

Sensitive Network Architecture Algorithm based on LED Optical Wireless Communication

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Abstract— Today LEDs are continuously expanding in accordance with domestic and overseas energy policies, and related visible light communication technologies are attracting attention. This study constructs a sensing communication mode together with a unidirectional communication mode and a bidirectional communication mode of LEDs. In particular, the sensing communication mode proposes a design that dynamically configures the sensing module to optimize the communication performance and quality according to the external environmental variables of the optical wireless communication. The performance evaluation environment is a room where indoor fluorescent light and outdoor natural light illuminate. Therefore, we describe the sensitive design and future research directions of indoor LED based wireless visible light communication system.

Keywords— VLC, LED Communication, Ubiquitous, Mobile, Optical wireless

I. INTRODUCTION

Recently, researches utilizing LED lighting have been actively carried out and the importance of utilizing new and renewable energy has been demanded, and the technology related to LED field has been expanded in many fields. LED technology has begun in the field of lighting and is expanding into LED TV, automobile LED lighting, indoor and outdoor lighting, mobile phone, and so on. In addition, as the use of LEDs increases, its importance and application range have expanded, and LED wireless visible light communication has attracted attention as a way to realize ubiquitous environment [1]. Visible Light Communication (VLC) is a communication technology that transmits information using visible light with wavelength band of 400 ~ 700nm [2].

As the development of wireless communication technology, which is the basis of ubiquitous technology, has been required, various researches on LED wireless visible light communication technology are under way. LEDs have features such as long life, small size and low power consumption. LEDs can also be used as receivers that can periodically adjust the brightness, transmit data, and receive not only light but also incoming light [3].

Optical wireless transmission is sensitive to the external environment including light intensity. In order to stabilize the optical wireless communication system, the external communication environment variable is continuously detected and the built-in communication modules are dynamically

configured according to the state of the external environment variable to overcome the external noise and maximize the optical wireless communication bandwidth and communication quality.

In order to maximize the application and performance optimization of the LED communication system, the LED communication method has been improved to improve the transmission distance, transmission performance, and stability in a stable indoor environment where the LED communication is good. Consider dynamic LED environmental variables. In this paper, we define new dynamic environment variables and define the relationship between these variables and system performance variables.

In this paper, we study and study the design of LED based wireless visible light communication system. In Section 2, the communication module and communication environment are designed. Section 3 describes the proposed sensitive algorithm for constructing advanced LED communication system. Section 4 describes the conclusion and future research directions.

II. ARCHITECTURE OF LED WIRELESS VISIBLE LIGHT COMMUNICATION MODULE AND ENVIRONMENT

A. LED wireless visible light communication module design

In this section, LED wireless visible light communication module is designed considering communication direction. Figure 1 of the unidirectional communication module converts the light from the LED or PD of the receiving end into the electric signal through the visible light of the LED of the transmitting end and receives the data through the amplifier. A unidirectional LED-to-LED system consists of a transmit module and a receive module, respectively. The transmission module and the receiving module are classified, and the transmitting module can transmit only, and the receiving module can receive only.

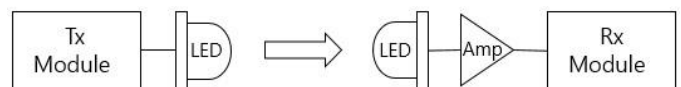


Figure 1. Unidirectional mode : one way LED wireless visible light communication module

The transmitting module of the unidirectional system performs only the simple forwarding function of the data generated by the MCU. The receiving module of the unidirectional system amplifies the signal received from the LED using the OP-AMP and transmits it to the MCU.

The bidirectional communication module is designed according to the half-duplex communication method and the full-duplex communication method [4][5]. Figure 2 of half-duplex communication module can perform transmission and reception in one module. However, there is a need for a device that cannot receive when transmitting, cannot transmit when receiving, and can control the direction of communication. There are switches, sensors, etc. to control the communication direction. Figure 3 of full-duplex communication module can transmit and receive simultaneously in one module [6].

