OPTIMIZING THE READING EXPERIENCE FOR AN INTERPERSONAL NETWORK MAP

Guidelines for designing an interpersonal network map for a mobile platform.
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Aalto University
Collaborative and Industrial Design
ABSTRACT

This Master of Art thesis aims to optimize the reading experience for an interpersonal network map in mobile devices, the reason for focusing on mobile devices, is based on the 2017 Pew Research Center report, 85% of U.S adults now get their news on a mobile device, and from the research of Eric Enge, mobile usage in total internet traffic reached 63% in 2017 in the US. The trend of mobile-centered seems to continuously grow in the near future.

During the literature review and the user studies, it provided a fundamental knowledge base of how user interact and respond to the graphical user interface in sociogram. The findings offer the framework of the prototype. Visual experiments of the interpersonal network map and user interface wireframes had gone through rounds of design iteration with the user group closely. Target user validations and prototype testing provide positive result.

At last, the research question was answered. The design and development team can follow those practical design guidelines (A) Personalization: customized to personal need and expectation (B) Environmental adaptation system: automatically switch the brightness and the UI color contrast, based on the reading environment or reader’s personal preference. (C) Automatic Map tutorial: lowering the learning curve for readers. (D) Minimize cognitive load: with limited information shown, improve the efficiency of reading. (E) Organic visual language: easier for the user to connect the visuals with the human relationship. (F) Incentivize reading experience: give the user a timely respond on certain interaction. Those design guidelines for the interpersonal network map in mobile devices, can also be applied for other related areas, particularly in displaying infographic in digital mobile devices.

KEYWORDS

Data visualization, network map, user interface design, infographic, sociogram.
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Helsinki, Finland April 2019,
Yuchao Chien
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INTRODUCTION
1.1 INTRODUCTION

Humans deliberately make and remake their social networks. With the conscious or unconscious tendency to associate with people who resemble us. (Nicholas A 2009. p17)

In recent years, there is a growing attempts to distill digital network data and convert it into an insightful analytic tool, Social network structure is elusive and constantly transforming, understanding our own network’s status quo is important for both individual and society as a whole. A study published on Nature Communications by Carolyn Parkinson, Adam M. Kleinbaum and Thalia Wheatley in early 2018 shows our brains are evolved to ensure we will come to hold to the beliefs and values of those around us, individuals tend to befriend others who are similar to them in terms of a range of physical and psychological attributes. The network intensify the bond we feel with those around and enhanced our capacity to forecast the future and better coordinate in the society as an individual.

In general, people behave differently between online and real life, but our online social data reflects partly of who we are and who we are connected with. By collecting our digital social footprint and visualizing it in a strategic manner can assumably assisting people’s understanding on how we form and maintain meaningful relationships. But beforehand, some critical questions required further study and clarification. What trigger the motivation for the reader to read their network record in the first place? What information they need and want? What probable actions points will the target user take after receiving and processing such information? In which visualization approach can guarantee high readability in limited screen size? Etc.

This Master of Arts thesis started initially from the author’s personal design project: Designing a effective network map to help people to consciously shaping their own interpersonal network. This thesis aims for constructing practical design guideline for network data visualization and identifying core visual components in the process which can effectively assist user’s understanding and potentially stimulate user’s emotional response. Specifically, in a mobile based context. The Pew Research Center based in Washington, D.C. released a survey in 2017 found that 85% of U.S. adults now get their news on a mobile device, which is 72% in 2016 and 54% in 2013. The trend of mobile centered reading/learning seems to continuously grow in our society, hence it has become an key medium for data visualization.

Research associate with sociology, psychology, data architecture, privacy act, will not be addressed in this thesis.
1.2 BACKGROUND

As interconnected creature we have continuously been influenced by people closed to us, for better and for worse. By seeing ourselves as part of a mega social network enable us to better comprehend each individual’s actions, choices, experience and perspective.

Based on the study of Business Insider Intelligence published in 2017. Globally, more than 2.8 billion people, which equals to 37% of the world’s population use social media. According to PEW research center, 69% of US adults have at least one social media account in 2018. After the first social media platform Six Degrees.com appeared in 1997, and many other social media sites followed. Now our day to day social interaction can hardly separated from the mass and rapid changing digital communication applications. In recent days, without a social media account or a digital communication applications tend to result in some degrees of social isolation. People heavily relied on social media sites and digital communication tool to entertain, learn, network and work.

All those actions accumulates massive digital interaction footprints throughout the last two decades, which have lots of potential to be utilized in multiple fields. In 2011 Linkedin Lab developed InMap, which informing people about their social network status and social behavior. Their goal was to make network analysis more accessible for everyday users, and in NodeXL, a project from Social Media Research Foundation providing a paid service for user to visualise their facebook, twitter or Youtube’s network, those are just a few examples we can see in the past few years, but the network visualization result on those platforms are often have low readability, too complicated to comprehend, or providing exceeding amount of information which users are not even interested to read through.

That is the outset of this thesis, how to design a network visualization map which resonated with the user’s specific requirement? How to lower the reading threshold and optimizing the reading experience? And from the UX perspective, how to increased the user acceptance about offering essential data materials from those social media sites in the first place?
Processing the visualization of interpersonal network required numerous data sources from multiple social media platforms. Considering the sensitivity of the information collected, the designer must process those materials with extra caution.

The General Data Protection Regulation which was implemented in European Union and the European Economic Area on the 25th of May 2018, all websites or applications which required user’s data and personal information require the user’s consent beforehand. This newly formed regulation can possibly becoming a worldwide standard in the coming years. Also the awareness of privacy and data protection raised rapidly among the general public, all those had made the access to certain critical social data and information challenging or in some cases impossible, but there still remained some openly shared data the system platform can collect without violating any privacy regulation. On the other side, the development team will need to consider: do those public shared data enough to paint a accurate visualization of interpersonal network?

Much of the key interactions among those social media platforms are intentionally hidden and clean up regularly with diverse reasons. Ideally the system needs to recognize those intention and provide an alternative outcome of the interpersonal map with clear explanation or instructions.
1.3 THESIS STRUCTURE

This thesis studies followed the general design process (Design Council UK, 2015) Double Diamond and with four subsectors: Discover, Define, Develop, Deliver. (see figure 1. and table 1.) For the Discovering phase, contained literature review, survey study, workshops and user interviews, the goal is to obtain fundamental insights and co-creating the user journey map and rapid low-fi prototype with target user groups to initiate the thesis research. In the Define phase, the author further framed the major, secondary and third user personas, listed out sitemap, UX redroute and core motivation (Octalysis Framework), clarified scope of the user interface and visualization design. In the Develop stage followed a Build-measure-learn feedback loop (Ries 2011. page 75) to iterate the network visualization design guide with several rounds of interactive prototype with user validation. In the final section: Deliver, showcased the final design outcome which followed strictly with the interpersonal network map design guide.

Table 1: <Thesis Structure List>

<table>
<thead>
<tr>
<th>Discover</th>
<th>literature review, survey study, workshops and user interviews.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Define</td>
<td>User personas, listed out sitemap, UX redroute and core motivation (Octalysis Framework)</td>
</tr>
<tr>
<td>Develop</td>
<td>Build-measure-learn feedback loop prototype experiments and validation</td>
</tr>
<tr>
<td>Deliver</td>
<td>Showcased the final design outcome which followed strictly with the interpersonal network map design guide.</td>
</tr>
</tbody>
</table>
DEVELOP
- Iterated the prototype
- Iterated the guideline
- User Validation

DELIVER
- Showcased final design
- Showcased design guideline

Figure 1: <Thesis Structure>

DISCOVER
- literature review
- survey study
- workshops & interviews
- co-created user journey
- co-created low-fi prototype

DEFINE
- 1st, 2 & 3 user personas
- Listed out sitemap
- UX red route
- Octalysis Framework

continuously target user studying

continuous prototype test

timeline
1.4 THESIS OBJECTIVE & RESEARCH QUESTION

Main research question:
How to optimize the reading experience for interpersonal network visualization in mobile devices?

This thesis’s primary intention is to structure a practical design guideline for network visualization in mobile devices, the study will first focus on identifying interpersonal network map target user groups and their specific motivation and information requirements. Then investigate the usability, user preference and readability for diverse visualization experiments, which includes color usage, contrast, textures and wireframes. With a tight iteration loop of measure, learn and build, finally reach to the foundation of interpersonal network map visualization design guide and accomplish a design outcome followed strictly with the guideline.

