SoLoMo User Experience Study Using a Pivoted Parallel Coordinates

Xiaohua Sun, Jie Qiu, and Lei Zhang

Tongji University, 1239 Siping Road, Shanghai, China
xsun@tongji.edu.cn, {queenaquin,zhanglei89}@gmail.com

Abstract. With the development of mobile and location-based technology, SoLoMo is becoming the trend for applications in different fields. However, many of the existing applications only take advantage of a very small part of the rich potentials provided by the SoLoMo framework. We introduce in this paper a pivoted parallel coordinates supporting the study of the complex user experiences in SoLoMo applications. We also present a series of studies and designs we did utilizing this coordinates. Hope the approach and tools introduced in this paper can serve as a means for more designers to better position existing applications and for them to identify novel scenarios that are otherwise buried in the numerous factors involved in SoLoMo.

Keywords: SoLoMo, SNS, LBS, Mobile Application, User Experience, Parallel Coordinates.

1 Introduction

SoLoMo is a concept referring to the convergence of Social, Local, and Mobile in the future development of the Web. As a mash-up concept, SoLoMo is considered by some as a buzzword. Existing studies about it are also mostly from the marketing point of view [2][3][4][5]. However, the integration of social network, location-based service, and mobile application does bring many new possibilities that could change our life evolutionarily. Most of its potential application scenarios have also never existed before. Many of the existing applications only touch bits and pieces of SoLoMo without a comprehensive understanding of the overall structure. In-depth study of the intertwining factors involved in SoLoMo is thus important for inventing innovative applications and improving existing ones.

As revealed in its name, multiple dimensions are integrated in SoLoMo, which further form complex combinations. An appropriate method is thus needed to help comb things out. Inspired by the approach used to study high dimensional data, we invented a pivoted parallel coordinates which makes it possible for looking at all of the relevant dimensions in one place and for further consolidating them into a system tailored for the study of SoLoMo use cases and application scenarios.

Using such a coordinate system, we did a series of studies examining existing applications and analyzing how SoLoMo could play a role in different application fields.

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We also did design explorations on top of the field analysis. In the following sections we will introduce in detail our design of the coordinate system and our findings from the studies.

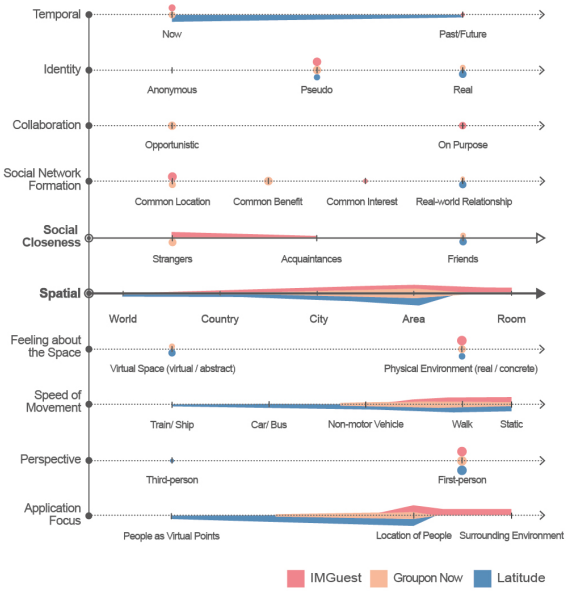

Fig. 1. Analysis of examples of three main types of SoLoMo applications

2 Design of the Pivoted Parallel Coordinates

Literally, SoLoMo involves social, location, and mobile three aspects. For the purpose of fostering design of innovative applications, we further refine the dimensions to study from the following three directions: properties of various aspects of the three fundamental dimensions, focus of design of an application, and users' experience when using an application. During the design of the coordinate system, existing and potential applications are also used as references for the selection of the axes and the definition of the values. As a result, 10 axes are chosen (Fig. 1).

