

OWC based Smart TV Remote Controller Design Using Flashlight

Vinayagam Mariappan*, Minwoo Lee*†, Byunghoon Choi**, Jooseok Kim***, Jisung Lee****, and Seongjhin Choi*****

* Graduate School of Nano IT Design Fusion, Seoul National Univ. of Science & Tech., Seoul, Korea

vinayagam_m@hotmail.com, alsdnya@gmail.com

** Foundation for Research and Business, Seoul National Univ. of Science & Tech., Seoul, Korea
sechoi@seoultech.ac.kr

*** Technology Commercialization Division, Electronics and Telecommunications Research Institute (ETRI), Daejeon, Korea
kjs7205@etri.re.kr

**** Intelligent Robot System Research Group, Electronics and Telecommunications Research Institute (ETRI), Daejeon, Korea
leekk@etri.re.kr

***** Dept. of Electronic and IT Media Engineering, Seoul National Univ. of Science & Tech., Seoul, Korea
ssjchoi@seoultech.ac.kr

Abstract

The technology convergence of television, communication, and computing devices enables the rich social and entertaining experience through Smart TV in personal living space. The powerful smart TV computing platform allows to provide various user interaction interfaces like IR remote control, web based control, body gesture based control, etc. The presently used smart TV interaction user control methods are not efficient and user-friendly to access different type of media content and services and strongly required advanced way to control and access to the smart TV with easy user interface. This paper propose the optical wireless communication (OWC) based remote controller design for Smart TV using smart device Flashlights. In this approach, the user smart device act as a remote controller with touch based interactive smart device application and transfer the user control interface data to smart TV trough Flashlight using visible light communication method. The smart TV built-in camera follows the optical camera communication (OCC) principle to decode data and control smart TV user access functions according. This proposed method is not harmful as radio frequency (RF) radiation does it on human health and very simple to use as well user does need to any gesture moves to control the smart TV.

Keywords: OWC (Optical wireless communications), Smart TV, VLC (Visible Light Communication), OCC (Optical Camera Communication), Computer Vision, Flashlight, Smart Remote Control

1. Introduction

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Corresponding Author: *alsdnya@gmail.com*

Tel:+82-02-970-7081, Fax: +82-02-974-6123

Graduate School of Nano IT Design Fusion, Seoul National Univ. of Science & Tech., Seoul, Korea

The usage of smart TVs increase due to the method of media content access, the kind of application supported, and user-centered comfortable user control interfaces utilize the keyboard, voice recognition, and motion sensor methods to access media content on smart TVs. The recent emergence in ubiquitous computing power in smart TVs defines the advanced level of user navigation functions to access media content, games, education, and internet content access in the living areas [1]. These applications requirement facilitate the smart TV manufactures to focus on advanced user impressive navigation method to access the media contents. The advanced interaction method includes smart device based user control using bluetooth communication, web based user control, body gesture based user control, etc.

The available remote control interface methods allows user to access limited level navigation and not efficient to access media content as user expecting. In these days, the effective smart device based remote control interface is most user like to use to access smart TV media contents. This paper propose the effective and radiation free smart device Flashlight based remote controller design for user access through smart devices using OWC. In this proposed method, the Flashlight work as an OWC transmitter and smart TVs built-in camera work as OWC receiver. The proposed approach is emulated on two smart device and evaluated the Flashlight based OWC communication efficiency to access the media content.

2. Related Work

The digital convergence of computing and communication provides advanced smart TV platforms with ubiquitous computing capability which leads to provides many entertainment functions and advanced remote user control to access the media contents. The motion sensor based remote control is promising interface to focus on smart application operation on smart TVs [1], but the motion detection is sensitive factors to decide the user action and need more manual adjustment factor need to be addressed to different displays.

The recent smart TVs are armed with powerful software and hardware platform resource and allows user to interact more effectively using screen-sharing smart remote control system in which [2] but this kind of application more powerful application processing which may affects the normal media content rendering. The web component based runtime user interface design [3] developed for an interactive smart TV system.

The recent development focusing on user hand gestures for user interfaces of the interactive TV applications [4] shown in Figure 1, which is enough to control simple iconic only and need high computing complexity computer vision algorithm on Smart TV boxes. The long range virtual touch using smartphone based gesture recognition approach is presented [5], in this approach the smartphone must connected with smart TV to provide user interaction as well as smart phone high computational power to execute the computer vision algorithms.



