TWO-WAY VISIBLELIGHTCOMMUNICATION AND ILLUMINATION WITH LED'S

R.Blessy Beulah Mary[1] ,T.Jasmine Aaron[2],S.Nalini[3], Mr.M.I.Prasanna M.Tech[4]
1,2,3-Final year students(ECE)
4-Professor for ECE Department
1,2,3,4-Dr.G.U.Pope College Of Engineering

Abstract:

The circuit described here can be built and used in your vehicle for an automatic dipping and dimming operation of the headlamps,in response to the intense light coming from an opposite vehicle headlamps. You must have come across this irritating situation while driving at night when you find the headlight focus an opposite vehicle falling straight in your eyes,making things difficult to assess,giving rise to a situation of a collision or some kind of possible accident.Incidently ,the driver of the opposite vehicle might be going through the same situation due to the headlight focus from your vehicle.where the driver is prompted to dip the focus of his headlight,thus giving the opposite vehicle a chance to adjust his vehicle and also an indication that he too needs to "dip" his vehicle lamps.However,doing the above operation manually,every now and then can become horribly laborites and troubleness,therefore if some kind of automatic system is incorporated,can help to save this hedache of the driver,especially while he is driving in stressful conditiona and on dangerous highways.so for we using VLC technique to detect the opposite vehicle headlight condition dim/dip,and also in petrol theft identification implemented ,for that here we are going to using flow sensor and PIC controller.

Index Terms:

Visible light communications, LED, sensing, two-way channel.

I. Introduction:

Visible light communication (VLC) refers to communication in the visible part of the spectrum. This involves a VLC transmitter that transmits information by modulating its light output and a receiver that is capable of decoding the transmitted information. Embedding information by modulating light output has become easier with the ad vent of light emitting diodes (LEDs). A number of applications in lighting control, light interaction and infotainment networking [1], [2], [3], [4] make use of VLC with LEDs. In addition to being used as transmitters, LEDs have been recently used as light sensors in different applications [5], [7]. However limited work exists on the use of LEDs as receivers, with the notable exception of the body of works [8], [9], [10], [11], [13].

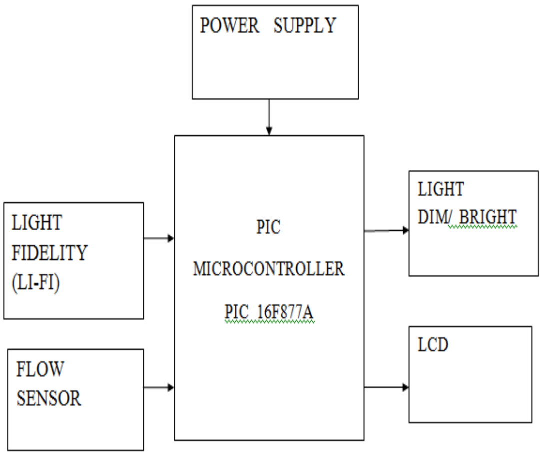
In this paper, we consider the use of LEDs as transceivers to achieve two-way communication, while providing basic illumination. In the proposed system, we use LEDs as both transmitters and receivers in two-way VLC, without usingadditional dedicated light sensors as receivers. Two-way VLC refers to two devices transmitting simultaneously using VLC. In our system, two LED devices transmit information to each other, while additionally serving as sensors to receive this information and providing illumination. The design of this new system brings about a number of technical challenges: [i] how should data encoding/decoding be designed to enable LEDs to transmit/receive for a two-way VLC, while also providing illumination without perceivable flicker; [ii] how should the LED devices be synchronized for two-way VLC; [iii] what are the communication and illumination trade-offs in such a system.

