PROCEEDINGS OF

ADVANCED RESEARCH SOCIETY FOR SCIENCE AND SOCIOLOGY

ARSSS

INTERNATIONAL CONFERENCE

Place: Crete, Greece **Date:** 25th -26th July 2024

In Association with:

academics world

Biofora
The future of Health care

PROCEEDINGS OF

ARSSS

INTERNATIONAL CONFERENCE

CRETE, GREECE

Organized by

ADVANCED RESEARCH SOCIETY FOR SCIENCE AND SOCIOLOGY

Date of Event

25th -26th July, 2024

In Association with

Corporate Address

INSTITUTE OF RESEARCH AND JOURNALS
Plot No. 30, Dharma Vihar, Khandagiri, Bhubaneswar, 751030
Odisha, India
www.iraj.in

Publisher: **Institute for Technology and Research (ITRESEARCH)**

ISBN: 978-93-90150-29-8

Edn: 03

Disclaimer: Authors have ensured sincerely that all the information given in this book is accurate, true, comprehensive, and correct right from the time it has been brought in writing. However, the publishers, the editors, and the authors are not to be held responsible for any kind of omission or error that might appear later on, or for any injury, damage, loss, or financial concerns that might arise as consequences of using the book.

Type set & Printed by:

Institute for Technology and Research (ITRESEARCH)

Khandagiri, Bhubaneswar

About Institute of Research and Journals:

Institute of Research and Journals (IRAJ) is an advanced Non-profit technological forum under Peoples Empowerment Trust, for the Researchers & Scholars "to promote the progress of Science and Technology" by displaying their knowledge in the vicinity of Science and Technology for the service of mankind and the advancement of general welfare.

Objective of IRAJ:

- To provide a world class platform to researchers to share the research findings by organizing International/National Conferences.
- To use the research output of the conference in the class room for the benefits of the students.
- To encourage researchers to identify significant research issues in identified areas, in the field of Science, Engineering, Technology and Management.
- To help dissemination of their work through publications in a journal or in the form of conference proceedings or books.
- To help them in getting feedback on their research work for improving the same and making them more relevant and meaningful, through collective efforts.
- To encourage regional and international communication and collaboration; promote professional interaction and lifelong learning; recognize outstanding contributions of individuals and organizations; encourage scholar researchers to pursue studies and careers in circuit branches and its applications.
- To set up, establish, maintain and manage centers of excellence for the study of /on related subjects and discipline and also to run self supporting projects for the benefit of needy persons, irrespective of their caste, creed or religion.

About ARSSS:

The **Advanced Research Society for Science and Sociology (ARSSS)** is an academic association for scholars interested in the advance research in Science, Engineering, Technology and Sociology .It holds a registered “Non Profit “ statues and a unit of PET. It is an international, member-based support network promoting critical and scholarly Internet research, independent from traditional disciplines and existing across academic borders. The Association maintains an active membership of more than 4,500 individuals in 85 countries, approximately two-thirds of whom are academic scholars, professors, and graduate students. Other members are in government, the media, communication technology, business law, medicine and other professions

Conference Committee

Program Chair:

Dr. P. Suresh
M.E, Ph.D. Professor and Controller of Examinations,
Karpagam College of Engineering,
Coimbatore, India.

Managing Director:
Mr. Bijan Kumar Barik

Conference Convener:

Miss. Gitanjali Pradhan
Mob: +91-9937054932

Publication Head:
Mr. Manas Ranjan Prusty

INTERNATIONAL ADVISORY MEMBERS

Prof. Goodarz Ahmadi,
Professor, Mechanical and Aeronautical Engineering, Clarkson University, USA

Dr Chi Hieu Le,
Senior Lecturer, University of Greenwich. Kent ME4 4TB. United Kingdom

PROF. (ER.) Anand Nayyar
Department of Computer Applications & I.T.KCL Institute of Management and Technology, Jalandhar
G.T. Road, Jalandhar-144001,Punjab, India.