1.5 RESEARCH METHODS

Visualisation is about human-centred design, demonstrating empathy for the audiences and putting them at the heart of decision making. (Kirk 2016. p38) identifying the target user’s need and goal is the first step in empathizing with the user.

A Visualisation process that lacks an initially articulated curiosity can lead to a very aimless solution (Kirk 2016. p64) In the defining stage, the author established a well-defined personas through continuous validation. Which went through multiple rounds of survey and interviews to narrow down key user groups, prioritize major, second and third personas with their group size, interest level, demographic information.

Next step is to frame the main usage context with UX red routes table, and clarified the display information through usage motivation analysis. The Octalysis Framework is a human-centric gamification design framework that lays out the eight core drivers for users motivation developed by Yu-Kai Chou. Which is generally used in the gaming industry but it can also be applied to general digital products to analyze user’s key drive and motivation. This can further support the major and secondary personas built in the defining stage.

Other research method which were implemented in the development stage is paper prototyping, low fi prototype and in the later stage the high fidelity interactive prototype with tight user testing and interviews.
meaning  avoidance  scarcity  unpredictable  social  influence  ownership  achievement  empowerment  Octalysis Framework

Red Route Analysis

always use
frequently use
occasionally use
rarely use

used by few  used by some  used by many  used by everyone

Figure 2: <Red Route Analysis>

Figure 3: <Octalysis Framework>

Thesis Introduction
2.1 DATA VISUALIZATION

The process human received and respond to a visual representation of the data is complex, many variables on the contents, the audience and the environments. An epistemic action is an activity intended to uncover new information (Ware 2012), but human eyes and mind are not equipped to translate easily the textual and numeric values into quantitative and qualitative meaning. (Kirk, 2016) Therefore designer or frontend developer have the responsibility to strategically transform data and information into an easily digestible format. Which generally included finding the compatible reading medium, comprehensible data representation and color usage, suitable tables or chart and arranging all those components with a clear visual hierarchy. Depends on the specific context and usage, a standard chart elements like, chart title, chart area, plot area, category labels, attributes, legend, (x,y,z) value axis and their units and etc.

2.1.1 FACILITATE UNDERSTANDING

Data visualizer’s main task is to make the data and pattern been effortlessly to spot for the viewers. When consuming a visualization, the viewer will go through three steps process: perceiving, interpreting and comprehending. (See figure 4) (Kirk 2016, p22) Comprehension is a process with lot of microsteps. As many other design profession, data visualizer won’t have the complete control of how the audience perceiving the information presented, to complete this journey require a collective collaboration between the designer and the audience. Before the outcome distribute to the target audience. Designer must be aware of any factors which may reduce reader’s cognitive productivity.

Figure 4: <Andy Kirk : Three Steps of Understanding >
The audience’s response in the second and third steps largely influenced by their pre-existing knowledge or values about the predicted subject, while those conflicted, often the credibility or even the intention of the data visualization will be in questioned, therefore the assurance of the trustworthiness of the data source should be the most fundamental elements in the data visualization, data sources should be always accessible for the audience for further understanding.

If the information mattered for audiences, the comprehending stage can sometime lasts for days or months on and off, the mind will be processing new information with multiple angles, considering how those information means to themselves personally. Does the information solidified their beliefs or contradict? At this step, designer should consider is there a necessary action step the user wish to take on? If so, when and how?

### 2.1.2 HIGH-LEVEL DATA VISUALIZATION PRINCIPLES

When going through the data visualization design process, there are some widely recognized high level guiding rules in the industry which can anchor the direction of the project. Inspired by the essence of the 10 design principles from Dieter Rams (see Table 2), Andy Kirk came up with a three principles of good visualization design (see Table 3) which specifically drafted to be applied in the modern digital sociality. Among the 10 design principles (1) innovative and (7) Long lasting, are not necessarily applicable to all data visualization.

#### Dieter Rams 10 Design Principles

| 1. Good design is innovative. | 6. Good design is honest. |
| 2. Good design makes a product useful. | 7. Good design is long lasting. |
| 3. Good design is aesthetic. | 8. Good design is thorough down to the last detail. |
| 4. Good design makes a product understandable. | 9. Good design is environmentally friendly. |
| 5. Good design is unobtrusive. | 10. Good design is as little design as possible. |

*Table 2: <Dieter Rams 10 Design Principles>*

#### Three Principles of Good Visualization Design (Andy Kirk 2016)

| Principe 1 | Principe 2 | Principe 3 |
| Good data visualization is **TRUSTWORTHY** | Good data visualization is **ACCESSIBLE** | Good data visualization is **ELEGANT** |

*Table 3: <Three Principles of Good Visualization Design (Andy Kirk 2016)>*
2.2 INTERACTION WITH VISUALIZATIONS

In 1998 Ben Shneiderman constructed a visual information seeking behavior guide, “Overview first, zoom and filter, then details on demand.” But through numerous gaze plot or heat map testings, tracking the audience’s eye movement, we found in reality, audience’s reading movement or priority can be variable. Data visualization display in digital medium is an interface which should be able to support key reading activities in different action order. Data objects or attributes should be capable of offering further detail information if the audience request, vice versa, disappear when not needed.

The reading journey in interactive visualization is composed by series of iterative eye-hand motions, sensing and measurement (see figure 5), and throughout the whole process, continually adsorbing new appearing information, reformulated concept or simply observe the updated visualization followed by each user action point. After the user familiarized themselves in the visualization navigation, means they can pay more attention on the actual content of the data visualization, which eventually translate to more efficient learning. But if the threshold of mastering the navigation system in the data visualization is too high, it will diminished dramatically the user’s motivation of continuing going through the reading journey. Abnormal delays of respond in UI or inaccurate touch screen respond will have the same effect as well.

Figure 5: <Colin Ware 2012>
2.2.1 TWO DIMENSIONAL POSITIONING AND HUMAN PROCESSING

While the user operating the user interface, it’s a iterative process of eye-hand coordination. We starts by calculating the distance to the target (can be a button, text or link) and initiates the hand movement. Which illustrated in the figure 5. The efficiency of the operation largely depends on individual user’s prior experience with different controlling devices. According to Paul Fitts (1954) and Colin Ware (2012) Greater distances and smaller targets both result in more eye-hand coordination iterations. One of generally executed method in the field of user interface to reduce this iteration loop is to implemented “Hover Queries”, the user simply need to control the mouse cursor and hover on top of an attribute or data visualization object, an extra information or visuals reveal. But this may be unable to implemented on touch screen, VR glasses, game controller or joystick interactions without accurate eye movement tracking technology. The other method is through step by step instructions, it can be a pop-up windows or video tutorial to remind user where to focus, and what’s the operation procedure. Given an optimal state of readiness, with a finger poised over a button, a person can react to a simple visual signal in about 130 msec. (Kohlberg 1971) but according to Hick’s Law, if there are numerous selections or action points showcasing at once, it will largely increased the response time.

In general, it will be more intuitive to execute tasks in computer interfaces if the interfaces are compatible with real life movement and response. If user observe the world inverted with a mirror, it can take weeks of adaptation for them to learn to operate in an mirror upside-down world. (Harris, 1965)

To encourage tighter learning loop among the users, the computer system should provide rapid and clear feedback of the consequences of the user actions (Hammond, 1987) this can largely reduced the cognitive load from the user, prevent operational mistakes, increase the acceptance and usability and above all, allowing the user to focus on primary task at hand. Also by allowing the user to cancel the previous decision or pause the process without unforeseen consequences, will improve the user’s willingness to explore the interface with more confidence.
2.2.2 TWO HANDED NAVIGATION

In common daily routine, people naturally use both hands to process intricate errands, like driving a vehicle, cooking, gardening, exercising and etc. But when we are conducting interaction on mobile devices, we might be limited to only operating it with our dominant hand, since the non-dominant hand are often occupied with other item or task. For bigger touch screen devices, like ipad or any tablets, one hand interaction is still the main option for designers, since considering the user might need the non-dominant hand to hold the device, or in some case, only the non-dominant hand’s thumb will be involved in the interaction. (Colin Ware, 2012) (see figure 6) For two handed interactions in tablet, mostly in mobile games, a immersive map or urgent tasks, which required user’s full attention, at this usage context, the tablet will be placed on table steadily, to free up both hands.

