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Analysis of Wireless Fidelity and Light Fidelity for PAN and Implementation

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***Abstract*— The LED lighting system can achieve lower power consumption and has a longer life-time compared to the wireless fidelity system. The proposed paper analyses light fidelity over wireless fidelity for personal area network on the basis of different environment parameters speed, power and frequency etc.**

This paper reflects the Future of wireless communication which may affect all lives. The visible light communication which may be the future of Internet as number of users gets increased in wireless network and speed decreases proportionally. The light fidelity is a framework for all of these providing new capabilities to current and future services, applications and end client.

Keywords*— *Li-Fi, Wi-Fi, PAN, LED, VLC, , Radio Frequency Spectrum

I. INTRODUCTION

Li-Fi technology is based on visible light communication (VLC). A visible light communication is combination of illumination and communication**.** It refers to the communication technology which uses the visible light source as a signal transmitter, the air as a transmission medium, and the appropriate photodiode as a signal receiving component [1]**.**

In visible light communication which use LED (Light Emitting Diode) provides the potential for highly efficient lighting.LED have many combined characteristic with their long operating life and reliability has made them becoming a potential choice for next generation of lighting systems including automotive, emergency, backlight, indoor, and outdoor [2].

II. LITERATURE SURVEY

A wireless communication can offer businesses more flexible and inexpensive ways to send and receive information [3]. Current scenario the bandwidth capacity which is available is finite & is not capable enough to sustain with the constantly increasing demand of wireless data Light fidelity technique use a relieving the heavy loads which the current wireless systems face since it adds a new and unutilized bandwidth of visible light to the currently present radio waves for data transfer [4].

Wireless Personal Area Networks (WPANs) is a rising technology for future short (up to 10 meters) range indoor and outdoor multimedia and data centric applications [5].

The first significant step for evolution of the LED based VLC was the establishment of Visible Light Communication Consortium (VLCC) in Japan in 2003. In this consortium, Japanese technology companies aimed to standardize and promote the VLC technology.

In office, mall, industry and private area which use wireless networks. Some problem occur like cracking others passwords to connect to the Internet that time probably you would be frustrated at the slow speed as many devices access the same host. Every internet user wants to use wireless data but capacity is drying up [6].

III. OBJECTIVE

In this paper analyze different type of wireless communication for personal area network. A wireless communication system has some drawback like Speed of data transfer, Power consumption, Variation in frequency, Low bandwidth. Analyze wireless fidelity communication and light fidelity communication for personal area network.

So here we use the immerging technology that is Li- Fi which is based on light produced by LEDs instead of radio frequency spectrum produced by Wi- Fi.

By applying this technology we can save power, increasing data rate and create a harmless environment in specific areas. This technology doesn't deal with radio waves and produce better results than Wi-Fi, so widely useful in the area of personal area like Hospital and Nuclear Plant, Science Lab. Similarly on large scale it can also easily applied in the places where Bluetooth, Wi- Fi and other source of communication can't reach.

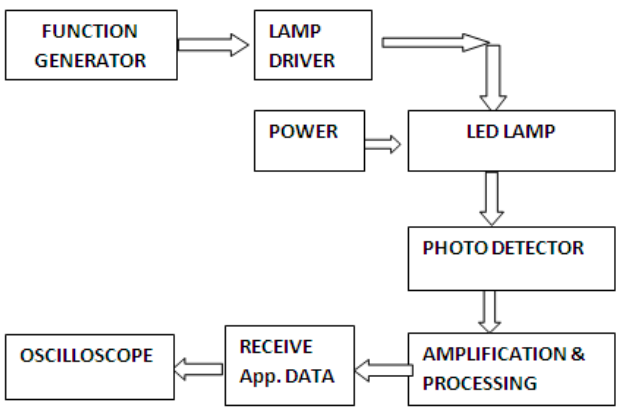

Fig:1 Block Digram of Li-Fi System

IV. LIGHT FIDELITY TECHNOLOGY PRINCIPLE

Li-Fi is a wireless communication system which is used to produce visible light communication for high speed wireless communication. It acquired this name due to similarity to Wi-Fi. Li-Fi work on simple light principle ,When the LED bulb is turn ON, it will transmit a binary digital "1", when bulb is turn OFF it will transmit a binary digit "0". The LED bulb can be turn ON and OFF very rapidly so that we can transmit data in zero and one form by using LED. To encode data into LED at different intensity of light a controller circuit is also used.

This technology was developed by German physicist, Harald Hass. It is a technology that may be as fast data transmission compare to Wi-Fi. Li-Fi is alternative technology, cost effective, more robust and useful than Wi-Fi [6].

