
Tools for Designing for Home Entertainment: Gesture Interfaces, Augmented Reality, and Smart Spaces

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Abstract

We are witnessing major developments in sensing, processing, and communications that have led toward an integrated composition of the world, in which physical and digital intertwiningly coexist, environments emanate intelligent presence, and interactions dissolve into human behavior in the form of gestures that manipulate the new physical-digital space. This course explores the ways in which home entertainment systems benefit from such technological advances, in the quest to design highly-interactive smart home entertainment spaces. Attendees will be introduced to the fundamental principles of *smart spaces* and *ambient intelligence*, *augmented reality*, and *gesture interface design* by falling back on examples of designs and applications for home entertainment. Notions such as *context awareness*, *mixed reality*, and *naturalness of gesture interaction* will be clarified for participants in the context of home entertainment. Practical aspects of augmented reality and gesture sensing and recognition technology will be explained and accompanied by examples from research and industry. It is my hope that this course will prove a valuable source of inspiration for practitioners interested in prototyping novel, highly-interactive smart spaces toward designing our future home entertainment experience.

The CHI community interested in this course

CHI features the **Games & Entertainment** community that includes researchers and practitioners interested in the “*design, development and evaluation of entertainment applications including interactive TV, multimedia and interactive applications for media and entertainment use whenever, wherever, and on whatever device.*”¹

This course is addressed to the members of this community that want to explore new design options for their prototypes. The course will provide them with the fundamentals of gesture interface technology, augmented reality and ambient intelligence principles to get them started in their projects.

¹<http://chi2014.acm.org/spotlights/games-entertainment>

Author Keywords

Home entertainment, augmented reality, gestures, ambient intelligence, interactive TV, mixed reality.

ACM Classification Keywords

H.5. Information Interfaces and Presentation: Multimedia Information Systems, User Interfaces; I.5. Pattern Recognition: Applications, Implementation.

Introduction

Today’s home entertainment systems possess enormous potential to engage their users into complex enriching activities, all taking place in the comfort and familiarity of the home environment [1]. Home entertainment is therefore transforming from a *standalone* electrical appliance, *e.g.*, the TV set, into an experience shared *throughout* the environment: the interactive TV and beyond [8,11,13]. Digital and real are mixed in complex engaging scenarios for the design of which engineers and architects work together to deliver new standards of multisensory experiences [3,11]. In this vision of future home entertainment, remote controls don’t find their place any longer. Because such standard input devices can’t handle the ever increasing number of functionalities without ruining and diminishing user experience [2], new interaction paradigms must be explored. Among these, gesture interfaces represent a potentially viable candidate [6,7,9,10] for which an increased interest has been manifested recently from the Smart TV industry, see Samsung’s TV gesture book¹ or LG’s Magic Remote². Also, new entertainment functionalities cannot be supported without recurring to design principles of ambient intelligence [1] or without using the technology of augmented reality [5].

¹http://www.samsung.com/global/microsite/tv/common/guide_book_5p_vi/main.html

²<http://www.lg.com/us/tv-accessories/lg-AN-MR500-magic-remote>

Course outline and schedule

The course is structured into three chapters that will introduce participants to (1) *ambient intelligence principles* applied to home entertainment, (2) *augmented reality* applications, and (3) *gesture interaction design*. Relevant examples from research and industry will be discussed. The course will be offered in the form of two sessions of 80 minutes each.

1

Introduction

(15 minutes)

A short introductory section, during which participants will be reminded of today’s fast-changing technologies that have found applications in home entertainment and Smart TVs, and, consequently, changed the appearance of home entertainment forever. Relevant examples will be presented to participants to make them aware of the benefits, but also pitfalls, of adapting new technology to existing systems, *e.g.*, gesture interfaces may not work for all user categories. This session will also serve as an opportunity to introduce participants to each other, identify their motivations and expectations regarding the course.

2

Augmenting reality: Home entertainment that dissolves within living-rooms (30 minutes)

The fundamental principles of designing augmented reality applications will be presented [5], and examples from research and industry will be provided to participants in the context of home entertainment and the interactive TV [3,7,11]. Specifically, the mixed-reality Around-TV system [11] will be used to pinpoint specific aspects of designing augmented reality applications for home entertainment.

