

MR.TV: A System for Augmenting

Viewers' Experiences of Watching TV with Mixed Reality

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Abstract

Recent developments in digital transmission technology opened up the possibilities for interactive television and various researches regarding interactive television are in progress. This paper describes MR.TV (Mixed Reality TV), a system that expands viewers' experiences of watching television using Mixed Reality. From a point of view of television viewers, we can think a space shown on the television as a virtual one and a space where a viewer exist as a real world. The boundary between the virtual space and the real world will be blurred by viewers' actions placing real objects on the television screen and virtual objects in the real world. The MR.TV system can be applied to t-commerce, education, game and so on, also it will invite the former passive viewers into an interactive space and provide new experiences over an easy and familiar interface.

Key words: Interactive Television, Mixed Reality

1. Introduction

In the 1930s, television was widely accepted by people as it could deliver its viewers images and sounds at the same time unlike radio. The desire for interactive television that enables communication between viewers and broadcasters has been there since the birth of television. The limitation of technological capability, however, restricted television to be a one-sided medium that offers passive experiences to viewers.

Recent development of technology suggests the possibility of interactive television. Especially the digital transmission technology makes it possible for viewers and broadcasters to communicate with each other instantly by making it possible for broadcasters to send plenty of information about the interaction. As more related technologies are developed, more interesting and new ways of interaction are emerging.

Many researches about interactive television currently focus on the convenient usage of television and the advanced content of the program. We can see it by the development of EPG (Electronic Program Guide) that displays television schedule on the screen so makes it easier for viewers to find the program they want to

watch. And there are some research groups that study the interactivity of interactive television contents. This part of the research is called advanced television. It is an interactive television service that makes an existing television program better, while that program is running and shortly afterwards. It is usually implemented by typically adding overlays, text and graphics. However most of advanced television programs are limited to some contents, such as sports events and quiz program and some commercial advertisement. It is also limited to the application of delivering related information from existing media like the Internet [1].

In this paper, a new system called MR.TV is suggested that augments viewers' experiences of watching television with Mixed Reality. This system enhances the experience of viewers by applying Mixed Reality technology and offering increased interactivity between the virtual space on the television screen and the real world.

2. Background

1) Previous researches regarding advanced television

Various researches about advanced television providing viewers more information about the program and enriching their indirect experiences are in progress. Viewers can deliver their opinions to broadcasters by pressing buttons on the remote control and gain more information and fun related television program. There are researches that try to construct a system creating an enhanced, more personalized television viewing experiences by linking the related information between television and Internet [2]. We can think MR.TV is an extension of this content augmentation, means how information linking and personalization bring values and advanced experience to viewers and used in the above paper. Also some efforts to develop haptic interfaces delivering tactile stimuli and feedback for more immersing and interesting experiences are on their way as an example of advanced television [3].

As an extension of this concept, this paper suggests MR.TV as a novel system that merges the virtual space and the real world by applying Mixed Reality.

2) Relevant researches about Mixed Reality

For viewers existing in the real world, the world on the television screen is a virtual one. Therefore the interaction between the television and the viewers can be defined as an interaction between the reality and a virtual space. Mixed Reality is a notion derived from virtual reality but differs from it as Mixed Reality tries to add virtual objects to the real world or real objects into virtual space so enhance the space while virtual reality aims at creating a whole new world of its own [4]. As MR.TV is trying to provide viewers with new experiences of an interval space where the real and virtual world meet, a study regarding Mixed Reality is needed.

3. Design principles of MR.TV

MR.TV is an application of Mixed Reality that enables television viewers to experience the virtual and real world at the same time and have more enjoyable experiences while watching television. The followings are the main design goals of MR.TV.

1) The Creation of the 3rd Space

MR.TV makes viewers experience an expanded space through the creation of the third space between the virtual space and the real world. In the act of placing real objects in the virtual world and virtual objects in the real world, a vast and new space is created on the blur of boundaries between the real world and the virtual space. We call this new space as the 3rd space because of it is not exactly the real world or the virtual space and it is a completely different space created by merging two spaces.