Prof. R. M. Khaire,
Professor, Dept. Of Elex. and Telecommunication, B, V University, India

Dr.P.Suresh,
Professor, Karpagam College of Engineering, Coimbatore,Tamilnadu

Mark Leeson
Associate Professor (Reader)
Area of Expertise: nanoscale communications,
evolutionary algorithms, network coding and communication systems

Dr. P. K. Agarwal
Professor, Deptt. of Civil Engineering, MANIT Bhopal ,Ph. D: IIT Kanpur
M.E: Civil Engg.IIT Roorkee, Membership: Indian Road Congress (IRC), Institute of Urban Transport (IUT)

Shahriar Shahbazpanahi
Islamic Azad University,
Department of Civil Engineering, Sanandaj, Kurdistan, Iran, PhD (Structural Engineering),
University Putra Malaysia, Malaysia, 2009-Present

Harun Bin Sarip
Head of Research and InnovationDept, UniKL-MICET
Doctorate: Université de La Rochelle, France
Member : International Society of Pharmaceutical Engineer, Singapore Chapter

Dr. Md. Al-Amin Bhuiyan
Associate Professor
Dept. of Computer Engineering, King Faisal University
Al Ahssa 31982, Saudi Arabia

Prof. (Er.) Anand nayyar
Department of Computer Applications & I.T.
KCL Institute of Management and Technology, Jalandhar
G.T. Road, Jalandhar-144001, Punjab, India

Prof. Aleksandr Cariow

★★★

TABLE OF CONTENTS

★★★

EDITORIAL

It is my proud privilege to welcome you all to the ARSSS International Conference at Crete, Greece. I am happy to see the papers from all part of the world and some of the best paper published in this proceedings. This proceeding brings out the various Research papers from diverse areas of Science, Engineering, Technology and Management. This platform is intended to provide a platform for researchers, educators and professionals to present their discoveries and innovative practice and to explore future trends and applications in the field Science and Engineering. However, this conference will also provide a forum for dissemination of knowledge on both theoretical and applied research on the above said area with an ultimate aim to bridge the gap between these coherent disciplines of knowledge. Thus the forum accelerates the trend of development of technology for next generation. Our goal is to make the Conference proceedings useful and interesting to audiences involved in research in these areas, as well as to those involved in design, implementation and operation, to achieve the goal.

I once again give thanks to the ARSSS, Institute of Research and Journals, Academicworld & Biofora for organizing this event in Crete, Greece. I am sure the contributions by the authors shall add value to the research community. I also thank all the International Advisory members and Reviewers for making this event a Successful one.

Editor-In-Chief
Dr. P. Suresh
M.E, Ph.D. Professor and Controller of Examinations,
Karpagam College of Engineering,
Coimbatore, India.

★★★

MUSEUM LI-FI GEOLOCATION: A WIRELESS TECHNOLOGY FOR THE FRUITION AND PRESERVATION OF CULTURAL HERITAGE

[1]FABRIZIO CUMO, [2]ELISA PENNACCHIA, [3]CLAUDIA ZYLKA

[1,2]Interdepartmental Centre for Territory, Building, Conservation and Environment, Sapienza University of Rome, Via A. Gramsci, 53-00197 Rome, Italy
[3]Department of Astronautical, Electrical and Energy Engineering, Sapienza University of Rome, Via Eudossiana, 18-00184 Rome, Italy
E-mail: [1]fabrizio.cumo@uniroma1.it, [2]elisa.pennacchia@uniroma1.it, [3]claudia.zylka@uniroma1.it

Abstract - The archaeological, architectural, historical-artistic, and ethno-anthropological heritage represents a significant wealth for any country. The management, security, and promotion of this heritage are crucial. In this regard, it is important to focus attention on emerging 6G technology. This technology facilitates the interconnection between people and things, enabling the rapid trans-mission of large amounts of data and information. The aim of the research is to facilitate the cataloging and management of artworks by heritage professionals through the utilization of Li-Fi technology. Museum staff should be able to independently update the information associated with each movable or fixed artwork (e.g., wall or ceiling frescoes, tapestries, etc.) with the objective of maintaining up-to-date information on conservation and management. The same technology aims to be used to transmit historical and cultural information related to the museum and its artworks directly to visitors' personal devices (such as tablets and smartphones), based on their location and what they are viewing. Such technology can also be applied to optimize the maintenance of technical elements and installations within the exhibition and to reduce the energy consumption of the display devices.

Keywords - Efficient Maintenance; 6G; Heritage Data Management, Li-Fi Indoor Navigation; Cultural Preservation Technologies; Light-Based Communication.

