

Cost Effective High Speed Hardware Modelling of VLC System with LED

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ABSTRACT: Light, rather simply removing the darkness is now used as a legendary source of communication. This manuscript discuss about the incorporation of light as a medium for data communication. Here two devices are interfaced through light without any interconnection. This proposed model describes how LED can be used as a source for data transmission and sensor for data reception. Here we are using light emitting diode (LED) instead of using photo sensor for cost reduction. This model acts as test bench and renders satisfactory results for serial communication with in 5meter. The comparative study shows better trade of when compared to other proposed model in reputed journal.

Keywords: VLC, Super Bright LED, Op-Amp, BJT, FSO.

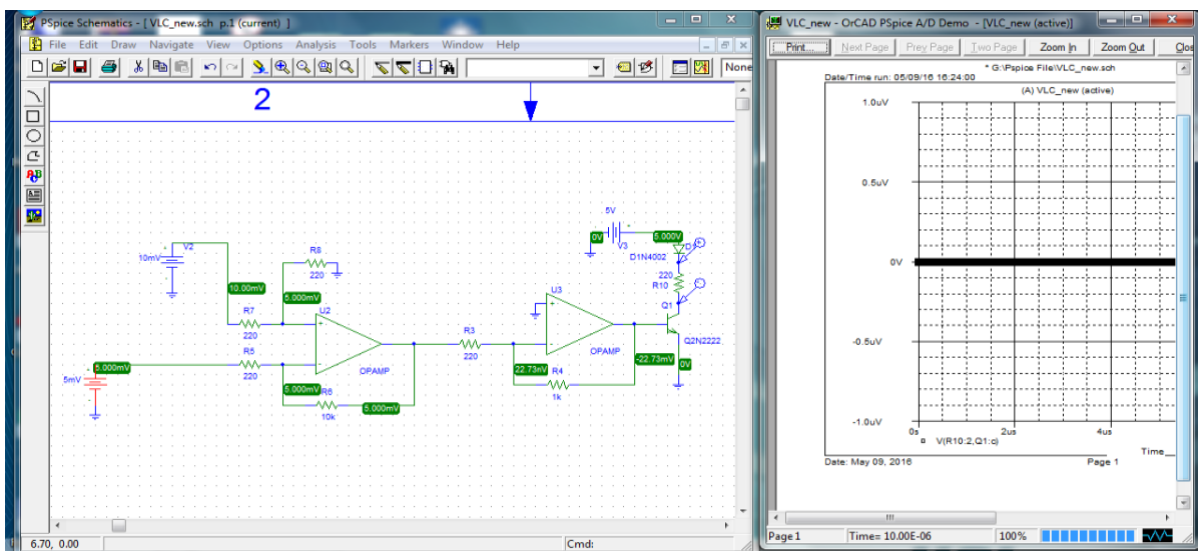
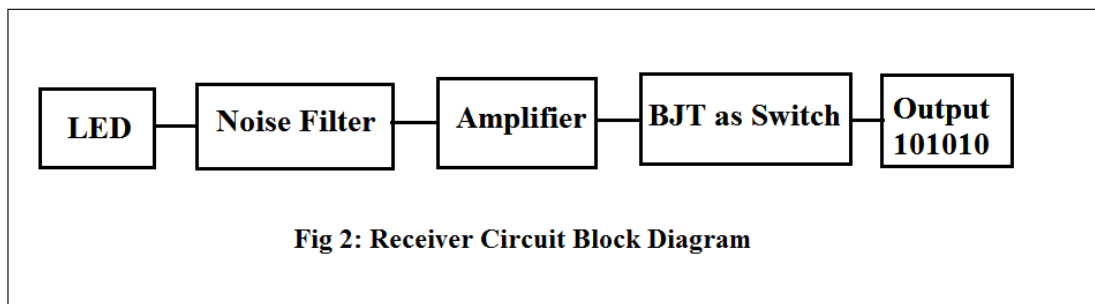
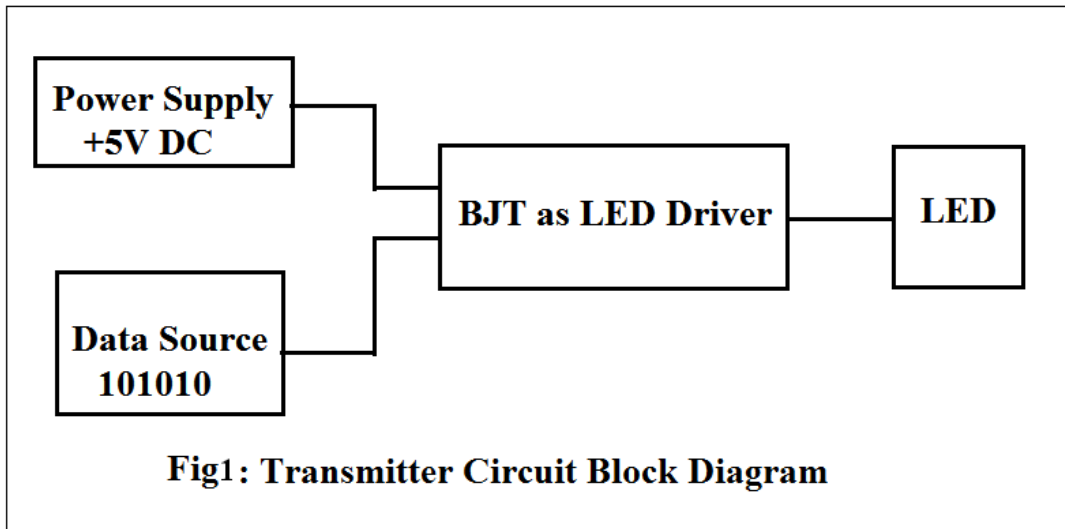
I. INTRODUCTION

