Algorithms to Resolve Conflict in Multiuser Context Aware Ubiquitous Environment

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ABSTRACT

Conflict resolution in context-aware computing is getting more significant attention from researchers as pervasive/ubiquitous computing environments take into account multiple users and multiple applications. In multi-user ubiquitous computing environments, conflicts among user’s contexts need to be detected and resolved. Conflicts arise when multiple users try to access or try to have a control on an application. In this paper, the authors propose a series of algorithms to resolve conflict which can be embedded in different context aware applications like context aware devices (say TV, Mobile, AC, and Fan) and Context Aware Ambient (like Meeting Room, Living Room, Restaurant, Coffee Shop, etc.). The algorithms discussed in this paper make use of different tools like Probability, Fuzzy Logic, Bayesian Network and Rough set theory. In addition the algorithms utilize various factors like social, personal and environmental. The motto of this paper is to enable context aware applications to offer socialized and personalized services to multiple users by resolving service conflicts among users.

Keywords: Algorithms, Bayesian Network, Fuzzy Logic, Multiuser Context, Probability, Rough Set Theory, Ubiquitous Computing Environments

1. INTRODUCTION

Context aware applications are usually associated with one or more users competing for availing one or more multiple services. Ubiquitous computing is a cross-disciplinary area that extends the application of computing to various usage models. Computing devices are increasingly able to facilitate daily activities by becoming more aware of users and their operating contexts. Context is defined as any given information such as time and location that relates to an object like user. In a sensor rich multiuser ubiquitous environment, it is possible to encounter conflicting and ambiguous information. Ubiquitous applications need to resolve conflicting context information. The context of an object is defined as any given information such as time, identities, activities, location and intentions which can be exploited to perceive...
the environment related to the object. It includes background information (such as history), specification of user and application requirements as well as measurements of physical entities in the environment. This paper proposes a series of algorithms for conflict resolution in a context aware ubiquitous environment.

Humans resolve conflicts with heuristics such as starting a discussion, compromising the agreement, retiring gracefully, or ignoring the conflict altogether (McLaughlin & Herlocker, 2004; Sunir & Adams, 2001). Unlike computational objects, humans dispute and argue contradictory, incomplete, irrelevant, ambiguous, inaccurate or false proposition. Computational devices are less likely to resolve such conflict through mediation or argumentation, because they are limited to rule-based reasoning (Chen, Jiang, & Zhao, 2010). The paper proposes a series of methods based on different techniques like Rule base, Bayesian Probability based and Rough set theory approach to resolve conflict in multiuser environment.

2. RELATED WORK

Most of the conflict resolving systems use Collaborative Filtering or Content-based methods or hybrid conflict resolving methods to predict new items of interest for a user (Herlocker, Konstan, & Ried, 2002; Feng, Xian, & Feng, 2004; Rong & Bin, 2007). The system called Tapestry is often associated with the genesis of computer-based conflict resolving, recommendation, and collaborative filtering systems. In Tapestry (Goldberg et al., 1992), users were able to annotate documents with arbitrary text comments and other users could then query based on the comments of other users. The key attribute of this system is that it allowed recommendations to be generated based on a synthesis of the input from many other users. Making recommendations based on the opinions of like minded users rather than filtering items based on content has become known as collaborative filtering. The collaborative filtering paradigm which began with Tapestry was later automated in a number of projects (Resnick & Varian, 1997; Balabanovic & Shoham, 1997; Karypis, 2001; Herlocker et al., 2004; Wang et al., 2007).

The main advantage of collaborative filtering is the ability to make serendipitous recommendations (Herlocker et al., 2004). Most systems use a notion of inter –user distance and thus can define “neighbors” for a user. If an item of a particular genre is highly preferred by user’s neighbor, then that item could be recommended even if the recommendee has no previous experience with items of that genre.

One of the primary problems associated with collaborative filtering is that they work best when the number of item rated per user is high. Since a purely collaborative filter relies on user opinions of items in order to make recommendations on items for which it has no information (the “cold-start” and “early rater” problems), or for users who are sufficiently dissimilar to all other users. There are many good examples of collaborative filters and recommender system. For a survey of current technologies please see (Adomavicius & Tuzhilin, 2005).

Content-based filtering items are matched either to a user’s interest profile or query on the basis of content rather than opinion. One strength of this approach over collaborative filtering is that as long as the system has some information about each item, recommendations can be made even if the system has received a small number of ratings or none at all. The downside is that each item must be characterized with respect to the features that appear in a user’s profile and further the profile of each user must be collected and modeled. Naturally these descriptive features must themselves be acquired be acquired or engineered somehow.

In work that shares several characteristics with this paper, Claypool et al. (1999) introduced the p-tango method, which makes use of both a collaborative and content – based filter through a linear combination to produce a more accurate filter than either method alone. In the process of tuning the weighting parameter to find an optimal balance between the two rec-
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