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Universal Plug'n'PEAKS – Towards easy Deployment of Multi-modal Tele-medicine

Abstract

With today's increase of the elderly part of the population, one has to find ways to create easily accessible and elderly-friendly interfaces to technology that is useful for this group of our community. This is especially true for tele-medical applications, easing the daily life of people who need to visit physicists more often than the average. What is presented here is a possible integration of tele-medical functionality into an intelligent living environment adapted to elderly people which is controlled by natural language. To achieve this, PEAKS (a client-server based system for the automatic evaluation of speech and voice disorders, http://peaks.informatik.uni-erlangen.de) will be modified to be easily integrated into an intelligent living environment (ISA-Haus) currently developed at the University of Erlangen-Nürnberg.

Introduction

Today, we have technology that would allow us to really ease the lives of elderly people, especially tele-medical applications. The main problem of these systems is acceptance, which is a factor that is severely influenced by ease of use. Our approach to deal with that problem is to build a dialogue system-based intelligent living environment [1] that can be easily adapted to individual needs and that is simple to extend. For that, we use UPnP (Universal Plug'n'Play, http://www.upnp.org), a specification developed for consumer electronics, which provides mechanisms for auto-configuration and remote controlling of any devices implementing the specification. The intelligent living environment used here is the product of a subproject of the research association FitForAge which focuses on solutions to counter the consequences of demographic change.

Used Applications

We chose PEAKS (**P**rogram for **E**valuation and **A**nalysis for all **K**inds of **S**peech) [3] as the tele-medical application to be integrated into ISA-Haus (Intelligentes Senioren-Angepasstes Haus, Intelligent Senior-Adapted House). PEAKS is a client-server based application, using a client with appropriate sensors like microphones and cameras to record the data and send it directly to the server. The server side does all necessary computations on the data, generating a report to be sent back to the client which displays it to the patient. This is illustrated in Figure 1. For these data transmissions, PEAKS currently uses its own protocol. On the other side, ISA-Haus uses UPnP for all needed communication. The dialogue system used for controlling the features built into the living environment therefore acts as an UPnP control point, while every device that needs to be controlled is implemented as a standard UPnP device. This setup creates a high flexibility since every device that is to be controlled just needs to implement the UPnP specification.

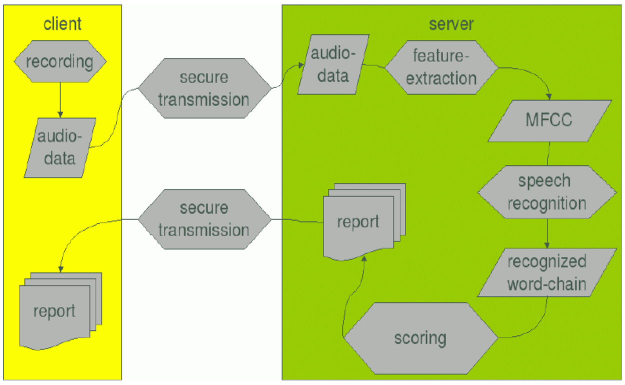

Fig. 1: PEAKS architecture: Client records data, server processes it. [2]

Software Modifications

The easiest way to integrate PEAKS into ISA-Haus is to change its communication protocol to UPnP, as well between client and server as between the client and the sensors. This enables the microphones already built into ISA-Haus for the dialogue system to be also used by PEAKS, and an extension of PEAKS like the planned use of cameras [5] would be eased. Therefore, a stream handling system is needed as the microphones and cameras are not directly connected to the PEAKS client anymore. Furthermore, this system needs to be able to synchronize the streams because of the latencies introduced by the network connections. To be compatible with the UPnP standard, the communication between the PEAKS client and the computers streaming the sensor data works via an UPnP MediaServer. Please note that only the PEAKS server has to run on its own computer, the rest of the system may be distributed across multiple machines but does not have to.

Stream Handling

This stream handling mechanism will be implemented as a specialized UPnP MediaRenderer that is able to “display” multiple sources. It will synchronize the incoming streams and prepare them for delivering them to the PEAKS server by recoding and wrapping them up in a container format like avi or ogm. This means the PEAKS client does not directly communicate with the PEAKS server anymore, but the synchronizing MediaRenderer is taking the role of a proxy.

