International Conference on Latest Advancements & Future Trends In Engineering, Science & Management
Sambhram Institute of Technology, Bangalore (India)
03rd - 04th May 2019 www.conferenceworld.in ISBN : 978-93-87793-86-6

Implementation of Li-Fi for data transfer in Android devices

Shreyas S[1], Shreyas G[2], Praveen J Pattar[3]

[1]*Electronics and Communication Engineering, SJB Institute of Technology (India)*

[2]*Electronics and Communication Engineering, SJB Institute of Technology (India)*

[3]*Electronics and Communication Engineering, SJB Institute of Technology (India)*

ABSTRACT

This thesis deals with a design of a half-duplex communication system between two Android mobile phones using Li-Fi (Light-Fidelity) technology. We have identified that it is possible to use the VLC (Visible light communication) to establish a Near-field communication network for data transfer by using the existing infrastructure in a modern android device without any additional devices or modules. We also have successfully developed an android application for the same purpose.

***Keywords: Android, Li-Fi (Light-Fidelity), VLC (Visible light communication)*.**

1. INTRODUCTION TO LI-FI

Dr.Harald Haas in his TED talk (2011) on Visible Light Communication proposed a technology in order to overcome the radio spectrum congestion. In this talk, Dr. Haas demonstrated his invention, which he referred to as “data through illumination”. The technique behind this was to transfer data at speeds exceeding 10Mbps using light waves from ordinary table lamp to a nearby computer. This technology known as Light Fidelity or Li-Fi stands for data transmission through visible light and is therefore considered as an optical version of Wireless Fidelity or Wi-Fi.

2. LITERATURE SURVEY

In recent days where we are seeing growing number of researches in wireless communication. Studies on Visible Light Communication using LED are actively conducted as convergence of wireless communication and green IT. Technical advance of semi-conductors allows implementation of diverse range of wavelengths for LED and it has outstanding benefits including miniaturization, low weight, low power and semi-permanent life span, thereby being greatly anticipated as the next generation, eco-friendly light source. LED can significantly save energy due to its high energy conversion efficiency and applying it to visible light communication will enable high speed digital signal transfer, allowing wireless communication in any places with LED light. Using visible light as a medium, it is harmless to human body and can be used in places where electromagnetic wave can cause malfunction or serious problem of equipment such as in airplane, hospital, etc.

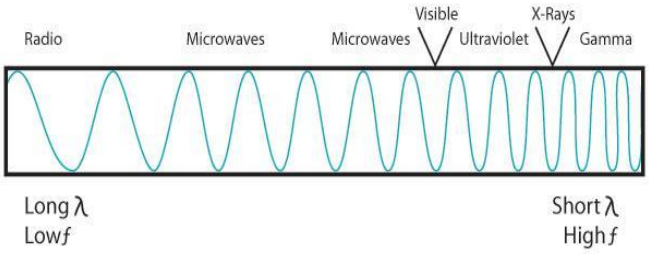
Due to the increasing demand in wireless data communication, the available Radio spectrum below 10 Ghz has become insufficient. The wireless communication industry has responded to this change by considering the

ISBN : 978-93-87793-86-6

radio spectrum above 10 Ghz. However, higher frequencies mean increasing path loss according to Free-space path loss formula.

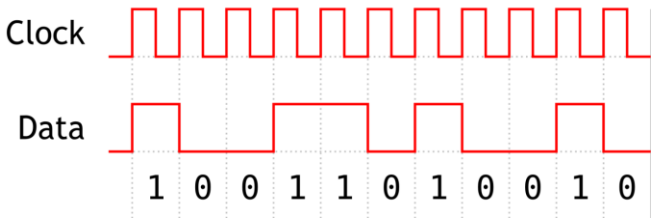
$$\mathrm{FSPL} = \left(\frac{4\pi d}{\lambda}\right)^2$$

When the IOT (Internet of Things) becomes a reality that is when nearly 20billion devices are connected to the internet and all the information providers become interconnected we will be consuming more wireless data than entire humanity put together. So, we have an increasing demand for wireless data and an increasing vulnerability of that data and we need energy to fuel all this. If light and internet will start using the same channel, we can provide communication by the same means by which we use for lighting. By, this we will be utilising an unprecedented bandwidth and repurpose the energy we use for illumination to provide wireless communication. Through this work we catch a glimpse of future through Li-Fi devices, which already use light to transmit wireless internet as we move through our world any source of light will become sources of access to the internet. Li-Fi is a reality today for the enterprise market and will soon be available for consumers, allowing the entire world to be connected by light.



