Tai-hoon Kim Hojjat Adeli
Dominik Slezak Frode Eika Sandnes
Xiaofeng Song Kyo-il Chung
Kirk P. Arnett (Eds.)

LNCS 7105

Future Generation Information Technology

Third International Conference, FGIT 2011 in Conjunction with GDC 2011 Jeju Island, Korea, December 2011, Proceedings

Design and Implementation of a Remote Control for IPTV with Sensors

Jae Ha Song[1], Woo Yeol Kim[2], Hyun Seung Son[2], Junbeom Yoo[3], Jae Seung Kim[2], Robert Young Chul Kim[2], and Jung Hun Oh[1]

[1] Deptartment of Embedded System, Baron Co. Ltd., Siheung-si, Korea
{songjh3218,1190JH}@paran.com
[2] Dept. of CIC(Computer and Information Communication), Hongik University, Jochiwon, 339-701, Korea
{john,son,jskim,bob}@selab.hongik.ac.kr
[3] Department of Computer Science and Engineering, Konkuk University, Seoul, 143-701, Korea
jbyoo@konkuk.ac.kr

Abstract. Existing TV remote controls using relative coordinates have some difficulties in selecting various types of IPTV content. This paper proposes an absolute coordinates based remote control to make the selection of IPTV channels more convenient. It uses a laser pointer to point at an IPTV, a camera mounted the remote control to locate the spot pointed at, and control software to calculate the absolute coordinates of the spot pointed to on the screen.

Keywords: IPTV, Remote Control, Absolute Coordinates.

1 Introduction

Internet Protocol television (IPTV) [1] is a system through which digital television service is delivered using internet protocol, while other TVs use traditional radio frequency broadcast or cable television formats. IPTV provides various services via two-way communications, such as VOD (Video On Demand), shopping, online video games, singing rooms and chatting as well as TV channels [2-4]. It needs a set-top box for the IP based services and an advanced remote control to utilize the services easily and efficiently [5].

While the latest set-top box technologies have offered a number of interactive services, the remote controls have found some difficulties in keeping up with them. They just provide additional arrows buttons for moving a cursor, and it makes the interactive selection of contents difficult [6-8]. When pressing an arrow button, the cursor does not move directly to the point or contents on the screen which a user wants, but moves to the content next to the current one. It creates the need for a number of button presses and inconvenience.

T.-h. Kim et al. (Eds.): FGIT 2011, LNCS 7105, pp. 223–228, 2011.

The paper is organized as follows. Section 2 discusses related work on existing IPTV remote controls. Sections 3 and 4 explain the design and implementation of the proposed remote control, respectively.. Section 6 concludes the paper.

2 Remote Control for IPTV

IPTV remote controls can be divided into 3 types: remote controls with a number of buttons; multi-function remote controls with a touch screen; and motion remote controls with internal motion sensors.

A button type remote control, such as the hanaTV remote [9], is easy to implement since it is the same as the existing remote controls. It however has some drawbacks. It is difficult to update as new functions, contents and channels are added. It is also too slow for users to move the cursor into the location where he wants, since he has to push arrow buttons several times.

Touch screen type remote controls were proposed by Caviar [10] and Harmony1000 [11]. Caviar used a 3.5 inch touch screen, but it was too expensive for use as an IPTV remote control. Logitech Harmony1000 is an integrated multi-media remote control with a 3.5 inch touch screen like the Caviar. The difference is that the Harmony can be updated through the Internet. The updating procedure however is complicated for general users to manage. It uses a joy-stick for cursor movements instead of buttons.

A couple gyro sensor installed motion remote controls are the Wii remote [12] and the Magic motion remote control [13]. The Wii remote for the Wii game console is a type that is controlled with the use of an acceleration sensor. The acceleration sensor is installed internally so that the control is possible with different motions. For example, circling and crossing movements are translated into the execution of selecting and canceling. The Wii remote is mostly used for gaming content. The Magic motion remote control is for Xcanvas by LG Electronics. Like the Wii remote, the Magic motion remote control with an acceleration sensor can control screen shifts and movements. However, both products rely on a relative coordinate system which lacks direct selection from the objects on the screen.

