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IOT BASED WIRELESS DATA TRANSMISSION THROUGH VISIBLE LIGHT COMMUNICATION

[1]Ms.Shiva Parvathi, [2]P.Sindhu,[3]P.Amulya,[4]V Durga Bhavani

[1]Assistant Professor, Department of Electronics And Communication Engineering, Malla Reddy Engineering College For Women, Hyderabad.

[2,3 &4]Ug Scholar, Department of Electronics And Communication Engineering, Malla Reddy Engineering College For Women, Hyderabad

ABSTRACT

This stands for light fidelity, or LiFi. Like WiFi, LiFi is a completely interconnected wireless networking system that can transmit data in both directions at high speeds. By transmitting data through an LED light bulb, which can change its intensity more quickly than the human eye, LiFi enables data transfer through lighting. Not only does the light we use every day illuminate our surroundings, but it also serves as a means of communication. Interference and excessive delay are problems with radio frequency (RF) communication. Also, a distinct arrangement is needed for the transmission and receiving of RF waves in order to carry out RF communication. Due to its large bandwidth and tolerance to interference from electromagnetic sources, Visible Light Communication (VLC) is a popular communication approach that overcomes the aforementioned restrictions. This study presented IoTVLDC, an Internet of Things (IoT) based Visible Light Data connectivity system, which enables efficient data transmission between source and destination using LiFi connectivity. To gauge the efficacy of the planned effort, this will be contrasted with the standard Visible Light Communication (VLC) paradigm. A two-way, wireless light-based communication system is employed. I intend to provide a detailed analysis of LiFi Technology in this work. With this technology, we can achieve data rates much higher than 10 Mbps, which is significantly higher than our LAN. Compared to WiFi, LiFi is far more beneficial since it employs VLC, which allows us to utilize the whole 60 GHz spectrum. LiFi allows data transfer using light-emitting diode bulbs, the intensity of which changes at a rate too high for the human eye to detect. LiFi can only operate in a lit area, making it an extremely regulated setting. In addition to being more environmentally friendly, this LiFi technology for wireless communications will also make communication in the future safer and more affordable

I. INTRODUCTION

There is a rising interest to provide wireless connectivity to "Things" through the internet infrastructure by extending the realms of the internet with a growing trend in smart city, smart grids, smart manufacturing, and smart transportation concepts [1,2,3,4]. The exponential growth of the Internet of Things (IoT) and the advancement in wireless communication have resulted in an astronomical increase in the number of 'Things' taking part in IoT causing a radio frequency (RF) spectrum scarcity [5,6,7]. Today, there is genuine concern for research efforts to investigate new wireless communication alternatives capable of delivering massive connectivity, diverse data rate, low latency, high capacity, and efficiency as well as high security. In this regard, visible light communication (VLC), which is an emerging and very promising wireless communication technique, could be considered capable of solving key challenges of wireless communications infrastructure in the wireless communication industry [8,9]. For example, most of the major challenges currently facing the implementation of 5G technology can be mitigated by the use of VLC [10,11,12,13]. Yet, the most desirable capability of VLC is that it offers an alternative to the already overloaded radio frequency (RF) spectrum with 10,000 times more capacity than the RF spectrum [14,15]. Furthermore, the VLC spectrum remains unregulated and unlicensed [16]. At present, it is the only safe-to-use bandwidth solution capable of alleviating the RF spectrum scarcity challenge [17]. Moreover, VLC can be deployed together with other critical communication systems and devices, e.g., in the airplane and hospital since it does not interfere with the electromagnetic fields generated by RF devices [18]. Currently, there are several ongoing studies aimed at transmitting medical data such as photoplethysmography, electrocardiography, and body temperature using VLC applications [19]. Unlike RF signals, visible light cannot penetrate through walls and does not spread uncontrollably making it appropriate for highly secured connections where wireless data transmission is intended to remain within the range of an access point [20,21]. For all these reasons, VLC can be applied to most IoT-based smart systems. As a result, a new paradigm in wireless communication known as the internet of light-emitting diode (LED) which integrates IoT with VLC using LED has been introduced and is being investigated. For instance, this technology has been applied in indoor navigation and art gallery monitoring where an array of LEDs on the ceiling of departmental stores and museums which act as a source of illumination are used to transmit the position of certain products and artworks to a user mobile device [19,22,23,24]. Another area of application is in the automotive industry where LED headlights and taillights of modern cars have been used in automobile collision prevention systems through vehicular VLC [11,14,25]. In addition, VLC-IoT can be applied to transmit medical data in biomedical sensing and data transmission [19]. These and more attributes have made VLC an attractive alternative solution to RF signals for high data rate transmission and limitless broadband solutions. As a result, there is a new upsurge in research contributions on VLC and on how to improve different aspects of VLC communications. Additionally, many scientists and engineers are now making attempts in implementing VLC for different application areas to overcome specific communications challenges. Unfortunately, there is a dearth of contributions highlighting the potentials, prospects, approaches, challenges, and solutions on the implementation of VLC for IoT communications. Therefore, we recognize the need for an effort that combines the above-mentioned in a single work.