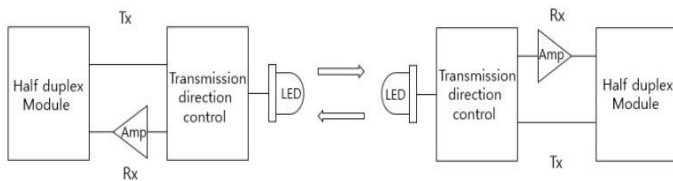


Figure 2. Bidirectional half mode : two way(half-duplex) LED wireless visible light communication module

The bidirectional system can implement a method of transmitting data using the RS-232 method. LED does not transmit and receive at the same time. In order to overcome this disadvantage, a circuit of two states, a transmission state and a reception state, is constructed and controlled by a switch to transmit and receive data. The normal state is the data reception state. When the data is to be transmitted, the state is changed to the transmission state, and the data is transmitted through the LED. When the data transmission ends, it returns to the reception state again. Data reception is performed by amplifying the signal input from the LED through the OP-AMP and sending it to the MCU to read the data and output it to the receiving end.

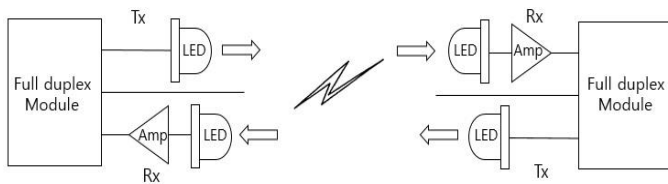


Figure 3. Bidirectional full mode : two way(full-duplex) LED wireless visible light communication module

Figure 3, as a modified model of bidirectional transmission mode in Figure 2, shows a hardware configuration that enables simultaneous transmission and reception of LED devices. In this study, we implement circuit structure and LED device structure to support concurrent transmission mode and receiving mode. Is it possible to configure the LED receiving module and the sending module independently? How do we perform independent functions? These detailed issues need to be addressed consistently.

B. LED wireless visible light communication environment design

This section considers the environment of LED lighting and describes the conceptual design. LED lighting is mostly fixed on the ceiling, and most of the research on wireless visible light communication has been published on ceiling fixed lighting. Figure 4 of direct lighting environment model has a lighting environment that can communicate in a certain area and a lighting environment that changes the communication range as needed.

As shown in Figure 4, the direct LED communication environment model has characteristics of communication environment variables such as low noise ratio, short transmission distance, low mobility and stability.

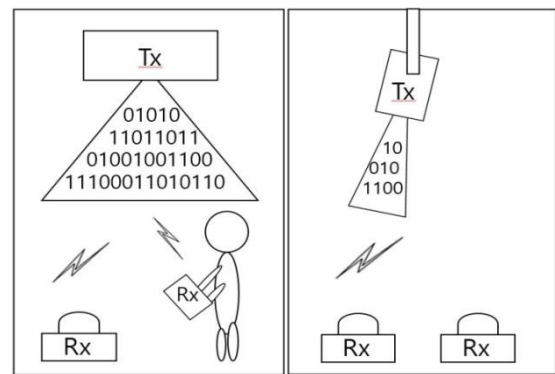


Figure 4. Model of Direct lighting environments

LED lighting is mainly fixed on the ceiling, but it can also be placed on the ceiling for design or purpose. Figure 5 of indirect lighting environment model is an environment in which the receiving module indirectly receives reflected information from the LED of the transmitting end. As shown in Fig. 5, the indirect LED communication environment model has characteristics of communication environment variables such as high noise ratio, long transmission distance, and high mobility.

Indoor LED wireless visible light communication is limited in the movement of the terminal, and the signal is reduced and distorted due to ambient noise, flicker, etc., affecting performance [7].

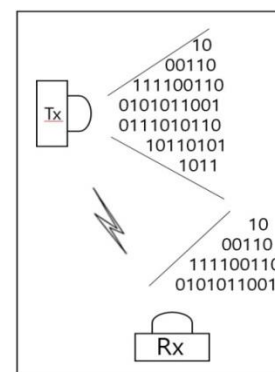


Figure 5. Model of Indirect lighting environments

In addition, the expansion system may further include an external server connected to the active terminal in a wireless or wired manner, and the external server may include a passive information collection interface-based patch sensing system capable of receiving a biometric information signal of a patient from an active terminal acting as a mobile agent.

III. SENSITIVE ALGORITHM FOR ADVANCED LED COMMUNICATION SYSTEM

The detailed components for implementing the LED communication system include communication client device and access points as follows. The proposed algorithm dynamically selects and combines transmission modules to detect LED external environment variables and to optimize and improve the performance of LED optical communication.