In the era of digital personalization, more applications nowadays allowing the user to have an option to switch the dominant hand to the left in system settings, makes the digital product more inclusive for all, including the left handed person or people with different levels of disabilities.

Figure 6: <Colin Ware 2012>
2.3 INTERACTION WITH DATA

With the development of technology and digital product, it had dramatically altered the behavior of how general public absorbing new information. Data itself is an outcome of discovery, research, interpretation and collection. It’s the raw material for delivering message and facts. But without a compatible communication channel to distribute, timely and responsive interface or simply lack of trust. The target audience will not be benefited from the information, hence the information accessibility is too low.

Converting the data to actionable knowledge or wisdom is a series of process (Shedroff, 1994) (see figure 7), depending on the collaboration between the information producer and the readers. The viewers are not anymore passively taking information, but instead gradually transform themselves into a proactive user or learner role, through personalization and presenting the data in a objective and meaningful manner, it will largely improve the efficiency or accuracy of getting necessary information in shorter time frame.

Figure 7: <Shedroff, 1994>
2.3.1 FEATURES OF DATA INTERACTION

Before selecting the potential features in the data visualization, it will first required the designer to have a thorough understanding with the behavior and motivation of the target users, will the interaction add any value to the user experience? Is the interaction necessary? or it can be replace by other easier alternatives? Then recognize (1) the proper action input, it can be a click, swipe, hover, drag and etc. (2) the control, it can be button, or any element or area in the data visualization, which allowing the user to interact. (3) Reaction, the outcome operation that is displayed. The ultimate goal of those interaction is to enabling the users to freely adjust and manipulate the data visualization, so they can narrowing the scope of the information which been displayed, and result in finding the key information in a more timely manner. Below are 8 common features in data interaction structured by Andy Kirk in 2016 (see Table 4):

**Framing:** Giving the user the power to adjust the criteria of what information and data is visible, it is a strong usage advantage, especially in the context when the reading time is limited, or involve huge volume of information, or the reading space(screen size) is small.

**Navigating:** Enabling the user to increase or decrease the level of displayed data, helping the user to establish a clearer overview picture. The most common example in the user interface will be the zoom in/out features in the map.

**Animating:** Data which composed by temporal components, and being presented via animating sequences. This can be a automatically trigger animation once the user enter the landing page of the site.

**Sequencing:** Data which evolve through time, often this data visualization will presented in a video format with a adjustable timeline. The goal is to reveal the trend or phenomena with high clarity to the user.

**Contributing:** Inviting the user to offer their information or data, this help the system to collect more key information proactively. The reason for the user to provide information can be varied, in many cases, by submitting personal information, the user can comparing themselves in a bigger group. I.e.: personal income level in certain area, individual record in sports and etc.
Besides the data adjustments, the methods of how the data been presented can also facilitate assistance and bettering the reading experience.

**Focusing:** This feature controls what part of the data been highlighted, common implementation will be increase the color contrast between the key data and other unessential data, or increase the font size of the key data, or utilized the hovering response, once the mouse cursor hovering over certain chart or element, that particular element will change color or in size.

**Annotating:** While the data visualization is relatively elaborate and contain complex structures which required longer time to comprehend. Using a pop-up windows or tooltip to reveal annotations, can provide a guidance to the readers of how to read and understand the information faster. Avoiding overwhelmed the user with too much information at the first second.

**Orientating:** This helps the user to gain better sense of where the user located within the data display, especially when the user have a limited view of a data landscape display, this can give the user a sense of progress or discovery.

**Table 4: <Features of Data Interaction>**

<table>
<thead>
<tr>
<th>GENERAL DATA ADJUSTMENTS</th>
<th>PRESENTATION ADJUSTMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Framing</strong></td>
<td><strong>Focusising</strong></td>
</tr>
<tr>
<td>Isolate, include or exclude data.</td>
<td>control what data is visually emphasised.</td>
</tr>
<tr>
<td><strong>Navigating</strong></td>
<td><strong>Annotating</strong></td>
</tr>
<tr>
<td>expand or explore greater levels of detail in the displayed data.</td>
<td>interact with marks to bring up more detail.</td>
</tr>
<tr>
<td><strong>Animating</strong></td>
<td><strong>Orientation</strong></td>
</tr>
<tr>
<td>depict temporal data via animated sequences.</td>
<td>make better sense of your location within a display.</td>
</tr>
<tr>
<td><strong>Sequencing</strong></td>
<td></td>
</tr>
<tr>
<td>navigate through discrete sequences of different angles of analysis.</td>
<td></td>
</tr>
<tr>
<td><strong>Contributing</strong></td>
<td></td>
</tr>
<tr>
<td>customising experiences through user-inputted data.</td>
<td></td>
</tr>
</tbody>
</table>

---

**Filter selection**
- category A
- category B
- category C

**Timeline**
- 1938
- 1900
- 2019

---

**Submit**
- Related slide
- Input data value
2.3.2 ADVANTAGES OF INTERACTION IN DATA VISUALIZATION

Incorporating interactive features into the data visualization can make the reading experience more memorable, alter perspective and possibly even trigger user’s behavioral change. But before jump into the brainstorming of how to impress the user with trendy visualization animation. The development team need to focus on what’s matter and relevant for the users at that moment, and what is the extra information or features which only a small portion of the user will be interested in exploring? If too many redundant data or interaction been presented to the user, the user will have a high possibility of decrease their motivation and switching the attention elsewhere.

The ultimate goal of the those interaction should be facilitate a effortless process of comprehending, deciphering the complexity of the displayed information to the target user. According to Andy Kirk in 2016 incorporating features / interactions into data visualization, might offer many advantages:

1. It expends the physical limits of what you can display in a given space.
2. It increases the quantity and broadens the variety of angles of analysis to serve different curiosities and motivations.  
3. It facilitates manipulations of the data displayed to handle varied interrogations.  
4. It increases the overall control and potential customisation of the experience.  
5. It amplifies your creativities and the scope for exploring different techniques for engaging users.
2.4 SOCIAL NETWORK ANALYSIS

A social network is a collection of actors (such as people, organizations or other social units) and associations among the actors, showcasing the means in which actors are connected socially (such as friendship, relationships, trade or information exchange). [Wasserman et al. 1994] And social network analysis examine sets of interrelated individuals that are regards for analytical purposes, in practice human relationship are often ambiguous and constantly evolving, and hard to measure or quantified. The interest in social network analysis has developed rapidly in recent years, it grew with the booming of numerous social media platforms and communication channels in the last two decades, we are living in the extreme connected time. But the history of social network analysis has been used since the early mid-1930 to advance research in the social and behavioral sciences. (Carrington, Scott, and Wasserman. 2005) Researchers utilizing sociograms reflecting substantive concerns which contain reciprocity, structural balance, transitivity of various diseases, cash flow or influence. For example (1) Through sociograms, epidemiologists discovered epidemics do not usually spread across continents uniformly through populations, and (2) in the field of management, business owner often use sociogram or organization chart to analyze company structure.

The mass majority of social network studies are using either "whole-network" or "sole centric" structure (see figure 8), depends on the research objective. Sole centric involving a core individual and the surrounding persons to which him or her connected. Conversely a whole network contains numerous sole centric networks, each knit deeply into one another, without a pronounced focal point. Both of those network types required a clear defined network boundaries, to outlined the framework of the structure, and result in a more authentic outcome. The network boundaries typically set before the data collection, to guarantee the collected data is relevant.

Figure 8. <whole-network structure v.s sole centric structure>
Before the dominance of social media era, the researcher of network studies relied extensively on survey and questionnaire data, Surveys allowing investigators to determine on which relationships to measure and individual's to be approached. (Carrington, Scott, and Wasserman. 2005) providing materials which allowing participate to recognize or recall target relationships, and heavily relied on individual's self report and subjective experience. (Ferligoj and Hlebec 1999) And through the process, network researchers discovered the reliability of ratings to be somewhat higher than the binary judgments.