3. ON-OFF KEYING (OOK)

On-Off keying denotes the simplest form of amplitude-shift keying (ASK) modulation that represents digital data at the presence or absence of a carrier wave. This On-Off activity in the LED lights enables data transmission using binary codes i.e., when the LED is ON, logical '1' is transmitted and when the LED is OFF, logical '0' is transmitted.



4. SYSTEM DESIGN

Android run smart phones were used for this study. The transmitter which is the flashlight LED for visible light communication sends binary signal by turning on/off the flashlight LED, and the receiver which is the Ambient

sensor (explained in section V) gets the binary signal by detecting the on/off of light by measuring the ambient light.

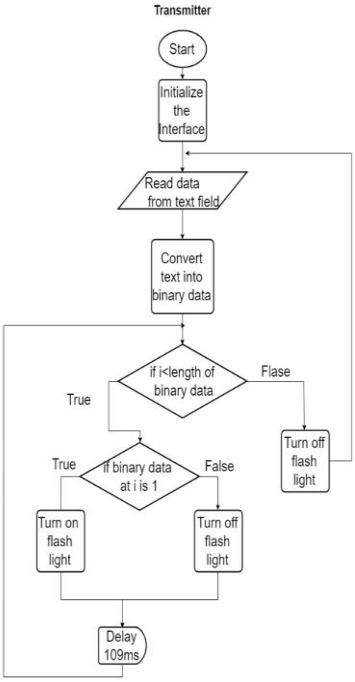
5. AMBIENT SENSOR

Ambient sensor is a photodetector component that is used in smartphones, notepads, automotive displays and LED TVs. It is used to sense the amount of ambient light present and approximately dim the device's screen to match it.

The standard international unit for illuminance of ambient light is the lux. The typical performance of an ambient light sensor is from less than 50 lux in dim light to over 10,000 lux at noon. By the end of 2004, about 30% of phones sold in Europe had ambient light sensors, while in 2016, 85% had a built-in ambient light sensor.

6. TRANSMITTER APPLICATION DESIGN

The transmitter receives data from the user and it sends the data to an asynchronous thread. The asynchronous thread converts data into binary and transmits the data. The transmitter uses OOK (On-Of keying) and it turns the flashlight 'on' if the binary code is '1' and 'off' for '0'.



7. BIT STUFFING

Bit stuffing is the insertion of one or more bits into a transmission unit as a way to provide signalling information to the receiver. The receiver knows how to detect and remove or disregard the stuffed bits. We have defined two conditions in the design of the transmitter application as an extended application of bit stuffing.

7.1 Start condition

An additional bit of binary value '1' is appended at the beginning of the message bits which will be detected by the receiver and will signal the receiver to start collecting data after comparing it with a threshold value. This condition also helps in the synchronisation of the transmitter and receiver.

