Indonesian Journal of Electronics, Electromedical Engineering, and Medical Informatics
Multidisciplinary : Rapid Review : Open Access Journal Vol. 5, No. 1, February 2023, pp.60-65 e-ISSN: 2656-8624

RESEARCH ARTICLE OPEN ACCESS

Manuscript received Desember 31, 2022; revised Januari 21, 2023; accepted Februari 02, 2022; date of publication Februari 25, 2023
Digital Object Identifier (**DOI**): https://doi.org/10.35882/ijeeemi.v5i1.262

How to cite: Sentagi Sesotya Utami, Winny Setyonugroho, Iman Permana, Tri Lestari, Muhammad Dian Saputra Taher, Gilang Ari Widodo Utomo, Akhmad Khanif, "Data Communication Stability Test a Data Acquisition System (DAQ) for Inpatient Rooms", Indonesian Journal of Electronics, Electromedical Engineering, and Medical Informatics, vol. 5, no. 1, pp. 60–65, February. 2023.

Data Communication Stability Test a Data Acquisition System (DAQ) for Inpatient Rooms

Sentagi Sesotya Utami[1], Winny Setyonugroho[2], Iman Permana[3], Tri Lestari[4], Muhammad Dian Saputra Taher[5], Gilang Ari Widodo Utomo[6], Akhmad Khanif[5]

[1] Department of Nuclear and Physics Engineering, Faculty of Engineering, Universitas Gadjah Mada, Indonesia
[2] Department Hospital Administration, School of Postgraduate, Universitas Muhammadiyah Yogyakarta, Indonesia
[3] Department of Nursing, School of Postgraduate, Universitas Muhammadiyah Yogyakarta, Indonesia
[4] Department of Information Technology, Politeknik Negeri Padang, Indonesia
[5] Department of Anthropology, Faculty of Cultural Sciences, Universitas Gadjah Mada, Indonesia
[6] Department of Electrical Engineering, Faculty of Engineering, Universitas Muhammadiyah Yogyakarta, Indonesia

Corresponding author: Tri Lestari (e-mail: trilestari@pnp.ac.id).

ABSTRACT In inpatient services, the patient's bed is usually limited by a curtain or partition to maintain patient safety. At the time of data collection, obstacles or obstacles were considered as a result of effectiveness and validation of medical device sensor data. This study aims to explain the results of testing the reliability of Bluetooth and internet on CovWatch hardware and applications. This research is an action research; used comparisons using devices (tools) with different specifications. Testing internet and Bluetooth connectivity from the CovWatch unit and applications installed on the Samsung A01, Redmi Note 10 and Oppo A57 devices, the results were mixed. Measurement of the range of connectivity is carried out using a barrier (Selected Semi PVC, Multiplex, Kalsiboard) and without a barrier. The results of this experiment show that the CovWatch Hardware and Samsung A01 are considered the best at obtaining vital sign data, while the Redmi Note 10 and OPPO A57 are not good because some data cannot be obtained so they do not appear on the monitor unit. This test identifies obstructions and optimal distances that can be used to provide data quickly, adopting innovative, flexible and integrated care delivery models to ensure optimal continuity and access.

INDEX TERMS DAQ, CovWatch, Connectivity, Inpatient Rooms, smartphone

I. INTRODUCTION

Hospitals are institutions that provide individual health services that provide inpatient services, outpatient care, and emergency department. Safe and quality health services in hospitals have become the main hopes and objectives of the community/patients, health workers, hospital managers, owners, and regulators [1]. The safety and quality of healthcare services in hospitals are of paramount importance for patients, healthcare workers, hospital managers, owners, and regulators. Patients and their families expect to receive safe and effective care in hospitals. Healthcare workers require a safe working environment that enables them to provide high-quality care. Hospital managers and owners aim to provide safe and effective healthcare services to patients while ensuring the efficient use of resources. Regulators oversee hospitals to ensure they comply with safety and quality standards and provide safe and effective healthcare services to the public[2]. One of the many services provided at the hospital is inpatient. In inpatient services, patient beds are usually limited by curtains or partitions to maintain the patient's safety (privacy). The curtain sticks sturdy using a unique rail of curtains on the ceiling with the aim of patient safety and safety. At the time of data collection, the barrier or barrier is considered to the effectiveness of the results and validation of medical device sensor data.

