Information Navigation and Knowledge Discovery in Virtual Communities

Wenyuan Li
Nanyang Technological University, Singapore

Wee-Keong Ng
Nanyang Technological University, Singapore

Kok-Leong Ong
Deakin University, Australia

INTRODUCTION

Over the past decade, advances in the Internet and media technology have literally brought people closer than ever before. It is interesting to note that traditional sociological definitions of a community have been outmoded, for community has extended far beyond the geographical boundaries that were held by traditional definitions (Wellman & Gulia, 1999). Virtual or online community was defined in such a context to describe various forms of computer-mediated communication (CMC). Although virtual communities do not necessarily arise from the Internet, the overwhelming popularity of the Internet is one of the main reasons that virtual communities receive so much attention (Rheingold, 1999). The beginning of virtual communities is attributed to scientists who exchanged information and cooperatively conduct research during the 1970s. There are four needs of participants in a virtual community: member interest, social interaction, imagination, and transaction (Hagel & Armstrong, 1997). The first two focus more on the information exchange and knowledge discovery; the imagination is for entertainment; and the transaction is for commerce strategy.

In this article, we investigate the function of information exchange and knowledge discovery in virtual communities. There are two important inherent properties embedded in virtual communities (Wellman, 2001):

- **Social Networks:** When people interact with one another in virtual communities, they are inherently social. The typical case is CMC. As stated by Wellman (2001), computer networks principally support social networks, not groups. As a result, CMC has become part of people's lives rather than being a separate set of relationships.
- **Information and Knowledge Bearing:** If we view people in virtual community as information and knowledge bearers, they become an information and knowledge base. These pieces of information and knowledge possessed by community members are the important assets of the virtual community.

These two properties indicate different views of the virtual community. The first reveals the networked nature of virtual communities and provides an interesting and novel perspective to explore and understand them. The second, our main target of research, represents an important function in virtual communities. In this paper, we discuss virtual community from these two perspectives, by taking social network property as the target to be explored, and by setting information navigation and knowledge discovery as the function to pursue and implement. For this purpose, the representation and phenomena of social networks shall be introduced. Thereafter, approaches and analysis for information navigation and knowledge discovery based on these phenomena and representation shall be investigated.

BACKGROUND

The Internet increases people's social capital, increasing contact with friends and relatives. Wellman (2001) proposed that computer networks are inherently social networks, linking people, organizations, and knowledge. For social networks to characterize the intrinsic property of virtual communities (Wellman & Gulia, 1999), techniques and theories from social network analysis are helpful to visualize, analyze, and understand virtual communities. However, there is much research on ethnographic studies and CMC that tends toward experimental contexts, while there are few studies on relational data (the ties and patterns of interaction amongst the participants in virtual communities) that is a direct indicator of the phenomena they are researching (Chen, 2002). These relational data embedded in virtual com-

munities naturally generates social networks. Any interaction among participants in virtual communities may be viewed as a kind of relationship.

In mathematics, the graph is the most important abstract model to characterize social networks. Vertices and edges in the graph can be instantiated by different contexts. There has been much research on observing, modeling, and analyzing graphs, not only from pure mathematics but also from physical phenomena in the real world. Therefore, graph representation of social networks in virtual communities provides a concrete theoretical base for the observation and analysis of the function of information navigation and knowledge discovery. In essence, graph representation of the virtual community encodes information of how information and knowledge flows and distributes in a virtual community.

Mathematically, a graph G is represented as a triplet $G=(V, E, f)$, where V is a set of vertices, E is a set of edges connecting some vertex pairs in V, and f is a mapping $f:E\rightarrow V$. In a virtual community, vertices represent unique participants who stand for information or knowledge nodes, and edges may represent their interactions that are dynamic and that may have different related values to stand for their roles in transferring information or knowledge. A graph is measured by a series of metrics from many related research areas, which shows insights into how a graph looks like and provides the necessary quantitative analysis. The important phenomena and approaches of graphs in the real world are represented by these metrics. The following shows a summary of some popular graph metrics:

- **Degree:** The number of edges connected to a vertex.
- **Path:** A sequence of distinct vertices (v_0, v_1, … , v_n) with edges connecting v_{i-1} and v_i for all $1\leq i\leq n$.
- **Distance:** The number of edges in the shortest path between two vertices. For the entire graph, the average distance is computed over all pairs of vertices.
- **Clustering Coefficient:** the clustering coefficient of the vertex v whose degree is k is the ratio between the number E_v of edges that actually exist between these k vertices and the total number of $k(k-1)/2$, i.e.,

$$\frac{2E_v}{k(k-1)}$$

- **Betweenness:** The number of paths between two other vertices that connect through this vertex.
- **PageRank:** It measures the authority of a vertex by summing the "votes" of vertices connected to it. It has become infamous through its prominent use by Google (Lawrence, Sergey, Rajeev, & Terry, 1999).

MAIN THRUST

Information Navigation and Knowledge Discovery in Virtual Communities

Virtual communities assemble information and knowledge from their participants and thus, actually become informal knowledge bases. Therefore, it is a crucial entity functioning as knowledge and information sharing (Bruk, 2000). However, it is different from typical man-made knowledge bases with predefined and formulated rules and formats. In some sense, information and knowledge are stored in social networks, where nodes carry information and knowledge, and relationships indicate how and what information flows (interactions among community members). This knowledge and information organization format has the characteristics of mobility and indetermination—for its relationships and knowledge bearers often change and shift. This situation is different from that addressed by traditional organizational theory, which comprehends densely knit workgroups neatly structured in bureaucratic, hierarchical organizational tree (Contractor, 1999; Wellman, 1997). Besides, in such networks, finding knowledge and information becomes more important, as it does not provide the search function. In general, we often use the term search function to find and retrieve what we need in virtual communities. However, in many cases, the issue is to find out who knows what—a more complex task in virtual communities (Cross & Borgatti, 2000). In particular, how do people in virtual communities obtain knowledge from others when they do not know whom to ask? This question is of immediate practical importance to virtual communities. Normally, one attempts to examine the documentation or other help sources (these functions are mainly focused on searches based on the attributes of document contents) and then asks for familiar friends. The problem becomes acute, however, when the knowledge base is built on social networks. The commonly used retrieval of and access to the knowledge base are implemented by a typical search function. Clues for linking knowledge requesters and holders are not provided by such search functions.

Therefore, to address these issues, new techniques are needed to help people navigate and find knowledge in complex, fragmented, networked societies (Wellman, 2001). Finding knowledge in virtual communities can be

An Immersive Tractor Application for Sustainability: A South African Land Reform and Learners' Perspective
Ofentse Mabiletsa, Sarel J. Viljoen, Jason Arthur Farrell, Lwando Ngqwemlaand Omowunmi Elizabeth Isafiade (2020). *International Journal of Virtual and Augmented Reality (pp. 35-54).*
www.irma-international.org/article/an-immersive-tractor-application-for-sustainability/262623