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Surface Mounted Wireless Body Area Network - A Review

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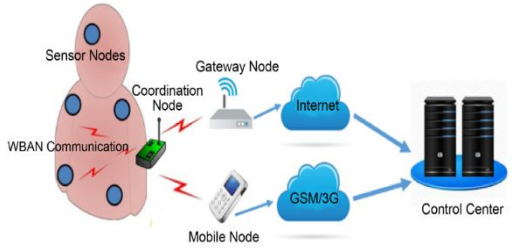
***Abstract:** In the present era, the use of wireless networks is increasing day by day and the electrical devices are getting smaller in size, due to these factors the research area of Wireless Body Area Networks (WBAN) has expanded. Nowadays there are so many accidents occurred in different sectors of society just because of the late arrival of input information. But with the help of this technology, we together can overcome such types of Activities to save victims. The SM-WBAN technology is used on the human body and operates on small power consumption, less frequency. This consists of 4 different sections in its Architecture. We have reviewed SM-WBAN protocols and techniques related to it for solution and application in this paper. In this paper, there are works of various authors in this field of the same view.*
***Keywords:** SM-WBAN - Surface Mounted Wireless Body Area Network; Frequency; Power Combustion; Input Information.*

I. INTRODUCTION

A Wireless body area network (WBAN) is just a WSN where the wireless sensors are placed over, or inside the body of a patient or individual, to gather biomedical data. The biosensors generate the data and transmits them to at least one or more sinks for storing or processing**.** In this paper, we have reviewed the on body WBAN which is also known as Surface Mounted Wireless Body Area Network. A WBAN connects independent nodes (e.g., sensors and actuators) that are situated on the body or we can say on the surface of the body of an individual. The network typically expands over the entire physical body and therefore the nodes are connected through a wireless channel. In the medical field, for instance, a patient is often equipped with a WBAN consisting of sensors that constantly measure specific biological functions, like temperature, vital signs, heart rate, electrocardiogram (ECG), respiration, etc. The advantage is that the patient doesn't need to stay in bed, but can move freely across the space and even leave the hospital for a short time. This improves the standard of life for the patient and reduces hospital costs. In addition, data collected over a extended period and within the natural environment of the patient, offers more useful information, allowing a more accurate and sometimes even faster diagnosis. If we explore the utilization of networks within the physical body, the physical body features a nervous system that gives signals about the environment, and may be a conduit for control and feedback through the whole body. An important step while developing WBAN is the characterization of the physical layer of the network, which includes an estimation of the delay occurred and hence the path loss between two nodes on the body. This requires an in-depth characterization of the electromagnetic radiation propagation and antenna behaviour near the physical body. A typical WBAN consists of several sensors/actuators nodes and a body control unit (BCU) (i.e., a PDA or smartphone). Sensor nodes collect the patient's physiological signals like pulse, blood heat, blood pressure, glucose level, and electrocardiogram (ECG).

II. ARCHITECTURE

WBAN is meant with a special purpose sensor which may autonomously connect with various sensors and appliances, located inside and out of doors of a person's body.
Figure 1 demonstrates a simple WBAN architecture which is divided into several sections. Here we've classified the specification into four sections.



The first section is the WBAN part which consists of various numbers of sensor nodes. These nodes are cheap and low-power nodes with sensors, strategically placed on the physical body. Different types of medical sensors are often used for continuous monitoring of movement, vital parameters like pulse, ECG, vital sign etc. and the surrounding environment.

The next section is that the coordination node where the whole sensor nodes will be directly connected with a coordination node referred to as Central Control Unit (CCU). CCU takes the responsibility to gather information from the sensor nodes and to deliver to subsequent section. For monitoring human body activities, there is no such wireless technology which is fixed for targeting WBAN [1].

The third section is that the WBAN communication which can act as a gateway to transfer the knowledge to the destination. A mobile node is often a gateway to a foreign station to send Mobile Message to a cellular network using GSM/3G/4G. A router or a PC are often a foreign node to speak via email or other service using Ethernet.

The last section is going to be an impact centre consists of end node devices like mobile for message, PC for monitoring and email and server for storing the knowledge in the database [2].