II Related work: A number of works have considered VLC systems with LEDs and dedicated light sensors as VLC receivers [1], [14], [15], [16], [17], [18], [19], [20], [21], [22], [23]. In [1], the performance of a LED lighting system that provides illumination and VLC with photodetectors was analyzed. The possibility of achieving high data rates with VLC were shown in [14], [16], [21], [22], [23]. A hybrid communication protocol for mixing camera communication with faster modulation designed for photodetectors was considered in [17]. In [18], a platform for distributed, multi-hop VLC was presented. Full-duplex VLC relaying across luminaires in an indoor lighting system was proposed in [19], [20], with advanced signal processing techniques for dealing with self-interference at the photodetector at the relay luminaire. For a recent overview on VLC,see [15].The use of LEDs as receivers has been explored in [8], [9], [10], [11] to achieve VLC for LED-to-LED communications in consumer toys and entertainment applications. Christo Ananth et al. [6] discussed about Positioning Of a Vehicle in a Combined Indoor-Outdoor Scenario, The development in technology has given us all sophistications but equal amounts of threats too. This has brought us an urge to bring a complete security system that monitors an object continuously. Consider a situation where a cargo vehicle carrying valuable material is moving in an area using GPS (an outdoor sensor) we can monitor it but the actual problem arises when its movement involves both indoor (within the industry) and outdoor because GPS has its limitations in indoor environment. Hence it is essential to have an additional sensor that would enable us a continuous monitoring /tracking without cutoff of the signal. In this paper we bring out a solution by combining Ultra wide band (UWB) with GPS sensory information which eliminates the limitations of conventional tracking methods in mixed scenario(indoor and outdoor) The same method finds application in mobile robots, monitoring a person on grounds of security, etc.An open source embedded Linux platform with an LED transceiver front-end, OpenVLC, was presented in [11]. A carrier sensing multiple access/collision detection and hidden avoidance MAC protocol was presented , by which in-band bi- directional transmission was realized in a visible light network of LEDs. This system results in asymmetric data rate, with the achieved data rate in one direction being half of the data rate in the other direction. Also, the illumination level of the receiver depends on its payload and is less than 50%. In [13], we proposed a LED system for achieving unidirectional VLC while providing flicker-free illumination. The receiving LED was OOK modulated for VLC reception in the OFF periods. The receiver LED was allowed to be asynchronous with the transmitter, with a phase offset within a preset range.

III Proposed System:

In the proposed system, we use LEDs as both transmitters and receivers in LI-FI.Using VLC technique to detect the opposite vehicle headlight condition dip/dim.

BLOCK DIAGRAM:



The power supplymis given to the PIC microcontroller.LIFI means light fidelity it convert the light energy into data stream.It is used tocommunicate the data between the LEDS.Flow sensor is used to find the fuel theft identification.When the fuel is droped into the tanks the LCD measuring level is ON.LCD is used to measuring the fuel level.

SYSTEM STRUCTURE

The structure of a two-way VLC system with two LED devices is illustrated in Fig. 1It consists of a dual-mode driver and a LED based transceiver communicating over the optical free The signaling waveform of a LED device is designed such that the transceiver can receive optical signals during the OFF period of the waveform. TheLED driver operates in two modes. The signaling waveform of a LED device is designed such that thetransceiver can receive optical signals during the OFF period of the waveform. TheLED driver operates in two modes In the emitting mode of the driver circuit,theLED device is forward-biased to output a constant light level. In the sensing mode, the LED device is switched off to convert the received light power to a photocurrent signal.