### 2.4.1 APPLICATION OF INTERPERSONAL NETWORK MAP

Many different data visualization techniques have been applied on interpersonal networks map throughout the years, but the purpose of the interpersonal network map largely remain unchanged. Interpersonal network map/sociogram is to unwarp the relationships between groups of people. This can further be used to increase investigator's understanding of certain group behaviors and connections. Epidemiologists utilize the network map to calculate the spread of various kind of transmitted diseases, and then can further effectively control it's spreading (see figure 9). Law enforcement can leverage the network map to detailly illustrate the organized crime. In the field of education, usually in elementary or middle school, interpersonal network map can assist teacher to establish an objective observation of individual student's social status, and provide a proper support to socially isolated student, eventually cultivate a more positive learning environment for all.

Contrary with the public usage, in the individual level, the goal of creating and reading the interpersonal network map is mainly self-serving. Generally, it utilized as a self-reflecting visual aid for communicating individual’s status quo for it’s reader in a comprehensible manner.

General goal of usage in the individual level, will be identifying the network central persons (or network influencer) and the one who is relatively more isolated in the whole structure, as human is extremely social animals, the potential next step for the map viewer, will be building closer connection to those network centered individuals. Those decision and action can be done both intentionally or unconsciously. Through studies, researcher found out without enough social interaction, our sense of confidence and competence is compromised, and this perception has wide-ranging consequences (Vandell & Hembree, 1994) Additionally, some user’s will be considering applying the interpersonal network map on career growth.
Conducted by a team of sociologists Shafii, Stovel, Davis and Holmes (2004) a Network of 288 students involved in romantic relationship at X high school from the National Longitudinal Study of Adolescent Health. (The name of the specific investigated high school is under protection.) Grey dots indicate girls, black dots indicate boys. The aim of this research is to observe how STD spread through a middle size high school environment.

2.4.2 READING BEHAVIOR IN INTERPERSONAL NETWORK MAP / SOCIОGRAMS

Depending on the type of interpersonal map, reading environment, reader motivation, layout and wireframe, the designer can provide different value for the end user base on their motivation. In this literature review, the author focused on how will the structure of the interpersonal networking affect the reader’s understanding of the content. Particularly where the reader think he or she located in the network structure and how many connections or linkages had been visualized in the interpersonal network map. Human perceptions of network map can be affected by the layout of a sociogram [McGrath et al. 1996, 1997]. Scott [2000, p. 64], when visualizing a network into to a sociogram, what matters is relationship patterns, not the physical positioning of nodes (individual).

Due to a numerous different motivation from different reader and a variety of differences in network structure, there is no single best layout existing to communicate all the network information effectively [McGrath et al. 1997].
In the early 2000, experiments had shown the reader had tendency to believe that nodes (the dots which each represent a person) in the center or on the top are more important, and nodes in close positioning belong to the same group. And most readers assumed the nodes which positioned on the edge of the map, symbolized some levels of isolation. Some preliminary recommendations for sociogram design and hypotheses about human reading behaviors are proposed by (Huang, Hong, Eades 2005) which will be listed in the following section.

Nearly 100% of subjects indicated that drawings with fewer crossing lines are more desirable and easier to read. They commented drawings with many crossings “hard to read”, “confusing”, etc. This is consistent with previous research results on edge crossings effects [e.g. Purchase 1997]. But interestingly, the crossing lines did support the reader’s understanding of key network influencer effectively. Usually the node with relatively dense crossings lines means key network influencer. But the connecting lines usually fail to represent the quality of the relationship between two individuals, how well did these two connected? And on the other hand, high frequency of interaction between the two doesn’t necessary means stronger bond, in case of workplace it simply shows they belong to the same team. Therefore the sociogram need to stated clearly what the lines represent in the map legend section.

In a large study in which 133 subjects were involved, McGrath et al. [2004] investigated: 1. The difference of layout formats did not have a significant effect on user’s reading performance. 2. The introduction of motion with hierarchical layout significantly increased perception accuracy of network changes. 3. Subjects’ prior knowledge and experience with a particular layout format could affect their overall network interpretations. Also the sociogram reading experiment conducted by (Huang, Hong, Eades 2006) concluded in a few recommendations on how to design a sociogram which can provide a better reading experience in paper format, which listed below: 1. Reduce the number of crossing lines or arrows 2. Properly highlight important individual, by color, shape or size. 3. Do not treat all nodes equally, or layout the individual person evenly in the map. 4. Provide visual hint, annotation and a complete map legend which is required in most cases. 5. Separate few major groups spatially or by adding boundaries with background color.

Those finding were the initial steps toward the full understanding of how people read the interpersonal networking map. Contrary to the paper format, in the digital platform, the interpersonal networking map can and should provide various interactions and guidance to enhance the comprehension of oneself’s network status, and with certain degree of customization, the interpersonal networking map can better fits into individual user’s need with higher accuracy.
2.5 FORMING PROTO USER PERSONAS

For better understanding the user, the author conducted, 2 rounds of survey with 43 questionnaires collected and 2 rounds of workshops which each had 4 and 3 paracitants. Those user studies are essential to construct the major, secondary and third user personas. In the personases, it can provide a guidency of what information should be reveal in the interpersonal network map, present in what format? Also potential action point afterwards. The intention of the first two rounds of survey were to narrow down the scope of target user group’s demography, and based on the demography, inviting the potential user to further test their level of interests with the networking map and core motivation (Octalysis Framework page 45). In the interpersonal network map survey, the first survey was for collecting potential reader’s individual demographic information (nationality, age, field of profession, education background) and some essential digital behaviors (interest level with interpersonal networking map, basic social media behavior and familiar reading or learning devices.). In the second survey, the author provided few examples of network structure diagrams, asked the tester to rank the network diagrams based on their preference. And covered the motivation research and the possible action points and the chances social behavior change after reading their own network map, etc. The format of the survey were conducted in both online and face to face.

In The first workshop, all participants were selected based on the demographic information from the two previous surveys. The author collected individual motivation of reading a networking map, and the possible usage or action points after reading the interpersonal networking map. With the participants then grouped and voted the top three usage contexts, then analyzed the required data or information to structure the interpersonal maps. Then co-draft the user journey with the participants.
In the second workshop, conducted a quick prototype testing (First digital prototype, see page 36, figure 13) which followed by the co-drafted user journey in the previous workshop. And based on the feedback, the author refined the user journey (see page 32, Figure 12) and the prototype.

All interviews were voice recorded. The feedback and comment then later been grouped based on their category. The essential discoveries which found during the survey, workshop and interview were all applied into the next iteration loop of design guideline and prototype. The process of user studies please check the figure 10.

### 2.5.1 KEY USER DEMOGRAPHIC

The user studies survey subjects were limited to the author’s own network and connections, among 43 responses, 32.6% are Taiwanese, 14% Americans, 11.6% Mexicans, 11.6% Finnish, 6.9% Koreans and 23.3% with other nationalities, which included China, Japan, Estonia, UK, Turkey, France and Egypt. The author focused on the group which had positive feedback in “the interest level of reading interpersonal networking map”. The survey result shown there was no obvious correlation between the interest level and nationality or field of professions, but response from Taiwan, US and Mexico and the one with marketing background shown relatively higher interest level. For age group, 21-25 (32.6%) is the primary potential target. Most response reply interacting on social media (post and or write a comments) on weekly basis (39.5%). Generally the one whom behaved more actively on the social media platform have a stronger interest in the sociogram.

The second round of survey focused on the one who responded positively on the interest level of reading an interpersonal networking map. From level 3 and above, in total 36 individuals, so the author can had a better understanding regarding the group’s motivation and preferences. For the motivation of reading the interpersonal networking map, Self reflection, discovering key influencer and head hunting were the top three motives for using the interpersonal networking map, surprisingly “understanding how friends connect with each other” had the least votes. And even with strong interested in reading the map, most people 68.7% responded will not trigger any change in social behavior after reading the map. The survey also provide 5 different structures of sociogram to see the target group’s general preferences. The result shown the most complicated and the one with more lines knitting across the whole map get the lowest vote. Contrary to that, the one with clear network boundaries and different hierarchies of personnel is the favorite choose. For the support and additional map features, having a filters, marking key personnel, map introduction, zooming in and out had the top votes.
Rate your interest level of reading your own interpersonal networking map / sociogram.

- Zero interest: 3 (7%)
- No: 54.8%
- Maybe: 21.4%
- Yes: 23.8%

Have you ever read a interpersonal networking map / sociogram before?

