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Protocol Design for Hybrid Visible Light Communication (VLC) and RF Communication in Indoor Environment

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ABSTRACT

This paper introduce the concept of "visible light" for an enabling technologyin indoor environment. Over the years many different strategies and technologies have been proposed for communication and bidirectional data transfer. Visible light communication (VLC) uses a immense unregulated and free light spectrum. It is considered to be a solution as overcome the crowded radio spectrum as wireless communication systems. However, duplex communication, user mobility, and handover mechanisms are becoming ambitious tasks in a VLC system. This project proposes a hybrid network model of VLC and RF in which the VLC channel is only used for downlink transmission.

I. INTRODUCTION

For any communication, a communication medium like a wire or Radio Frequencies is required. With conventional radio frequency (RF) communication bandwidth becoming more and more crowded by existing wireless communication technologies like Wi-Fi, Bluetooth etc.hence there is a need for new communication technology that does not require RF. Visible Light Communication (VLC) is fast emerging technology that can serve as an alternative to many wireless communication technologies [1].

Instead of having a separate medium such as wires or radio frequency the project proposes to have visible light as medium.

VLC uses optical communication, it has many inherent advantages over RF technologies. VLC is capable of higher bandwidths than RF technologies. VLC does not cause any radiation exposure hazards. VLC is also immune to electromagnetic interference and hence can be used in applications where most RF technologies cannot be used like inside aircrafts and industries [2].Unlike other optical technologies like IR, VLC involves visible light spectrum and can be implemented with our ordinary light source itself[3].

Thin-film high-power phosphorescent white LED used as VLC[4]. This system will enable high quality of service by the high radiation power from this lighting equipment. And, this system does not cause or suffer from radio or electromagnetic interference [5].Optical wireless was limited for a longtime due to insufficient optical power Recently, low-cost high-power LEDsare available using infrared andvisible lightfor data transmission, LED can bemodulated at high speed Flicker is not visible[6]

II. DESCRIPTION OF PROPOSED SYSTEM

The proposed system uses visible light as a medium of communication. LED lamps as used for data transmission instead of separate transmitters. The design of a VLC bridge circuitry that performs bidirectional data transfer between PCs has been proposed in this work.

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The block diagram of proposed VLC transmitter is shown in Figure 1.

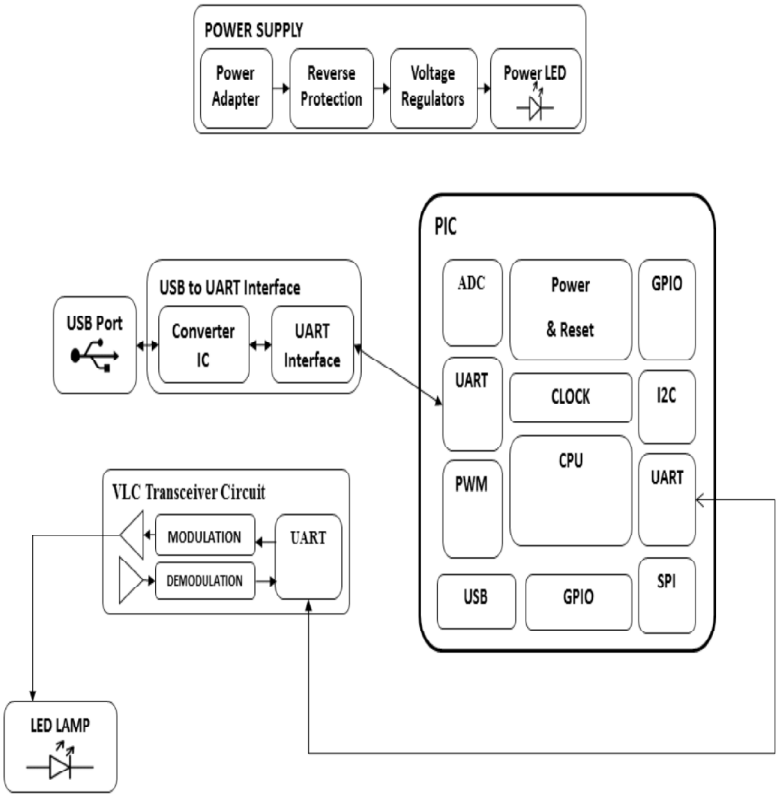

Figure 1: VLC Transmitter

Visual Basic program has been coded to handle connection and data transfer between VLC hardware and PC through USB interface.

The block diagram of proposed VLC receiver is shown in Figure 2.