Figure 1. Gesture based Smart TV User Interface

All these approaches required to have high computation capability and need to add additional HW components on smart TVs HW platform. This paper propose the novel OWC based remote controller design using smart device flashlights. In this case, the flashlight is an OWC transmitter and smart TV built-in camera is an OWC receiver.

The IEEE 802.15 developed the standard [6] for short-range OWC with data rate from tens of b/s to hundreds of Mb/s for PD and OCC. The smartphone based gate security control system using IEEE 802.15.7 PHY/MAC protocol is proposed and evaluated the door access control and user authentication using OWC is emulated and evaluated [7].

3. Flashlight Based Smart TV Remote Controller System

The traditional way to access smart TV content uses the radio waves to communicate with Smart TVs and the radio spectrum is become congested then connection radio spectrum become weak leads to failure of media content access. This paper propose the visible light based user interface design between user and smart TVs through smart device. The proposed approach simple to implement, the Smart TV HW platforms does not required to high computational power, and does not required to add any additional HW components on the Smart TV HW platforms. The proposed Flashlight based Smart TV user interface system design architecture is shown in Figure 2.

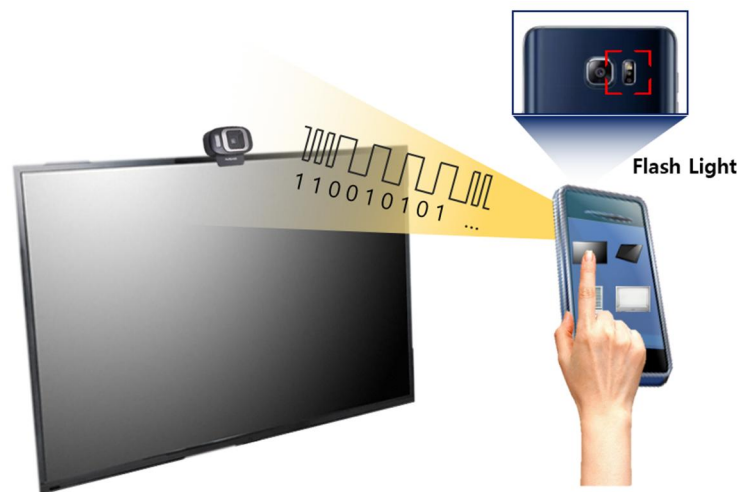


Figure 2. Flashlight based Smart TV-System Architecture

In this proposed approach uses focusable LED based flashlight as an OWC transmitter and a camera as an OWC receiver. The OWC uses the visible light communication (VLC) protocol as defined in IEEE802.15.7-2011 standard [6]. The VLC based system design research become the next generation communication based system design for potential commercial and personal space application. The flashlight based OWC transmitter is designed with components: a focusable flashlight, light controller, and light control switch circuit as shown in Figure 3.

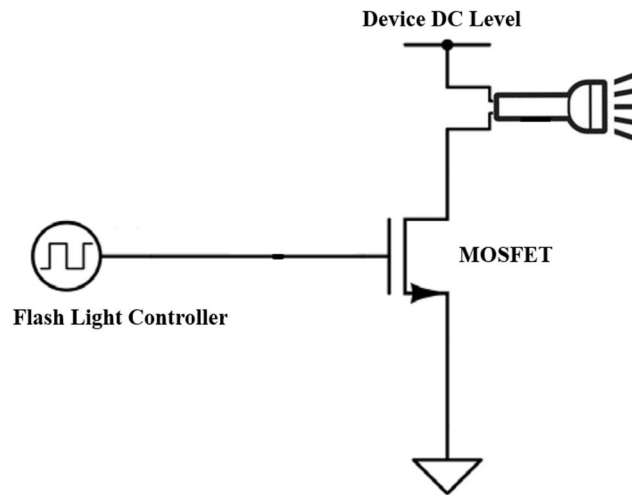


Figure 3. Flashlight based OWC Transmitter

In the smart device application, the focusable flashlight is configured to dimming the light onto a smart TV camera fused area that is simultaneously observed by a smart TV built-in camera OWC receiver application to control smart TV functionality according to the user selection. Any generic camera and LED flashlight can be integrated as components to the system with little modification beyond making the appropriate electrical connections. The flashlight needs to be focusable to allow the strength of the signal to be tuned to the distance between the light source and the intervening object. The OWC transmitter uses the OOK modulation method to encode the data to transmit over flashlight.