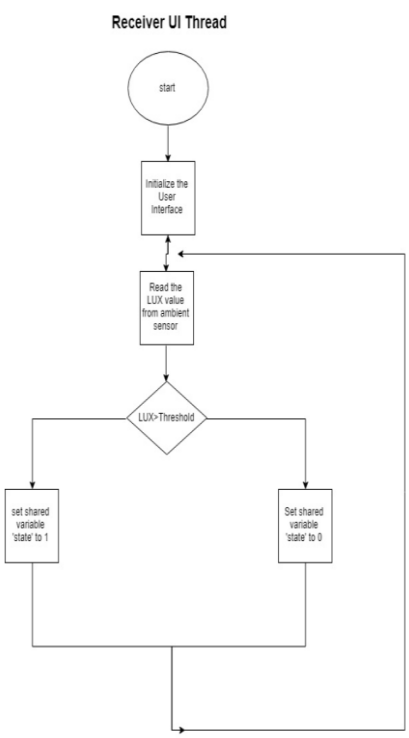
7.2 Stop condition

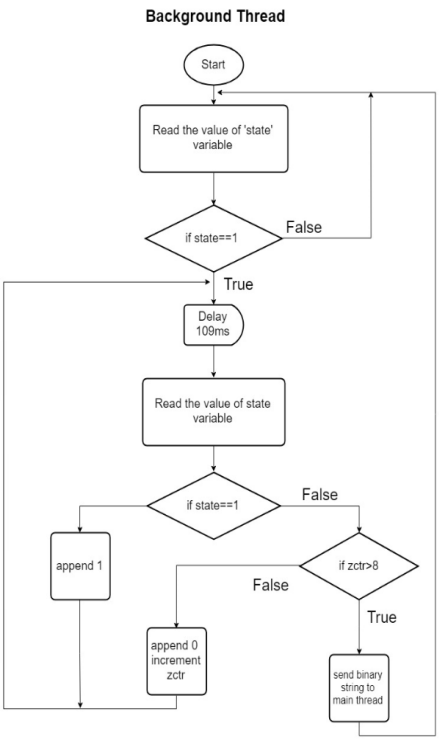
When the transmission of message bits is over, the transmitter keeps on appending bits of binary value '0' and keeps transmitting it. Which results in absence of the carrier wave and this continuous absence of carrier wave for longer duration is picked up by the receiver and directs the receiver to stop collecting data.

1	1110110010110011111010110010101001010101011	0000000000000000
start condition	message bits	stop condition

8 RECEIVER APPLICATION DESIGN

The receiver has two parts functioning simultaneously, the main thread and the background thread. The main thread registers the listener for the ambient light sensor, as soon as a change is detected the main thread writes it to a shared variable. The shared variable is common to both the threads and contains variables to transfer information between the threads. The background thread checks for changes in shared variable and starts receiving the data when a start condition is detected. The data received is sent back to the main thread by a handler once the stop condition is received.The main thread updates the UI (user interface) with the received information.





ISBN : 978-93-87793-86-6

9 SYSTEM IMPLEMENTATION AND SOFTWARE DETAILS

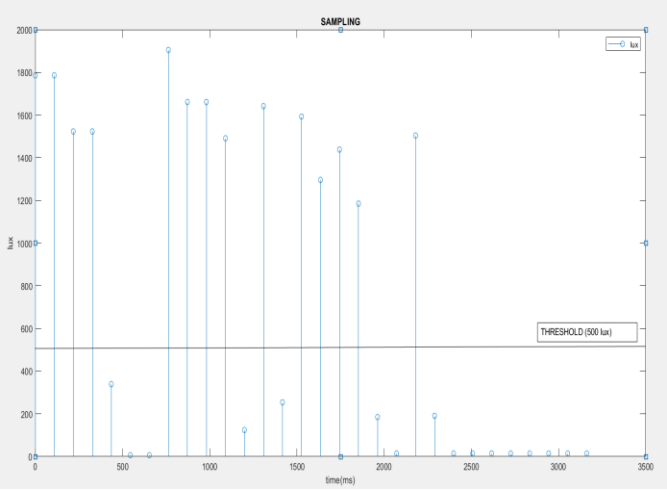
With Android platform mobile devices, we developed an application that allows flashlight to turn ON/OFF representing '1' and '0'. For the receiving side, we developed an application which senses the ambient light with the help of the ambient sensor and classify the signal to either '1' or '0' after comparing it with a predefined threshold. Which is 500 lux is this case (the threshold was set after experimentation).

