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# LIFI BASED PARAMETERS MONITORING SYSTEM FOR SPACE APPLICATION

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**AIM:** Design and development of LIFI based parameters monitoring system for space applications**.**

**PURPOSE:** Technology advancements are needed for space applications. So many parameters consider for space programs. Especially for space parameters monitoring like temperature, humidity, pressure and solar irradiation are mandatory for existence in space. Reading of these kind of parameters are displaying is complex task in space because wire communication not allowed in few cases. Because of wire communication, normal wires are more weight to carry satellites into orbit. Other wireless communications available but little bit expensive than LIFI. Here our idea is to replace regular communications with LIFI. This kind of communication will helps like satellite to satellite communication or space station to satellite when they are closer. Project title is LIFI based parameters monitoring system for space application.

## INTRODUCTION

German physicist Harold Haas proposed Li-Fi (Light-Fidelity) as the basic solution for high-speed data networks [1]. Li-Fi networks, also known as visible light communications, enable data to be transmitted through the illumination of a light-emitting diode (LED) bulb (VLC). In the age of the Internet, there is a constant demand for quicker, safer, and more efficient wireless-wire communication in all areas, though wireless networks are favored in all domestic applications in general, and healthcare applications in particular [2]. The reason for using a wireless network in a hospital is that cables linking devices and travel over the patient's body can cause contamination. The increasing demand for radio spectrum and bandwidth places the increasing reliance on wireless internet and a burden on wireless Wi-Fi technology [3]. To relieve the strain on Wi-Fi, Li-Fi is a new type of wireless internet that has applications in almost every field [4]. This system can employ many forms of modulation methods, One approach for encoding digital data through multiple carrier frequencies is orthogonal frequency division multiplexing (OFDM) [5]. The simplest type of amplitude-shift key (ASK) modulation is on-off keying (OOK), which the presence or absence of a carrier wave is used to reflect digital data [6]. Pulse-width modulation (PWM) is a modulation method that converts a message into a pulsing signal. It can be used to encode data for transmission. PPM (pulse-position modulation) is a signal modulation technique

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that encodes 'M' message bits by transmitting a single pulse in one of several possible time-shifts that are repeated every 'T' seconds [7]. This paper aims to establish? a human body healthcare continuous monitoring system based on Li-Fi technology as a safe environment to activate Wi-Fi in hospitals to avoid electromagnetic interference. Therefore, Li-Fi offers a high-speed technology for using light as a means of transmitting data and thus providing a safer and greener environment. As compared to Li-Fi, Wi-Fi patient monitoring is slower and also has less bandwidth. Li-Fi has a higher level of reliability via Wi-Fi. Since data is transmitted on Wi-Fi through radiofrequency waves, these waves have the potential to affect the human body [8]. The Li-Fi technology has a 3m range and allows for safe communication. VLC is the wireless transmission of information using light.

**Literature survey**

**Sarkar, A., Agarwal, S., & Nath, A. (2015). Li-Fi technology: data transmission through visible light. International Journal of Advance Research in Computer Science and Management Studies, 3(6).**

Li-Fi stands for Light-Fidelity. The technology is very new and was proposed by the German physicist Harald Haas in 2011. Li-Fi provides transmission of data through illumination by sending data through an LED light bulb that varies in intensity faster than human eye can follow. In this paper, the authors will discuss the technology in detail and also how Wi-Fi can be replaced by Li-Fi. Wi-Fi is useful for general wireless coverage within buildings while Li-Fi is ideal for high density wireless data coverage in confined areas where there are no obstacles. Li-Fi is a wireless optical networking technology that uses light emitting diodes (LEDs) for transmission of data. The term Li-Fi refers to visible light communication (VLC) technology that uses as medium to deliver high-speed communication in a manner similar to Wi-Fi. Li-Fi provides better bandwidth, efficiency, availability and security than Wi-Fi and has already achieved high speeds in the lab. In the present paper the authors will give a detailed study on Li-Fi technology, its advantages and its future scope. Professor Harald Haas, the Chair of Mobile Communications at the University of Edinburgh, is recognized as the founder of Li-Fi. He coined the term Li-Fi and is the co-founder of pureLiFi. He gave a demonstration of a Li-Fi prototype at the TED Global conference in Edinburgh on 12th July 2011. He used a table lamp with an LED bulb to transmit a video of a blooming flower

