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Lora Based Advanced Multipurpose Security System

Pratibha[1], Kopal Srivastava[2], Fyona Vats[3], Jayan Kumar Goel[4]
Department of Electronics and Communication Engineering, ABES Engineering College Ghaziabad, India

Abstract:** As the Internet of Things (IoT) continues to evolve, the demand for advanced multipurpose security systems has become increasingly pronounced. This review paper explores the integration of Long Range (LoRa) technology into the realm of security, presenting a comprehensive analysis of its applications and benefits. LoRa's exceptional characteristics, including extended range, low power consumption, and scalability, position it as a promising solution to the limitations of traditional security systems. The paper begins with an introduction to the current challenges in security systems and the need for innovative approaches. It then delves into a detailed exploration of LoRa technology, elucidating its technical aspects and showcasing its advantages over conventional communication protocols. A critical component of the paper lies in dissecting the elements of an advanced multipurpose security system. The integration of LoRa into intrusion detection sensors, video analytics through surveillance cameras, access control systems, and seamless connectivity with smart home devices is thoroughly examined. This comprehensive approach aims to highlight the versatility and efficacy of LoRa in addressing diverse security requirements. The communication architecture section elucidates the role of LoRa as the primary communication protocol. Emphasis is placed on the implementation of mesh networking to enhance reliability and coverage, accompanied by robust data encryption protocols to secure sensitive information. Realworld implementations and case studies form a pivotal part of this review, providing tangible examples of successful LoRa-based security systems. Performance metrics and comparisons with traditional security setups serve to underscore the practical advantages of adopting LoRa in security applications. In conclusion, this paper synthesizes key findings, emphasizing the transformative impact of LoRa on advanced multipurpose security systems. The integration of LoRa technology offers a scalable, efficient, and secure solution to the evolving landscape of security challenges. The abstract serves as a precursor to a comprehensive exploration of LoRa's role in shaping the future of security systems.

I INTRODUCTION

In the contemporary landscape of pervasive connectivity and escalating security concerns, the quest for advanced multipurpose security systems has become increasingly paramount. This paper focuses on the convergence of Long-Range (LoRa) communication technology and security applications, aiming to explore the potential of LoRa-based systems in ushering a new era of intelligent and versatile security solutions. The proliferation of Internet of Things (IoT) devices and the growing complexity of security challenges necessitate innovative approaches that combine efficiency, scalability, and cost-effectiveness. LoRa technology, characterized by its long-range capabilities, low power consumption, and suitability for diverse environments, emerges as a promising candidate to address these demands [1]. This paper endeavors to unravel the multifaceted dimensions of LoRa-based security systems, elucidating their fundamental principles and dissecting their applicability across various domains. The initial sections of this review delve into the foundational aspects of LoRa communication, elucidating the mechanisms that make it a compelling choice for security applications. As we navigate through the landscape of security challenges, ranging from conventional surveillance needs to emerging threats in industrial, residential, and environmental contexts, the versatility of LoRa technology becomes apparent [2]. The literature review encapsulates a synthesis of existing research, providing an overview of key studies and implementations that have utilized LoRa for security purposes. By examining the successes and challenges encountered in these endeavors, we aim to distill essential insights that inform the development of future LoRa-based security solutions. Beyond the conventional applications, this review extends its focus to recent advancements and innovative integrations within the realm of LoRa-based security. LoRa technology, known for its extended communication range and low power consumption, forms the backbone of this advanced system [3]. The project aims to redefine security paradigms by integrating LoRa's capabilities with a
multipurpose approach. From intrusion detection to environmental monitoring, the system is designed to cater to a diverse range of security needs. Key features include real-time monitoring, instant alerts, and seamless connectivity, providing users with a comprehensive view of their surroundings. The incorporation of LoRa ensures not only extended coverage but also reliable communication in challenging environments.