Progress in health services will increase the use of tools in healthcare facilities. Medical devices are essential to provide health care in improving individual health and population[3]. Understanding the needs of patients, symptoms, and finally, diagnosis is highly dependent on communication skills and interactions between health workers and patients. This is also related to the ability to control medical devices[4]. The demands of efficiency and practicality in electronics are essential, especially in controlling medical devices with digital and wireless data collection. To provide protection and guarantee the truth of the feasibility of medical devices, it is necessary to test tools. This is done for the availability of quality tools and guaranteed accuracy of their use, especially after creating various transmitter and receiver frequencies when the doctor's initial prognosis needs are related to the patient's identification and diagnosis.

The selection of appropriate wireless connectivity technology is a crucial design decision. This determines the interoperability of the protocol, distance, durability, and cases of use for the system developed. Some of the Wireless Connectivity Technologies that are growing now are Wireless M -us, Wi-Sun, Mioty, Amazon Sidewalk, Proprietary, WiFi, Thread, Zigbee, and Bluetooth[5]. Bluetooth Low Energy (BLE, Bluetooth 4, Bluetooth Smart) is a new technology created by the Bluetooth Special Interest Group (SIG). It aims to be the best alternative to the many standard wireless technologies already on the market, such as IEEE 802.11b (Wi-Fi), ZigBee, ANT+, and Bluetooth Classic (Bluetooth 3.0, Basic Rate/Enhanced Data Rate)[6]. BLE is a good choice for a wide range of applications because it works well and is widely available (it is in all PCs, tablets, and smartphones today). It is used in the medical field for e-health applications [7]–[9], for example, in a body area network [10](using ECG [11], [12], a heart rate sensor [13], [14], EEG [15] a blood flowmeter [16], and EMG for prosthetic hand control [17]. Moreover, BLE has been utilized in Internet of Things (IoT) technologies [18], such as the transmission of Internet Protocol Version 6 (IPv6) packets across Low Power Wireless Personal Area Networks [19], [20] (6LowPAN) in the context of a health monitoring application [21].

It is essential to test devices for Bluetooth connectivity to ensure that devices can communicate without interference or noise [22]. This wireless technology can provide numerous benefits, including the mobility of medical devices and granting physical and nursing uninterrupted access to patients. Health Records, Current Medical Condition, and Decluttering an Otherwise Cluttered Hospital[23].

CovWatch clock devices are devices created and used to retrieve data on vital signs (TTV) of patients in the form of heart rate, blood pressure, oxygen saturation, temperature, HRV, stress level, and sleeping pattern. The TTV data was then acquired by CovWatch hardware and CovWatch applications installed on a smartphone; the acquisition process aims to continue TTV data to the cloud so that it can be read on the dashboard online. Between clock devices and hardware or smartphones requires a liaison in the form of the internet and Bluetooth so that data can be integrated and read in real-time. The internet and Bluetooth are critical determinants of reading TTV data in the dashboard for monitoring purposes. Thus, it is necessary to validate the range to find the best connection distance between CovWatch Clock devices and hardware and applications in terms of Bluetooth and the Internet.

This study aims to explain the results of the reliability testing of Bluetooth and the internet on hardware and CovWatch applications. Reliability is needed to consider the distance between CovWatch Clock devices and data acquisition (DAQ), which nurses can use as a reference in taking vital sign data. Considering the distance between the nurses who take data, it can be known that the contribution of this research is:

a. The contribution of this research is as part of the operational standard in the use of devices that use Bluetooth connectivity in inpatient wards, especially hospitals in Indonesia.
b. Most inpatient wards use partitions and barriers which cause Bluetooth connectivity to be less than optimal. This paper’s results can be seen in the range of Bluetooth connectivity with rooms that use partitions and barriers (multiplex, kalsiboard, and semi PVC Certain).
c. provide comfort in use, both in terms of patients and nurses.

II. MATERIALS AND METHOD

This study is action research, where researchers take practice actions to ‘test the tools by doing different treatments to find the results of each condition. On the other hand, the comparison is also used using devices (tools) with different specifications. Action Research aims to see the effectiveness of internet connections and Bluetooth from each of the other actions and devices so that the action can produce repair of tools that meet the needs of the virtual environment.

Several tools are used to test the reliability of the internet and Bluetooth, the testing of 2 types of testing for Hardware CovWatch (Data Acquisition System (DAQ) and 1 type of testing for CovWatch applications. The tools for CovWatch applications are Android mobile phones using Samsung A01, Redmi Note 10, and OPPO A57 devices.