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that was then projected onto a screen. During the talk, he periodically blocked the light from the lamp with his hand to show that the lamp was indeed the source of the video data. Li-Fi can be regarded as light-based Wi-Fi, i.e. instead of radio waves it uses light to transmit data. In place of Wi-Fi modems, Li-Fi would use transceivers fitted with LED lamps that could light a room as well as transmit and receive information. It makes use of the visible portion of the electromagnetic spectrum which is underutilized. Li-Fi can be considered better than Wi-Fi because there are some limitations in Wi-Fi. Wi-Fi uses 2.4 – 5 GHz radio frequencies to deliver wireless internet access and its bandwidth is limited to 50-100 Mbps. With the increase in the number of Wi-Fi hotspots and volume of Wi-Fi traffic, the reliability of signals is bound to suffer. Security and speed are also important concerns. Wi-Fi communication is vulnerable to hackers as it penetrates easily through walls. In his TED talk, Professor Haas highlighted the following key problems of Wi-Fi that need to be overcome in the near future: a) Capacity: The radio waves used by Wi-Fi to transmit data are limited as well as expensive. With the development of 3G and 4G technologies, the amount of available spectrum is running out. b) Efficiency: There are 1.4 million cellular radio masts worldwide. These masts consume massive amounts of energy, most of which is used for cooling the station rather than transmission of radio waves. In fact, the efficiency of such stations is only 5%.

**Kulkarni, S., Darekar, A., & Joshi, P. (2016, March). A survey on Li-Fi technology. In 2016 International Conference on Wireless Communications, Signal Processing and Networking (WiSPNET) (pp. 1624-1625). IEEE.**

The wireless internet service is offered to the people through Wi-Fi technology in commercial and industries. It is working based on radio waves in the spectrum. These waves are very harmful to the diseased people, signal sensitive areas. Hence it could not be utilized in environments such as hospitals, scan centers, air lines etc. To overcome these limitations, Li-Fi is the technology that is developed to work in such environments. This paper is presented the study of Li-Fi technology, working principles, challenges and applications with comparison of Wi-Fi technology. The comparative study is also presented the features of both technologies. The observations show that Li-Fi performs harmless data transmission at high speed

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using light source. Recent emerging technology and size of smart phones, laptop and other smart devices are leading to increase the interest of common people in wired and wireless communication. Most of the people are connecting through network for data sharing, interaction, communication, knowledge updates, education and social activities. Hence, people are interested to transmit the data swiftly, and efficiently using low cost and bandwidth. Wireless Fidelity (Wi-Fi) is the most versatile, competent and effective technology that compact with Radio Frequency (RF) / microwave frequencies for rapid wireless data transmission. The high sensitivity receivers provide wide coverage at low frequencies and Line of Sight (LoS) communication at high frequencies. However, Wi-Fi is facing many challenges and issues in terms of capacity, efficiency, availability and security since hasty demand for wireless communications [1]. Numerous companies and industries motivate the research groups to work on Li-Fi technology that is absolutely dissimilar from electromagnetic spectrum. These researchers have been tested the experiments to support higher speed optical wireless technology that should overcome the limitations and drawbacks of RF based wireless spectrum. The initial research has been carried out to provide the high speed communication and reduce the harmless, electromagnetic field free environment in the wireless network [2], [6].

**Sarkar, A., Agarwal, S., & Nath, A. (2015). Li-Fi technology: data transmission through visible light. International Journal of Advance Research in Computer Science and Management Studies, 3(6).**

In this current era where all the facilities that includes banking, shopping, online payments, games etc. can be accessed with internet, has lead to a drastic soar in wireless communication usage. The usable radio frequency spectrum is completely exploited and bandwidth re-use has begun to compensate with the increasing user demand. But, this reuse is shrinking the network and gap between user demands and network availability is increasing gradually. The visible light communication is the best solution for growing user demands. Li-Fi, is a innovative wireless communication system which uses VLC as a source of communication. The technology utilizes LEDs that help in the transmission of information much quicker than that of Wi-Fi. This technology is best for high density wireless data communication in restricted

