Augmented Social Reality

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Abstract

One potential breakthrough application of real-time mobile device sensing data is the ability to effect changes in the social systems in real time. This data can come from devices that we carry with us anyway: our cell phones, our name tags, and other computing devices. As we have shown in previous work, by using this data in offline analysis we can use this information to not only identify social ties, but also the context of those ties. We discuss a model for how this data should be used to improve social system structure through augmented social reality.

1. Introduction

Systematic study of how to engineer organizations using real-time data has, to our knowledge, never been attempted. In the past, researchers have used surveys and the like to discover the latent structure of organizations, but these methods often suffer from subjectivity and the unreliable memories of participants.

We now have accurate computational devices that can gather behavioral data from hundreds of individuals with high accuracy and over long periods of time, alleviating these problems. Our research group has created such a device: the Sociometric badge [5]. The badge can recognize human activities and extract speech features in real time. In addition, it can communicate with Bluetooth enabled cell phones, PDAs, and other devices to study user behavior and detect people in close proximity [4]. The badge can also capture face-to-face interaction time using an infrared (IR) sensor. We can then construct a social network from this interaction data, where a social network is defined as a collection of relationship ties between people. In our case, a tie represents a communication relationship.

Using this real-time information on the context and strength of social ties across a wide range of individuals in a social system, we can augment and change the social reality of users by building systems that work with people to create a more optimal social environment.

2. Related Work

When we talk about a social network, we are describing the overall structure of relationship links between individuals. Eagle and Pentland [4] explored how to retrieve this data from mobile phones, and Olguín [5] describes how Sociometric badges can be used to capture rich interaction data for social network analysis. Eagle and Pentland also created the Serendipity system, which automatically connected individuals to each other in socially natural ways [4]. The Serendipity application was loaded onto a cell phone with Bluetooth capability and would scan the area for other users with similar interests based on a manually entered user profile. If it found a match it would alert users that they may wish to meet someone in the area.

Terry et al. [7] presented a system that attempted to connect individuals through mutual friends, in an approach similar to our tightening method (described below). When two individuals wearing a sensing device were near each other the devices would exchange friendship lists and see if there were any commonalities. If there were, a message would be sent to the mutual friend so that they could arrange an introduction. Paulos and Goodman [6] also point to the importance of this form of user control, while they argue against introducing pure strangers simply due to propinquity. Our approach attempts to address this

concern while utilizing the technique of common friend introduction, turning everyone into a social connector.

2.1. Natural Social Connectors

Social connectors are vital for any social system to thrive [3]. We all know them: the gregarious coworker who introduced you to dozens of his friends across the company, or the affable cousin who clued you in to a perfect job opening. These are the people that make our lives better and help society as a whole by connecting disparate social segments together.

Connectors tend to be more productive than non-connectors [2], and in organizations where this skill is recognized and rewarded the organization benefits [3]. But why can't we all be social connectors? What if everyone could tap into the same skills used by these individuals?

2.2. Artificial Social Connectors

Imagine an application that lets people know when their social connections could help their friends. While a natural connector may have picked up on this information, it is difficult task for most people, who do not have wider knowledge of the structure of the social systems that they inhabit [3]. By creating an augmented social reality tool that sent out such notifications we would allow everyone to become a social connector.

3. Methodology

In order to create an augmented social reality mechanism, we must allow users to specify when they wish to be introduced. Doing this explicitly would place a huge burden on the user, so we instead opt for an implicit method where the users specify *desired properties* of their social system. Some parameters that are easy to understand as well as practically useful are characteristic path length and density [8].

Naturally, in order for this approach to work we must first acquire knowledge of who knows whom: the "true" social network. In addition, we should ignore spurious interactions (such as saying "Hi" in the hallway) when building this model since this is not indicative of a social tie that can be used for introductions. To quantify these ties a wearable sensor such as the Sociometric badge is the obvious tool of choice, since it is an accurate and objective measurement device and could be used as an ID replacement in most formal organizations [5].

In order for two people who have no friends in common to be introduced to each other, introductions must be made through intermediaries. This will create a patchwork of ties that would slowly close the gap between these two users in a process we call *tightening*. Tightening consists of creating a link between two target users by introducing them to users that they do not have prior ties with and are on the shortest path in the social network between the targets. The new ties formed in this process must bring the targets strictly closer to each other as long as there is not resistance from a user on the shortest path. If a user does not want to be introduced with one of the targets, then we can attempt to circumvent them by taking the next shortest path through the network. Both targets connect to each other when they have a common acquaintance who introduces them. We illustrate the concept of tightening below in an example.