The data collection process is conducted at a distance of 0 to 10 meters, which is adapted to the ward setting in the hospital, with a maximum distance of 10 meters in each room. Without impediments, semi-PVC curtain barriers, multiplex board barriers, and kalsiboard boards were all tested. Each type of test is conducted twice, with data collection beginning at 0 meters and proceeding to 10 meters (away from the data capture device) before returning to 0 meters (closer to the DAQ).

Data collection was carried out for 14 days, from 6 - 13 June 2022; monitoring was carried out online on the CovWatch dashboard, while the test was carried out directly in the room that had been set as needed. Reliability testing uses a CovWatch unit consisting of sensor and DAQ devices and the CovWatch application installed on the Samsung A01, Redmi Note 10, and OPPO A57 devices. The CovWatch unit is a vital sign data-taking device that can be monitored on the website dashboard page when the indicator lights are connected to the DAQ box. Testing carried out within 5 hours in a state may be cut off with a minimum break-up time for data collection of 60 minutes. Working with a period of 5 hours based on the dialysis process in the hemodialysis unit, within 5 hours, the time is seen breaking up or unique findings. The time of breaking up can be seen from the change in the color of the DAQ indicator lights from the blue one means connected to red which means it is cut off. This test is carried out in an ideal condition; the perfect state of the device sensor is used on the left wrist, and the distance between the device sensor and the DAQ max is 1 meter.

Testing Bluetooth connectivity and hardware Internet and CovWatch Applications using Samsung A01, Redmi Note 10, and OPPO A57 devices are carried out with several connecting parameters, namely without obstacles, curtain obstacles made from semi-PVC, multiplex board obstacles, and kalsi board obstacles. The connecting parameters are tested using the connectivity distance point consisting of connected and not connected. The connectivity distance is measured from the closest distance to the farthest reach of 0 - 10 m and the farthest distance point to the most relative distance of 10 - 0 m.

III. RESULTS

The results show that there are 5 themes, namely; Hardware Reliability Test Based on Time (5 Hours Under Ideal Conditions) which explains hardware tests in real time under ideal conditions without hindrance; Hardware Bluetooth and Wi-Fi Connectivity Testing (Range 0-10 m) which explains that hardware connectivity is being tested with various obstacles and different distance ranges; Testing Bluetooth and Wi-Fi Connectivity (Range 0-10 m) Samsung A01 describes a hardware comparison test with the Samsung A01 device; Testing Bluetooth and Wi-Fi Connectivity (Range 0-10 m) Redmi Note 10 describes a hardware comparison test with the Redmi Note 10 device; Testing Bluetooth and Wi-Fi Connectivity (Range 0-10 m) OPPO A57 describes a hardware comparison test with the OPPO A57 device.

A. HARDWARE RELIABILITY TEST BASED ON TIME (5 HOURS UNDER IDEAL CONDITIONS)

A CovWatch unit with a sensor device and a DAQ was used for reliability testing. The test is run in disconnected mode for 5 hours with a minimum of 60 minutes for data recovery. The best circumstances for this test are for the sensor device to be worn on the left wrist and no more than one meter between the sensor device and the DAQ. The trial demonstrates that there are no issues at this time. The active sensor device is safe during testing and transmits the patient's vital sign information to the dashboard.

