International Journal of Electronics and
Communication Engineering (IJECE)
ISSN(P): 2278-9901; ISSN(E): 2278-991X
Vol. 10, Issue 1, Jan–Jun 2021; 27–44

International Academy of Science, Engineering and Technology
Connecting Researchers; Nurturing Innovations

LI-FI INTEGRATED TO POWER-LINES FOR SMART ILLUMINATION CUM COMMUNICATION

G.S. Uthayakumar

Research Scholar, Department of Electronics and Communication Engineering, St. Joseph's Institute of Technology, Chennai, India

ABSTRACT

Li-Fi is basically known as LIGHT FEDILITY, an outcome of twenty first century. Data can be transmitted through LED light whose intensity varies even faster than the human eye. As the transmission of the data takes place through the light emitting diodes (LED's), the data transmission rate is comparatively very high than Wi-Fi. Hence it is called as the optimized version of Wi-Fi. The major advantageous of this technology is to decrease the cost of wireless communication system.

KEYWORDS: *Light, Fedility, Light Emitting Diodes, Wi-Fi*

Article History

Received: 31 May 2021 | Revised: 02 Jun 2021 | Accepted: 08 Jun 2021

INTRODUCTION

In order to know the working of Li-Fi we need to know the necessity for Li-Fi. With the vast development in living the use of gadgets and invention of new gadgets is increasing which lead to the technological developments. There are many situations in which people get frustrated with the dull performance signals of Wi-Fi at a place with many network connections in seminars and conferences, but Li-Fi fulfils these needs. The LED is ON then the binary bit 1 can be transmitted and if the LED is OFF then the binary bit 0 can be transmitted. LED's can be switched ON and OFF very quickly. For transmitting data successfully we require only LED's and controller that code data into LED's. Parallel data transmission can be done by using array of LED's or by using red, green, blue LED's to alter light frequency with the frequency of different data channel. Advancements and enhancements in this field generate a speed of 10Giga Bytes per second. LI-FI usually is based on light and so it can be probably implemented in articrafts and hospitals that are prone to inference from radio waves. Unlike Wi-Fi, LIFI Technology can work even under water which makes it. This is shown in Figure 1.

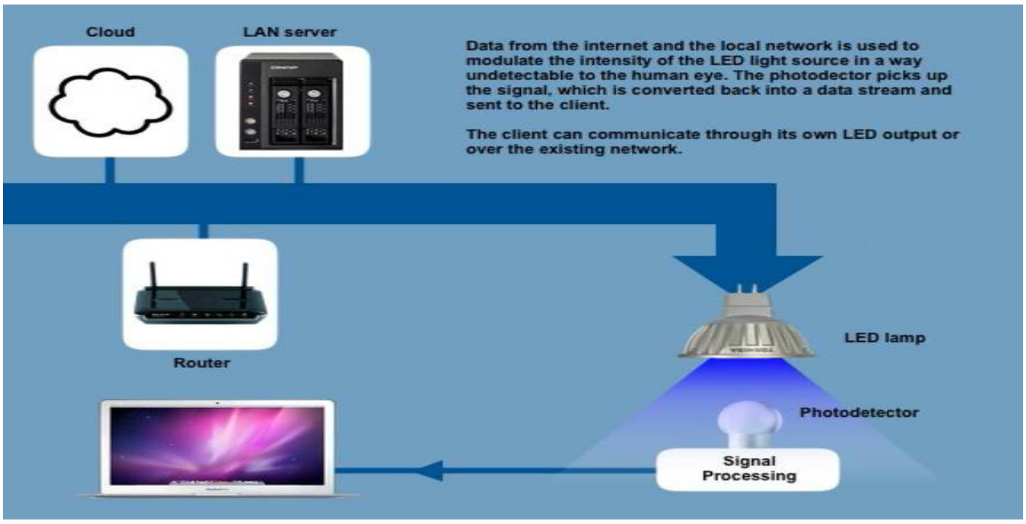

Figure 1: Working of LI-FI.

Comparison between Li-Fi & Wi-Fi

LI-FI is a term, one used to describe visible light communication technology applied to high speed wireless communication. It acquired this name due to the similarity to WI-FI, only using light instead of radio. WI-FI is great for general wireless coverage within buildings and li-fi is ideal for high density wireless data coverage in confined area and for relieving radio interference issues, so the two technologies can be considered complimentary.

Block Diagram of Proposed System

The transmitter in a visible light communication system is an LED luminaire. An LED luminaire is a complete lighting unit which consists of an LED lamp, ballast, housing and other components. The LED lamp (also referred as an LED bulb in simpler terms) can include one or more LEDs. The lamp also includes a driver circuit which controls the current flowing through the LEDs to control its brightness. When an LED luminaire is used for communication, the driver circuit is modified (further details in Section 5) in order to modulate the data through the use of emitted light. For example, in a simple On-Off Keying modulation, the data bit “0” and “1” can be transmitted by choosing two separate levels of light intensity. The block diagram is shown in Figure 2

VLC Transmitter

Modulation Method With the understanding of path-loss, noise and SNR, we now discuss various modulation methods used in VLC. The most striking difference between VLC and RF is that in VLC, the data can not be encoded in phase or amplitude of the light signal. This means that phase and amplitude modulation techniques can not be applied in VLC and the information has to be encoded in the varying intensity of the emitting light wave. The demodulation depends on direct detection at the receiver. These set of modulation techniques are referred as IM/DD (Intensity Modulated/Direct Detection) modulations.