- No: 54.8%
- Maybe: 21.4%
- Yes: 23.8%

What device will you use to read your interpersonal networking map / sociogram?

- Smartphone: 48.8%
- iPad Tablets: 32.6%
- Laptop: 18.6%

From 1 - 5 please self evaluate the tech savvy level of yourself.

- 1 (7%)
- 2 (9.3%)
- 3 (20.9%)
- 4 (20.9%)
- 5 (20.9%)

- Tech Basic: 6 (14%)
- Tech Savvy: 12 (27.9%)
- Coding skills required: 11 (25.6%)

Age group

- 15-20: 7%
- 21-25: 4.7%
- 26-30: 25.6%
- 31-35: 39.5%
- 36-40: 9.3%
- 41-45: 2.3%
- 50+: 7%

Active level in social media platform.

- Weekly basis: 39.5%
- Monthly or less: 20.9%
- Multiple times per day: 16.3%
- 1 / day: 23.3%

The possibility of triggering some level of change in your social behavior by reading your own sociogram?

- No: 68.7%
- Maybe: 19.4%
- Yes: 11.9%

Education Level

- Bachelor: 48.8%
- Master: 39.2%
- PhD: 7%
- High school: 5%
- Master: 7%
Most preferable structure of interpersonal networking map / sociogram.

36 responses

Least preferable structure of interpersonal networking map / sociogram.

36 responses

What motivate you to read the interpersonal networking map / sociogram?

36 responses

- **Self reflection** - improving understanding of your network and general infos.
- **Discovering key influencer** - to identified key influencer in your own network.
- **Head hunting** - searching for teammates for particular project.
- **Building new connections** - finding potential new person to connect.
- **For fun** - pure entertaining purpose, no clear goals.
- **Career beneficial** - building key connections.
- **Network strategy materials** - Can provide guidance for improving one’s social network.
- **Understanding how your friends connected**

What kind of support / features will help you understanding the content of the interpersonal networking map / sociogram?

- **Filter**
- **Marking the key personal**
- **Reading guidency**
- **Zooming in or out**
- **Grouping certain backgrounds**
- **Name search**
- **Timeline**

*Figure 11 <User Survey result>*
2.5.2 WORKSHOP GROUP ONE FINDINGS

Facilitating workshops to identify core user motivation, key features of the interpersonal networking map and validating the feasibility, the possibility of access essential data. Also drafting the initial user journey. The participants concluded it is necessary to display two networking maps to serve the top three-four motivations. (1) Identified key influencer, (2) network profession background, (3) general information for individuals network (this information doesn’t necessary need to visualized in the form of sociogram).

Linkedin, facebook and instagram are the top three social media sites the participants will choose to input their information. Other application like line or whatsapp can also provide reliable communication records but users may concern the sensibility of those information and refused to provide it in the interpersonal networking map’s platform.
More than half of the participants showed strong concern of privacy protection of personal information, and the lack of trust can largely reduced the user acceptance. Therefore, showing a clear privacy statement and what social media sites the user allowing the platform to collect information from is crucial. Also at the end of the user journey, the system need to guarantee the outcome of the interpersonal networking map won’t be shared without the permission of the user. And it needs to be easy to delete account and user information after the user stop using the web application.

In the early stage of user journey, the introduction and examples section, before the user committed to give personal data and information, they should have the chance to view some outcome examples. And the introduction of the interpersonal networking map should explain how the system access to those personal information to structure the map, and how to read and utilized the final content. Those steps should be able to increase the user’s acceptance rate.

One participant showed the interests of sharing the final outcome on social media site, while most of other participants have zero interest to show the map to others, but all concluded that there should be an options for the user to save, download and share the content if needed.

**Figure 12 <User Journey>**

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**3. INTERPRETATION**

- **006 SELECTING INPUT INFO**
  - Read the privacy agreement and 1) selecting the information input, and process. 2) if the user doesn’t trust the website, the journey ended here.

- **007 OUTCOME PAGE**
  - System loading and revealing the result. Notice few highlight and reminder for the first time user.

- **008 NETWORK MAP**
  - Start to read the overall network map status and get into different pages for more detail information, examining the accuracy of the data, part of the reader will lose interest if the infographics aren’t close enough to their own network status, (might because of not enough information input.)

- **009 EDITING**
  - Manually editing details of the information, improving the accuracy, and possibly re-selecting the information input sources to receive better result.

- **010 LOG OFF**
  - Forming the understanding of their own network, forming strategy to reach to their ideal network status, possibly saving the result.

---

If the previous steps failed to provide trust with the user, then selecting the input can be a uncomfortable experience.

Examining the result can be a positive experience, some unexpected surprise facts show up along the way.

While the user reading the interactive infographics, the content will most likely reminding their interaction with friends and family.

Allowing the user to remove some of the calculation mistakes, irrelevant person or some individuals the user prefer not to see.

After learnt their network, most likely will have a positive emotion level, feeling acknowledged or even empowered.
During the brainstorming section of the workshop, participants came up with numerous concepts for what the interpersonal networking map platform can be. For examples: providing new match function to build new friendship, connection alarm to warn certain connection are getting neglected for a long period of time, gamified the user experience with VR, providing consulting service for extended personal network and communication training. Which were all valued but those were out of the scope of this thesis studies.

*Figure 13*  
<Wireframe UI prototype> The first Low-Fi UI prototype after the first user study workshop.
2.5.3 WORKSHOP GROUP
TWO FINDINGS

In the second workshop the author ran prototype testing with three participants individually, the prototype were made accordingly to the draft user journey from the previous workshop. Additionally, test the user acceptance rate of using the interpersonal network map as a mobile app. In the duration of the prototype testing, the author encouraged the participant to thinking out loud while conducting three key tasks. Task 1: produce your interpersonal networking map, Task 2: find out the nationality spreadsheet in your network, what’s the percentage of Taiwanese in your network? Task 3: remove one connections in the interpersonal networking map. The result showed there was no critical usability issue, part of the tasks took longer for the participants to go through, but all tasks were successfully completed with the participants.

After the user testing, during the one-to-one interviews. All participants responded they will not use the service if it required the user to download the app, install plug-in in their laptop or smart device at the beginning of the user journey. Since it's time consuming and there are already too many application in their tablets, smartphone or laptop.

In the duration of a group discussion, the author asked the participants to list out feedback to improve the prototype with a strategic manner. Feedback 1: information overload in the landing page, there was a lot of information displayed, and some examples of the end result, but it was relatively effortful to find the start button. Feedback 2: privacy protection remained as a major concern for all participants, among all, one participant stated clearly, if it's in a real life situation there is almost zero chance for her to give away those personal data and information, unless it’s purely for academic usage. The privacy statement in the prototype only reach the minimum standard of building trust. Some extra approach needed to be implemented. Feedback 3: all participants showed a great interest of transforming the interpersonal networking map to a talent hunt database which can display individual connection’s seniority in their professional field. I.e: when the user want to search a senior UX designer in his or her network, there can be a list of senior UX designer shown in the map. Feedback 4: Regarding the priority of the information been shown. Two participants would like to put the “network general info” in the first page, to give the overall information
in the first second. Also the general network info page's information have the lowest threshold to comprehend, make the user experience more welcoming. Feedback 5: assuming in a fully functional interactive interpersonal networking map, all participants showed the importance of manually re-editing of the content of the final map, since there will be some connection the user will choose to neglect or delete. Feedback 6: How can the system provide a healthy way of viewing oneself network status? Nowadays the majority of population in western society experience loneliness, can this service provide some guidance? Feedback 7: The information and data display in this platform are extremely intimate and private. The user interface and the visualization should also be aware of this. Feedback 8: Honesty policy, since the platform only collect social behavior and human interaction online, which only partially reveal the real day to day human interaction, and many of our close friend or colleague which will have a high chances of been left out in the system, the service should add a disclaimer in the early stage of the user journey.

After the group discussion and prototype evaluation, the workshop continue to identify user red route, refining the proto-personas and building the Octalysis framework by filling up core user motivation survey.
Figure 14 <Workshops Photos>
DEFINING
3.1 USER PERSONAS

After analyzed the demographic information, user challenges and user motivation which accumulated in the previous steps included two rounds of survey and workshops, the author focused on the 36 responses which shown positive interest level toward the sociogram / interpersonal networking map. Based on two key behaviors / characteristic (1) Active level on social Media. (2) Tech-savvy level, the author visualized those on matrix chart and grouped individuals into major, secondary and third user personas.(check table 5 and figure 15) The result of the user personas had been through few rounds of iteration followed on the feedback of individual interviews. The user personas contained user basic demographic (age, position and nationality) main working tasks, key behaviors in digital environment, favorite mobile application, pain points, purpose and goals. All those elements aim to portray a vivid standard user groups for design reference in later steps.