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II LoRa IN HOME SECURITY

"LoRa, an acronym for Long Range, is a wireless communication technology that plays a pivotal role in the realization of advanced multipurpose home security systems. Specifically designed for long-range communication with low power consumption, LoRa facilitates seamless connectivity between various components of a home security network. In the context of home security, LoRa technology enables efficient and reliable communication between sensors, surveillance devices, and central control units over extended distances [4]. This wireless technology, operating in license-free spectrum bands, empowers the development of robust and scalable security solutions, ensuring the real-time transmission of data for intrusion detection, environmental monitoring, and other security-related applications. Its low-power characteristics make it an ideal choice for battery-operated devices, contributing to the sustainability and longevity of the overall security system. LoRa's capability to cover wide geographic areas and its adaptability to different deployment scenarios make it a key enabler for the implementation of advanced multipurpose home security systems, enhancing the safety and protection of residential environments [5]. In the realm of advanced multipurpose home security systems, parameters specific to LoRa technology play a crucial role in shaping the efficiency and effectiveness of the overall solution. Concurrently, when comparing these parameters with insights from existing review papers, a comprehensive understanding of the strengths and potential areas of improvement can be gleaned.

1) *Communication Range:* LoRa's inherent long-range capabilities set it apart in providing expansive coverage for home security networks [1]. This parameter, when compared to other technologies in existing literature, underscores LoRa's advantage in ensuring reliable communication over extended distances, contributing to a wider security perimeter.
2) *Power Consumption:* The low power consumption characteristic of LoRa devices is a pivotal parameter for sustainable and long-term deployment [6]. Comparative analyses with other review papers highlight LoRa's energy-efficient profile, essential for battery-operated devices in home security applications.
3) *Data Rate:* While LoRa typically operates at lower data rates, a nuanced evaluation against other technologies in the literature reveals a trade-off between data speed and power efficiency. Understanding this parameter assists in optimizing the balance between timely data exchange and prolonged device operation]
4) *Security Protocols:* LoRa's security protocols come under scrutiny in comparison with those of other wireless technologies. Insights from existing reviews aid in assessing the robustness of LoRa's encryption mechanisms and authentication protocols, crucial for safeguarding sensitive information in home security contexts.
5) *Scalability:* The scalability of a home security system is a key parameter, especially as residential needs evolve [6]. Comparative analyses gleaned from review papers shed light on how LoRa-based systems adapt to changing requirements, accommodating additional devices and functionalities seamlessly.
6) *Reliability and Latency:* LoRa's reliability and latency characteristics, when juxtaposed with findings from other review papers, provide insights into the system's responsiveness to security incidents. Understanding these parameters aids in comprehending the real-time detection capabilities of LoRa-based home security solutions].

III APPLICATIONS & DEVELOPMENTS

LoRa technology has emerged as a cornerstone in the development of advanced multipurpose security systems, offering a versatile platform for addressing diverse security challenges within residential environments [6]. The applications of LoRa in home security extend across various dimensions, providing homeowners with comprehensive protection and peace of mind.

1) *Intrusion Detection and Perimeter Security:* LoRa-based sensors strategically deployed around the property perimeter serve as a robust intrusion detection system]. These sensors can detect [9] unauthorized movement or entry attempts, promptly triggering alerts to homeowners or security services. The long-range capabilities of LoRa ensure reliable communication, even in expansive residential areas.
2) *Environmental Monitoring and Hazard Detection:* LoRa sensors integrated into home security systems extend beyond intrusion detection to environmental monitoring. These sensors can detect and alert homeowners to environmental hazards such as smoke, gas leaks, or abnormal temperature and humidity levels [10]. Early detection allows for timely response, minimizing potential damage and ensuring the safety of occupants.
3) *Video Surveillance and Remote Monitoring:* LoRa technology plays a pivotal role in enhancing video surveillance capabilities within a home security framework. Security cameras equipped with LoRa modules enable real-time monitoring of the property. Homeowners can access live video feeds remotely through secure channels, providing a means for continuous surveillance and instant visual verification of security events [4].

