International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-8 Issue-11, September 2019

Implementation of Visible Light Communication for Data Acquisition using System on Chip

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Abstract: ***Visible light communication is the future of the globe communication having applications in trust areas like V2V communication, Vehicle to infrastructure, medical domain etc., We propose a design for a computer architecture in data acquisition system using system on chip to transmit the image data and the same is received in the receiver side. The proposed mode consist of hardware and software task.The hardware task is designed using zybo board which is soc board and Xilinx is used as an interface between hardware and the system. The proposed mechanism proves to have better data acquisition capability than other models at a higher data rate.***

Keywords—Light fidelity (Li-Fi), Physical layer, System-on-Chip, Visible Light Communication, Xillinx OS

I. INTRODUCTION

Transmission of information from one place to a different place wirelessly is noted as wireless communication. Wireless communication plays a vital role in our daily lives. Different types of waves are utilized in communication between the devices for wireless transmission of information, the one is electromagnetic waves. For example Cordless & Cell phones, radio & TV broadcast stations, satellite communication systems, radio location communication, GPS, Wifi, bluetooth and conjointly two-way radios all uses the RF spectrum. And today accessing mobile data network is augmented and the mobile information rate is increasing rationally with an rapid increase in usage of media services and within the same In future there'll be hundred billion IOT devices which will support the necessity for sensible houses and city developments that create the employment of frequency spectrum. Using the RF spectrum for all the wireless transmission makes the RF spectrum deficiency. Rf spectrum is limited and saturated the alternate solution to provide an reliable Rf spectrum using VLC

VLC = Illumination + communication

As a comprehensible source of illumination are often used each for illumination and communication, Using VLC the problem which arises in RF communication due to low bandwidth can be resolved due to the provision of extensive bandwidth as illustrated in table I. VLC has many advantages over RF communication like energy potency, as a result of lighting infrastructure are often reused on illumination by using data bearing techniques. The major prospective of VLC is making use of the available bandwidth resources up to 670 rate. With feasibility of VLC modulation of light signal can extend from 380-780nm. IF we have a tendency to opt for wireless communication it plays wide selection of role in our everyday life that uses frequency communication.

The advantages of VLC over RF is shown in table-I

Table-I comparison of VLC and RF

Feature	Visible Light Communication	Radio Frequency
EM Interference	VLC communication is not affected due to EM sources.	RF communication is affected due to EM sources.
Power Consumption	Less, It is power efficient system.	High, It is power inefficient system.
Bandwidth	High (400-800 Thz)	Low(3-300 G Hz)
Security concern	It provides secured communication due to LOS (Line Of Sight) communication within the room.	It does not provide secured communication as RF signal penetrate walls and can be intruded by some one from the other room.
Health risk	No health risks involved in VLC based wireless communication.	RF communication is harmful when high power is used for transmission.
Visibility	Yes	No

There are may applications based on visible light communications. For example LIFI, Vehicle to vehicle communication, under water communication, robots in hospitals, location based service.

II. IMPLEMENTATION

A. Major tasks in VLC

The task consists of two major parts. The first part is to design and build a transmitter and a receiver. The second part is to implement software to control these devices. Fig.1. and Fig.2. shows a more detailed structure of the task.

Manuscript published on 30 September 2019.
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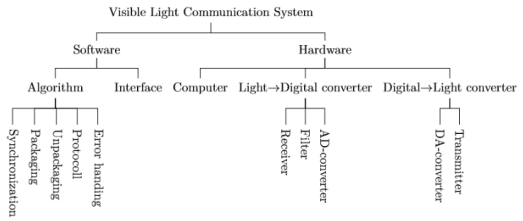


Fig.1. Major tasks in VLC

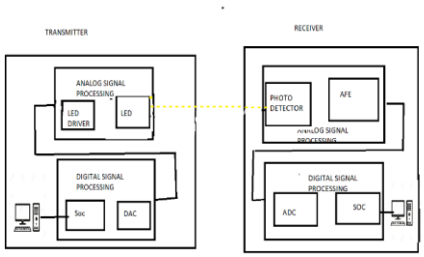


Fig .2. Block diagram of proposed module

B.SOC for image processing

Wireless communication which passes the data through a system on chip through Ethernet module to the computer system. and the modulated signal is then converted using DAC and the analog signal is then modulated into an light signal by the use of circuitry for LED driver , the LED driver then propagate the signal via light to the receiver, we already aforementioned that photodetector is employed for receiving the light-emitting diode transmitted signal, photo detector will convert the optical signal to electrical signal. Analog front end will process the SOC board, the AFE is used to signal amplifying, filtering of the transmitted signal. The AFE output is given to the ADC converter, analog output is converted represented by sequence in the form of digital signals, the binary sequence is read by the soc board in the receiver side, the information that is processed are th en transmitted to computer system using Ethernet module further process the information and display them.