Instead of leaving them as standalone axes like those in normal parallel coordinates, we further organize the axes into a system better supporting the study and design of SoLoMo applications. Out of the three aspects of SoLoMo, Location is the one that bridges the Social and the Mobile. Location links the virtual social network with the mobile applications used in physical environment and brings the development of both aspects to a new stage. As an inseparable concept of location, spaces at different scales are where all the activities carried out no matter it is a physical interaction with the surrounding people and environment, a virtual communication with people world-wide, or an intermediate one of viewing a location-based augmented reality advertisement. Aligning the values on different axes with the Spatial

dimension as a pivot could thus help to present the properties of different applications on top of a framework that already has a meaningful scenario structure encoded. For example, along with the change of the size of the space from a room to an area, a city, a country and the world, people's experience about space changes from a concrete physical environment to a virtual abstract representation such as a map. The way people look at the space also changes from first-person view that cares more about the physical experience to third-person view that sees space as abstract location and sees people as virtual points.

Because of the virtual characteristic of online social connections, the mapping between values on the social-related dimensions and those on the spatial dimension is not always the same in different contexts. However, those social-related dimensions themselves could be well aligned. We thus choose Social Closeness as another pivot axis. Any multivariate relationship between the Social Closeness dimension and the Spatial dimension applies to the other social-related dimensions as well.

As shown in Fig. 1, dots of different sizes and stripes of different thicknesses are used to plot discrete and continuous values on the coordinates. When there is more than one case under study in a plot, different colors are used. When there are multiple values plotted at one spot, dots are lined up vertically, strips are piled up in a way like the ThemeRiver[1] visualization.

As can be seen from the analysis later on, the Social, Location, and Mobile aspects are being realized in each application at different levels of richness, which in turn affects different number of points in the coordinate system. For example, in the check in function in Latitude, locations are mostly taken as virtual points by themselves or as endpoints of path lines; for Groupon Now, besides being a virtual point on the map, a location is also associated with the surrounding environment and the interest-based exploration; location in IMGuest on the other hand starts from the locale where people meet in the first place, then further links to past visit of the same place and future encounter at different places. It is thus obvious that not only the number of aspects an application covers matters, the depth to which it reaches in each aspect and the layers of functions supported are also important for the design of a successful SoLoMo application. For this reason, at the same time of studying the various aspects involved in SoLoMo, we also worked on defining the levels of them. For example, from bottom up, the location aspect could be defined into seven levels: 1) referring to a large area such as a city, 2) referring to a specific point on the map, 3) including multiple points on a path, 4) focusing on the surrounding environment, 5) looking from multiple spatial scales, 6) considering both past and future visit, 7) considering interactions among people and interactions between people and the environment. Size of the dots and thickness of the stripes in the plot represent a combinatory result of the percentage of which one application is at a specific value and the level that application reaches in the corresponding dimension.

3 Study of Three Main Types of SoLoMo Applications

Through a comprehensive survey, we found that exiting SoLoMo applications can be categorized into three main types: Check-in, Elastic Network, and Mobile Group

Buying. Utilizing the pivoted parallel coordinates designed above we first looked at characteristics of each type and then studied the overall pattern revealed through the plot of example applications (Fig. 1).

3.1 Check-in

Check-in-based location information sharing is one of the first types of SoLoMo applications that introduce to users the fresh concept of location-based socialization on mobile devices. As a representative application of this type, Latitude not only has the basic functions of keeping friends posted about one's activities, checking friends' locations, and searching for friends close-by, but also does a good job in keeping a nice balance between people's needs for information sharing and needs for privacy protection through its subtle multi-layered privacy setting mechanism. However, as we can tell from the plot in Fig.1, Latitude (other Check-in applications as well) has a very limited scope in the social closeness and activity aspects and unavoidably has its users taken away by other applications that further take advantage of users' location information for various forms of social network development and collaboration.