III. REQUIREMENTS OF WBAN

Within the regulations, some requirements of WBAN are:

A. Sensors must be lightweight and small. Size and weight of the sensors are mainly determined by the size and weight of batteries [17].

B. The nodes must be able to provide stable and reliable communication irrespective of the movement of the person.

C. A WBAN can integrate the UWB technology with narrow band transmission to cover the different environments and support high data rates [9].

D. Personal and critical data should be handled with care to ensure the privacy and security of the data.

E. The WBANs must include energy-saving systems, should consume very less power that will allow the users to operate them in power-restricted environments.

F. . The packet error rate (PER) for a 256-octet payload must be less than 10% for most links that are based on the best PER performance [10-14].

G. Quality of service (QoS): it's essential for medical data to be transmitted and received without error and during a useful time [8].

Table 1: Below lists the frequency bands designated by the IEEE for WBAN [14,15].

Human body communication	
frequency	bandwidth
16 MHz	4 MHz
27 MHz	4 MHz
Narrowband communication	
frequency	bandwidth
402–405 MHz	300 KHz
420–450 MHz	300 KHz
863–870 MHz	400 KHz
902–928 MHz	500 KHz
956–956 MHz	400 KHz
2320–2400 MHz	1 MHz
2400–2438.5 MHz	1 MHz
UWB communication	
frequency	bandwidth
3.2–4.7 GHZ	499 MHz

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IV. TECHNOLOGIES USED IN WBAN

WBAN is a short-range wireless network so various types of short-range technologies can be used. In this section we will describe some of them.

1) *Bluetooth*: Bluetooth is a short-range wireless communication technology in which up to eight devices can be connected with each other. This network is additionally referred to as piconet during which one device acts because the master while other devices act because the slaves. Slaves need to synchronize by the system clock of the master and follow the hopping pattern, determined by the master [3]. Key feature of Bluetooth is the ability of devices to communicate without need of line-of-sight positioning of connected devices. Bluetooth devices operate within the 2.4 GHz ISM band (Industrial, Scientific and Medical band) [20], utilizing frequency hopping among 79.1 MHz channels at a nominal rate of 1600 hops/sec to reduce interference.
2) *WiFi*: WiFi is a family of wireless network protocols which is based on the IEEE 802.11 family of standards, they are commonly used for networking of devices and Internet access in local area [16]. In general, it comes with four standards (802.11 a/b/g/n) that runs on ISM band 2.4GHz and 5 GHz with a modest coverage of 100 meters. WiFi permit the users to transfer data at broadband speed when connected to an access point (AP). In some modified version, WiFi devices are often utilized in data acquisition applications that allow an immediate communication between the sensors and the smart phones/ PC even without an intermediate router.[4]
3) *IEEE 802.15.6:* IEEE 802.15.6 standard aims to provide an international norm supporting low complexity, low cost, ultra-low power consumption, and extremely reliable wireless communication [7]. The main goal of this standard is to offer an answer to service differentiation for brief range communication between tiny devices within the encompassing area of the physical body. IEEE 802.15.6, which operates on PHY and MAC layers, come up with two topology types, one-hop and two-hop star topologies. An IEEE 802.15.6-based WBAN consists of 1 and just one coordinator (also named a hub) and variety of connected nodes, which varies from 0 to 64 nodes.[6].
4) *ZigBee:* ZigBee is an IEEE 802.15.4 standardized solutions for wireless telecommunications designed for sensors and controls, and suitable to be used in harsh or isolated conditions. One of the biggest advantages of ZigBee network is that it consumes very less power. ZigBee topology consists of three sorts of devices or nodes like coordinator, router and end device. One coordinator exists in every ZigBee network. It starts the network and handles management functions also as data routing functions. End devices are devices that are battery-powered thanks to their low-power consumption. They are in standby mode most of the time and become active to gather and transmit the data. [7].

V. CLASSIFICATION OF ROUTING PROTOCOLS FOR WBAN:

The classification of routing protocols of WBAN can be done in several categories. This section gives an overview of the existing protocols which can be categorized as shown in the figure 2.