I. INTRODUCTION

In recent years, there has been a notable evolution in communication standards, transitioning from 3G communications, introduced in 2001, to 4G in 2010, which brought significant improvements and enabled download speeds of 100 Mbps, thus facilitating the development of internet-based services. With the advent of fifth generation (5G) connectivity, latencies have been minimized to mere milliseconds, thanks to the utilization of millimeter waves and a novel network architecture known as "Network Slicing" [1]. This architecture allows various independent logical and virtual networks to operate simultaneously, theoretically enabling data transmission speeds of several gigabits per second. The upcoming sixth generation (6G) of connectivity is poised to play a pivotal role in advancing civilization into the 2030s, characterized by its flexibility and the seamless integration of the physical and digital worlds, creating a continuous immersive experience without discontinuities [2]. Although a standardized definition has yet to be established, 6G is envisioned as an advanced wireless communication system that will surpass the capabilities of its predecessors in terms of data transmission speeds, latency, connectivity, security, and immersive experiences [3]. This network will feature collaborative sensing, programmability, efficient energy use, reliability, scalability, and economic accessibility, enabling advanced applications such as the metaverse and immersive communication [4]. The Telecommunication Standard Bureau (TSB) of the International Telecommunication Union (ITU) [5], an international body responsible for regulating telephonic and tele-graphic telecommunications, is already engaged in defining the guiding principles for 6G. With the advent of 6G and its ability to handle enormous amounts of data, coupled with increasingly sophisticated artificial intelligence (AI) applications, a new era of services is anticipated. These services will be capable of predicting desires and resolving problems by processing and interpreting information according to cognitive logic. 6G will fully extend to the Thz light frequencies (sub millimetric waves) [6], spanning from visible to non-divisible infrared light, opening the door to the "Tera Economy" and allowing for the complete integration of objects, people, and environments.

In this context, the Li-Fi (Light Fidelity) represents a cutting-edge technology that harnesses LED light modulation for data transmission [7], offering an excellent alternative to traditional wireless networks [8]. It stands as one of the pillars of the future 6G, with applications al-ready present in various areas such as museums, hospitals, schools, and corporate environments, where communication speed and security are paramount. The Li-Fi technology was pioneered by German physicist Harald Haas from the University of Edinburgh. In 2012, he conducted an innovative demonstration showcasing Li-Fi's potential as a high-speed wireless communication technology using visible light [9]. His work laid the groundwork for further developments and explorations of Li-Fi's capabilities across various applications. This innovation not only illuminates environments but also efficiently and securely connects them, with Li-Fi technology emerging for its distinctive advantages in the communications landscape. Indeed, compared to conventional Wi-Fi networks, Li-Fi offers several significant advantages. Firstly, its ability to operate at higher speeds is a fundamental strength. With data transfer speeds approaching 1 Gbps and prospects of reaching 1 Tbit/s by 2025, Li-Fi promises faster and more efficient connectivity, facilitating instant processing and exchange of information. Additionally, Li-Fi's higher bandwidth, supported by the broad light spectrum from violet to red, presents an opportunity for the development and implementation of advanced technologies. Sectors such as IoT, Industry 4.0, and Smart Cities benefit from this wide range of possibilities, enabling greater integration and optimization of systems. Another key aspect is the security offered by Li-Fi: thanks to its transmission through visible light rather than radio waves, Li-Fi significantly reduces the risk of external interference and cyberattacks. This aspect becomes particularly crucial in sensitive environments or those exposed to potential cyber threats, ensuring safer and more reliable communication. Finally, the cost-effectiveness of Li-Fi is another advantage. Without the need for expensive radio transmission devices or the installation of wired lines, Li-Fi emerges as an economical and scalable solution for implementing advanced connectivity in a wide range of contexts. In summary, the advantages offered by Li-Fi technology - from higher speed to enhanced security and cost-effectiveness - make it an increasingly attractive and promising choice in the modern communications landscape [10].

