MythMote: Alternative Remote Controllers for Television

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ABSTRACT

In this paper we analyze the viability of alternative gesture and motion based remote controllers for conventional television sets. Our prototypes are realized using the Nintendo Wii Remote and they intuitively map hand motions to common control signals for a TV. We also present the results of a controlled user study evaluating the different control interfaces with respect to factors like ease of use, intuitiveness, speed and accuracy. The results indicate that a hybrid remote controller combining button and gesture based input methods is preferred by most users over any other solitary input method.

INTRODUCTION

The Television is one of the most widely used electronic entertainment mediums in the world. According to a survey conducted by the A.C. Nielsen Co. in 1998, the average person in the US watches more than 4 hours of TV every day [1]. There have also been numerous case studies in the past [2,3,4,5] that have exposed the increased health risks due to the physical inactivity while watching television. This work of ours is intended to address this very fact in trying to design an appropriate "active" remote control for TV sets of the future that also appeals to different sections of the TV watching population.

Television remote controller design and the buttons-based interface has not changed much since the days of the first remote developed by Zenith Corporation in the early 1950s [6]. With the significant advances made in human computer interfaces over the years, we believe it is time to rethink the way we control our TV sets. The Wii Remote (Wiimote for short) was introduced in late 2005 as a motion based controller for the Nintendo Wii gaming console. The popularity and attention it has received show us that there is a clear market demand for such control devices. Also, the encouraging results from studies [7] on WiiFit, an exercising video game developed by Nintendo, is compelling enough to apply the principles to television watching as well.

Our system (MythMote henceforth) consists of several hardware and software components that interact to accomplish the task of controlling a television through gestures and buttons. We use the Wiimote as our primary control device owing to its low cost of procurement and the availability of open source programmable libraries to re-purpose it. The gesture-only input prototype remote control samples motion data from the accelerometer in the Wiimote periodically, feeds it over a bluetooth connection to a gesture recognition toolkit in a PC for translation into TV control commands. The hybrid input prototype remote control combines the recognized gestures with button press events to contextually map the combinations to TV control commands. Finally once the command has been determined, we issue it to a software TV application like MythTV through interprocess communication. We also used a conventional infra-red receiver/remote control pair in our study for comparison with the other two methods.

The primary contributions of this paper are four-fold:

(I) The design and implementation of a purely gesture based TV remote control using the Wiimote.

(II) The design and implementation of a hybrid TV remote control that combines accelerometer based gesture recognition and contextual button press capabilities.

(III) An intuitive, contextual mapping of motion and button press actions to TV controls.

(IV) A qualitative evaluation of the different remote controllers.

RELATED WORK

There has been no real attempt to incorporate Wiimote gestures and IR input into MythTV, however there has been a guide made to use the regular buttons on a Wiimote. Although there has been much work done in the area of

hacking the Wiimote, there has not been anything to control a television cable UI via gestures. The current work falls into two major categories: button mapping, and sensor control. In all of these approaches the Wiimote itself is used as the control device. The button mapping category is simple enough, the Wiimote is linked to the PC and the buttons are mapped using Bluetooth communication. The button mapping can be used in a number of different applications. One such application is in conjunction with a game emulator to play emulated console games on a PC [12]. The sensor control category is used in conjunction with the button mapping to use the wiimote as a computer mouse substitute. The accelerometers on the wiimote are used exclusively to affect mouse movement through tilts of the wiimote. The infrared camera is also used exclusively as a point and click device. There are several people who have done this in several different ways as documented in [13], [14].

There have been few studies on remote controls for television sets and set top boxes. The first known gesture based control system was developed by Enns et.al. [17] who found that the system was not entirely applicable to people of all ages. This lays the basis for simpler intuitive gestures and retaining the button based control interface. Lessiter et.al. [15] study three popular button based remote controls in the UK. They use metrics like difficulty, accuracy, timing and attractiveness to evaluate them for participants of different age groups. The study also finds that older people of 75 years of age or more have difficulty with the conventional button based remote primarily due to the small button and text markings on them. Berglund et.al. [16] study a paper and pen based digital TV guide navigation system. They propose and develop a digital pen & paper based remote where users interact with the television using tick marks. They find that the intuitiveness of pen and paper was the primary motivation for participants to adopt this new technology.