C.SOC for network enabled VLC

SOC consist of hardware board are physical layer and MAC layer They have their own functions as well as they support each other in order to provide reliable communication between peer network layers of two IP enabled devices. In software aspect Xilinx vivado, these hardware and software are realized in FPGA development board. The field-programmable gate array (FPGA) is more feasible to utilize compared to general microcontroller for high-speed DSP application

D. Transmitter

For the VLC technology, switch kind light-emitting diode driver could be a general structure. It has high market growth in lighting technology to manage this of light-emitting diode with straightforward and by providing economic solutions in methodology, the traditional structure shown in Fig 1.3. It has floatable buck driver device with peak mode of current control. The systematic form of the structure additionally has PWM circuit for dimming illumination. This method has a possibility that the switch kind light-emitting diode circuit driver which limits the transmit speed has limitation speed. Because due to its limitation of ancient semiconductor device used. The utilization of an semiconductor device having lower power ends up in a frequency having low components in motive force. Moreover, we aim to minimize this and ripple voltage of light-emitting diode having with lower switching frequency, giant passive device are inevitable to store energy Moreover, the passive elementary device brings frequency at lower resonance.

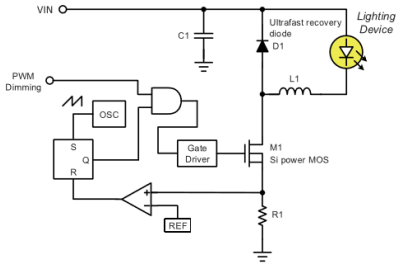


Fig .3. conventional floating bulk LED driver with PWM

In this proposed system to increase tha data rate GaN power device is used which is shown in the Fig. 1.4. this GaN has the capability of high change speed and low power loss. So that the silicon power is replaced with GaN, by this the proposed driver circuit achieves 10 megaherts switching frequency, and also it increases the bandwidth of the transmission information. The achieved bandwidth is almost 1 Mb/s. although in MOSFET by using ultrafast recovery diode with reverse recover mode shown in Fig. 1.3, will impact an extended change interval and high change of loss. So it is better to include the diode-connected GaN power semiconductor shown in Fig. 1.4. rather than the standard ultrafast recovery diode as a rectifier. The GaN power semiconductor connected with diode M2 that includes zero Qrr wont increase the deta rate and potency of the diode driver, resulting in a system's potency of 88% at 1-Mb/s rate. the M2 is ON where as the M1 is OFF and vice versa.

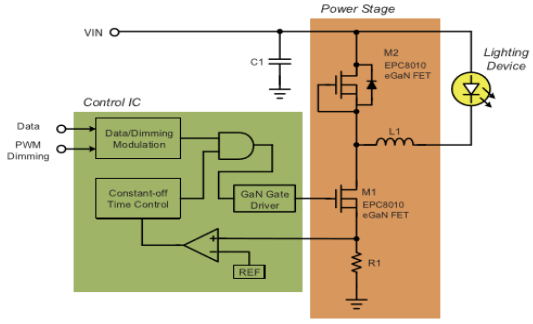


Fig .4. Proposed LED Driver

LED has much advantages than incandescent. Because of its characteristics in long expectancy, high tolerance in wetness, it consumes less power, and generates low heat lighting. LED is used with black white light and also in color which is used in traffic light controller and lot of alternative suggests that of illumination. To get the blue and green light InGaN material is used and commercially available in market. Compared

with standard lighting strategies, white diode has lower power consumption and lower voltage, longer lifespan, smaller size. And in basically LED is not only used for lightening it also can be used as a transmission medium for wireless communication.

Fig .5. LED for communication

The transmitted signal is then received by photo-diode, photo diode is that the device which will convert light signal into electrical signal on the receiver side. The signal then amplified by analog before processed additional by DAS and DSP system. The VLC receiver receives signals if they reside within LOS with the transmitter, so the receivers outside the area of the VLC supply won't receive the signals and so, because of it's the immunity to security problems that happens within the RF communication systems

E. Rolling Shutter Methodology

For visible light communication LED as used as a transmitter switching speed of LED is less than 1 µs So when the LED is on it is given as 1 in binary codes and 0 when the led is turned off, this on and off action permits information transmission utilization of binary codes. Photo detector is used to recover the original image, Nowadays all cameras embedded with CMOS camera. CMOS image sensors are operated in rolling shutter effect. rolling shutter is a method of capturing the image in a still camera or video frame is captured not by taking a snapshot of the entire scene at a single instant in time but rather by scanning across the scene rapidly, either vertically or horizontally And camera phones are widely used in daily lives. Therefore existing mobile phone sensor is highly desirable as the VLC Receiver. Which can provide low cost communication. The information is captured by camera in the form of light and dark stripes, these image in processed.