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area and to overcome radio intervention problem. Li-Fi provides improved bandwidth, availability, efficiency and security and has already obtained very high speeds of about 10,000 times more than the conventional Wi-Fi in the lab. By using the low cost LED lamps and light producing units we can use visible light bandwidth. This paper attempts to review basic concept of visible light transmission, how it is different from Wi-Fi, its applications in various fields, future usage, challenges and latest advancements over WiFi. A current era in digital wireless communication is on the edge of revolution. Li-Fi (Light Fidelity) is the superior modification Wi-Fi. It is the latest and one of the greatest 21st century inventions. The thought behind this machinery is that the information required for communication can be transmitted by using LED light whose intensity varies more rapidly than the human eye can sense, that intensity is captured by using a detector. It is a form of VLC which is part of optical wireless communications and could be a substitution for RF ie Wi-Fi and cellular network communication. This new Li-Fi technology is till now calculated to be more than 10,000 times faster than many of Wi-Fi implementations [1], reaching up to the speeds of 250 gigabits per second. HARALD HASS, who is known to be the father of Li-Fi from Edinburgh University at United Kingdom, says that at the centre of this technology there is a new generation of very sensitive ultra LEDs. He said, “My greatest vision is that light bulbs will become part of broadband communications equipment, so that the light emitting diode is not only able to provide light but also become a more necessary tool for visible light communication” *2+. As the transmission of the data takes place by using light emitting diodes (LED’s) the equipments are comparatively small. Now, days, it is called as the optimized version of WIFI. The advantage is the wireless communication through visible light which decreases the cost and instead of Wi-Fi modems and routers. Li-Fi would use transceiver fitted LED lamps that can serve dual purpose lighting a room as well as transmit and receive information in bits. As simple light bulbs are used, there be in principle many number of access points [3]. This technology uses a part of the electromagnetic spectrum other than RF. Great thing about this technology is that we can encode data in the light by varying the rate at which the LED bulbs flicker on and off to give different strings and sequences of 1s and 0s. The intensity of LED can be modulated so rapidly that human eyes cannot

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notice, so the output appears almost constant [4]. More advance techniques could raise VLC data rates dramatically. Researchers at the University of Oxford and Edinburgh are focusing on analogous data communication by means of arrays of LEDs, where each LED transmits a dissimilar data stream than earlier. Some groups are using mixtures of red, green and blueLED bulbs to alter the frequency of light, so that each frequency can encode a different data channel [5,6]. He envisions a future where data for computers, mobile phones, and tablets can be send out by using the light in a room instead of RF routers and security would be increased as- if you can't see the light, you can't access the data. The future applications of the this great technology can be predicted and extended to different platforms similar to educational fields, medicinal field, engineering and industrial areas and lots of other fields in wake of our future generations….!!

**Bhateley, P., Mohindra, R., & Balaji, S. (2016, April). Smart vehicular communication system using Li Fi technology. In 2016 International Conference on Computation of Power, Energy Information and Commuincation (ICCPEIC) (pp. 222-226). IEEE.**

This project presents the latest technology called as LI-FI in which two vehicles are communicated with the help of LEDs bulbs. Our main objective is to avoid collision and accidents. LI-FI can be transmitted any data such as break, zone, fuel level, vibration etc. Advantages of using LED based communication such as fast switching, high power efficiency and safe to human vision. This concept can be implemented at very low cost and with higher efficiency. Hence, this project presents ecofriendly data communication which consists of the white LEDs that transmit messages to the receiver. The field of science and technology is rapidly moving towards its advancement. The human being is utilizing this change of technology for the comfort and time saving. Progress varies from wired to wireless communication; In the recent years, the modern society shows an increasing interest towards wireless communication technologies and invented light fidelity technology. Harald Hass is known as the father of Li-Fi from university of Edinburgh who told about existence of this technology in his TED talks. According to Harald, the heart of this technology lies in the intensity and the potential of light emitting diodes. Li-Fi is an upcoming technology in near future which uses visible light spectrum for

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transmission of data which is 10,000 times more than the band used in Wi-Fi technology [1]. As large number of users are demanding for Wi-Fi thus RF spectrum is constantly being used and resulting in clogged signal. The idea is to use light bulbs at our homes as a source for transferring data. Road accidents are resulted in the loss of human lives. These accidents occurred due to the collision between vehicles. Studies reveals, majority of accidents are due to following vehicle are unaware of the actions of vehicle ahead. Collision can be avoided if the vehicle ahead can communicate with the rear vehicle, as shown in Fig. 2. There are many techniques to implement such communication prototype i.e. 5.9 GHz Dedicated Short Range Communication DSRC wireless in which two vehicles can communicate at the frequency of 5.9 GHz and Vehicular Ad-Hoc network which is the application of MANETs in which two vehicles can communicate by wireless fidelity [2]. The purpose of using Li-Fi is to implement a system that is cost effective and has high data rate. Since high intensity LED lights are already present in cars these lights can be utilized as Li-Fi transmitters. By adding only cheap circuitry, the collision can be avoided in vehicles using Li-Fi technology.

