Context-Aware Multimedia Services in Smart Homes

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Abstract

The evolution of "smart homes" technologies exposes a broad spectrum of modern personal computers (PC), consumer electronics (CE), household appliance and mobile devices for intelligent control and services in residential environments. With high penetration of broadband access networks, PC, CE and mobile device categories can be connected on home networks, providing a home computing context for novel service design and deployment. However, conventional home services are characterized by different operations and interactive usages among family members in different zones inside a house. It is prospective to realize user-oriented and location-free home services with modern home-networked devices in smart home environments.

The contribution of this paper proposes a reference design of a novel context-aware multimedia system in home-based computing networks. The proposed system integrates two major functional mechanisms: intelligent media content distribution and multimedia convergence mechanisms. The first mechanism performs intelligent controls on services and media devices in a context-aware manner. This mechanism integrates face recognition functions into home-based media content distribution services. Some devises capable of capturing images can recognize the appearances of registered users and infer their changes of location region inside a house. Media content played in the last locations can thus be distributed to home-networked devices closer to the users in the current locations. The second mechanism offers multimedia convergence among multiple media channels and then renders users a uniform presentation for media content services in residential environments. This mechanism can provide not only local media files and streams from various devices on a home network but also Internet media contents that can be online fetched, transported and played onto multiple home-networked devices. Thus, the multimedia convergence mechanism can introduce an unlimited volume of media content from the Internet to a home network.

The development of a context-aware multimedia system can be described, as follows. A conceptual system playground in a home network contains several Universal Plug and Play (UPnP) specific home-networked devices that are inter-connected on a singular administrative network based on the Ethernet or Wi-Fi infrastructure. According to UPnP specifications, home-networked devices are assigned IP addresses using auto-IP configuration or DHCP protocols. Then, UPnP-compatible devices can advertise their appearances on a network. When other neighbor devices discover them, they can collaborate on media content sharing services in a network. In addition, some UPnP-

compatible devices are capable of face recognition to capture the front images of users inside a house. Those captured images can be sent to a user database and compared with existing user profiles corresponding to individuals in the family community. After any registered user is recognized, the system can refer to the stored details of this particular user and then offer personal media services in a smart manner. On the other hand, the components and functionalities of the proposed system can support intelligent media content distribution and multimedia convergence mechanisms. Technically, the proposed system combines several components such as UPnP control point, UPnP media renderer, converged media proxy server, image detector and profile database of registered users and family communities. Though there are diverse media sources and formats in a home network, users remain the same operational behavior on sharing and playing media content according to common UPnP and Digital Living home Alliance (DLNA) guidelines.

Prototypical development achieved a proof-of-concept software based on the Android SDK and JVM frameworks, which integrates the distribution of intelligent media content and converged media services. The resulting software is platform-independent and application-level. It can be deployed on various home-networked devices that are compatible with UPnP standard device profiles, e.g., UPnP AV media server, media player, and mobile phones. Real demonstration has been conducted with the software implementation that runs on various off-the-self home-networked devices. Therefore, the proposed system is able to offer friendly user experience for context-aware multimedia service in residential environments.