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Virtual Teratak: A 3D Home Control and Entertainment System

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Abstract

Virtual Teratak, a 3D virtual home navigation and control system is designed and developed to complement or replace existing remote controls, allowing home users to control network-connectable devices such as controllable lights, televisions, fans, etc. easily and conveniently with Android-based smartphones. The system is augmented with actual photos of the home so that users can control home devices more intuitively. A 3D virtual home navigation interface is also implemented with WebGL and HTML5 running on web browsers, which enable the users to have a more immersive experience in controlling their home appliances. Users can thus navigate the 3D virtual home, touch the 3D virtual appliances and control the actual appliances easily. Virtual Teratak has been successfully implemented and integrated into the Digital Home located within Multimedia University, Malaysia.

Keywords: 3D virtual home, interactive home control, smartphone.

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1. INTRODUCTION

Controlling home appliances such as televisions, DVD players, music players, lamps, fans, etc. has become part and parcel of the daily activities for home users in today's modern lifestyle. These devices usually come with their respective remote controls operating via infrared signals. Consequently, the number of devices to be managed becomes unwieldy as these individual remote controls, although similar in appearance, are often incompatible with each other. Thus, it can be very confusing for users to determine which controller belongs to a particular device. Furthermore, users have to take considerable times to familiarize with the various different layouts of each remote control in order to access the necessary functionalities. In most cases, trial and error button pressing is an inevitable phase prior to achieving the intended outcome.

In order to address these inconvenient experiences, the Virtual Teratak[1] is designed and implemented to provide a more convenient and natural way to control home devices through smartphone technology. The system eliminates the need for multiple different controllers of these home appliances. Instead, it provides users with a 3D virtual home environment and ubiquitous access to home devices in every room, simply by touching one screen. Two versions of the application have been developed: one for computers with touch screens and another for Android phones.

The paper is structured as follows: Section 2 discusses related work: the universal remote control, the integrated media centre, and 3D content for web browsers; Section 3 presents the design, implementation and discussion of Virtual Teratak. The paper ends with the overall conclusions and discussions on future work.

2. RELATED WORKS

Most of today's consumer electronic devices are equipped with either the legacy IR-based remote controls that are dedicated to the specific devices [1] or the Universal Remote Controls (URCs) that combine functions of individual remote controls into a single interface. The latter is gaining popularity– as it reduces the number of physical controllers needed. However, the complexity of the layout and the functionalities of this integrated controller are increased significantly. Users have to remember the function of each button on the URC for different controlled devices. Two types of URCs available are: button-based URCs and screen-based URCs. Button-based URCs use dedicated buttons for selection of appliances, where each button corresponds to one appliance. One of the disadvantages of such URCs is the number of appliances supported is limited by the number of dedicated buttons available on the control panel. On the other hand, screen-based URCs provide a small built-in display and navigation buttons for users to select and control appliances.

Apart from URCs, integrated media centers, such as Crestron [2], LinuxMCE [3], AMX [4], etc., have been used to control home appliances with portable computers communicating via the home network. Portable computers provide a larger display at the expense of reducing portability as compared to URCs. In recent years, smartphones and tablet computers such as the Android tablet, iPhone, Blackberry, etc. have also been adopted in home controlling to provide an adequate display size while maintaining the flexibility offered by URCs. Smartphones and tablets have their own operating systems and can run customized applications for various purposes, such as playback of movies and music, surfing the Internet, gaming and so on. In fact, some research prototypes were developed by universities that used smartphones for users to control and monitor home appliances conveniently [5,6].

Over the years, the role of the World Wide Web has evolved extensively from information browsing and distribution, to social networking activities, office applications, gaming and so on. The Web content has also evolved from simple text and images to a myriad of multimedia content including audio, video, 3D graphics, etc., through various plug-ins to web browsers, such as Flash, O3D, VRML and X3D [7,8,9,10]. Rendering of 3D graphics without any plug-ins is also possible through WebGL, a cross-platform web standard for hardware accelerated 3D graphics by the Khronos Group [11]. WebGL allows programmatic rendering of 3D graphics on web pages using the HTML5 canvas that is based on desktop OpenGL ES 2.0. HTML5 is the 5th major improvement of HTML by the W3C Consortium, aiming to enable web browsers to run desktop-style applications and support advanced graphics elements, such as canvas and WebGL, in order to render 3D graphics.

[1] "Teratak" is a word in the Malay language for home.