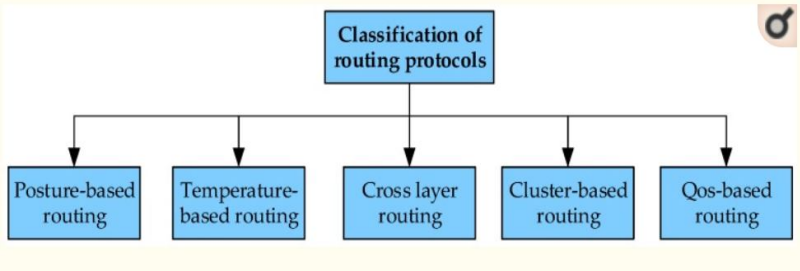


FIGURE-2: Classification of Routing Protocols

1) *Posture-Based Routing*: In geographic (posture –based) routing, the forwarding by a node is primarily made based on the position of a packet's destination and the position of the nodes one-hop neighbors. The position of the destination is stored in the header of the packet [18].
2) *Temperature-based Routing*: The antenna radiation, its absorption and interference are the major challenges to be considered while designing a body sensor network [19]. The radiations have a strong and dangerous impact on the human body. The goal of all temperature-based protocols is to reduce the temperature rise of the sensor nodes by avoiding routing through hotspots.
3) *Cross-Layer Routing*: These protocols use the concept of cross layering [5], in which every layer in the protocol stack shares their information unlike in the strict layered model. In WBANs, we can utilize the cross-layering concept between network and medium access control (MAC) layers for routing, this can upgrade the overall network performance.[19]

4) *Cluster Based Routing:* In WBANs, the limited energy source is the main constraint to be analyzed. Hence, several efficient cluster-based schemes are proposed for both networks to minimize the power consumption and maximize the network lifetime [21]. While comparing hybrid indirect transmission to power-efficient gathering in sensor [22] information systems and low-energy adaptive clustering hierarchy [23], it consumes less amount of energy if the number of nodes are small [24].
5) *QoS Based Routing***:** Presently, there are a number of diverse QoS aware protocols available, which cannot be as such implemented in WBANs [25], but by considering its unique curbs it can. In WBAN.

VI. CHALLENGES OF WBAN

1) *Privacy*: WBAN must ensure privacy because people are afraid that their private information may get leaked while using WBAN.
2) *Security:* It is the main and most important challenge; efforts are being made to make data transmissions in WBAN more secure. The data should not be accessible to the unauthorized.
3) *Consistency:* The data consistency should be maintained, because the data generated in WBAN is fragmented and transferred at various nodes which may cause inconsistency of the data.

VII. APPLICATIONS OF WBAN

1) *Military:* There are various opportunities for using WBANs in the forces. The military applications for WBANs includes monitoring health, location, and high temperature and hydration levels. A battle dress uniform includes a WBAN and become a wearable electronic network that connects devices such as cameras, RF and personal PDAs, health monitoring, and transports data to a computer. This network could perform several functions such as chemical recognition, detection to prevent victims from friendly fire and also monitor the soldier's physiological condition [26].
2) *Remote Patient Monitoring:* Telemedicine and remote patient monitoring are the most applications of WBAN. Telemedicine means diagnosis and treatment of patients located at a foreign location using information technology. Due to WBAN, it has now become possible the delivery of certain healthcare services for the patients at a distant location. Using telemedicine, a large number of patients can be served. Sensors on the body collect signals and transfer it to the distant physicians and doctors for processing [29]. Doctors use this information for health estimation for diagnosis and prescription. This creates a smart health care system. The daily-life activities of patients can be monitored to collect various parameters from the human body [30].
3) *Rehabilitation*: Rehabilitative treatment methods help the patients to restore their normal functional capabilities. If proper rehabilitation measures are followed then it can enable a person, who has experienced a stroke, to function independently [27]. These patients are constantly monitored to take care of an accurate motion pattern. This will create awareness regarding certain physiological activities [28].
4) *Assisted living*: Through assisted living technologies, elderly and disabled people can be monitored at their individual homes. This will lower the healthcare costs. Through these devices and technologies, the health condition of the people are often estimated appropriately. This helps in improving the quality of life.