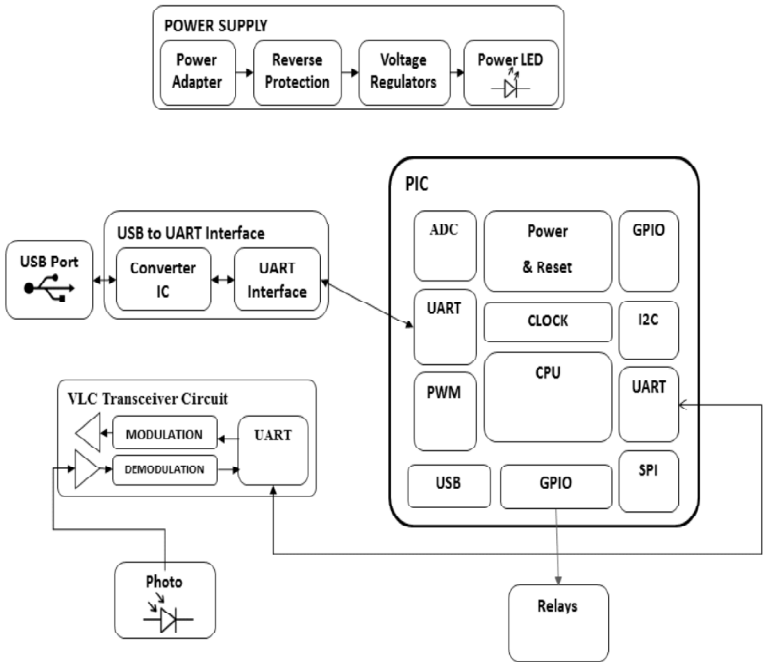

Figure 2: VLC Receiver

(A) Control Module

The PIC controller has peripheral features like inbuilt ADC, required to get the signals from the various sensors. Maximum clock frequency is 48MHz. Hence faster than 8051.Embedded C is used for programming the microcontroller.

(B) USB to Full Handshake UART IC

Single chip USB to asynchronous serial data transfer user interface. Entire USB protocol is handled by chip. No USB specific software programming required. Fully integrated 2048 byte multi-time-programmable (MTP) memory, storing device descriptors and CBUS I/O configurations. Data transfer rates from 300 baud to 3 Mbaud (RS422, RS485 and RS232) at TTL levels.

(C) VLC transceiver

12V LED lamp is used as VLC Transmitter and Photo receiver that receives white light is used as VLC receiver.Bi-directional data communication over the visible light spectrum is done.Data is transmitted by modulating the intensity of the light, which is then received by photo-sensitive detector, and the light signal is demodulated into electronic form.

(D) Switching Circuit/Relay Drive

Relays are electromechanical switches that can be controlled by ordinary digital pins.But relays require more current than that can be given by a microcontroller or PLC.Hence a relay drive is required for current amplification between the low current digital circuitry and the relays.

III. IMPLEMENTATION OF VLC TRANSCEIVER

(A) Software design

The Getting Started window appears when you launch LABVIEW. Use this window to create new projects and open existent files. Also we can access resources to expand the capability of LABVIEW and information to help learn about LABVIEW. The Getting Started window disappears when open an existing file or create a new file and reappears whenwe close all open front panels and block diagrams. It also displays the window from front panel or block diagram by selecting View»Getting Started Window.

It contain two interfaces

- Front panel
- Block diagram

The Front Panel is “the window through which the user interacts with the program”.When we run a LABVIEW VI, we must have the front panel open so that we can input data to the executing program.The front panel displays program’s output.

The block diagram window contains the graphical source code of a LABVIEW VI – it is the actual executable code. construct the block diagram by cabling together objects that perform specific functions.The various components of a block diagram are terminals, nodes and wires. The block diagram of proposed system design in LABVIEW is shown in figure 3.

The output panel of proposed work in LABVIEW is shown in figure 4.

(B) Hardware design and results

The design of VLC transceiver involves VLC white LED, Photo diode , Relay KT-603 .All these components are interfaced to PIC controller. FT231X used to interface between software and hardware. When the COM