In Li-Fi system LED is use as transmission device of data through illumination and Photo detector is use as receiver device is to receive the light signal and then extract original data from received light signal.

Microchips inside LED will do the processing of data. The light intensity can be manipulated to send data by tiny changes in amplitude. The technology transfers thousands of streams of data simultaneously in higher speed with the help of special modulation technique [7].

In paper two modulation schemes presented. At first, a scheme called subcarrier pulse-position modulation is presented which is already established as VLC-standard by the VLCC. The second modulation scheme to be addressed is called frequency shift keying, commonly referred to as FSK. A detailed account on modulation can be found in Sugiyama et al.

V. WIRELESS FIDELITY TECHNOLOGY PRINCIPLE

The IEEE 802 standards committee formed the 802.11 Wireless Local Area Networks standards working group in 1987. The **802.1 1** final approval was obtained in 1997[8].

A wireless fidelity technology use much more efficient coding techniques (process of converting 0's and 1's into efficient radio signals) that also contribute to the much higher data rates. Wireless Fidelity technology has the ability to change frequencies. The radio signals are transmitted from antennas and routers that signals are picked up by Wi-Fi receivers, such as computers and cell phones that are ready with Wi-Fi cards. An antenna is an electrical conductor or system of conductors to send/receive RF signals. Factors affecting wireless system design as Frequency allocations, multiple access mechanism, Antennas and propagation, Signals encoding, Error correction [9].

VI. WIRELESS FIDELITY ARCHITECTURE

The wireless fidelity circuit simulation was carried out using NI Multisim 12.0. The Wireless Fidelity circuit consists of a simple 555 timer connected in astable mode, an optocoupler, and Sample-RF coil antenna connected in transmitter and receiver circuit with NPN transistor. The input data is set by using Crystal oscillator and the receive output as signal from using an oscilloscope.

The input frequency is given using a Crystal oscillator. This input is transmitted by converting the signal into square waves using a 555 timer configured in astable mode. These square waves represent the bits 1s and 0s of the data. These electrical signals are then transmitted using an antenna. The input signals carries from the receiver antenna. Signal is going through NPN transistor and signal is viewed using the virtual oscilloscope.

