Distributed and Adaptable Home Control Interface with VoodooIO

Nicolas Villar, Florian Block and Hans Gellersen
Computing Department
Lancaster University
Lancaster, LA1 4WA, UK
{villar, block, hwg@comp.lancs.ac.uk}

ABSTRACT
We propose to demonstrate a novel type of physical interface for home control based on the VoodooIO architecture. The system is targeted at home environments that are rich in networked appliances and devices that can be remotely operated. The aim is to allow users to define and maintain a single coherent interface, which provides effective control of the collective functionality of their home.

INTRODUCTION

We envision an interface that is physically distributed across the surfaces of the architecture (e.g. walls, doors) and objects within it (e.g. furniture, appliances).

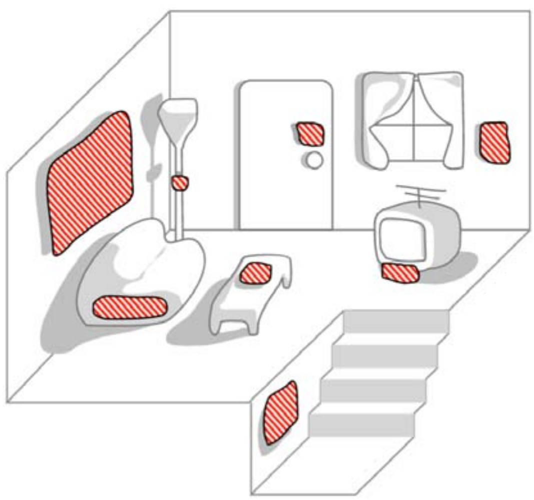

Figure 1: We envision an interface for home control that is distributed across the surfaces of the architecture, furniture and appliances.

In the scenario sketched in Figure 1, certain surfaces are designated as control areas – that is, areas on which controls to the home can be placed. Users are then able to dynamically distribute generic controls (e.g. switches, buttons, knobs) amongst any of these control areas. Individual controls can be located on, arranged and moved between, or removed from control areas in an ad hoc fashion. The style of interaction we aim to support is illustrated by the following example:

UIST '06, October 15-18, 2006, Montreux, Switzerland

Lisa buys a new lamp, which she places in her living room. After living with it for a while, she finds that, while reading in her armchair, she regularly has to get up and cross the room to adjust the brightness of the lamp as the light conditions change throughout the day. To resolve this, she selects a generic knob-type control from her VoodooIO control repository. She places the control on the armrest of the chair – a surface that she has previously defined as a control area, and which already holds a number of controls to other appliances. She is able to easily map this control to the light-dimming functionality of her lamp, so that by turning the knob she is able to control the brightness of her lamp without having to leave her armchair.

Such an interface paradigm is different from current solutions, targeting a design space somewhere between wireless (e.g. remote controls) and wired (e.g. predefined control fixtures) solutions for home control. We are particularly interested in exploring an interface solution that supports the changing control requirements of a home, where new appliances are introduced and old ones are removed or replaced.

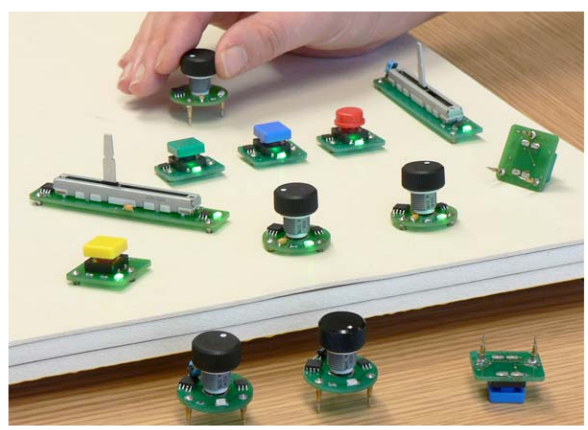

Figure 2: The VoodooIO architecture: substrate material and control devices.

Our design allows users to make interesting use of the spatial arrangement of controls around the house, allowing controls to be dynamically placed on surfaces where they are most desirable, useful or easily accessible. We envision controls such as a “Turn Everything Off” button which could be located next to bedside table, or moved near the front door when leaving the house. The mapping interface design supports additional functionality, such the ability to duplicate control functionality in an alternate location, for example: a copy of the kids' stereo volume control in the parents' bedroom.