3.2 Elastic Network

Elastic network refers to the opportunistic network formed among people based on common location, common interest or common benefit. Different from traditional social network like Twitter or Facebook where fixed (e.g. follow) or long-term (e.g. friend) relationships are needed, the formation of elastic network is normally through a key point, such as a common location, over which the information of users close-by are pushed to each other. They can then interact with each other directly without going through the complex process involved in traditional SNS. The concept of elastic network conforms to the trend of people-centric information gathering and sharing. Both the formation and the dissolving of the network are all around peoples' once a time activity or interest.

IMGuest is an application that successfully targets the user group appropriate for elastic network: travelers looking for partners and social activities at places out of their everyday life circle. When users of IMGuest check in to the same hotel or hotels close-by, they can "see" each other on IMGuest and mark those with similar interest or experience as "like" or "interesting". They can further contact those of interest for face-to-face communication or become partners during later part of the trip. IMGuest can also remember those being checked about, marked or contacted by a user and notify him/her when they signup another time at places close-by. This increases the level of its use of the location information by incorporating both the temporal and the social factors. For the tricky issue of privacy common to all elastic network applications, IMGuest already did a good job by confining its users to those who have more needs for temporary socialization over the needs for privacy protection at the time of using the application. More actions could be taken to improve elastic network applications' user experience in this regard, e.g. revealing only the information critical for the one-time socialization and protecting those unrelated, or opening communication channels only for those who share common interests, etc.

3.3 Mobile Group Buying

Web-based group buying is no longer a new concept. With the development of mobile internet, the real-time location dimension is nicely introduced to group buying. Using applications like Groupon Now (mobile service provided by Groupon, first of the kind in group buying), users can find great local deals that they can buy or use right now. The system can also provide a detailed transaction list based on users' location, which enhances people's feeling about the surrounding place and largely fosters their passion for purchasing at the moment. Groupon Now shows many of the characteristics common to mobile group buying applications such as simple search-based instead of advertisement-based deal suggestion and location-based group buying information pushing and recommendation. It even supports intuitive and customized search by pressing the "I'm hungry" or "I'm bored" button and supports discussion and experience sharing with friends. Made for collective and location specific buying activities, mobile group buying applications cover a pretty broad scope on the coordinates (Fig.1). Considering of the fact that people do group buying are very likely to have similar interest, increasing the level of its social aspect from one-time location or benefit-based elastic network to long-term common interest-based network could make the application more beneficial. For example, instead of having the users do opportunistic collaboration every time, a long-term social network can form among them, which could be further refined over more group buying activities. Similar to the IMGuest function of notifying acquaintances close-by, users could receive notifications about people nearby who had ever done group buying together with them. They may then enjoy some local deals together again.

Besides the three types of applications analyzed above, there are also applications that incorporate the main functions from multiple types. For example, Foursquare has both the ingredient of the check-in service and that of the mobile group buying and experience sharing. Instead of simply running as a combo of two different types of applications, when the functions from both are placed together, new possibilities come into being. For example, the accumulated check-in information can reveal various demographic characteristics of the users. When checking-in at a place, a person could receive deals recommended by the system from venues preferred by people of his/her gender or age group. This is where the potential of SoLoMo is. Under an open framework, SoLoMo applications can expand their functionalities by incorporating more dimensions, developing more in-depth in each dimension, and digging out innovative features through the intersection of different dimensions.

Looking at the plot of the representative applications of the three main types (Fig.1), it is easy to see the following patterns common to existing SoLoMo applications: 1) For the Social Closeness aspect, more attentions could be placed to the group of acquaintance; 2) Even though there may exist practical constraints, making an application available globally could tremendously increase its value; 3) Designing functions for space of small size such as the surrounding environments and for the moving speed of vehicles are where more efforts could be placed; 4) Increasing the level of the temporal dimension, supporting the integration of previous and future social and location-based information with the current ones is a way to increase the SoLoMo level of an application in general; 5) Looking at the world as an abstract environment and looking at people as virtual points from the third-person view is another part of

the SoLoMo landscape which has not been well explored. There could be new applications taking this as the launch point.