2) Realistic Experience of Size

MR.TV makes viewers possible to have a real experience of virtual objects by offering intuitive usage regarding size of them. Size plays an important role in perceiving objects and places when people encounter them for the first time. For example, when people see a skeleton of a dinosaur in the museum, they are overwhelmed by the size of it, but the television program is not able to represent intuitive information like the size of object. Viewers have to guess the size in comparison to other people or objects on the screen. MR.TV gives viewers direct information about sizes by putting the virtual objects on the screen to the real world or letting an avatars enter the screen.

3) Anthropometric Avatars

An experience of entering the virtual space in the television for a viewer is provided to viewers by using avatars. The avatar that represents a viewer enters the television using MR.TV, which gives the viewer more precise information of the environment on the television screen. And as the avatar resembling the viewer enters

the screen, the viewer can perceive the size of virtual objects intuitively.

Furthermore, people tend to have more fun when they see themselves appeared on the television screen. As an avatar of a viewer emerges on the screen, the experience that the avatar has on television will make the viewer feel like she is actually experiencing it. And for viewers seeing themselves on television increases the familiarity about the television program and makes watching television more pleasant experience.

4) Beyond Laboratory

Unlike previous researches whose results were restricted to the use inside the laboratory, MR.TV is applicable to our living space. Future technologies become more and more invisible and will hide themselves in our living environment. And the experience of new technologies will become intuitive leaving out the learning process.

Using only things that we can find at home easily, MR.TV can improve people's indirect experience of watching television. And this is one of the design goals of MR.TV.

4. System Overview

1) The ultimate system overview of MR.TV

MR.TV consists of a television, a MR-STB, a webcam and a MR-Carpet. A television is a displaying device every family possibly can have. And a MR-STB is a kind of set-top box having the MR module inside of it. A set-top box is a device that enables a television to become a user interface to the Internet and also enables a television to receive and decode digital television (DTV) broadcasts. The MR module in MR-STB receives television program data from antenna or DVD or VCR and video data from webcam, combines the data and makes a new picture applied MR. MR.TV uses two cameras. One of them is attached on the top of the television and the other is attached on a remote control or a pen so can be easily grabbed and used by viewers. A webcam attached on the top of the television can built in the television. webcams recognize viewers and objects

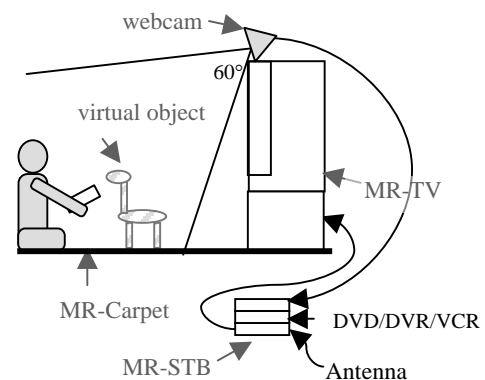


Fig. 1 A basic system configuration of MR.TV

around viewers and transmit data about them to MR-STB. A MR-Carpet is a carpet that has a marker on it, so it can play a role as a tracking pointer. All the specified things can easily be provided in every day life and this is a distinctive feature of MR.TV.

2) Simple Scenario of using MR.TV

During a viewer watches the television, if there is a virtual object related to the television contents, an icon with 'MR' appears on the right corner of the screen and starts to blink. If the viewer would like to see the object, she can push the 'MR' button on the remote control. Then the virtual object on television appears in the real world as a captured image as likely as the viewer displays on the screen with the virtual object. Actually the viewer and the virtual object appear on the television screen but she can feel as if she and the virtual object are in her room because she can see herself and the object together in her room.

The viewer can try to touch the object and interact with it. The television program, whose size has become smaller, will be shown continually on the upper right corner of the screen. So the viewer can watch the television without cutting off and enjoy the interaction with the virtual object. The virtual object represents its size exactly compared to the viewer. So the viewer can understand about the object more intuitively.

3) Possible Applications

The following are examples of possible applications.

