# Connecting Senior Citizens through Interactive TV
# Ambient-Assisted-Living-Kongress 2010

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## Zusammenfassung

Wir beschreiben ein semantisches Empfehlungssystem für interaktive TV-Dienste, welches speziell dafür ausgelegt ist soziale Netzwerke für Senioren zu ermöglichen und die Kontaktpflege zu verbessern. Obwohl die Akzeptanz und Nutzung neuer Technologien von Senioren üblicherweise erst in einer späten Phase nach ihrer Erscheinung gewährleistet ist, behaupten wir, dass gerade Senioren von der Nutzung neuer Technologien und im speziellen von Online-Netzwerken profitieren. Aufgrund von Alterserscheinungen und im Besonderen durch eingeschränkte Mobilität, wird die direkte Kontaktaufnahme mit anderen Menschen erschwert. Während junge Internet-Nutzer meist in mehreren sozialen Netzwerken und Online-Diensten aktiv sind, stellt bereits die Medienumstellung für viele Senioren eine nicht zu überwindende Einstiegshürde dar. Somit werden die Möglichkeiten zur generationsübergreifenden sozialen Vernetzung für Senioren stark eingeschränkt. Unser Ansatz ist es Senioren diese Möglichkeiten zu bieten und die Nutzung neuer Technologien so einfach wie möglich zu gestalten, indem sie in das gewohnte TV-Medium integriert und darüber angeboten werden. Wir schlagen ein semantisches Empfehlungssystem basierend auf interaktivem Fernsehen vor, welches speziell auf die Bedürfnisse von Senioren zugeschnitten ist. In diesem Beitrag zeigen wir den geplanten Einsatz des semantischen Empfehlungssystems im SmartSenior-Umfeld[1].

## Abstract

We describe a semantic recommender system for interactive TV services adapted to the task of building and improving communities of senior citizens. Although senior citizens are traditionally seen as late adopters of technology, they may be the part of society that could profit most from online communities, due to reduced mobility limiting face-to-face contacts. While it is expected from young internet users to use multiple social networking sites and other online services, this task seems particularly difficult for seniors. Therefore opportunities for social interconnection that appeals to people of all ages are very limited. Our approach is to provide these opportunities to senior citizens by integration of new technologies to the known TV medium with ease of use. We propose a semantic recommendation system based on interactive TV specially tailored to the needs of senior citizens. In this paper, we show the planned use of applying our recommender system in the SmartSenior environment[1].

## 1 Introduction

SmartSenior is an ongoing project, founded by the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung–BMBF), with the goal to design and implement smart services for senior citizens to help them in their every day lives. In particular, senior citizens are usually underrepresented in social Web communities. To make the Web community available to senior citizens, SmartSenior proposes an intelligent recommender system that brings together seniors with similar interests and tastes. To make the system accessible to seniors, it is integrated into the home TV and media system, and seamlessly integrates into the daily TV viewing routine of senior citizens. This paper describes the semantic recommender system used in SmartSenior.

To compute recommendations, SmartSenior aggregates various data such as past viewing behavior, explicit movie ratings, and known social links between seniors. This data is then used to provide intelligent recommendations to seniors. These recommendations are delivered in the form of invitations to start a video chat with another senior. To lower the barrier of entry, the chat is proposed in real-time during TV watching, in a way that allows seniors to chat about the current TV program as it runs.

In the field of information retrieval, a recommender system is defined as a system that is able to find entities in a dataset that may be of interest to the user [1]. In contrast to search engines, recommender systems do not base their results on a *query*; instead they rely on implicit and explicit connections between users and items, such as ratings or other past interactions. SmartSenior follows the semantic approach to recommendation: known data about users and TV programs is represented in a semantic repository and special semantic algorithms are used throughout. This allows any data to be considered in the recommendation process, resulting in a flexible and extensible recommender system.

[1] http://www.smart-senior.de/

In the rest of paper, we first motivate semantic recommenders, then describe other related projects and finally describe the SmartSenior recommender in detail.

## 2 Motivation

Due to demographic changes the proportion of senior citizens in society will increase in the future, and there will thus be more and more isolation of these, which is already a problem nowadays. This isolation has a number of reasons. In addition to the limited movement, it is also the restriction of a fundamental physical sense. Once these symptoms occur, seniors run the risk of shifting back and living in retirement. The result is that they are sitting in front of a television most of the time, because they know it and like it, and lose the connection to the world more and more. Because of this problem seniors meet less in real life and their social network shrinks inevitably. Recent studies have shown that social television can maintain a social network or even enlarge it [10]. But there are no known solutions in the domain of social television for seniors which could specifically interconnect seniors with each other, in a way that everyone could benefit.