II. EXISTING SYSTEM

We are all slowly but surely moving towards "smart" contemporary infrastructure [11] and objects thanks to the rapid development and interoperability of new ideas and technology spearheaded by the internet of things as well as cloud computing on a global scale. In this article, we discuss the future of LiFi communication and how it will be used in smart city linked automobiles. For high-speed vehicle-to-vehicle communication that provides more bandwidth, more connections, and more secure communication, the term "LiFi" is used. Not only are the benefits of LiFi technology highlighted, but also its drawbacks are outlined and examined. When used as a communication channel, LiFi technology offers several advantages to vehicles and communications with traffic infrastructure. We provide a LiFi "Transmitter" and "Receiver" model that allows for secure wireless communications between vehicles and traffic infrastructure, allowing for seamless integration of vehicles into the network [11]. Data is sent from a LiFi transmitter to a LiFi receiver utilizing visible light communication as the medium in this research [

III. PROPOSED SYSTEM

The LiFi standard, an innovative data transmission protocol, has the potential to radically alter the ways in which devices may communicate with one another. Rather than relying on a physical connection, LiFi allows data to be transferred between devices by means of visible light. Visible light communication is the theoretical basis for this concept as it employs LEDs that emit visible light to convey data. The foundational idea of LiFi is the standardization and well definition of data transmission by the amplitude modulation of light sources. The idea is straightforward: the LED flashes rapidly on and off, making it invisible to the naked eye. Binary streams of 0s and 1s are generated from this ribbon of on/off signals. LiFi is said to be eighty percent more efficient than WiFi because to the absence of conflicting light frequencies Many wireless gadgets, including PDAs, mobile phones, and laptops, as well as a multitude of LED lights or lamps, make up LiFi architecture. The following are important considerations for LiFi design: (a) Light must be in direct line of sight. (b) The driver for the lamp that is linked to the internet, the switch, and the LED light. (c) Use LED lights for improved performance. (d) Data was obtained using a photo detector.

IV. LITERATURE SURVEY

Cevik, T.; Yilmaz, S. An overview of visible light communication systems. *arXiv* 2015, arXiv:1512.03568

Visible Light Communication (VLC) has gained great interest in the last decade due to the rapid developments in Light Emitting Diodes (LEDs) fabrication. Efficiency, durability and long life span of LEDs make them a promising residential lighting equipment as well as an alternative cheap and fast data transfer equipment. Appliance of visual light in data communication by means of LEDs has been densely searched in academia. In this paper, we explore the fundamentals and challenges of indoor VLC systems. Basics of optical transmission such as transmitter, receiver, and links are investigated. Moreover, characteristics of channel models in indoor VLC systems are identified and theoretical details about channel modelling are presented in detail. Depending on the technological developments, the variety and quality of the communication devices and applications running on these devices have increased dramatically. These high quality applications require excessive data transfer capacity and speed. Much of the internet transmission at the backbone is handled by the Optical Fiber Infrastructure that can achieve data speeds on the order of