1.1 Li-Fi workflow

Li-Fi technology harnesses the visible light range from violet to red [11] as the basis for data transmission. This innovative technology utilizes amplitude modulation to transmit information, relying on LEDs, electronic components capable of emitting light when traversed by an electric current and allowing the flow of current in one direction, producing incoherent monochromatic radiation through energy transformation, thus conveying light signals [12]. Thanks to the rapid switching on and off of LEDs, much faster than human visual perception, it is possible to encode the transmitted data: when the LED is on, the signal is interpreted as '1', while when it is off, it is interpreted as '0'. The operation of Li-Fi is simple yet effective: an LED transmitter sends light signals [13], which are then detected by a photodetector, a bi-polar semiconductor component. Analog signals are converted into light and trans-mitted via the transmitter, while on the receiving end, the photodetector converts the light back into digital data. What makes this technology particularly interesting is the use of new high-intensity LEDs, capable of rapidly varying their light intensity. This allows for efficient and secure data transmission, utilizing every light source as a hub for data transmission. Another noteworthy feature is the ability to encode data in the light itself, through variations in the frequency of LED switching on and off.

This modulation is so fast that it is not perceived by the human eye, ensuring fast and reliable data transmission. Ultimately, Li-Fi technology represents an innovation in the field of wireless communication, utilizing visible light to transmit in-formation effectively and securely (Fig. 1) [14].Given the invaluable nature of our nation's cultural heritage, embracing 6G technology is crucial for enhancing the management and security of these cherished sites. The advent of 6G technology promises remarkable advancements in data transmission, latency, connectivity, security, and immersive experiences. Renowned for its flexibility, versatility, sustainability, and reliability, 6G technology stands poised to revolutionize the preservation and promotion of cultural heritage. By harnessing frequencies within the Thz and visible light spectrum, 6G facilitates seamless integration of sensors into communication infrastructures and lighting systems, fostering immersive cultural environments across archaeological sites, museums, monuments, archives, and libraries. Additionally, 6G's ability to analyze visitors' emotions through affective computing offers personalized and engaging interactions, enhancing cultural experiences [15].

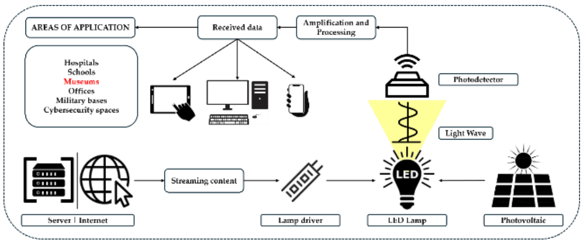


Figure 1: Li-Fi scientific diagram [15].

Li-Fi, as a precursor to 6G, is already revolutionizing connectivity in museums. Infratel Italia, within the Wi-Fi Italia project, has introduced Li-Fi technologies in various southern Italian museums, including the National Archaeological Museum of Taranto (Marta) [16]. This collaboration, involving Infratel Italia, startup To Be, and the Italian Videogame Academy (Aiv), uses LED light for data transmission, making museum visits more engaging. The light illuminating artworks transmits directly to visitors' smartphones via an application, providing multimedia content based on their location and observations. This innovative approach is currently available in approximately 20 Italian museums, such as the Barracco Museum in Rome [17], the Archaeological Museum of Altamura, the Castel del Monte Museum [18], and the Archaeological Park of Pompeii [19]. Li-Fi technology applications in museums empower visitors to access detailed information about exhibits on their devices, offering personalized multimedia content such as audio guides, video presentations, and comprehensive descriptions. It also facilitates interactive and immersive experiences that respond in real-time to visitors' interactions. The research introduces a pioneering scientific approach focused on developing a Li-Fi Geolocation system aimed at cataloging and managing artworks within the framework of conservation management. This system integrates several key functionalities:

- **Management of conservation technical sheets**: Overseeing technical documentation associated with artworks identified through the Li-Fi signal, ensuring thorough conservation management.
- **Indoor navigation and equipment localization**: Enabling precise indoor navigation and localization of mobile devices within museum premises, enhancing visitor experience and operational efficiency.
- **Management of historical and cultural information**: Centralizing historical and cultural information pertaining to artworks, enriching the educational and interpretative aspects of museum visits.

The proposed research aims to develop a software platform that integrates seamlessly with Li-Fi technology, advancing museum management capabilities and enhancing visitor engagement. Beyond visitor interactions, Li-Fi optimizes museum operations by managing visitor flows and reducing energy consumption through DALI dimming control integrated with the Li-Fi infrastructure. It supports the ongoing maintenance of exhibited artworks and technical installations by providing immediate access to conservation-related information. In conclusion, the integration of Li-Fi technology promises to revolutionize museum experiences by combining enhanced visitor engagement with efficient museum management practices, ultimately enriching the preservation and presentation of cultural heritage.