4 Existing Application Expansion

Since one of the main purposes of this study is to help with the invention of innovative SoLoMo applications, we present in this section our study of a series of existing applications in light of the SoLoMo concept: which SoLoMo aspects they already have, what actions they are taking to enrich their SoLoMo flavor, and what potential features we would like to suggest them to incorporate.

4.1 Mobile and Local (Get Off Now, Taxi By Me)

Get Off Now and Taxi By Me are two location information-oriented applications. With Get Off Now, users can set their destinations and the type of transportation tools used. When getting close to their destinations, users will be alarmed to get off. Get Off Now prevent users from missing their stops in crowded, noisy or unfamiliar places or when they are in the middle of taking a nap, playing a game or reading some eBooks. Considering of the level concept discussed above, in the mobile aspect, Get Off Now reaches a pretty high level by not only taking the phone as a mobile device but also using it to get the speed of movement. So far, Get Off Now is a widget-like application limited to individual use. Since many of the users using Get Off Now on their way commute to work and back home, the information of individual user's time and location of getting off can actually be collected and used for the formation of elastic social networks. For example, people could see those getting off at the same stop as them around similar time of going to work on a daily basis, who are very likely to work in the same area as them. They can then choose to get to know each other and maybe have lunch together sometime. Similarly, those getting off at nearby stops around similar time back from work may live in the same neighborhood and can contact each other to hangout together after work.

By collaborating with Taxi companies, Taxi By Me shows on the map taxies running in the near vicinity along with their plate number, company, driver's name, and how far they are from the user. One can directly contact drivers displayed on the map or wait to be contacted by sending out a request for taxi to certain destination. Taking advantage of mobile location information sharing, this application solves the problem of having passengers and empty taxies nearby missing each other. Its function can actually be further enhanced by increasing the level of the social aspect. For example, the location-based one-time relationship between the driver and the passenger can be expanded to a long-term common benefit-based elastic network. Passengers can check the availability of drivers in this network when they need taxi in the future. Incorporating drivers' real-world relationship into the system is another way to increase the social level. For example, when drivers received the request broadcast are busy at the moment, they can recommend to the system their friends who are not far away from the place.

4.2 Mobile and Social (Sina Weibo, WeChat)

Sina Weibo is the most popular micro-blog service in China. With the advent of Sina Weibo mobile application, some nice location-based features are introduced. "People Close-by" lets the users see people in near vicinity along with their micro-blogs. With location-based elastic network applications like MoMo, people interact directly with strangers they don't know much about. "People Close-by" of Sina Weibo on the other hand enables users to know more about people close-by from their micro-blog information accumulated over time and also provides the way for users to interact with other people in the indirect way of following them on the micro-blog. Another function, "Weibo Close-by", displays recent micro-blog messages posted at places close-by sorted by the distance and time of posting. It is a nice way to introduce to users what's going on next to them, which provides the context information of the authors and their previous posts at the same time. Both functions take advantage of Sina Weibo's strength in information sharing, use the rich content, either accumulated over time or posted in real-time, to enhance location-based socialization or to realize location-based information sharing.

WeChat is a mobile application supporting instant communication. It has rich multimedia features such as voice messaging that are not available in its desktop-based predecessor, QQ. In the location aspect, WeChat also introduced the "People Close-by" function. However, unlike that in Sina Weibo, this function doesn't grow out of WeChat's essential functionality. There is not much difference between it and the main function of applications like MoMo. WeChat can actually make its location-based socialization function more unique by taking advantage of its strength in having a user group built mostly on top of real world or long-term relationship. For example, the "People Close-by" function can be modified to "Friends Close-by" and returns those in one's "Friend Circle" and those in the "Friend Circle" of his/her friends' who agree to be revealed. In this way, the social relationship context unique to WeChat can help increase the elasticity of the location-based network and make the function more sticky.