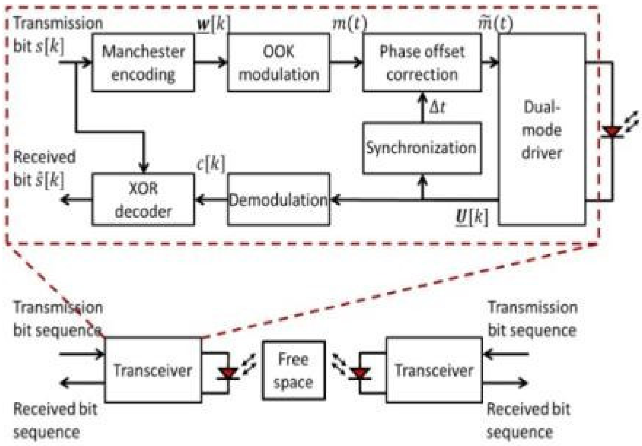
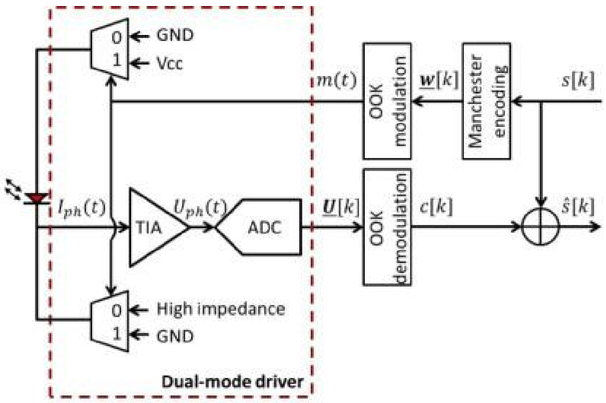


Fig. 1: System structure and transceiver block diagram.space medium. N.

TABLE I: System truth table, describing channel outputs given the inputs, for each time slot.

LED device 1	LED device 2	Transreceiver 1measurement	Transreceiver 2measurement
Sense	Sense	No light	No light
Sense	Emit	Light	Unknown
Emit	Sense	Unknown	Light
Emit	Emit	Unknown	Unknown

Consider a time slotted structure. During each time slot, the LED device is either in transmit/receive for two-way VLC. We begin by considering the trade-off between the system rate and illumination in such a system. A first contribution of this paper is to establish that the combination of the Manchester coding and OOK modulation achieves optimum system performance in the sense of balancing the rate-illumination trade-off. This encoding scheme achieves a rate-illumination quadruple (0.5, 0.5, 50%, 50%). Rates are equal to 0.5 bit per channel use(time slot) and illumination levels of 50% can be realized, which is optimal. The reader is referred to the Appendix for a detailed analysis and proof.Consider one of the LED transceiver blocks in Fig. 1. The k- th transmission bit s[k] is Manchester encoded into a binary codeword w[k] = (w1[k], w2[k]). We apply OOKmodulation to represent the digital codeword with a square wave m(t).During the ON period of the square wave, the LED is forward-biased to output a constant light level. During the OFF period of the square wave, the LED turns off and outputs photocurrent in response to the incident light power. Switching between the light emitting and sensing modes is realized by the dual-mode driver. The driver converts the photocurrent to a voltage signal and outputs a vector of samples U [k]. The demodulation and decoding steps require tight synchronization between the transmissions of the two devices. As such, samples are first used in a synchronization scheme to estimate the phase offset Δt between the two LED transceivers.If the two transceivers are determined to be asynchronous, we reshape the square wave m(t) to compensate for the phase error. The resulting square wave is denoted by m(t). Upon synchronization,we extract a binary bit c[k] from U [k] by a demodulation scheme. The decoder then performs an exclusive-OR (XOR) operation between c[k] and the transmission bit s[k] to obtain the received bit ŝ[k]. These schemes will be discussed the emit or sense state. Only when in the sense state can a LED device decide whether the other one has emitted light or not. Communication and illumination can be expressed by the system response given in Table I. In this table, the first two columns list the four possible states of the two LED devices.

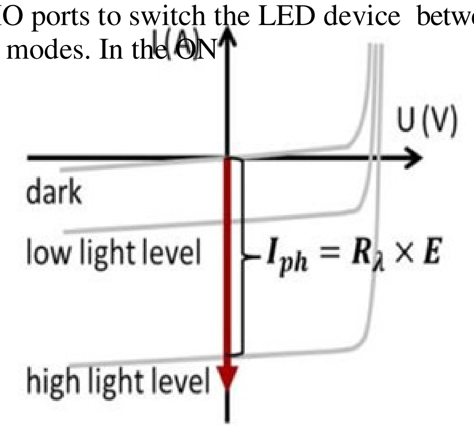


For each device, depending on its state, the correspondingtransceiver outputs three types of measurements: ‘light’, ‘no light’ and’unknown’.Consider the first row. Both transceivers have output ‘no light’ since these devices are in sense state and there is no transmission. Now consider the second row as example. Transceiver 1 outputs ‘light’ in response to the emit state of LED device 2, and LED device 1 being in sense state. On the other hand, transceiver 2 outputs ’unknown’ because LED device 2 is in emit state and hence cannot decide the state of the other device.