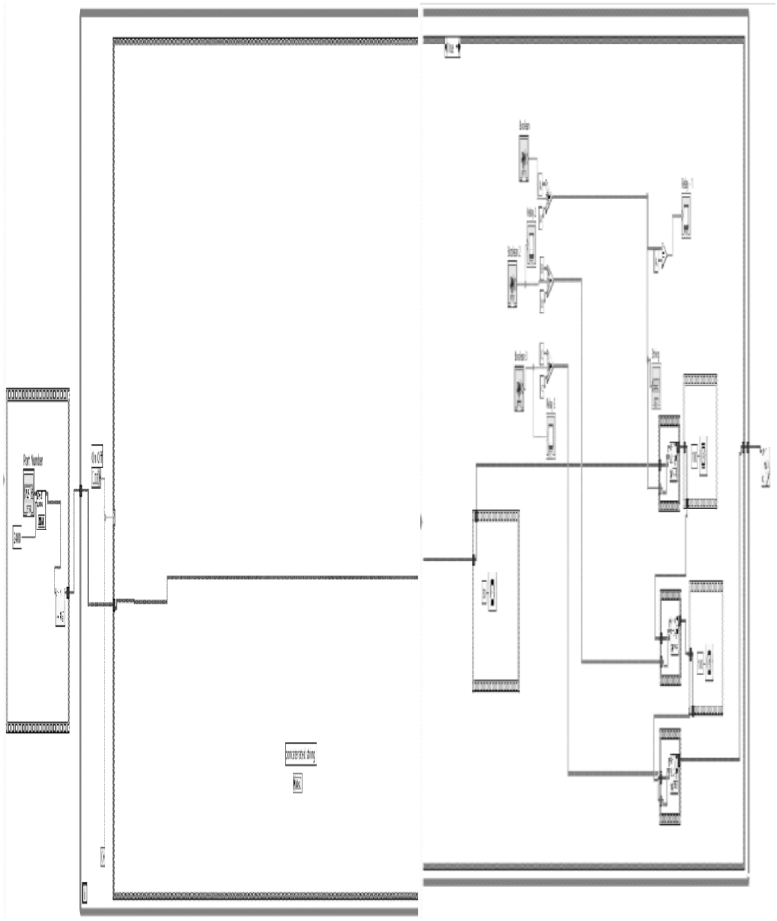

Figure 3: Block diagram design in LAB VIEW

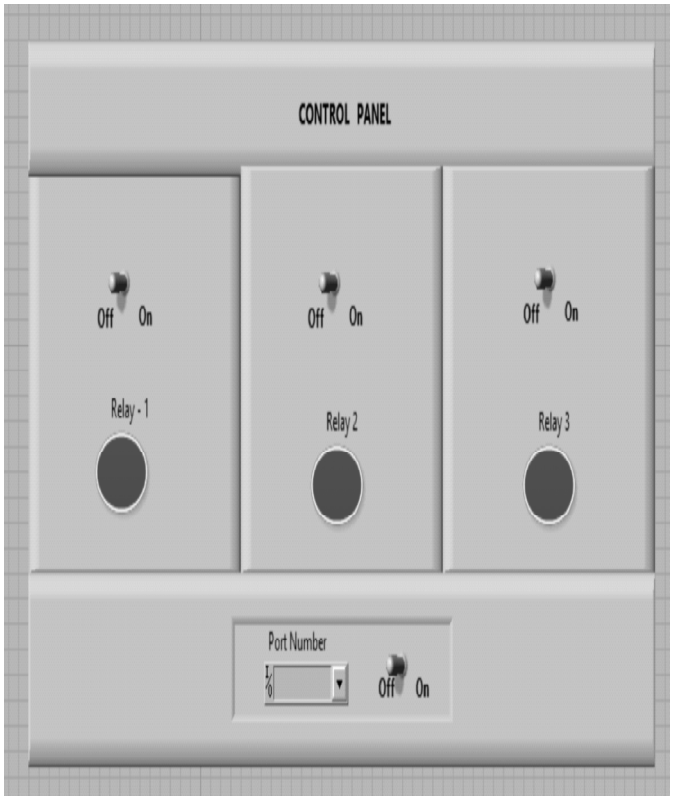

Figure 4: Output panel of proposed work in LAB VIEW

16 is entered in the Port Number and ON the port then communication between the hardware and software started

In an LED light bulb, a constant current is applied which produces a constant stream of photons that are emitted from the bulb which is observed as visible light. When the current is varied slowly the output intensity of the light dims up and down.The optical output is modulated at extremely high speeds by varying the current and is detected by a photo-detector device and converted back to electrical voltage. Due to its high speed the intensity modulation is imperceptible to the human eye.the hardware implementation of VLC transmitter is shown in figure 5.