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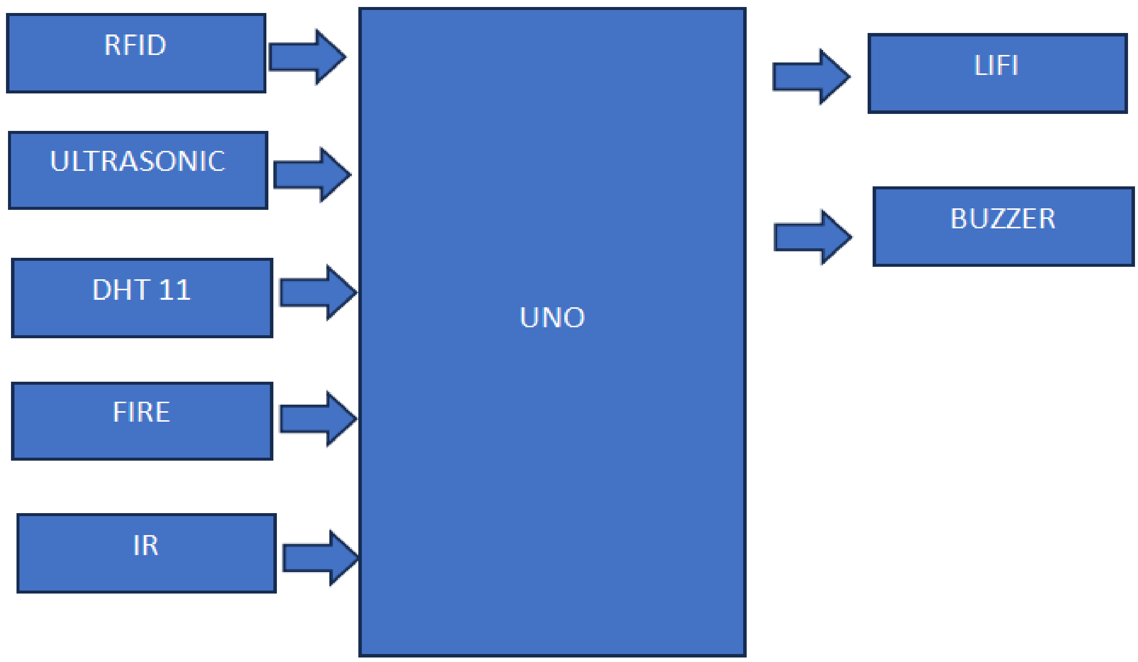
Tb/s. On the other hand, these high data rates at the backbone part cannot be perceived by the end users. Nevertheless, it is not always beneficial and conceivable to deploy a cable infrastructure to every point of a site. Therefore, the importance of wireless communication increases day by day and is being widely used in the last-meter such as home, office and campus environments. Even though wireless communication is favorable in terms of cost, practicality and ease of operation, it brings about the bottleneck problem. RF waves that fall beneath the 10 GHz frequency portion of the electromagnetic spectrum have been widely used in wireless communication. However, since the existing bandwidth cannot satisfy the required capacity and speed demands, as well as multiple technologies contemporaneously share the same bandwidth (Wi-fi, bluetooth, cellular phone network, cordless phones), scientists and professionals have focused on new research areas in wireless communications. An alternative solution proposed for this first-meter bottleneck problem is shifting the working frequency interval to the unlicensed 60 GHz band. By this way, it is desired to widen the bandwith and achieve higher data rates [1]. Given the name WiGig, and standardized by Wireless Gigabit Alliance [2], it has become possible to reach about 6-7 Gb/s data rates with this technology [3]. However, shifting towards the right side of the frequency spectrum, reduces the wavelength of the electromagnetic waves. The propogation range of short wavelength signals is very limited. As the signal spreads over longer distances, the error rate increases due to the weakening of the energy [4]. Therefore, WiGig technology is intended to be used for data communication at high speeds in more enclosed areas. Regarding to these quests, it is desired to utilize the mm-length electromagnetic waves ($\lambda <= 1$mm, $f > 100$ GHz) with the aim of enabling supplementary communication channels. Commuication with the mm wavelength on the right side of the spectrum is called Optical Wireless Communication (OWC). Data transfer on the infra-red band is already provided. Around 100 million electronic devices per year take place on the shelves adopted with infra-red technology. Moreover, the next generation wireless communication technology 4G and the follower are not built on a single technology. These Technologies are desired as an integrated topone system that will compromise multiple technologies working in harmony. The OWC technology is expected to be an important figure of 4G and 5G systems especially in the section that the end users are connected to the internet [5]. The outstanding advantages of OWC when compared with Radio Frequency Communication (RF) can be listed as follows [6-10]: • Unregulated 200 THz bandwith in the range of 155-700nm wavelengths. • No licensing fee requirement • Optical signals can not pass through walls like radio waves penetrate. Therefore, the signals emitted in a room provides significant benefits in terms of security by staying in that room. For long-distance communications Line-of-Sight (LoS) is essential, that is, the sender and the receiver must see each other directly. Any intervening situation or barrier can be easily recognized. Thus, OWC is significantly preferred in the military and state mechanisms that require high information privacy and security. • Stay of signals in the room or office, elliminates the possibili ity of any interference in adjacent rooms or offices. By this way, each room will constitute a cell and the capacity prodcutivity will rise to the top levels. • The equipment used is cheaper when compared with RF devices. • Optical signals are not as detrimental as RF signals to the human health. • OWC requires lower energy consumption than RF systems. Data transfer by using the infra-red portion of the spectrum is already provided. Latest research activities have been focused on achieving data transfer simultaneously with enlightenment by means of using LED lighting equipment. These energy stingy and cost effective LED devices are desired to be used for data transfer without using RF signals, especially in short ranges. By using visible light, it is intended to achieve wireless communication in the environments and situations such as airplanes, hospitals etc, where it is not convenient to use RF waves. The idea of illumination and data communication simultaneously by using the same physical carrier is firslty suggested by Nakagawa et al. in 2003 (Nakagawa Laboratory). Their studies [11- 15] pioneereed many following research activities. Later on, the Nakagawa Laboratory went into coperation with the famous Japan technology firms and they established the Visual Light Communication Consortium (VLCC). Followingly, many research activities have been done that the most outstanding is the European OMEGA Project. Eventually, in 2011, IEEE completed the release and visual light wireless communication gained a global standard with the name 802.15.7- 2011 [16]- IEEE Standard for Local and Metropolitan Area Networks--Part 15.7: Short-Range Wireless Optical Communication Using Visible LightUsing Visible Light [17]. Though a standard of visual light communication has been released in 2011, prevalent usage of this technology will take further time.

