Luminous Data

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***Abstract*— We live in the age of wireless technologies such as WIFI, Bluetooth and are surrounded with radio waves. These various technologies theoretically provide speeds of up to 150 Mbps as per IEEE 802.11n but we are still falling short of communicating frequencies and the practical speed required for the various modern day tasks carried out. Thus, we came up with a solution to this very big problem of ours, Luminous Data. We propose to send text and images from one mobile phone to other mobile phone using visible light communication. We are using Light emitting diodes which can be made to switch on and off at a very high rate to transmit digital data and it cannot be registered by the human eye. The sender has to just point in the direction of the receiver and use the interface of the application to send data. The project consist of mainly 3 different parts: The sender hardware, the receiver hardware and the interfacing provided on both sides. This method of using the Light Fidelity (LI-FI) technology to send data is much secure, faster and cheaper as compared to conventional technologies.**

***Keywords*— Light Fidelity (LI-FI), Visible Light Communication, Luminous Data, Wireless, Light emitting diode**

I. INTRODUCTION

In a world of increasing mobility, there is a growing need for people to have timely access to information regardless of the location of the individuals or the information.[1] Considering the major advantages of flexibility, ease of use, durability and pricing that wireless communication provides, it has become the most widely used form of communication today.[2] While wireless technologies are confined mostly to radio waves and infrared waves, it has become the need of time to search for alternative technology. Considering the fact that the advantages provided by visible light are far more than those of radio or infrared waves, we consider visible light as a good alternative for wireless data transfer. Though visible light has been used for communication through fibre optics, we consider the use of light directly taking the fibre out of the fibre optics for wireless communication.

The major strength of visible light is the speed. While the other used technologies limit their speeds, visible light can attain a communication speed of up to 500Mbps.[3] Also since visible light communication is a line of sight communication it provides a very secure environment for data transfer with no restriction to the transmission range. While the bandwidths are depleting due to tremendously increasing use of newer wireless technologies, visible light provides with a completely new range of transmission band that has not been explored yet. With just a few white light LEDs and photo diodes, a low cost, high performance and low maintenance system can be developed for wireless communication using visible light. The added advantages being that the technology is completely harmless to human body considering the adverse effect caused due to radio and infrared waves.

We form a system that integrates the visible light technology with our mobiles phones. We propose to make an android application that makes use of this wireless technology in order to transfer data wirelessly. This android application can provide a very high speed transfer of text and multimedia in a very secure environment to devices within their line of sight. For added security we are encoding the data before transmission.

II. EXISTING SYSTEMS

A. *Morse code*

Developed in the 1830s and 1840s by Samuel Morse, this code worked by transmitting electrical signals over a wire laid between stations Although the telegraph had fallen out of widespread use by the start of the 21st century, replaced

by the telephone, fax machine and Internet, it laid the groundwork for the communications revolution that led to those later innovations. [4]

B. *Infrared*

The Infrared Data Association (IrDA) is an industry driven interest group that was founded in 1993 by around 50 companies. In infrared communication an LED transmits the infrared signal as bursts of non-visible light. At the receiving end a photodiode or photoreceptor detects and captures the light pulses, which are then processed to retrieve the information they contain. [5] However, these are short range waves easily blocked by common things. Also this technology is weather sensitive. [6]

C. *Bluetooth*

Bluetooth is a wireless technology standard for exchanging data over short distances using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs).However, Bluetooth is not designed for high-speed data transfers. Also, the range of communications is often limited to a few feet. Some devices do not have profiles compatible with the devices you want to connect to. *[7]*

D. *Wi-Fi*

Wi-Fi is a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. The technology provides speeds up to 150mbps. However, one can get interference from other sources; including interference which causes the users devices to no longer function. Also, Wi-Fi networks have limited range. A typical Wi-Fi home router might have a range of 45m indoors and 90m outdoors. [8]

E. *ZigBee*

ZigBee is the one of the standards-based wireless technology designed to address the unique needs of low-cost, low-power wireless sensor and control networks in just about any market. ZigBee can be used almost anywhere, is easy to implement and needs little power to operate. However, the main disadvantages of ZigBee include short range, low complexity, and low data speed. Due to their high cost, GSM and GPRS are normally used in concentrators to transmit data to the main station, or in high end multi-function meters. [9]

III. PROBLEM STATEMENT

We propose to develop a system based on visible light which can touch the aspects of communication where invisible waves falter. The project should aim to transmit data between two mobile devices using light as a channel. The sender and receiver mobile will both have a small hardware attached with LED and Photodiode to exchange information. Use the visible light communication for transmission of data between the two devices (text and images). The system developed should be secure to prevent eavesdropping and loss of data.

IV. SYSTEM DESIGN

A. *Architectural Design*

The application uses a white LED and a photo diode to carry out the transmission. The LED is illuminated by the current passed to it through the board. The photo diode in turn catches the illumination signals. The process is carried out as follows. The LED, on receiving a signal from the application, turns ON i.e. current is passed to the LED. This is noted as a high signal. For displaying a low signal the flow of current is stopped and the LED turns OFF. This constant flickering of the LED is the binary input from the mobile application.

On the receivers end the photo diode catches these signals and interprets them as high and low signals. Each signal is interpreted, converted back to the data stream and displayed on the mobile device.