Table 5
<User Personas Materials A>

This chart only mapped out the responses which got 3 and above interest level toward the network map. (36 in total)
OLIVYA CHIEN
Marketing Manager 32
Taiwan, Taipei

She is focused, organized, goal-oriented and have a strategic leadership role. Her main concern is how to form a practical plan for her team and herself to reach out to target audiences more effectively. Studied in UK for bachelor degree. Have a 9-5 office job in Taipei. Outgoing, hanging out with friends on a weekly basis. Started to attend a few career networking events.

Pain Points
Emotional Needs

(1) Can’t find an easy-to-access and practical networking tools with constructive insights.
(2) Reliable analytics with strong cybersecurity, clear and comprehensible infographics with key information only.
(3) Tech-Savviness (6.5)
Social Media Extroverts (10)
Financial Level (5)
Educational Level (5)
Active Analyst (6)
Team management and participate in recruitment.

Purpose & goals
Extend his network to its fullest. Connecting with as many talents as possible. Finding friends who are the top influencers in his network.

Key Behavior in Digital Environment
Can browse through tech news, Wikipedia, academic research papers for hours non-stop on his laptop and smartphone. Once visit some interesting websites, he will inspect the code and try to figure out how did the team design the website, and how to improve it.

Tech-Savviness (4)
Social Media Extroverts (8)
Active Analyst (3)

Figure 15
<User Personas Materials B>
3.2 RED ROUTE AND SITEMAP STRUCTURE

The purpose of creating the UX red route and sitemap is to see how the Interpersonal networking map be nicely integrated into a digital product. Map out the key actions points and web structure to avoid critical usability failure in the development stage. The sitemap (see figure 16) was built on the foundation of the user journey which created during the workshop with the participants. The UX red route was the accumulated result of prototype testing and interviews. The author used the red routes to analyzed the frequent paths the users take to complete their tasks. With a clear list of webpages and their individual position in the structure, it can make the user interface design process in the later stage much more efficient. The sitemap can help the designer to further check if each webpage have all the necessary elements and linkages.

In the red routes table(see table 6), the author found out in the most use cases, the users will naturally use two fingers to zoom in or out the final map outcome, expecting to see more details info in the map. In the duration of the creating user account and produce the user’s personal interpersonal network map, more than half the participants quickly jump through intro slides, privacy statement. Only in the “data input selection” step, they will start to pause for few seconds more to carefully reviewing and selecting the sources of data input. And only one participants click the “share” function, most participants clearly stated they prefer not to share private information publicly.

Most of the users will click the map’s introduction during the first time visiting the page, privacy statement and information protection guarantee triggered a long discussion in the workshop, but when in the prototype testing context, most participants will fastly press the agree button and passing through this section.

<table>
<thead>
<tr>
<th>Check account settings</th>
<th>Finding key influencers</th>
<th>Data input selection</th>
<th>Account creating</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Skipping intro slides</td>
<td>Zooming in-out in Maps to see more details</td>
</tr>
<tr>
<td>Save Maps / download</td>
<td>Re-select data input</td>
<td>Delete certain network</td>
<td></td>
</tr>
<tr>
<td>1. Sharing the outcome</td>
<td>privacy statement</td>
<td></td>
<td>Check map introduction</td>
</tr>
<tr>
<td>2. Check Map examples</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6 <UX Red Route>
Figure 16 <sitemap of interpersonal networking map>
3.3 OCTALYSIS FRAMEWORK

The octalysis framework was designed by Yu-Kai Chou (2015). Originally designed specifically for framing the core motivations for gaming products and their players. Recently more and more development teams also utilized the octalysis framework into the development process of digital product design. Through the workshop survey, the author used the octalysis framework to identify participant’s key motivation of using the interpersonal network map. (see table 7, page 45) Top one is by using the networking map, they could feel a sense of social influence. Then the (2) development and accomplishment, (3) empowerment. The users felt they could gain the control over their network started by first understand their network status quo. The top influencers in their network can potentially be their window to build more meaningful connection. Also exploring personal digital interaction records and their visualization through computer algorithm do have a certain degree of unpredictability involved, based on the result “discovering the unknown fact” of your network was not the core motivation for the users.

3.4 INITIAL NETWORKING MAP DESIGN GUIDELINE

**Emotional Need**
Considering the sensitivity of the information in the sociogram, the color and the texture of the visualization need to be able to deliver trustworthiness, protected and provide empathy. Ideally, the use of visual element need to support the readability and helping reader focus. A research conducted by Lehrl, Gerstmeyer, Jacob and their team in 2007. Showing the blue (colour) light is capable of significantly increase alertness and the speed of information processing for the reader. Plus the color blue usually symbolized reliability, rational and advance. Therefore became the main color tone in the interpersonal networking map.

**Less line, clear hierarchy**
Only reveal the most important linkages between each individuals, overload the interpersonal networking map with crossing lines will not only limited the space for other data or information but also decrease the motivation for the user to read through the information. Prioritize a clear visual hierarchy, the user should first see the individuals which have the highest frequency of interaction with themselves (the user).
Clear theme for each map
Don’t overwhelmed the user with too much information or features in each step, instead provide multiple maps each display specific structure to match their contents. And this can increased the readability and the usability of the interpersonal networking map.

Organic shape
Human relationships and networks are constantly transforming, the visualization of the interpersonal networking map need to provide some visual clues for the users to connect the map content with their real life networks. Based on the prototype testing with the user, the author found out with organic shape or color gradient, the user responded with the interpersonal networking map more positively, the overall interest level increase and more willingly to spend longer time read through the details.

Personalization
With personalization features like, theme change, content editing and filter, can effectively support and match with the user’s current reading habits and behavior, which will enhance the user experience and give the target users a strong sense of ownership and empowerment.
4.1 INTERPERSONAL NETWORK MAP VISUALIZATION EXPERIMENT

In the interpersonal networking map’s visualization experiment, the author divided the map into two main categories, one with light background, and the other with dark background. Theoretically, the dark background can provide the viewer a sense of safe, reliable and secure. The light background is relatively more energetic and generally provided a better readability. For the map’s core content, the author have a mixture of 2D, 3D, line based, brick based, solid color and gradient, the goal is to provide a wide range of visual style and wire frame to analyzed the user’s preference in a practical level. With three different field of information of the personal network’s information. (1) core connections with background spread. (2) top influencers among user’s network, and the main fields of connections they currently have. (3) general information of the user’s network, which includes 2 different pie charts (nationality spread and age spread) at this stage the visualization experiment conducted on laptop screens with 3 user interviews. In this stage of visualization, the author have not included the animation, interaction or any other features, because those might decrease the user’s focus on visualization. (see figure 17, page 48)
Figure 17: <Network Map Visualization Experiment>
4.1.1 INTERPERSONAL NETWORK MAP VISUALIZATION USER TESTING

The user testing were done through 1-1 interview through skype and other communication channels. Before the interview started, the author provide an overall view of all 18 maps presented. The first question was to ask reader to rank the favorites and the one least favorite style in each map categories. And if possible, explain to the author their choices. The second task was to vote on the four emotional feedback, the author tested on (1)accuracy, (2)trustworthiness, (3)organic, (4)secure. The participant need to choose one form of visualization which enable them to related with these four key words separately.

The result indicated, line based or static style of the map visualization have more votes due to the accuracy and trustworthiness. But also those visualizations are among the top lists of the least favorite form of visualization. The feedback from the readers was the visualization somehow remind them the chart which is commonly used in powerpoint or other microsoft office product. Which will decreased their interest of reading it. The one with 3D and gradient color efficiently provide are more pleasant to the eyes to the reader, but also make the reading experience more effortful. In general, the darker backgrounds and rounded edges can create a feeling of safe and secure and have a more pleasant reading experience for the users. Regarding the readability of the interpersonal network map, it depends on the user’s reading environment, in a darker environment, naturally the user will choose the darker background, and in the bright environment (office, or outdoor during day time) most people will select the lighter background.

