Proposal to participate in the NCGIA and Vespucci specialist meeting on Volunteered Geospatial Information:

Weaving Space and Time into the Web of Trust

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Abstract

The scope of this research is on trust and how it functions on social networks of agents moving in space and time. We are investigating the dynamics of trust and particularly its spatial and temporal properties. Our assumption in this study has two aspects. The first is that with the lack of traditional Geographic Information (GI) quality criteria (lineage, accuracy, consistency and completeness) understanding the spatio-temporal dynamics of trust in social networks of agents (e.g. humans) will enable using trust as proxy for GI quality. Trusted agents tend to provide more useful and relevant information compared with not (or less) trusted agents. Quality is a subjective measure here (and always to some extent). The second aspect is that from the perspective of an individual mobile agent. Our understanding of the spatio-temporal dynamics of trust will enable us to provide agents with trust filtered, dynamic information based on their current information needs. Each agent or community of agents will have its own situation aware information view, which assists it in navigating or filtering the vast amounts of volunteered/collaborative GI.

2 Motivation

The proliferation of GI production in web-based collaboration environments, such as mapping mashups, Openstreetmaps, geotagging, etc. opens the door for innovation. In these environments, millions of users are not only consumers but are also collaborative producers of GI. Users produce layers of GI about their local spaces that can enrich the underlying datasets. These contributions are characterized by locality (users contribute local knowledge) and by breadth of scope (pictures, restaurant reviews, jogging tracks, etc.).

The problem with such a large flow of information is essentially to identify high value contributions/contributors and discard others. Such collaborative environments call for a new outlook on measures to validate and evaluate this information. In [1] we proposed to use trust as such a measure in a collaborative truck navigation scenario. Trust here is defined as a "bet about the future contingent actions of others" [2]. Trusted users, now and in the future tend to provide information that is more relevant. If some trust-rated geospatial information is useful and relevant to a larger group of users, it can then be assumed to have satisfactory quality in a more objective sense. We have extended the more traditional trust in social networks with two novel notions. The first is the notion of the spatio-temporal dimensions of trust and the second is that of network dynamics.

3 Grounding by example

In this section, we try to ground the ideas of this paper in examples to bring the message to bear. The two examples cover the two aspects of this work raised earlier.

From the perspective of trust as the measure of quality

A navigation data provider is interested in both growing and enriching her own data holdings via collaborative GI. This means they are not only interested in contributions to the core dataset but also in value added contributions such as pictures, events, POI reviews. In this vision it should be possible for the users of the navigation data to find places to park there cars and do some hiking on the nearby hiking tracks. Those hiking tracks are as well mapped and shared by hobbyists. Navigation data providers can use data update tools, which automatically ingests valuable GI provided by trusted users from across the web to update their core data holdings. In Figure 1 which is a hybrid affiliation-one mode network structure which we are currently studying, white dots (n_i) are agents/humans and black dots (m_i) are user reported collaborative GI. In the figure m_4 has been reported three times by three users. While m_1 was

reported two times by two users. By studying the spatio-temporal dynamics of those users in relation to their GI contributions we take into accounts things like which users live or work closer to the GI they reported? Weight the links between the users and the GI they contributed by the distance between them at the time of reporting. Which users have previously reported GI that turned out to be useful to others? Which user has an overall good reputation based on her provenance of using the system? By studying, the dynamics of such factors it could be that m_1 is more trustworthy than m_4 despite m_1 being less frequently reported by users. Our hypothesis is that understanding the spatio-temporal dynamics of trust in the users and the information they contribute can assist in establishing trust based quality measures for collaborative GI as a proxy for GI quality.

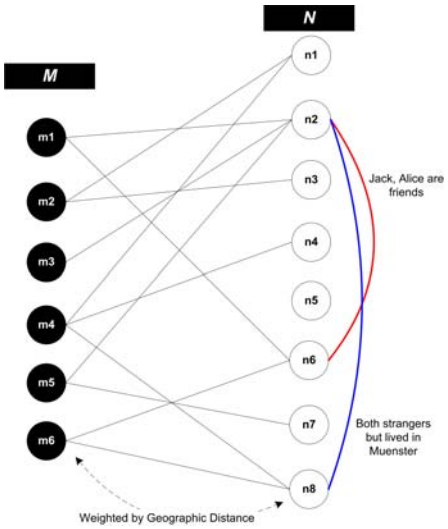

Fig.1 an affiliation network of agents/users (white nodes) and the information they contribute (black nodes) with social network links weighted by distance as an example of a naïve representation of space. Red-blue lines are a separate agent-agent social network making this model a hybrid affiliation-one mode social network

From the perspective of the agent as a data consumer

A user is running a query on her mobile device to locate some recommendations for interesting activities in an area. The user preference is to find activities recommended by other users with similar profiles rather than just advertised activities or sponsored links. Assuming the user is in a popular location such as the center of Frankfurt, the potential result of his query would be rather large. Many results in such a popular area would be from infrequent visitors who simply tagged and bookmarked their experiences. However it is likely that a user is more likely to trust results from frequent visitors or local people or those he knows- those who are familiar with the area.

As an example we resort to Figure 1 and assume the following scenario. Let n_2 be Jack and n_6 be Alice. Alice and Jack were friends in Muenster city for 6 months where they studied together. Alice has since moved to Frankfurt and has been there for a long while. If Jack is visiting Frankfurt and he finds new collaborative GI m_4 and m_6. In this situation, which information is Jack likely to trust more? Would he trust m_6 more because Alice affirmed it (specially) among other users? Would other affirming users who have been in Muenster before make m_6 more relevant and trust worthy to Jack? Our hypothesis is yes, it would. Such hypotheses are at the core of our research.

4 Conclusions

A simplistic initial model studying the network structure in Fig. 1 has been introduced in [3]. This introduced model accounts for a naïve representation of space and initially makes no consideration of time and consequently of network dynamics.

The aim of our research is first to establish trust based quality measures for evaluation and validation of collaborative/volunteered GI and second to enable situation aware, trust based information filtering from the perspective of each individual agent/community. Our initial goal is to build models of spatio-temporal dynamics of trust in social networks. Our ultimate goal is a theory of the dynamics of trust on social networks that takes into account the spatio-temporal dimension of agents. This theory should be applicable on a large class of social networks.

Reference:

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