B. HARDWARE BLUETOOTH AND WI-FI CONNECTIVITY TESTING (RANGE 0-10 M)

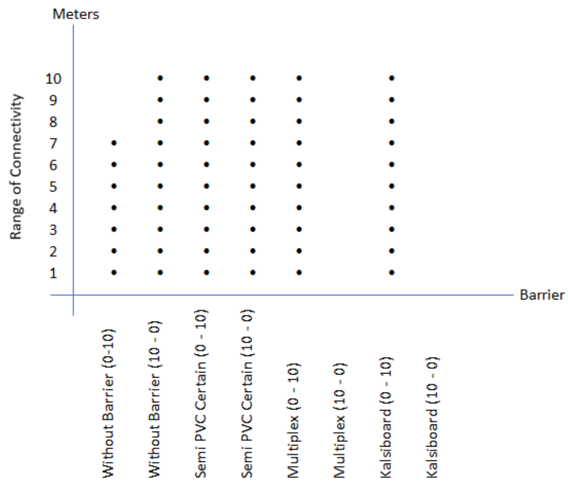

FIGURE 1. Range of Connectivity using Hardware Bluetooth

According to the findings of testing Bluetooth and Internet Hardware CovWatch connectivity under no-obstacle conditions, the connectivity distance points were connected at a distance of 0–7 meters and were not connected at a distance of 10–8 meters. The tested connectivity distance points are then connected at a distance of 0–10 meters and 1–0 meters on the connecting parameters using semi–PVC curtain barriers. The multiplex board and kalsiboard with a length of 0–10 meters were connected while on the obstacle parameters, but the connectivity distance points at a distance of 1–0 meters were still not connected (FIGURE 1).

C. TESTING BLUETOOTH AND WI-FI CONNECTIVITY (RANGE 0-10 M) SAMSUNG A01

The Samsung A01 was used for the CovWatch application's Bluetooth and Internet connectivity test (FIGURE 2). The results show that when the connecting parameter is set to be without obstruction (0–10 meters), the connectivity point is connected at a distance of 0–1 m and is not connected at a distance of 2–10 m. Connectivity points are connected at distances of 9–6 meters, 4 meters, and 0 meters in the connecting parameter without obstruction at a distance of 10.0 meters. Still, they are not connected at distances of 10 meters, 5 meters, and 3 meters. The tested connectivity distance points are connected at a distance of 0-7 meters and are not connected at a distance of 8-10 meters in the connecting parameters with semi-PVC curtain barriers (0-10 meters). The connectivity points are connected at a distance of 9-6 meters on the semi-PVC curtain barrier (10-0 meters) parameter and are not connected at a distance of 10 meters and 5 meters.

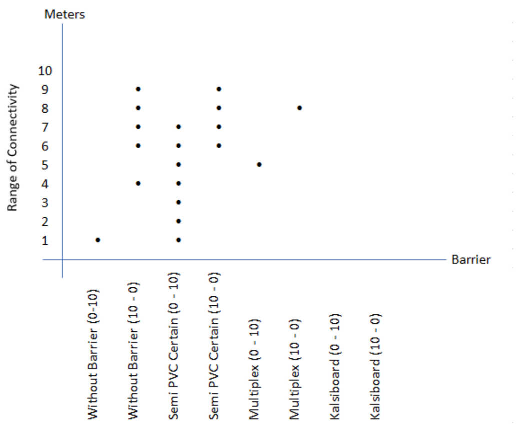

FIGURE 2. Range of Connectivity using Samsung A01 with Barrier (Semi PVC Certain, Multiplex and Kalsiboard) and Without Barrier

D. TESTING BLUETOOTH AND WI-FI CONNECTIVITY (RANGE 0-10 M) REDMI NOTE 10

The results of testing bluetooth connectivity and the CovWatch Internet application using the Redmi Note 10, namely with the connecting parameters without obstacles (0-10 meters), the connectivity points are connected at a distance of 8 m, 10 m, and not connected at a distance of 0 – 7 m, 9 m (FIGURE 3). In the parameter of unobstructed connecting at a distance of 10-0 meters, connectivity points are connected at a distance of 10 m, and 7 m and are not connected at a distance of 9-8 m and 6-0 m. In the connecting parameters with semi-PVC curtain barriers (0-10 meters), the connectivity distance points tested are not connected at a distance of 0-10 meters. Then on the semi-PVC curtain barrier (10-0 meters) parameter, the connectivity point is not connected at a distance of 10-0 m.