3 Design of Remote Control

As seen in Figure 1, the system to control the contents of an IPTV consists of a TV set, an IPTV set-top box, a wireless receiving circuit and a camera-type remote control. As for the way of operating the system, when placed at a spot aimed by the remote control, the wireless transmitter will convey the coordinate information to the set-top box. The IPTV software installed inside the set-top box receives the location coordinate aimed at by the remote control and marks the cursor on the TV screen. The set-top box will be perceived to be like a mouse, freely selecting the contents on the TV screen. In this paper, a remote control, the core out of the overall system composition, is designed and implemented.

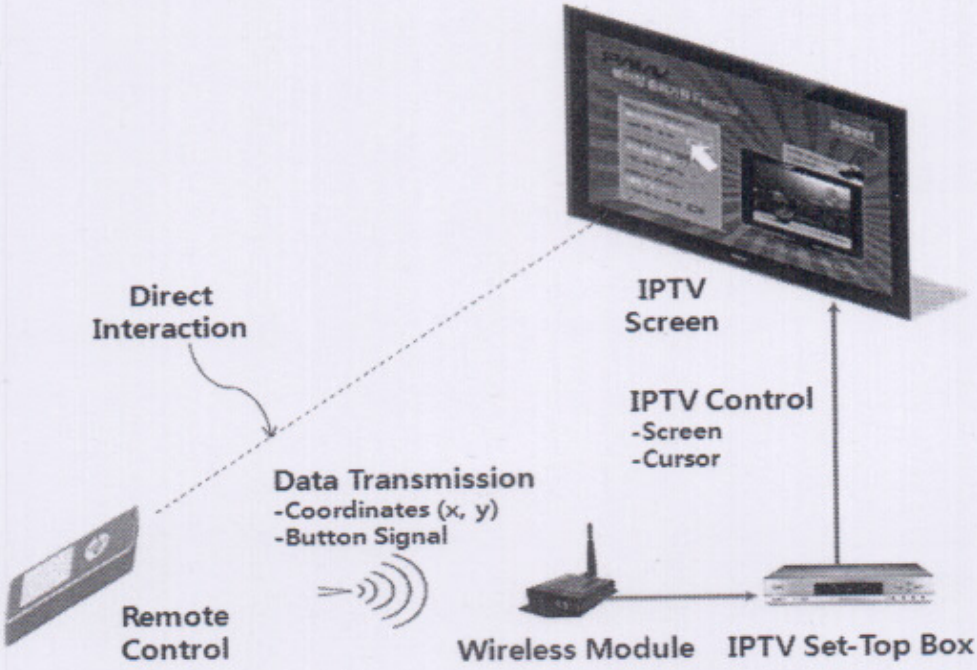

Fig. 1. The system architecture of the IPTV remote control

The camera-typed remote control consists of a CCD camera, an A/D convertor, FPGA. MCU and a wireless transmitter, as shown in Figure 2.

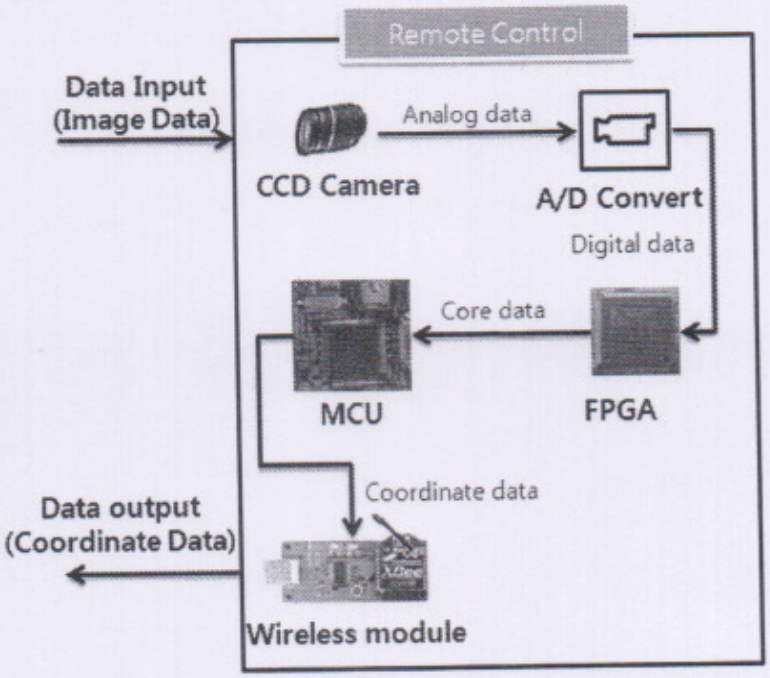

Fig. 2. H/W architecture for a remote control based on a camera

The image signals produced are generally analog signals, but in the case of a small-sized camera built into a cell phone, they are digital image signals. When choosing a digital camera outputting digital image signals, it is not necessary to design an additional A/D transformation circuit. On the other hand, a CCD camera is usually

analog, so it needs an A/D converter. In the case that a camera with a 1280 × 1024 resolution outputs images at 15 times per second, it is required to choose a FPGA able to process 8 bit data at over 30 MHz speed.