VLC Receiver

VLC receiver can be used to receive the signal transmitted by an LED luminaire with photo detector - also referred as photodiode or no imaging receiver. These multiple LEDs can be treated as multiple transmitters that can enable visible light MIMO communication. Multiple LEDs can be used for higher spectral efficiency in VLC. Note that there are certain similarities between the VLC MIMO systems discussed in this section and screen-camera links as both of them can use an image sensor as a MIMO receiver. The difference is that unlike smartphone screens, the multiple LED transmitters considered here are also used for the illumination.

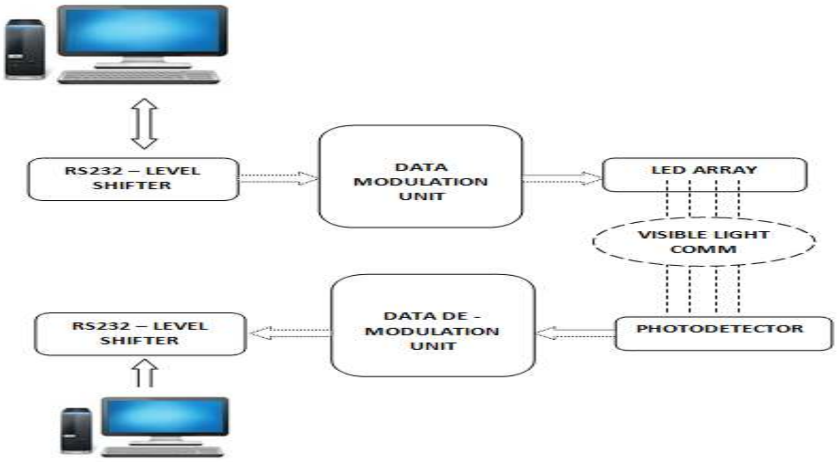

Figure 2: Block Diagram of Proposed System.

MIMO Receiver

The performance of the system depends on whether imaging (image sensor) or non-imaging (photodiode) receiver is used. Non-imaging receiver in a MIMO system is a set of independent photodiodes each with its individual concentrator optics. The advantage of such a receiver is that a very high gain can be achieved due to narrow FOV of each photodiode. The disadvantage, however, is that such a receiver requires careful alignment with the transmitters because of the narrow FOV, and the capacity can reduce dramatically even with minor misalignment.VLC system architecture. Detailed understanding of the system components can allow researchers to build a VLC platform that can be used to evaluate newly design protocols or techniques.VLC platform that can be used to evaluate newly design protocols or techniques.

RS232

When we look at the connector pin out of the RS232 port, we see two pins which are certainly used for flow control. These two pins are RTS, request to send and CTS, clear to send. With DTE/DCE communication (i.e. a computer communicating with a modem device**)** RTS is an output on the DTE and input on the DCE. CTS are the answering signal coming from the DCE. Before sending a character, the DTE asks permission by setting its RTS output. No information will be sent until the DCE grants permission by using the CTS line. If the DCE cannot handle new requests, the CTS signal will go low. A simple but useful mechanism allowing flow control in one direction. The assumption is that the DTE can always handle incoming information faster than the DCE can send it. In the past, this was true. Modem speeds of 300 baud were common and 1200 baud was seen as a high speed connection.

Power Supply Unit

The AC voltage, typically 220v rms is connected to a transformer which steps that AC voltage down to the level of the desired DC output. A diode rectifier then provides a full wave rectified voltage that is initially filtered by a simple capacitor filter to produce a DC voltage. This resulting dc voltage usually some ripple or AC voltage variation. The potential transformer will step down the power supply voltage (0-230V) to (0-6V) level. Then the secondary of the potential transformer will be connected to the precision rectifier, which is constructed with the help of op–amp. The advantages of using precision rectifier are it will give peak voltage output as DC, rest of the circuits will give only RMS output. Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustable set voltage.

The transmitter communication module is responsible for modulation and digital to analog conversion of the data. The dimming module maintains the desirable dimming level for the illumination. The driver circuit combines the analog input data for communication and dimming control signal (DC power level), and superimposes them to drive the LED. The visible light signals emitted by the LED are then received by the photodiode. Note that both LED and photodiode typically employ a lens to achieve a specific FOV. The received signal is filtered using an optical filter of specific wavelength and amplified. The receiving communication module converts the received analog signals to digital and demodulates them. If the communication modules are software-defined, various modulation/demodulation and MAC modules can be programmed and evaluated. We next survey programmable VLC platforms that are used in some of the recent research.

The pioneering efforts of utilizing LEDs for illumination as well as communication date back to year 2000 when researchers in Keio University in Japan proposed the use of white LED in homes for building an access network. This was further fuelled by rapid research, especially in Japan, to build high-speed communication through visible light with development of VLC support for hand-held devices and transport vehicles. This led to formation of Visible Light Communications Consortium (VLCC) in Japan in November of 2003. VLCC proposed two standards - Visible Light Communication System Standard and Visible Light ID System Standard - by 2007. These standards were later accepted by Japan Electronics and Information Technology Industries Association (JEITA) as JEITA CP-1221 and CP-1222 respectively. The first IEEE standard for visible light communication was proposed in 2011 in the form of IEEE 802.15.7 which included the link layer and physical layer design specifications. In last couple of years, the achievable VLC link capacity has surpassed 1 Gbps, and increasing research efforts are being directed towards realizing the full potential of VLC.

Vehicular Communication

In this section, we review the application of VLC in the vehicular communication. As the VLC based vehicular communication systems are used in the outdoor scenario, they have one distinguishing characteristic compared to the indoor applications. Solar radiation and other light sources, such as the road Vehicular communication In this section, we review the application of VLC in the vehicular communication. As the VLC based vehicular communication systems are used in the outdoor scenario, they have one distinguishing characteristic compared to the indoor applications, namely the non-negligible ambient light interference due to background solar radiation and other light sources, such as the roadlight, the building lights, etc. Most of the VLC vehicular communication systems address the problem and present ways to mitigate the effects of intense ambient interference.

