

Service Recommendation for Conflict Resolution in Context-aware Media Services*

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ABSTRACT

In this paper, we propose Conflict Manager to resolve conflicts for context-aware media services in smart home environments. Conflicts arise when multiple users access a media service or when various media services share limited resources to provide customized responses. In order to resolve conflicts among users, the Conflict Manager sums users' preferences of contents and recommends the specific contents ordered by the summed preference. In addition, Conflict Manager detects conflicts among media services by utilizing properties of each media service and resolves them by recommending conflicting media services ordered by the preferences.

Keywords

Context-awareness, service conflict, recommendation

INTRODUCTION

The aim of ubiquitous computing is to provide users with intelligent services based on the information obtained from distributed but invisible computing resources. These services do not require any cumbersome interface or learning procedures from users. Especially context-aware applications offer appropriate services to users by utilizing contextual information of environments and users [1]. This information is obtained from various sensors or computing resources distributed in our daily life. However, conflicts occur in context-aware applications when multiple users share the applications in an environment or these applications share the limited resources in the environment. Service conflict among users is the scenario when multi-users access an application, and then the application has to choose one user to provide a customized service [3]. As a result, it is difficult not only for the applications to make a suitable decision to start a service, but also for each user to enjoy personalized services. Resource conflicts also occur among services if each service attempts to share resources at the same time. Consequently, applications start serving to the users without possessing all the necessary resources

and thus may result in unsatisfactory services.

In this paper, we propose Conflict Manager which resolves conflicts among multiple users as well as among multiple media services by recommending preferred properties and contents of media services.

CONFLICT MANAGEMENT

Conflict Manager resolves the conflicts which occur not only due to multiple users who trying to access one media service at the same time, but also due to multiple media services trying to share resources in their surrounding.

Conflict Resolution among Users

Conflict Manager resolves conflicts caused by users who are trying to use the same media service within a service area. To resolve the conflict, Conflict Manager manipulates user contexts in two steps: building a conflict list and selecting a proper user from it. Figure 1 depicts a conflict situation and resolution procedure.

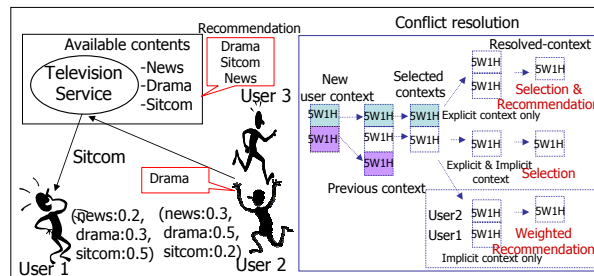


Figure 1. Conflict resolution among users

As shown in Figure 1, there is a television service providing user 1 with a sitcom program in a service area. Simultaneously, user 2 is trying to use the service and user 3 is leaving out the service area. Therefore, a service conflict arises due to use of television services by the two users. In this conflict situation, Conflict Manager builds a conflict list consisting of contexts of user 1, user 2 and user 3. Based on the conflict list, it then sums the preferences of each user. In this scenario, user 1 has the ordered preference on contents of television service: 0.2, 0.3, and 0.5 to News, Drama, and Sitcom, respectively. User 2 has the ordered preference on contents of television: 0.4, 0.5, and 0.1 to News, Drama, and Sitcom, respectively. Summarizing the preferences, Conflict Manager obtains the preference of 0.5, 0.8 and 0.7 on the contents of the

service. Consequently, Conflict Manager recommends Drama, Sitcom and News program ordered by the preference value.

Conflict Resolution among Media Services

Conflict Manager also detects and resolves conflicts caused by multiple media services which are trying to share limited resource in a service area. In order to detect possible conflicts among media services, it collects contextual information of other services and monitors resource usage of other services within the corresponding services. Figure 2 shows a conflict situation and the corresponding resolution strategy.

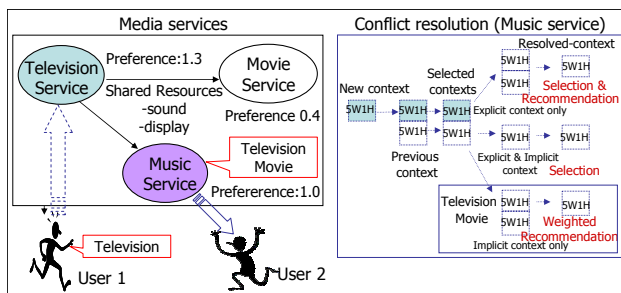


Figure 2. Conflict resolution among Media services

In the service scenario, music service, television, and movie service share a sound resource of Television. Furthermore, television and movie services need a display resource to show their visual contents. Therefore, a conflicts arise when the start of music service. In order to detect expected conflicts, Conflict Manager deals with the conflict in two ways. First of all, Conflict Manager resolves conflicts caused by other services within a service area. It builds a final context which contains information about the conflicting media services if resources involved in other services are the same as those of the service itself. Based on the context, the music service shows the conflicting services to the display. Conflict Manager also prevents the registered service causing conflict with other services. To detect possible conflicts, it checks if there are any services exploiting the same resource before delivering a final context to the registered service. Therefore, each media service provides users with customized responses without causing any conflicts.