II. MATERIALS AND METHODS

The objective of the research is to enhance the cataloging and management of artworks by heritage professionals through the implementation of Li-Fi technology.
The methodological approach consists of four main phases (Fig.2):

1. The initial research phase focuses on an in-depth analysis of current technologies, selecting the most appropriate options for the research goals using simulations. Its objective is to gather essential information (hardware and software architectures, performance and operational specifications, modeling specifications) to guide subsequent phases of implementation and prototype development.

2. Following this, the second phase aims to define the technological characteristics and system architecture for the upcoming implementation phase. This step will provide detailed guidelines for prototype development, including toolsets and procedural frameworks derived from the preliminary investigation. It involves scrutinizing processes and roles, identifying their unique aspects and potential challenges. Additionally, an investigation will assess technical requirements, considering constraints imposed by existing technologies and optimizing future-proof technology adoption opportunities.

3. In the third phase, the focus shifts to studying a Li-Fi geolocation system tailored for tracking individuals and objects within a museum environment. This system facilitates indoor navigation, georeferenced multimedia access, enhanced accessibility, intelligent visitor flow management, and energy consumption optimization. Users benefit from easily locating points of interest and accessing facility provided informational resources via smartphones. Moreover, the system enhances safety during emergencies by enabling direct access to evacuation plans. Museum staff gain seamless access to artwork technical specifications and can update records in real-time. Energy efficiency is enhanced through integration of DALI dimming control with the Li-Fi system, while logistical operations benefit from analytics-driven improvements based on aggregated data. The positioning system is designed for flexibility, accommodating future enhancements and changes in exhibition layouts. The system comprises both hardware and software components, with detailed market analysis guiding selection and testing of lighting fixtures essential for comprehensive coverage and Li-Fi signal propagation. Furthermore, a hardware prototype will be developed for object tracking, leveraging Li-Fi VLC technology alongside performance evaluations against alternatives like Bluetooth Beacons and RFID tags. Software development will focus on integrating the Li-Fi capabilities within the Li-Art platform.

4. Finally, the fourth phase will encompass the actual implementation and testing of the Li-Fi system prototype designed to enable geolocation services within the museum. Building upon insights and outcomes from earlier research phases, this stage marks the concrete development and validation of the system's functionality.

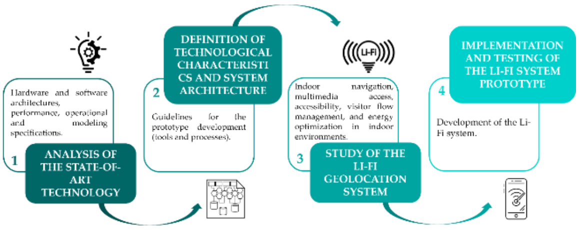


Figure 1: The methodology workflow.

III. THE STUDY CASE

Such a methodological approach is applied to the case study of a building used as stables, located in the village of Isola Sacra near Fiumicino, within a decommissioned area that is slated for extensive redevelopment. Specifically, the building in question will undergo a change of use, being transformed into a Museum of Peasant Civilization in Fiumicino (Fig. 3).

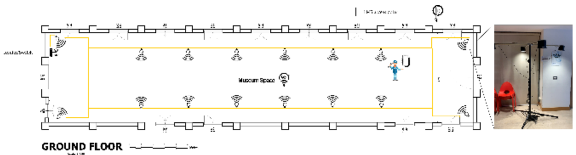


Figure 2: Li-Fi technology in the Museum of Peasant Civilization in Fiumicino.

For this building, an indoor geolocation system is developed using Li-Fi technology, which leverages LED light modulation and a dedicated mobile application to accurately determine indoor geographical positions (latitude and longitude). This geolocation information enables location-based services crucial for navigation within the museum, aiding maintenance personnel in their artifact conservation tasks. Specifically, these individuals are supported in navigating the museum spaces to optimally orient themselves and accurately assess the condition of exhibited objects. The technology operates as follows:

1. The LED lamps transmit a unique Li-Fi code and a Bluetooth signal, which are detected by the mobile device (smartphone and/or tablet).
2. After installation, the position of the LED lamps is stored in a cloud-based localization database.
3. The Li-Fi app (iOS/Android) accurately detects the smartphone’s position and orientation within the museum's layout, providing a map with various possible routes.
4. By activating the specific service package, the user can access and monitor the data collected by the maintenance personnel (Fig.4).