On the third visualization: the general network status. Most testing results indicated the readers are pleased with the smooth color change and rounded graphic, the visuals support the reader to related the content to a sense of well-being or caring. However the aesthetically pleasing reading experience did not transform well into a efficient reading behavior, in order to maximise the space for the diverse form of pie charts visualization in the background, the title and explaining texts are small and require the users to zoom in to make it readable. Also without the percentage numbers aside, it is extremely hard, or nearly impossible in some cases for the reader to accurately prioritize the size difference from the biggest to the smallest among each areas. This readability problem existed in all sorts of pie charts.
Some interviewees suggested other forms of visualization to introduce the information in the “general network status” section, to provide a more efficient reading experience. To support the user get the required information as easy as possible should be one of the primary goal. For example a well organized bar charts or simply a text based information display. Which was later implemented in the next round of digital prototype.

4.2 INTERACTIVE PROTOTYPE

In this phase, the author used interactive InVision prototype with a touch screen laptop to conduct the user testing for the structure of interpersonal networking map website in a mobile based usage. The overall color palette of the prototype were intentionally limited to the blue, grey, white and black to create a clam and rational user experience. And with limited color palette, it can help the author and the tester to focus on the content, functionality or the structure of the prototype. The visualization of the interpersonal network maps were selected by the one which received the most positive feedback in the previous interview. All of the user testing environment were conducted in user’s home or student dormitory which most likely where the reader will open the interpersonal networking map, if it happen in the real life scenario. Due to the limitation of the timeframe, the author didn’t customize the content of digital prototype to be better matched with each tester’s network status. In total there was three rounds of in depth interviews been carried out. For the screenshot of the InVision prototype please check figure 18 in the following page.
In this stage the InVision prototype only limited to the red routes of the user journey, to validate and see if the process and structure are comprehensible for the users. The participants in the user testing were generally pleased with the selection of the UI color palette, and the overall graphical user interface (GUI), but the limitation in the mockup downgraded the satisfaction of the tested user experience, the transition between page to page seems puggy.
Selected interpersonal network maps & general network status

The features in the interpersonal network map section included editing, remove or add new contact, drag to reposition the individuals, map introduction, sharing visualization outcome and download, but those only implemented partially in the InVision.
4.2.1 INTERACTIVE PROTOTYPE USER TESTING

The second prototype testing mainly focused on the UX red route, part of the interactions were further away from the research focal points therefore was not included by the author in the InVision mockup. During the user testing, there were four main tasks which the tester needed to completed without any additional support from the author in a limited timeframe. The tasks were (1) Please create your own interpersonal network map, selecting the “FB messenger” and “Linkedin” as information input channels and process. (2) Please told the interviewer how many percent of your friends are Finnish? Who are the top three influencers in your network? (3) Please find the Map 1 “introduction”. (4) Please remove one person in Map 1.

Throughout the whole user testing the three participants were encourage to think or feel out loud to notify the author their thinking process. With only one testing factilitor(the author himself). These three interviews were conducted with voice records in order to later note down the feedback and result thoroughly.

The user testing found out, few key interactions were still difficult to process, due to essential buttons were hard to spot. For example the Map introduction almost blend with the title, and the testers were misunderstanding it as a subtitle which generally got neglected. Two testers were also said it was not clear enough that the user should swipe down to reveal the next map and general network information, some visual clues are necessary.

After the user testing, the author also ask the testers two open questions, (1) What element or text in this prototype doesn’t add value while you trying to complete the tasks and should be removed? (2) Will you be interested in using this service/product in real life scenario? Share the network map with your friends and family? All three testers reported the sign in/ out text in every page is redundant, and an extra page for the map gallery is not really useful, since there already have some examples in the landing page. The emphasis on the information protection seems forced and unnecessary, overly addressed in this part can possibly raise more questions. Since it’s a basic ethic rule nowadays in all digital products. All three testers showed great interests in using the interpersonal network map as a service, but don’t have any motives to share this with their friends or family.
5.1 DESIGN OUTCOME

Through numerous iteration, the author accumulated the result of the previous round of user testing and suggestions then distilled it into an interpersonal network map design guideline, which guided the design direction of the final visualization and mobile prototype (see page 60 - 67, figure 22-27). Part of the design guideline are applicable to sociogram design, social media platform, friend list showcase and many other context when the development team need to explain the central character’s or user’s connection with various other individuals. Built on top of the design guide is the final visualization outcome of the interpersonal network map, and the key user interfaces which was adjusted based on the previous feedback from the testers.

5.2 DESIGN GUIDELINE

(A) PERSONALIZATION

Allowing the user to opt the data sources freely, can support the system to depict a more accurate result. (see figure 19.) Making sure the network map can be more effectively reflecting the user’s real life network. Also the user need to be able to directly edit the final result of the interpersonal network map, which included add, delete individual person on the map, this can further enhance the accuracy of the map and pull it closer to the user’s expectation. Re-editing the visual features (UI color palette, font size, background) could improve the user’s sense of ownership toward the final outcome, but won’t add too much value for the users whom will only be accessing the network map once. and enable the visualization to be better matched with the user’s reading behaviors and habits. But providing with too much non-essential options can overwhelm the user. According to Hick’s Law (William Edmund Hick and Ray Hyman, 1952) the more choices you offered to the user, it required longer time to processing information and making decisions. The designer needs to do numerous user testing to find the balance point.

Figure 19: <Personalization: user selecting data inputs for network map>
(B) ENVIRONMENTAL ADAPTATION: DARK & BRIGHT MODE

Ideally, both the visualization and the user interface should be capable of adapting itself to different reading environments. (see figure 20.) In dark environment, a full white background will make the reading experience on the mobile device challenging and painful, and contrary with that, in a bright environment, reading contents on a dark background can be a toilsome work. The switch between day and night mode can be set as automatically syncing with real world scenario. This automatic feature can be design as a system default setting which also allow the user to freely adjust, according to their personal preference or reading environment.

Figure 20: <environmental adaptation: dark & bright mode>

System automatically adjusting the UI color contrast accordingly to its environment, provide a more comfortable reading experience.
(C) AUTOMATIC MAP TUTORIAL

In the previous user testing, the author found out most users will skip through the tutorial, particularly in the early stage of the user journey. (See Figure 21: Tutorial Example.) When in poor execution, the tutorial can even be a degrading experience for some users. Instead, using a 2-4 seconds tutorial video clip which automatically play once the user enter the interpersonal network map page. This can be a more effective way to display the interactive features of the interpersonal networking map, guide the user how to read and edit the content of the map.

**Figure 21: Tutorial Example**

From the first screen to the last step of video tutorial, shouldn’t be over 4 seconds. Otherwise, the user will soon lost the interest to read through.

Also the application shouldn’t force the user to click through all the mentioned steps in the tutorial.
(D) **Reduce cognitive load**
Shortening the learning curve for the user by only reveal the necessary information, visual elements and action points in each steps, utilized the side menu or hamburger menu and minimized the complexity of the user interface. Which might add one or two user clicks to achieve certain tasks, but it improve the efficiency of exploring new information for the user. This should result in a cleaner wireframes and a more intuitive webpage for the target users.

(E) **Organic structure**
The diagram need to resonate with some of the essential characteristic of the information which it is presenting. In this thesis research in particular: the human relationships and connections, a living network which is constantly evolving and expanding. After few rounds of user testing and interviews, the author found out by utilizing organic shape, streamline or gradient color, will make it easier for the reader to connect the presented data and information with their personal network status. Another advantage of this guideline, is to prevent the final visualization become a standard powerpoint charts which tend to largely reduced the motivation of the reader to continue exploring in the interpersonal network map.

(F) **Incentivized reading experience**
Driven user engagement and rewarding the user when they start exploring the interpersonal network map with delightful microinteraction, more detail informations or encouraging text. The goal is to give timely feedback to the user, to avoiding time wasting or misunderstanding. Also this can support the user emotionally, making sure the reading experience is effortless. A practical and commonly executed method in the world of UI is to incentivize the reading experience by the installing a percentage/progress bar on the side of the screen, notifying the reader of how much information left to explore.
Top Influencers in your network

This map visualized the top 3 influencers among your current network. Also display what fields of professional backgrounds that influencer is connecting with.