IMPLEMENTATION and EXPERIMENT

In order to implement the proposed resolution method, we utilized ubi-UCAM 2.0. The ubi-UCAM is a unified context-aware application model for ubiquitous computing environments supporting independence between sensors and applications [2]. Especially, the proposed Conflict Manager was implemented as a part of Context Manager of ubiService in the ubi-UCAM. The ubi-UCAM also utilize unified context to represent and share users' contextual information among various applications. The unified context represents the contextual information as 5W1H (Who, What, When, Where, How and Why). We then

applied the ubiService recommending contents and services to each media service of ubiTV application such as television, movie, Internet service in ubiHome test-bed.

In order to measure the usefulness of the proposed resolution method, we experimented on user conflict in two ways: the resolution method selecting a user's context [3] and the proposed resolution method recommending preferred contents. The former method assigns the priority to conflict contexts and then chooses one user context having the highest priority. On the other hand, the proposed resolution method recommends available contents ordered by users' preferences to the television screen. To evaluate two methods, we employed television service that users use most in home environments. While using the television service, family members cause conflicts due to their preferences and its broadcasts. In order to estimate the conflict in home environment, we questioned 30 volunteers in ages from 20 to 39 who had experienced context-aware media service supporting recommendation. Table 1 shows the user satisfaction on the proposed resolution and the resolution method selecting one user.

Table 1. User satisfaction (%)

Age	User selection	Service recommendation
20~29	59	73
30~39	53	71

As shown in Table 1, the respondents showed higher satisfaction on the proposed resolution method than that of resolution method selecting a user having the highest priority. This is because users resolve their conflict situation with additional information provided by Conflict Manager.

CONCLUSION

In this paper, we proposed the Conflict Manager to resolve conflicts among users and among media services. In order to resolve conflicts among users, the proposed Conflict Manager maintained the preference of users and recommended preferred contents sorted by the users' preferences. Furthermore, Conflict Manager detected and resolved conflicts among media services based on properties of each media service.

REFERENCES

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This additional page includes the overall architecture of ubiTV application and an example of service recommendation. Figure 1 shows the overall architecture of ubiTV application.

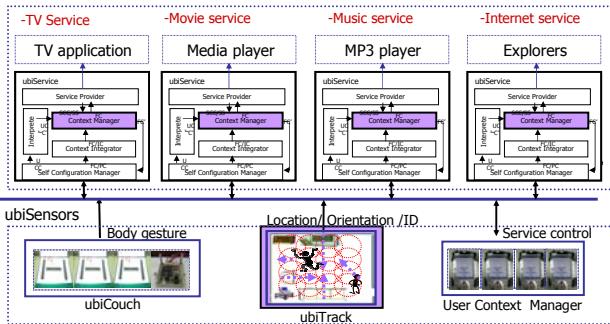


Figure 1. ubiTV application

The ubiTV application provides various media services such as television, music, movie, Internet service. In addition to the services, we also exploited various sensors: ubiCouch sensors, ubiTrack. The ubiCouch sensors are couch sensors, comprising of on/off switches and PIC16F84, detect user's behaviors. ubiTrack is infrared-based location tracking system that tracks user's location. Furthermore, we implemented ubiRemocons, a kind of remote controllers, based on Personal Java, to control these services. Figure 2 shows an example of service recommendation.

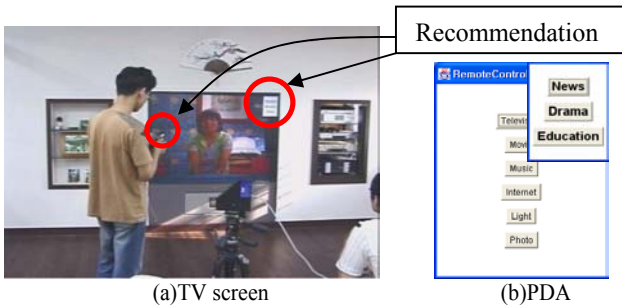


Figure 2. Service recommendation

In this scenario, there are two users in ubiHome. They are conflicting due to their preference on the television. User 2 wants to enjoy News program, but user 1 has been enjoying Drama. Therefore, the television service recommends available contents sorted by their preferences. Finally, the television service recommends News, Drama, and Education programs. After their discussion about television program with recommended contents, they can decide their proper program in this conflicting situation.