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# Sixth Sense Technology: An Implanted IoT system for E-health Monitoring and Management

**Abstract:** Wearable sensors that can perform a wide range of physical and physiological measurements have recently become more widely available. These sensors have achieved tremendous advancements in recent years, illustrating their growing importance as well as their potential utility in the future, among other things. In the case of wearable electronics, a person can wear them on a regular basis and incorporate them into their clothing, which is a form of electronic device in and of itself. By measuring physiological states and processes, it is feasible to use EIT (Electrical Impedance Tomography) as an imaging method to monitor muscular activity. This paper presents an implantable EIT system that has been developed that makes use of an electrode bracelet worn on the arm. In a preliminary examination, the EIT data for various hand movements were analysed. Making "a sixth sense" was demonstrated in the production of the second design artefact, "Hearing the Hidden," which utilised re-accented research reasoning in order to design for such an aesthetic experience by "adding a sixth sense." There are many various types of wearable devices available, each with a varying amount of complexity and sophistication. An extremely useful tool for regularly analysing one's personal health and daily routine is the wearable data gathering device.

**Keywords:** Sixth Sense, Wearable Devices, Electrical Impedance Tomography

## 1. Introduction

Because technology is such a vast subject, it is impossible to explore all of its facets in a short period of time, especially given the limitations of space, time, and resources available. As one of the most talked-about topics right now, it is challenging people to use the word "impossible" and sparking a new revolution inside its own industry [1]. The primary objective of this thesis paper is to illuminate the genuine meaning of sixth sense technology as well as its application in the field of technology. Due to the fact that the topic is so new, obtaining relevant study resources has proven to be a significant challenge. For a long time before starting this thesis, the subject of technological advancement, as well as how it interacts with people and the environment, was at the forefront of my thoughts [2]. As the investigation into the mystery progressed, sixth sense gadgets were uncovered, which raised even more concerns and stoked even more interest. Sixth sense technology was selected to provide answers to questions that arose about the subject. Despite the fact that Google has recently discontinued retail sales of its wearable computer, the company has built a real-time system that will be used for wearable computing for the next few decades. Products from Vuzix, GlassUp, and other companies, on the other hand, are equivalent or even superior to those offered by the competition. The system under discussion includes wearable computer user interfaces, augmented services, and social networking services [3]. When it comes to preparing for the coming era of wearable social networks, the Glass Development Kit/Mirror API, an open-source social network engine, and improvements to facial recognition were all used (WSN). As wearable computers become more widely used in our daily lives, they predict that this will have an impact on human behaviour and interactions with one another in the not-too-distant future, as they become more prevalent in our daily lives [4]. Issues such as system performance, recognition techniques and user privacy/limitation are also addressed. Nowadays, everyone has access to a digital device such as a smartphone, a laptop computer, or a tablet computer. Everyone must have all of the devices listed above on them at all times, whether in their handbag or pocket. "Google Glass" was Google's attempt to usher in a new era of wearable technology. This is the ideal answer for individuals who do not want to carry along a large computer with them [5]. This paper discusses wearable technology, how it works, its merits and disadvantages, and other related topics. The device's mechanism is really simple to understand. The programme gathers information from the user's environment, conducts an internet search, and delivers the findings to the user through a display [6]. When a user's actions are displayed on a screen, such as an image or a gesture, gesture recognition technology and a computer vision algorithm are used to comprehend the user's actions as they appear on the screen. When it comes to a device that can be utilised in any industry, the working area is only limited by the number and type of programmes that are placed on the device.

## 2. Sixth Sense Technology

It's no longer necessary to own a timepiece in order to keep track of the passing of the hours. In addition, customers don't have to take their phone out of their pocket to use it. When utilising the clock application on the sixth sense gadget, users merely need to reveal their wrist in front of the camera and draw a circle on it to see the time [7]. This will show the user's current time on a hand-held clock. The user can only exit the application by swiping his fingertip from left to right. Figure 1 shows how a clock face can be projected onto the wrist of a user.