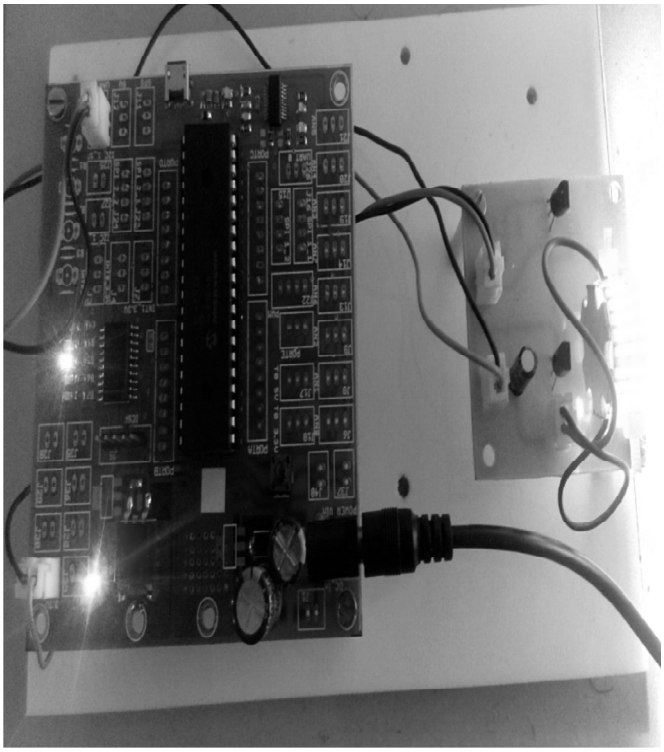

Figure 5: Hardware implementation of VLC transmitter

The 3 relays ON on the control panel is shown in figure 6

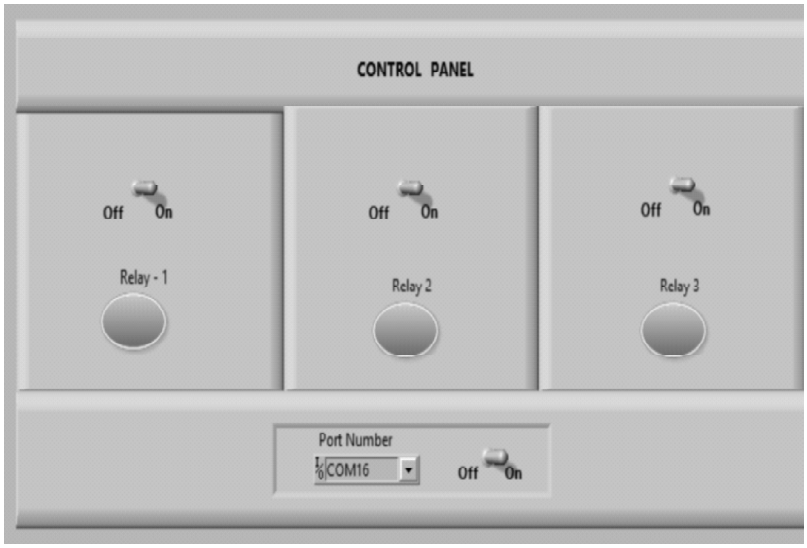

Figure 6: 3 relays ON on the control panel

All the 3 relays are ON in hardware implementation is shown in figure 7

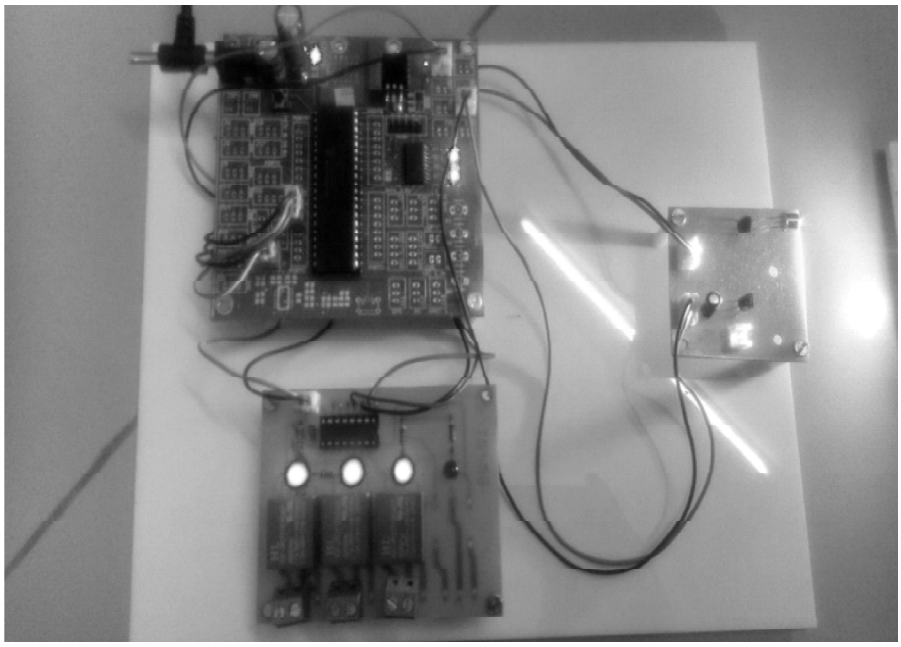

Figure 7: All the 3 relays are ON in hardware implementation

IV. CONCLUSION

This proposed model can be used in bandwidth constrained places and in places fear of electromagnetic interference such as aircrafts and industries. Also this model providesIncreased Data density and more security withLess ecological impact

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