LED TRANSCEIVER FRONT-END

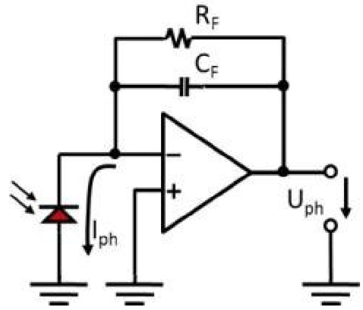
The LED transceiver front-end is a dual-mode driver circuit that connects the LED devices with the digital baseband modules. Fig. 2 illustrates the block diagram of the LED transceiver with front-end details. The transmitting part consists of a Manchester encoder, an OOK modulator and two configurable general-purpose input/output (GPIO) ports. A transmissionbits[k]is encoded and modulated into a square wave m(t). It configures two

GPIO ports to switch the LED device between two modes. In the ON



a) Short circuit mode.

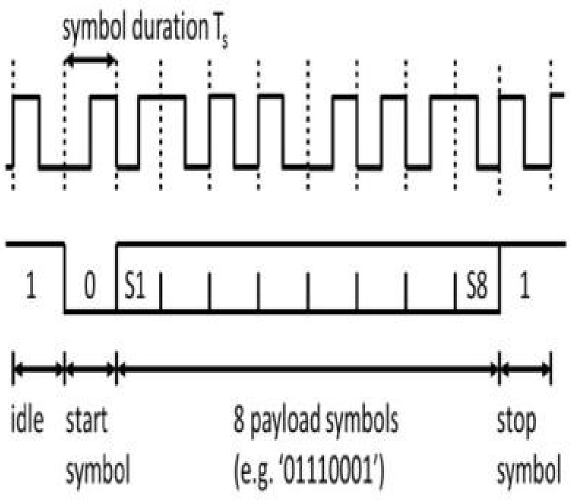
period of m(t), the LED device is in emitting mode. In the OFF period of m(t), the sensing mode is activated and the LED device is zero-biased to receive light. A photocurrent Iph(t) is excited and measured by the receiving part of the dual-mode driver.The receiving part consists of a trans-impedance amplifier (TIA) and an continuous analog-to-digital converter (ADC). The TIA converts the photocurrent to a voltage signal $U_{ph}(t)$ that is quantized using the ADC. The resulting samples U [k] = (U_1[k], U_{N_s} [k]) consists of N_s number of 10-bit ADC words and are used for demodulation and decoding. The light sensing and voltage conversion are detailed in Fig. 3. .In Fig. 3a, we show the current-voltage characteristics of a light sensing LED that operates photocurrent equals zero in a dark environment with E = 0. As such, theI_{ph} measurements are purely attributed to the power of the incident optical signal. This is an advantage over the photoconductive mode. Measurements of photocurrent I_{ph} are typically implemented with current-to-voltage converters (i.e. a TIA). It makes the temperature dependence of the output voltage signal much lower and is linearly proportional to a wide range of incident light intensity [29]. photovoltaic mode.The schematic of a TIA converter is shown in Fig. 3b. A feedback resistor R_F is connected between the inverting input of an operational amplifier (op-amp) and its output. This feedback resistor provides gain across the op-amp. For indoor situations where low light levels are



b)TIA Schematic.

possible, a large RF value is chosen so as to convert a weak photocurrent Iph to a voltage signal within the sensing range of the ADC. The output voltage is then Uph = Iph × RF . Despite a high op-amp gain, a large feedback resistor results in a noisy output signal. To compensate, the feedback resistor connects to a noise reducing capacitor CF in parallel. The capacitance balances the trade-off between stability and bandwidth of the TIA converter [30].

