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Methods for Brightness Control of Illumination and Visible Light Communication System

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ABSTRACT: In this paper, authors have created two brightness control techniques for illuminating and visible light communication systems. One strategy is Pulse Width Modulation (PWM), the other is changing modulation width. Utilizing these proposed techniques, we can accomplish both dimmer for example brightness control and wireless communication simultaneously. We examined the connection between PWM frequency, LED brightness and communication performance. The outcomes show that we can control brightness from 0% to 87.5% when we use PWM and information transmission conceivable when PWM frequency is sufficiently high. Brightness can be controlled from 0% to 100% and communication performance is superior to that of PWM when we change modulation width.

KEYWORDS*:*Brightness, Control, Communication, Illumination, Modulation, Pulse Width Modulation

I. INTRODUCTION

The quick dissemination of compact communication terminals for example, PDAs has raised the significance of indoor wireless communication and wireless neighborhood systems. We note that Light Emitting Diodes (LEDs) [1] offer numerous favorable circumstances as far as lower power utilization, longer life, and the capacity to be cut back. They are normal to turn into the prevailing light source in future enlightenment systems. They have been as of now utilized in full shading shows, traffic lights, and numerous different applications

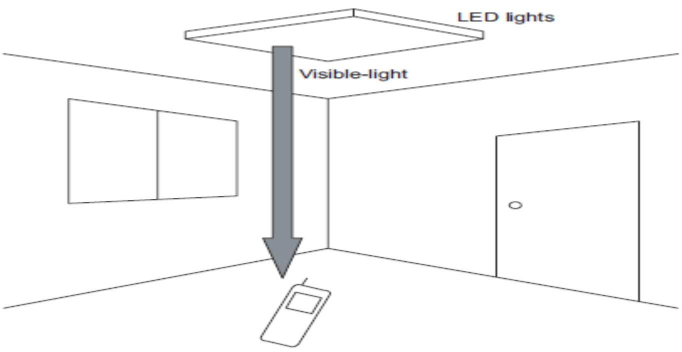

Fig.1: Visible-Light Communication System Using LED Light

Our research center built up an indoor noticeable light communication system that utilizations LED light, not just for illuminating yet in addition for optical wireless communication [2], [3]. The work depends on the quick exchanging of

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LEDs and the modulation of the noticeable light waves for nothing space interchanges. The picture of noticeable light communication system is appeared in Fig. 1.

II. OPTICAL CHANNEL

In noticeable light communication system, modulation/demodulation strategy is intensity modulation and direct detection (IM/DD). The optical wireless channel model is appeared in equation below [4], [5]. The transmitted waveform X(t) is the momentary optical intensity of the light wave producer. The got waveform Y (t) is the momentary current in the accepting photograph detector, which is relative to the got momentary force. We can accept that the clamor is additive white gaussian noise (AWGN)[6].

$$Y(t) = RX(t) \otimes h(t) + N(t)$$

where R is the detector responsivity (A/W), h(t) is the impulse response, N(t) speaks to the AWGN, and image $\otimes$ implies convolution. Since the channel input X(t) speaks to momentary optical force, the channel input must be non-negative:

$$X(t) \geq 0,$$

and average optical power P_t is given by

$$P_t = \lim_{T\to\infty} \frac{1}{2T} \int_{-T}^{T} X(t)dt.$$

The average received optical power is

$$P_r = H(0)P_t.$$

Wireless optical link's performance is linked to electrical SNR as:

$$SNR = \frac{R^2 P_r^2}{R_b N_0} = \frac{R^2 H^2(0) P_t^2}{R_b N_0},$$

where N_0 is double sided power spectral density.

III. METHOD OF MODULATION FOR VISIBLE LIGHT TAG

The standardized modulation strategy for "Obvious Light Tag" is subcarrier pulse position modulation (SC-PPM). Subcarrier modulation is a strong modulation since it is liberated from the impact of foundation light, for example, fluorescent light [7], [8]. Transmitted waveform is appeared in Fig. 2. In SC-LPPM, image interim is separated into L time spaces and the optical sign is subcarrier during l-th opening, consistent incentive during different openings. Bits are transmitted by the position where the subcarrier exits. The normal force of transmitted sign is constantly consistent autonomously of information grouping; a glint isn't produced more than a few kbps. Transmitted waveform X(t) is communicated as follows:

