IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 1, January 2024

DOI: 10.17148/IJARCCE.2024.13129

IoT Based Human Area Networking Implementation of Biotelemetry Utilizing RedTacton

Partho Kumer Nonda[1], Md. Inzamul Haque[2], Md. Shadman Rafid Khan[3], Al- Ispahani Arif Jahan Jiko[4], Md. Maruf Hasan[5]

Lecturer, Department of Electrical and Electronic Engineering, Varendra University, Rajshahi, Bangladesh.[1]

Executive (Lab), Department of Electrical and Electronic Engineering, Varendra University, Rajshahi, Bangladesh.[2]

Student, Department of Electrical and Electronic Engineering, Varendra University, Rajshahi, Bangladesh.[3,4]

Student, Electrical, Electronic and Communication Engineering, Pabna University of Science and Technology, Pabna, Bangladesh.[5]

Abstract: Human Body Communication (HBC) is an innovative form of communication that offers enhanced safety compared to other technologies. RedTacton is a user-friendly pervasive technology that enables the- human body to establish communication with nearby devices [7]. This paper introduces a model for a human area networking technology that facilitates communication through touch, and demonstrates how this technology can benefit both patients and doctors [6]. With HBC, doctors no longer need to be constantly present beside the patient, as the technology operates through contact. Patients can simply touch the device to access information about their condition and consult with a doctor. By utilizing the body as a transmission medium, HBC seamlessly integrates with various devices, particularly wireless biomedical monitoring devices [4]. The use of on-body sensor nodes allows for the monitoring of vital signs in individuals by utilizing the body as a transmission medium. This technology provides numerous benefits for long term clinical monitoring, offering users increased freedom. Biotelemetry is employed to achieve remote observation, measurement, and preservation of an organism's activity, condition, or function. Human Body Area Networks (HBANs) consist of sensor nodes that are either attached to or implanted into a subject's body [2]. The implementation of RedTacton technology has effectively addressed challenges associated with radio transmission limitations, data rates, and potential security threats from unauthorized signal interceptions.

Keywords: Human body communication, RedTacton, Human Body Area Network (HAN), Biotelemetry, Body Coupled Communication (BCC), IoT, Notification [1].

I. INTRODUCTION

RedTacton, a revolutionary technology developed by Nippon Telegraph and Telephone Corporation (NTT) in Tokyo, Japan, represents a groundbreaking paradigm in the realm of communication [3]. It harnesses the human body's surface as a swift and secure network transmission line, aptly referred to as NTTs [5]. This innovative approach automatically establishes a transmission path whenever a person comes into physical contact with a device, initiating seamless communication between mobile terminals. The name "RedTacton" bears cultural significance, as it incorporates the auspicious color red, symbolizing warmth, and "TACTON," denoting "activity induced by touching."

It was NTT, driven by an unwavering commitment to innovation, that ultimately surmounted these technical barriers by leveraging photonic electric field sensors. With this breakthrough, NTT forged the path to the development of the RedTacton technology, which embodies human area networking at its finest.

In today's fast-paced digital landscape, the need for digital communication and data transmission permeates every facet of life. From the everyday individual utilizing voice calls, SMS, and messaging applications for data transfer, to specialized domains such as defense and finance, where safeguarding sensitive information from prying eyes and malicious intent is paramount. Secure data transfer stands as the bedrock of modern connectivity.

Human Area Networks (HANs) represent a pivotal advancement in the realm of communication technologies [1]. These networks employ radio frequency (RF) waves to facilitate long-distance data transmission in scenarios were establishing a Personal Area Network (PAN) is impractical [8]. Notably, HANs excel in near-field communication, enabling data exchange within the immediate proximity of our hands.

DOI: 10.17148/IJARCCE.2024.13129

Within the domain of medical technology, biotelemetry plays a transformative role. It enables remote monitoring of an individual's physiological processes, encompassing vital indicators such as body temperature, heart rate, blood pressure, and even more intricate signals like electrocardiogram (ECG) and electroencephalogram (EEG). Furthermore, biotelemetry extends its reach to control devices like artificial limbs and drug delivery systems. Within this context, implantable biotelemetry takes center stage, focusing on equipment surgically inserted into the human or animal subject under study. An integral part of the biotelemetry system comprises physiological function sensors, strategically positioned on transmitters [4]. The distinguishing feature of implantable biotelemetry is its wire-free transmission, eliminating the need for physical wires to connect transmitters and receivers.

