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Experimental study on visible light communication based on LED

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Abstract

A visible light communication system using white light emitting diode (LED) has been proposed and demonstrated, in which the transmitter and receiver of visible light communication have been designed and realized. In the experiment, the illumination of the receiving surface in different distance between LED and photodiode receiver has been tested, and the effect of background light has been considered. The experiment results show that the data transmit bit rate can be achieved at 111.607 kbit/s when the average indoor illumination is 40 lx, with the communication distance of our visible light system at 1.5 m.

Keywords visible light communication, white light emitting diode, system circuit

1 Introduction

As LED has many advantages such as long life, small volume, low power consumption and low heat radiation, it had been widely deployed in many applications, such as indoor lighting equipment, traffic lights, car indicator, displays and so on [1–3]. White LED is expected to replace incandescent and fluorescent lights in the future and considered to be the next generation lighting source. LED can support high speed lighting and off. In this case, high speed data can be carried by the modulated light from the LED, which makes information transmission possible while lighting our life. When signals reach the receiver through the indoor wireless channel, the photodiode will convert the optical signals to electrical ones and the original information will be recovered [4–5]. The visible light communication based on LED is a novel developing technique in the optical wireless communication field.

Fig. 1 vividly represents a scene of indoor visible light communication system based on LED. Compared with the traditional wireless access technique, the proposed system has many advantages: easy installation, high data rate, no electromagnetic interference and so on [6–7]. And it is believed that visible light communication based on white LED will play an important role in the next generation broadband access networks. Many research works about visible light communication had been performed in recent years [8–11]. But most of the researches are in the simulation stage, experiment results are very few, and the research is still in its initial stage.

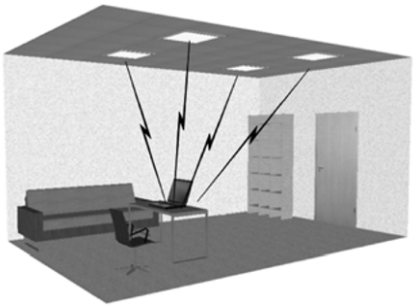

Fig. 1 Visible light communication system using LED

In this paper, we have designed a visible light communication system using one 3 W LED light as signal source, and demonstrated this visible light communication system in the room with the average illumination of about 40 lx. Point-to-point transmission of this indoor wireless

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optical communication system has been realized at the distance as long as 1.5 m. Different transmission rates were compared and discussed.

2 System architecture

2.1 System model

The proposed visible light communication system is illustrated in Fig. 2.

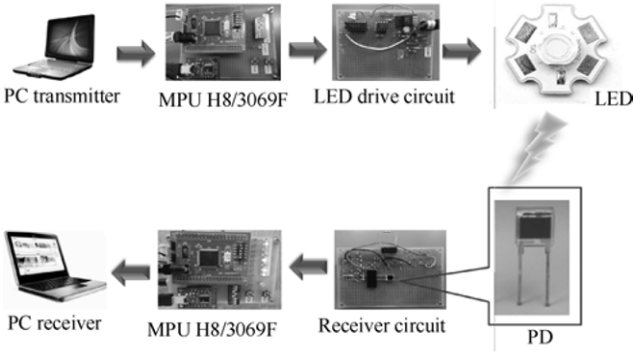
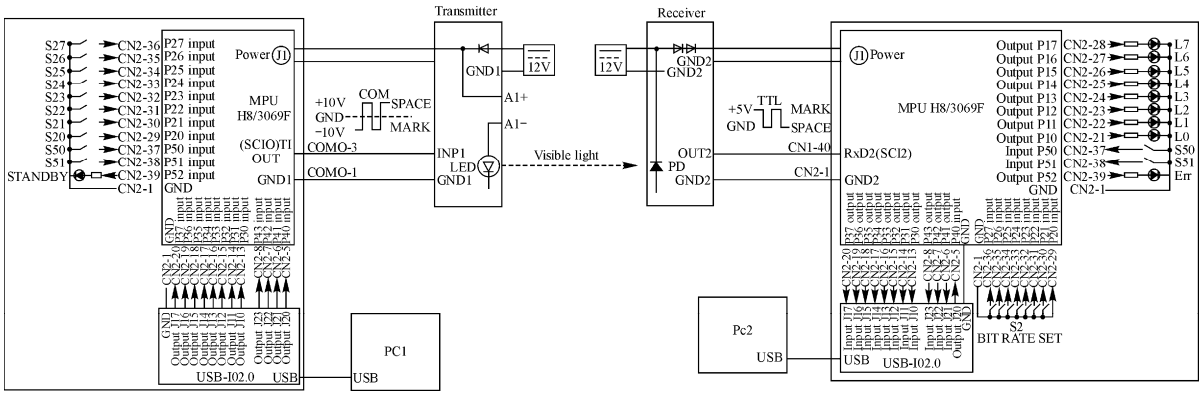


Fig. 2 Block diagram of visible light communication

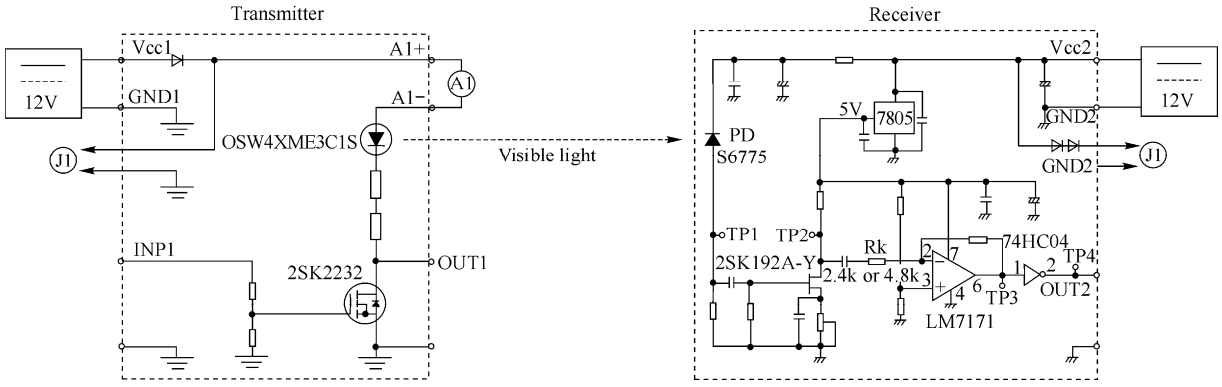
The input data from personal computer (PC) transmitter is first coded into a string of pulse electrical signals by micro processor unit (MPU) H8/3069F though the interface circuit. Then, the electrical signals drive LED source directly through a LED driver circuit, with which electronic-to-optical conversion is achieved. Because of the high on-off speed characteristic of LED, people cannot perceive the twinkling phenomena so that both lighting and information transmitting can be realized simultaneously. The generated optical signals carrying original information then delivered into the indoor wireless channel. At the receiver, pin photodiode will detect the optical signal and do the optical-to-electronic conversion. Then the detected weak electrical signals are delivered into a receive circuit which contains preamplifier for signal amplification to meet the need of the following signal processing. The output data from receive circuit will arrive at the MPU H8/3069F device and be decoded into primary signal, and then sent to the PC receiver though the universal serial bus (USB) interface circuit.

2.2 Experimental circuit

Our experiment circuit diagram is illustrated in Fig. 3.



(a) Communication system circuitry diagram



(b) Transmit and receive circuit diagram

Fig. 3 Experimental circuit diagram of visible light communication