3. DESIGN AND IMPLEMENTATION

The overall system architecture of Virtual Teratak is presented in Figure 1. The objective of this system is to enable the home users to control their home appliances in a more convenient and intuitive manner using smartphones or tablets. A home media server known as LinuxMCE is used in the system to provide the services of controlling and monitoring various home appliances connected through a wireless setting. Various movies are stored in the home media server itself, which is directly connected to a TV on the initial prototype. Other home appliances (lamps, fans, etc.) are each connected to a Z-wave receiver and communicate over radio frequency at the 908MHz band with a Z-wave transmitter that is connected to the home media server. Devices that support Internet Protocol (IP), e.g. the IP surveillance camera, would be accessed directly through the home network (refer to Figure 2). Customized home control applications were developed to allow users to control home appliances on Android phones and standard PCs.

FIGURE 1: Overall system architecture of the Virtual Teratak

Two versions of the Virtual Teratak home control application were designed and developed. The first version was implemented in Java and uses actual photos of the home as the interface (refer to Figure 3).Thus, it provides visual feedback of the devices that can be controlled, as well as the status of the controlled devices in a more intuitive manner. For example, to watch a movie, users simply tap on the image of the TV on their smartphone and a list of movies will be displayed for selection. The selected movie will then be streamed to the actual TV for the users' enjoyment, as shown in Figure 5. To increase the range of controlled appliances, different buttons are provided to enable the users to change the view of different locations in the home.

The second version uses a 3D virtual home as the interface for the Virtual Teratak to provide an immersive experience for users to navigate through the home and control the home devices accordingly (refer to Figure 4). It is implemented in HTML5 and WebGL so that no installation would be required as it runs on a web browser. Both versions of the Virtual Teratak provide ubiquitous access to home appliances anywhere within the home through the wireless network. Control operations that are supported include playing movies on the TV, dimming of lights,

adjusting the volume of the speakers, accessing the security IP cameras, etc., on top of the basic on-off functionality provided by other existing home automation systems. The Virtual Teratak eliminates the need to memorize the functions of the many buttons on the different remote controls prior to controlling the desired appliances.

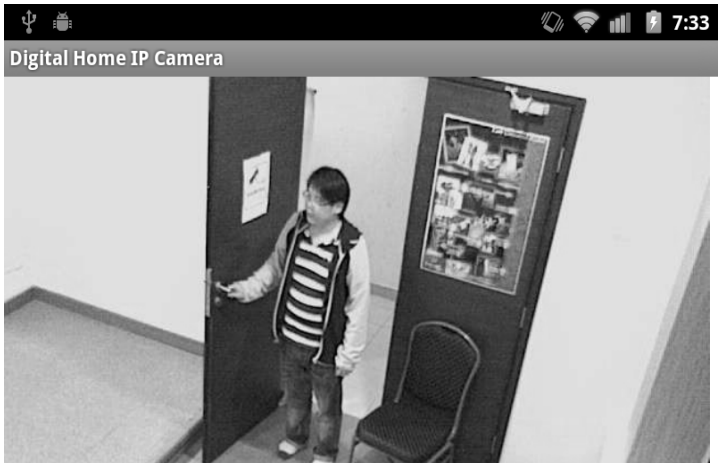

FIGURE 2: Monitoring an IP camera via the Virtual Teratak

FIGURE 3: Augmented Photo Interface of the Virtual Teratak

FIGURE 4: 3D Virtual Home of the Virtual Teratak

FIGURE 5: Controlling Home Device with the Virtual Teratak

Virtual Teratak provides many unique features that are able to enhance the user experience with respect to home control and entertainment. These include:

- **Intuitive and Easy.** Unlike many of the existing home control systems that use a standard GUI as the interface, Virtual Teratak uses a 3D model of the home, as well as real photos of the home, as the main interface for users to navigate and control home appliances intuitively. All it takes is a tap on the model or photo of the appliance of interest in the virtual home in order to control it, making the system very easy in operation. The system eliminates the need to remember the buttons on different remote controls or to search through the various buttons, graphics and plain text GUIs of existing home media servers, in order to control the desired appliance.
- **Ubiquitous.** The Virtual Teratak is able to run on mobile devices e.g., smartphones or tablets, as well as laptops and other computer-based systems, making it accessible anywhere within the home.
- **Informative.** Augmented feedback is used in the system to provide additional information on the controlled appliances, such as the current operating status of the devices.