Available solutions are not applicable for this audience since they are not enough to maintain their social networks. Unlike young people, seniors have only few contacts outside their own family. Instead of proposing a contact list the idea in this work goes further since a recommendation system helps to find other contacts fitting to themselves. This is a complex issue since the proposed system needs to analyze seniors to get their behavior and find other seniors matching them.

To be useful however a recommender system needs data to analyze. In traditional social networking systems, this data comes from the users themselves, which have to enter information such as interests or maintain a friend list. For senior citizens however we must handle the case in which the users do not enter or maintain such information themselves. How can we then collect information about the senior citizens' tastes and interests? The answer is to use information that is always available: TV data. To process this data, we propose a semantic approach. Using a semantic representation of data has two advantages: The recommender system is flexible because data from other domains can be added without redesigning the recommender, and the recommender is able to work without expert knowledge, and is thus universal.

## 3 State of the Art

In the domain of social television there are already several projects existing. After instant messaging (IM) became popular the 2BeOn project made through a prototype workbench system the old plain television user online by integrating basic communication services, in this case IM, in 2001 [2].

Later AmigoTV combined broadcast television with personal content and rich communication [3]. Personal content included personal data such as photos or movies but also liked and recommended content. Furthermore, rich social experience including buddy lists and rich presence was added by supporting communities allowing users to watch programs simultaneously and share their thoughts by posting emoticons that are overlayed on the TV programs of the other users. Today, social television has reached mobile users through projects such as AMUSE [4]. With IPTV, which has an own feedback channel, today more and more people are watching television. Therefore, we assert that the idea of social television needs to be shifted to set-top-boxes (STBs).

## 4 Our Approach

In the past, we dealt with topics in the domain of recommendation systems and interactive television separately. We built a system based on the IP Multimedia Subsystem (IMS) which integrated television captured from DVB-T and rich communication services using voice over IP, video conferencing and instant messaging [5]. The client of this system is illustrated in Figure 1. Social community aspects were covered by allowing users to recommend content (live or recorded) or join a special chat room belonging to a broadcast.


**Figure 1** Client of the Interactive Television System, showing a main TV channel and four on-screen displays at the bottom.

The architecture of the SmartSenior recommender consists of a server, a client running on a set-top-box connected to a television. The setup is designed to be as little intrusive as possible. In contrast to existing solutions, our system integrates TV and the recommender, instead of providing the recommender as a service on top of TV.

Figure 2 shows the demonstrator and its components. Blue components denote the data management layer, white components the business intelligence layer and green components the application layer. In the following sections these will be described accordingly.

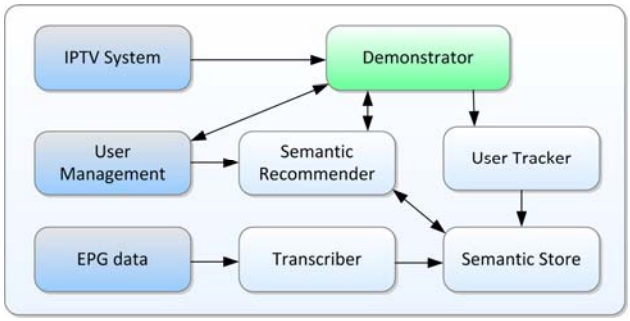


**Figure 2** Overview of the demonstrator and components

## 4.1 Semantic Store and Transcriber

The content-level and user-level data of SmartSenior is managed by the semantic store, a Resource Description Framework (RDF)-based storage solution for semantic data management [6]. Data managed in the semantic store contains the EPG data enriched by the transcriber component with additional meta-information, user information and feedback, as well as user interaction data. The semantic store connects all information to a large-scale semantic knowledge network that represents the information base for the SmartSenior recommender. Recommendations computed by the SmartSenior recommender are saved to the semantic store as well and become part of the knowledge network.

The system architecture of the semantic store, as depicted in Figure 3, consists of two different layers. An input layer offering different access methods for the different components, a management layer responsible for the data integrity and a physical layer to store data in different storage solutions, such as oracle, MySQL or pure RDF-based storage solutions.

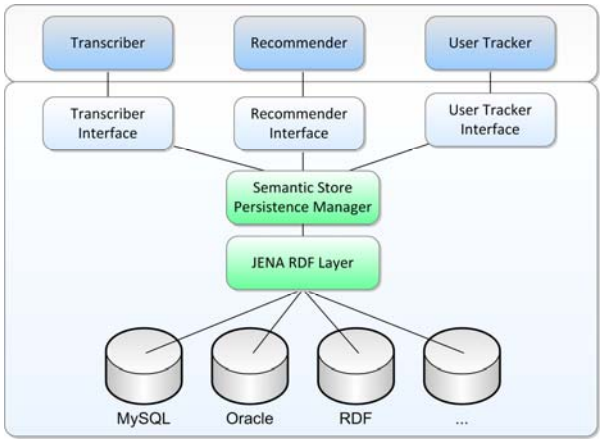


**Figure 3** Architectural overview of SmartSenior.

The goal of the semantic store is not only to persist data, but also to manage data in a semantic knowledge network enhanced with meta information shared among different applications.