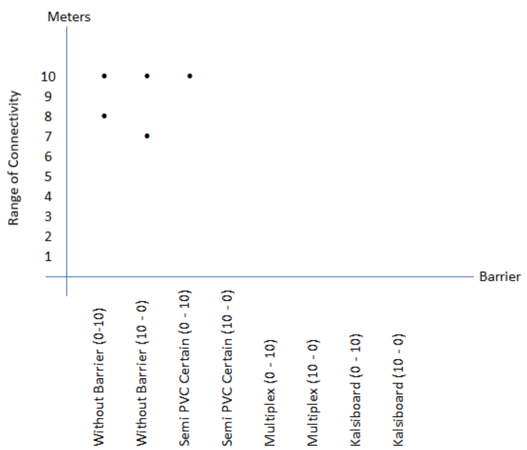

FIGURE 3. Range of Connectivity using Redmi Note 10

E. TESTING BLUETOOTH AND WI-FI CONNECTIVITY (RANGE 0-10 M) OPPO A57

The results of testing bluetooth connectivity and the CovWatch Internet application using the OPPO A57 Device, namely with the connecting parameters without obstacles (0-10 meters), the connectivity points are connected at a distance of 0-10 m (FIGURE 4). In the parameter of unobstructed connecting at a distance of 10-0 meters, connectivity points are connected at a distance of 10-0 m. In the connecting parameters with semi-PVC curtain barriers (0-10 meters), the connectivity distance points tested are connected at a distance of 0-10 meters. Then on the semi-PVC curtain barrier (10-0 meters) parameter, the connectivity point is connected at a distance of 10-0 m.

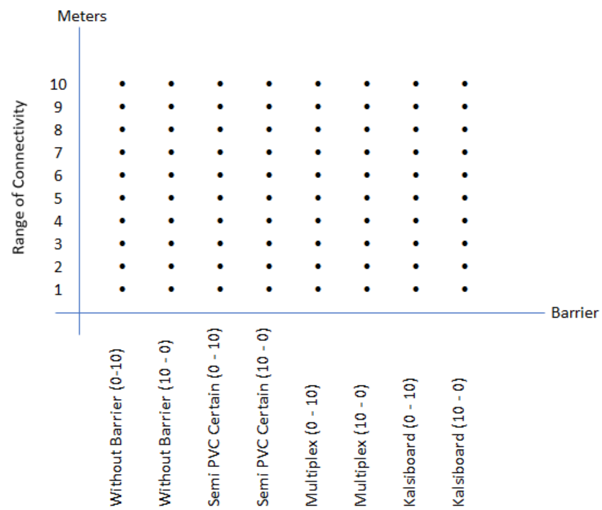

FIGURE 4. Range of Connectivity using OPPO A57

IV. DISCUSSION

This test identifies obstructions and optimal distances that can be used to provide data quickly, adopting innovative, flexible and integrated care delivery models to ensure optimal continuity and access. The practice used as a parameter in the wifi and Bluetooth reliability test considers the existence of obstacles that have different levels at different distances, such as semi-PVC curtains, multiplex boards, and kalsiboard boards. The use of Bluetooth in smartphones and Covwatch Hardware, namely in the form of a Data Acquisition System (DAQ), categorizes the level of optimization of the connected distance on the monitor. A similar discussion was conveyed in the writings of Indrayana, A.S. et al.[24]; sending data via Bluetooth Low Energy (BLE) is affected by distance. Namely, the worst delay is in the range of 10 meters with a value of 5 seconds. This is in line with the tool test results with different treatments using the Samsung A01, Redmi Note 10, and OPPO A57 Devices. In the vulnerable zone, 0-7 meters is a safe category for data acquisition. Wireless technology in medical applications will improve the quality of patient care and the efficiency of hospital administration. Some patient health monitoring activities require wireless sensors to periodically check the Body Area Network (BAN) (Masa, 2019). Using a smartphone to acquire data is considered adequate for implementing monitoring. The same was conveyed in the previous study by Matenge, S. et al. [25], which underlined 'Telehealth integration is critical to ensure care continuity. Range validation of this system is displayed in FIGURE 5.

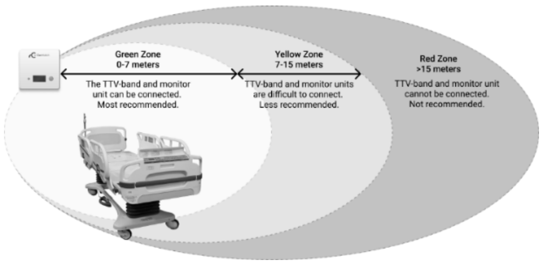

FIGURE 5. Range Validation divide Three zone (Green Zone 0-7 meters, Yellow Zone 7-15 meter, Red Zone >15 meters)

This research has a limitation in that the trial was conducted in a room that was designed to resemble an inpatient ward, but it was not tested on an actual inpatient ward, so actual implementation may yield different results. Because the wards of each hospital and each type of class are unique and cannot be generalised, this is the case. The implication of this study is that the signal frequency used in monitoring device technology can be affected by a variety of factors that have implications for the connectivity of collected patient data. This research contributes to the operational standard for the use of Bluetooth-connected devices in inpatient wards, particularly in Indonesian hospitals.

