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# Smart control panel: Developing conventional domestic infrastructures into ambient media

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**Abstract.** In this paper, we present novel development of domestic central heating control panel from conventional wall-mounted device to ambient media. We perform cycles of designs and evaluations in order to refine the understanding of the new media. Based on that we investigate potential methodologies to develop conventional devices into ambient media and, explore types of messages which may be provided by new ambient media.

**Keywords:** Central heating, control panel, domestic infrastructure, smart media, ambient media

## 1 Introduction

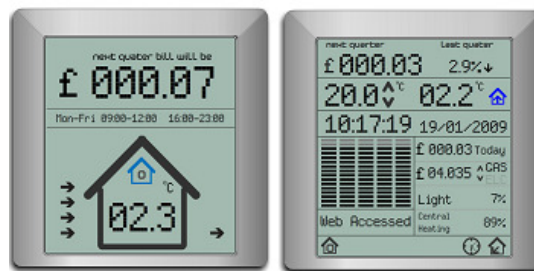
Research into ubiquitous computing has begun to examine the domestic environment since last decade, projects such as MIT's "Place Lab", Samsung's "Smart Home" and Microsoft's "MS Home" made positive progresses in understanding how domestic smartness may be [1]. Many systems of smart ambience have also been developed in Europe which include "dwelling house" in UK, "PROSAFE" project in France and the "HIS" project in Grenoble [2]. Current attention mostly has been given to domestic appliances such as home media pond, easy mailbox [3] and pin-boards [4]. However steps towards domestication move slowly due to dynamic ways of integrating new technologies into various domestic legacies. In the home smartness is regarded as high awareness and responses which means, in the terms of environments it should be responsible to mediate ambient information between users and environments outside. Current studies suggest the home as a set of organizational systems and routines which provide sufficient evidences for interactive technology design [5], other critical studies reflect that design in existing and pragmatic way may be better than in the way of revolutionary progresses [6]. With the increasing emergence of interactive technologies such as radio, television and email we have been in a world fulfilling of information and connections while, coexisting many conventional domestic infrastructures.

Thus we proposed a design of conventional wall-mounted central heating control panel to investigate possible ways of developing home infrastructures into smart media which may be able to mediate messages and relationships between ambient

environments and user requirements. Meanwhile evaluations with synthetic methods were adopted to find out the usefulness of design and explore what types of messages new media may provide.

## 2 First study

We began the design by observing existing devices which provide us understandings of consumption behavior patterns. According to that we designed a new interface which added many novel features such as rooms' temperature setting, energy supplying switcher and real-time energy consumption display. And the most advanced feature is the prediction of consumption costs which was shown intuitively (Figure 1). Besides, the other improvement included device migration from wall-mounted to mundane coffee table. One of the reasons of this migration was to transform the device into a form of ambient media rather than a physical device meanwhile, keeping the original cognitive as a control panel. By ceiling-mounted projector and camera, the interface was projected on the coffee table and all manipulations were achieved by object detections by camera overhead (Figure 2).



**Figure 1** The left interface is main interface; by clicking it the right one can be accessible for detailed information.

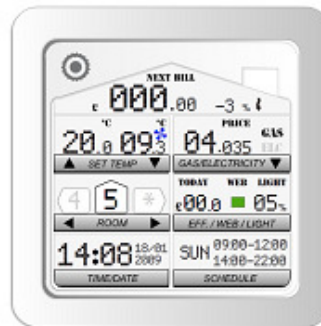


**Figure 2** Ceiling-mounted projector and camera

The evaluation of new ambient media adopted methods including scenario setting, questionnaires, and teach-back. Scenario setting was used to render atmospheres of evaluation in the laboratory; questionnaires were used to investigate how participants thought about this interface as ambient media; and teach-back was used to validate how much participants understood the interface. The questionnaire results indicated that all participants were motivated to change their attitudes or behaviours towards domestic energy consumption through relative they were told. As well, participants all admitted that they paid more attention to ambient environments such as respective rooms' temperature and real-time energy consuming. However we were also told some shortcomings of design. Participants got confused in the way of control, they did not know which component was clickable and which was not; neither crowned information displays gave explicit and easy understandings.

### 3 Second study

The evaluation was useful in identifying usability of preferred features and helped us to improve next design in visualising control buttons and grouping displayed messages. Based on this we improved the device interfaces and features particularly in the terms of lacking mentioned above (Figure 3). More physical appearances were introduced to simulate virtual interface such as buttons in new design to indicate the control area and, information displays were also respectively grouped according to different functions.



**Figure 3 Improved design. Buttons were highlighted and message displays were categorized according information types.**

The progresses of improvement also evolved our methodology thinking. In the second evaluation we replaced teach-back method as semi-formal interview due to the requirement of precise understanding of new features. The result analysis showed that new interface provided intuitive information for participants interpreting and controlling the ambient environments. All the participants preferred improved design to previous one.

At this point the evaluation subsequences encourage us to radically develop conventional domestic infrastructures into ambient media. The first reason is our objective, which is to explore the methodologies to develop domestic infrastructures, has effectively captured some ideas. And secondly we gain new understandings of message types which ambient media can provide and of ways we explore to represent these messages.

## 4 Conclusions

Our understandings were gained under conditions of laboratory therefore we are still at the early stages of developing practical domestic media. In order to evaluate the effectiveness of development methods, comparison with evaluation in real domestic environments is still required. However through practices of design and evaluation we have clarified that it is potential to move old infrastructures into interactive ambient media. And these two short studies have also convinced us that the messages provided by new ambient media should be intuitive as original function meanings. Although revolutionary inventions of domestic ambient media have yet been tested in our studies, it is evident that messages evolving from existing artefacts may be more acceptable.

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