For healthcare professionals and patients alike, the constraints posed by traditional wired monitoring solutions are impractical and limiting. Wireless technologies have emerged as indispensable tools, facilitating greater patient mobility and flexibility, particularly during long-term monitoring, daily activities for non-ambulatory patients, and medical procedures [1]. These wearable sensor networks, collectively referred to as Body Area Networks (BANs), represent a pivotal evolution in healthcare, fostering real-time data collection and analysis to enhance patient care and treatment outcomes [1,9].

Features of RedTacton

The groundbreaking technology known as RedTacton, pioneered by the Nippon Telegraph and Telephone Corporation (NTT) in Tokyo, Japan, represents a transformative shift in the field of communication. It harnesses the human body's surface as a high-speed and secure network transmission conduit, aptly labeled NTTs. This innovative approach establishes a transmission pathway automatically whenever an individual physically connects with a device, initiating seamless communication between mobile terminals [1]. The moniker "RedTacton" carries cultural significance, blending the auspicious color red, symbolizing warmth, with "TACTON," signifying "activity induced by touch."

II. LITERATURE SURVEY

In the fascinating realm of position sensor human interface research conducted at the Massachusetts Institute of Technology (MIT), a remarkable discovery unfolded in 1995, thanks to the work of Zimmerman et al. Although their focus was primarily on position sensors, they serendipitously stumbled upon a groundbreaking concept known as body-coupled communications. Coincidentally, around the same time, researchers at Sony Labs were engaged in parallel efforts, resulting in the development of a wearable key prototype. The emergence of these breakthroughs triggered an initial media frenzy, capturing the imagination of both the scientific community and the public at large. Yet, the fervor surrounding body-coupled communications soon waned due to what were then perceived as insurmountable technological limitations. It's worth noting that Zimmerman's thesis included a claim, albeit erroneous, stating that the technology had a fundamental limitation of 852 Kb/s [1]. Concurrently, there were nascent explorations into body-powered devices, exploring the potential of human-generated energy for various applications.

Fast-forward to 2004, and the landscape of body-coupled communications experienced a seismic shift with the introduction of RedTacton by Robin Gaur Jind and their colleagues. This new iteration of the technology adopted an electro-optical implementation, pushing the boundaries by achieving impressive speeds of up to 10 Mb/s. Meanwhile, NTT (Nippon Telegraph and Telephone) seized the opportunity to leverage the human body as a conduit for transmitting video, showcasing the versatility and adaptability of this innovative technology. In the middle of 2004, the Skin plex technology emerged as a relatively simple and energy-efficient implementation of body-coupled communications [1]. While it boasted limited speeds and primarily served the purpose of user identification, it marked a significant step forward in the evolution of this field.

In the same year, M. Shingawa and their collaborators presented an intriguing development in the form of a near-field-sensing transceiver designed for intra-body communication, where the human body served as the transmission medium [1]. The crux of this transceiver lay in an electric-field sensor crafted from an electro-optic crystal and laser light. This unique sensor, distinguished by its exceptionally high input impedance, was ideally suited for detecting small and erratic electric fields generated by the human body. Astonishingly, this transceiver facilitated IEEE 802.3 half-duplex communication at a blazing speed of 10 Mb/s, bridging the gap between hands with an operating range spanning approximately 150 cm (about 4.92 feet) [1]. The packet error rate remained impressively low at just 0.04% for packet sizes of 1070 octets, underscoring the reliability of this technology.

The quest to understand the intricacies of body-coupled communications continued to evolve. In 2008, T.C.W. Schenk and their research team embarked on an in-depth exploration, scrutinizing factors such as electrode design, electrode placement, and the influence of body motion on propagation loss [1].

DOI: 10.17148/IJARCCE.2024.13129

Their investigations also encompassed the characterization of interference experienced within these communication channels. The findings were enlightening, revealing that the maximum propagation loss within the entire-body channel was less than 80 dB. Remarkably, these parameters exhibited marked advantages over radio frequency (RF) Wireless Body Area Network (WBAN) channels, particularly in terms of frequency dispersion and the impact of body movement on channel attenuation [1].