The FPGA plays a role in receiving the camera image signal data and extracting the core data. The MCU calculates the point coordinate aimed at and transmits the coordinate and button signals calculated to the set-top box through the wireless transmitting circuit. The remote control proposed can be completed by designing and assembling hardware and firmware, such as a camera, a lens, FPGA, MCU, and a wireless transmitting circuit in a proper case.

4 Implementation of the Remote Control

To implement the remote control, the IR filter is built in the front of the lens as shown in Figure 3 so that only images in the infrared-ray domain can be accepted as input into the camera in the front of the remote control. Since both interior and exterior images of the TV set correspond to the domain of visible rays, it will be easy and simple to extract the location of the TV screen in the case of using the infrared-ray LEDs as particular marks.

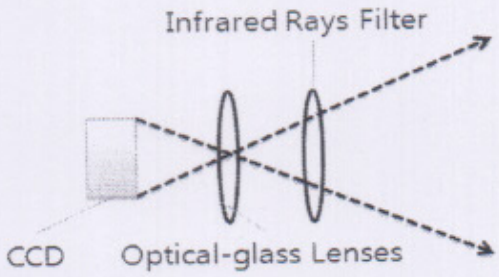

Fig. 3. Optical Composition of the Camera to Perceive Particular Marks

The wavelength of visible rays is defined to below 700 nm, but in other cases, it can be defined to be 750 nm or even below 800 nm. For example, if the wavelength of the infrared-ray LED is 770 nm and the IR filter passes wavelengths over 750 nm, the luminescence domain of the infrared-ray LEDs should be perceived to be brighter. In an actual circumstance, there exist visible rays over 750 nm, so there may exist a low brightness illuminated domain in addition to the domain of the infrared-ray LEDs. Even though it is less bright than the luminescence domain of the infrared-ray LEDs, any domains with a little illumination can be obstacle factors in the process of extracting only the domain of the infrared-ray LEDs. To prevent the visible rays from going into other domains as much as possible except for the particular marked domains, it is required to use infrared-ray LEDs with wavelengths over 800 nm and set the wavelength of the IR filter to over 800 nm. Since a camera mostly perceives the domain of visible rays and infrared wavelengths below 1,000 nm, the wavelengths of the infrared-ray LEDs and IR filter need to be set to over 800 nm and below 1,000 nm. Wavelengths of 850 nm for the infrared-ray LED and of 800 nm for the IR filter should be chosen for the proposed remote control.

