

Chapter XXXII

Middleware Support for Context-Aware Ubiquitous Multimedia Services

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ABSTRACT

In order to facilitate the development and proliferation of multimedia services in ubiquitous environment, a context-aware multimedia middleware is indispensable. This chapter discusses the middleware support issues for context-aware multimedia services. The enabling technologies for the middleware such as representation model, context management, and multimedia processing are described in detail. On top of our previous work, the design and implementation of a context-aware multimedia middleware, called CMM, is presented. The infrastructure integrates both functions of context middleware and multimedia middleware. This chapter also aims to give an overview of underlying technologies so that researchers in ubiquitous multimedia domain can understand the key design issues of such a middleware.

INTRODUCTION

With rapid development of wireless communication technologies like mobile data networks (e.g., GPRS and UMTS), it becomes possible to offer multimedia content to people whenever

and wherever they are through personal digital assistants (PDAs) and mobile phones. The multimedia content to access can be quite overwhelming. To quickly and effectively provide the right content, in the right form, to the right person, the multimedia content need to be

customized based on the user's interests and his current contextual information, such as time of day, user location, and device conditions. These services are called context-aware multimedia services.

Context-aware multimedia services have attracted much attention from researchers in recent years, and several context-aware multimedia systems have been developed. However, building context-aware multimedia systems is still complex and time-consuming due to inadequate middleware support. The application developers have to waste and duplicate their efforts to deal with context management and multimedia content processing. Software infrastructure is needed to enable context information as well as multimedia content to be handled easily and systematically so that the application developers merely need to concentrate on the application logic itself.

In this chapter, we discuss the enabling technologies for the middleware including representation model, context management, and multimedia processing. We also present the design and implementation of a context-aware multimedia middleware, called CMM.

BACKGROUND

Currently, a lot of multimedia applications have been provisioned and used through Internet, such as video conferencing, video-on-demand, and tele-learning. However, with the emergence of mobile devices, people tend to receive and enjoy multimedia content via the devices with them or around them. These trends have led to the emergence of ubiquitous multimedia. Ubiquitous multimedia refers to providing multimedia services in ubiquitous environment through various end devices connecting with heterogeneous networks. For better audio and visual experience, the provisioning of ubiqui-

tous multimedia need to be adapted to the user's changing context involving not only the user's needs and preferences but also the conditions of the user's environment (e.g., terminal capabilities, network characteristics, the natural environment, such as the location and time, and social environment, such as companions, tasks, and activities).

Dey and Abowd (2001) state that context is any information that can be used to characterize the situation of an entity. An entity is a person, place, or object that is considered relevant to the interaction between a user and an application, including the user and the application themselves. Specifically, context in multimedia services can be user preference, location, time, activity, terminal capability, and network condition. Such context-based services are called context-aware multimedia services.

As for context-aware computing, it was first introduced by Schilit and Theimer (1994) to be software that "adapts according to its location of use, the collection of nearby people and objects, as well as changes to those objects over time." Dey and Abowd's definition (2001) states that "a system is context-aware if it uses context to provide relevant information and/or services to the user, where relevancy depends on the user's task."

Context-aware multimedia services are aware of user contexts and able to adapt to changing contexts seamlessly. In a smart-home environment, a context-aware multimedia service might, for example, record TV programs that family members are favorite of, show suitable content based on user social activities (e.g., holding a birthday party), and present content in appropriate form according to capabilities of the displaying device and network connection.

Context-based multimedia services have attracted much attention over the past decade. Traditional multimedia recommendation sys-

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