Furthermore, in 2016, H. Ando and their associates delved into the potential of extensive and simultaneous recordings of neural activity [1]. Their research elucidated how such recordings, conducted over extended durations and within biosafe environments, could yield invaluable insights. This approach enabled the acquisition of crucial information that could be harnessed for various applications, particularly in the realm of neuroscience and neuro technology, opening new frontiers in our understanding of neural processes.

In summary, the journey of body-coupled communications, from its serendipitous beginnings to its transformative potential, has been marked by a series of remarkable discoveries, pioneering implementations, and a commitment to overcoming technical challenges. As this field continues to advance, it holds the promise of reshaping the way we communicate and interact with technology, offering boundless possibilities for the future.

III. SYSTEM ARCHITECTURE

From the above discussion the proposed block diagram for biotelemetry using human area networking is shown in figure 1. The setup has two sections namely, Transmitter and Receiver. The proposed system uses the human body as a transmission medium for data communication. Here, the biomedical data of a patient will be transmitted from the transmitter to the receiver section through human body. In this system, we are using only one sensor which is attached to the human body along with RedTacton transmitter and the data at the receiver section can be collected using the RedTacton receiver.

The abbreviation of "IoT" is "Internet of Things," it is a network of interrelated devices that connect and exchange data with other IoT devices and the cloud. The "Internet of Things" (IoT) describes the network of physical objects, or "things" that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet. Over the past few years, the IoT has become one of the most important technologies of the 21st century. Now that we can connect everyday objects like home appliances, cars, etc. to the internet via embedded devices, seamless communication is possible between people, processes, and things. In this hyperconnected world, digital systems can record, monitor, and adjust each interaction between connected things. By means of low-cost computing, the cloud, big data, analytics, and mobile technologies, physical things can share and collect data with minimal human intervention. In this way, the physical world meets the digital world, and they cooperate.

Here, the sensor module in the transmitter section consists of MAX 30102 (Heart rate Sensor), NodeMCU 8266 WiFi Module, OLED Display (0.96 i2C), 5-volt DC Power Supply. It is attached to the RedTacton transmitter. The receiver section has RedTacton receiver and a monitor to display the data for biotelemetry function. A common ground must be connected between the transmitter and receiver [1].

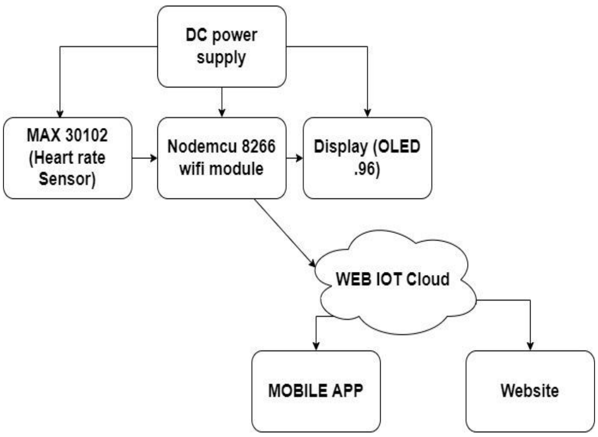

Figure 1: Proposed Model [1]

ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⁜ Peer-reviewed & Refereed journal ⁜ Vol. 13, Issue 1, January 2024

DOI: 10.17148/IJARCCE.2024.13129

IV. WORKING PRINCIPLE OF REDTACTON

RedTacton operates straightforwardly. RedTacton Technology will have a transmitter and a receiver like previous technologies. The transmission starts when physical contact is formed between the transmitter and the body, and it lasts until contact is made [1]. In this instance, we are using an NodeMCU 8266 WiFi Module coupled to a MAX 30102 heart rate sensor. We linked a display to the NodeMCU 8266 WiFi Module as well. So, the working principle is that when a person touches the sensor, the sensor detects the heartbeat and displays the heartrate value on the 0.96 i2C OLED display, as well as the same value in our mobile app and the web dashboard at the same time. With this technique, we can get the other value as well. Such as by adding the glucose-detecting sensor, we can get the glucose level of a person. Other than the actual signal-carrying electric field, there will be other electric signals that are small and have no role in the communication. This can be compared to noise in communication, and this is automatically sent to ground at the receiver end [1]. There is a feature in it for getting heart rate-related notifications on the smartphone of the users. When a finger is placed on the sensor, it will collect the highest heartbeat rate data and send the related notification to the user's phone as soon as the finger is removed from the sensor.