IMPLEMENTATION

Both of our remote controller prototypes were built on a standard PC running Ubuntu Linux 8.04 with a Pinnacle PCTV HD 800i TV tuner card. The MythTV 0.24 [18] software TV application was built from its latest source code.

Our first prototype gesture-only remote control consists of three primary software components: the Wiimote Bluetooth interfacing module, the Accelges gesture recognition module, and the MythTV Wiimote Controller Class Module. Bluez open source stack was used as the Bluetooth driver. For the Wiimote Bluetooth interface, the open source C Linux Myth Library CWiid [8] was used. The Wiimote sends USB HID format reports [11] periodically with the status of its buttons, data from the accelerometer etc. The CWiid library intercepts these reports and passes it on to the gesture recognition module. Accelges [9], an open source Google Summer of Code project, was used for the gesture recognition. The gesture recognition toolkit had to be trained to recognize different gestures. Communication between the gesture recognition module and MythTV was established using D-Bus [10], an open source interprocess communication service for Linux.

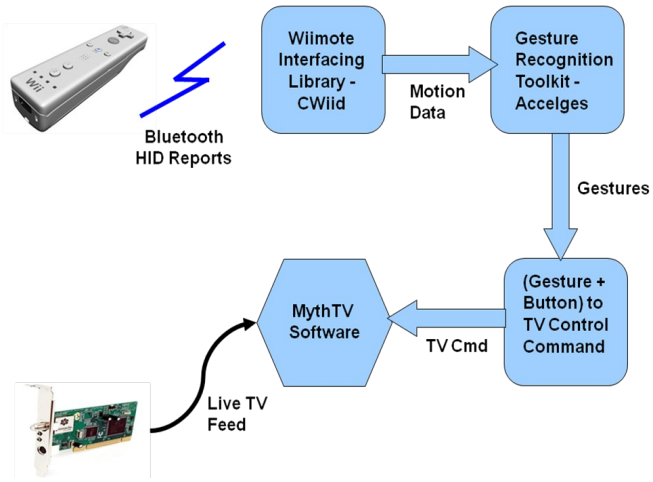

Figure 1 - General MythMote System Architecture

Our second prototype, the hybrid gesture and button based remote control was implemented using the Python programming language. Interfacing with the MythTV software was done using simple Telnet commands supported by MythTV. The table below shows a mapping of button and gesture data to TV control commands:

Table 1. Gesture Remote Controls

Gesture	MythTV Menu Navigation
Swing Left	Navigate Left
Swing Right	Navigate Right
Swing Up	Navigate Up
Swing Down	Navigate Down
Poke Forward	Push Menu Item
Swing Diagonal	Escape Current Menu
Swing Up	Volume Up
Swing Down	Volume Down
Swing Right	Channel Up
Swing Left	Channel Down
Swing Diagonal Up-Right	Fast Forward

Swing Diagonal Up-Left	Rewind

This mapping was chosen because they are in the natural directions one would make. Select is chosen by literally moving your hand towards the screen, as if to poke the screen choice.

Table 2. Hybrid Remote Controls

Gesture	MythTV Menu Navigation
Hold B, Move Left	Navigate Left
Hold B. Move Right	Navigate Right
Hold B, Move Up	Navigate Up
Hold B, Move Down	Navigate Down
Press A	Push Menu Item
Press Home Button	Escape Current Menu
Arrow Up	Volume Up
Arrow Down	Volume Down
Hold B, Swing Right	Channel Up
Hold B, Swing Left	Channel Down
Hold B, Twist Right	Fast Forward
Hold B, Twist Left	Rewind

With these controls, navigation through menus and playback was much more fluid. Menu navigation attempted to mimic click and drag, and rather than a button press or gesture for every up or down, a fluid pointing motion was used. Buttons were placed where the team felt it made sense, and gestures were only used where it was felt the user experience would be improved.