The technology utilizes the DALI (Digital Addressable Lighting Interface) system, a bidirectional communication protocol that allows for the control of various components of the lighting system, enhancing lighting quality and energy efficiency. The presence detector and the sunlight monitoring system can significantly improve the comfort of the premises while automating energy usage, resulting in energy savings.

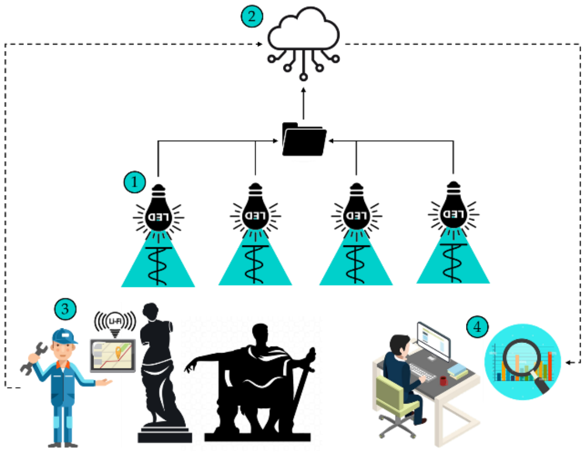


Figure 3: How the Li-Fi technology operates.

IV. DISCUSSION AND CONCLUSIONS

As evidenced by the following research, Li-Fi technology presents numerous advantages for indoor environments. Firstly, the data transmission speed is exceptionally high, frequently surpassing that of traditional Wi-Fi, which makes it highly efficient for data-intensive applications [20]. Secondly, the security of Li-Fi is significantly enhanced because light waves cannot penetrate walls, thereby preventing unauthorized interception and ensuring more secure communication channels [21]. Moreover, Li-Fi is immune to electromagnetic interference, making it an optimal choice for use in sensitive environments such as hospitals, airplanes, and other areas where electromagnetic signals can be problematic [22]. This lack of interference also ensures more reliable connections and consistent performance. Utilizing visible light, Li-Fi technology alleviates the congestion of radio frequencies, which is a growing issue with the proliferation of wireless devices [23]. Furthermore, it can be seamlessly integrated with existing LED lighting infrastructures, thereby improving overall energy efficiency and reducing operational costs [24]. Finally, Li-Fi enables highly accurate indoor localization due to the precision with which light can be directed and controlled. This capability supports advanced positioning services within buildings, enhancing navigation, asset tracking, and location-based services [25].

This innovative system can be effectively employed in museum settings. As pro-posed in the following research, it offers substantial benefits not only to visitors but also to the museum staff responsible for maintaining and managing the collection. For visitors, the Li-Fi technology enhances their experience by making it more interactive, providing them with additional information, multimedia content, and personalized tours that can greatly enrich their understanding and enjoyment of the exhibits [26]. For museum personnel, particularly those involved in the maintenance and management of the collection, Li-Fi technology is indispensable. It facilitates the cataloging and organization of artworks, allowing for more efficient inventory control and oversight. The ability to update information associated with each exhibit point autonomously is a significant advantage. Staff can quickly and accurately record changes, such as the replacement or relocation of objects, ensuring that all data remains up to date. This feature is particularly useful during exhibit rotations, special exhibitions, or when objects are moved for conservation purposes. By streamlining these processes, the technology not only saves time and reduces errors but also enhances the overall management and preservation of the museum's collections. This proactive approach to collection management ensures that the system remains responsive to the dynamic nature of museum displays and collections, ultimately supporting the mission of the museum to educate and engage the public while preserving cultural heritage.

REFERENCES

[1] TECH TARGET, Network Slicing. Available online: https://www.techtarget.com/whatis/definition/network-slicing#:~:text=Network%20slicing%20is%20a%20technique, and%20allocation%20of%20network%20resources.

[2] Siniarski, B., Sandeepa, C., Wang, S., Kountouris, M., et al. (2024, July). ROBUST-6G: Smart, Automated, and Reliable Security Service Platform for 6G. Paper presented at the 2024 Fifteenth International Conference on Ubiquitous and Future Networks (ICUFN), Budapest, Hungary.