V. RESULTS AND DISCUSSION

Figure 2 shows how the suggested biotelemetry system performed in practice. Real-time data will be gathered and shown at the receiver section using a RedTacton transmitter and receiver with the human body serving as the transmission medium [1]. We are only showing a man's pulse here. The input pins on the sensor module, which includes a heart rate sensor, will be used to provide data to the module [4]. Using the display, the output will be displayed.

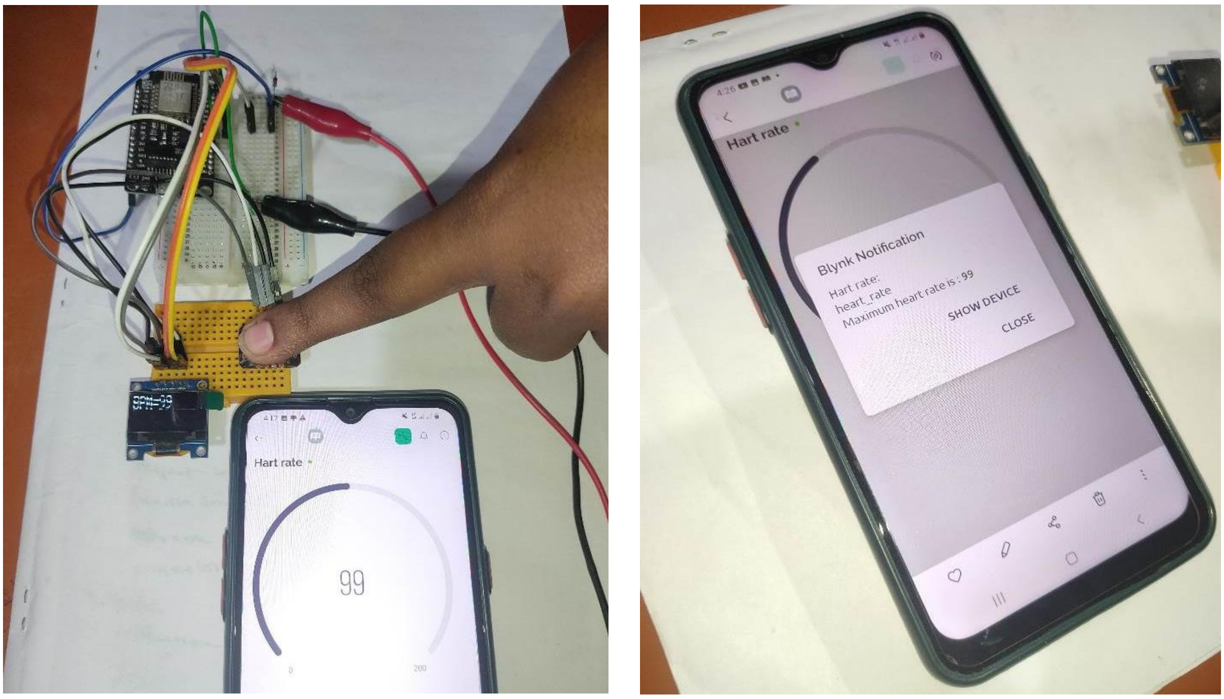

Figure 2: Resultant values of Biotelemetry System [1]

After activating some physical effort, the sensor picks up the pulse's variation. We can see that the pulse rate is 99 lead up to action, which is good. The pulse, however, changes after engaging in physical activity, as shown in the image.