VIII. CONCLUSION

This paper provides a complete overview of WBAN's architecture, technologies used, requirements, challenges, and applications. WBAN is a technology that is emerging and promising that will change people's healthcare experiences, also it is a system that provides a less costly and ambulant smooth inspection during routine work in close collaboration with WBAN. Nowadays we can see ample amount lifesaving as well as the quality of life-improving products which use WBAN as their basic idea. We can conclude that it has a large number of applications and are very useful for the real-time analysis of data, in the area of remote health monitoring, home/health care, sports, medicine etc., all of which take the advantage of the unconstrained freedom of movement a WBAN offers.

REFERENCES

[1] Arefin, Md.T., Ali, M.H. and Haque, A.K.M.F. (2017) Wireless Body Area Network: An Overview and Various Applications. Journal of Computer and Communications, 5, 53-64. https://doi.org/10.4236/jcc.2017.57006
[2] Aashima Arya1, Naveen Bilandi, A Review: Wireless Body Area Networks for Health Care. Vol. 2, Issue 4, April2014. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press.
[3] RimNegra, Imen Jemili, Abdelfettah Belghith wireless Body Area Networks: Applications and technologies / Procedia Computer Science 83 (2016) 1274 – 1281.
[4] M.T. Arefin, M.H. Ali, A.K.M.F. Haque, Wireless body area network: an overview wand various applications, Journal of Computer and Communications, 5, 53-64. https://doi.org/10.4236/jcc.2017.57006

[5] Mendes LDP, Rodrigues JJPC (2011) A survey on cross-layer solutions for wireless sensor networks. J Netw Comput Appl 34(2):523–534. doi:10.1016/j.jnca.2010.11.009

[6] Fourati, Hend and Khssibi, Sabri and Val, Thierry and Idoudi, Hanen and Van den Bossche, Adrien and Azzouz Saidane, Leila Comparative study of IEEE 802.15.4 and IEEE 802.15.6 for WBAN-based CANet. (2015) In: 4th Performance Evaluation and Modeling in Wireless Networks (PEMWN 2015), 11 November 2015 - 13 November 2015 (Hammamet, Tunisia).

[7] Pawan Kumar Verma | Preeti Sondhi "Review Paper on Wireless Sensor Body Area Network" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456- 6470, Volume-3 | Issue-5, August 2019, pp.648-650, https://doi.org/10.31142/ijtsrd26437

[8] Luis Filipe, Florentino Fdez-Riverola Nuno Costa, António Pereira Wireless Body Area Networks for Healthcare Applications: Protocol Stack Review Volume: 11 issue: 10, First Published October 19, 2015.

[9] Carlos A. Tavera, Jesús H. Ortiz, Osamah I. Khalaf, Diego F. Saavedra, Theyazn H. H. Aldhyani, "Wearable Wireless Body Area Networks for Medical Applications", Computational and Mathematical Methods in Medicine, vol. 2021, Article ID 5574376, 9 pages, 2021. https://doi.org/10.1155/2021/5574376.

[10] T. X. Tran, X. P. Nguyen, D. N. Nguyen et al., "Effect of poly-alkylene-glycol quenchant on the distortion, hardness, and microstructure of 65Mn steel," Computers, Materials & Continua, vol. 67, no. 3, pp. 3249–3264, 2021. View at: Publisher Site | Google Scholar

[11] C. A. T. Romero, J. H. Ortiz, O. I. Khalaf, and A. R. Prado, "Web application commercial design for financial entities based on business intelligence," Computers, Materials & Continua, vol. 67, no. 3, pp. 3177–3188, 2021. View at: Publisher Site | Google Scholar

[12] M. J. Awan, M. S. M. Rahim, H. Nobanee, A. Yasin, O. I. Khalaf, and U. Ishfaq, "A big data approach to black Friday sales," Intelligent Automation and Soft Computing, vol. 27, no. 3, pp. 785–797, 2021. View at: Publisher Site | Google Scholar

[13] F. W. Alsaade, T. H. H. Aldhyani, and M. H. Al-Adhaileh, "Developing a recognition system for classifying covid-19 using a convolutional neural network algorithm," Computers, Materials & Continua, vol. 680, no. 1, pp. 805–819, 2021. View at: Publisher Site | Google Scholar

[14] M. Krichen, S. Mechti, R. Alroobaea et al., "A formal testing model for operating room control system using internet of things," Computers, Materials & Continua, vol. 66, no. 3, pp. 2997–3011, 2021. View at: Publisher Site | Google Scholar.