4. SYSTEM EVALUATION AND DISCUSSION

Prototype evaluation of the developed Virtual Teratak was conducted within the Digital Home at Multimedia University, located at Cyberjaya, the first intelligent city and heart of the Multimedia Super-Corridor (MSC) area of Malaysia. The purpose of the evaluation was to obtain feedback from the users on the usability of the Virtual Teratak. The system was also showcased at the 21st International Invention, Innovation and Technology Exhibition [12] for public viewing and testing. Overall, the comments by a diverse range of evaluators and visitors were encouraging and positive, resembling those of the initial evaluation. Some visitors were concerned that the screen size of smartphones (4 inches) may not be suitable for the elderly and they recommended tablets (7 to 10 inches) to be used instead. Some visitors also raised concerns of the security issue in controlling home appliances with smartphones, e.g. what if it is stolen?

The Virtual Teratak provides an innovative solution for users to control consumer electronics devices intuitively in the home. However, there are some limitations of the system which can be summarized as follows:

- **Not Fully Platform Compatible:** During prototype testing on various smartphones, it was discovered that the existing iPhone devices were not able to render the 3D content of Virtual Teratak on their web browsers. This was due to the fact that iOS had yet to support WebGL for 3D rendering, thus Virtual Teratak would not run on devices such as iPhone, iPod Touch and iPad for the time being.
- **Wireless Connection:** Home control and 3D rendering information within Virtual Teratak is achieved through a wireless connection with the home media server. Therefore, any interruption or fault in the wireless internetworking could hinder the system from operating properly.

- **Reprogramming:** Although the configuration of the home control could be reset and reprogrammed, home users may find it tedious to carry out these tasks whenever new device is added to the system.

5. CONCLUSION AND FUTURE WORK

Virtual Teratak was designed and implemented to make it easier for home users to control their electronic devices leveraging on smartphone technology. The system provides a ubiquitous, intuitive and innovative way for users to control home appliances through augmented photos of the actual home or by navigating through a 3D virtual home. Initial evaluation of the prototype reported positive and encouraging feedback. Further evaluation of Virtual Teratak in terms of accessibility and usability would be carried out in future with a larger population of participants resembling different types of users in a home, such as the elderly, children, people with disabilities, people with minimum experience in using smartphones, etc. in addition to the average tech-savvy user. Each category of user will have different requirements and expectations of the system. Further improvement is also needed to support users with visual disabilities, including the possibility of integrating speech recognition into Virtual Teratak.

6. ACKNOWLEDGEMENT

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7. REFERENCES

1. W.K. Park, C.S. Choi, J.S. Han and I. Han. ”Design and implementation of ZigBee based URC applicable to legacy home appliances,” in Proc. of International Symposium on Consumer Electronics, 2007, pp. 1-6.

2. Crestron Electronics, Inc. “Control System for Home Automation, Campus & Building Control by Crestron Electronics.” Internet: www.crestron.com, Jul. 15, 2011 [Sep. 1, 2012].

3. The LinuxMCE Project. “Welcome to LinuxMCE.” Internet: www.linuxmce.org, Jun. 24, 2011 [Sep. 1, 2012].

4. AMX. “AMX.com – It’s Your World Take Control” Internet: www.amx.com, Jul. 16, 2011 [Sep. 1, 2012].

5. Y. Zhong, Y. Suo, W. Xu, C. Yu, X. Guo, Y. Zhao and Y. Shi. "Smart home on smartphone," in Proc. of 13th International Conference on Ubiquitous Computing, 2011, pp. 467-468.

6. S. Kartakis, M. Antona and C. Stephanidis. "Control smart homes easily with simple touch," in Proc. of International ACM Workshop On Ubiquitous Meta User Interfaces, 2011, pp. 1-6.

7. Adobe Systems Incorporated. “Flash Help.” Internet: helpx.adobe.com/flash.html, 2012 [Sep. 1, 2012].

8. The O3D Project. “WebGL implementation of O3D.” Internet: code.google.com/p/o3d/, Apr. 30, 2011 [Sep. 1, 2012].

9. VRML.org. “Virtual Reality Modeling Language.” Internet: www.vrml.org/, Jul. 19, 2011 [Sep. 1, 2012].

10. Web3D Consortium. “X3D for Developers.” Internet: www.web3d.org/x3d/, Nov. 30, 2011 [Sep. 1, 2012].

11. Khronos Group. "WebGL Specification." Internet: www.khronos.org/registry/webgl/specs/latest/, Jul. 9, 2012 [Sep. 1, 2012].

12. CIS Network Sdn Bhd. "ITEX 2012 Malaysia – 23th International Invention Innovation & Technology Exhibition." Internet: www.itex.com.my, Jul. 22, 2011 [Sep. 1, 2012].

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