices. More

importantly, HTML technology has developed many years. The

accumulation of technology helps it growing easily. The scenarios which I

analyse prove that the environment for this new experience is mature. It is

reasonable to believe that this form is active to influence the development

of the Internet.

6.2 Challenges

Although the merits of this kind of web interactions are inspirational, its drawbacks are obvious as well. Firstly, through my design process, I have to admit that it is less efficient to develop as a website builder when we compare it with the responsive design. It is really a matter if it has difficulty in creating and producing because all website creators have to encounter the fact that the time and the cost are limited. If the difficulty is far beyond the expectation people can afford, it would not be the primary choice. I have no straight solution for this issue so far, but I believe that with the developing environment becomes mature, the cost of development will be affordable eventually.

Secondly, the interactions are not suitable for any webs. Through my research and the questionnaire, not everyone is willing to use mobiles as tools to conduct web interactions. It is inevitable that you cannot make everyone satisfied. Also, this way of web interactions is not applicable in everywhere. As the scenarios I illustrate in the field research chapter, many scenarios do not meet the condition that the users have both the computers (laptops) and mobile phones. Overall, I am satisfied with the conditions which allow this interaction to be conducted.

6.3 Future Directions

This thesis project is conducted by various mobile sensors, but the camera is missed since the iPhone does not allow its camera to be used by web browsers; also, the computer's web camera or laptop's camera is not available on the latest version of Chrome, Firefox and Safari as well. The software engineering is a crucial limitation. In terms of mobile websites, it has not worked out so well in practice although it runs on any hardware and any operating system in theory (Banga & Weinhold, 2014). The platforms (iOS, Android, Windows 8, etc.) have different permission. For instance, at iOS platform, web apps are not allowed to access the camera of iPhone users, which means, for QR codes scanning, iPhone users need to install a native app with the scan function. To get a better user experience on the web app, the issue needs to be addressed.

Besides, the project is limited by the schedule and the deadlines. If the time is allowed, I would develop different webpages with more interactions, especially focusing on commercial websites. Because I found that commercial websites usually demand fancy and funky interactions. It is critical to see how this type of interactions works in a wide range of different products and brands in the business model. Also, it is required to get as many people as possible in user testing. For

getting more accurate statistics, the number of participants involved in

this study is not convincing. It is ideal to spread the user testing in a wider

range.

References

Bajarin, B. (2015). Apple and the user experience business model. Retrieved from http://www.imore.com/apple-and-user-experience-business-model

Banga, C., & Weinhold, J. (2014). *Essential Mobile Interaction Design: Perfecting Interface Design in Mobile Apps*. Addison-Wesley Professional.

Barker, T (2015). *Build Mobile Apps - The Complete Guide. Concept design, coding, distribution and monetization: everything you need to create cross-platform mobile apps.* Textbook, publication due 2016.

Carroll, J. M., & Kjeldskov, J. (n.d.). The Encyclopedia of Human-Computer Interaction, 2nd Ed. Retrieved from https://www.interaction-design.org/literature/book/the-encyclopedia-of-human-computer-interaction-2nd-ed

De Graeve, K. (2011). HTML5 - Responsive Web Design. Retrieved from https://msdn.microsoft.com/en-us/magazine/hh653584.aspx

Dow, S., Glassco, A., Kass, J., Schwartz, M., Schwartz, D. L., & Klemmer, S. (2012). Parallel Prototyping Leads to Better Design Results, More Divergence, and Increased Self-Efficacy. In *CSCW: ACM Conference on Computer Supported Cooperative Work*.

Garrett, J. J. (2010). *Elements of user experience* (2nd ed.). New Riders.

Lim, Y., Stolterman, E., & Tenenberg, J. (2008). The anatomy of prototypes: Prototypes as filters, prototypes as manifestations of design ideas. *ACM Transactions on Computer-Human Interaction (TOCHI), 15*(2), 1-27. doi:10.1145/1375761.1375762

Mantyjarvi, J., Paterno, F., Salvadoz, Z., & Santoro, C. (2006). Scan and tilt: towards natural interaction for mobile museum guides.

McNeil, P. (2013). *Mobile Web Designer's Idea Book: The Ultimate Guide*

to Trends, Themes and Styles in Mobile Web Design. HOW Books.

Milton, A., & Rodgers, P. (2013). *Research methods for product design*.

Morris, C. (2012, September 14). Console grows a pad: Wii U accesses TV fare via 2nd screen. *Daily Variety*, *316*(53), 2. Retrieved from http://ezproxy-library.ocad.ca/login?URL=http://go.galegroup.com/ps/i.do?id=GALE%7CA304050796&sid=summon&v=2.1&u=toro37158&it=r&p=AONE&sw=w&asid=acc615e1a3849056e349d03c99fb345f

Neil, T. (2014). *Mobile Design Pattern Gallery* (2nd ed.). O'Reilly Media.