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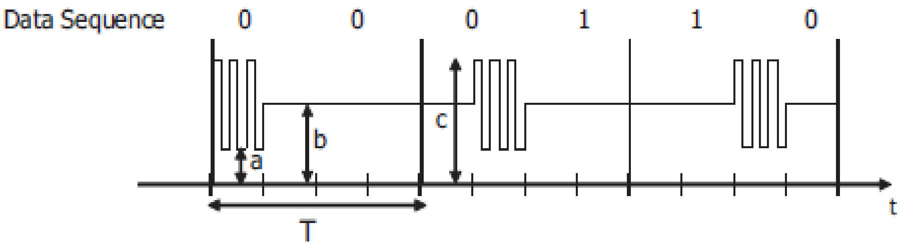

Fig.2: Transmitted Waveform with SC-4PPM

$$X(t) = \sum_k p_{l[k]}(t - kT),$$

where $\{p_l\}$ is a family of pulse shapes given by

$$p_l(t) = \begin{cases} 1 - cos(\omega t), & t \in [(l-1)T/L, lT/L) \\ b, & \text{elsewhere} \\ & i \in \{1, 2, \ldots, L\}. \end{cases}$$

The receiver design that consists of a low pass filter (LPF), band pass filter (BPF) and diode is shown in figure 3.

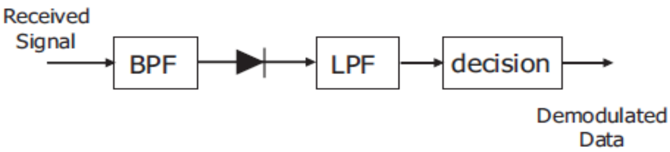

Fig.3: Example of the Receiver Design

IV. BRIGHTNESS CONTROL METHOD: PULSE WIDTH MODULATION

PWM is a method for carefully encoding simple sign levels. PWM is utilized in engine drive circuit, dimmer control, furthermore, power control and so on. The obligation pattern of a square wave is tweaked to encode a particular simple sign level. Fig. 4 shows three diverse PWM signals. Fig. 4 (a) shows a PWM yield at a 10% obligation cycle. That is, the sign is on for 10% of the period and off the other 90%. Fig. 4 (b) and (c) show PWM yields at half and 90% obligation cycles, individually. These three PWM yields encode three unique simple sign qualities, at 10%, half, and 90% of the full quality. The PWM signal is as yet advanced on the grounds that, at any given moment of time, the yield is either completely on or completely off [9]. Since we can change signal levels effectively with computerized circuit, PWM have been now utilized in drive circuit of backdrop illumination in basement telephones. It will be utilized in too drive circuit of LED enlightenment system.

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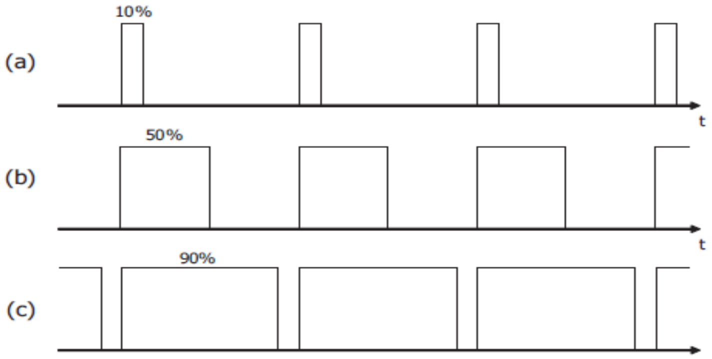

Fig.4: Pulse Width Modulation

We can utilize PWM and SC-PPM simultaneously by picking PWM frequency sufficiently high. SC-PPM is utilized for transmitting information grouping, and PWM is utilized for controlling brightness of LED lights. Transmitted waveform is made by increasing SC-4PPM waveform by PWM waveform. Fig. 5 shows transmitted waveform. Data bits are transmitted by the position where the subcarrier (28.8kHz) exists. Brightness is constrained by evolving pulse width for example obligation cycle.