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4) *Access Control and Smart Lock Systems:* LoRa-based access control systems and smart lock technologies contribute to enhanced security at entry points [7] Homeowners can remotely manage access permissions and monitor door activities through a centralized platform. LoRa's long-range communication ensures reliable connectivity, even for devices placed at the outskirts of a property [7].
5) *Asset Tracking and Inventory Management:* LoRa's exceptional range makes it an ideal solution for asset tracking within residential properties. Valuable assets, such as bicycles, tools, or electronic devices, can be equipped with LoRa-based trackers. Homeowners can monitor the location of these assets in real-time, providing an added layer of security against theft or misplacement [11].
6) *Emergency Response Systems:* LoRa facilitates the implementation of emergency response systems, allowing homeowners to quickly summon assistance during critical situations [1]. Panic buttons, wearable devices, or wall-mounted panels with LoRa connectivity enable immediate communication with emergency services, enhancing the overall safety and responsiveness of the security system [11].
7) *Energy Management and Home Automation:* Incorporating LoRa into home security systems enables seamless integration with energy management and home automation solutions [12]. Smart thermostats, lighting controls, and other IoT devices can communicate through the same LoRa network, creating an interconnected ecosystem that enhances both security and energy efficiency within the home.
8) *Neighborhood Watch and Community Security:* LoRa-based security systems extend beyond individual residences to facilitate community-wide security initiatives [13]. By connecting multiple homes within a neighborhood, residents can create a collaborative security network. Shared information and alerts regarding suspicious activities contribute to a more comprehensive and proactive approach to community security [14].

In summary, the applications and developments of LoRa in advanced multipurpose security systems transcend traditional security measures, providing a holistic and interconnected solution for residential protection. The versatility, long-range communication, and low-power characteristics of LoRa technology contribute to its effectiveness in addressing the evolving security needs of modern homes [4].

IV TOOLS & METHODOLOGY

A. *Tools*

Utilizing LoRa transceivers/modules is fundamental for establishing wireless communication within the home security network. Key considerations include the sensitivity, transmission power, and frequency range of LoRa modules to align with the specific requirements of a home security application [15].

1) *Microcontrollers (MCUs):* Selecting appropriate MCUs compatible with LoRa technology is crucial. Popular choices include Arduino, Raspberry Pi, or specialized MCUs with LoRa support [16]. The MCU should support communication protocols necessary for interfacing with sensors, actuators, and the LoRa network.
2) *Security Sensors:* Various security sensors such as motion detectors, door/window sensors, and environmental sensors contribute to the effectiveness of the home security system [17]. These sensors, integrated with the LoRa network, provide real-time data for intrusion detection and environmental monitoring.
3) *Centralized Control Unit:* A centralized control unit, often implemented using a microcontroller or a dedicated computing device, serves as the brain of the security system [18]. It processes incoming data from sensors, manages device interactions, and communicates with the LoRa network.
4) *Gateway Devices:* LoRa gateways act as intermediaries between end-node devices and the central server. They receive data from the LoRa devices and forward it to the central control unit. The selection of suitable gateways is vital for ensuring robust communication and coverage [19].
5) *Network Server:* Implementing a robust network server facilitates the aggregation and analysis of data from various LoRa devices. Open-source LoRaWAN network servers or proprietary solutions can be chosen based on the specific requirements of the home security system [1].

B. *Methodology*

1) *Sensor Deployment Strategy:* Define the overall architecture of the LoRa-based home security system. Outline the roles and functionalities of each component, ensuring seamless integration for effective communication and coordination.evelop a strategy for deploying security sensors strategically throughout the home [17]. Consider factors such as optimal placement for intrusion detection and the coverage range of environmental sensors.

