

# LI-FI Based Data Storage Device

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## ABSTRACT

We here intend to develop an external portable wireless data storage hard-drive as an interfacing device with other secondary storage present in laptop or desktop. Thereby attaining lightning fast data transfer at speeds, when compared to present day external hard drives. Using fast switching LED's to transfer electronic data that can be written wirelessly, instead of trivial electronically transferred files through low speed existing wireless standards such as Wi-Fi, Bluetooth etc.

**Keywords:-** LI-FI, VLC, Data storage, Contact free, Light Emitting Diode(LED).

## I. INTRODUCTION

Light Fidelity (Li-Fi) is a bidirectional, high-speed and fully networked wireless communication technology similar to Wi-Fi. It is a form of visible light communication and a subset of optical wireless communications (OWC) and could be a complement to RF communication (Wi-Fi or cellular networks), or even a replacement in contexts of data broadcasting.

It is wireless and uses visible-light communication or infrared and near-ultraviolet instead of radio-frequency spectrum, part of optical wireless communications technology, which carries much more information, and has been proposed as a solution to the RF-bandwidth limitations.

[1]Li-Fi is transmission of data through illumination by taking the fiber out of fiber optics by sending data through a LED light bulb that varies in intensity faster than the human eye can follow. By flickering the light within ON and OFF phases you can transfer data as 1's and 0's respectively. The switching is done at such a high rate that it remains unphased to the human eye. This gives an advantage over present wireless means of data as it is cost effective, consumes lower amounts of energy, is faster upto 70Mbits/s etc.

## II. PREVIOUS WORK

The data gathering community has become very diverse and flexible with it's terminology of a smart wireless hard drive. It can expand from a wireless USB pen drive that is portable with a charged battery in which you can share content wirelessly to three mobile devices using WI-Fi ( as released by [21] SanDisk connect wireless disk, [22]

Kingston Wireless Mobile G3 pro ) to the likes of Seagate's flash hard drive storage that plugs into your home network and can provide content to all the devices that are connected to the network ( as released by [22] [Seagate's Passport Wireless.](#) )

The above mentioned products though are very convenient and alluring in principle but aren't so practical in everyday situations. For e.g. – the battery backup of the SanDisk Smart Connect wireless Stick is only upto 4.5 hours and will not connect dually between your PC and your cellular device. It constricts data movement.

Also, the devices available in the market have a constraint of only allowing a certain data speed which can take a lot of time and in case a large file which has to be transferred, will take an even larger period of time along with a significant drain on the battery life.

Li-Fi on the other hand has fast data transfer rate, if developed properly is very cheap and user friendly with lower battery consumption. But due to the evidently new development of the system and a significantly raw application in terms of usability it has not been raised up in the market yet.

## III. PROJECT OVERVIEW

[1]Li-Fi was first showcased by Harald Haas from University of Edinburgh, UK, in his TED Global talk on VLC. He explained," Very simple, if the LED is on, you transmit a digital 1, if it's off you transmit a 0. The LEDs can be switched on and off very quickly, which provides magnificent range for transmitting data."

Li-Fi as explained above is a concept related to data transmission using light sources such as bulbs, tubelights,

LED etc. It involves sporadic switching ON and OFF of the light source in order to transmit data. The human perception of light presence is only present upto a certain extent after which it feels to be a constant ON or OFF. Hence, data transfer can happen without disturbing human contact as the rate of switching lights ON and OFF is far too high.

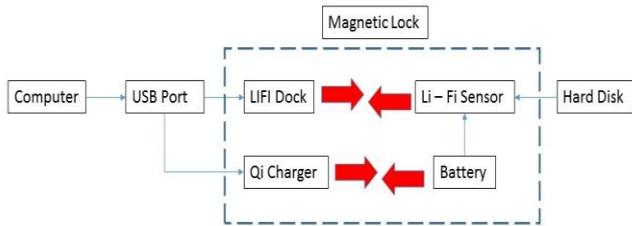


Fig. 1. Overview of the project

As Fig.1 suggests the block diagram for the overall functioning of the data storage and transfer drive it has a few crucial components.

The data sending console i.e. Computer like desktop, laptop, cellular device etc. has data that needs to be transferred. The Li-Fi dock is connected via a USB 3.0 port to the computer. The Li-Fi dock has parallel set of LED's for high speed data transfer. On the other side there is a Li-Fi sensor connected from a hard drive that stores magnetic data onboard a memory chip or platter.

The Li-Fi Dock and the sensor as shown in Fig.2, Fig.3 are secured and maintain contact via a magnetic lock to enhance data transfer rate that will not get tampered due to external light. The Docking scheme is powered by a wireless Qi charging mechanism based on resonant - inductive coupling of battery placed near the sensor to power up the hard drive to read/write data.