V. CONCLUSION

In implementing the CovWatch unit, the best and worst points for internet and Bluetooth connectivity were found, which were then divided into three zones based on distance ranges.

The green zone (0-7 meters) is the most recommended distance, where the vital sign band and monitor unit can be connected, provided there are no obstructions (in this test, these were semi-PVC curtains, multiplex board obstructions, and clipboard obstructions). The yellow zone (7-15 meters) is a distance that is not recommended because vital sign bands and monitor units are difficult to connect; based on the tests carried out, some data cannot be acquired. The red zone (>15 meters) is a distance that is not recommended because the vital sign band and the monitor unit cannot be connected, and all data retrieved through the vital sign band cannot be acquired. Thus, in implementing CovWatch units in clinics and other health facilities, patient movements must be considered, including the distance the patient goes and obstacles hindering vital sign band monitoring with the CovWatch device.

ACKNOWLEDGMENT

This work was partly supported by the Higher Education Applied Research Scheme (PTUPT), Ministry of Education, Culture, Research, and Technology Republic of Indonesia.

REFERENCES

[1] Menteri Kesehatan Republik Indonesia, "Peraturan Menteri Kesehatan Republik Indonesia Nomor 30 Tahun 2022 Tentang Indikator Nasional Mutu Pelayanan Kesehatan Tempat Praktik Mandiri Dokter Dan Dokter Gigi, Klinik, Pusat Kesehatan Masyarakat, Rumah Sakit, Laboratorium Kesehatan, Dan Unit Transfusi Darah," 2022.

[2] B. M. Jennings, "Chapter 24. Restructuring and Mergers," vol. 2.

[3] World Health Organization, "Medical devices: managing the mismatch: an outcome of the priority medical devices project," *Dispositivos médicos: la gestión de la discordancia: un resultado del proyecto sobre dispositivos médicos prioritarios*, 2010, Accessed: Feb. 16, 2023. [Online]. Available: https://apps.who.int/iris/handle/10665/44407

[4] W. Mohsen *et al.*, "Hepatitis C treatment for difficult to access populations: can telementoring (as distinct from telemedicine) help?," *Intern. Med. J.*, vol. 49, no. 3, pp. 351–357, 2019, doi: 10.1111/imj.14072.

[5] Texas Instruments, "Wireless Connectivity Technology Selection Guide."

[6] J. Tosi, F. Taffoni, M. Santacatterina, R. Sannino, and D. Formica, "Performance Evaluation of Bluetooth Low Energy: A Systematic Review," *Sensors*, vol. 17, no. 12, p. 2898, Dec. 2017, doi: 10.3390/s17122898.

[7] A. H. Omre and S. Keeping, "Bluetooth Low Energy: Wireless Connectivity for Medical Monitoring," *Journal of Diabetes Science and Technology*, vol. 4, no. 2, pp. 457–463, Mar. 2010, doi: 10.1177/193229681000400227.

[8] A. R. Fekr, K. Radecka, and Z. Zilic, "Design and Evaluation of an Intelligent Remote Tidal Volume Variability Monitoring System in E-Health Applications," *IEEE J. Biomed. Health Inform.*, vol. 19, no. 5, pp. 1532–1548, Sep. 2015, doi: 10.1109/JBHI.2015.2445783.

[9] X. Fafoutis *et al.*, "DesigningWearable Sensing Platforms for Healthcare in a Residential Environment," *EAI Endorsed Transactions on Pervasive Health and Technology*, vol. 3, no. 12, p. 153063, Sep. 2017, doi: 10.4108/eai.7-9-2017.153063.

[10] "2010 Index IEEE Transactions on Biomedical Circuits and Systems Vol. 4," *IEEE Trans. Biomed. Circuits Syst.*, vol. 4, no. 6, pp. 477–487, Dec. 2010, doi: 10.1109/TBCAS.2010.2096330.

[11] V. P. Rachim and W.-Y. Chung, "Wearable Noncontact Armband for Mobile ECG Monitoring System," *IEEE Trans. Biomed. Circuits Syst.*, vol. 10, no. 6, pp. 1112–1118, Dec. 2016, doi: 10.1109/TBCAS.2016.2519523.