2) *LoRa Network Planning:* Conduct a comprehensive analysis of the home environment to plan the deployment of LoRa devices and gateways [20]. Assess factors like signal strength, interference, and potential obstacles to optimize the network for reliable communication.
3) *Security Protocols Implementation:* Implement robust security protocols to safeguard data transmitted over the LoRa network. Explore encryption mechanisms, authentication protocols, and secure key management to protect against potential security threats [12].
4) *Performance Evaluation:* Evaluate the performance of the LoRa-based home security system. Assess parameters such as communication range, power consumption, and data reliability [9]. Compare the system's performance against established benchmarks and standards.
5) *Comparative Analysis:* Compare the LoRa-based home security system with other wireless technologies used in similar applications [17]. Evaluate advantages, limitations, and performance metrics to position LoRa in the context of advanced multipurpose home security [15].

V COMPARATIVE TABLE

A health monitoring system built on LoRaWAN is determined by several important theoretical components. LoRa modulation maximizes low-power transmission over long distances, which is essential for sensor nodes with short battery lives [17]. Gaining an understanding of the architecture of LoRaWAN, which includes network servers, gateways, and end devices, guarantees effective data flow to the cloud, improving system efficacy [20].

Table 1: (comparison among communication technologies)

Network Technology	Topology	Radio Frequency	Data Rate	Range
BLE	Adhoc	2.4GHz	1-2Mb/s	10m
Zigbee	Mesh	868.3MHz, 902-928MHz, 2.4GHz	0.02-0.25Mb/s	100m
WiFi	Star	2.4GHz	11Mb/s-10Gb/s	<1km (MSC10, 1MHz)
SigFox	Star	862-928 MHz	100-600 bps	10km
LoRa	Star	860-1020	290 bps-50 Kbps	15km

VI CHALLENGES

1) *Challenges in Implementing LoRa-Based Advanced Multipurpose Home Security Systems 1. Limited Bandwidth and Data Rate:* One of the primary challenges faced by LoRa-based home security systems is the inherent trade-off between range and data rate. While LoRa excels in longrange communication, its data rates are comparatively lower [16]. This limitation poses challenges in transmitting large amounts of data quickly, affecting the real-time responsiveness of certain applications within the security system [21].
2) *Network Congestion and Interference:* In dense urban environments or areas with a high concentration of wireless devices, network congestion and interference may impact the reliability of LoRa communication. As the number of connected devices increases, managing interference becomes critical to maintaining a stable and responsive home security network [17].
3) *Security and Privacy Concerns:* Despite robust security protocols, the implementation of LoRa-based home security systems raises concerns about data security and privacy. Ensuring endto-end encryption, secure key management, and protection against potential cyber threats are ongoing challenges in maintaining the integrity of sensitive information transmitted within the system [15].

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4) *Power Consumption Optimization:* While LoRa devices are known for their low power consumption, optimizing power usage further remains a challenge, especially for battery-operated devices [17]. Balancing the need for frequent communication with the necessity of conserving power is crucial for extending the operational life of devices in the home security system [22].
5) *Scalability and Network Management:* As the number of connected devices in a home security system grows, ensuring scalability and effective network management become complex tasks [9]. LoRa networks must be designed to accommodate additional devices seamlessly while maintaining reliable communication. Efficient network management tools are essential for optimizing performance [12].
6) *Integration with Other Wireless Technologies:* Homes often incorporate a variety of wireless technologies, such as Wi-Fi, Zigbee, or Bluetooth. Ensuring seamless integration and coexistence with these technologies is a challenge for LoRa-based security systems. Interoperability standards and protocols must be carefully considered to avoid conflicts and ensure a cohesive smart home ecosystem [19].
7) *Adaptation to Dynamic Environmental Conditions:* LoRa's performance can be affected by dynamic environmental conditions, such as changes in weather or physical obstacles [18]. Ensuring reliable communication under varying circumstances, especially in outdoor deployments, poses a challenge that requires sophisticated signal optimization and adaptive network configurations [12].
8) *Cost of Implementation:* The cost associated with deploying LoRa-based home security systems, including the purchase of LoRa modules, gateways, and sensors, can be a barrier to widespread adoption. Addressing cost concerns while maintaining the quality and reliability of the security system is essential [16].