The OWC receiver is designed from the smart TV components: Smart TV built-in camera, and Smart TV designed base band processors. The OWC receiver computer vision method to decode the data from the camera capture image.

4. System Implementation and Analysis

The proposed OWC system for Smart TV emulation is implemented using LG G4 and VEGA smart device with customized Android based application. The LG G4 based smart device platform used to implement the flashlight based OWC transmitter and VEGA based smart device platform used to implement the camera based OWC receiver.

The OWC transmitter is developed using standard Android flashlight system calls provided by the mobile device manufacture and OWC receiver implemented using image processing methods provided by the OpenCV framework 3.0.

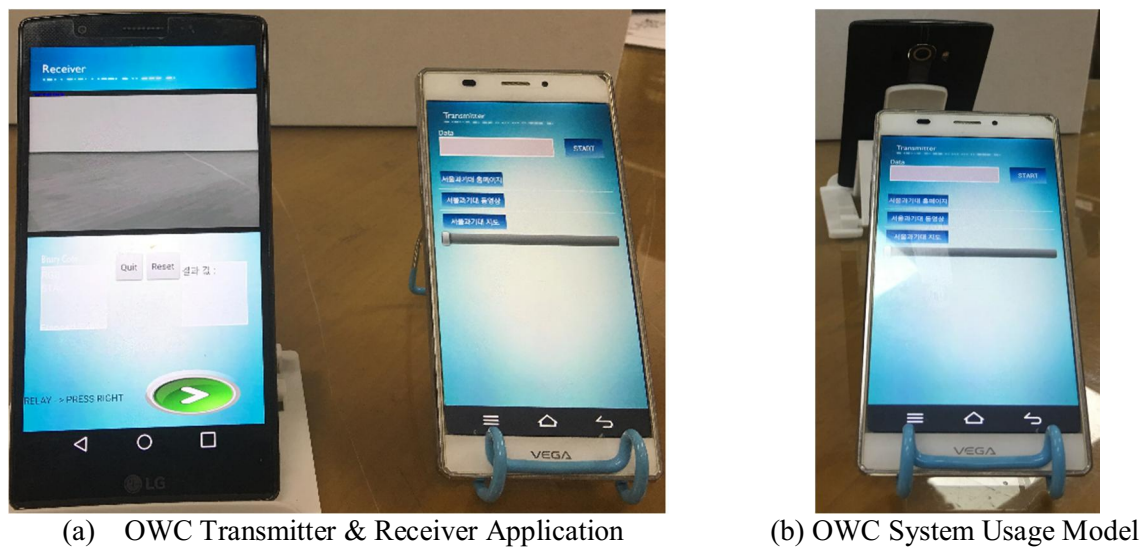


Figure 4. Flashlight based OWC System Emulation

In this approach, the system designed without adding any additional HW components on development platform and designed only with SW components so did not consume any additional time to design the HW components. The smart TV main functional components is accessing the media content based on the user control selection and user control interface on the Smartdevice which implemented and evaluated on smart phone application. The system performance evaluated with different level of user access and response time and gives effortless user access with minimum access time without any problem. This can be easily emulated on smart TV and evaluate the functional access with access response time.

5. Conclusion

This paper presented the novel OWC based smart TV remote controller design using smart device Flashlight for user immersive interactive interface to access the media content on display. To prove this proposed approach, the Flashlight based smart phone application developed to provide OWC interface between user and smart TVs. The smart TV built-in camera used as OWC receiver and OWC receiver functional method implemented on is smart TVs HW platform using OCC principles. The proposed approach simple to implement, the smart TV HW platforms does not required to high computational power, and does not required to add any additional HW components on the Smart TV HW platforms. This approach not harmful to human health as like other RF communication, secured, and interference free with other electronic devices. The functional implementation of smart TV based user interface is emulated on smart phones access locally stored media content through another smartphone flashlight.

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