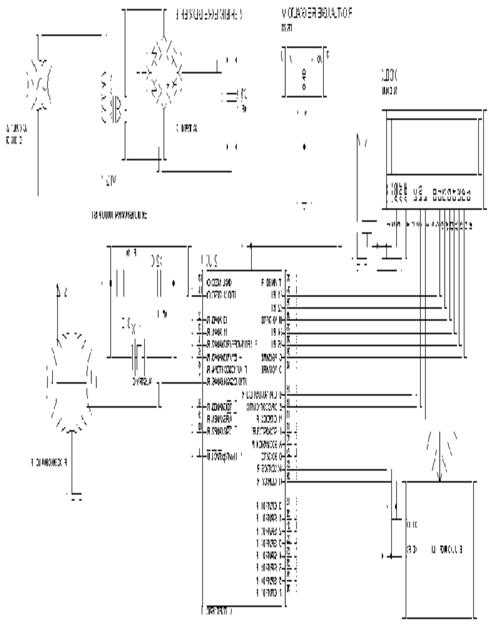
Fig. 4: Data frame structure.



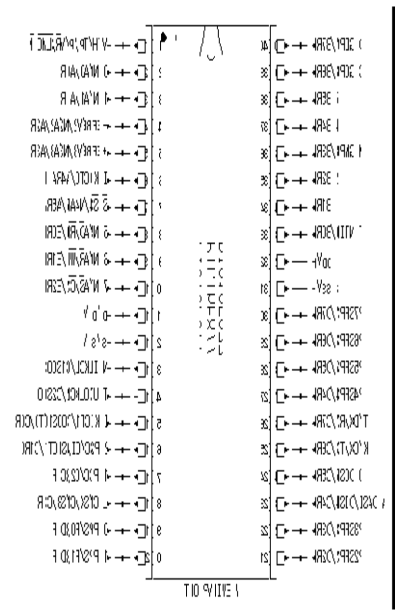
4 **CIRCUIT DIAGRAM**:

Step down transformer are connected the 230v ACinto 12v.Bridge rectifier are the circuit which convert AC into DC.Using the diodes arranged in the bridge circuit configurated.In the bridge rectifier there are four diodes are used.there are D1,D2,D3,D4.Input is supplied across the terminal A&B.Output is collected across the terminal C&D.Voltage regulator are used to convert the AC voltage into DC voltage.In 7805 voltage regulator has 3 pins input,output and ground.The output 12V DCisground to the pic microcontroller.

In the PIC has 40 pins.33I/O pins.then the 2 pins are supply,2 pins are ground,2 pins are oscillatorI/O,1 pins are reset/clr.They are 5 ports in PIC 16F877A .port A has analog input,digital I/O,other 4 ports are analog I/O .The oscillator input is given to the 13 pin and output is taken from the 14 pin.the flow sensor is connected to the 7 pin.LCD is used to measure/display the output.It is converted to the LCD display.LIFI module has 2 sections transmitter &receiver.The transmitter section are connected into the 26 pin and receiver section are connected the25 pin.