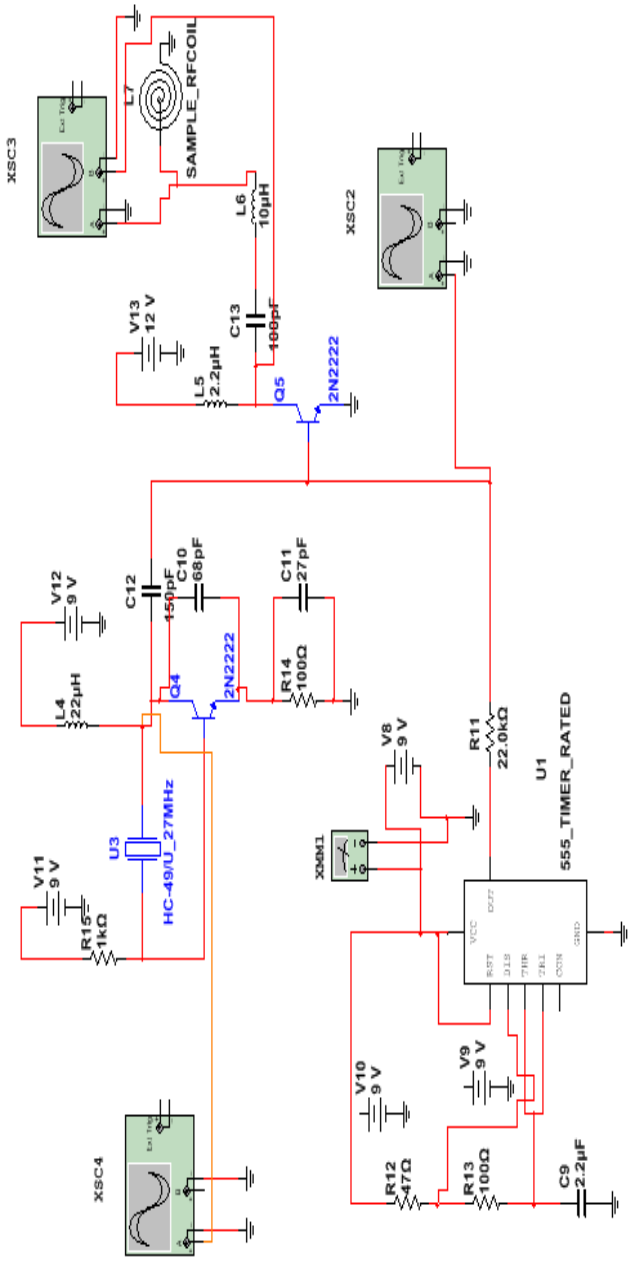

Fig 2 : WI- FI Transmitter Architecture

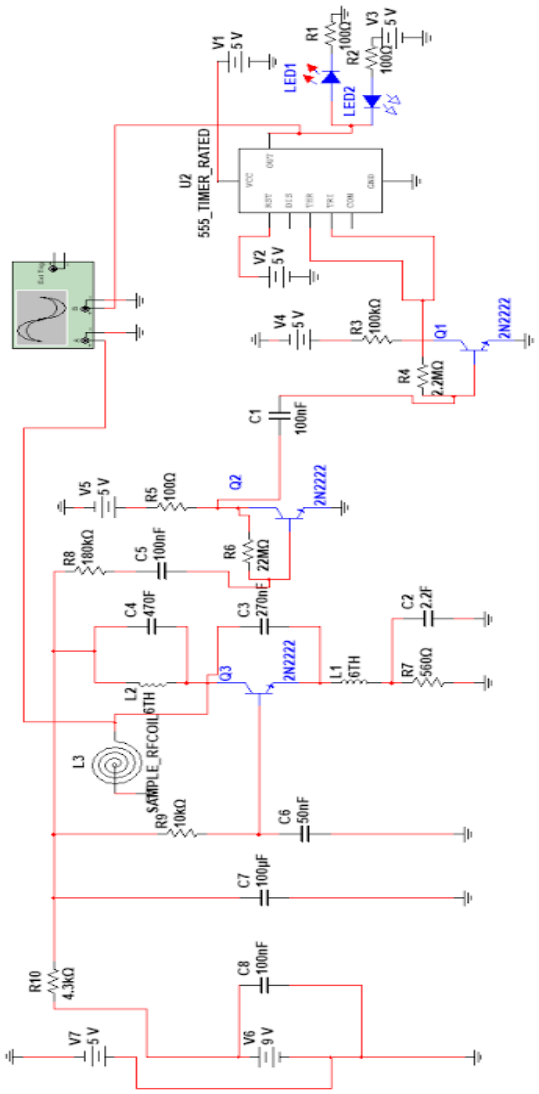

Fig 3 : Wi- Fi Receiver Architecture

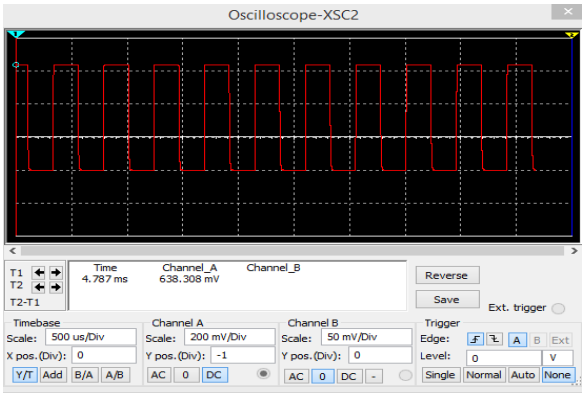

Fig 4: Wi -Fi Circuit Wave

VII. LIGHT FIDELITY ARCHITECTURE

The light fidelity circuit simulation was carried out using NI Multisim 12.0. The light fidelity circuit consists of a simple 555 timer connected in astable mode, an optocoupler, and an inverting amplifier. The input data is set by using mice and the get output as sound form using a speaker.