The VLC vehicular communication systems address the problem and present ways to mitigate the effects of intense ambient interference. The VLC applications for vehicular communication fall into two categories: Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V). For the V2I applications, they focus on utilizing the traffic related infrastructure, such as traffic light, street light etc. to communicate useful information. There are two types of cells in V2I communications. In the first type, the street lights whose primary purpose is to provide illumination can be used for data communication with cars or pedestrians. Such VLC cells can typically provide coverage in 50 - 100 meters range. The other type of outdoor LEDs is traffic signalling LEDs that can communicate with cars. Since their primary purpose is not illumination and because they are always ON (even when there is sunlight), they are more suitable for applications such as vehicle safety, traffic information broadcast etc. On the other hand, the illumination LEDs are available on streets even where there are no traffic lights, making them more suitable for high-speed Internet access type of applications. For the VLC based vehicular communication systems, both types of receivers - the photodiode and the image sensor are used. Another advantage of the image sensor is that it is more resistant to the light interference.

Human-Computer Interacting Using Visible Light

There is a growing interest in utilizing the wireless communication systems for enabling improved HCI. Recently, RF communication systems, especially WiFi, have been extended to perform motion detection, gesture recognition and efficient input detection. Visible light-based interaction systems are well studied in research and many similar commercial products are available already. For example, optical mouse utilizes LEDs and photodiodes to detect fine-grained motion. Similarly, Kinect system uses a combination of infrared and visible light to perform accurate 3D-gesture recognition. However, the problem with such 3D-gesture recognition systems is that they are expensive mostly because they require sophisticated image sensors along with advanced graphics techniques to process the captured images.

Some recent research has proposed inexpensive means of providing richer HCI using visible light. Authors in showed that human presence or motion causes changes in the electromagnetic field around the fluorescent lamp. This changes result in variations in home/office power-line network, hence the gestures can be recognized by another pluggable module anywhere on the power-line network. Similarly, it was demonstrated in how LEDs can be used to receive the visible light (like a photodiode) and applied it to different sensing application. The projected light on the sensor unit provides a GUI where user can provide various commands to control the physical object. Okuli presented a system where user's finger can be precisely located within a small workspace using an LED and two photodiodes, allowing the user to interact with mobile/wearable devices with small form-factors.

Indoor Localization

Location-based services have observed tremendous growth in last few years. Mobile device localization in outdoor scenarios largely depends on Global Positioning System (GPS). However, the GPS does not work indoors, requiring alternative ways of localizing devices. Among the alternatives, WiFi-based indoor localization has proven to be most attractive where existing WiFi AP deployment is leveraged to identify client's location.

It was observed in that there are 10 times more LED luminaires than the number of WiFi APs in a typical indoor building. This higher density can allow more accurate triangulation of the mobile device resulting in higher accuracy. Epsilon presented the first practical visible light localization system. In Epsilon, the mobile device performs receiver side localization by receiving the light beacons from LED sources. To avoid collisions between the beacons of uncoordinated LED sources; a distributed channel hopping is utilized. The receiver (a photodiode) on a mobile device receives the beacon from multiple sources. It utilizes the RSS values of received beacon to estimate the distance from the received to the LED source. Based on the distance estimates, the receiver uses trilateration to obtain its own location. Additionally, if the receiver can see less than 3 LED sources, the user can actively move the device to increase the visibility.

It was shown that Epsilon can achieve the location accuracy of ≈ 0.4 meters - compared to 3 – 6 meters accuracy achievable in WiFi-based schemes. Another practical visible light localization approach was presented in Luxapose. Different from Epsilon, in Luxapose, the receiver is considered to an imaging sensor such as the Smartphone camera. The user takes an image of LED luminaires using the camera. The image is then analyzed to detect the beacon information broadcast by the luminaires and the angle-of-arrival (AoA) of the beacon. Based on the orientation of the smartphone camera, angle-of-arrival from the luminaires is then used for triangulation to localize the receiver device. Luxapose to shown to achieve localization accuracy of ≈ 0.1 meters. Similar to Luxapose, it was shown in how an imaging sensor can be used to receive from multiple luminaires each of which creates a visual landmark. Other variations of visible light localization include both RSS and AoA are used.

MATERIALS AND METHOD

Overview of Embedded System

An embedded system is a special-purpose computer system designed to perform one or a few dedicated functions, often with real-time computing constraints. It is usually embedded as part of a complete device including hardware and mechanical parts. In contrast, a general-purpose computer, such as a personal computer, can do many different tasks depending on programming. Embedded systems have become very important today as they control many of the common devices we use. Since the embedded system is dedicated to specific tasks, design engineers can optimize it, reducing the size and cost of the product, or increasing the reliability and performance. Some embedded systems are mass-produced, benefiting from economies of scale.

Embedded System Provide Several Functions

Monitor the environment; embedded systems read data from input sensors. This data is then processed and the results displayed in some format to a user or users. Control the environment; embedded systems generate and transmit commands for actuators. Transform the information; embedded systems transform the data collected in some meaningful way, such as data compression/decompression.

Block Diagram of an Embedded System

An embedded system usually contains an embedded processor. Many appliances that have a digital interface -- microwaves, VCRs, cars -- utilize embedded systems. Some embedded systems include an operating system. Others are very specialized resulting in the entire logic being implemented as a single program. These systems are embedded into some device for some specific purpose other than to provide general purpose computing. A typical embedded system is shown in the following Figure 3.