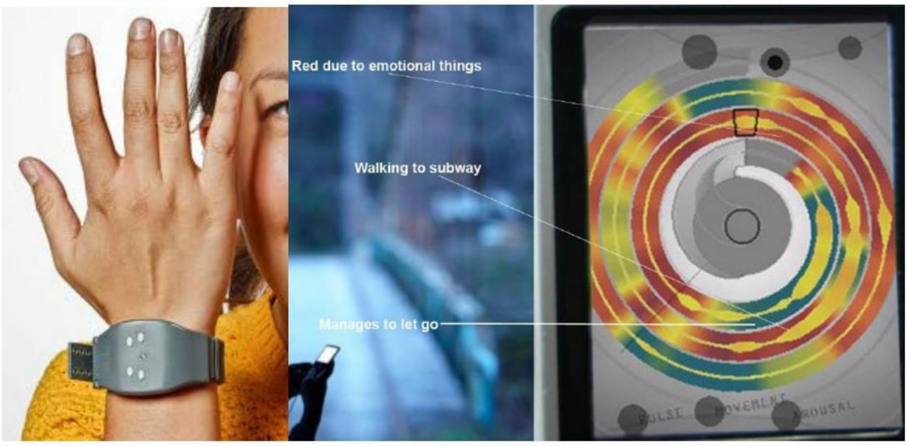


Figure 1: Sixth Sense Clock [7].

## Wearable Devises in Health care

A variety of wearable devices are discussed in this study, including distinct non-invasive wearables (such as skin-based wearables), bio fluidic-based wearables (such as those based on saliva, urine, and tears), and wearable applications for drug delivery systems. Figure 2 depicts HWDs made of textiles as well as HWDs made of tattoos, both of which are skin-based HWDs [8]. It is the focus of this study to demonstrate the utility of HWDs as a diagnostic and treatment tool for a variety of illnesses. In addition, the article compares and contrasts a number of important HWDs that are now available for purchase on the market. Wearables in healthcare are also evaluated for their current and future challenges and limitations, as well as their potential benefits.