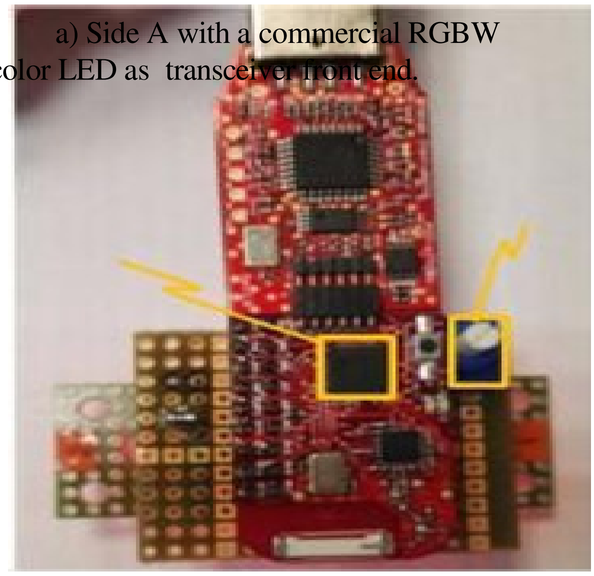


5 PIC MICROCONTROLLER(16F877A)



RA0-5	Input output port A
RA0-7	Input output port B
RC0-7	Input output port C
RD0-7	Input output port D
RE0-2	Input output port E
AN0-7	Analog input port
RX	USART Asynchronous receive
TX	USART Asynchronous transmit
SCK	Synchronous serial clock input
SCL	Output for both SPI and $I^2{}_C$ Modes
DT	Synchronous data
CK	Synchronous clock
SD0	SPI Data out
SD1	SPI Data in
SDA	Data I/O
CCPL,2	Capture in/capture out PWM out
OSC2/CLKOUT	Oscillator out check out
MCLR	Master clear
VPP	Programming voltage input
THV	High voltage test mode control
VREF+/-	Reference voltage
SS	Slave select for the synchronous serial port
TOCKI	Clock input to timer 0
TIOSO	Timer 1 oscillator output
TIOSI	Timer 1 oscillator input
TICKI	Clock input to timer 1
PGD	Serial programing data
PGC	Serial programing clock
PGM	Low voltage programming input
INT	External interrupt
RD	Read control for the parallel slave port
WR	Write control for the parallel slave port
CS	Select control for the parallel slave
PSPO-7	parallel slave port
VDD	Positive supply for logic andI/O pins
VSS	Ground reference for logic and I/O pins

a) Side A with a commercial RGBW color LED as transceiver front end.



b) Side B with MCU, integrated TIA and communication interface.

6.Conclusion:

We presented the design of a two-way VLC system with LEDs used as transceivers and also for illumination. We showed that for time-slotted VLC, the combination ofof Manchester codingand OOK modulation achieves the optimum trade-off between system rate and illumination. This scheme was used for data transmission along with a simple XOR decoding scheme at the receiver. At the receiver, OFF periods in the signal waveform were used for retrieving the transmitted information. We implemented a proof-of-concept LED prototype system with low-power single red LED and showed that data rates in the order of kbps could be achieved at a distancof a few tens of cm. . A detailed study of the impact of different LED material technologies on communication performance is beyond the scope of this study and is a subject of future work.

Reference:

[1] T. Komine and M. Nakagawa, "Fundamental analysis for visible-light communication system using LED lights," in IEEE Transactions on Consumer Electronics, vol. 50, no. 1, pp. 100-107, Feb. 2004.

[2] H. Yang, T. C. W. Schenk, J. W. M. Bergmans and A. Pandharipande, "Enhanced Illumination Sensing Using Multiple Harmonics for LED Lighting Systems," IEEE Transactions on Signal Processing, vol. 58, no. 11, pp. 5508-5522, Nov. 2010.

3] S. Rajagopal, R. D. Roberts and S. -K. Lim, "IEEE 802.15.7 visible light communication: modulation schemes and dimming support," IEEE Communications Magazine, 2012

[4] G. Corbellini, K. Aksit, S. Schmid, S. MangoldandT.Gross"Connectingnetwoks of toys and smartphones with visible light communication," in IEEE Communications Magazine, vol. 52, no. 7, pp. 72-78,Jul.2014.

[5] P. Dietz, W. Yerazunis and D. Leigh, "Very low-cossensing and communicatio usingbidirectionalLEDs," International Conference on Ubiquitous Computing, Oct. 2003.