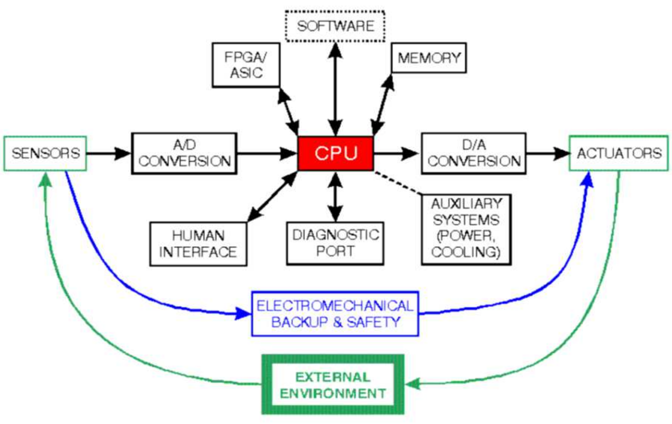

Figure 3: Block Diagram of Embedded System.

Characteristics

Embedded systems are characterized by a unique set of characteristics. Each of these characteristics imposed a specific set of design constraints on embedded systems designers. The challenge to designing embedded systems is to conform to the specific set of constraints for the application.

Reactive System

As mentioned earlier, a typical embedded systems model responds to the environment via sensors and control the environment using actuators. This requires embedded systems to run at the speed of the environment. This characteristic of embedded system is called "reactive". Reactive computation means that the system (primarily the software component) executes in response to external events. External events can be either periodic or aperiodic. Periodic events make it easier to schedule processing to guarantee performance.

Distributed System

A common characteristic of an embedded system is one that consists of communicating processes executing on several CPUs or ASICs which are connected by communication links. The reason for this is economy. Economical 4 8-bit microcontrollers may be cheaper than 32-bit processors.

Heterogeneous Architecture

Embedded systems often are composed of heterogeneous architectures. They may contain different processors in the same system solution. They may also be mixed signal systems. The combination of I/O interfaces, local and remote memories, and sensors and actuators makes embedded system design truly unique. This is shown in Figure 4.

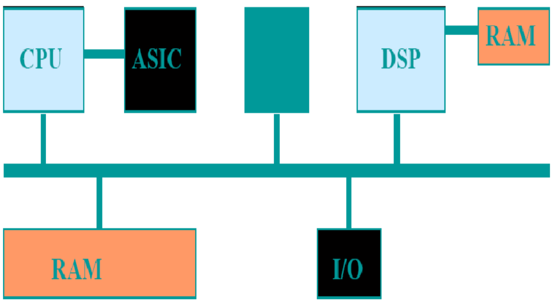

Figure 4: Heterogeneous Architecture.

System Safety and Reliability

As embedded system complexity and computing power continue to grow, they are starting to control more and more of the safety aspects of the overall system. These safety measures may be in the form of software as well as hardware control. Mechanical safety backups are normally activated when the computer system loses control in order to safely shut down system operation.

Power Management

Embedded systems have strict constraints on power. Given the portability requirements of many embedded systems, the need to conserve power is important to maintain battery life as long as possible. Minimization of heat production is another obvious concern for embedded systems.

Small and Low Weight

Many embedded computers are physically located within some larger system. The form factor for the embedded system may be dictated by aesthetics. For example, the form factor for a missile may have to fit inside the nose of the missile. One of the challenges for embedded systems designers is to develop non-rectangular geometries for certain solutions. Weight can also be a critical constraint. Embedded automobile control systems, for example, must be light weight for fuel economy. Portable CD players must be light weight for portability purposes.

IMPLEMENTATION

ARM7 Family

The ARM7 family includes the ARM7TDMI, ARM7TDMI-S, ARM720T, and ARM7EJ-S processors. The ARM7TDMI core is the industry's most widely used 32-bit embedded RISC microprocessor solution. Optimized for cost and power-sensitive applications, the ARM7TDMI solution provides the low power consumption, small size, and high performance needed in portable, embedded applications.

The ARM7TDMI-S core is the synthesizable version of the ARM7TDMI core,available in both VERILOG and VHDL, ready for compilation into processes supported by in-house or commercially available synthesis libraries. Optimized for flexibility and featuring an identical feature set to the hard macro cell, it improves time-to-market by reducing development time while allowing for increased design flexibility, and enabling >>98% fault coverage.The ARM720T hard macro cell contains the ARM7TDMI core, 8kb unified cache, and a Memory Management Unit (MMU) that allows the use of protected execution spaces and virtual memory. This macro cell is compatible with leading operating systems including Windows CE, Linux, palm OS, and SYMBIAN OS. This is shown in figure 4.1.

ARM7 TDMI

The ARM7TDMI core is based on the Non Neumann architecture with a 32-bit data bus that carries both instructions and data. Load, store, and swap instructions can access data from memory. Data can be 8-bit, 16-bit, and 32-bit.