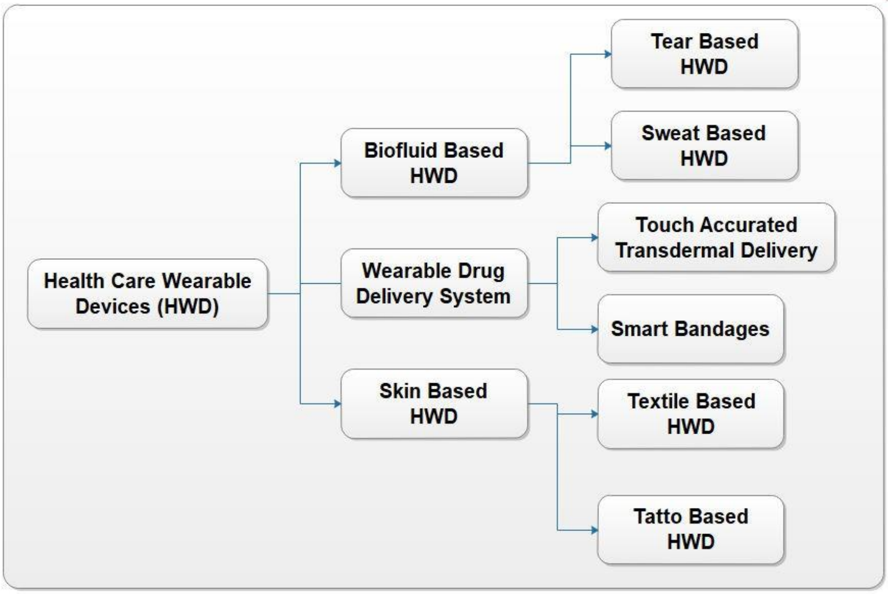


Figure 2: Types of Health care wearable devices

**Wearable Devises in E-education**

A number of tools have been developed to help educators improve and modernise their practises. So, books and libraries have fallen to the bottom of our favourite sources of information list as a result of this [9-14]. Every piece of technology, from laptops and cell phones to desktop computers and televisions, is unconstrained by these standards. While listening to an audiobook or reading a book, students can use their wearable devices to take notes, complete a task, and receive notifications. Children and instructors aren't the only ones who can profit from these qualities. With the help of these educational apps, it is possible to maintain better control over children. While their children are at school, parents can use a GPS tracker to keep track of their whereabouts and to check their physical and mental health. Furthermore, teachers can set up reminders for pupils to complete homework assignments and take exams on a regular basis [15]. Wearable technology enables you to achieve all of this and much more because to its flexibility. Every year, a rush of new applications is introduced to the market. Consider investing in wearable technology if you want to make a large financial commitment without committing to anything else. Technology that can improve the educational system while also allowing you to make a lot of money is on the way in the near future.


Figure 3: Wearable devices in E-education [16]

**Wearable Sensors**

Medical sensors that are worn on the body (wearable medical sensors, or WMSs) are attracting more and more interest from both the scientific community and the business world. As a result of technological advancements in sensing, wireless networking, and machine learning, WMS-based systems have begun to revolutionize our daily lives and work environments. Wireless monitoring systems (WMSs) have been in use since their conception, and they are now being employed for a wide range of applications outside of the health care industry [17]. Educational, human-computer interaction, and security applications, to name a few examples, have been proposed as viable applications for this technology. Although there has been a significant increase in the number of such studies over the last several years, the potential challenges associated with their design, development, and implementation have not been adequately investigated or identified. WMSs have been used to create a wide range of services, applications, and systems, and this article discusses their goals and challenges in the context of the design process for each of these systems [18]. Following that, we'll take a look at how the market for warehouse management systems is growing. Following that, the breadth of WMS-based systems is examined. Following that, we'll go through the general structure and components of a typical WMS-based system, as well as the constraints that the system must adhere to. In the next section, we present a set of design objectives that WMS-based systems should attempt to meet. Finally, we'll go over a range of WMS-related research directions and how previous studies have attempted to overcome the limitations of the components used in WMS-based systems while also meeting the design objectives [19-22].

