ImpactTV: Controlling Media With Physical Objects

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Abstract. People are comfortable with the notion of remote controls and have been using them to change the settings of their TV sets for a long time. However, as remote controls become more and more complicated due to the escalation in complexity of consumer electronic devices, people increasingly find themselves faced with a formidable challenge every time that they want to change their TV channels. We describe a system that solves this problem in a very creative fashion. It allows people to control their TV sets by throwing objects against them. We developed an infrastructure based on an object recognition system that permits us to relate real physical objects with different kinds of video programming. In terms of future work, we are investigating the possibility of applying the concepts behind ImpactTV to other types of media such as audio and the World Wide Web.

1 Introduction

Historically, people have always relied on some kind of control device to change TV channels. Even though most people became familiar with the notion of having a remote control as a means to control their TV sets, most people have great difficulties when it comes to pressing the right button in the ultra modern remote controls of today. We present an interface to control the settings of a TV that removes the need of a remote control altogether and that can be easily used by anyone.

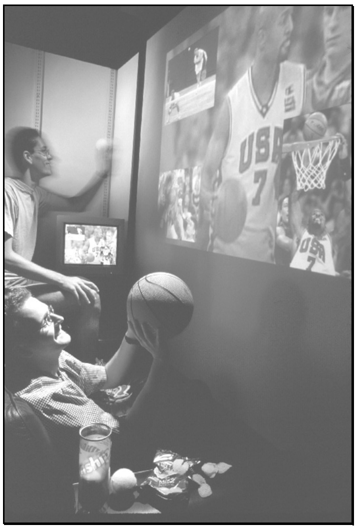

Fig. 1. Our ImpactTV system at work

2 Method

We propose the creation of a system that allows people to control their TV sets by throwing objects against its screen.
From a practical point of view, a typical CRT or LCD screen would not be able to sustain the impact of objects thrown against it, so we developed a special projection system together with a wooden board that works perfectly given the requirements of our system. As previously programmed objects are thrown against the screen, the TV set could change one or more of its settings and also the current channel that is tuned to.

3 Implementation

The entire ImpactTV system consists of 4 components: a video projection subsystem, a video screen, a sound detector and an object recognition subsystem.

3.1 Video projection subsystem

The ImpactTV video projection subsystem is made of a standard projector, a set of polarized lenses and a video generator.

3.2 Video screen

The ImpactTV video screen is nothing more than a wooden board mounted on the wall. Since it would not be possible for users to throw heavy objects against a real video screen, we decided to project our video signal against a board that could easily withstand a significant amount of physical stress as objects were throw against it.

3.3 Impact sound detector

The impact sound detector is composed of two inexpensive electret microphones, an audio conditioning circuit and a simple RS232 communication system built with a standard PIC microcontroller.

3.4 Object recognition subsystem

Our object recognition subsystem consists of a video camera, a set of polarized lenses and a pattern recognition software application written using the Isis graphics framework developed by Stefan Agamanolis [1].

4 Discussion

In general, computer vision techniques require algorithms that consume lots of system resources. Since we need to recognize objects only at specific points in time, we designed a special sound detecting circuit with inexpensive microphones that activates our pattern matching software program and video camera only when objects are thrown against our video screen.

The microphones are positioned behind the video screen, in parallel and in contact with the back of the video surface. The physical positioning of the microphones behind the video screen turns out to be essential as the microphones are only able to detect the noise of the objects as they hit the screen and not the audio track of the video being projected against the screen. Whenever an object hits the video screen, the microphones generate a small but detectable electric signal. This electric signal is then conditioned and sent to an on-board microcontroller. The purpose of the microcontroller in the circuit is to detect an impact by means of the conditioned microphone signals and then notify the object recognition subsystem that an object has just been thrown against the video screen through a simple RS232 serial data exchange.

When the object recognition subsystem is notified that an object has just hit the video screen, it is responsible for taking a picture of the screen and the object that was hurled against it using its video camera. The video camera is mounted on the ceiling, right in front of the video screen. A picture is taken at the exact moment that an object hits the video screen, therefore and most importantly, not only is the video screen in the picture but also the object that was thrown against it. The picture is then redirected to our pattern recognition program to be analyzed.

It is important to mention that the polarized lenses of the object recognition subsystem are used in conjunction with the polarized lenses of the video projection subsystem. The polarized lenses are used to filter out unwanted reflected light and glare that affects the performance of our visual pattern matching algorithms. The polarized lenses are added both to the lenses of the projector and to lenses of the video camera.

Our object recognition software application examines the pictures taken by the video camera and distinguishes different objects thrown against the video screen by size and by color. We have managed to easily recognize up to 5 different objects with very little effort. As objects are identified by our software, a simple TCP/IP communication channel is established between our object recognition subsystem and the video projection subsystem. The object recognition software application associates the different objects that it is capable of recognizing with different Ids. These different Ids are then sent to the video generator according to the object that was thrown against the screen.
The video generator itself is just a computer that outputs a video signal to the video projector. The generator changes its video output depending on the type of the object that was thrown against the screen.

An important aspect of our system that is worth mentioning is that the objects themselves do not have to be altered in any way to function with ImpactTV. We would just have to train our object identification algorithms to recognize new objects by their natural physical dimensions and associate these new objects with different channels or video signals.

5 Conclusion and Future Work

Our system was originally designed for an open house here at the MIT Media Lab and it worked wonderfully. People were surprised and thrilled with the idea of throwing objects against a TV screen to change the type of programming that they could watch. Not surprisingly, our system was especially popular with kids and we are studying the possibility of developing a game for kids with the infrastructure that we built for ImpactTV.
In terms of future work, we are currently exploring the concept of ImpactTV with audio and web content as well. Instead of having to bookmark web pages, people could simply associate different physical objects with different World Wide Web pages. In this case, different objects would behave as physical bookmarks to locations on the Internet.

References

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