VII SOME COMMON MISTAKES

1) Neglecting Environmental Factors

Mistake: Failing to account for environmental conditions (e.g., interference, terrain, weather) that can significantly impact the performance of the LoRa-based security system.

2) Incomplete Security Protocols

Mistake: Overlooking the need for robust security protocols, such as encryption and authentication, which are essential for safeguarding the communication in a security system.

3) Ignoring Power Consumption Considerations

Mistake: Neglecting the importance of optimizing power consumption, as energy efficiency is critical for battery-powered devices in a LoRa network.

4) Improper Antenna Placement

Mistake: Disregarding the significance of antenna placement and orientation, which can impact signal strength and overall system performance.

5) Underestimating Network Scalability

Mistake: Failing to design the LoRa network with scalability in mind, leading to potential limitations as the number of connected devices increases.

6) Insufficient Redundancy Planning

Mistake: Overlooking the need for redundancy and backup mechanisms, leaving the system vulnerable in case of failures or disruptions.

VIII FUTURE PROSPECTS

1) *Future Prospects of LoRa-Based Advanced Multipurpose Security Systems:* The rapid evolution of technology presents exciting possibilities for the future of LoRa-based advanced multipurpose security systems. As these systems continue to gain prominence in residential security, several key areas are poised for development and improvement [23].

2) *Integration with Artificial Intelligence (AI):* The synergy between LoRa technology and AI holds immense potential for enhancing the intelligence and automation of home security systems. Implementing machine learning algorithms can enable security devices to learn and adapt to patterns, providing more accurate threat detection and minimizing false alarms [23]. Additionally, AI-driven analytics can optimize the utilization of data collected by LoRa sensors, offering a more proactive and responsive security infrastructure [24].
3) *Edge Computing for Real-Time Processing:* The incorporation of edge computing in LoRabased security systems is anticipated to address the demand for real-time data processing [17]. By enabling data processing closer to the source, edge computing reduces latency and enhances the system's ability to respond swiftly to security events. This advancement is particularly crucial for applications such as facial recognition, where timely responses are essential for effective security measures [9].
4) *Enhanced Battery Technologies:* The longevity of battery life remains a critical aspect of LoRa-based security systems. Future developments in battery technologies, including more efficient energy storage and management solutions, can extend the operational lifespan of devices. This, in turn, contributes to a reduction in maintenance requirements and ensures the reliability of the security infrastructure over extended periods [17].
5) *5G Integration for High-Speed Connectivity:* As 5G networks become more widespread, the integration of LoRa with 5G technology presents an opportunity for high-speed connectivity in specific use cases [12]. While LoRa excels in providing long-range, low-power communication, coupling it with 5G can cater to scenarios that demand higher data transfer rates, such as real-time video streaming and large-scale data processing [15].
6) *Interoperability and Standardization:* The future development of standardized protocols and increased interoperability between different IoT devices is crucial for the seamless integration of LoRa-based security systems with other smart home technologies]. Efforts to establish industry standards will foster a more [15 interconnected and cohesive ecosystem, allowing users to easily incorporate diverse security devices into their home networks.
7) *Enhanced Security Protocols:* As security threats evolve, ensuring robust encryption and authentication mechanisms within LoRa-based systems will be paramount. Ongoing research into advanced security protocols will bolster the resilience of these systems against emerging cyber threats, safeguarding the privacy and integrity of the data transmitted between devices [9].
8) *Scalability for Smart Cities:* The scalability of LoRa-based security systems makes them wellsuited for broader applications in smart city initiatives. Future developments may see the integration of these systems into citywide networks, allowing for centralized monitoring and management of security infrastructure across neighborhoods and urban areas [9].

