Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: Resolution on the IR-band Issue of Communication Range in TG7a TCD
Date Submitted: 14 April 2021
Source: Sang-Kyu Lim [ETRI] and Vinayagam Mariappan [SMR Automotive Modules Korea]
Address: 218 Gajeong-ro, Yuseong-gu, Daejeon, 34129, Korea
Voice:[+82-42-860-1573], FAX: [+82-42-860-5218], E-Mail:[sklim@etri.re.kr]

Re:

Abstract: This document is to resolve the technical issues in TCD and to improve the TCD document.

Purpose: Contribution to IEEE P802.15.7a

Resolution on the IR-band Issue of Communication Range in TG7a TCD

Sang-Kyu Lim [ETRI]

Vinayagam Mariappan [SMR Automotive Modules Korea]

IR-band Issue on the Communication Range in TCD

4.7 Communication Range

The standard should support communication range of 0.1 meters to 5 meters for application A1, and communication range of 0.5 meters to 200 meters for application A2, A3, A4 and A8. Communication range depends on the size and the luminance of a transmitter with some protocols, therefore communication range is measured in the condition of the size of 1 meter and the luminance of 300 Cd/m^2 for performance comparison.

- The current TCD specifies the condition for communication range measurement which is valid only for visible band.
- Need to add the condition which is valid in IR band for IR OCC.

An Example of IR OCC (1)

Journal Name	Optics Express
Edition	2019
ISSN No.	1094-4087
JCR Impact Factor	3.669
% Ranking	19.072

Research Article Vol. 26, No. 15 | 23 Jul 2018 | OPTICS EXPRESS 19657

Optics EXPRESS

Experimental demonstration of indoor uplink near-infrared LED camera communication

WILLY ANUGRAH CAHYADI AND YEON HO CHUNG*

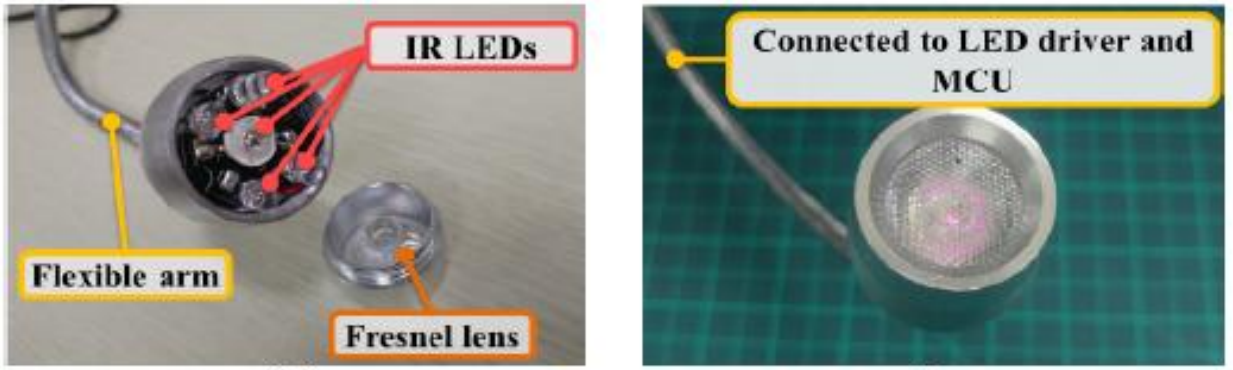
Department of Information and Communications Engineering, Pukyong National University, Busan 48513, South Korea

**yhchung@pknu.ac.kr*

Abstract: In this paper, we present experimental demonstration of an indoor uplink near-infrared LED camera communication (ICC) that employs near-infrared (IR) light as a communication medium and a camera as the receiver. The proposed ICC exploits advantages of the camera receiver to provide wider coverage and accurate indoor positioning in IR communications. Since near-IR light is the communication medium, ICC can safely increase the light intensity compared with other visible light based wireless communication schemes. Unlike previous studies focused on positioning only, the ICC provides practical uplink indoor wireless communication as well as positioning. As in optical camera communications, the blooming effect from slow speed cameras needs to be mitigated in the ICC. An adaptive intensity compensation algorithm is also proposed for reducing this blooming effect. The blooming reduction algorithm is based on the absence of visible light interference in IR communications. Experiments demonstrate that employing an even low-specification webcam and low-power LEDs can provide centimeter-scale accuracy for the user positioning and a data rate of 6.72 kbit/s at a distance of 100 cm.