**Existing system**

As of my last knowledge update in January 2022, there is no specific information available about an existing Li-Fi-based parameters monitoring system for space applications. However, the concept of utilizing Li-Fi technology for communication and monitoring in space has been explored in the broader context of space technology. Such a system would likely involve the integration of Li-Fi transmitters and receivers to establish communication using light signals. Sensors designed to monitor various parameters in space, such as temperature, pressure, and radiation levels, would be an integral part of the system. Microcontrollers or processors would process the data from these sensors, and a dedicated data processing unit might be employed on-board a satellite or spacecraft. Additionally, the system would need to incorporate space-grade components capable of withstanding the harsh conditions of space. Ensuring data security through encryption measures would be essential, given the critical nature of space missions. The successful implementation of a Li-Fi-based parameters monitoring system for space applications would also require rigorous testing, validation, and integration with existing satellite systems. It's advisable to check for the latest developments beyond my last update in January 2022 to find more

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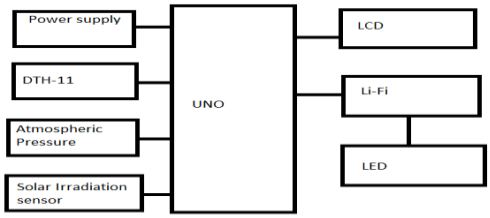
recent information on this specific technology.

**Proposed system**

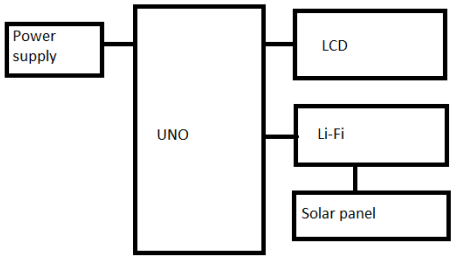
A proposed Li-Fi-based parameters monitoring system for space applications envisions the integration of cutting-edge technology to enhance data transmission and monitoring capabilities in the space environment. This system would employ Li-Fi transmitters and receivers to leverage light signals for data communication, offering potential advantages over traditional radio frequency-based systems. Sensors designed for space-specific parameters, including temperature, pressure, and radiation levels, would be strategically deployed and connected to microcontrollers or processors. These components would work in tandem to process and prepare data for transmission using Li-Fi technology. The proposed system would prioritize the use of space-grade components capable of withstanding extreme conditions such as temperature variations and radiation exposure. A dedicated data processing unit onboard the spacecraft or satellite would further streamline the analysis of monitored parameters. To address the critical nature of space missions, robust encryption measures would be implemented to secure the transmitted data. The proposed system would undergo comprehensive testing and validation to ensure its reliability in the demanding space environment, and integration with existing satellite systems would be a key consideration for seamless operation and coordination. This innovative Li-Fi-based monitoring system holds the potential to revolutionize data communication and parameters monitoring in space, offering increased efficiency and reliability for future space exploration endeavors.

**Block diagram**

**Transmitter**




**Receiver**




**WORKING**

At transmitter side Arduino reads all sensors data and send them to LIFI transmitter. LIFI

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transmitter converts data into light format and transmits in light format. LIFI receiver receives data and converts into text format and displaying on LCD display.

## CONCLUSION

This paper introduces a real-time patient monitoring system using a short-range wireless connection using Li-Fi technology. This wireless communication technology is useful because it causes no interference to sensor measurements such as ECG and allows the free movement of the patient and the medical practitioners to treat the patient. The device implementation uses very cheap components and license-free software, so it has the potential to be an incredibly cost-effective solution. The new system would help doctors who operate in busy, high-pressure settings, care for patients more efficiently and effectively. This method offers a realistic approach to using four different kinds of sensors installed on a single system. At present, four vital signs are calculated to determine the early warning score: pulse, oxygen in the blood, airflow, body temperature, and ECG. The system has been built with the future in mind so that it can easily be expanded to include other data.

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