Our demonstrable implementation of such a system is based on the VoodooIO architecture for physically malleable interfaces (c.f. Figure 2), which is described below in more detail.

DEMO SCENARIO

We will demonstrate our concept in an environment that is part physical and part simulated (displayed by a projector), and which will emulate a home environment on which the VoodooIO interface might be deployed (c.f. Figure 3). It will contain some physical artifacts (armchair, table, wall or partition) and some virtual home appliances simulated on a projected display.

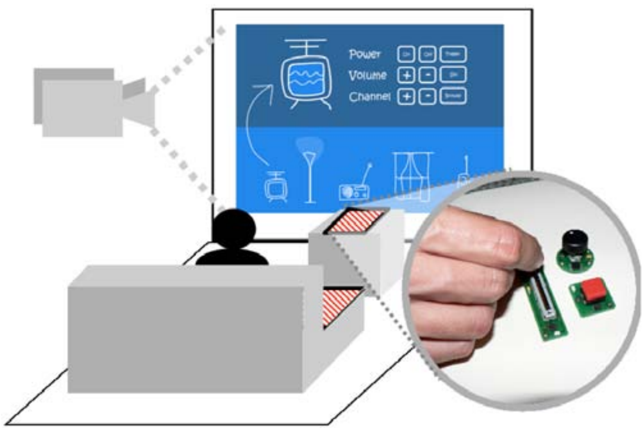

Figure 3: The demo installation consists of a mixture of physical artifacts and simulated appliances.

The setup will allow participants to experience the process of defining, modifying and using interfaces for a collection of virtual home appliances. The demo focuses on taking participants through the following scenarios:

- Augmenting surfaces as control areas using the VoodooIO substrate material.
- Placing and arranging controls on control areas
- Assigning functionality to controls via a touch-screen mapping interface
- Moving controls between areas
- Duplicating control functionality

As part of the demo experience, information will be presented about how such an interface has been implemented with the VoodooIO architecture, as well as explaining the wider possibilities of the technology.

TECHNOLOGY: VOODOO-IO

The VoodooIO architecture deconstructs the interface into atomic units of control – such as buttons, switches, knobs, sliders and lights – and provides a mechanism that facilitates the aggregation and spatial organization of controls on control surfaces distributed across the environment. The result is a "softwired" user interface, where physical controls become decoupled from predefined placement and usage.

VoodooIO enables interaction environments where controls can be freely and ad hoc assigned of meaning and purpose through physical arrangement, spatial layout, and software association. The effect is a malleable interface that can be constructed, adapted and modified in real-time. We have recently documented the application and use of this interface technology to the areas of musical expression and game control in [2] and [3].

The hardware components of VoodooIO are built on the technology originally developed in the Pin&Play project [1], which contributed a mechanism for the ad hoc networking of devices that connect to a common network substrate material.

The net effect is that individual controls are empowered with digital connectivity through physical attachment to the substrate. On attachment, controls are recognized and uniquely identified. While attached, they are supplied with power and provided with a communication medium through which they can transmit changes of state (e.g. pressing a button, or rotating a dial). The removal and re-attachment of controls is also actively monitored and communicated.

The network substrate is produced as a flexible material in sheet form, which can be easily cut to size and deployed to augment existing surfaces (see demonstration video at http://www.voodooio.com/). Interconnect cables aggregate substrate areas into sub-networks. Substrate Access Point devices manage individual sub-networks, and provide an application-level interface on a local-area network.

FUTURE WORK

As well as acting as proof-of-concept, the demonstrable system will serve as an investigation platform for future work. It will allow us to explore specific interaction issues with our home control scenario, free from the interoperability issues found in currently available home appliances. At the same time, further work will concentrate on leveraging the various current standards in home and appliance control protocols to realize a system that is applicable to real-world deployment.

REFERENCES

1. Van Laerhoven, K., Villar, N., Gellersen, H. et al. Pin&Play: The Surface as Network Medium. *IEEE Communications*, Vol.41 No.4., 2003, pp. 90-96.

2. Villar, N., Gilleade, K.M., Ramduny-Ellis, D., Gellersen, H. The VoodooIO Gaming Kit: A realtime adaptable gaming controller. *Prof. ACM ACE 2006 (Advances in Computer Entrertainment Technology)*, Hollywood, USA, June 2006, ACM Press.

3. Bowers, J., Villar, N. Creating Ad Hoc Instruments. *Proc. New Interfaces for Musical Expression (NIME '06).* Paris, France, June 2006