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# 'LiFi' A Secure and Universal Interface to IoT Applications

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***Abstract – IoT deals with interconnection of devices and LiFi is a medium to achieve networking. Hence Light Fidelity (Li-Fi) is the biggest facilitator of IoT and Big Data. Li-Fi is a wireless technology which enables bi-directional and high speed data transfer. LiFi could be installed anywhere users might like light and data services: bus shelters, train stations, street lights, tourist information kiosks could all provide data transmission as well as light. As the market for IoT devices grows and sensors are added to more and more things and places, faster and heavier data transmission will be required. Our current infrastructure simply cannot handle the quantity of data that will need to be transmitted if the IoT continues to grow at predicted rates. LiFi may be the only viable solution if we want Big Data and the IoT to continue to grow.***

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## 1. INTRODUCTION

LiFi is a category of Visible Light Communication; an LED light flickers at speeds undetectable to the naked eye to transmit data — a bit like high tech morse code. In fact, scientists have demonstrated in a lab that they can transmit information at as much as 224 gigabits per second, the equivalent of 18 movies of 1.5 GB each being downloaded every each second [1]. In an office setting, they were able to achieve speeds up to 100 times faster than average WiFi speeds. In smart cities, the possibilities are really exciting. There have been tests, for instance, that explore the use of Li-Fi in disaster situations, and they have proved successful. Li-Fi also has potential applications in guiding sight-impaired passengers on public transit systems, measuring customer journey times through supermarket aisles, and offering ultrafast, secure Internet access for citizens. It has proved to be an enabling connectivity on military bases, enabling data transmission in transportation infrastructure like traffic lights, and even enabling vehicle-to-vehicle communication with Li-Fi-enabled headlights. This is where the IoT really shines [2]. Li-Fi isn't the solution for everything, of course. Li-Fi requires light, so enabling public Internet access through Li-Fi would require constant light sources, and that may not be plausible. Also, Li-Fi is limited by physical barriers, since light can't penetrate walls. Depending on the context, this last limitation could actually be considered a good thing. For instance, if you're using Li-Fi to connect to the internet in your home or business, no one outside of an LED's direct light could piggyback on your network. This paper primarily focused on challenges, applications and future directions of integrating light fidelity and IoT.

## 2. LIFI IN IOT TECHNOLOGY

Visible light communication (VLC) is a class of technologies for wirelessly transmitting and receiving information using light (from infrared, through visible, into ultra-violet visible light spectrum of about 400 THz to 800 THz) instead of radio waves. Li-Fi demonstrated data transfer at 1 Gbps, or about 100 times faster than Wi-Fi. Indian researchers developed Triplet Li-Fi (T-Li-Fi) using three colors, each carrying different data streams, thus tripling conventional Li-Fi capacity [4]. The system consists of a modulator that connects to the lighting fixture and a USB dongle to connect a computer or television display. Li-Fi is a potential substitute for Wi-Fi, but it has strengths and weaknesses that put it in contention with Bluetooth, near field communication, low-power wide-area network technologies like LoRa and Sigfox, and even industry-specific technologies like RFID or iBeacons. The primary constraint is the need for a line-of-sight link, usually no more than 10 meters away (Bluetooth range can be more than 50 meters), without interference by artificial light or bright sunlight. As noted above, the Li-Fi Consortium is addressing Li-Fi's inability to penetrate walls with a repeater device, which reads signals in one room and repeats them in another. But combining it with other complementary technologies can create a new ubiquitous

computing platform. Under this integration, every device large enough to mount an LED and a light sensor can be connected and even powered by Li-Fi. Any light bulb could include Li-Fi, a camera, microphone and speaker to function like an Amazon Echo — an unobtrusive, universal interface to the internet of everything.

## 3. APPLICATIONS OF IOT ENABLED BY LI-FI:

**3.1 Heath Monitoring:** Growing demand for spectrum, alongside limited availability of spectrum, will certainly help this growth along. Concerns about data security may also help push Li-Fi adoption in environments like hospitals. Global Market Insights' analysis also suggests Li-Fi's market share in intrinsically safe environments that can't tolerate the use of Wi-Fi will experience a 88% CAGR (compound annual growth rate) between 2016 and 2023[5]. Due to increase in population the number of patients are increasing day by day so to make doctor task is not so easy hence proper heath monitoring system using VLC technology will not cause interference in operation theatres, ICU or other devices[6]. All the existing bulbs are to be replaced by Li-Fi compatible bulbs and the wires to transfer data, in the backbone local area network must be added inside the ceiling and/or wall. Latest smartphones are compatible for this technology usage. i-phone has high-resolution camera built in with external flash light. Furthermore, a Li-Fi supportable operating system (OS) is found in i-phone OS 9.1 firmware by Apple Inc. Hence, an i-phone can be included in basic infrastructure for Li-Fi networks [7]. Li-Fi networks can be used as fully automated system. Normally doctors and nurses should periodically keep an eye on patient's health condition by taking measurements of blood pressure, heart rate, temperate, respiration rate, etc.

