Lightweight Inter-device Interface Control System for the Machine-to-Machine(M2M) Interaction in the Internet of Things

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1. Introduction

With the development of IT technology, various screen devices such as mobile phone, smart TV, digital signage are installed in widespread use. As they are connected to the network, it is now possible to also consume itself different types of content. In particular, people would like to use the same content or application on the any devices. Therefore, Multi-screen services which can move and share content to other devices are required gradually.

In the past, TVs were limited to consumption of the multimedia content from the broadcast center. But recent smart TV installed web browser can handle web contents and offers more interactive services. In order to control those services the conventional remote controller should have dozens of small buttons and more complicated. Conversely, multi-touch interface is a useful tool in that environment. However, the touch interface on a large screen is very expensive and requires high performance hardware. In this paper, we propose a remote control scheme to perform interaction in a very large distant screen conveniently using multi-touch interface in the mobile phone.

The rest of this paper is structured as follows. Section 2 briefly explains related works. Section 3, we present the system architecture between a mobile phone and a large screen. Section 4 describes the message flow of interacting multi-devices and the prototype of proposed system. Finally, we present the concluding remarks and outline the future work directions.

2. Related works

Interaction between remote devices and mobile phone is not a new topic. Generally, Virtual Network Computing (VNC) which is commonly remote screen sharing tool used and remote desktop on the window platform are good examples [1,2,3]. Ruan et al. introduces a cursor control technique: namely, TouchInteract providing various functionalities such as cursor positioning, object selection and text input using touch screen in mobile phone [4]. On the other hand, to provide multi-screen service, L. Bassbouss proposes web-based application model that allows develops to focus on the implementation the service itself and not on consideration about multi-screen functionality [5]. Our system targets multi-screen service and can support collaboration with multiple devices through exchange various web contents.

3. System Architecture

As seen in Figure 1, remote control system we proposed is composed of a mobile device for transmitting control events and a remote screen containing interactive contents. The remote screen such as PC, smart TV is equipped with a web browser. In order to move and share contents between heterogeneous inter-devices freely we are targeting to the web content. Thus, the screen is operated on the web platform and its related control module is implemented with a web browser plug-ins like Chrome or Firefox extension that extends the functionality of a web browser. UPnP connection module in the screen has been implemented as a plug-in of NSAPI (Netscape Server Application Programming Interface) base to be able to work with.

The mobile terminal is formed by a control module that generates a message or analyzes user input events and the image recognition processing module for using a built-camera to recognize the remote screen. To transfer the user event information between devices, UPnP protocol is used the mobile phone and the screen.

As recognizing the region of a distant screen from the mobile device, the device receives a user input event through the touch interface in a shooting state of the camera. User events are identified from the touch screen. After converting the input event available on a large screen such as a keyboard and a touch event, event simulator in the web browser extension generates a virtual input event. The method can give the same effect that user handle contents on the touch panel in the remote screen.
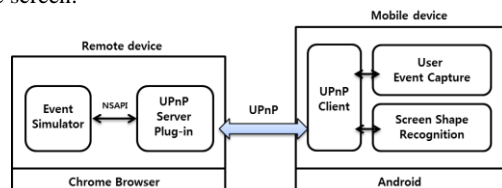

Figure 1. The architecture of the remote control system

4. Overall System flow

Figure 2 illustrates the overall flow of our system. Message broker that only relay messages between devices can be located within remote screen or other systems. First, remote screen device is connected with the message broker and send the size of screen. User also connects to the broker and checks whether there is a remote screen can be handled. Mobile device receive the information of screen size if it exists. And it can recognize a shape of rectangle though image processor with the image of camera. After mapping between recognized region and real screen, it can calculate real position of remote screen. Therefore, when user touches or makes gesture in the mobile screen, it will interpret the events and send the type as well as position information of them.

Figure 3 shows how to control some contents on the remote screen using mobile devices. Their devices contain image recognition processor as we mention above which can identify the shape of rectangle for markless objects. The processor is implemented with OpenCV library and designed for selecting maximum size among the identified candidates with rectangle-type. When it finds the screen green lines will be displayed in the mobile screen. After that, user can take contents what he wants at a long distance or send various gesture data such as long-touch, page up/down, selection of screen mode etc.
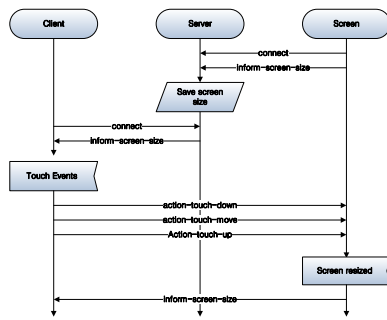

Figure 2. Message flow of system

Figure 3. Remote control and share web contents

5. Conclusion

In this paper, we proposed a method for controlling the contents of the screen in using a mobile terminal remotely. To implement the method we describe a remote control process using the mobile device containing screen image recognize module. In general, remote desktop protocol (RDP) should be equipped with extra streaming server on the main screen device and the data traffic on the network also increases. However, in the case of the interaction technique we presented, there are some advantages that the proposed method can minimize the transmitted data between devices and offer an intuitive interface in a very similar way as user handles a large display equipped with touch-screen.

6. Acknowledgement

7. References

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