Stay-in-touch: a system for ambient social reminders

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ABSTRACT
Social interactions among a group of friends will typically have a certain recurring rhythm. Most people interact with their own circle of friends at a range of different rates, and through a range of different modalities (by phone, instant messaging, face-to-face meetings etc.). When these naturally recurring interactions are maintained effectively, people feel at ease with the quality and stability of their social network. Conversely, when a person has not interacted with one of their friends for a longer period than they usually do, a problem can be identified in that relationship which may require action to fix. We present Stay-in-touch, an ambient information system which provides peripheral cues to the user which serve as occasional recommendations of which of their friends they should contact soon in order to keep their social network in a healthy state.

Author Keywords
Ambient displays, reminder systems, information visualisation, social networks analysis.

INTRODUCTION
When modelling the social interactions among a group of friends, a certain recurring rhythm is identified, which will differ between social groups. Within this group, a single person may have a range of different rhythms with each of their friends, due to the similarity of their schedules, the differing strengths of those friendships, and a range of other social factors. When these rhythms are maintained well — that is, the person interacts with that friend at the regularity that they normally do — the health of that friendship will feel natural. If on the other hand the friendship falls out of rhythm, through neglect or unfortunate circumstance, and the two people do not see each other or otherwise interact, this gap will be felt, though perhaps not always understood.

A person's "social rhythm" describes the rate and regularity with which they interact with the various people they know. In this regard it is a fuzzy metric; if asked how often you interact with a certain friend of yours, you will probably reply with "about twice a week" or "most days", not something like "once every 37 hours". Stay-in-touch is an application we have developed to notify a user when it detects a lull in one of their social connections. It does so by analysing their social interaction history through data gathered from a multitude of sources, and attempting to quantify their social rhythm.

A person's ability to regulate their own social rhythm relies on their perception of time running like clockwork, but the human mind's perception of the passage of time is capricious at best [5]. Numerous studies have pointed to the fallibility of this ability [3, 14]. Without external prompts, keeping up with friends — especially peripheral friends, who are not part of one's close social circle — can become a matter of chance and circumstance. Because social interactions are inherently vague and intuitive, there is no single point in time at which one is motivated to rekindle a dwindling friendship. For this reason we believe that explicit cues based on historically observed rhythms would help in this area, while still feeling natural and unforced.

Stay-in-touch provides the observer with suggestions of actions they can take to maintain the stability of their social network through a visual interface. This encourages users to contact their friends regularly, but also helps them to identify problems with certain friends early, so that they can take steps to correct a deviation before it becomes more pronounced. Thus, if a user tends their network well, they will have stronger ties with a wider and more diverse set of friends.

We are particularly interested in studying the effectiveness of these social reminders in the context of calm computing, as defined by Weiser [15]. Our intuition is that oftentimes it is an artefact that you come across arbitrarily which spurs you into contacting a friend about something. For example, seeing a photograph of you and a friend may prompt you to talk about an experience you shared. It is along these lines that we seek to provide subtle reminders of a friend at the right time, to lead a user into reestablishing contact. If the user can ignore the system when all is well in their social network, they will be more likely to engage with it when an issue does arise. Conversely, if the system demands attention at too frequent an interval, the user may become frustrated and begin ignoring notifications. Finding the ideal balance between avoiding interrupting the user's workflow and effectively providing information when it would be beneficial would provide valuable insights into how a busy person's attention is divided.

In the next section we will describe some social network analysis research that is relevant to this project, followed by a discussion of the the design of the system we have built. Next we discuss the applicability of this type of data to ambient information systems and describe how we could evaluate this sort of system.

SOCIAL NETWORK ANALYSIS

Previous studies have analysed social rhythms in socio-technical systems, although the focus of these studies was on the general trends of social rhythms apparent on a large scale. Golder et al. studied interactions between college students over the social networking site Facebook, and found that students' social calendars were heavily influenced by their school schedule [12]. Leskovec et al. analysed all conversations conducted over Microsoft's Messenger instant messaging service in the month of June 2006, and concluded that users of similar age, language and location were most likely to communicate frequently [7].

"Dunbar's number" is a proposed upper bound to the number of people an individual can maintain stable social relationships with. Among humans, this bound stands at approximately 150, and is due to the cognitive overheads involved in remembering and being able to meaningfully interact with others [4]. Although social networking applications have long allowed users to have many more than this number of "friends" identified within the system [2], it is unlikely that a user would report that they are friends with all of these people in the traditional sense [1].

Online social networking sites are generally used to maintain social connections which were originally forged offline [10]. These websites present a low-cost way for people to stay in contact with a wide array of friends and acquaintances. Combined with temporal reminders, sites like Facebook are an ideal avenue through which to evolve, maintain and reenforce a user's social circle.