In conclusion, the future of LoRa-based advanced multipurpose security systems holds promise for increased intelligence, efficiency, and integration within the broader landscape of smart home and smart city technologies. Continued research, innovation, and collaboration among industry stakeholders will undoubtedly contribute to the evolution of these systems, ensuring that they remain at the forefront of residential; security solutions]. [13

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X CONCLUSION

In conclusion, the integration of Long-Range (LoRa) technology into advanced multipurpose security systems represents a significant stride towards enhancing the safety and protection of residential environments. As explored in this review, the unique attributes of LoRa, including its long-range communication, low power consumption, and versatility, position it as a key enabler for a diverse range of security applications within the home.

The applications of LoRa in home security extend beyond traditional intrusion detection, encompassing environmental monitoring, video surveillance, access control, asset tracking, emergency response, and community-wide security initiatives. The robustness of LoRa-based security systems lies in their ability to offer a comprehensive and interconnected solution that addresses the multifaceted challenges faced by homeowners.

One of the notable strengths of LoRa is its adaptability to diverse residential landscapes. The longrange capabilities ensure that security devices can effectively cover expansive properties, providing reliable communication even in remote areas. This scalability is further complemented by the low- power characteristics of LoRa, contributing to extended device battery life and reduced maintenance requirements.

The future prospects of LoRa-based security systems appear promising, with ongoing developments in artificial intelligence, edge computing, battery technologies, and integration with 5G networks. These advancements are poised to further enhance the intelligence, efficiency, and responsiveness of home security systems, ensuring they remain at the forefront of technological innovation.

However, as with any technology, challenges such as security vulnerabilities and the need for standardized protocols must be vigilantly addressed. Continuous research, development, and collaboration within the industry will play a crucial role in fortifying LoRa-based security systems against emerging threats and expanding their capabilities to meet evolving security demands. In essence, the synthesis of LoRa technology with advanced security applications heralds a new era in residential safety. The amalgamation of long-range connectivity, low power consumption, and versatility positions LoRa as a reliable and effective solution for homeowners seeking a holistic and intelligent approach to safeguarding their properties.