[15] M. Ghamari, B. Janko, R. S. Sherratt, W. Harwin, R. Piechockic, and C. Soltanpur, "A survey on wireless body area networks for ehealthcare systems in residential environments," Sensors, vol. 16, no. 6, pp. 831–833, 2016. View at: Publisher Site | Google Scholar.

[16] Vallejos de Schatz, C.H., Medeiros, H.P., Schneider, F.K. and Abatti, P.J. (2012) Wireless Medical Sensor Networks: Design Requirements and Enabling Technologies. Telemedicine and e-Health, 18, 394-399. https://doi.org/10.1089/tmj.2011.0169

[17] Anastasi, G., Conti, M., Di Francesco, M. and Passarella, A. (2009) Energy Conservation in Wireless Sensor Networks: A Survey. Ad Hoc Networks, 7, 537-568.

[18] Nishat Fatima and M. Narayana. Survey on Position based Routing Protocol in Vehicular Ad-Hoc Networks. ISSN 0973-6972 Volume 10, Number 5 (2017), pp. 1017-1033.

[19] Bhanumathi, V., Sangeetha, C.P. A guide for the selection of routing protocols in WBAN for healthcare applications. Hum. Cent. Comput. Inf. Sci. 7, 24 (2017). https://doi.org/10.1186/s13673-017-0105-6.

[20] J. Haartsen et al., "Bluetooth: Vision, Goals, and Architecture," ACM Mobile Comp. Commun. Rev. 2, No. 4, 38 (1998).

[21] Heinzelman WB, Chandrakasan AP, Balakrishnan H (2002) An application-specific protocol architecture for wireless microsensor networks. IEEE Trans Wirel Commun 1(4):660–670. doi:10.1109/TWC.2002.804190

[22] Culpepper BJ, Dung L, Moh M (2004) Design and analysis of hybrid indirect transmissions (HIT) for data gathering in wireless micro sensor networks. ACM SIGMOBILE Mob Comput Commun Rev 8(1):61–83. doi:10.1145/980159.980169

[23] Lindsey S, Raghavendra CS (2002) PEGASIS: power-efficient gathering in sensor information systems. Proceedings of the IEEE aerospace conference proceedings. Big Sky, Montana, pp 1125–1130.

[24] Lindsey S, Raghavendra CS (2002) PEGASIS: power-efficient gathering in sensor information systems. Proceedings of the IEEE aerospace conference proceedings. Big Sky, Montana, pp 1125–1130.

[25] Uthra RA, Raja SV (2012) QoS routing in wireless sensor networks—a survey. ACM Comput Surv 45(1):9. doi:10.1145/2379776.2379785.