That said, a person's social network cannot be described by data from any one source. Though the majority of a user's friends may indeed be present in an online social networking website, they will also have friends that they interact with purely offline, or mostly by phone or email. These ongoing social interactions are equally valid in characterising a user's circle of friends.

VISUALISING SOCIAL INTERACTIONS

There have been many visualisations generated of social networks, particularly since the rise of social networking websites and the rich data sets they present. Many visualisations use a familiar node-link diagram of a graph [6]. These visualisations will often present the graph from an "ego-centric" perspective, where the user being analysed is shown at the centre of the view, with their friends arrayed around them. In this project, because we are not interested in the network links that exist between friends, we can dispense with this network view, and focus on the strength of the connections between a user and their immediate network of friends.

A weakness we have identified with existing network visualisations is that they treat all edges in the network as being uniformly-weighted. That is, an edge is either present or not present; there is no gradation to the strength of each link, and all links are drawn with equal length. In real life, we know that friendships do not behave like this. The social links between people become weaker over time and grow stronger through positive interactions. We wish to visualise these details of the network from a single user's perspective, and allow them to answer questions about the health of their network at a glance.

Data Sources

Ambient systems can leverage the vast amounts of data available from the physical and virtual worlds. We now leave digital traces of most of our social interactions: all of our email is archived on a server somewhere, our instant messages are logged locally and remotely, posts to social network profiles are publicly visible, and so on. Even co-location data can be recorded if the users both wear a tracking device of some kind, allowing the identification of events like two people conversing in a research lab.

Though all of this data is attractive, for this first version of the Stay-in-touch system, we decided to focus on records of mobile phone interactions, which we are able to access from our telecommunication provider's website. The software has been built to be agnostic to the nature of the interactions, so adding support for emails in future, for example, is a matter of writing a small client to parse the user's inbox and find mails that they have sent or received from their friends. These, along with other discrete interactions, can then be entered into the system.

The visual display

Our visualisation is built using Processing [11], a Java-based visualisation framework which supports rapid prototyping of visualisation techniques.

Stay-in-touch presents a time series plot, visible in Figure 1. Each row represents a person's social interactions with one of their friends, showing mobile phone interactions; blue dots indicate phone calls, with the size of the dot reflecting the length of the call, while red dots indicate text messages and are uniformly-sized. Weeks are subtly delineated by differing background colours to provide users with an indication of their longer-term habits at a glance.

The current day is highlighted, and the next week is visible on the right of the display. Cues for future interactions are displayed in this area in the form of hollow circles. Their colour and size indicate the type of interaction suggested, based on a prediction algorithm that we have written for this purpose. Predicted social interactions are drawn on the day that our algorithm has calculated to be most likely for them to occur, but the user can see them a week in advance. This gives the user several opportunities to act on the information being presented to them at an appropriate time.

If the user does not interact with their friend in any way before the suggested interaction , an "X" is marked at this position and this is counted as a "miss". The prominent marking of these events (or non-events, if you will) serve to draw the user's attention to these more critical cues.

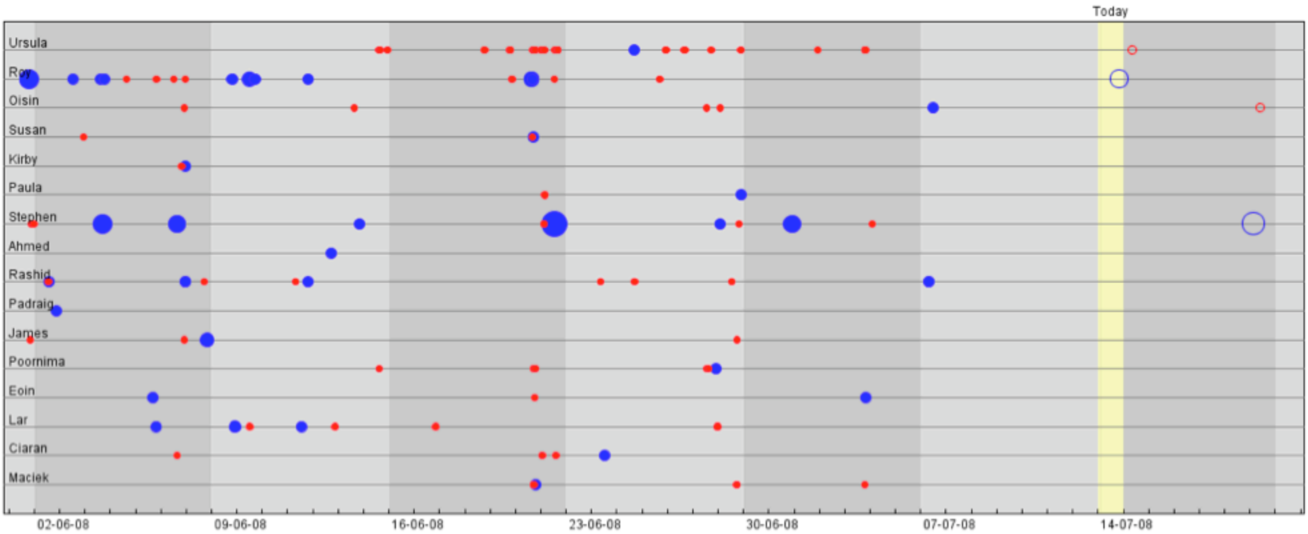

Figure 1. The Stay-in-touch display, showing a record of a user's interactions with a subset of their friends. Blue circles are phone calls; the size of the circle reflects the length of the call. Red circles are SMS text messages. Suggested future social interactions are indicated by hollow circles on the right, giving the user time to act on those suggestions when it is convenient.