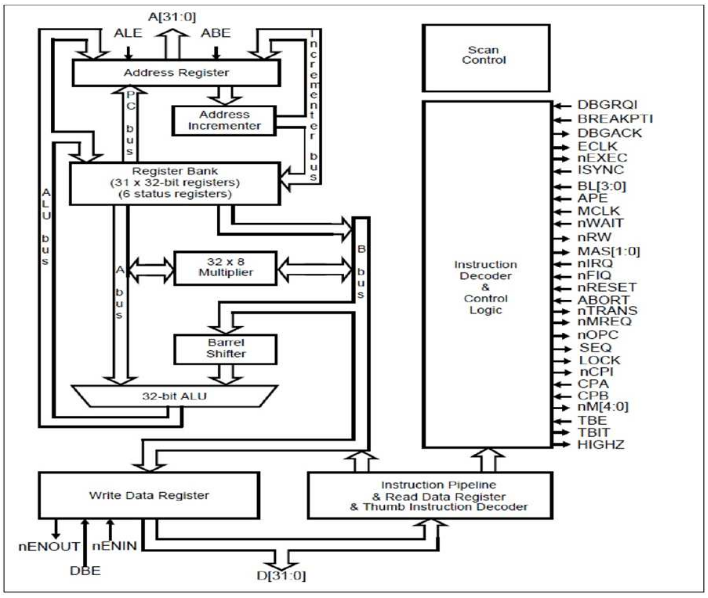

Figure 5: ARM7TDMI

Memory Formats

The ARM7TDMI can be configured to treat stored words in either big-endian or little-endian format. Performance, code density and operating states.

The ARM7TDMI core supports two operating states and instruction sets:

- ARM state for 32-bit, word-aligned instructions
- Thumb state for 16-bit, half word-aligned instructions.

The ARM instruction set allows a program to achieve maximum performance with the minimum number of instructions. The simpler thumb instruction set offers much increased code density reducing memory requirement. Code can switch between the ARM and thumb instruction sets on any procedure call.

ARM7TDMI Processor Core

The ARM7TDMI processor core implements the ARMv4T Instruction Set Architecture (ISA).This is a superset of the ARMv4 ISA which adds support for the 16-bit Thumb instruction set. Software using the Thumb instruction set is compatible with all members of the ARM Thumb family, including ARM9, ARM9E, and ARM10 families.

Registers

The ARM7TDMI core consists of a 32-bit data path and associated control logic. This data path contains 31 general-purpose 32-bit registers, 7 dedicated 32-bit registers coupled to a barrel-shifter, Arithmetic Logic Unit, and multiplier.

Modes and Exceptions

The ARM7TDMI supports seven modes of operation

- User mode
- Fast Interrupt (FIQ)
- Interrupt (IRQ)
- Supervisor mode
- Abort mode. This is shown in Figure 6

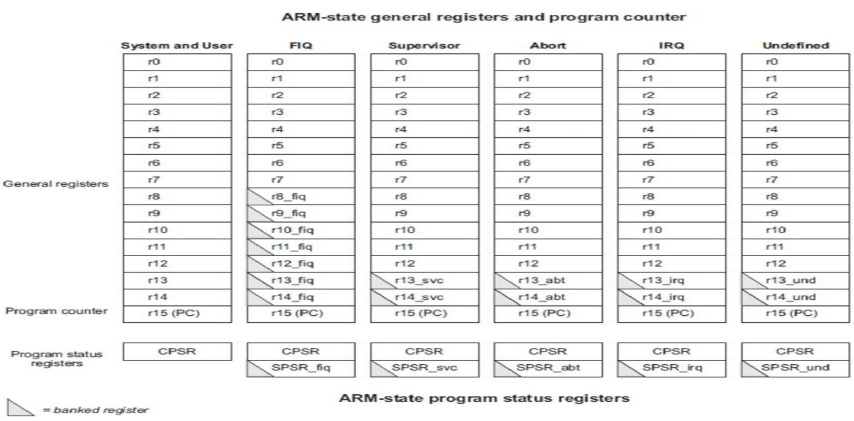

Figure 6: Modes and Exceptions.

Applications

Using the ARMv7 architecture, ARM can strengthen its position as a low-power/performance leader while conquering new markets to carry its cores up in high performance and down in the low-cost high-volume domain of the microcontroller ARM designs the technology that lies at the heart of advanced digital products, from wireless, networking to imaging, and storage devices.

LPC2148 Micro Controller:

LPC2148 microcontroller board based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontrollers with embedded high-speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty. The meaning of LPC is Low Power Low Cost microcontroller. This is 32 bit microcontroller manufactured by Philips semiconductors (NXP).Due to their tiny size and low power consumption, LPC2148 is ideal for applications where miniaturization is a key requirement, such as access control and point-of-sale. The architecture is shown in Figure 7 and the pin diagram is shown in Figure 8.

Features OF LPC2148 Micro Controller

- 16-bit/32-bit ARM7TDMI-S microcontroller in a tiny LQFP64 package.
- 8 kB to 40 kB of on-chip static RAM and 32 kB to 512 kB of on-chip flash memory; 128-bit wide interface/accelerator enables high-speed 60 MHz operation.
- Single 10-bit DAC provides variable analog output (LPC2148 only).
- Low power Real-Time Clock (RTC) with independent power and 32 kHz clock input.
- Multiple serial interfaces including two UARTs (16C550), two Fast I2C-bus (400 kbit/s),SPI and SSP with buffering and variable data length capabilities.
- On-chip integrated oscillator operates with an external crystal from 1 MHz to 25 MHz and Power saving modes include Idle and Power-down
- Individual enable/disable of peripheral functions as well as peripheral clock scaling for additional power optimization.
- Processor wake-up from Power-down mode via external interrupt or BOD.