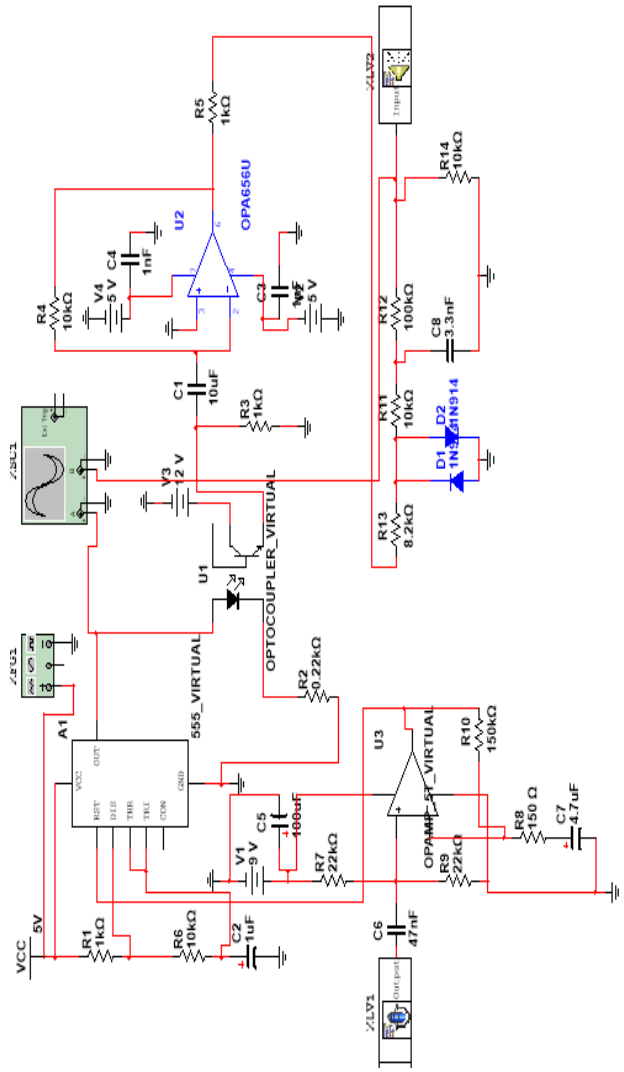

Fig 5 : Li- Fi Architecture

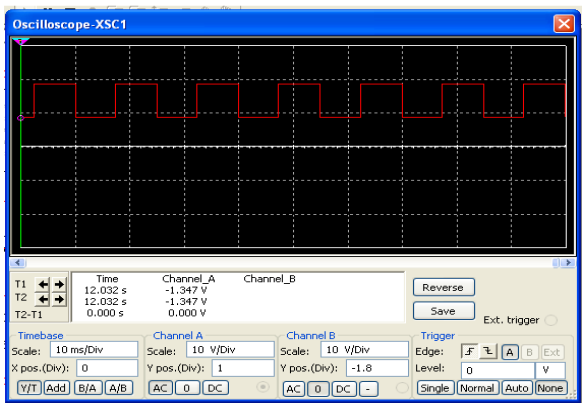

Fig 6: Li-Fi Circuit Wave

In second mode of circuit consists of a timer circuit, an optocoupler and an amplifier circuit. The input frequency is given using a virtual function generator (XFG1). This input is transmitted by converting the signal into square waves using a 555 timer configured in astable mode. These square waves represent the bits 1s and 0s of the data. These electrical signals are then transmitted using an optocoupler. The output signal from the optocoupler is fed into an inverting amplifier constructed using Opamp OPA656. The input signal from the function generator and the output signal from the amplifier are viewed using the virtual oscilloscope.

VIII. EXPERIMENT WORK AND RESULT

Calculate power in light fidelity circuit and wireless fidelity circuit. In circuit we used Battery as input current and find how much power is used by circuit device. Multimeter tool is used to calculate current and voltage.
We measure the current I and Voltage V using a Multimeter and then calculate power as:

$$P = V * I \quad \text{.....eq. (1)}$$

Where P is power
Where V is Volt
Where I is Current
For Power $P_1 = V_1 I_1$

Total power of circuit P:

$$\mathbf{P = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 \ldots\ldots + P_n}$$

In Light Fidelity circuit calculate Power:

$$\mathbf{P = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8}$$

$\mathbf{P}$=1216.057*10^{-9}+111.764*10^{-9}+1838.729*10^{-9}+ 571.295*10^{-9}+22.165* 10^{-9}+4.512*10^{-9}+ 2516.692 * 10^{-9} +56.366*10^{-9}
P = 6393.946*10^{-9} Watt

In Wireless Fidelity circuit calculate Power.

$$\mathbf{P = P_1 + P_2 + P_3 + P_4 + P_5 + P_6 + P_7 + P_8}$$

$\mathbf{P}$ =337.6562*10^{-9}+988.1605*10^{-9}+5446.954* 10^{-9}+231.466* 10^{-9}+16.76 *10^{-9}+5.242*10^{-9} +3100.265*10^{-9}+751.94* 10^{-9}+1.515*10^{-9}
P= 10879.958*10^{-9} Watt

On the basis of this calculation we compare that power consumption of circuits by light fidelity is less then compare to wireless fidelity.