IJARCCE ISSN (O) 2278-1021, ISSN (P) 2319-5940

International Journal of Advanced Research in Computer and Communication Engineering

Impact Factor 8.102 ⵂ Peer-reviewed & Refereed journal ⵂ Vol. 13, Issue 1, January 2024

DOI: 10.17148/IJARCCE.2024.13129

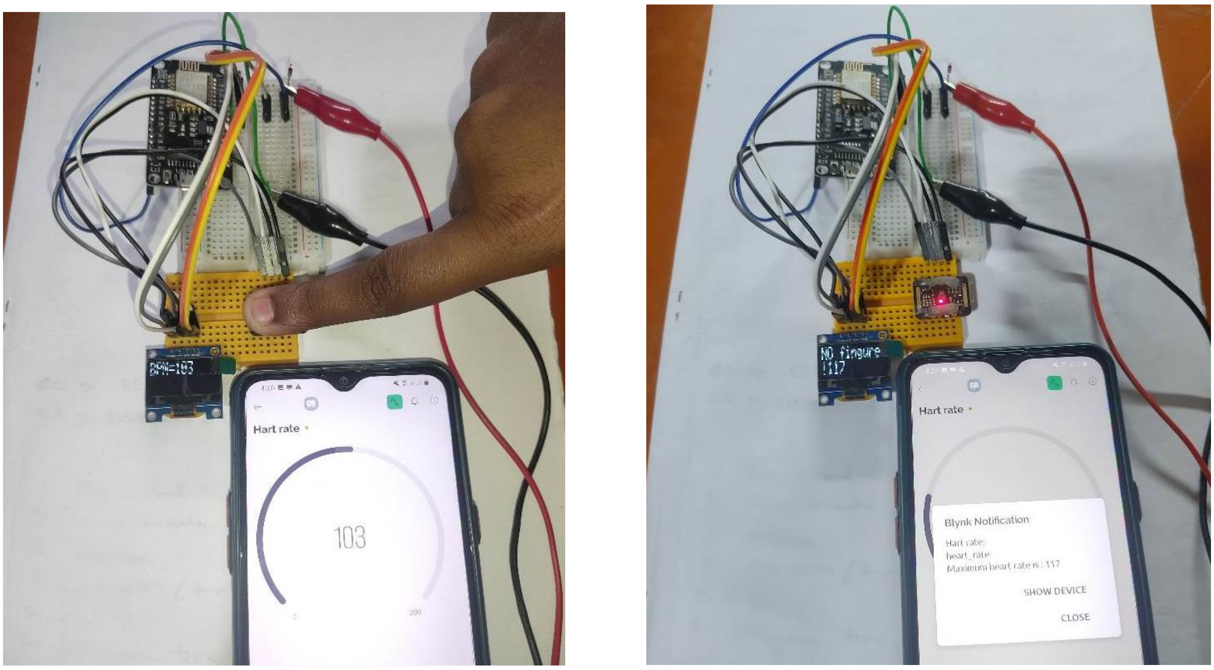

Figure 3: Resultant values of Biotelemetry System [1]

Other sensors can be added in comparable manner. Only one sensor was employed in the study. We understand that this concept will work well even with just one sensor. This concept is also applicable in desperate situations. When we are short on time to monetize.

VI. RESULT DATA

Table 1: Trial Data.

Trail No.	After certain time workout	Heart Rate
I.	00 Min	99 bpm
II.	02 Min	103 bpm
III.	08 Min	105 bpm
IV.	10 Min	109 bpm
V.	12 Min	117 bpm

VII. FUTURE DEVELOPMENT

As a human area networking technology, the RedTacton includes a wide range of novel functional features that are exceptional and have enormous potential [7]. Future development of this technology could result in a portable gadget that is applicable everywhere. Again, a wireless body area network can be used for biotelemetry. Data transmission may take place through the user's attire, backpack, or shoes. Once more, anyone with a special card can unlock the door by simply touching the knob or by standing in a particular location without pulling the card out. I believe that numerous advantages, including a walk-through ticket gate, a cabinet that only authorized individuals can use, and a television control that automatically chooses preferred shows, will become commonplace in the future. Additionally, the response produces security [1].

It makes sure that only drivers, and not bystanders, can access their cars by touching the doors when the keys are in their pockets [1]. Instead of using open-source hardware, it is possible to significantly reduce costs by using ASICs (Application Specific Integrated Circuits).