4.3 Mobile and Cloud (Dropbox)

Mobile cloud computing is a new technology paradigm with great potentials. It empowers mobile devices with infrastructure, platform and software provided through the cloud and makes mobile applications both lightweight and powerful. Dropbox is one such application, which supports cloud-based file, photo, music, and playlist backup, synchronization, and sharing. Following the trend of SoLoMo, Dropbox expands its social capability through group file sharing and through the integration with other applications like Instagram, Flickr, and Facebook (e.g. being tagged on Facebook by a friend can cause the automatic transfer of a Facebook photo to one's Dropbox). Droxbox also incorporates location-based function of sharing photos uploaded by people within 10 miles. Even though the social and location elements in Dropbox didn't bring fundamental revolution to its main functions, the direction of combining social and local with mobile and cloud suggested by Dropbox is a very promising one. This could bring the power of SoLoMo applications to a new level, especially in situations where the convergence of social, local, mobile and high performance computing is crucial, such as the SoLoMo game scenarios studied in [6].

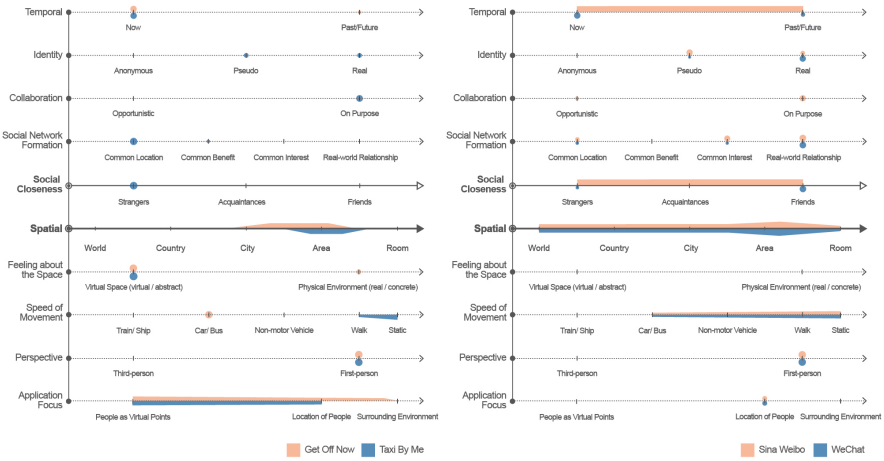

Fig. 2. Analysis of the Mobile and Local and the Mobile and Social applications

5 Analysis by Field

Besides the above study by application, we also analyzed the use of SoLoMo in twelve different application fields: transportation, travel, logistic, medical, advertisement, media, social network, shopping, exhibition and gallery, home and family life, education and academic research, and game. For each field, we plot on the coordinate system representative applications, summarize the overall trends, point out potential needs, and further line out design ideas inspired by the pattern revealed. For example, for the field of transportation, five applications are chosen for study. Car-friend Connection and Waze are two applications for community-based traffic information sharing and navigation. XQ is a public transportation route-based socialization platform. Uber is a location-based Taxi or private driving service request application similar to Taxi By Me introduced above. Tiramisu is a crowd-powered transit information system. All together, they represent the vivid development of applications over a broad spectrum. They also have a good coverage over the parallel coordinates (plotted above the axes in Fig. 3). However, we still identified from the plot needs that are not well addressed by existing applications (plotted in red color below the axes in Fig. 3), such as needs by passengers on the train or ship and needs for nice transitions between the virtual map and the physical environment. Correspondingly, we designed two applications, OnBoard and CarSNS (first two colors plotted below the axes in Fig. 3).

Staying together in a closed environment for certain period of time, there are many social needs unique to people on the train or ship, e.g. needs for help from professionals such as doctors, and needs for killing time by chatting or playing with others. OnBoard is designed to support the formation of a special elastic social network that can satisfy these needs. For example, doctors can signup in the “Doctor on Board” section and have their positions and contact information displayed. People can also initiate or join groups for playing different types of games. As an application for this special community of people on the train or ship, we also designed other practical location-based functions for people to locate their friends on the same train/ship,

check information about cities or sceneries on the way, and get alerted when getting close to their destinations.