[3] Singh, C. (2023, December). A 6G Network: Future of Nations? Challenges in 6G Communications. DOI: 10.52783/tjjpt.v44.i4.2584.

[4] Liyanage, M., Porambage, P., Zeydan, E., Siniarski, B., et al. (2024, giugno). Promuovere la sicurezza per le reti e i servizi intelligenti 6G. Articolo presentato alla Conferenza Europea del 2024 sulle Reti e le Comunicazioni e al Summit 6G (EuCNC/6G Summit), Antwerp, Belgio.

[5] ITU, General information in TBS. Available online: https://www.itu.int/en/ITU-T/info/tsb/Pages/geninfo.aspx.

[6] CORRIERE COMUNICAZIONI, 6G: cos'è, quando arriverà e cosa si potrà fare. Available online: https://www.corrierecomunicazioni.it/digital-economy/6g-cose-quando-arrivera-e-cosa-si-potra-fare/.

[7] S. Spagnolo, L. Cozzella, F. Leccese, S. Sangiovanni, L. Podestà, and E. Piuzzi, "Optical wireless communication and Li-Fi: a new infrastructure for wireless communication in saving energy era," in 2020 IEEE International Workshop on Metrology for Industry 4.0 & IoT, 202, https://doi.org/10.1109/MetroInd4. 0IoT48571.2020.9138180.

[8] LUMI 4 INNOVATION, Li-Fi (Light Fidelity): cos'è e come funziona la connessione via LED. Available online: https://www.lumi4innovation.it/li-fi-light-fidelity-cosa-e-come-funziona/.

[9] Monisha, M., & Sudheendra, G. (2017). "Tecnologia Li-Fi - Light Fidelity". In 2017 Conferenza Internazionale sulle Tendenze Attuali in Informatica, Elettricità, Elettronica e Comunicazioni (CTCEEC) (pp. 1-5). Pubblicato da IEEE. DOI: 10.1109/CTCEEC.2017.8455097.

[10]Faruq, O., Rahman, K. R. S., Jahan, N., Rokoni, S., &Rabeya, M. (2023). "Valutazione di un sistema di trasmissione dati a lungo raggio in spazio libero basato sulla tecnologia Li-Fi". International Review of Applied Sciences and En-gineering, 14(3), 413–425. DOI: https://doi.org/10.1556/1848.2023.00620.

[11]L. Samudika, K. Jayasinghe, E. Gunathilaka, Y. Rumesh, R. Weerasuriya and D. Dias, "Stereo audio streaming via visible light," in 2016 Moratuwa Engineering Research Conference (MERCon), 2016, https://doi.org/10.1109/MERCon.2016.7480128.

[12]Chergui and S. Abdesselam, "Design and realization of a visible light communication system for Li-Fi application," in 2020 1st International Conference on Communications, Control Systems and Signal Processing (CCSSP), El Oued, Algeria, 2020, pp. 30–5. https://doi.org/10.1109/CCSSP49278.2020.9151780.

[13]FOL, Li-Fi (Li-Fi (Light Fidelity: cos'è e come funziona la trasmissione di dati attraverso la luce. Available online: https://www.fol.it/light-fidelity-connessione-luce-francesco-paolo-russo/.

[14]Ganesan, D., Jayanthi, N., Rahul, S., e Anand, M. (2023). "Una revisione critica sulla tecnologia Li-Fi e le sue future applicazioni." Pubblicatosu AIP Conference Proceedings, 2690(1), 020061. DOI: 10.1063/5.0121967.

[15]Papi, Luca, e Francesco Paolo Russo. "Verso la tecnologia 6G per i luoghi della cultura: trasmissione di enormi quantità di dati e informazioni in pochi secondi." Archeomatica, vol. 15, no. 1, 2023, pp. 6-9.

[16]CORRIERE COMUNICAZIONI, Li-Fi per i musei, parte dal Marta di Taranto il "pilota" nazionale Infratel Italia. Available online: https://www.corrierecomunicazioni.it/digital-economy/li-fi-per-i-musei-parte-dal-marta-di-taranto-il-pilota-nazionale-infratel-italia/.

[17]TO BE, Available online: https://tobe-srl.it/li-fi-e-musei-l-innovazione-sostenibile-arriva-al-museo-barracco/.

[18]TO BE, Available online: https://tobe-srl.it/lifi-evoluzione-tecnologia-trasmissione-dati-luce/.

