Smart Home in Your Pocket

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ABSTRACT
In this poster we present HYP, an application that enables a mobile phone user to create his own context-aware services for his smart home. By setting criteria tailored for the individual user, HYP can for example warn the inhabitants of a house if the TV is on when no one is watching. We developed HYP in J2ME, making it possible to run on any java enabled handheld device. Future work includes attaching it to a real smart home, in order to test the actual employment of the application.

Keywords
Context-aware computing, smart homes, handheld devices

INTRODUCTION
The seamless interaction between a house and its inhabitants that context-aware homes strive for is shown to be difficult to achieve [6]. The advantages of a home with functions that adapt and assist according to sensor measures seem numerous; however, people have very different habits and ways of leading everyday life, and applications that are developed for one lifestyle therefore might not work for another. For example routing phone calls to the room where the receiver is present might work in a busy nuclear family, but for the elderly couple, who both enjoy getting calls from their grown children (meaning the call in not directed at one person, but both), the function might not be optimal or even relevant.

In this project we approach the problem by suggesting a new application, which enables people to create their own context-aware applications for a sensor saturated home. The user defines the sensor measures (criteria) that should be taken into account when performing a specific action; the action then depends on user specified criteria, making the applications more flexible and tailored, rather than having a programmer specify each application. We have developed a prototype of the system that runs on a handheld device, but it is still not attached to a real smart home or any sensors. We first present the HYP application and examples of functions the user can develop, second, we review related work. Finally, we discuss the implications, conclude and suggest future research.

THE HYP APPLICATION
The HYP application is developed in Java, using its micro-edition API [3] in order to make it run on a handheld device with limited processing power and memory. It is in its development phase and therefore still only a prototype with no back-end so far; eventually the goal is to connect it to a sensor equipped (test) home in order to make further user testing. The core concepts of HYP are the *actions* and the *conditions* as seen in figure 1. An action is a single action, for example 'turn on coffee maker' or 'turn off TV'. The conditions are the more complex user specified criteria that make up one action. Conditions can for example be 'light on in bedroom' or 'motion detected in bathroom'. The conditions for each action are all defined in an 'and'-aggregation. The conditions can be wrapped in a timer, so the user can specify a specific time frame for the condition, e.g. 'for at least 10 minutes', however, a condition can be a time interval in itself, meaning that all conditions are restricted to a specified time frame, for example 6-9 PM. In order to provide more insight into the use of HYP we provide three examples of sub-applications.

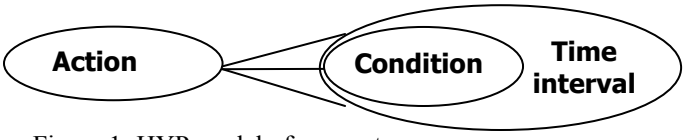

Figure 1: HYP model of concepts

Examples of Tailored Functions
The first example function alerts the user when the next bus will leave from the closest bus stop. The user models this from the criteria that the fridge door opens between 7 and 9 in the morning, while the light in the bathroom has been on for more than 10 minutes. This particular user knows that he drinks a glass of milk in the morning after showering, which always takes more than ten minutes; therefore the bus schedule is relevant at this point in his schedule, as opposed to a fixed time.

In another function, the user defines the action of turning on the record button on the VCR. The user defines the five criteria as there are no lights on in the living room and the cell phone is not in its cradle; the front door has not been opened the last 10 minutes and the TV is not on. If it is Sunday night, 9pm, the VCR turns on and tapes the latest episode of the user's favorite show: Sex and the City.

The final example alerts the user if he is about to forget his cell phone in the morning. If he opens the front door between 7 and 9 in the morning and the cell phone is still located in its cradle, the cell phone alerts the user with a loud beep that he has not taken it with him.

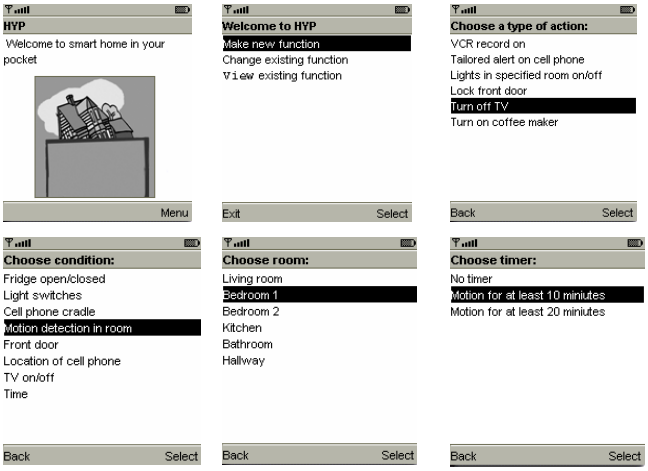

Figure 2: Screen shots from HYP: actions and conditions

RELATED WORK

A fair amount of research has focused on developing smart homes; one example is The Aware Home at Georgia Institute of Technology [5]. Here, the purpose was to make the sensors learn about the users' habits to facilitate the development of human-centered applications for a rich sensor infrastructure. MIT's House_n is build with another goal: to teach and motivate the user to take control in a sensor augmented house instead of having the smart house overriding the user's actions with inappropriate behavior[4]. In our view, the goal of a smart home is to assist individual inhabitants with everyday tasks by tailoring functions to their habits and behavior.

Other relevant work includes context-aware applications for handheld units such as the Tour Guide and the Cyber Guide[2,1]. These applications change their content according to the surrounding context, for example location, time and identity of the user. Finally, iCAP is a system that enables users to create context-aware applications [7]. But where iCAP focuses on end-user programming on a desktop computer, HYP goes all the way and enables mobile users to define their own criteria 'on the go'.

IMPLICATIONS OF THE HYP APPROACH

While HYP is in essence still an outer layer of the prototype, it illustrates a new way of specifying a smart home. It is our goal to empower the users by giving them simple options for dynamic functions. By making it easy to revise existing sub-applications, the chance that users will reject context-aware functions is diminished, because the user can change it to better fit his needs. However, in order to keep HYP simple, the options provided are limited. When creating a timer for example, the user is left with few selections (see figure 2), which in some cases might not satisfy the user's needs. It is likely that the user wishes to create applications that are not possible and finds that it is difficult to define the right criteria for a specific action. Most people lead irregular lives, resulting in exceptions that might initiate the action at the wrong time. However, the HYP approach makes users understand why the system acts like it does, because they specify the conditions themselves.

CONCLUSIONS AND FUTURE WORK

We have presented our prototype application HYP that illustrates how users can create their own smart home functions on a handheld device. The concept of HYP emphasizes the user's individual and unique lifestyle by letting him define his own criteria. This approach lets the user stay in control of the technology and thereby prevents the user from not using the application due to irrelevance. It is our belief that this type of context-aware applications will, in many environments, be preferred over the more autonomous ones, which, in their effort to work smooth and transparent, leaves little free choice to the users.

Since we have not performed any formal user evaluation on HYP, this is the next step. Testing how users interact with it and see if they are able to create desirable applications, are essential for further deployment. Our second goal is to connect the HYP prototype to a sensor equipped smart home in order to develop the application further and get real user feed back. Finally, it should be considered which other environments will likely benefit from a similar approach.

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