Considering of driving safety, privacy protection, and the need for smooth virtual-physical transition, we designed CarSNS as an improved social network application for cars. It takes cars instead of drivers as fundamental units in the network and uses augmented reality (AR) display on windshield as interface of the application. In this social network of cars, driver along with his/her mood, interest etc. is just one property of a car. Other properties may include driving destination, whether there is pet or kid in the car, whether grouping with other cars is desired, etc. All these information can be overlaid on cars in the AR display. One can search for cars close-by that have certain characteristics. The result will be displayed through an AR lighten up function. Cars can also ask for or provide help to others only at the car level without the need for the drivers to know each other if they don't feel like or if it is not necessary. This design eliminates a lot of the transitions from real to virtual and then back to real. It also helps to protect privacy by keeping the car-to-car communication with cars as the participating entity. Even though not as practical to realize as smartphone applications, we try to use this as an example to show how the analysis of the overall pattern of SoLoMo uses and needs in one field can help pull the design of new applications out of the confinements from existing examples and can even point out directions for the development of supporting technologies.

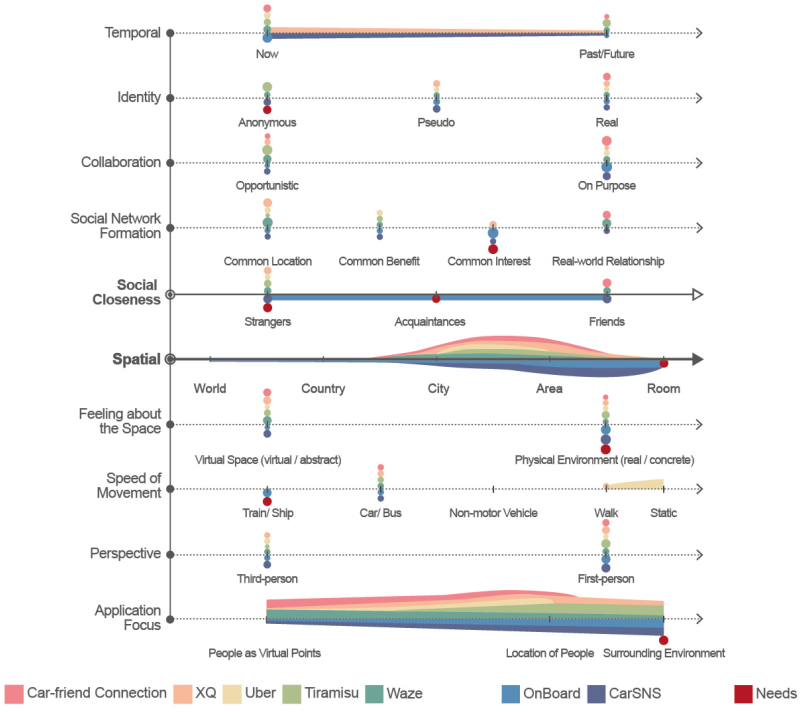

Fig. 3. Analysis and design for the field of transportation

6 Conclusion and Future Work

In this paper, we presented an approach to analyze the rich potentials provided by the SoLoMo framework from the point of view of user experience and application design. In particular, we invented a pivoted parallel coordinates supporting thorough study of all related factors in one place. The analyses of existing applications and different application fields using this coordinates turned out to be informative and are useful for pushing the design of SoLoMo applications to a new level by expanding the coverage in the SoLoMo landscape and by utilizing each element in a high level manner. As part of our future work, we would like to develop an interactive application of the pivoted parallel coordinates, which can support dynamic definition of the dimensions and numerical assignment of the values. This would be helpful for quantitative analysis of more applications and for studies at different levels of focus, e.g. study of the factors involved in a specific topic such as privacy in SoLoMo. We would also like to invent a more systematic way to define and study the levels at which an application reaches in utilizing different SoLoMo dimensions.

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