Multidimensional Approach to Online Interest Networks

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Abstract. Online social networks allow users to socialise with others and also construct and manage their identities via self-presentation. This creates a network of interests that is often represented by a single network that aggregates all of the connections, however it is possible to increase the possibilities by dividing it into layers of individual networks. In this paper we propose a model for a multidimensional network of interests based on the interests that online social network users provide on their profiles. This multidimensional approach can be useful for getting insights about user behaviour or even help organisations understand the impact of their online content.

Introduction

With the social media impact on the daily life of a large part of people in the world, online social networks (OSN) take an important role. Through these networks users can present themselves to the world, with a lot of rich information encoded on the content of interactions among its actors \cite{1}, and where new clues and aspects about an individual personality emerge from little aspects that most individuals do not notice at all.

A large number of people shifted themselves into the virtual world making their online virtual profile a mirror of their true identity. With numbers \cite{2} (September 2016) surpassing the one billion active users on OSN like Facebook (1,712 million) and WhatsApp, 899 million on QQ (Chinese OSN), or 500 and 313 million on Instagram and Twitter respectively, OSNs have a strong impact on the daily life of people and even companies and brands are using them as a channels of communication, marketing, and to get insights and reach new potential customers.

We are now starting to look at OSNs in a multidimensional way rather than the plain single network that we are used to, and in this paper we propose a multidimensional model focused on the user’s interests that can be useful for understanding user behaviour, patterns of usage, and can be of extremely importance to companies to measure the impact of their online content.

This paper is structured as follows. Section two presents the motivations that drives people to use OSN, and the concept of the need to belong and the need for self-presentation. Section three introduces the overall concept of multidimensional networks, how they are starting to be used on the social aspect of the OSNs, and the lack of multidimensional approaches to the interest network. Section four contains our multidimensional model proposition, the purpose behind the definition of each layer, the reasons and vision that motivate us to the definition of this model, as well as a conceptual example.

Motivation for the Usage of OSNs

Due to a constant presence in the lives of their users, OSNs have a decidedly strong social impact leading to a blur between offline and virtual life as well as the concept of digital identity \cite{2}. OSNs not only permit users to socialise with others, but also offers the possibility to construct and manage their identities \cite{3}. Users can create their visible profiles that requires, at a minimum, a name, gender and a date of birth. Among these required basic fields, users can add basic facts about themselves such as home town, contact information, personal interests, job information, and even a profile photograph. Looking at the numbers related to OSN usage \cite{2} we must understand the
reasons that motivate people to use them. These motivations differ from user to user, some focus on broadcasting information about themselves while others are more interested in passively consuming information produced by others [4].

It is possible to say that OSNs are a mirror where users reveal a lot about themselves both in the way they share and how they share-it, and this personification of OSN profiles can be of great value for marketers and companies, as they can be used to identify different users as potential customers if they indicated a preference towards a product/brand by using the interaction actions present on the OSNs [5] (such as pressing the 'Like' button). OSNs connect people who share interests and activities across geographic borders and have become a social commerce platform for businesses in recent years [6].

OSNs request that users construct truthful representations of themselves with varying degrees of accuracy [7]. Even demographic aspects can influence the type and frequency of usage. For example, the work of K. Moore and J. C. McElroy [8], developed some interesting results, they found a significant positive relationship between gender and a number of variables of interest where was possible to find that women spend more time on the OSN Facebook, had a greater number of friends, posted more photographs, and did more postings about themselves, when compared to men. Although in terms of frequency, women visit their Facebook account less frequently than men do.

Accordingly to Nadakarni and Hofmann model [9] the motivation for the usage of an OSN is primarily motivated by two basic social needs, the need to belong and the need for self-presentation.

The Need to Belong

The need to belong is associated with the necessity for affiliation with others and the gain of social acceptance, since humans are highly dependent on the social support of others. Some type of obstruction from the social group have a negative impact in humans on a variety of health-related variables, including, self-esteem and sense of belonging, emotional well-being, sense of life meaning, purpose, self-efficacy, and self-worth [9].

G. Seidman [10] says that the need to belong is a fundamental drive to form and maintain relationships and a major motivator factor for OSN use. OSNs like Facebook allows users to fulfil belonging needs through communicating with and learning about others. Facebook can be an effective method for coping with feelings of social disconnection, as it enables peer acceptance, relationship development, and can even boost self-esteem.

The Need for Self-presentation

The need for self-presentation is correlated with the continuous process of impression management. OSNs open the possibility for its users to display their idealised, rather than accurate, selves through their profiles [9].

Activities that accomplish self-presentational goals include posting photographs, profile information, and display relations. According to G. Seidman [10] popularity seeking users tend to disclose information, engage in strategic self-presentation, and enhance their profiles (that generally represent an accurate self-presentation).