In this proposed method, the measurements are made without any human intervention and various patient statistics are also recorded (real-time health monitoring system). Each patient is provided with a tag for their identification and to study their previous medications which can be useful if they are moved to another hospital or medicated by some other technicians. Various sensors used are temperature sensor LM35 can be used to measure body temperature. Electrocardiogram (ECG) sensor where. ECG electrode is attached to a patient's body during electrocardiogram procedure. Future work will focus on miniaturizing and better packaging the electrode as well as reducing the power consumption of the digital and wireless transmitter components [8]. Respiration sensor, where the difference in temperature of our breath changes the thermistor's resistance which is used in the sensor. Glucose sensor Blood glucose sensor is an instrument used for monitoring glucose level in blood.

**3.2 Smart Home:** Unlike Wi-Fi technology, Li-Fi cannot travel through non-transparent material such as walls, which will provide more secure data transfer as it confines the data transmission to one area and it do not have any interference issue. The use of LED light in Li-Fi, makes it more suitable for indoor applications because it is cheaper and safer for eyes (Soro and Heinzelman, 2009). As a security system in our proposed smart home, we suggest the use of a WVSN (Wireless Visual Sensor Network) that consist of a large number of tiny visual sensor nodes called camera nodes, which integrate an image sensor, an embedded processor, and a wireless transceiver[10]. These nodes can collect image / video data from a region of interest, process it collaboratively, and transmit the useful information to the base station.

**3.3. Smart Vehicle to Vehicle Data Transmission:** Communication between vehicles is also possible by using Li-Fi technology. Vehicle to vehicle communication can be used to reduce accidents by calculating distances between vehicles. To calculate distance active ultrasonic sensors are used which generate high-frequency sound waves and evaluate the echo which is received back by the sensor, measuring the time interval between sending the signal and receiving the echo to determine the distance to an object [11]. Each vehicle includes a circuit consisting of ultrasonic sensors, head-lights and tail-lights attached to Arduino microcontroller. Vehicles must maintain a minimum distance from each other. The distances between the vehicles are continuously calculated by the ultrasonic sensor and being compared with the minimum distance. If any two vehicles come closer than the minimum distance then a slowdown command is generated and a signal is sent to the second vehicle to slow down through tail-light to head-light of another vehicle using Li-Fi technology which is then decoded by the Arduino microcontroller. Thus accidents can be reduced.

**3.4 Smart City:** Traditional radio frequency (RF) that is used for wireless communication today has a limited spectrum, and with the rise of smart home and smart city technology the abundance of connected devices is placing strain on our current networks. Li-Fi can help solve this problem. As the visible light spectrum 10,000 times larger than the radio spectrum it can be utilised to connect devices and assist in taking the strain off current networks [13]. Philips Lighting is offering Light Fidelity (LiFi), a technology in which high-quality LED lighting provides a broadband Internet connection through light waves. It is the first global lighting company to offer LiFi-enabled luminaries from its existing office lighting portfolio [14].

**3.5 Big Data:** LiFi may be the only viable solution if we want Big Data and the IoT to continue to grow. Because existing LED light bulb technology requires only the addition of a tiny microchip to

become a LiFi transmitter, eventually, the more than 14 billion light bulbs in the world could be converted into 14 billion LiFi transmitters. In the time to come, Li-Fi will not only become an accepted form but people will be able to explore real devices with real applications that use it. People would be able to install Li-Fi at any place such as tourist information kiosks, street lights, train stations, and bus shelters, where Li-Fi could get the required light to enable data transmission. Faster data transmission and connectivity promised by Li-Fi is an encouraging space for businesses across the world. The integration of big data, IoT and Li-Fi will provide various business opportunities for businesses and individuals alike [12].

## 4. SECURITY ASPECTS:

With Li-Fi, IoT systems can overcome signalling and security related challenges and with a proper monitoring of IoT systems connected over LiFi, the omnipresent detection can be tackled. The features of not passing through walls, less radiation, and the possibility of having a good number of access points make Li-Fi suitable for IoT [15].

## 5. CONCLUSION

As the market for IoT devices grows and sensors are added to more and more things and places, faster and heavier data transmission will be required. This Big data is a high volume, high velocity and high variety information assets that demands cost-effective and fast rate of information processing and decision making. Big Data can be leveraged to create better value propositions based on customer data and behavior rather than simple sensors and building management optimization. Big Data is the field which can be connected to lighting and ample source of data at very cheap rate can be provided and this will transform the Big Data to a new level. As lighting will provide a backbone for data collection, it can also provide an infrastructure for data dissemination. Li-Fi can convert a collection infrastructure into a truly dynamic network. The smart LED lights are cost effective and can be powered up using solar cells and batteries and as the medium of data transfer is light. It does not create any kind of electromagnetic interference like the way Wi-Fi does. Due to all this advantages Li-Fi can be thought of as the best options for advancement in the field of IoT and Big Data.

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