Block diagram

Tx:



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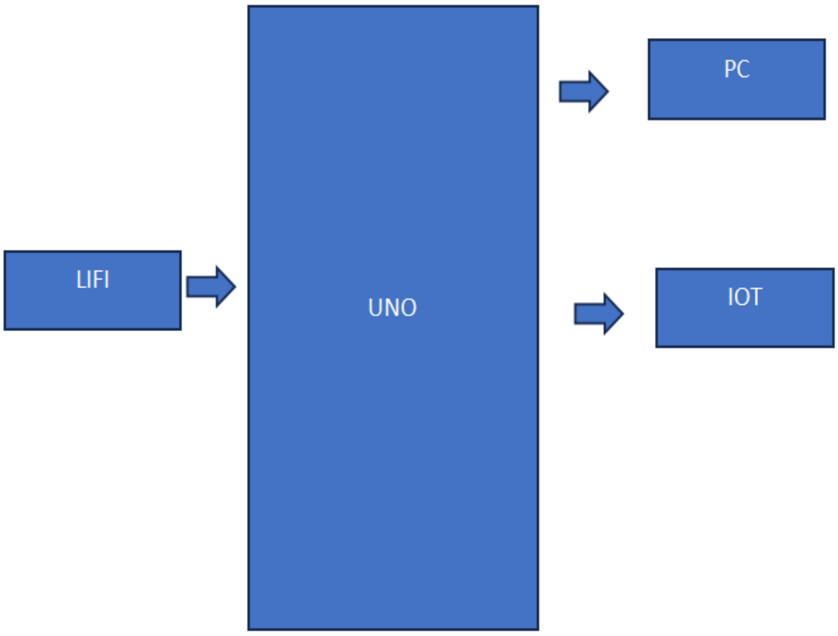
Rx:



V.CONCLUSION

VLC is a promising and emerging technology. Therefore, there is an attraction to apply it for almost every single application. Accordingly, in recent years, the VLC concept has gained a lot of attention. However, it was discovered that most contributions have been geared towards improving the speed and data rate of the VLC concept leading to a lack of a comprehensive review of the application of the VLC concept to improve other wireless communication technologies. For instance, IoT combined with AI and robotics has transcended M2M type communication to become the pillars of 4IR with all the emerging smart environments and things that will be built and deployed to assist in dedicated application domains, ranging from smart cars, smart cities, smart campus to smart manufacturing. Although, 5G is supposed to provide the needed frequency bands for IoT, nonetheless, supporting IoT only by the cellular network providers will not be possible due to different factors such as legislation, country by country regarding frequency band allocation, and mainly the under 1G band. Therefore, in this paper, we undertook a comprehensive review of the prospects of implementing VLC for IoT. Moreover, we investigated existing and proposed approaches implemented in the application of VLC for IoT. Additionally, we looked at the challenges faced in applying VLC for IoT and offer solutions where applicable. Then, we identified future research directions in the implementation of VLC for IoT.

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