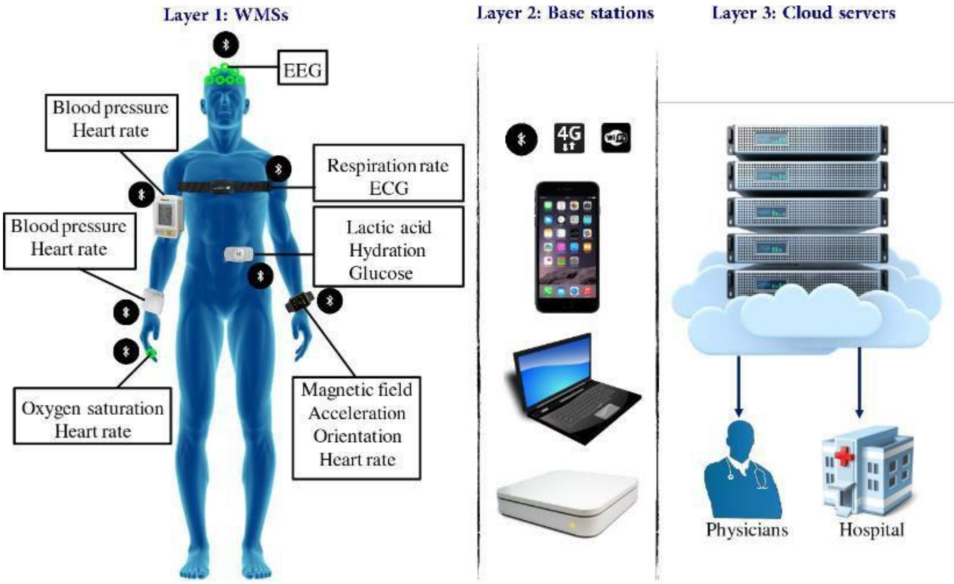


Figure 4: Design of wearable Sensors

**Feet Belt**

The bones and muscles of the human foot, as well as the arteries and veins that nourish them, are all separate structures [22]. Because the pulsations of both arteries can readily be felt, it has been common practise in clinics to use them as an indicator of peripheral vascular health. The dorsum region of the foot is depicted anatomically in Fig. 5. (A). The FeetBeat system, a wearable device that can measure both pedal pulse impulses and muscle activity, was introduced for the first time in this research. A wearable and inconspicuous form of these functions was achieved by embedding the FeetBeat array, which has been shown to have the highest reported pressure-to-capacitance sensitivity, within the tongue of a sports shoe. We have demonstrated these advantages in high-sensitivity pressure sensing with excellent mechanical ruggedness and reliable flexibility in our previous studies [23]. This is because the ultrahigh capacitance and quick polarisation of the iontronic materials demonstrate the FITS principle's advantages in pressure sensing.

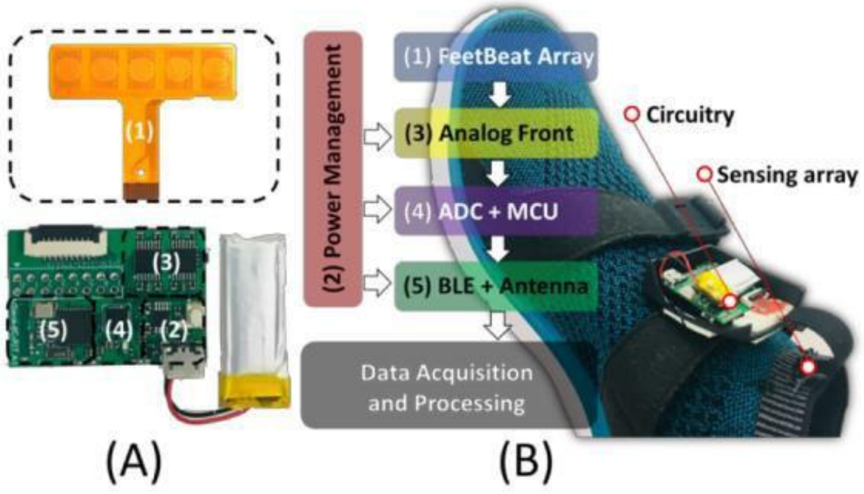


Figure 5: Structure of Feetbelt

The camera transmits both video and the movements performed by the user's hand across the Internet. The tips of the user's fingers are painted in a variety of vibrant colours, which aids the camera in recognising and capturing the action. The camera is equipped with a sensor that recognises the gesture. It is the computing device that interprets these streaming images of objects and gestures as commands. After that, the gadget follows the instructions and, if necessary, executes a query to the internet, returning the results to the user with the information. Through the projector, the information is projected onto the target surface or object, which is reflected back to the projector. After that, the user can interact with the projected image in order to provide another instruction.