Visible Light Communication (VLC), a brain child of famous scientist Alexander Graham Bell was reported in 1880s in Washington, D.C. named "Photophone" which transmitted speech on modulated sunlight over some 213 meters (700 feet) apart[1]. Contemporary research works was initiated in 2003 in Nakagawa Laboratory, in Keio University. In 2006, Researchers from CICTR at Penn State proposed a combination of Power Line Communication (PLC) and white light LED to provide broadband access for indoor applications[2]. Then after in January 2010 a team of Researchers from Siemens demonstrated VLC transmission at 500 Mbit/s over a distance of 5 metres and 100 Mbit/s covering longer distance[3]. By now VLC standardization process is included in IEEE Wireless Personal Area Network working group (802.15.7). In July 2011 a live demonstration of high definition video being transmitted from a standard LED lamp was publicized at TED Global[4]. Recently Organic LEDs (OLED) have been used as optical transceivers to build up VLC up to 10 Mbit/s[5]. In October 2014, Axrtex launched a commercial bidirectional RGB LED VLC system called MOMO that transmits down and up at speeds of 300 Mbit/s and with a range of 25 feet[6]. In May 2015, Philips collaborated with supermarket giant Carrefour to deliver VLC location based services to shoppers' smartphones in a hypermarket in Lille, France[7].

Now we introduced a virtual model of VLC system using an interactive learning model, and using our virtual model we can transmit data between two laptops. Our proposed model can be incorporated in other communication devices. Further study reveals that there is an ample scope of research in this category so that future VLC can be made commercially available for Internet access, vehicle-to-road communication using traffic signal lights, home security systems etc. VLC has a widespread application in power plant, railway signalling system, highway traffic control, automatic car breaking system, under water communication, indoor robotic vehicles controlling, hospitals, and large open offices. The shortcomings of radio frequency bandwidth may be resolved by VLC. Further it can be introduced for a high speed (10 GB/s+) and long range (3 – 5 km) by Free-Space Optical Communication (FSO) system.

II. PROTOTYPE OF THE PROPOSED COST EFFECTIVE VLC

The authors aim to develop a VLC system with very low cost. So, emphasis was given to use LED as a photo sensor. The operational manoeuvres that one LED transmits information and another LED can receive this information. In transmitter part a +5V constant DC power supply was used, a data source (like a square pulse generator) for sending information, a LED driver, and a super bright LED comprised the proposed model of VLC. On other side for receiver part a super bright LED, a noise filtering circuit, an amplifier, a switching circuit, and an output device like CRO was attached. Later the model was simulated in PSpice Schematics simulator and subsequently hardware model was designed that can successfully transmit and receive data up to 5 meter (In quite dark) and 3 meter (In normal light) using one transmitter LED only and one receiver LED (Serial data transmission). The block diagram of the proposed model is depicted in Fig 1.