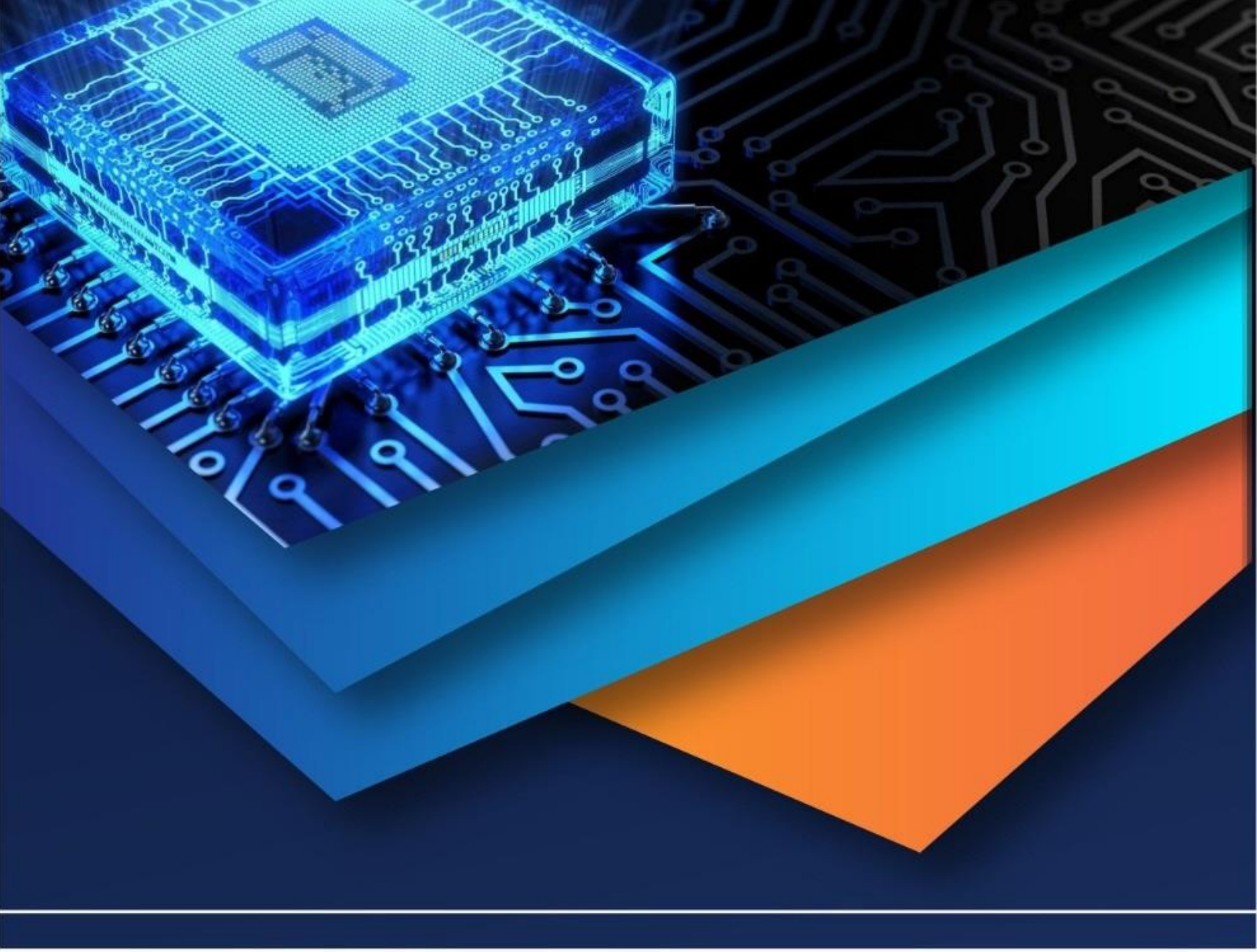
[26] M. V. Scanlon, C. G. Reiff, L. Solomon, ―Aerostat acoustic payload for transient and helicopter detection‖, Spie Defense & security Symposium, Orlando, Florida USA, 9-13 April 2007.

[27] Hadjidj, A., Souil, M., Bouabdallah, A., Challal, Y., & Owen, H. (2013). Wireless sensor networks for rehabilitation applications: Challenges and opportunities. Journalof Network and Computer Applications, 36(1), 1-15.

[28] Zhou, H., & Hu, H. (2008). Human motion tracking for rehabilitation survey. Biomedical Signal Processing and Control, 3(1), 1-18.

[29] oulemtafes, A., & Badache, N. (2016). Design of Wearable Health Monitoring Systems: An Overview of Techniques and Technologies. InmHealth Ecosystems and Social Networks in Healthcare (pp. 79-94). Springer International Publishing.

[30] Chakraborty, C., Gupta, B., & Ghosh, S. K. (2013). A review on telemedicine-based WBAN framework for patient monitoring. Telemedicine and e-Health, 19(8), 619-626.



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