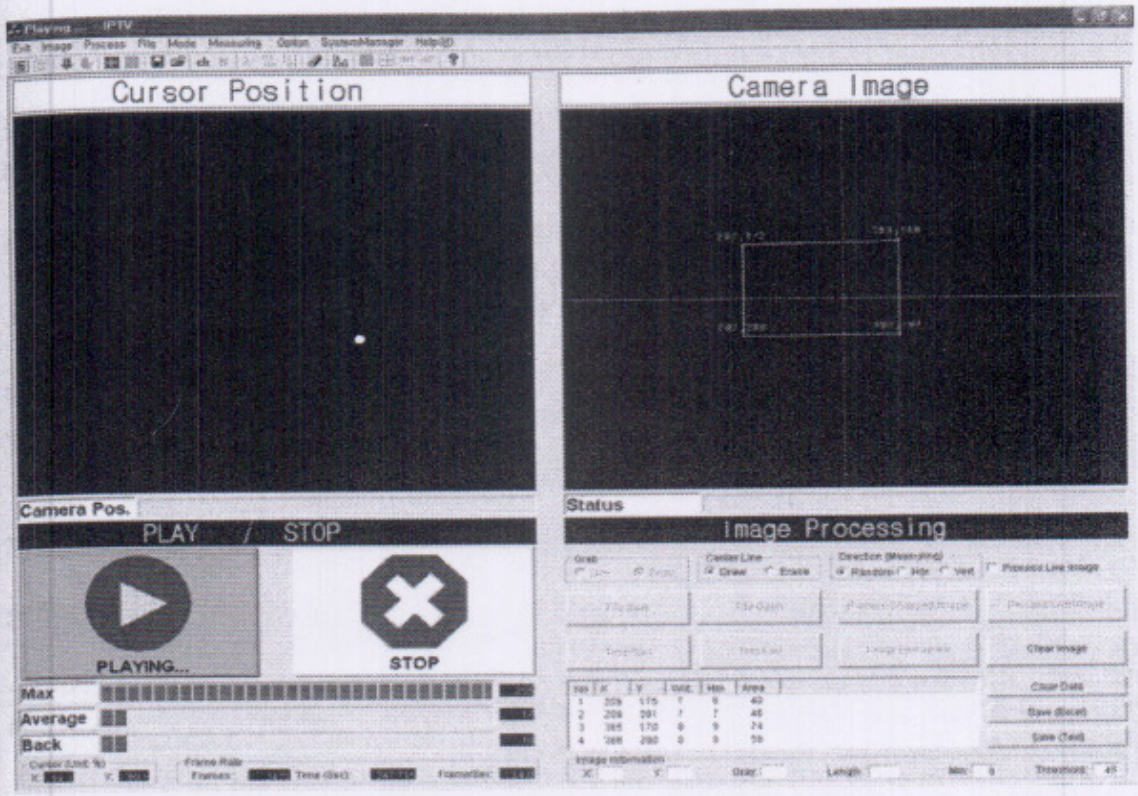

Fig. 4. GUI of the software for IPTV

Figure 4 shows the prototype implementing the software designed. On the left side is marked the coordinate of the screen cursor on the screen, and on the right side is the image information input from the camera on the screen.

5 Conclusion

IPTV (Internet Protocol Television) provides a variety of two-way services, such as a VOD service, a TV home shopping service, on-line games, a singing-room service and an internet chatting service, in addition to the existing TV channels. With existing remote controls it is difficult to easily select among the hundreds of types of content available through IPTV.

To solve this problem of the existing remote control technology, this research designed and implemented a new remote control for IPTV based on absolute coordinates. The remote control methodology is to install four infrared-ray LEDs on the TV set and to calculate coordinates through a real-time analysis of the images taken by the camera. For this process, an algorithm was developed to create coordinates with the input images from the camera by using trigonometric functions and an equation to calculate the distance.

Acknowledgments. This research was supported by the MKE(The Ministry of Knowledge Economy), Korea, under the ITRC(Information Technology Research Center) support program supervised by the NIPA.(National IT Industry Promotion Agency(NIPA-2011-(C1090-1131-0008)))

References

1. Yang, X., Xiaojiang, D., Jingyuan, Z., Fei Hu, G.: Internet Protocol Television (IPTV): The Killer Application for the Next-Generation Internet. IEEE Communications Magazine 45(11), 126–134 (2007)
2. Kerpez, K., Waring, D., Lapiotis, G., Lyles, J.B., Vaidyanathan, R.: IPTV service assurance. IEEE Communications Magazine 44(9), 166–172 (2006)
3. Ji-Eun, L., Minsoo, S.: The role of public services in the convergence era: IPTV case. Info. 12(1), 39–53 (2010)
4. Montpetit, M.J., Klym, N., Mirlacher, T.: The future of IPTV: Adding social networking and mobility. In: 10th International Conference on Telecommunications 2009 (ConTEL 2009), pp. 405–409 (2009)
5. Ortiz Jr., S.: Phone Companies Get into the TV Business. Computer 39(10), 12–15 (2006)
6. Dan-Hee, Y.: IPTV Service and Improvement in Korea. Review of Korean Society for Internet Information 8(1), 23–28 (2007)
7. Enns, N.R.N., MacKenzie, I.S.: Touchpad-based remote control devices. In: Proceeding CHI 1998 Conference Summary on Human Factors in Computing Systems (1998)
8. Jana, R., Yih-Farn, C., Gibbon, D.C., Yennum, H., Jora, S., Murray, J., Wei, B.: Clicker - An IPTV Remote Control in Your Cell Phone. In: 2007 IEEE International Conference on Multimedia and Expo, pp. 1055–1058 (2007)
9. hana TV, http://www.hanatv.co.kr
10. utas, http://www.utas.co.kr
11. Harmony1000, http://www.logitech.com
12. Wii remote, http://www.nintendo.com/
13. Magic motion remote control, http://www.xcanvas.co.kr/