Course history

Part of this course was offered in 2014 and 2015 at TVX'14 and TVX'15 (the ACM International Conference on Interactive Experiences for TV and Online Video) with focus on augmented reality for iTV. Before that, tutorials were delivered during EuroITV'12 and EuroITV '13 (the 10th and 11th European Conference on Interactive TV and Video, ACM SIGCHI) under the title "Designing Gestural Interfaces for Future Home Entertainment Environments", which were well received by attendees. For example, one participant said the tutorial *"was quite comprehensive and included a lot of background information. This is how a tutorial should be"*. The plan for CHI'16 is to reach a wide audience of researchers and practitioners by adopting an integrative approach of augmented reality, ambient intelligence, and gesture interface design principles for prototyping our future home entertainment experience.

3

Ambient intelligence for the home: What part does home entertainment play? (30 minutes)

The fundamental principles of ambient intelligence will be presented to participants in the context of designing home entertainment systems and applications. As ambient installations are context-aware, personalized, adaptive, and anticipatory of their users' demands [1], integrating home entertainment as part of such scenarios puts similar demands on applications running on the TV set. Participants will be presented with practical ways of making that happen by discussing user identification and intent recognition.

4

Gesture user interfaces for the home: Sensing, recognition, and gesture set design (60 minutes)

The main technologies available today to acquire human gestures will be presented: worn and hand-held equipment (e.g., motion sensing game controllers, gloves, mobile phones and devices) and non-invasive solutions (e.g., video cameras). Advantages of each approach will be discussed in the context of the home entertainment environment [8]. The Nintendo Wii remote, the Microsoft Kinect sensor, and the Leap Motion controller will be highlighted to participants as easy-to-use, low-cost technologies for rapid prototyping and evaluation of gesture user interfaces, with videos showing systems from the literature. A simple, efficient, and widely-used technique for recognizing gesture motions will be presented: the Nearest-Neighbor classification approach employing the Euclidean and Dynamic Time Warping cost functions employed by popular gesture recognizers [4,12]. Guidelines showing how to design and evaluate gesture commands will be provided. Design criteria for gestures, such as ease of execution, learnability, and gesture fit-to-function will be explained and exemplified to participants.

5

Take-aways: A summary of design guidelines for home entertainment environments (20 minutes)

Practical guidelines will be extracted for participants based on case studies in which gestures, ambient intelligence, and/or augmented reality have been integrated into interactive TV and home entertainment scenarios. Examples from research and industry will be again reminded to participants [3,6-11].

Instructor

Radu-Daniel Vatavu, Ph.D., works in the field of Human-Computer Interaction with focus on designing novel interactions for new usage contexts and scenarios. He is particularly interested in designing for the home environment, such as for the interactive TV, with a specific concern toward human aspects and the way technology is able to enhance everyday human-human interactions.



"All the theoretical and technical developments in which I have been involved have the ultimate goal of understanding the user or, better put, the human caught in the middle of fast-developing technology. Understanding fundamental human characteristics and designing for those characteristics are the most worthy goals I can imagine as a researcher in the Human-Computer Interaction field of study."

Instructor's web page:

<http://www.eed.usv.ro/~vatavu>

Target attendees

Researchers and practitioners working in general Human-Computer Interaction, user interfaces, and design of the home entertainment user experience. A mixture of participants from research and industry is ideal. No previous knowledge about gesture interface design, ambient intelligence, or augmented reality is required.

Presentation format

PowerPoint slides and videos. The web page of the course will be hosted on the instructor's web site www.eed.usv.ro/~vatavu offering course notes, pointing to literature references and other course resources, such as code and toolkits.

Teaching methods

The instructor will employ presentation, working with examples, discussions and collaboration to actively involve the auditory.

Examples of the instructor's research expertise relevant for CHI's Game and Entertainment community include the interactive TV coffee table [6], the TV wall [7], mixed-reality TV systems [10,11], using body sensing technology for social TV [13], or preoccupation for design guidelines for novel interfaces of future TV environments [8] resulted from user studies on the use of gestures to control the interactive TV [9,10].

Teaching experience

Radu-Daniel Vatavu is an Associate Professor at the Computer Science Department of the University of Suceava, where he has been teaching Algorithms Design, Pattern Recognition, Advanced Programming, and Advanced Artificial Intelligence for undergraduate and graduate students since 2008.

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