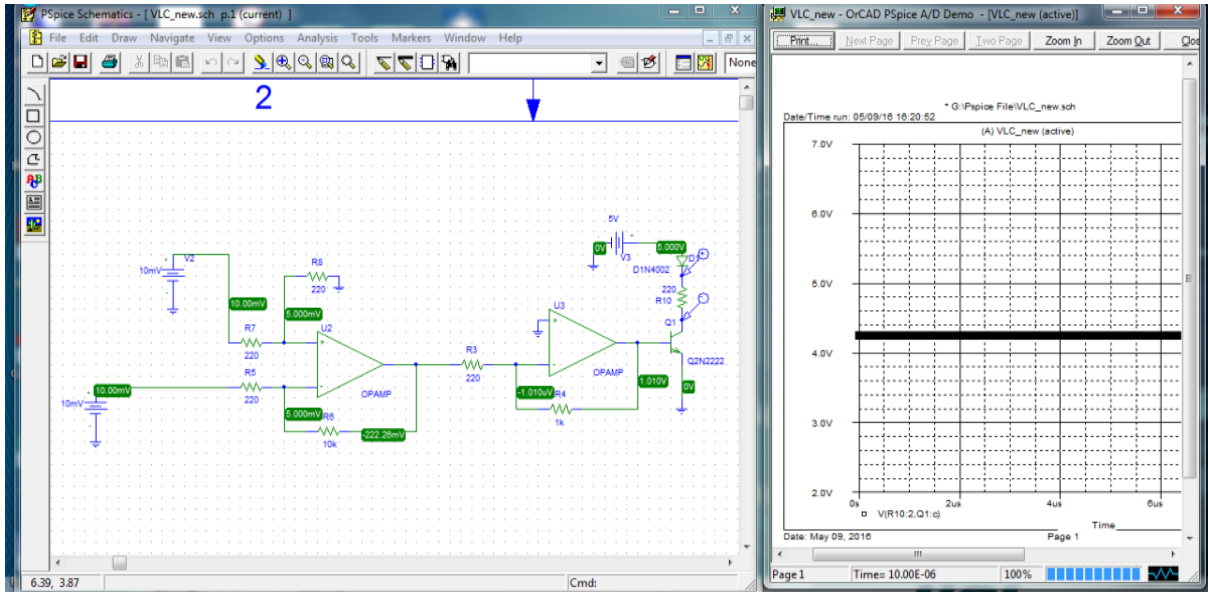


Figure 4: With LED Light

III. OPERATIONAL MANOEUVRE OF THE PROPOSED VISIBLE LIGHT COMMUNICATION

In the transmitter part when a signal (Like 101010) is given to the base of the transistor (BJT 547) then the transmitter LED will glow as per given signal. It resembles that when one wants to send information (transmit), the LED glows in unidirectional path.

On the other side in receiver section when the transmitted signal is received by another LED then this LED will generate some electrical voltage (when photons are received by a PN junction diode then it generates some electrical voltage). This small amount of voltage (10mV) is then amplified by an inverting amplifier. After amplification a subtractor circuit was used for removing noise (without transmitter light LED generates 5mV electrical voltage). Then we get the actual signal (Like 101010). If we connected a LED with this actual signal in transmitter section then this LED will glow as per given input signal in transmitter section.