AT ODDS WITH AMBIENCE

Neely et al. have previously explored their hypothesis that some context sources are more applicable to being presented in an ambient manner than others [9]. The reasons they described are precision, criticality, periodicity, interpretability and self-descriptiveness.

We add to these three properties of the system's primary output which we think make it a good candidate for application in an ambient display — the reminders are passive, temporal and simple. Passive means that changes in the information do not always require immediate attention; users can take note of reminders but choose not to act on them until later. Temporal means that the data changes over time; if the display remains at the periphery of a person's attention, they can monitor for changes while concentrating on other activities. Simple means that the information can be digested easily; at a basic level, a reminder simply consists of the name of a friend who they should contact soon. Other information may be present, such as a suggested contact time or medium, but this only serves to augment the primary information.

These three properties correspond well to the interaction, reaction and comprehension model proposed by McCrickard et al. [8]. Not all notification systems are as well-suited to an ambient implementation. Consider as a counterpoint the visualisation an air-traffic controller uses to direct planes at an airport. It satisfies none of the above criteria: the information requires immediate response, as planes must be given clearance to land or take off as quickly as possible; while the data does change with time, typically while there is any activity it is in a constant state of flux, and must be monitored constantly; and there are typically a huge number of variables to take into account for each notification, such as the plane's location, scheduled departure/arrival time, current velocity, etc. It would of course be possible to create an ambient display which delivers information about planes arriving and leaving an airport; while passengers might find this interesting and informative, air-traffic controllers would have no use for it.

This example highlights the fact that only certain classes of notifications suit application as an ambient display. This leads us to our key question: to what degree can reminders and notifications be incorporated into ambient systems, before the notion of calm computing is rendered meaningless?

FUTURE APPLICATIONS

The implementation described above could be used as both an interactive display, where a user filters the information processed by the system manually to achieve insights into their social trends, or as a information display, which allows a user to passively get a feel for the general health of their social environment in an instant. However, the application of the Stay-in-touch model to a more inherently ambient solution could take a radically different form. An example of such an ambient display in the area of social information is the Whereabouts Clock developed at Microsoft Research [13]. This is a glanceable ambient display placed on a wall in a home, which displays the current location of all of the members of the family. One could imagine a similar display for the Stay-in-touch model, which displays a collection of avatars representing some of the user's friends. The health of the social connection for each friend could be indicated on a danger scale — green meaning the relationship is growing in strength, yellow indicating no change and red suggesting a decline in the frequency of interactions.

Since the critical information output for the user — reminders indicating when a friendship is stagnating — is atomic and relatively simple, it could be used in conjunction with a number of lo-fi data delivery methods. The user could subscribe to receive suggestions as text messages on their mobile phone, or through email or twitter tweets, informing them of the person they need to catch up with. There is also the possibility of using small personal devices, such as the Chumby or iPhone, to allow more convenient access to reminders and provide a simplified version of the main visualisation.

FUTURE EVALUATION

We see an ideal evaluation of the system as a diverse user-based study; one would record the suggested social interaction time and type and along with the actual time that the person next contacted the friend in question. This data would be collected over a sustained period, and two parallel sets of social interaction data would emerge; the smaller the discrepancy between these two data sets, the more helpful the system is. A control group would be made up of a subset of the testers who would have their social interactions predicted as normal, but not shown to them. If the average difference between prediction and interaction is much lower for the informed group, then this would suggest that not only are the reminders influencing those users' social habits, but that they are promoting a more regular and sustained social rhythm.

In addition, if the study was administered to several groups of people, each with different levels of notification, we could get a good idea of when adding more frequent notifications or more vivid animations stopped being helpful and starting being distracting.

CONCLUSIONS

We have presented Stay-in-touch, which presents ambient information to a user based on the interactions that they have with members of their social network, and suggest how this kind of information can help a user to keep their social network in a healthy state. Given sufficiently careful treatment, infrequent notifications can become a useful addition to an ambient display. We have postulated that certain traits are desirable in an ambient reminder system; these are a long possible response time, variance in the timing and meaning of reminders, and simple, easy to interpret reminder information. Only extensive user testing can confirm that these qualities give an indication of the suitability of a type of reminder to ambient systems.

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