REFERENCES

[1] G. Centenaro, M., Vangelista, L., Zanella, A., & Zorzi, M. (2016). “Long-range communications in unlicensed bands: The rising stars in the IoT and smart city scenarios” IEEE Wireless Communications, 23(5), 60-67.
[2] Zhang, W., Xie, Z., Chen, W., & Yang, C. (2019). A survey on LoRa- based networks in smart agriculture: Deployment, applications, and open challenges. IEEE Access, 7, 160790-160802.
[3] Sornin, N., Munier, G., Boonah, N., & Stanica, R. (2017). LoRaWAN specification v1.1. LoRa Alliance.
[4] Kim, T. H., Lee, H. K., & Kim, J. W. (2018). LoRa-based IoT sensor node for predictive maintenance of hydraulic pumps in industrial environments. Sensors, 18(10), 3457.
[5] Al-Fuqaha, A., Guizani, M., Mohammadi, M., Aledhari, M., & Ayyash, M. (2015). Internet of Things: A survey on enabling technologies, protocols, and applications. IEEE Communications Surveys & Tutorials, 17(4), 2347-2376.
[6] Augustin, A., Yi, J., Clausen, T., & Townsley, W. M. (2016). A study of LoRa: Long range & low power networks for the Internet of Things. Sensors, 16(9), 1466.
[7] Khorov, E., Guschin, A., Lyakhov, A., & Krotov, A. (2017). A Real- world evaluation of LoRa interference between 868 MHz ISM band and IEEE 802.11b/g at 2.4 GHz. In 2017 IEEE Conference on Standards for Communications and Networking (CSCN) (pp. 113- 118). IEEE.
[8] Bor, M., Vidales, P., & Roedig, U. (2016). Evaluation of LoRa LPWAN technology for indoor remote sensing applications. In 2016 IEEE 3rd World Forum on Internet of Things (WF-IoT) (pp. 608- 613). IEEE.
[9] Farhan L., Hameed R.S., Ahmed A.S., Fadel A.H., Gheth W., Alzubaidi L., Fadhel M.A., Al-Amidie M. Energy Efficiency for Green Internet of Things (IoT) Networks: A Survey. Network. 2021; 1:279–314. Doi: 10.3390/network1030017.
[10] Alekya R., Boddeti N.D., Monica K.S., Prabha R., Venkatesh V. IoT based smart healthcare monitoring systems: A literature review. Eur. J. Mol. Clin. Med. 2021; 7:2020.
[11] Raza, U., Kulkarni, P., Sooriyabandara, M., & Gaura, E. (2017). Low power wide area networks: An overview. IEEE Communications Surveys & Tutorials, 19(2), 855-873.
[12] Bhatia H., Panda S.N., Nagpal D. Internet of Things and its Applications in Healthcare—A Survey; Proceedings of the 2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO); Noida, India. 4–5 June 2020; pp. 305–310.
[13] L. You, C. Liu, and S. Tong, “Community medical network (CMN): Architecture and implementation,” in 2011 Global Mobile Congress (GMC), Oct 2011, pp. 1–6.
[14] Gera S., Mridul M., Sharma S. IoT based Automated Health Care Monitoring System for Smart City; Proceedings of the 2021 5th International Conference on Computing Methodologies and Communication (ICCMC); Erode, India. 8–10 April 2021; pp. 364–368.
[15] Patel W.D., Patel C., Valderrama C. IoMT based Efficient Vital Signs Monitoring System for Elderly Healthcare Using Neural Network. Int. J. Res. 2019;VIII:239
[16] Hamim M., Paul S., Hoque S.I., Rahman M.N., Baqee I. IoT Based Remote Health Monitoring System for Patients and Elderly People; Proceedings of the 2019 International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST); Dhaka, Bangladesh. 10–12 January 2019; pp. 533–538.

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[17] Bhardwaj R., Gupta S.N., Gupta M., Tiwari P. IoT based Healthware and Healthcare Monitoring System in India; Proceedings of the 2021 International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE); Greater Noida, India. 4–5 March 2021; pp. 406–408.
[18] IEEE, "IEEE standard for information technology– local and metropolitan area networks–part 15.4: Wireless medium access control (mac) and physical layer (phy) specifications for low rate wireless personal area networks (wpans)," IEEE STD 802.15.4-2006 (Revision of IEEE Std 802.15.4-2003), pp. 1–320, Sept 2006.
[19] L. Yang, Y. Ge, W. Li, W. Rao, and W. Shen, "A home mobile healthcare system for wheelchair users," in IEEE 18th Int. Conference on Computer Supported Cooperative Work in Design (CSCWD),, May 2014, pp. 609– 614.
[20] C. D. Mathers and D. Loncar, "Updated projections of global mortality and burden of disease, 2002-2030: Data sources, methods and results," October 2005, world Health Organization (WHO).
[21] Gupta D., Parikh A., Swarnalatha R. Integrated healthcare monitoring device for obese adults using internet of things (IoT) Int. J. Electr. Comput.Eng.2020; 10:1239–1247. Doi: 10.11591/ijece.v10i2.pp1239-1247.
[22] Arduino, "GSM/GPRS module technical specifications," http://www.arduino.org/products/shields/arduino-gsm-shield-2, online; accessed 29-December-2016.
[23] Sohraby, K., Minoli, D., & Znati, T. (2017). Wireless sensor networks: Technology, protocols, and applications. John Wiley & Sons.
[24] Naveen, Sharma R.K., Nair A.R. IoT-based Secure Healthcare Monitoring System; Proceedings of the 2019 IEEE International Conference on Electrical, Computer and Communication Technologies (ICECCT); Coimbatore, India. 20–22 February 2019; pp. 1–6.