An Example of IR OCC (2)

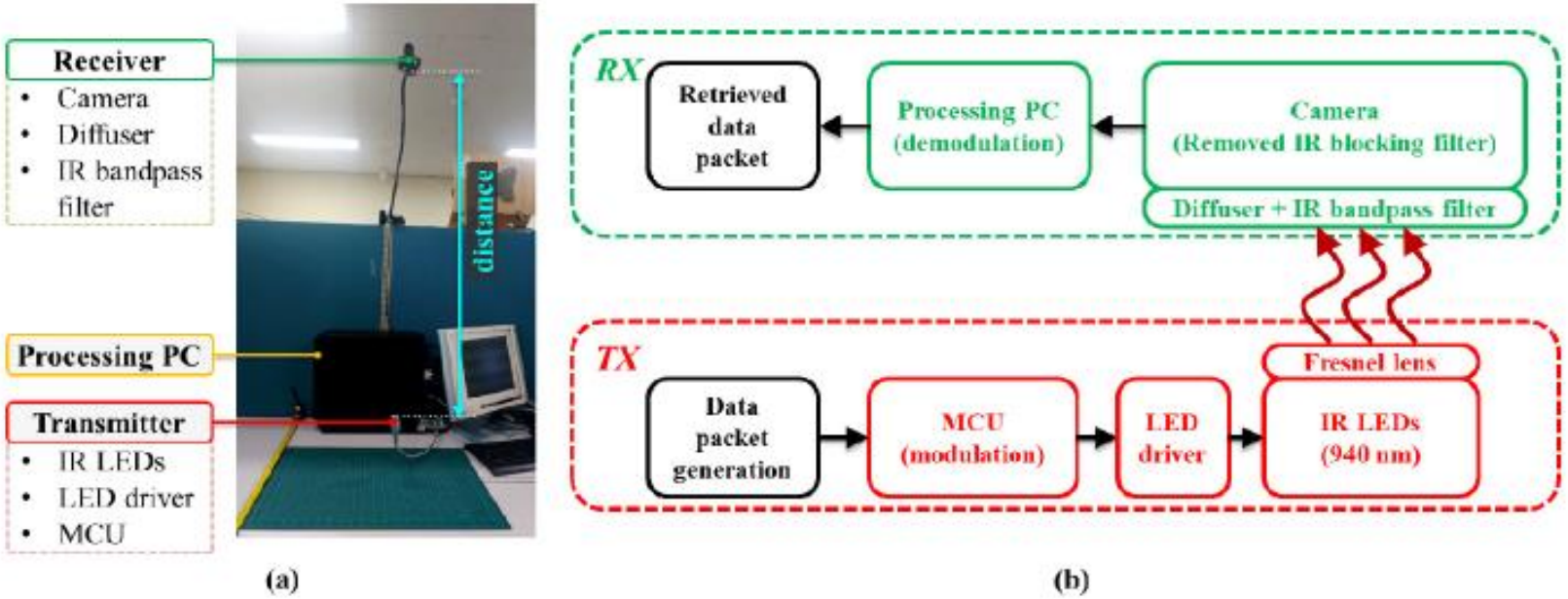
Figure 1(c) shows the schematic of the transmitter comprising an ATMega328P based MCU with a clock of 16 MHz, a TLC5940 based LED driver IC, and the IR LEDs as the transmitter. The designed transmitter unit, shown in Fig. 2(a), utilizes five IR LEDs emitting an IR light with a wavelength of 940 nm. Each IR LED has an operating voltage of 1.5 V with a maximum current of 120 mA. An acrylic based Fresnel lens with a diameter of 25 mm is installed on the metal cover. In addition, as illustrated in both Figs. 2(a) and 2(b), a flexible



(a) (b)

Fig. 2. Transmitter unit (a) assembly of the transmitter unit and (b) the installed transmitter unit.