EVALUATION

For the evaluation, we chose several common TV interactions in MythTV. We would ask users to change the channel up or down, turn the volume up or down, rewind, fast forward, use the guide to navigate to a channel, and use the menu system to open a video. These interactions were done 3 times in a row to see how quickly they became familiar with the controls. Users were first given a demonstration as to how these interactions were done with each remote, and then given a manual for reference.

The users were evaluated in several ways. Their interactions were all timed from instruction to completion of the task. Also, they were observed in the following areas: how many times they looked down at the remote, made mistakes, or had to check the guide. After, the users were given a questionnaire about their experience. Finally the users were asked to rank the remotes in order of which they would prefer to use. Five users in total were evaluated, all 20-25 years of age.

RESULTS

The qualitative and quantitative results from the experiment are shown below.

Qualitative Results

Button Remote

With the button remote, users did not look at the manual once. However, for every interaction, the user would still glance down at the remote. After the glance, each action was carried out very quickly with few mistakes. Even the second and third times through the interactions, the users still glanced down at the remote regularly.

Gesture Remote

The users again did not have to use the manual very often, nor did they have to glance at the remote. However, there were many mistakes made, and the interactions were physically frustrating to the user. Each interaction with this remote took many times longer than any other remote, and navigating the menu and guides were very difficult.

Hybrid Remote

With this remote, users often looked at the manual the first time though. However, in repetitions, the users rarely looked at the manual or the remote, and had few mistakes.

Quantitative Results

The quantitative results are shown below in Table 1.

Table 3. Quantitative Results

Metric	Button	Gesture	Hybrid
Avg Time/Interaction	6.8s	35.6s	4.2s
Avg Looks Down	24	3	6.2
Avg Mistakes Made	0	12	0.4
Avg Manual Reference	0	0.2	6
Avg Rank	2	3	1

The real difference in Average Time per Interaction came from menu and guide navigation as those were the lengthy actions. The Gesture Remote fell far behind here, while the Hybrid ended up being the most intuitive. In terms of Looks Down, the Gesture remote was the clear winner. However, this did not mean it was the easiest to use, as the looks down for the button and hybrid were quick glances that the

user is so accustomed to, that it may feel like second nature. Mistakes were made very regularly with the Gesture remote, while manual references were common in the initial stages of the Hybrid Remote.

DISCUSSION

The results clearly show that a purely gesture based remote is not wanted. The button remote that users were familiar with was as expected; users adapted quickly to the remote. However, the fact that users still had to look down at the buttons was telling, the users were used to it but it was still an unnecessary step. Also, the button remote gave a very standard user experience which users did not react to emotionally.

Problems from the gesture remote generally came from the menu navigation. Having to constantly swing up or down to move down one spot was not comfortable.

In complete contrast, users found the hybrid remote to be very easy for menu navigation and selection. As TV's add more and more content functionality, this will become increasingly important. With the hybrid remote, users were visibly happy to see the results. They enjoyed using the remote, and this was shown in the exit poll as it was unanimously chosen as the preferred remote. Also, users found the fast forward and rewind actions of the hybrid remote to be fun. They often said things like "cool."

FUTURE WORK

Now that the hybrid remote has shown favor over either of the other two control schemes, the hybridization itself must be studied and improved. Future user studies will focus on certain aspects of the hybrid control scheme to see if in fact the gesture or button based control is better in specific situations. As the television offers more functionality to the user the remote must keep pace. New features such as Netflix, movie times, and weather updates are being incorporated into the television viewing experience. Control for these features must be incorporated into the remote and then again studies will be conducted to find the most appropriate control approach. As the content and functionality changes the remote that controls it must constantly evolve, one day it may even move out of the realm of a hybridization of gestures and buttons.

CONCLUSION

The team has felt that a new and intuitive remote system in the Hybrid remote was found. Users were unanimous in picking it as the remote they would like to continue to use. Though there are many improvements that can be made, it is a good step towards the next iteration of television remotes. A purely gesture based remote was also found to be a poor choice due to difficulty in navigation.

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