The transcriber is an internal component reading television metadata, also known as Electronic Program Guide (EPG), transforming data into semantics and storing final data into the semantic store. The EPG data is essential for the recommendation system in order to see different user behavior. During this transformation process two well known formats are used: on the one hand TV-Anytime [7] and on the other hand the Programmes Ontology [8] of the BBC based on RDF [9]. At the same time recognition of duplicates needs to be ensured since data from different sources are aggregated. The transcriber is the connection between the raw television data and the semantic store.

## 4.2 Recommender

The goal of SmartSenior is to connect senior citizens with each other in order to build a community. To this end, the TV viewing behavior of seniors is analyzed and used to find similarities between seniors, from which recommendations are computed. SmartSenior recommends other seniors to connect with that have a similar viewing profile. The SmartSenior recommender is based in the Universal Recommender framework developed at the Technical University of Berlin [11].

The recommendations of SmartSenior are delivered directly in a way that makes it possible for the seniors to begin a video chat with each other instantly during the TV broadcast. Thus, seniors can discuss a TV program live as it is broadcast. To compute recommendations, both explicit and implicit information is used from the content-level and the user-level. Explicit information is for instance the list of programs a senior has watched. Implicit information is for instance the TV viewing history of users. Because all data is stored semantically, SmartSenior is able to find all types of connections between users. Two seniors could for instance be linked by a common TV program they have watched, but Smart Senior also considers longer connections. Two programs may be considered similar when they are of the same movie genre, or when the same actor plays in both. Because SmartSenior uses a semantic store, there is no restriction in the scope of data used for recommendation—all data that may be represented semantically can be considered. The currently running program is for instance specially weighted to allow seniors to connect when they watch the same program. Figure 4 shows a detailed view of the recommender system.

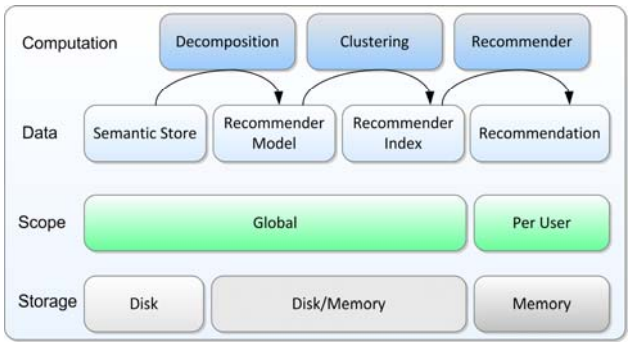


**Figure 4** Detailed view of the SmartSenior recommender. Recommendations are computed using a three-stage algo-

rithm. The first three stages are global and online. The last stage is personalized.

In the following we describe the three-tier recommender system of SmartSenior.

*Latent Recommender Model.* To compute recommendations, a latent recommender model is computed. This model maps the users, TV programs and other entities of SmartSenior into a latent space. In this space, predictions of user–item or user–user affinities can be computed efficiently. The function that maps entities into the latent space is a graph kernel, which SmartSenior learns automatically by considering past interactions [12].

*Recommender Index.* To turn similarity values of the recommender model into user recommendations, a recommender index is computed. Using this index, the nearest neighbors of any user can be computed efficiently. The recommender index ensures that SmartSenior scales to a large number of users, TV programs and view events.

*Online Computations.* SmartSenior uses a latent model and index that can be updated in an online way. In other words, the model does not have to be recomputed each time a new view event (or rating) arrives, but can be updated very fast. The same method is used to update the recommender index.

The SmartSenior recommender is thus semantic, universal, scalable, and learns the tastes of seniors automatically.

# 5 Conclusion

We conclude that social web services are not in themselves specific to young people, and can even provide extra benefits to senior citizens. As shown with the SmartSenior system, social web services can be made available to senior citizens, emphasizing a user recommendation approach that results in community building. We predict that SmartSenior and related systems will be successful in the future, only if they integrate social recommender systems. The recommender system we described in this paper can achieve that goal in the TV context.
On the level of recommender systems, we will continue to follow the goal of using semantics as the defining structure in the design of recommender systems. The context of home entertainment and communication is particularly suited to semantics since data are diverse and heterogeneous. We predict that as semantics get more and more established, semantic recommenders such as ours will become the norm.
Semantic recommenders will also benefit from other initiatives of connected senior citizens: Any service that connects seniors (literally or virtually) may be used as an additional data source for a semantic recommender, as long as it is described semantically. Therefore, the importance and utility of semantic recommenders will increase in the future.
The semantic recommender of SmartSenior will be evaluated along with other services and systems in a test study conducted by the Deutsche Telekom as part of the SmartSenior project.

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