[19]TO BE, Available online: https://tobe-srl.it/portfolio/il-progetto-smart-pompei/.

[20]Bellavista, P., Berrocal, J., Corradi, A., Foschini, L., Giovannelli, L., & Zanni, A. (2018). A survey on fog computing for the Internet of Things. Pervasive and Mobile Computing, 52, 71-99. https://doi.org/10.1016/j.pmcj.2018.12.007.

[21]LI-FI, How Li-Fi technology enhances security in your organization. Available online: https://lifi.co/lifi-blog/how-lifi-technology-enhances-security-in-your-organization/.

[22]Sabri, N., Aljunid, S. A., Salim, M. S., & Fouad, S. (2015). Fiber optic sensors: Short review and applications. In N. Sabri, S. A. Aljunid, M. S. Salim, & S. Fouad (Eds.), Recent Trends in Physics of Material Science and Technology (Springer Series in Materials Science, Vol. 204, pp. 299-311). Springer. https://doi.org/10.1007/978-981-287-128-2_19.

[23]Hussein, Y. S., Alabed, A. S., Al Mafrachi, M., Al-Maatouk, Q., & [Last Author], Q. (2020). Li-Fi technology for smart cities. Solid State Technology, 63(2s), 2391-2399. https://doi.org/10.1016/j.solmat.2020.04.027.

[24]Chatterjee, S., Agarwal, S., & Nath, A. (2015). Scope and challenges in Light Fidelity (Li-Fi) technology in wireless data communication. IEEE Transactions on Consumer Electronics, 61(2), 238-246. https://doi.org/10.1109/TCE.2015.7138454.

[25]Kouhini, S. M., Kottke, C., Ma, Z., Linnartz, J.-P., &Jungnickel, V. (2021). LiFi positioning for Industry 4.0. IEEE Journal of Selected Topics in Quantum Electronics. Advance online publication. https://doi.org/10.1109/JSTQE.2021.3095364.

[26]Shehade, M., & Stylianou-Lambert, T. (2020). Virtual reality in museums: Exploring the experiences of museum professionals. Applied Sciences, 10(11), 4031. https://doi.org/10.3390/app10114031

★★★

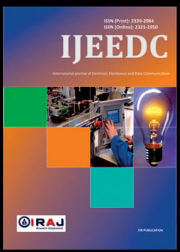
IRAJ INTERNATIONAL JOURNALS

IJMPE

www.ijmpe.iraj.in

International Journal of Mechanical and Product Engineering

ISSN(P):2320-2092
ISSN(e):2321-2071



IJEEDC

www.ijeedc.iraj.in

International Journal of Electrical, Electronics and Data Communication

ISSN(P):2320-2084
ISSN(e):2321–2950

IJACEN

www.ijacen.iraj.in

International Journal of Advance Computational Engineering and Networking

ISSN(e):2320-2106
ISSN(P):2320-2106

International Journal of Soft Computing And Artificial Intelligence (IJSCAI)

ISSN(P):2321–404X
ISSN(e):2321–4384

www.ijscai.iraj.in

International Journal of Advances in Computer Science and Cloud Computing (IJACSCC)

ISSN(P):2321–4058
ISSN(e):2321–4392

www.ijacscc.iraj.in

International Journal of Advances in Science, Engineering and Technology(IJASEAT)

ISSN(P):2321-8991
ISSN(e):2321–9009

www.ijaseat.iraj.in

International Journal of Industrial Electronics and Electrical Engineering(IJIEEE).

ISSN(P):2347-6982
ISSN(e):2349-204X

www.ijieee.iraj.in

International Journal of Advances in Mechanical and Civil Engineering(IJAMCE)

ISSN(P):2394-2827

www.ijamce.iraj.in

International Journal of Management and Applied Science (IJMAS)

ISSN(P):2394-7926

www.ijmas.iraj.in

International Journal of Advance in Electronics and Computer Science (IJAECS)

ISSN(P):2393-2835

www.ijaecs.iraj.in

Indexing Partners

IRAJ Journals Listed in University Library

MIT, University of California Berkeley, Stanford, Cambridge, Oxford, Harvard

Visit for Upcoming Conferences - www.academicsworld.org

This book will be available online at world Research Library www.worldresearchlibrary.org

ISBN
978-93-90150-29-8