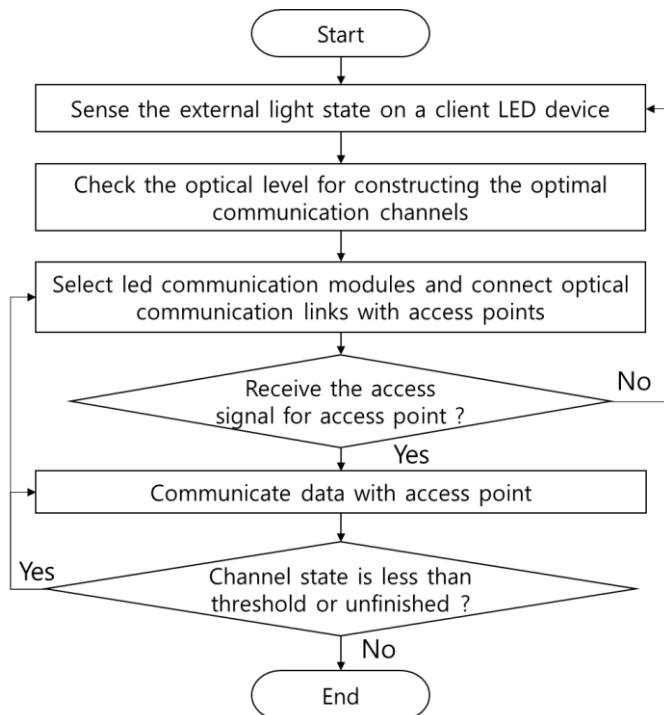


Figure 6. Sensitive algorithm on LED client

Figure 6 shows the communication sequences for connecting with LED access points on a LED client.

First, the LED client senses the state of external light intensity and selects a device module and a circuit for building an optimal wireless optical channel. Next, it requests the communication channel configuration to the access point adjacent to itself. Once the LED communication channel is established, it transmits and receives data. If the channel performance is lower than the threshold or the data transmission is not completed, the channel can be reconfigured or the data can be retransmitted.

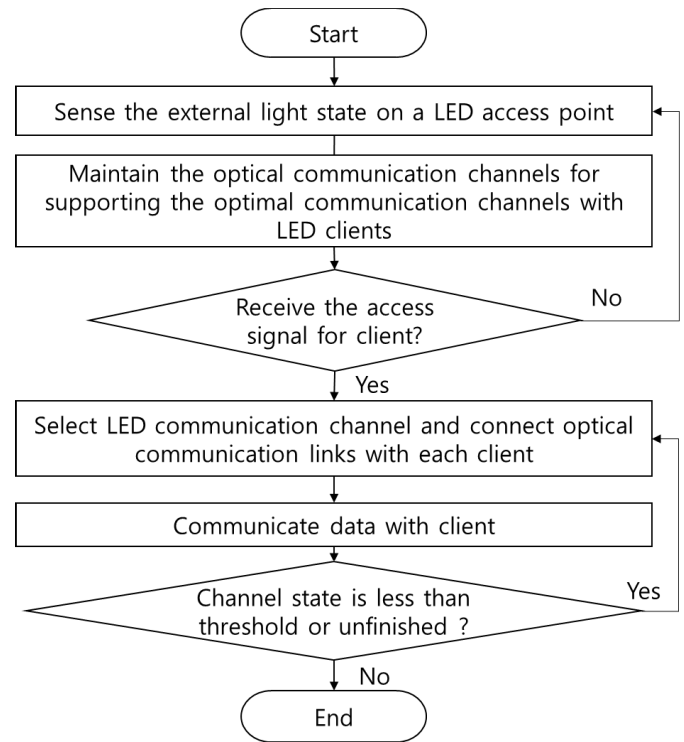


Figure 7. Sensitive algorithm on LED access point

Figure 7 shows a sensitive communication algorithm for connecting with LED clients on LED access point.

First, an LED access point senses the state of external light and manages available wireless optical communication channels. And, the LED access point constructs an optimal wireless optical channel when there is a communication channel request from adjacent LED clients. When an LED communication channel with an individual client is established, data is transmitted and received. If the channel performance is lower than the threshold value or the data transmission is not completed, the channel is reconfigured or the data is retransmitted.

IV. CONCLUSIONS

In this paper, the basic concept of designing the LED wireless visible light communication module according to communication direction is presented, and the indoor LED wireless visible light communication environment is discussed. Conventional visible light communication technologies have lacked the flexibility of the passive system. In order to realize LED wireless visible light communication including flexibility, it is necessary to merge various fields such as transmission method and characteristics of LED parts. In the inter-LED communication system, as the distance between the LEDs increases due to the linearity of the optical wireless signal and the external noise interference, the transmission performance decreases. Future research will examine various transmission methods of LED wireless visible light communication and proceed with basic unidirectional module design.

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