Oliveria, M. (2015). Mobile web usage tops computer surfing in Canada: Study | Toronto Star. Retrieved from http://www.thestar.com/business/tech_news/2015/01/07/mobile_web_usage_tops_computer_surfing_in_canada_study.html

Ruiz, J., Li, Y., & Lank, E. (2011). User-defined motion gestures for mobile interaction. Paper presented at the 197-206. doi:10.1145/1978942.1978971

Rolling out the mobile-friendly update. (2015). Retrieved from https://googlewebmastercentral.blogspot.ca/2015/04/rolling-out-mobile-friendly-update.html

Sahami Shirazi, A., Henze, N., Dingler, T., Kunze, K., & Schmidt, A. (2013). Upright or sideways? In *Proceedings of the 15th international conference on Human-computer interaction with mobile devices and services - MobileHCI '13* (p. 362). New York, New York, USA: ACM Press. http://doi.org/10.1145/2493190.2493230

Santosa, S., & Wigdor, D. (2013). A field study of multi-device workflows in distributed workspaces. Paper presented at the 63-72. doi:10.1145/2493432.2493476

Statista.com. (2015). Apple: most popular app store categories 2015 |

Statistic. Retrieved from
http://www.statista.com/statistics/270291/popular-categories-in-the-app-store/

Stößel, C., & Blessing, L. (2010). Tap, Swipe & Pinch: Designing Suitable Multi-touch Gestures for Older Users. In *Design 2010 - 11th international design conference* (pp. 463–472).

Torunski, E.; El Saddik, A.; Petriu, E., "Gesture recognition on a mobile device for remote event generation," in *Multimedia and Expo (ICME), 2011 IEEE International Conference on* , vol., no., pp.1-6, 11-15 July 2011

doi: 10.1109/ICME.2011.6012188
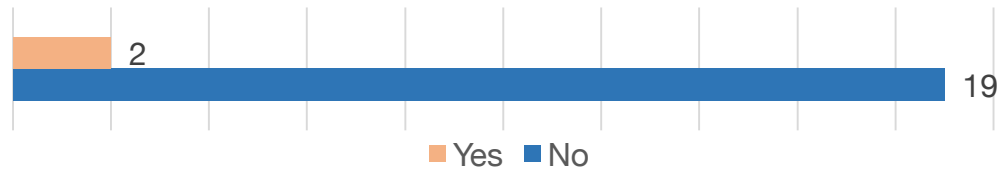
Appendix A – Questionnaires results

Do you often browse webpages on your mobile phone?
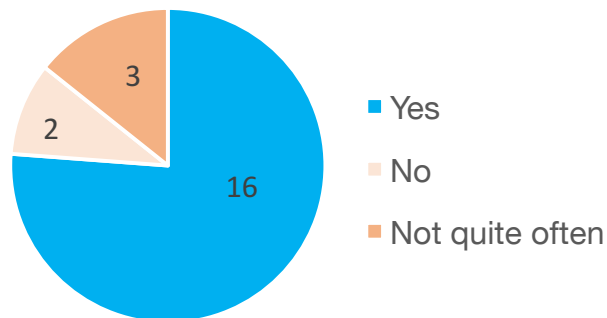
What is the most unpleased experience of browsing webpages you have

met?

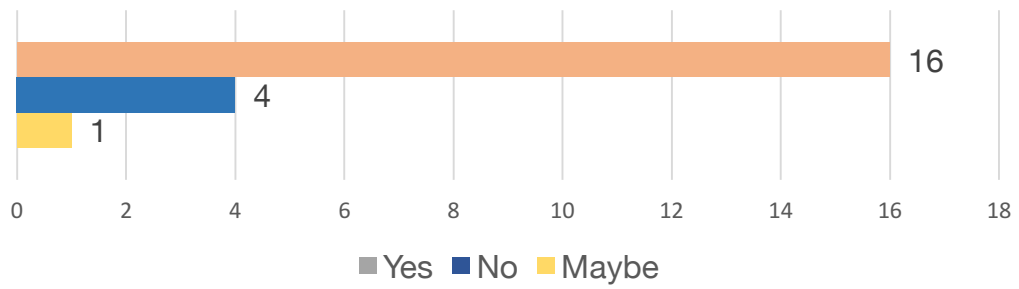| Really slow loading |
| --- |
| The picture and text sizes do not fit the mobiles |
| Bugs / many glitches |
| Popup many ads windows |

Did you experience any websites using mobile synchronization?

2

19

Yes No

Would you like to use the mobile phone to experience a webpage based

on the computer? (Before experience the prototype)

12

3

6

0   2   4   6   8   10   12   14

Yes No Maybe
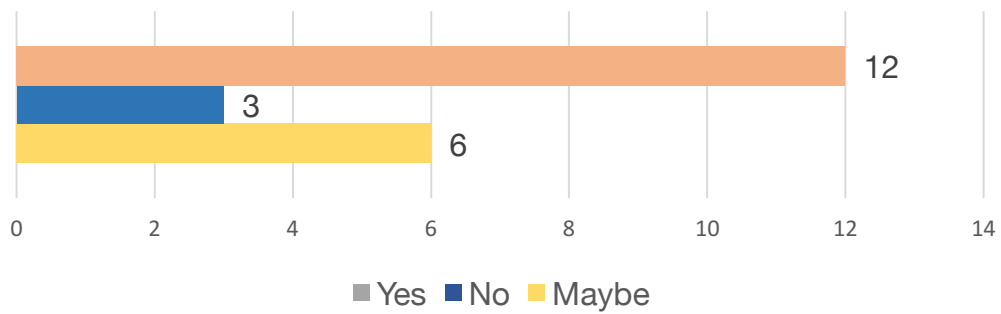
Would you like to use the mobile phone to experience a webpage based

on the computer? (After experience the prototype)

Which one is the best among 3 different ways of web user experiences?

Traditional web	Mobile web	Web on PC with mobile tech	Not Sure
5	4	9	1