Also calculate the frequency of light fidelity circuit and wireless fidelity circuit using:

$$f = 1/T \quad \text{.....eq. (2)}$$

Where is: f is frequency

T is time period

T is calculating using oscilloscope plots voltage in the y-axis and time in the x-axis. The time base is 1 ms/Div, meaning that the length of a grid block is 1 ms this can be adjusted to get a good view of the signal. Channel A contains the input voltage. The scale has been adjusted to 1 V/Div, meaning that the height of a grid block represents 1 V for the channel A signal. As expected, the source voltage peaks at 1 V, just as we instructed it. Channel B contains the voltage across R2, and has the same scale as channel A.

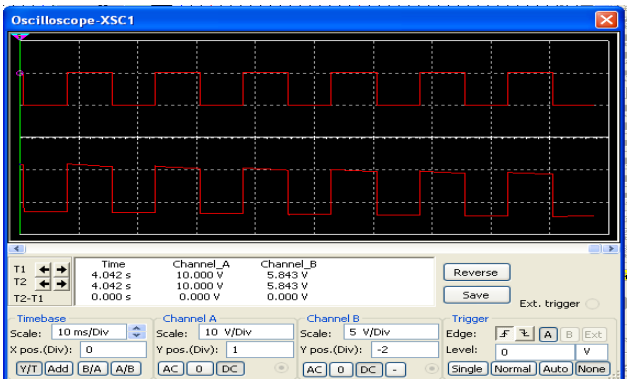

Fig 7: Li-Fi Circuit

T is calculating using number of division and time base for light fidelity input:
T=Number of division * Time base
T=1.5 * 10ms
f =1/ (1.5 *10ms)
= 666.66Hz
T is calculating using number of division and time base for output:
T=Number of division * Time base
T=1.7 * 10ms
f =1/ (1.7 *10ms)
= 588.23Hz
Calculate percentage of frequency loss
Input 666.66Hz
Output 588.23Hz
Loss of frequency F_{loss} =666.66-588.23 =78.43Hz
% of f_{loss} = (78.43/666.66)*100= 11.76%

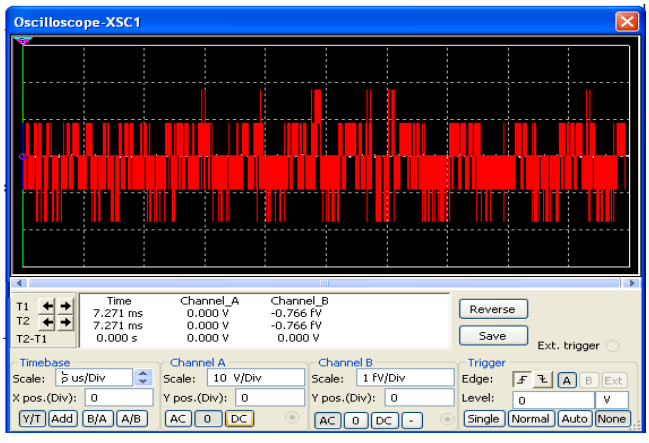

Fig 8: Wi -Fi Circuit Wave

T is calculating using number of division and time base for wireless fidelity input:
T=Number of division * Time base
T=0.4 * 1µs

f =1/ (0.4 *1μs) =1/ (0.4*1*10^{-6})
= 2.50MHz

T is calculating using number of division and time base for wireless fidelity output:
T=Number of division * Time base
T=0.11 * 5μs
f =1/ (0.11 *5μs) =1/ (0.11*5*10^{-6})
= 1.81MHz

Calculate percentage of frequency loss
Input 2.5MHz
Output 1.81Hz
Loss of frequency F_{loss} = 2.50-1.81 =0.69Hz
% of f_{loss} = (0.69/2.5)*100= 27.6%
After calculating we find in wireless fidelity frequency loss percentage is greater than compare to light fidelity.

VIII. CONCLUSION

In this paper we analyze different existing wireless communication techniques for personal area network. It also includes a comparative study of wireless fidelity and light fidelity. As now a day's most popular technique that is wireless fidelity has different drawbacks for personal area networks like – power consumption, increasing demand of data rate, generation of harmful radio waves according to need of user for better bandwidth and calculate bandwidth. To reduce these drawbacks we proposed circuit of light fidelity for PANs, and establish a circuit using Multisim.

SCOPE OF WORK

Project designing a simple and low cost data communication system using LED considers the efficient utilization of energy in a visible light communication (VLC) system. Light waves doesn't penetrates through walls can't be intercepted & misused data is present where there is light. Availability of light is present everywhere. Solves the issues such as the shortage of radio frequency bandwidth also allow internet where traditional wireless isn't allowed in personal area network such as aircraft, hospitals and nuclear plant. The simulation results show that the proposed scheme toward the clear, greener, safer & brighter future.

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