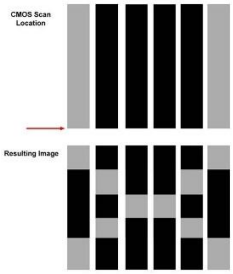
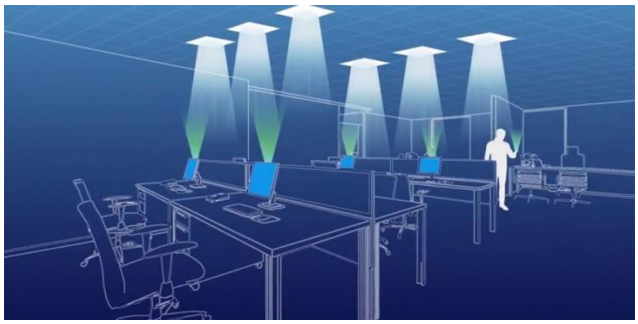


Fig .6. Rolling shutter Effect

F. Application Setup

A room is furnished by no of light fixtures which provides illumination and optical access point within the illumination pattern of light. The light can provide the optical downlink. the power and data can be provided to all the fixtures through different technique like power over ethernet, power line communication. Etc., the optical uplink is implemented by transmitters on user equipment. The both uplink and downlink works as transmitter and receivers.



Downlink transmitter Uplink Transimtter

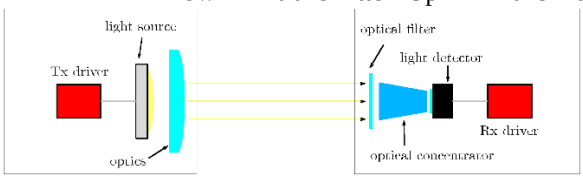


Fig.7.Key components in a LAC downlink transmission system.

In cellular system downlink communication uis defined as the transmission of data from access point to user equipment the basic block diagram of downlink is shown in figure

The light from the fixture is modulated with data and propagate to receiver on the user equipment.an optical element is used to propagate on photo diode which create the electrical signal and that further amplified to recover the data.

In connection for the uplink IR link is usually preferred, as the setup allows bidirectional communication with required filter in. Studies show that systems that only use VLC for the downlink and RF for the uplink show substantial efficiency gains over RF only networks

III. CONCLUSION

In this paper, we tend to design a Soc module for data transmission and digital data acquisition. By this testing, this proposed system is capable of achieving high data acquisition speed and its easy to transfer the data from soc board to computer to plot the sampled data using MATLAB. This high speed data acquisition will plays a crucial role as a subsystem of the visible light communication. For future work, we will integrate our DSP (FPGA Zybo) with analog front-end part. This work has strong correlation with the works. To track our research results and to know the relationship among others, the readers can find the following reference Later, the PHY layer on our Li-Fi subsystem can also be improved by designing RS based on H/W, then adding RLL 8B10B and Manchester Encoding.

REFERENCES

1. Digital image processing in LED visible light communications using mobile phone camera. IEEE 2016
2. Liu Y, Chen H., Liang K., & Hsu C., Visible light communication using receiver of camera sensor and solar cell, IEEE Photonic journal 2016

3. Danakis C, Afghani M, Povey G, et all Using CMOS Camera sensor for visible light communication // GLOBECOM WORKSHOPS 2012
4. Elgala H, Mesleh R, Hass H, Indoor broadcasting via white LEDs and OFDM IEEE Consumer Electronics 2009 55(3):1127-1134.
5. Liang C k, Peng Y C, Chen H. Rolling shutter Distortion correction[j]. Proceeding of SPIE – The International Society for Optical Engineering, 2005, 5960
6. Gonzalez R C, Wintz P. Digital image processing. [j]. prentice Hall International, 2001, 28(4):484.
7. Angga pratama putra. System on chip Architecture for High speed Data Acquisition in visible light systems. 978-1-5090-3840-4/16/$31.00 ©2016 IEEE.
8. Cihun-Siyong Alex Gong High Efficiency for LED Driver for VLC applications, scientific reports 2016