Multidimensional Networks

M. Kivela et al. study on multidimensional networks emphasis the increase on the study of networks with multiple layers, however that same explosion of studies produced a lack of consensus relative to the terminology. Their work presented a general definition of multidimensional networks (terms such as multi-layer network, multi-relational network, multidimensional network and multiplex network are considered synonyms [11]) that can be used to make a representation of most types of complex systems. In the real world, more than one kind of connections or interactions can exist between any pair of individuals, like friendship, family, or work, and accordingly to them, a multidimensional network has a set of nodes just like any normal network, and in addition there is the need to have layers that represent those types of different interactions that exist on the real world.
Despite not being new, the concept of multidimensional network [12] is fairly recent in the scope of OSNs and the work of A. Socievole et al. [13] makes reference to the effort that has been made into the definition of multi-layer social metrics that consider all the existing different social dimensions. Multidimensional approaches like the work of Brodka et al. [14] where they define a multi-layer social network as a set of single-layered social graphs with fixed set of nodes and variation on their edges, the work of M. Magnani and L.Rossi [15] where was proposed a multidimensional model where each layer corresponded to an OSN and a node mapping function between those layers, the work of A. Socievole et al. [13] where was presented a model with a routing protocol that makes use of multi-layer social networks to select nodes in order to act as message relays, or even the work of Forestier et al. [16] where was proposed a multidimensional social network from online discussions with relations derived from structure and text content.

**Proposed Model**

An OSN is a modelling of a set of nodes (individuals, groups, or organisations) and a set of relationships between them [17]. When given the task of representing an OSN, generally it is shown as a graph and defined as a network of interactions and relationships, where the nodes consist of actors and the edges consist of the relationships or interactions between these actors [1].

Despite the effort made in multidimensional networks in the context of OSNs, those works are heavily focused on the social aspect and relations between users (the need to belong). Studies [3] have investigated the relations between OSN actions (like, share, comments, and similar actions) and offline behavioural intentions [18].

Our model proposal represents a vision focused on the need for self-presentation, and exploration of those online actions. The usage of actions such as like, comment, and share can be represented as a way for users to manage their self-presentation by signalling their likes and dislikes, interests, preferences, and so on [3]. By dividing this entire network of interests into single layers it is possible weight each type of action (for example by the effort required to produce each type of action), understand online behaviour, and even understand which type of interests are supported and reinforced by other layers. Based on effort and type of actions, we divided the main network into three layers: association, interaction, and opinion.

**Association Layer**

Although the order of the layers does not matter, on a bottom to top approach, we consider the association network as the first layer of this model. This layer contains the long term relations that can be found on most of modern OSNs, such as group associations, follows, or even subscriptions. We consider this association as long term relations since they represent a higher permanent interest on a brand, people, or product, which can be seen as some kind of personal commitment.

**Interaction Layer**

The interaction dimension contains all of the less permanent types of actions such as likes (or similar action), or shares. In our vision, these type of actions are considered less permanent because of their ease and the less effort to perform. Like and share are a fast easy way to share content, they represent the user’s appreciation and support for the content [3].

**Opinion Layer**

The opinion dimension refers to a network of opinion extracted from written text like comments, or any form of publication. This type of network requires some opinion mining techniques in order to extract positive or negative references. Due to this division, there are scenarios where this network can be divided into two layers, each one containing either positive or negative opinions. The text type of expression present on comments, and any form of publication, allows for a dynamic expression of thoughts and feelings with, usually, no restrictions to what is said [3].
Multidimensional Online Interest Network

![Figure 1](image.png)

Figure 1. Multidimensional network representation, the left side represents a basic layered multidimensional view and right side represents a dimension containing the interaction layers of two different users.

In figure 1 it is possible to observe two examples of our model. In the left example we have a basic demonstration, where all of the layers are present (opinion layer was divided into two layers, each one containing either positive or negative opinions). With this multidimensional approach to an user OSN interest network, it is possible to understand behaviour and patterns of usage as well as defining weights to nodes. In this example it is possible to observe a heavily reinforced interest on the node 'B', followed by the interest on node 'C'. If, for this particular example, a new node 'F' is created on the Opinion Layer, it is automatically reinforced by the presence of the same node on the Interaction Layer. In the right example we have a dimension where were compared the interests present on two users interaction layers and where it is possible to observe common interests on the 'B' and 'F' nodes. By approaching the interest network on a multidimensional vision, like our model, it is possible to combine different types and amount of layers and/or users, creating different types of dimensions based on our context needs.

Conclusion and Future Work

Although this is a conceptual approach, our next step is to use real data on our model in order to create different types of dimensions for different types of contexts.

OSNs are a constant presence on the daily life of many people in the world, and even if users are more aware of the information they provide, and more concerned about how this information can be used to identify them, the virtualization of themselves is often accurate.

The way we look at OSNs is changing, and multidimensional networks models are emerging in this context. However, this type of models is heavily focused on the social aspect and interactions between users, and until now no model was approaching the interaction network in the same multidimensional way that we are doing. In this work we recognise the importance of our model either for understanding patterns of behaviour and getting insights of users’ interests, as well for companies or brands to measure the impact of their online content on users.

References