[12] Young-jin Park and Hui-sup Cho, "Transmission of ECG data with the patch-type ECG sensor system using Bluetooth Low Energy," in *2013 International Conference on ICT Convergence (ICTC)*, JEJU ISLAND, Korea (South), Oct. 2013, pp. 289–294. doi: 10.1109/ICTC.2013.6675359.

[13] A. M. Chan, N. Selvaraj, N. Ferdosi, and R. Narasimhan, "Wireless patch sensor for remote monitoring of heart rate, respiration, activity, and falls.," *Annu Int Conf IEEE Eng Med Biol Soc*, vol. 2013, pp. 6115–6118, 2013, doi: 10.1109/EMBC.2013.6610948.

[14] L. Guo-cheng and Y. Hong-yang, "Design and implementation of a Bluetooth 4.0-based heart rate monitor system on iOS platform," in *2013 International Conference on Communications, Circuits and Systems (ICCCAS)*, Chengdu, China, Nov. 2013, pp. 112–115. doi: 10.1109/ICCCAS.2013.6765297.

[15] U. Ghoshdastider, R. Viga, and M. Kraft, "Wireless time synchronization of a collaborative brain-computer-interface using bluetooth low energy," in *IEEE SENSORS 2014 Proceedings*, Valencia, Spain, Nov. 2014, pp. 2250–2254. doi: 10.1109/ICSENS.2014.6985489.

[16] K. Kuwabara, Y. Higuchi, T. Ogasawara, H. Koizumi, and T. Haga, "Wearable blood flowmeter appcessory with low-power laser Doppler

signal processing for daily-life healthcare monitoring," in *2014 36th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Chicago, IL, Aug. 2014, pp. 6274–6277. doi: 10.1109/EMBC.2014.6945063.
[17] D. Brunelli, E. Farella, D. Giovanelli, B. Milosevic, and I. Minakov, "Design Considerations for Wireless Acquisition of Multichannel sEMG Signals in Prosthetic Hand Control," *IEEE Sensors J.*, pp. 1–1, 2016, doi: 10.1109/JSEN.2016.2596712.
[18] M. R. Palattella *et al.*, "Internet of Things in the 5G Era: Enablers, Architecture, and Business Models," *IEEE J. Select. Areas Commun.*, vol. 34, no. 3, pp. 510–527, Mar. 2016, doi: 10.1109/JSAC.2016.2525418.
[19] H. Wang, M. Xi, J. Liu, and C. Chen, "Transmitting IPv6 Packets over Bluetooth Low Energy based on BlueZ," 2013.
[20] S. Raza, P. Misra, Z. He, and T. Voigt, "Bluetooth smart: An enabling technology for the Internet of Things," in *2015 IEEE 11th International Conference on Wireless and Mobile Computing, Networking and Communications (WiMob)*, Abu Dhabi, United Arab Emirates, Oct. 2015, pp. 155–162. doi: 10.1109/WiMOB.2015.7347955.
[21] R. Tabish, A. Ben Mnaouer, F. Touati, and A. M. Ghaleb, "A comparative analysis of BLE and 6LoWPAN for U-HealthCare applications," in *2013 7th IEEE GCC Conference and Exhibition (GCC)*, Doha, Qatar, Nov. 2013, pp. 286–291. doi: 10.1109/IEEEGCC.2013.6705791.
[22] N. M. Shah and G. Kaltsakas, "Telemedicine in the management of patients with chronic respiratory failure," *Breathe*, vol. 17, no. 1, 2021, doi: 10.1183/20734735.0008-2021.
[23] S. Seidman, W. Kainz, P. Ruggera, and G. Mendoza, "Wireless Coexistence and EMC of Bluetooth and 802.11b Devices in Controlled Laboratory Settings," *Open Biomed Eng J*, vol. 5, no. 1, pp. 74–82, Sep. 2011, doi: 10.2174/1874120701105010074.
[24] A. S. Indrayana, R. Primananda, and K. Amron, "Rancang Bangun Sistem Komunikasi Bluetooth Low Energy (BLE) Pada Sistem Pengamatan Tekanan Darah".
[25] S. Matenge, E. Sturgiss, J. Desborough, S. Hall Dykgraaf, G. Dut, and M. Kidd, "Ensuring the continuation of routine primary care during the COVID-19 pandemic: a review of the international literature," *Family Practice*, vol. 39, no. 4, pp. 747–761, Jul. 2022, doi: 10.1093/fampra/cmab115.