LPC2148 Micro Controller Architecture

Microcontroller architecture is represented in figure 4.2 as follows,

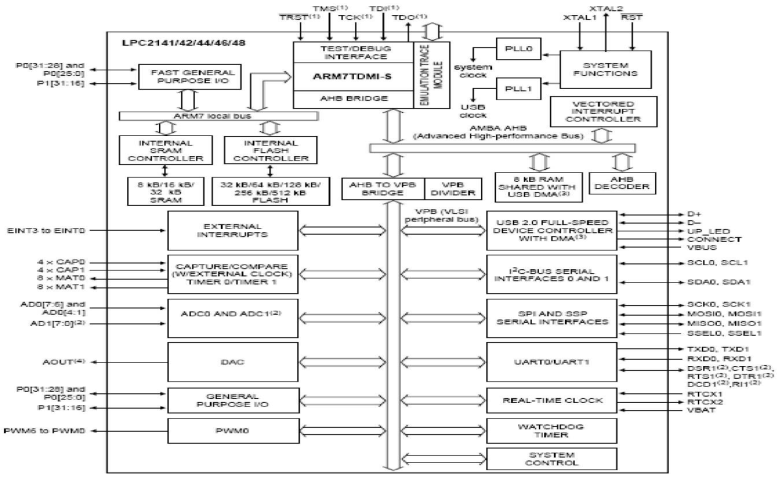

Figure 7: LPC2148 Micro Controller Architecture.

Pin Diagram

The pin diagram of LPC2148 is represented in Figure 8 as follows,

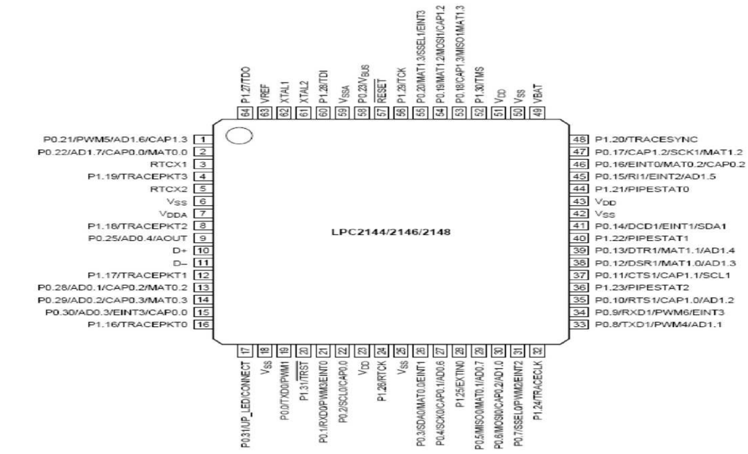

Figure 8: Pin Diagram of LPC2148.

ARCHITECTURAL OVERVIEW

The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. The pin diagram is shown in Figure 8.

Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with memory restrictions, or applications where code density is an issue.

On-Chip Flash Program Memory

The LPC2148 system incorporates a flash memory system respectively. This memory may be used for both code and data storage. Programming of the flash memory may be accomplished in several ways. It may be programmed In System via the serial port. The application program may also erase and/or program the flash while the application is running, allowing a great degree of flexibility for data storage field firmware upgrades, etc.

On-Chip Static Ram

On-chip static RAM may be used for code and/or data storage. The SRAM may be accessed as 8-bit, 16-bit, and 32-bit. The LPC2141, LPC2142/44 and LPC2146/48 provide 8 kB, 16 kB and 32 kB of static RAM respectively. In case of LPC2146/48 only, an 8 kB SRAM block intended to be utilized mainly by the USB can also be used as a general purpose RAM for data storage and code storage and execution.

Memory Map

The LPC2141/42/44/46/48 memory map incorporates several distinct regions, as shown in Figure 9.

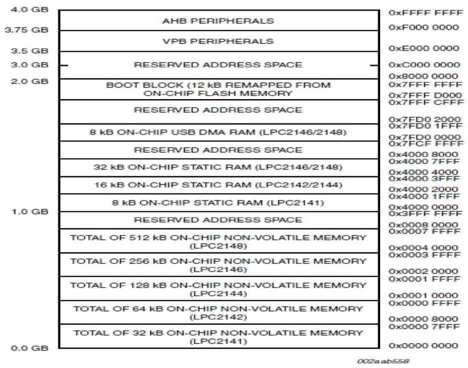

Figure 9: Memory Map.

Interrupt Controller

The Vectored Interrupt Controller (VIC) accepts all of the interrupt request inputs and categorizes them as Fast Interrupt Request (FIQ), vectored Interrupt Request (IRQ), and non-vectored IRQ as defined by programmable settings. The programmable assignment scheme means that priorities of interrupts from the various peripherals can be dynamically assigned and adjusted.

Fast General Purpose I/O (Gpio)

Device pins that are not connected to a specific peripheral function are controlled by the GPIO registers. pins may be dynamically configured as inputs or outputs. Separate registers allow setting or clearing any number of outputs simultaneously.

- GPIO registers are relocated to the ARM local bus for the fastest possible I/O timing.
- Mask registers allow treating sets of port bits as a group, leaving other bits unchanged.
- All GPIO registers are byte addressable.
- Entire port value can be written in one instruction.

USB 2.0 Device Controller

The USB is a 4-wire serial bus that supports communication between a host and a number (127 max) of peripherals. The host controller allocates the USB bandwidth to attached devices through a token based protocol. The bus supports hot plugging, unplugging, and dynamic configuration of the devices. All transactions are initiated by the host controller.

SPI Serial I/O Controller

The SPI is a full duplex serial interface, designed to handle multiple masters and slaves connected to a given bus. Only a single master and a single slave can communicate on the interface during a given data transfer. During a data transfer the master always sends a byte of data to the slave, and the slave always sends a byte of data to the master.

SERIAL COMMUNICATION

Introduction

Computers transfer data in two ways: parallel and serial. In parallel data transfers, often 8 or more lines (wire conductors) are used to transfer data to a device that is only a few feet away. Examples of parallel transfers are printers and hard disks; each uses cables with many wire strips. Although in such cases a lot of data can be transferred in a short amount of time by using many wires in parallel, the distance cannot be great.