This will ensure a wireless high speed data transfer between the external hard drive and the computer with easy/safe disconnection between the computer – hard drive after the data transferring applications are over.

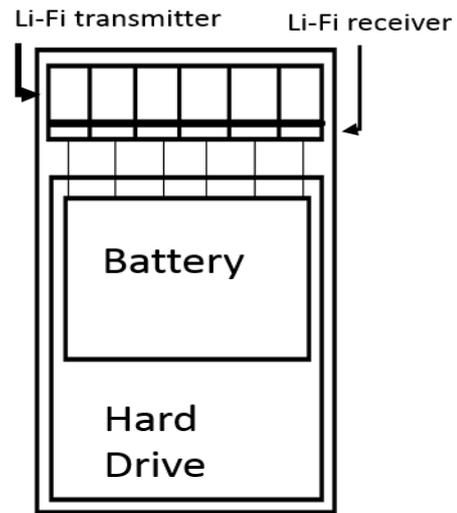


Fig. 2 Anterior View

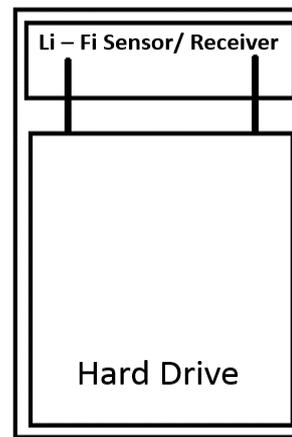


Fig. 3 – Posterior View

#### IV. HARDWARE

The complete apparatus as shown in Fig.1 has a few working parts as follows:-

**A. Computer** - The main data center of the connective device where the data is stored or transferred from. The USB port of the computer serves as the port from where the data bits get transferred from.

**B.USB port** – A USB 3.0 or USB class C port serves as the hardware data connection between the computer and the Li-Fi dock. With transfer speeds of 300 Mb/sec to 500 Mb/sec it will ensure fast data transfer rate between the computer and the Li-Fi dock.

**C. Qi Charger** - It is an interface standard developed by the Wireless Power Consortium for inductive electrical power transfer over distances of up to 4 cm (1.6 inches). The Qi system as shown in Fig. 4, comprises a power transmission pad and a compatible receiver in a portable device. To use the system, the device is fitted with a battery consisting of an inductive coil, this is placed on top of the power transmission pad which also has a secondary inductive coil. The charging happens when the current passes through the station's inductive coil generating an electromagnetic field, this field influences the inductive coil of the battery and provides it charge that powers it up like a regular battery or power source. This phenomenon of charging a device by mere contact is termed as resonant inductive coupling. The USB port provides upto 5A of power, when the device is paired using resonant inductive charging the pad provides operating energy to the battery of the hard drive.

[19]The Qi charger has sensors onboard the charging dock that first send out a test charge every once in a while to see if there is a compatible device in the vicinity that needs to pair. If the charge comes back it means there is a device and the pairing process is started but however, if the charge does not return it means there is no device in the vicinity and the charging pad is kept in a standby mode. This sensor can act as a convenient recognition medium on both the magnetic lock and the Qi charging system for readying the sensors for data transfer.



Fig. 4 - Qi / wireless charger

**D. Li-Fi sensor-** There are two sets of 6 LED's placed on the dock and the hard drive respectively. These are powered by the USB power and the Qi powered battery respectively. With fast switch on and off rates on both the LED's and the sensors the transferrable data rates can be very high when compared to the traditional wireless data transferring viz. Wi-Fi / Bluetooth / Infrared.

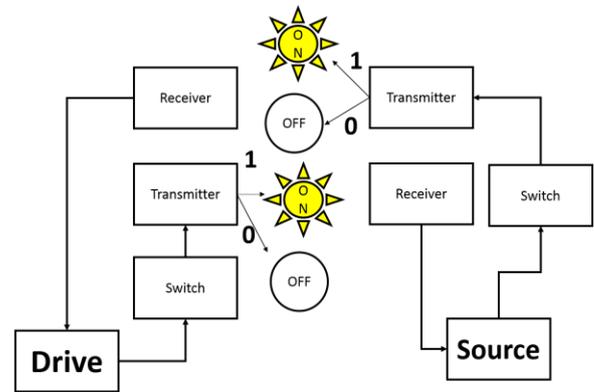


Fig. 5 Li-Fi operating diagram

Fig.5 explains the working of the Li – Fi mechanism where there is an ON-OFF witch that transmits a 0 when there is an OFF command and 1 when there is an ON command.

**E. Battery** – As the energy consumption by the LED is marginal but necessary, the battery requirement is kept to a very low margin in the range of 20mA battery at 2 V. The wireless charging will keep it active for the duration of the operation of LED's with a little residual energy when the data transfer has ceased. The battery is kept in excess in order to run the data read/write functions of the hard drive.