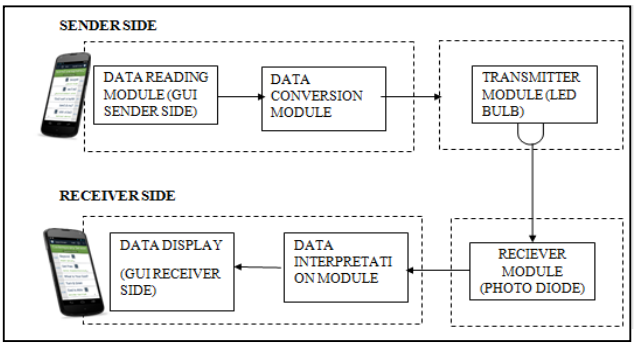

Fig. 1 Architectural Block Diagram

V. *SENDER SIDE*

1) Data Reading Block: This block reads the data which is to be transmitted encodes it and sends it to the next module for conversion in to proper format

2) Data Conversion Block: This block converts the data to a format suitable for transmission. In this case, data is sent in binary format. The binary data is then forwarded to the transmitter block

3) Transmitter Block: The data in binary format is used to generate on-off patterns of the LEDs. The LEDs switch on and off according to the data provided by the data conversion module. These switching patterns of the attached LED cause transfer of data.

C. Receiver Side

1) Receiver Block: The major component of this block is a photo diode. The diode captures the switching patterns of the LED. These patterns are then converted to binary format by the receiver block and sent for interpretation to the next block.

2) Data Interpretation Block: This block is used for data conversion. This block receives data in binary format from the receiver block and converts it to a format understandable by the user i.e. ASCII or EDCIDIC formats along with decoding the data.

3) Data Display Block (GUI): This block consists of the android application. The data display block acts as an interface between the user and the system. This block is used to display data received from a distant device and also to enter the data to be sent to the distant device.

VI. IMPLEMENTATION

The implementation of our luminous data application can be divided into three categories: communication technology, graphical user interface of the software and the software protocol all of which are explained below.

A. Communication technology

There are two hardware configurations on the sender side and the receiver side, it also includes the protocol implemented for the transfer of data between the two devices. The main principle of using visible lights is that led can be modulated at high rates (above human perception). That is, the intensity of the light emitted from the led changes as a function of time. A light sensitive photodiode device is then used to sense these changes in light intensity. For a simple digital communication system, a led in on state represents a 1 and led in off state represents 0. [10]

The transmitting hardware consists of a current mirror circuit which drives the white led. The receiving hardware consists of a photo diode which is connected to an amplifier. The output of the amplifier is in mv which is then given to a negative feedback amplifier with a gain of 100. This gives a typical output between 5-12 V peak-to-peak.

The hardware is interfaces with an ioio board which allows android applications to communicate with the hardware connected through the mini-usb port. The only disadvantage of using ioio board is that it limits the application to only android based platforms, other devices can be easily supported by using the audio jack for communication.

Fig.2 IOIO OTG board

The software protocol used in uart serial protocol based on rs-232. The entire code is written in android since ioio can be directly interfaced with android platform.

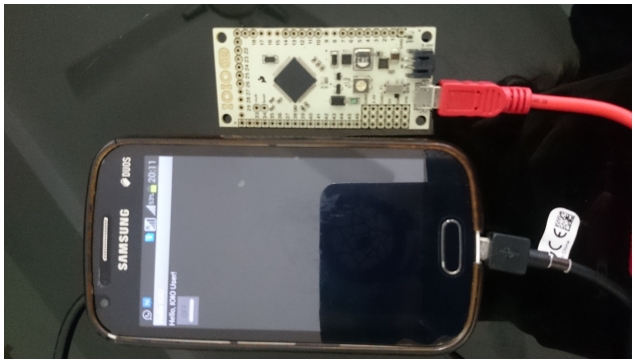

Fig.3 IOIO board interfaced with mobile

B. Graphical user interface

It provides the interaction between the user and the system developed. Thus we have developed an intuitive GUI which has an easy navigation flow. On the sender side we select the type of data to be sent that is text or image and then enter the data and press the send button. On the receiver side the user needs to press the receive button to turn on the application and then it is ready to receive the data

C. Software protocol

The application uses a simple UART protocol to send and receive the data. Before the transmission the data is encoded so that there is added security.

VII. FUTURE WORK

While our app provides a high speed, efficient n secure means of transfer text and images, videos can also be sent using our application in future. Also we suggest improvements which could make the system more effective and easy to use for the users like embedding the visible light technology within the mobile phones instead of putting up the additional hardware could make the mobile phones much handier. Also we can use hardware peripherals like reflective mirrors or lens to spread the LED beam to a wider area so as to have more stable communication and also increase the number of participating users. This would

include built-in LEDs in the mobile phones. Further, many applications can be developed that use visible light in the field of gaming, peer to peer data sharing etc. Also steps can be taken in order to increase the communication bandwidth.

VIII. CONCLUSIONS

Thus, Luminous Data is as simple as using a flashlight. The most useful application in its league, luminous data lets users communicate within each other's line of sight. It has no hassles of pass codes and pins which other systems possess. A rightful name given to this application, using light as medium it illuminates the data making it not only faster but also a visual experience in itself. The use of light has made this secure because the flickering rate is not perceptible to naked eye. The simplicity in its use is a great asset. Unlike Wi-Fi and Bluetooth systems there is no need of premeditated connection. Two users just need to be in the line of sight to exchange information. It is quick, easy and safe.

IX. REFERENCES

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