In serial communication a single data line is used instead of the 8-bit data line of parallel communication makes it not only much cheaper but also makes it possible for two computers located in two different cities to communicate over the telephone. For serial data communication to work, the byte of data must be converted to serial bits using a parallel-in-serial-out shift register; then it can be transmitted over a single data line. This also means that at the receiving end there must be a serial-in-parallel-out shift register to receive the serial data and pack them into a byte. Of course, if data is to be transferred on the telephone, it must be converted from 0s and 1s to audio tones, which are sinusoidal-shaped signals. This conversion is performed by a peripheral device called modem, which stands for modulator/ demodulator.

Data Transfer Rate

The rate of data transfer in serial data communication is stated in bps (bits per second). Another widely used terminology for bps is baud rate. However, the baud and bps rates are not necessarily equal. This is due to the fact that baud rate is the modem terminology and is defined as the number of signal changes per second. In modems, there are occasions when a single change of signal transfers several bits of data. As far as the conductor wire is concerned, the baud rate and bps are the same.

RS232 Standards

To allow compatibility among data communication equipment made by various manufacturers, an interfacing standard called RS232 was set by the Electronics Industries.

Connection to RS232

The details of the physical connections of the ARM to RS232 connectors are given here. The RS232 standard is not TTL compatible; therefore, it requires a line driver such as the MAX232 chip to convert RS232 voltage levels to TTL levels, and vice versa. The interfacing of ARM with RS232 connectors via the MAX232 chip is discussed here.

SOFTWARE TOOLS

Types of Tools

- KEIL C
- Flash Magic
- ORCAD

Keil C

Keil software is the leading vendor for 8/16-bit development tools (ranked at first position in the 2004 embedded market study of the embedded system and EE times magazine).Keil software is represented worldwide in more than 40 countries, since the market introduction in 1988; the keilC51 compiler is the de facto industry standard and supports more than 500 current 8051 device variants. Keil software makes C compilers, macro assemblers, real-time kernels, debuggers, simulators, integrated environments, and evaluation boards for 8051, 251, ARM and XC16x/C16x/ST10 microcontroller families. The Keil C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today.

The Keil C51 C Compiler for the 8051 microcontroller is the most popular 8051 C compiler in the world. It provides more features than any other 8051 C compiler available today. The C51 Compiler allows you to write 8051 microcontroller applications in C that, once compiled, have the efficiency and speed of assembly language. Language extensions in the C51 Compiler give you full access to all resources of the 8051. The C51 Compiler translates C source files into relocatable object modules which contain full symbolic information for debugging with the µVision Debugger or an in-circuit emulator. In addition to the object file, the compiler generates a listing file which may optionally include symbol table and cross reference.

Flash Magic

Flash magic can control the entry into ISP mode of some microcontroller devices by using the COM port handshaking signals to control the device. Typically the handshaking signals are used to control such pins as Reset, PSEN and VCC. The exact pins used depend on the specific device. When this feature is supported, Flash Magic will automatically place the device into ISP mode at the beginning of an ISP operation. Flash Magic will then automatically cause the device to execute code at the end of the ISP operation.

ORCAD

ORCAD really consists of tools. Capture is used for design entry in schematic form. You will probably be already familiar with looking at circuits in this form from working with other tools in your university courses. Layout is a tool for designing the physical layout of components and circuits on a PCB. During the design process, you will move back and forth between these two tools. The design flow diagram is given below Figure 10.

Design Flow of ORCAD

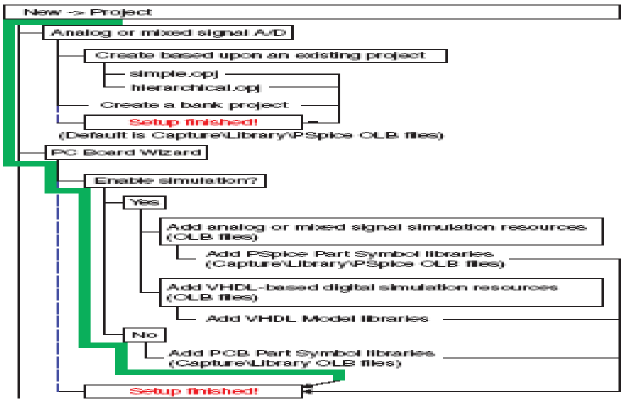

Figure 10: Design Flow of ORCAD.

HARDWARE TOOLS

- ARM 7
- Li Fi
- PC
- RS 232

Li-Fi

VLC represents only a fraction of what appears to be a much larger movement towards optical wireless technologies in general. This larger world has been dubbed 'Li-Fi' (Light Fidelity) by people such as Dr Harald Haas of Edinburgh University and organizations such as the Li-Fi Consortium. Li-Fi is transmission of data through illumination of the LED by taking the fiber out of the fiber optics by sending data through the LED light bulb that varies in intensity faster than the human eye can follow. The LED blubs will hold a micro-chip that will do the job of processing the data.

The light intensity can be manipulated to send the data by tiny changes in the amplitude. This technology uses visible spectrum of light, a part of the electromagnetic spectrum that is still not greatly utilized. In fact this technology transfers thousands of streams of data simultaneously in parallel in higher speed with the help of the special modulation using a unique signal processing technology. The light used to transmit the data is called D-light by herald hass, the inventor of LiFi.

Features

- Transmit data serially at 57600 baud rate
- Distance of 1 feet to 10 feet can be achieved
- Low power requirement
- No effect on human health
- Highly secure compared to Wi-Fi
- High data density because visible light can be well contained

Li-FI Transmitter Side

- The Transmitter side will transmit the data
- It is connected to arrays of led through which data is transferred
- The receiver side is shown in the Figure 11.

