Smart domestic environments hosting social users: the SandS paradigm from a user's perspective

Current article discusses the human centered perspective adopted in the European project SandS within a framework of Internet of Things (IoT). SandS is a complete ecosystem of users within a social network developing a collective intelligence and adapting its operation through appropriately processed feedback. The aim is for the user to collectively, via the SNS, and intelligently, via the adaptive network intelligence, interface and finally control his household appliances. The overall interface is orchestrated through a domotic infrastructure. The central role of the user reflects on all aspects of the ecosystem, from the family of Things which are socially governed, the household appliances that affect our everyday life, up to the employed hardware and software: strictly open source. In this paper we will first give an overview of SandS architecture and then we will discuss the users' perspective and how users can be modeled through a number of stereotypical user profiles.

Thanks to pervasive computing practices, the IoT supports and enhances the cooperation between humans and devices in terms of: 1) facilitating communication between the (Internet of) Things and people, and among Things through a collective network intelligence driven by users in the SandS context, 2) people's ability to exploit the benefits of this communication with the increasing familiarity with ICT technologies, 3) a mashup vision where in certain respects people and things are homogeneous agents endowed with fixed computational tools. However, the ways of deploying the IoT paradigm may differ significantly, from the logistics-driven idea where individual consumer items are being tracked to the co-creative design approach where the user participates in a proactive manner in all stages of the product or system creation process.

Following a pragmatic approach, the FP7 European Project and FIRE framework "Social & Smart" (SandS: www.sands-project.eu) tries to highlight the potential of IoT technologies in a concrete user-centric framework. In an extreme synthesis, the project deals with a social network aimed at producing and managing recipes with tools of computational intelligence, to be dispatched to household appliances grouped in individual homes through a domestic infrastructure. A recipe is a set of scheduled, possibly conditional, instructions to be managed by an extended home middleware (Domestic Infrastructure - DI) in order to be properly transmitted to the appliances through suitable protocols. This entire procedure is devised so as to optimally carry out usual housekeeping tasks with a minimal low level intervention from the part of the user. A Networked Intelligence module collects feedback from the users regarding their satisfaction from the recipes from one side and responses from the appliances themselves on the other side thus forming a permanent recipe optimization loop, with offline advises and suggestions from the part of the appliance manufacturers. At the lower end of this architecture, an electronic board will interface each single appliance to the DI.

The architecture of SandS can be divided in three layers, lower, middle and top. The lower layer is formed by all actual devices such as a fridge, a washing machine, a microwave oven etc., where each one is abstracted by what we call a Unified-Node (UN). The UN is the first level of device abstraction. Its role is to: i) uniquely identify a device, ii) represent the device in terms of its properties, and iii) constitute a bidirectional gateway for all communication between devices and middleware.

The middle layer is constituted by the DI which is a set of modules, variously interconnected to interpret and control the commands issued by the users. To this aim, DI must interface with any device found in the home, i.e. any UN representing an actual device. It must be capable both of managing and interfacing with devices gathered in logical clusters, such as all the devices located in a certain room, and of processing logical rules for adapting optimally the instructions to the devices specifications and limitations. The modules of the DI will support these functionalities in two different modes, instantaneous commands, and recipe execution.

At the top layer, users (eahookers in SandS paradigm) interact with the middleware through a proper front-end either individually, an eahooker sending recipes to his home, or through the Eahookers Social Network (ESN). From SandS point of view, a social network is a large database, the Eahoukers Database (EDB), with an inquiry system based on advanced clustering algorithms. On this basis we may build a series of services, such as automatic friend finding, proposal of interest groups, forums, etc. The two elements that set apart the ESN are the way it fills the EDB and the main service it offers.

Subscribing to a common social network, such as Facebook, requires to enter a series of personal data that form the user profile. Providing this information is in general optional for the user. The user may want to enrich his profile both to give other users means for discovering him as a friend and to increase his appeal (for instance by publishing interests, activities etc.). On the contrary, an eahouker registers into ESN almost automatically. Once he contacts the social network he receives an ID and is roughly geolocalized. The same occurs in the case of the single appliance, thanks to appliance self discovery facilities. To these basic data, additional ones may be optionally added, which mainly concern practical aspects of the homes, for example the floor plan indicating where the appliances are located (to rule the appliances noise) or the maximum power supplied by the electrical meter (to avoid overloads). Each time the user asks for a recipe, he enriches his profile; the same holds for the feedbacks. Of course, a recipe request must be entered by the user. But this is neither burdensome (because it is rewarded by the recipe), nor arbitrary (because only valuable and exact information needs to be entered). There is no need for strict personal identification of the user. On the contrary, appliances must be completely identified through technical sheets supplied by the manufacturers (or every available documentation in the early implementations). They constitute a part of the EDB which will be inquired during the creation of the recipes. Finally, typical social network services will be provided, initiating various forms of information exchanges such as friendship, files, forums etc. The main (possibly, sole) service provided to eahoukers will be recipe generation.

By giving the means to the eahouker to intelligently control his domestic appliances and by placing him inside the ESN, SandS follows clearly a human and user centric approach. For this reason, User Modeling (UM) emerges as an important research direction inside the project. More precisely, UM not in a general sense, but relatively to the user's activity inside the ESN and with respect to the task on hand, the efficient orchestration of his household appliances (context). We are considering in particular a context-aware UM of eahookers, that is taking into account all the contextual information that could characterize the situation and condition of the system's entities. In SandS case this could be context information about the eahooker (distance to his house, communication device used, time of the day, weather,...), usage information (recipes used, feedback provided by user, frequency of use,..), information about the homes (geolocalisation, proximity to other homes, surface area, number of rooms,...), about the appliances (location inside house, energy consumption levels etc) and information specific to the social network itself (friendship statements, content exchanged between users, graph structure, communities formation,..). As soon as the eahookers activity will start producing this data, Computational Intelligence algorithms will extract knowledge about groups of similar users and construct for these groups stereotypical users (or Personas). Ultimately we will investigate how each individual eahooker could be modeled with a simple user model, consisting of a fuzzy combination of the extracted Personas.