T-Commerce

Watching a home shopping channel, viewers can check how big the product is or whether it suits to home and with other furniture by using MR.TV. In the past, viewers purchased objects at a rough estimate but now they can compare products more thoroughly and make a more careful decision.

Education

When a viewer watches a television program such as a documentary and discovers an interesting object or place, the viewer can get the virtual object into the room and see it in detail. She also can put herself into the virtual world and understand about the program better. Additional information provided by MR.TV improves educational effects.

Game

Children can invite their favorite cartoon characters into their room and play with them. Children will be excited to have their favorite characters by their sides.

5. Implementation and User testing

1) Implementation of the MR.TV system

We constructed a simple implemental environment for an experiment about a documentary. We implemented two documentary programs about dinosaurs and insects. Using MR.TV, people can bring the smallest dinosaur living in the Mesozoic period into their home and see the details of it.

For the implementation, a television, a remote control and a carpet attaching a marker are used. Instead of a set-top box, a computer is used to implement a MR.TV software for convenience of the experiment. Instead of receiving broadcast data we used 'avi' files stored in the computer. The MR.TV software, substituted for MR module in the set-top box, mixed and controlled properly inputs from files and the webcam. The software was programmed using VC++ and ARToolkit and run on a 2.4GHz Pentium 4 PC. For the convenience of tracking, MR.TV uses ARToolkit which is based on a marker. In the future, ARToolkit can be replaced with tracking technology that does not need specific markers so it can be hidden in our living environment. We use an 'iBOT 1394' web-camera.



Fig. 2 A circumstance of MR.TV system

Turning on a television, viewers can see a documentary program about dinosaurs or plants and insects. After a while an icon, which represents there is a virtual object viewers can see on the television, starts to blink on the right-below corner of the television. If viewers push the MR button, a virtual bee shows up and flies around the virtual flower. Viewers can try to touch the virtual flower and interfere with the bee's movement. The virtual bee avoids viewers and keeps flying.

In this experiment, we have not yet implemented that the original broadcast contents become smaller and be shown continually on the upper right corner of the screen. When new image captured and augmented with virtual objects is shown on the screen, viewers can only hear the sound of broadcasts.



Fig. 3 A viewer is trying to touch a virtual bee. He acts as if he really touches the object.



Fig. 4 Actually a virtual object is in the television not real world. A viewer is watching himself and the virtual dinosaur shown on the screen.

The 3D modeling data of the virtual objects are previously stored in the computer. We assume that the modeling data is delivered from broadcasters. For the interaction with the virtual object, MR.TV software detects the 2D position of the center of the viewer's hand. Using the difference of the color information of a hand and a background, we can gain 2D hand position. By only judging whether the viewer's hand touch the virtual object or not, if she touch the object, the object reacts as previously determined ways. It is pretty simple to implement but has the power to make viewers more fun.

2) User Testing

We made 10 students in the Department of Industrial Design experience MR.TV software. They can bring a virtual object near themselves, try to touch the object and interact with it. People who participate in the experimentation can control the virtual object and have augmented experience. Students experienced MR.TV software then we asked them a few questions about the effect of MR.TV.

We have shown a short documentary including virtual objects to students. We made students control the virtual object using MR.TV and asked their opinions about MR.TV. Most of them were very interested about it and

felt fun with it. They said that they feel like they are at home with the virtual object together. And they said they could understand it better because they could touch it and know its size well than before.

However students averagely answered that the virtual object looks pretty real but not very much, so they don't feel like that the virtual object are real and close to them. Therefore pretty many students answered that they felt like they were in the virtual world with the object. Though visual stimulus about virtual objects was shortage, students could feel that they were in the virtual space. Through interacting and playing with virtual objects they could feel immergence to the virtual world in television.

6. Conclusion

We have described about MR.TV, which augments current broadcast contents using Mixed Reality technology. Through seeing themselves and the virtual object together on the screen, viewers can gain advanced information and feeling about the original television contents.

Through simple experiment we made, we are sure of the possibility of MR.TV. The system is pretty simple now. But if there are more complicated interactive actions in the future, MR.TV will be able to give viewers more interesting experiences.

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