International Journal of Advanced Research in Computer and Communication Engineering
Impact Factor 8.102 ⁑ Peer-reviewed & Refereed journal ⁑ Vol. 13, Issue 1, January 2024
DOI: 10.17148/IJARCCE.2024.13129

A. Advantages

- Data transfer is faster and easier [1].
- Data transmission speed is more than the others Technologies [1].
- There is no data loss.
- Greater Security than others.

B. Disadvantages

- It can be hampered when multiple persons are touching each other [1].
- The Cost is little bit more but it can be minimized in future [1].

VIII. CONCLUSION

When compared to other technologies, we can say that this technology is superior. In the earlier study, we discovered that the data transfer rate, which is 10 Mbps over the shortest distance, is particularly good [5]. Although we can see that many sensors were used in the previous study, we did not feel that it was necessary. We think that just one or two sensors will be sufficient. In this paper, we put forth that idea. That is NodeMCU 8266 WiFi Module. In comparison to the previous one, it is also very affordable. This technology enables a new generation of user interfaces based on organic human action systems in the environment for the first wave of human area networking between body-centric electronic devices and PCs or other network devices [1,9]. Such as stepping, walking, holding, sitting, or touching a specific location. It might become a Bluetooth technology in the future. Cable usage may be eliminated thanks to this technology. We can predict that people will only trust this technology in the future.

REFERENCES

[1]. M. U. S. Khan et al., "On the Correlation of Sensor Location and Human Activity Recognition in Body Area Networks (BANs)," in IEEE Systems Journal, vol. 12, no. 1, pp. 82-91, March 2018, doi: 10.1109/JSYST.2016.2610188. C

[2]. T. Rashid, M. Riaz and M. Y. Wani, "Safety of human in body area network: A review," 2017 International Symposium on Wireless Systems and Networks (ISWSN), 2017, pp. 1-5, doi: 10.1109/ISWSN.2017.8250034.

[3]. X. -Q. Zhu, Y. -X. Guo and W. Wu, "Investigation and Modeling of Capacitive Human Body Communication," in IEEE Transactions on Biomedical Circuits and Systems, vol. 11, no. 2, pp. 474-482, April 2017, doi: 10.1109/TBCAS.2016.2634121.

[4]. H. Ando, K. Takizawa, T. Yoshida, K. Matsushita, M. Hirata and T. Suzuki, "Wireless Multichannel Neural Recording With a 128- Mbps UWB Transmitter for an Implantable Brain-Machine Interfaces," in IEEE Transactions on Biomedical Circuits and Systems, vol. 10, no. 6, pp. 1068-1078, Dec. 2016, doi: 10.1109/TBCAS.2016.2514522.

[5]. J. Bae, H. Cho, K. Song, H. Lee and H. -J. Yoo, "The Signal Transmission Mechanism on the Surface of Human Body for Body Channel Communication," in IEEE Transactions on Microwave Theory and Techniques, vol. 60, no. 3, pp. 582-593, March 2012, doi: 10.1109/TMTT.2011.2178857.

[6]. T. C. W. Schenk, N. S. Mazloum, L. Tan and P. Rutten, "Experimental characterization of the body-coupled communications channel," 2008 IEEE International Symposium on Wireless Communication Systems, 2008, pp. 234-239, doi: 10.1109/ISWCS.2008.4726053.

[7]. M. Shinagawa, M. Fukumoto, K. Ochiai and H. Kyuragi, "A near-field-sensing transceiver for intrabody communication based on the electrooptic effect," in IEEE Transactions on Instrumentation and Measurement, vol. 53, no. 6, pp. 1533-1538, Dec. 2004, doi: 10.1109/TIM.2004.834064.

[8]. T. G. Zimmerman, "Personal Area Networks: Near-field intrabody communication," in IBM Systems Journal, vol. 35, no. 3.4, pp.
609-617, 1996, doi: 10.1147/sj.353.0609.

[9]. N. Matsushita, S. Tajima, Y. Ayatsuka and J. Rekimoto, "Wearable key: device for personalizing nearby environment," Digest of Papers. Fourth International Symposium on Wearable Computers, 2000, pp. 119-126, doi: 10.1109/ISWC.2000.888473.