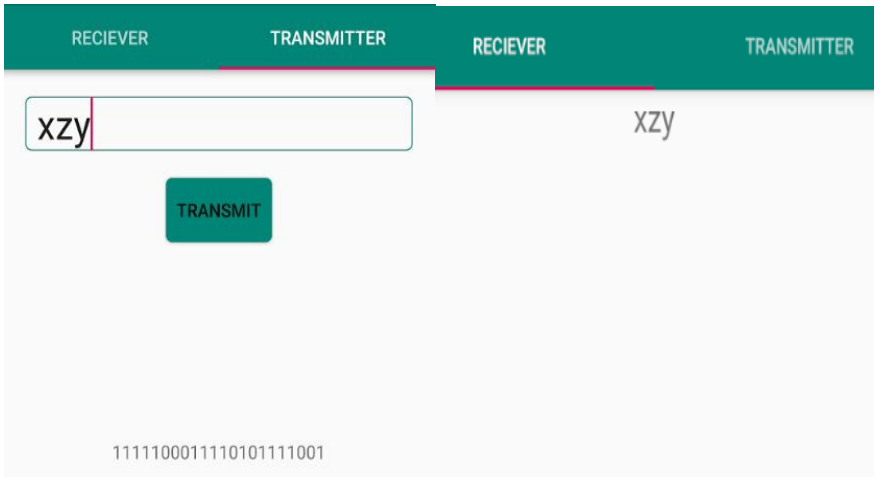
DIVISION	DESCRIPTIONS
Operating system	Windows 10
Language	Java
SDK version	Min sdk 22, Targeted sdk 28
Development Tool	Android Studio
Gradle version	3.3.2
JDK version	JDK 8(1.8)

10 RESULTS

We were able to successfully develop a half-duplex communication network between two Android mobile phones using Li-Fi technology.

In Android we use Sensor Manager to access the sensors of the device so the Sensor Manager library decides the sampling time of each sensor. Since ambient light sensor is used to measure the brightness of the surroundings which doesn't change rapidly it is only sampled once for every 109ms.





(transmitter UI) (receiver UI)

11 OBSERVATIONS

- The maximum distance between the transmitter and receiver should be within 15cm for noise free transmission.
- The transmission distance can be increased by using high capacity LED's.
- Always line of sight must be present between the transmitter and the receiver.
- Sampling speed was around 109ms due to the limitations in the kernel.

12 CONCLUSION

This proposed system can be used for data transfer between two Android devices or any other gadgets. With Li-Fi centric core research and customization of the electronics and sensors in the cellular phone an alternative way for data transfer at high rates can be implemented replacing the existing data sharing applications.

We do like to mention the disadvantages faced in real time implementation of Li-Fi systems such as

1. Ambient light/interference from other light sources.
2. Alignment between transmitter and receiver.
3. Scattering and multipath dispersion.
4. Very less mobility.

It is also important to note that significant research has been made to overcome these problems like selective wavelength filters allowing only certain wavelength of light to affect the photosensors thus eliminating interference.

With development of very sensitive sensors which can capture data from reflections the limitations are encountered. Considering the disadvantages with Li-Fi system and the limitations with the present day technology, we can conclude that Li-Fi may not be able to completely replace Wi-Fi but it will be the best complement for Wi-Fi.

Li-Fi is ideal for high density data coverage in confined areas where there are no obstacles. The potential outcomes of Li-Fi are immeasurable and it has to be investigated to facilitate the utilization of the technology.

ISBN : 978-93-87793-86-6

REFERENCES

[1] TED." Wireless data from every light bulb | Harald Haas." Online video clip. YouTube. YouTube, 2 Aug.2011.

[2] TEDx Talks. "LiFi – How every light could connect you to the Internet | Nikola Serafimovski | TEDx Bucharest." Online video clip. YouTube. YouTube, 26 May.2017.

[3] H. Haas, L. Yin, Y. Wang and C. Chen, "What is LiFi?," in Journal of Lightwave Technology, vol. 34, no. 6, pp. 1533-1544, 15 March15, 2016. URL: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7360112&isnumber=7425116

[4] Kil-Sung Park, Sun-Hyung Kim, Young-chang Kang, "Development of transceiver Flashlight and camera in VLWC." Advanced Sciencs and Technology Letters Vol.77

[5] Kosuri Siva Satyanarayana Raju, Velisetti Mohana Venkata Sai Deekshith, "PC to PC Transfer of Text, Images Using Visible Light Communication (VLC)." International Journal of Advanced Engineering, Management and Science (IJAEMS) [Vol-3, Issue-5, May- 2017] https://dx.doi.org/10.24001/ijaems.3.5.6 ISSN: 2454-1311 K.