An Example of IR OCC (3)



An Commercial IR LED – 940nm

Figure 1(c) shows the schematic of the transmitter comprising an ATMega328P based MCU with a clock of 16 MHz, a TLC5940 based LED driver IC, and the IR LEDs as the transmitter. The designed transmitter unit, shown in Fig. 2(a), utilizes five IR LEDs emitting an IR light with a wavelength of 940 nm. Each IR LED has an operating voltage of 1.5 V with a maximum current of 120 mA. An acrylic based Fresnel lens with a diameter of 25 mm is installed on the metal cover. In addition, as illustrated in both Figs. 2(a) and 2(b), a flexible

High Power Infrared Emitter (940 nm)

Applications

- Electronic Equipment
- Industrial Automation (Machine controls, Light barriers, Vision controls)
- Safety systems and CCTV
- Smoke Detectors

Type	Radiant intensity [1] I_F = 100 mA; t_p = 20 ms I_e	Radiant intensity [1] typ. I_F = 100 mA; t_p = 20 ms I_e
SFH 4546	63 ... 320 mW/sr	130 mW/sr
SFH 4546-AWBW	100 ... 320 mW/sr	130 mW/sr

	Forward voltage (VF)	typ.	1.5 V
		max.	1.8 V

An Commercial IR LED – 850nm

Figure 1(c) shows the schematic of the transmitter comprising an ATMega328P based MCU with a clock of 16 MHz, a TLC5940 based LED driver IC, and the IR LEDs as the transmitter. The designed transmitter unit, shown in Fig. 2(a), utilizes five IR LEDs emitting an IR light with a wavelength of 940 nm. Each IR LED has an operating voltage of 1.5 V with a maximum current of 120 mA. An acrylic based Fresnel lens with a diameter of 25 mm is installed on the metal cover. In addition, as illustrated in both Figs. 2(a) and 2(b), a flexible