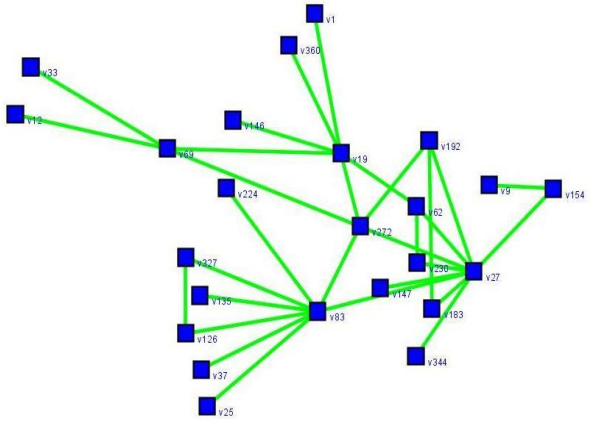

Figure 1. An example social network

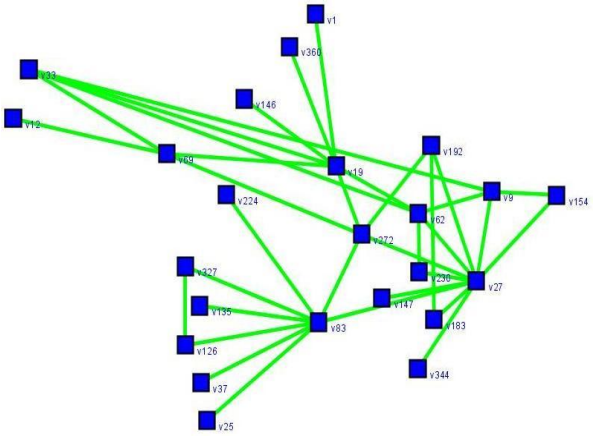

Figure 2. Social Network after tightening

Consider the example social network of a fictional organizational department pictured in figure 1, taken from [1]. We can see that the network would derive a large benefit in terms of characteristic path length

reduction if we connected v9 and v33, since we assume that because v9 and v33 are in the same department they will have useful information to hare with each other. To tighten this network, the system would operate long the shortest path from v9 to v33, which is v9-v154-v27-v272-v69-v33. First, the system would send an e-mail to v154 asking them to take v27 and v9 for coffee, since it knows that v154 is around the coffee machine with v9 and v27 at different times. Similarly, the system could ask v69 to arrange a meeting between v272 and v33. After these connections occur and the system observes that communication between v27 and v9 continues over an appropriate period of time, it would ask v27 to take v272 and v9 to lunch.

Suppose, however, that this attempted connection failed. The system could attempt to forge this link again, but it would be more advantageous to instead go through the v27-v62-v19-v69-v33 path, since it may be that v272 and v9 are simply not compatible for a relationship. We would continue tightening until we have finally linked v9 and v33, and in the process we have created a much more well-connected social network, the one shown in figure 2. This procedure only created four links before connecting v9 and v33, so applying this process many times to a network will not substantially increase the number of links but it will substantially reduce the characteristic path length.

Cross and Parker identified communication bottlenecks in the network as a source of significant problems [3]. In an organizational setting this approach could ease the pressure on these bottlenecks by reducing an individual's ties and delegating some of their responsibilities to others. This case is not only more delicate but more difficult than the case in which users want to increase ties. For example, in figure 1 v27 has eleven connections. This may be appropriate, but it may also be important to transfer some of v27's communication to others to avoid overload.

Users could specify thresholds for communication so that acquaintances could be guided away from overloading this individual. Since splitting an individual's task load is an extremely sensitive and complex issue, we would attempt to notify the individual themselves as well as other relevant people so that an appropriate response could be devised. It would be useful to combine this tool with a skill set database so that a list of individuals with similar functions that have a low number of ties could be encouraged to assume additional communication responsibility by their acquaintances.

We can use other powerful methods in organizational settings to create social cohesion by leveraging the opportunities afforded by projects. Projects do not just create a product, they also create *social* capital. To maximize the overall gain realized by a project we could suggest participants based not only on their skill set but also on the value of the social ties that will result from such a project.

4. Participation and Privacy

By offering users the ability to control which portions of their data to make public to be used in the augmented social reality system we can help allay privacy concerns. This is a necessary component for all sensing systems that collect potentially private data, since users naturally have private activities that they have every right to keep private. By providing these privacy tools and incorporating other functionalities into the devices beyond sensing capabilities we believe that users will be far more compelled to become actively engaged in their social system through their own augmented social reality.

5. References

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