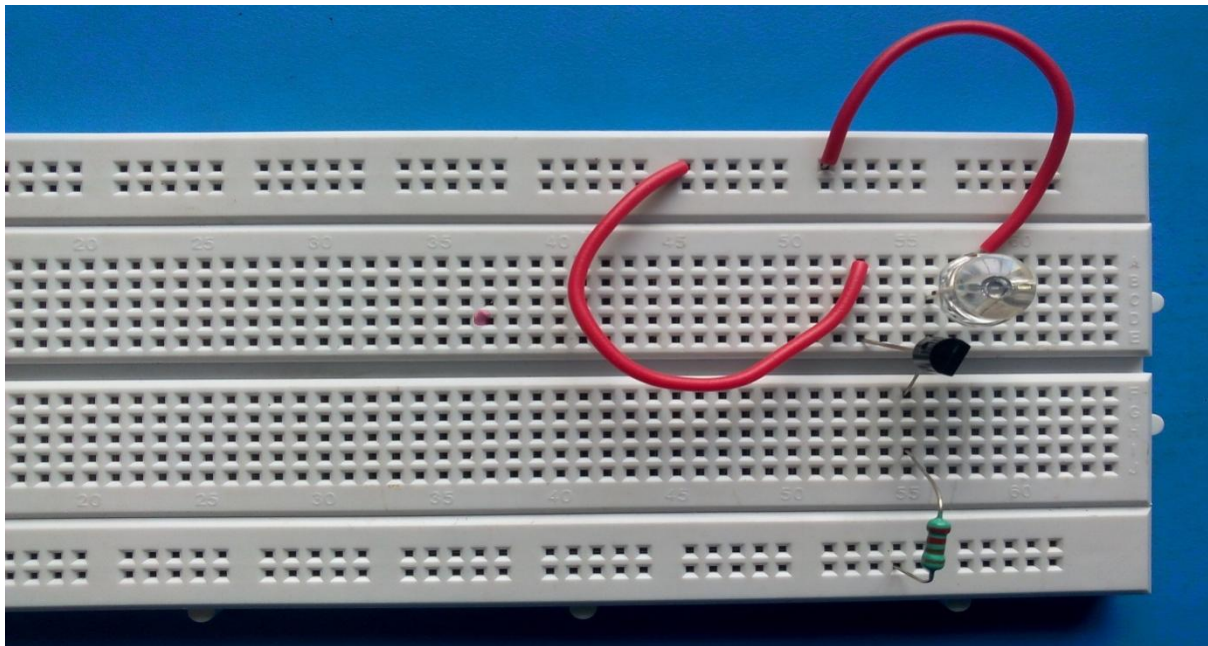


Figure 5: Transmitter Circuit

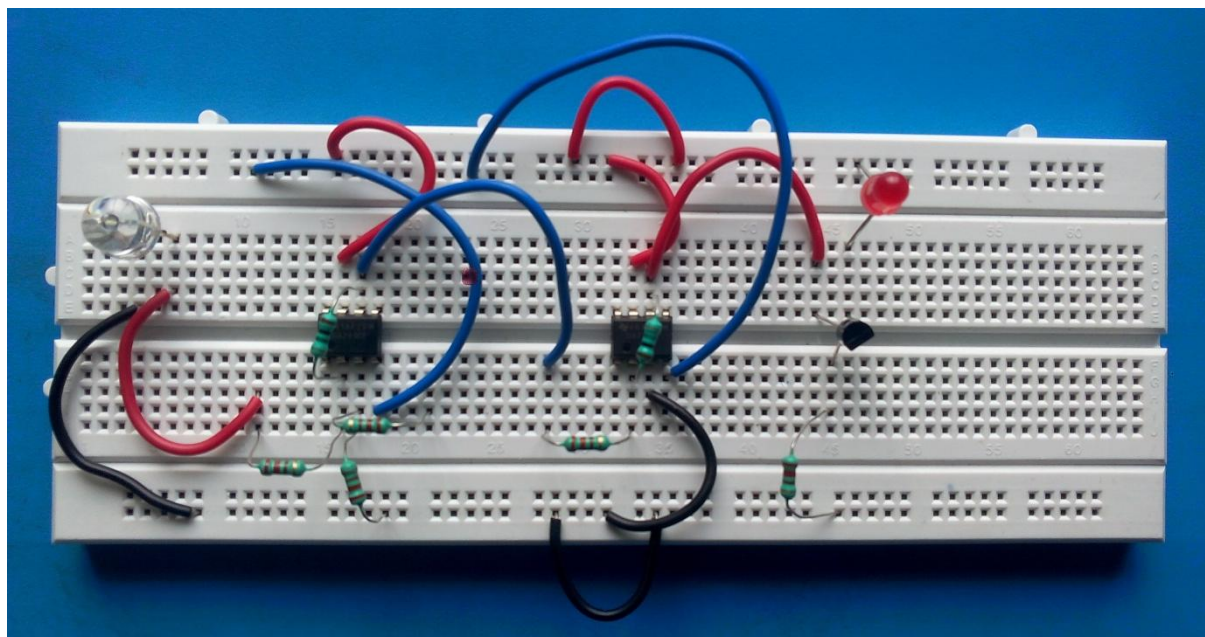


Figure 6: Receiver Circuit

IV. ADVANTAGE OF THE PROPOSED VLC

It is not only economic but is also soothing because humans can perceive it and act to protect their eyes too. This proposed VLC is quite trustworthy because visible light is obstructed by wall so i.e., if one can see then only he can access it. Further it can be integrated into medical devices and in hospitals as this technology doesn't deal with radio waves. It can be included in Bluetooth and Wi-Fi.

V. APPLICATION OF THE PROPOSED VLC

VLC has a widespread application such as power plant, railway signalling system, highway traffic control, under water communication, indoor robotic vehicles controlling, hospitals and large open offices. It is anticipated that our proposed model will be used as a street lamp and can be treated as data access point simultaneously.

VI. CONCLUSION

The target is to communicate using VLC at low cost. So photo sensor was replaced by LED. But the problem is that it can successfully transmit data up to 5 meter. But it can be overcome by proper focusing and by perfectly converging transmitted light. Also research on parallel data transmission technique using LEDs array for high speed transmission is in progress. Thus the author's conclusively state that our model in near future will be adopted in developing nations.

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