Key Connected Individuals

Dilok Ludovico
1658 connections

Scott Chen
Yu Lin
Dilok Ludovico

Chi-Fan Ken
Steven Chen
Amuyi Wen

Marcin Samsonowski
Derek Chan

Yu Chuan Wang
Ting-Jhen Yang

Earl Lee
Yip Lin

Dilok Ludovico
1658 connections
Figure 22: Final Design Outcome A: UI in Iphone X
Figure 23: <Final Design Outcome B : UI in Tablet>
Figure 25: Final Design Outcome D: Map 2 Interactions
5.3 BRIGHT BACKGROUND OPTION

The final design outcomes of the bright background mode were based on the previous invasion prototype and design guideline of the interpersonal network map. The goal is to provide the user with alternative option, which have less ingredients and higher readability, to ensure the visualization can adapt to difference reading environments and personal preference well, the author also broaden the color palette of the user interfaces, made overall atmosphere warmer, and easier for the reader to browse the information.

(Day time) Bright version

Considering if the user is in a bright reading environment, then complex background texture, 3D visualization and color gradient can’t support their reading experience, and often lead to low readability and downgrade the functionality of the whole website.

Figure 26: <Final Design Outcome E : Bright Mode>
In the final user interface design of the General Network Status section, the author merged two charts (Nationality Spread and Age spread of user’s network) into one frame, the size of the graphical elements remained largely the same, but they were served more as a UI background, the text information became the focal point of user’s attention. For the General Network Status page’s introduction and other action points, like save or share, the user can click the "+" icons or the title to reveal those options.
5.4 CONCLUSION

This Master of Arts thesis had explored how can the visual communication design supporting the reading experience of the interpersonal networking map in mobile devices. Distilled the user validation and the research finding result into a design guidelines for optimizing the reading experience for interpersonal network visualization in mobile devices.

To achieve this goal: optimize the reading experience of an interpersonal networking map, the author first processed to explore two fundamental questions (1) Who is the main users of the interpersonal network map? (2) What information they expected to read and what motivated them? Through user studies via, surveys, multiple workshops and interviews, the author had gained better understanding of different user’s goal and motivation on the defining stage (page 40).

The literature review provided contextual and theoretical knowledge of how user interact and respond to the graphical user interface, difference between one and two handed navigation and how visuals facilitate human reading. And the sociogram reading experiment which conducted by Huang, Hong, Eades in 2006 provided the solid base of the interpersonal networking map design guideline. The discoveries from the literature reviews, and user research were later accumulated into the user personas, octalysis framework, user journey and UI prototype with multiple iterations.

In the developing stage, with tight loop of build-measure-learn, an iterative design process, the key user’s insight were continuously provided into the UI prototype through user testing workshops and user interviews. And the insights were formed into a draft design guideline which later validate through user testing and interviews and became a proven hypothesis in the deliver stage. Based on the final design guideline, the research question had been answered. In the delivering stage, the author listed out the tested design guidelines (page 56)  (A) Personalization: customized to personal need and expectation  (B) Environmental adaptation system: automatically switch the brightness and the UI color contrast, based on the reading environment or reader’s personal preference. (C) Automatic Map tutorial: lowering the learning curve for readers. (D) Minimize cognitive load: with limited information shown, improve the efficiency of reading.  (E) Organic visual language: easier for the user to connect the visuals with the human relationship. (F) Incentivize reading experience: give the user a timely respond on certain interaction. Then executed those guidelines into the final outcome of interpersonal network map. The result of the second user evaluation was positive, Those guidelines is constructive and able to improve the reading experience, increased the user’s chances to explore the interpersonal network map, and can possibly lead to a better awareness of their own network status.
5.4.1 PERSONAL REFLECTION

Through the process of study in this thesis, I had encountered some challenges and surprises which listed below:

(1) Ideally the main objective of the visualization inside a digital product is to facilitate user journey, enhanced the user experience without requiring too much attention from the user. But finding a balance between providing pleasant visual delights, high readability and efficient usability is really hard and unavoidably required numerous user testing which is time consuming. In the duration of the testing, found out some readers were not aware of the influence of visual effects due to its subtleties, ignore the graphical elements or shown total disinterested with the role of visualization in the interpersonal network map. It’s an educational fact check for visual designers to see if the visual design works smoothly in the context, or should they redistribute their time and resource to elsewhere in the design project.

Figure 28: <Usage Context A>
(2) With a relatively long thesis studies period (more than one year). I found with the same interviewee, their core motivation of using the interpersonal network map was changing with time, personal career, financial or health situation.

(3) The thesis topic: How to optimize the reading experience for an interpersonal network in mobile devices? It’s a broad research topic which needs further clarifications in many areas. Spent months with numerous survey, workshops and interviews, I narrowed down the boundary of this thesis project. But if those definitions were well in place in the starting point, the whole thesis project should be process more efficiently.

At the end, after iterating various visualization experiments and interviews, I had seen the possibility of leverage visual elements to influence perception and facilitate understanding. And with the listed design guideline and design outcome, I hope the overall result can be inspiring for other designer.

Figure 29: <Usage Context B>
REFERENCE


Weidong Huang, Seok-Hee Hong, Peter Eades (2005), Layout Effects on Sociogram Perception, pp 1-12


APPENDIX 1:
Sociogram potential user questionnaire, with 43 response in total, the survey had conducted in both digital and paper form.

SOCI OGRAM USER STUDY

A sociogram is a graphic representation of social links that a person has. It is a graph drawing that plots the structure of interpersonal relations in a group situation.

1. Rate your level of interest in reading your own interpersonal networking map / sociogram from 1 - 5.

2. From 1-5 please rate the Tech savvy level of yourself.

3. How active you are in the social media platform? the frequency of post or write comments?

4. Education Level
   - High School
   - Bachelor
   - Master
   - Phd
   - Others

5. Have you ever read a interpersonal networking map & sociogram before?
   - Yes
   - No
   - Maybe

6. What device will you mainly reply on if you are reading your own interpersonal networking map / sociogram?
   - Smart Phone
   - Tablets / ipad
   - Laptop
   - others

Thank you for your time.
Email / contact info _______________________

☐ Willing to participate in the interpersonal networking map workshop in the future.
☐ Willing to continue for another interpersonal networking map survey in the future.
APPENDIX 2:
Secondary sociogram user questionnaire, further clarifying the user motivation, personal preference and preferable features when reading the sociogram in mobile devices.
Motivation survey for interpersonal network map

As a potential user, what best describe the motivation for using the interpersonal network map?

1. **Epic meaning and calling**
   - User believes he or she is doing something greater than oneself. The implementation of this drive can vary, and is not limited to altruistic behavior. Some of the world’s worst events and actions have happened with the belief of participating in something greater than oneself.

2. **Development & accomplishment**
   - Development and accomplishment is our internal drive for making progress, developing skills, achieving mastery, and eventually overcoming challenges.

3. **Empowerment of creativity**
   - Users are engaged in a creative process where they repeatedly figure new things out and try different combinations. People not only need ways to express their creativity, but also need to see the results of their creativity, receive feedback, and adjust in turn.

4. **Ownership and possession**
   - Users feel like they own or control something. When a person feels ownership over something, they naturally want to improve and improve what they own.

5. **Social influence**
   - This drive incorporates all the social elements that motivate people, including mentorship, social acceptance, companionship, and even competition and envy. When you see a friend that is amazing at some skill or owns something extraordinary, you become driven to attain the same. Think about how we naturally draw closer to people, places, or events that we can relate to.

6. **Scarcity**
   - Scarcity and impatience is the core drive of wanting something simply because it is extremely rare, exclusive, or immediately unavailable.

7. **Unpredictability and curiosity**
   - Unpredictability is the core drive of constantly being engaged because you don’t know what is going to happen next. When something does not fall into your regular pattern recognition cycles, your brain kicks into high gear and pays attention to the unexpected.

8. **Loss and avoidance**
   - Loss and avoidance is the core drive that motivates us to avoid something negative from happening. On a small scale, it could be to avoid losing previous work or changing one’s behavior. On a larger scale, it could be to avoid admitting that everything you did up to this point was useless because you are now quitting.

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**APPENDIX 3:**
Survey for building the Octalysis Framework, conducted in both paper and digital form, collected 8 responses in total.