

Developing a Distributed Context-Aware Collaborative Recommender System

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ABSTRACT

Much work has been done in the areas of distributed and shared interface environments and intelligent and context aware applications. This paper describes our goals in the enhancement of a collaborative travel recommender deployed with a DiamondTouch interface to encompass these technologies. The enhancements we propose will allow users to interact with installations on remote DiamondTouch devices and will grant the application access to an abundance of context data.

Keywords

Collaborative and Shared Environments, Distributed Environments, Dynamic Devices

1. INTRODUCTION

In the Adaptive Information Cluster (AIC) we have been working on several strands of work including the development of applications with shared interface environments [4, 5]; a context-aware middleware [6] and collaborative recommendation techniques. In this paper we describe work that combines these strands.

McCarthy et al. [4] describe CATS (the Collaborative Travel Recommender System) — a recommender system that combines intelligent individual and group recommendation strategies with a collaborative interface. The function of CATS is to assist a group of friends to select a skiing holiday that will maximally satisfy their individual preferences.

Currently, CATS is deployed on a single DiamondTouch table [1]. However one key restriction with this application is that it is not always possible to gather the members of a group together in a single physical location. This paper describes our work in extending this application to stretch the interface environment across two physically remote Di-

amondTouch tables. This will add remote web conference style communications to the existing face-to-face tabletop collaborative communications.

We would also like to investigate the effect of additional contextual information to the operation of CATS. We are deploying this application using the ConStruct middleware system [6]. ConStruct is a distributed, decentralised infrastructure for the collection, processing and distribution of context information in a ubiquitous computing environment. The problem space that ConStruct tries to address is the difficulty in collecting, reasoning about, and distributing context information among disparate sources. We have developed a number of sensors and applications that are also deployed using ConStruct. Using ConStruct, CATS will be able to leverage any data produced by these entities.

2. CATS

CATS is a multi-user recommender system designed to help a group of up to four friends plan and arrange their skiing vacation. This system is designed around the DiamondTouch interactive tabletop. The CATS system is based around the notion of a shared collaborative space for a group of users who also can access their own personal spaces. Individual user feedback is used to update explicit user models, on a per user basis, as well as a global user model. In addition, recommendations for the individual are generated in response to direct user feedback while at the same time group recommendations are generated proactively through the shared interaction space.

Users are invited to select their preferred holiday destination. They are assisted in this task by a personal travel recommender, which monitors their actions and attempts to model their preferences with a view to leading them through the search space. However, in order to ensure that group preferences as a whole converge, there is also a group recommender, which seeks to mediate between the group members. The group recommender constantly updates each user's display area with information about their level of convergence with the group and suggestions to attempt to pressure errant users to compromise.

It should be noted that while CATS is currently used for recommending skiing holidays, it would be just as useful in any domain where a group of users are looking to come to a consensus on the selection of a preferred item from a set

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of related items.

2.1 The DiamondTouch Interface

The DiamondTouch supports group collaboration by providing a display interface that allows users to discuss decisions openly whilst interacting with the display simultaneously [1]. It consists of a touch sensitive table connected to a computer whose display is projected onto the table. Research has shown that the DiamondTouch is a more effective interface for solving certain collaborative problems than the two-mouse and one-monitor alternative [2]. In general, the applications designed for the DiamondTouch allow multiple users share information, but they tend not to support co-operative multi-user interaction in the search of a common goal. That is, the ultimate goal does not require that all users in the group come to a consensus through their combined and individual interactions.

McCarthy et al. believe the DiamondTouch to be a natural interface for the collaborative task where friends need to book a skiing holiday together. Its ‘coffee table’ form factor and intuitive flat orientation allow users to easily and co-operatively search the space of options and at the same time understand the preferences of the other participants.

As further work, we intend to investigate alternatives to using DiamondTouch for supporting group collaboration. We will investigate the use of vision-based finger tracking systems, e.g. [3], which also allow the direct manipulation of graphical users interfaces, allowing multiple simultaneous user interacting with both hands on a large screen.

3. EXTENSIONS TO CATS

This section describes the two key enhancements that we are making to CATS: the distribution of the interface environment across two remote systems; and the deployment of CATS on ConStruct — our context-aware middleware.

3.1 Distributed CATS

The AIC is in possession of two DiamondTouch devices. We intend to connect these devices over the Internet in such a way as to spread a single interface environment across two remote physical locations. Groups of users will be able to use CATS and collaborate remotely. Web cams and speakers will be used to allow the groups to see and hear each other (and the remote interface). We will project a display window onto a wall in front of the DiamondTouch, which will display the actions of the remote group, and also the contents of the remote DiamondTouch display.

We also intend to incorporate finger tracking models on the wall mounted displays so that users can ‘touch’ the remote DiamondTouch and thus project their actions onto the remote group’s environment. By passing an object across to the end of the DiamondTouch, it will be transported to the remote environment. We will use a Jabber-like protocol for audio and video communication between the two groups of users.

3.2 Context-Aware Middleware

ConStruct is currently deployed on several computers in our university and there are a number of applications and sensors deployed using ConStruct. ConStruct makes data from these entities available to other ConStruct applications.

We are re-deploying CATS as a ConStruct application to allow it to avail of this contextual data. One application that

is already deployed is a calendar sensor. This makes a user’s online calendar available to other ConStruct applications. This type of data is of obvious benefit to CATS.

We are also developing applications based on presence technologies including UbiSense [7] and RFID that can be used to detect the location of group members to a high granularity. We will use this data to monitor the participation of the group members, e.g. they may not be interacting physically with the table, but are they sitting over the table or reclining, have they left the room?

There are also a number of other applications in development that may add value to CATS, including mapping and route-finding software, and airline timetabling sensors. The converse benefit of deploying CATS over ConStruct is that data generated by CATS would itself be available to other ConStruct applications, e.g. the group member’s calendars will be updated to reflect the final holiday booking.

4. CONCLUSION

This paper proposes two enhancements to McCarthy et al.’s CATS system. The first enhancement will allow a link to be formed between two remote DiamondTouch display environments, If this proves successful, we intend to re-engineer other DiamondTouch applications in the AIC, e.g. [5] to incorporate this functionality. The second enhancement is the deployment of CATS over ConStruct, which will integrate it within a suite of pervasive applications and sensors that are being developed by the AIC. CATS will benefit from the contextual data that these entities provide.

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