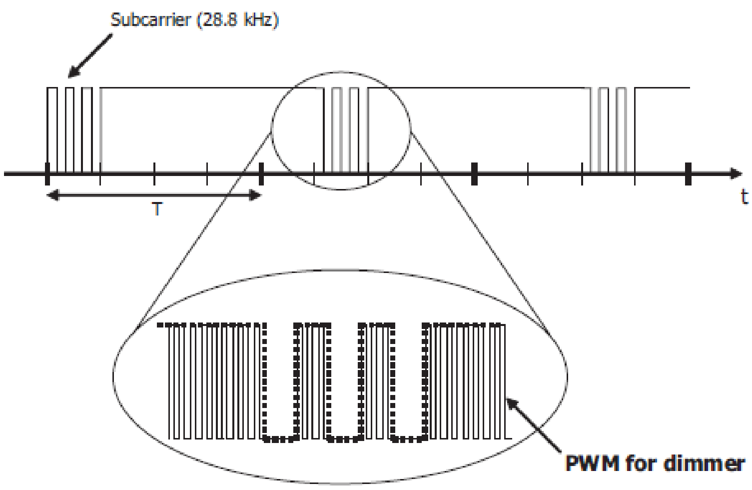

Fig.5: Transmitted Waveform with PWM and SC-4PPM

V. PERFORMANCE EVALUATION

Following two variables will influence communication performance. We assess the effect of following things.

• PWM frequency; in the event that it is excessively low, sub-carrier vanishes.

• LED brightness; if brightness is changed, additionally signal power changes.

We explain the effect of PWM frequency by reenactment. Table 1 shows the reenactment parameters. Adjustment for communication, bit rate and subcarrier frequency are based on the standard of "Visible Light Tag" in VLCC. PWM will influence the communication performance unequivocally on the grounds that PWM waveform might be obstruction to SC-4PPM [10] waveform relying upon the frequency. Moreover, the performance of BPF in Fig. 3 additionally influences communication performance. In useful beneficiary, BPF will be made of simple circuit. It is hard to plan a simple channel which has sharp edge. We reproduce the collector utilizing not simple channel however computerized channel.

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Table.1: Simulation Parameters

Modulation for Communication	SC-4PPM a = 0, b = c =1
Bit Rate	4.8 [kbps]
Subcarrier Frequency	28.8 [kHz]
PWM Frequency	20, 30, 40, 50 [kHz], 60, 80, 100, 200 [kHz]
LED Brightness	50%
Digital Filter	100 Taps FIR Filter

VI. CONCLUSION

Right now, created two brightness control techniques for enlightenment and visible light communication systems. Proposed techniques empower LED brightness controllable and to transmit information simultaneously. One technique is utilizing PWM, and the other is changing modulation width. At the point when we use PWM with SC-PPM, the brightness will be controlled from 0% to 87.5% and no issues happen in the event that we set PWM frequency over 60kHz. Moreover, driver circuit will be straightforward. At the point when we change tweak width of SC-PPM, the brightness will be controlled from 0% to 100%. From 12.5% to 87.5%, information transmission is conceivable at the best performance while driver circuit will be minimal muddled. Picking the most appropriate approach to control LED brightness, we can accomplish both brightness control and visible light communication simultaneously.

REFERENCES

[1] C. C. Chu *et al.*, "Light response by Frankliniellaoccidentalis to white fluorescent light filtered through color films and ultraviolet- and blue light-emmiting diodes," *Southwest. Entomol.*, 2005.
[2] Y. Tanaka, T. Komine, S. Haruyama, and M. Nakagawa, "Indoor visible communication utilizing plural white LEDs as lighting," in *IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, PIMRC*, 2001, doi: 10.1109/pimrc.2001.965300.
[3] T. Komine and M. Nakagawa, "Fundamental analysis for visible-light communication system using LED lights," *IEEE Trans. Consum.Electron.*, 2004, doi: 10.1109/TCE.2004.1277847.
[4] J. R. Barry, *Wireless Infrared Communications*. 1994.
[5] J. M. Kahn, "Wireless infrared communications," *Proc. IEEE*, 1997, doi: 10.1109/5.554222.
[6] A. Jung, Z. Ben-Haim, F. Hlawatsch, and Y. C. Eldar, "Unbiased estimation of a sparse vector in white Gaussian noise," *IEEE Trans. Inf. Theory*, 2011, doi: 10.1109/TIT.2011.2170124.
[7] H. Sugiyama, S. Haruyama, and M. Nakagawa, "Experimental investigation of modulation method for visible-light communications," *IEICE Trans. Commun.*, 2006, doi: 10.1093/ietcom/e89-b.12.3393.
[8] Hidemitsu SUGIYAMA, Shinichiro HARUYAMA, and Masao NAKAGAWA, "Experimental Investigation of Modulation Method for Visible-Light Communications," *IEICE Trans. Commun.*, 2006.
[9] D. G. Holmes and T. A. Lipo, *Pulse Width Modulation for Power Converters*. 2010.
[10] W. O. Popoola, E. Poves, and H. Haas, "Spatial pulse position modulation for optical communications," *J. Light. Technol.*, 2012, doi: 10.1109/JLT.2012.2208940.