**F. Data Storage Unit** – The most crucial part of the data storage unit is the hard drive or flash drive whichever is cheaper and faster as per the requirements. The Hard drive is a magnetic platter (Fig. 6) module which has a magnetic data transfer needle that encodes data, it is slower but safer. The flash storage (Fig.7) however is a faster but more expensive version but is also concise to be used and can save space.

The data from the magnetic platter is accessed using SATA connection via USB to suitable drivers on the computer.

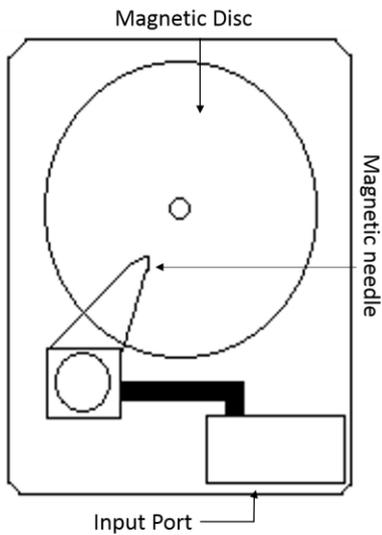


Fig. 6 Posterior View

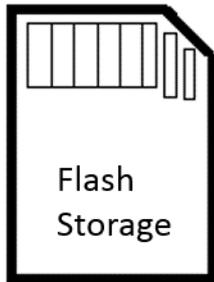


Fig. 7 Posterior View

**G. Magnetic Lock** – Li – Fi is based on the concept of light being used to transfer data as 0's and 1's. Sometimes due to unexpected light waveforms seeping in from exposed sensors/receivers from the external environment can alter the data pattern and cause undesirable disruption in the data transfer. Hence, a magnetic lock between an electromagnet on the dock that gets triggered when the Qi charger senses using its sensor's the presence of a compatible device. Only once, the magnetic lock is engaged does the data transfer process begin.

## V. SOFTWARE DESIGN

The hardware is the most essential part of the apparatus with the software playing a minute part in the functioning. The scheduling software is majorly intended to synchronize the data transfer by operating as a gate for the beginning and the end of the data transfer modules.

The USB gate gives the command via the bus line notifying that the connection has been successful on the dock and that data transfer can start. The computer then accepts the notification and starts the data layout by sending data in the form of 0's and 1's. The dock sensing the 0's and 1's, receives the data using sensors which take data as if LED's are OFF and data as 1 when LED is ON. This causes a flow of information from the computer and into the data storage unit.

## VI. Results

The module, this concept is based on is of a prototypic futuristic concept which has not yet been brought out into the market commercially and hence remains to be tested.

[1]Li-Fi has possible data transmission rates of 10Gbps according to latest demonstration using a single LED, with multiple LED's as demonstrated the data transfer rate can go much higher with literal eye blinks substituting as measures of data transfers.

[8] Red LED operates at a much lower voltage and requires lower energy to operate when compared to while LED's that are more commonly used and red being of the highest wavelength in the broad spectrum is a much better source of data transmission with it being easier for the sensors at the receiving end. Most other present day wireless sources of data transferring are much slower with their transfer rate being as high as 300-400 Mb/s.

However, with this technology only coming out of the cocoon it stands to differ in practical demonstration as compared to the already well established Wi-Fi/Infrared means of data transfer which have been in the market for a much longer time.

Hence, Li-Fi with consuming much less energy of the order of a few mA and even lesser amount of time for data transfer this apparatus shows promise for setting up a new means of transferring data wirelessly without the hassle of cable or plugging in your device to a computer.

## VII. CONCLUSION

The modern era has mobility as it's main aim. People need higher power and processing in small packages. However, there is only a certain limit to which technology

can quench man's thirst to get better and have convenience available to him. Newer avenues open almost every day and most of them get shoved under the rug as most people don't pay attention to them. Li-Fi is one such new technology that has come to light in recent times which have a lot of applications but are not being ventured into due to lack of awareness.

However, in the broader aspects of its functions due to its comparative young age we do assume certain obstacles will be there in its functioning such as the data transfer might take some time to reach the computer as data processing rate may not be as fast for the computers due to primitive nature of the computer or the read/write functions on the hard drive may take some time. Hence the addition of external data buffers maybe taken into consideration. Also, due to expenses or untrustworthy working conditions of Li-Fi sensors other means can be sought after like including RFID recognition between sensor and the drive. Use of Wi-Fi based data transfer can also be used as an alternative in the wireless spectrum due to its relative cheapness and previous success in the marketplace. These are a few obstacles whose solution we strive to solve in the upcoming attempts in perfecting the device.

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I would also like to thank the papers I have referenced to for making this paper. No copyrights are intended, respected writers and owners of contents have full authority of the paper.

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## PROFILE

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