[6] Christo Ananth, S.Silvia Rachel, E.Edinda Christy, K.Mala, "Probabilistic Framework for the Positioning Of a Vehicle in a Combined Indoor-Outdoor Scenario", International Journal of Advanced Research in Management, Architecture, Technology and Engineering (IJARMATE), Volume 2, Special Issue 13, March 2016, pp: 46-59

[7] S. Li and A. Pandharipande, "LED-based color sensing and control," IEEE Sensors Journal, pp 6116-6124, Nov. 2015

[8] D. Giustiniano, N. O. Tippenhauer and S. Mangold, "Low-complexity Visible Light Light Networking," IEEE Wireless Communications, vol. 22, no. 2, pp 94-100, 2015.

[12] Christo Ananth, Kanthimathi, Krishnammal, Jeyabala, Jothi Monika, Muthu Veni, "GSM Based Automatic Electricity Billing System", International Journal Of Advanced Research Trends In Engineering And Technology (IJARTET), Volume 2, Issue 7, July 2015, pp:16-21

[13] S. Li, A. Pandharipande and F. M. J. Willems, "Unidirectional visible light communication and illumination withLEDs," in IEEE Sensors Journal, vol. PP, no. 99, pp. 1-1, Oct. 2016.

[14] H. Elgala, R. Mesleh and H. Haas, "Indoor Optical Wireless Communication: Potential and Stae-of-the-Art," IEEE Communications Magazine, pp 56-62, Sep. 2011.

[15] P. H. Pathak, X. Feng, P. Hu and P. Mohapatra, "Visible Light Communication, Networking and Sensing: A Survey, Potential and Challenges," IEEE Communications Surveys and Tutorials, vol. 17, no. 4, pp.2047-2077,2015.

[16] Z. Wu, J. Chau and T. Little, "Modeling and designing of a new indoor free space visible light communication system," European Conference on Networks and Optical Communications, pp 72-75, 2011.

[17] N. Rajagopal, P. Lazik and A. Rowe, "Hybrid visible light communication for cameras and low-power embedded devices," ACM MobiCom Workshop on Visible Light Communication Systems, pp 33-38, 2014.

[18] L. Klaver and M. Zuniga, "Shine: A Step Towards Distributed Multi-Hop Visible Light Communication," IEEE International Conference on Mobile Ad Hoc and Sensor Systems, pp 235-243, 2015.

[19] H. Yang and A. Pandharipande, "Full-duplex relay VLC in LED lighting triangular system topology," InternationalSymposium on Communications, Control, and Signal Processing, 2014.

[20] H. Yang and A. Pandharipande, "Full-duplex relay VLC in LED lighting linear system topology," AnnualConference the IEEE Industrial Electronics Society, 2013.

[21] Y. Wang, L. Tao, X. Huang, J. Shi and N. Chi, "8-Gb/s RGBY LED-Based WDM VLC System Employing High-Order CAP Modulation and Hybrid Post Equalizer," in IEEE Photonics Journal, vol. 7, no. 6, pp. 1-7, Dec. 2015.

[22] J. J. D. McKendry, D. Massoubre, S. Zhang, B. R. Networking with LED-to-LED communication," in IFIP Wireless Days, Nov. 2012.

[9] S. Schmid, G. Corbellini, S. Mangold, and T. Gross, "An LED-to-LED Visible Light Communication system with software-based synchronization," GLOBECOM Workshops, pp. 1264-1268, Dec. 2012.

[10] S. Schmid, G. Corbellini, S. Mangold, and T. R. Gross, "Continuous synchronization for LED-to-LED visible light communication networks," in 3rd International WorkshopinOpticalWireless Communications (IWOW), Sep.2014.

[11] Q. Wang, D. Giustiniano and D. Puccinelli, "An Open-Source Research Platform for Embedded Vible

Rae, R. P. Green, E. Gu, R. K. Henderson, A. E. Kelly and M. D. Dawson, "Visible-Light Communications Using a CMOS-Controlled Micro-Light-Emitting-Diode Array," in Journal of Lightwave Technology, vol. 30, no. 1, pp. 61-67, Jan. 2012.

[24] T. Koike-Akino, P. Popovski and V. Tarokh,, "Optimized constellations for two-way wireless relaying with physical network