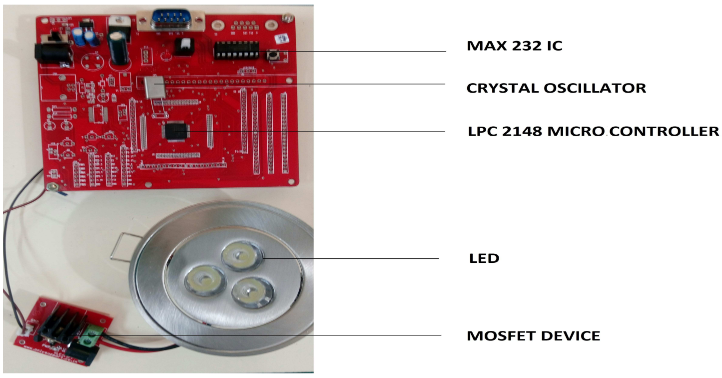

Figure 11: Li-Fi Transmitter Side.

LI-FI Receiver Side

- The receiver side will receive the data that is transmitted through the led panel.
- This led can be displayed to the HyperTerminal of the Pc by connecting a serial UART.
- The receiver side is shown in Figure 13.

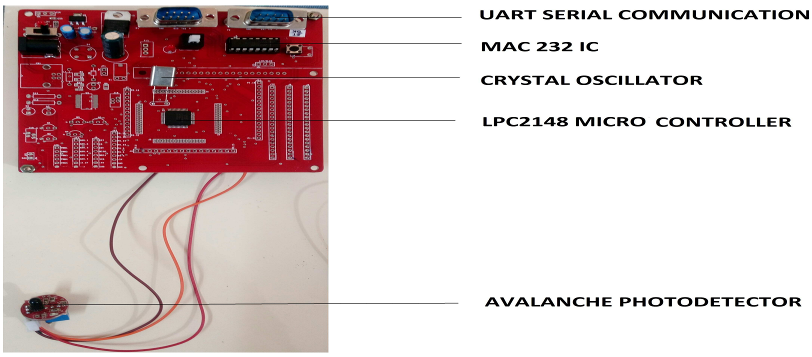

Figure 13: Li-Fi Receiver Side.

Output Implementation:

- The input data is given in the transmitter side which is the laptop1.
- The data is the transmitter to bits through serial communication.
- The led then glows in order to transmit the data using mosfet device.
- The data is then transmitted to the receiver through photodetector and transmitted to the laptop 2. This is shown in Figure 14.

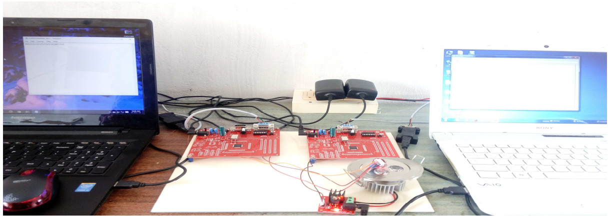

Figure 14: Output Implementation.

CONCLUSIONS

The possibilities are numerous and can be explored further. If this technology can be put into practical use, every bulb can be used something like a Wi-Fi hotspot to transmit wireless data and we will proceed toward the cleaner, greener, safer and brighter future. The concept of Li-Fi is currently attracting a great deal of interest, not least because it may offer a genuine and very efficient alternative to radio-based wireless. As a growing number of people and their many devices access wireless internet, the airwaves are becoming increasingly clogged, making it more and more difficult to get a reliable, high-speed signal. This may solve issues such as the shortage of radio-frequency bandwidth and also allow internet where traditional radio based wireless isn't allowed such as aircraft or hospitals. One of the shortcomings however is that it only work in direct line of sight.

As Li-Fi becomes more commercialized, it will usher in an era of incredible business opportunities, such as allowing telecom service providers to reach out to a wider customer base. We can look forward to broader accessibility with Li-Fi Cloud. Smartphones will soon be able to download traffic information from traffic lights or a program guide from a television.. In the future, shops will transmit advertisements to your phone as you pass by and bus schedule changes will be transmitted to a screen at the stop. Smarter home appliances that talk machine-to-machine (M2M) are already being extensively researched, where LED lights on electronics function as Li-Fi access points.

REFERENCES

1. *Anton.D, R. Bragos, and P. J. Riu, "Remotely accessible laboratory for instrumentation and sensors," in Proc. 21st IEEE Instrumentation and Measurement Technology*
2. *Karunatilaka.D, Zafar.F, Kalavally.V, and Parthiban.R, "LED Based Indoor Visible Light Communications: State of the Art," Communications Surveys Tutorials, IEEE, vol. PP, no. 99, pp. 1–1,2015.*
3. *Son.S, C. Lim, and N.-N. Kim, "Debugging protocol for remote cross development environment," in Proc. 7th IEEE Real-Time Computing Systems and Applications.*
4. *Tanaka.Y, S. Haruyama, and M. Nakagawa, "Wireless optical transmissions with white colored LED for wireless home links,"in Personal, Indoor and Mobile Radio Communications, 2000. PIMRC2000. The 11th IEEE International Symposium on, vol. 2, 2000, pp.1325–1329 vol.2.*
5. *Vucic.J, C. Kottke, S. Nerreter, K.-D. Langer, and J. Walewski,"513 Mbit/s Visible Light Communications Link Based on DMT Modulation of a White LED," Light wave Technology, Journal of vol. 28, no. 24, pp. 3512–3518, Dec 2010.*