High Speed Infrared Emitting Diode, 850 nm

APPLICATIONS

- Infrared radiation source for operation with CMOS cameras

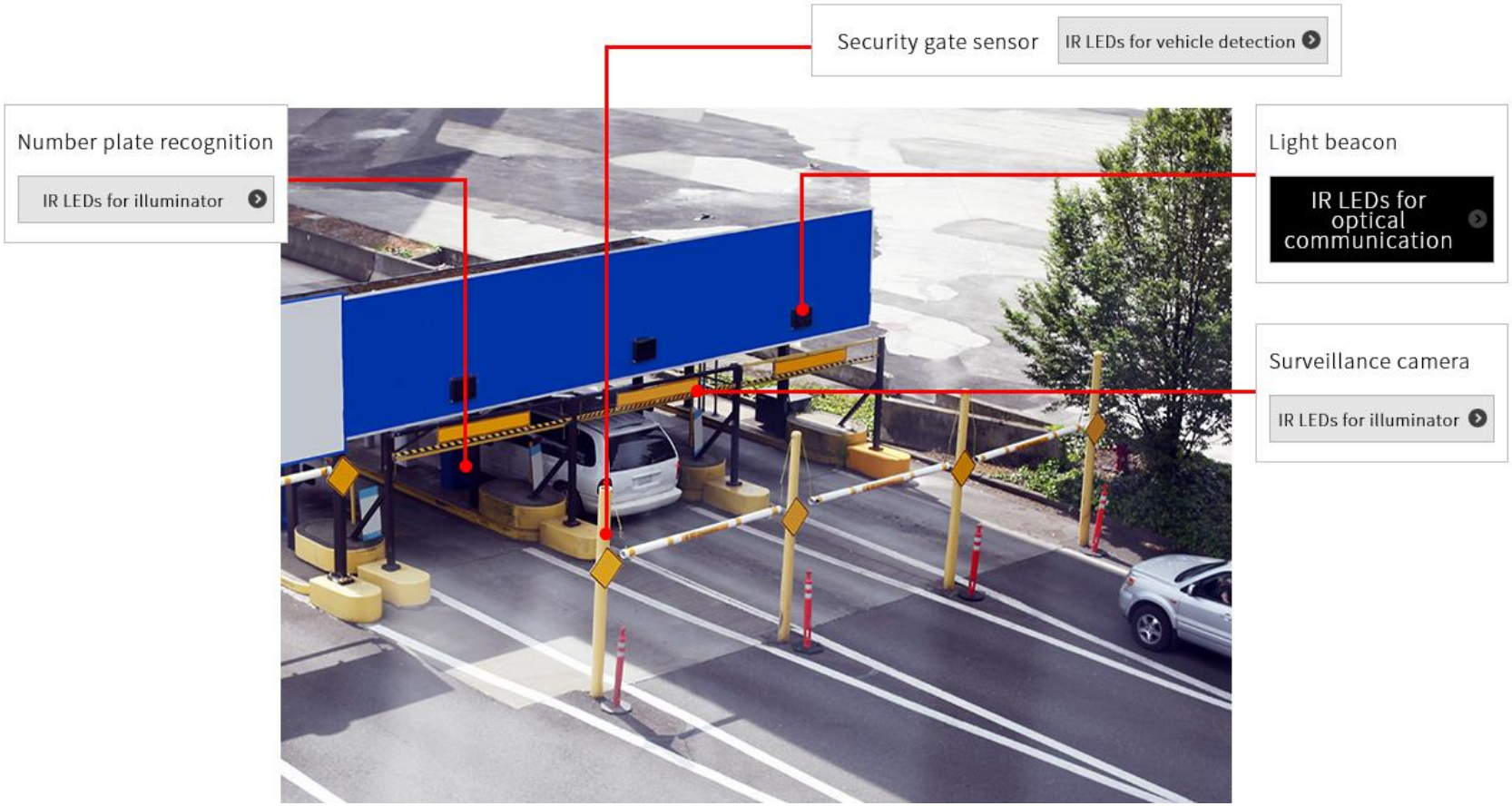
TSHG6200

Vishay Semiconductors

BASIC CHARACTERISTICS (T_{amb} = 25 °C, unless otherwise specified)

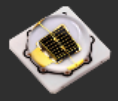
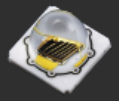
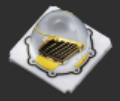
PARAMETER	TEST CONDITION	SYMBOL	MIN.	TYP.	MAX.	UNIT
Forward voltage	I_F = 100 mA, t_p = 20 ms	V_F		1.5	1.8	V
	I_F = 1 A, t_p = 100 µs	V_F		2.3		V
Temperature coefficient of V_F	I_F = 1 mA	TK_{VF}		- 1.8		mV/K
Reverse current	V_R = 5 V	I_R			10	µA
Junction capacitance	V_R = 0 V, f = 1 MHz, E = 0	C_j		125		pF
Radiant intensity	I_F = 100 mA, t_p = 20 ms	I_e	120	180	360	mW/sr
	I_F = 1 A, t_p = 100 µs	I_e		1800		mW/sr
Radiant power	I_F = 100 mA, t_p = 20 ms	ϕ_e		50		mW
Temperature coefficient of ϕ_e	I_F = 100 mA	$TK\phi_e$		- 0.35		%/K
Angle of half intensity		φ		± 10		deg
Peak wavelength	I_F = 100 mA	λ_p		850		nm

Infrastructure and Security Applications using IR Cameras and Sensors



* Reference : https://www.stanley-components.com/en/application/infrastructure-security.html

IR LEDs for Infrastructure and Security Applications

Product	NEW MHN1105MS 	NEW MHN1106MS 	MGN1105MS 	MGN1106MS 	MFN1105MS 	MFN1106MS 	MGN1107MS 	MGN1108MS 	MFN1107MS 	MFN1108MS 
Features	Exceptionally high radiant flux type for automotive applications		For automotive applications, etc.: Highly reliable package meeting automotive quality requirements				For security cameras, etc.: Inconspicuous black package			
Wavelength	945 nm		855 nm		945 nm		855 nm		945 nm	
Radiant intensity	750 mW/sr	385 mW/sr	530 mW/sr	280 mW/sr	440 mW/sr	230 mW/sr	530 mW/sr	280 mW/sr	440 mW/sr	230 mW/sr
Light output	1,630 mW	1,760 mW	1,100 mW		950 mW		1,100 mW		950 mW	
Forward current	1,000 mA		1,000 mA				1,000 mA			
Forward voltage	2.9 V		1.8 V		1.5 V		1.8 V		1.5 V	

* Reference : https://www.stanley-components.com/en/special/app/security/index.html

Conclusion

4.7 Communication Range

The standard should support communication range of 0.1 meters to 5 meters for application A1, and communication range of 0.5 meters to 200 meters for application A2, A3, A4 and A8. Communication range depends on the size and the luminance of a transmitter with some protocols, therefore communication range is measured in the condition of the size of 1 meter and the luminance of 300 Cd/m^2 for performance comparison.

- "communication range us measured in the condition of the size of 1 meter and the luminance of 300 cd/m^2 for performance comparison."

- "communication range us measured in the condition of the size of 1 meter and the luminance of 300 cd/m^2 in visible band and the radiant intensity of 500 mW/sr in IR band for performance comparison."