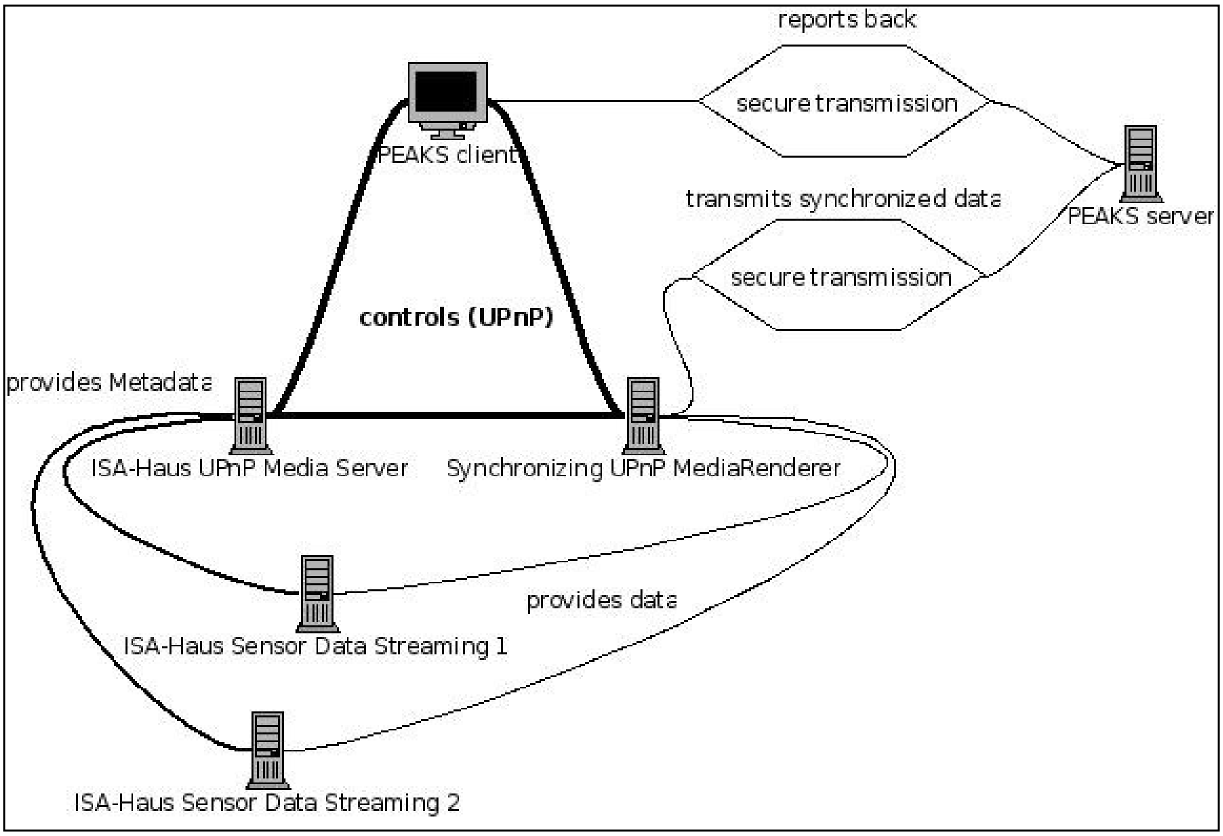

Fig. 2: Modified PEAKS architecture, integrated into ISA-Haus

By implementing this, we will not only augment PEAKS to a multimodal system, but we would be able to virtually support any multimodal application with just minor modifications to the existing software, and without any necessary modifications of the ISA-Haus system.

Discussion

As already described, the implementation of this system will create a feature-rich environment for the testing and deployment of tele-medical applications. Sensors are already set up, stream handling is provided and the communication of all parts is completely standardized, making it easy for developers to focus on processing the data. The whole system could easily be provided as a set of small stubs, all running on one machine as a cost-efficient development environment that could easily be shared by multiple teams. In addition to that, UPnP already has a sophisticated, standardized method for the auto configuration of devices which also eases the deployment of systems. The obvious drawback of introducing additional latencies by transmitting all data over a network is countered by the implementation of the synchronizing MediaRenderer.

Outlook

The presented system should be able to ease the deployment of any tele-medical application in the scope of our intelligent living environment by providing a sophisticated framework that allows easy access to sensors, synchronization of sensor data and transmission of that data to other hosts. Therefore, developers of tele-medical applications may concentrate on their task of processing the data without having to worry about its acquisition or the application's deployment. It will also provide a fitting environment for tests and experiments to validate those systems. To show this, it is planned to integrate a SKT (Syndrom Kurztest) system [4] that was developed at the University of Erlangen. This integration will include an augmentation of the SKT system with additional sensors.

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