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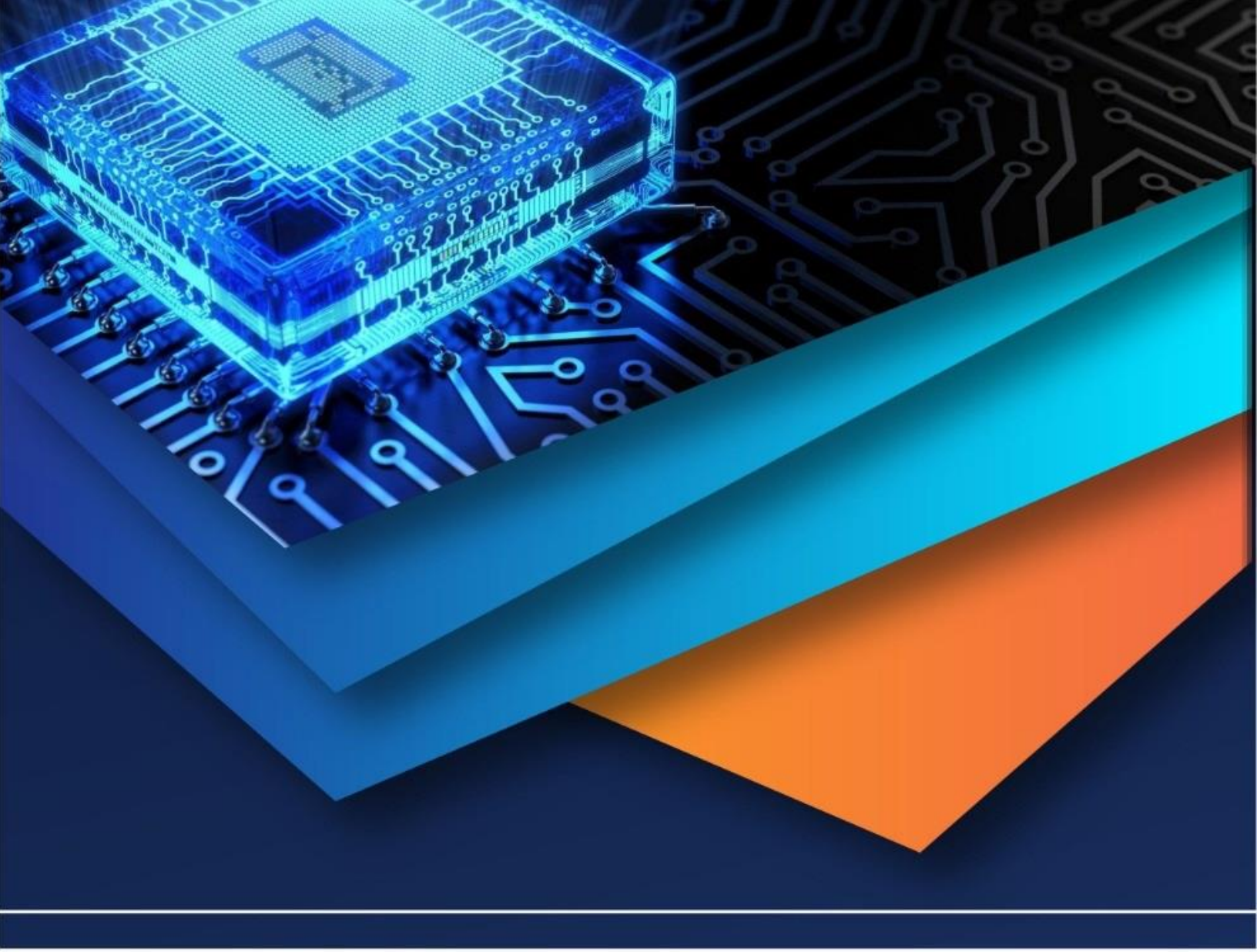

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