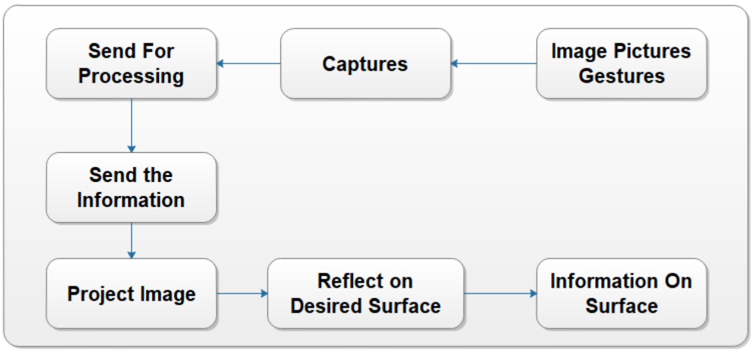


Figure 6: Workflow of Sixth Sense Technologies

## 3. Implementation

While at the height of technical development, the question of what to do next arises. Here are some suggestions. In this situation, the integration of sixth sense perception with technological equipment became the apparent option [24]. The concept has caught the attention of a wide range of enterprises. There are now a wide range of products available on the market that are focused on the sixth sense. Technological equipment and goods that include sixth-sense technology have already been introduced onto the market. Modeling is the process of constructing a physical representation of an object from a set of digital instructions. The purpose of modelling is to get a conceptual understanding of how a system appears and performs on a conceptual level. A system change's impact on the environment can be predicted using this technique [12]. Modeling techniques are employed in order to come as close as feasible to the original article. One of the objectives of this research is to develop an alternative energy system for wearable electronics, which might be used to monitor a person's health while on the go. In order to acquire and capture the energy generated by the human body, it is necessary to simulate the process [25]. With the help of energy modelling, it is possible to analyse a circuit and determine its output. An electric circuit is responsible for the generation of electricity. This energy model is often comprised of engineering design, mathematical optimization, and the demand for energy for wearable devices, among other factors.

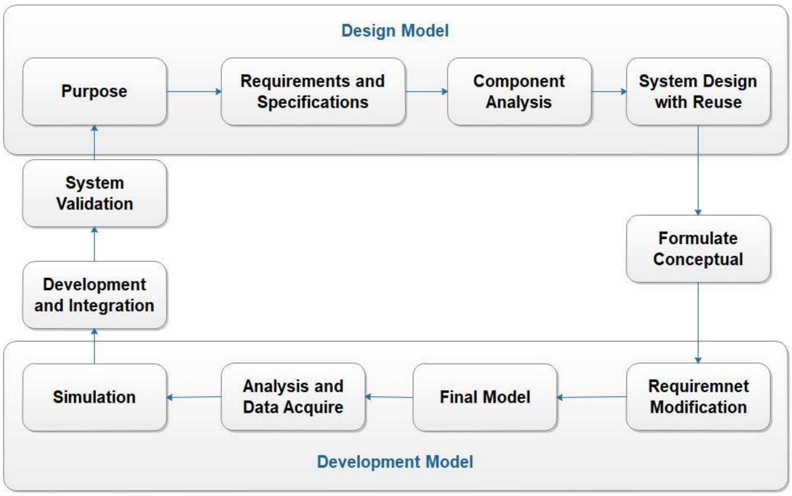


Figure 7: Block diagram for Design and Development Model

An illustration of the importance of modelling in system development may be found in the block diagram below. In this system, both the development of the model and the implementation of the model are included. When it comes to electronic systems, they are all built to fulfil a specific aim. The objective and scope of the system are the subject of a research project. The primary focus of this investigation is on electronic devices that assist in the monitoring of one's own health status. The design of energy harvesting devices is dependent on the circuits, components, and standards that are used. On the basis of the availability of components on the market, the designer develops a conceptual model for the product. Following the modelling phase, comes the analysis phase, which illustrates the expected results of the system.

In order to achieve these objectives, a mixed-signal system is depicted in Figure 8. The system's core CPU is responsible for all of the system's functions. To communicate with an external host, Bluetooth technology is employed. There is a digital to analogue conversion (DAC) converter at the beginning of the system's feeding chain that produces analogue signals. Converting digital signals to analogue signals is done by using DAC converters. In the following example, a voltage-controlled constant current supply is managed using a digital to analogue converter. The primary current source is a modified Howland current source. A cable connects the digital to analogue converter's input to the non-inverted Howland current source (DAC). Replaces Howland current source's second branch with an inverting amplifier second branch. This voltage source provides a voltage that has been reversed before it can be measured. The additional current drawn by a non-inverted Howland power supply is taken into account by lowering the common mode voltage by this amount. The feed-in current will not have an inverted phase current source or an undesirable DC component if this method is employed.

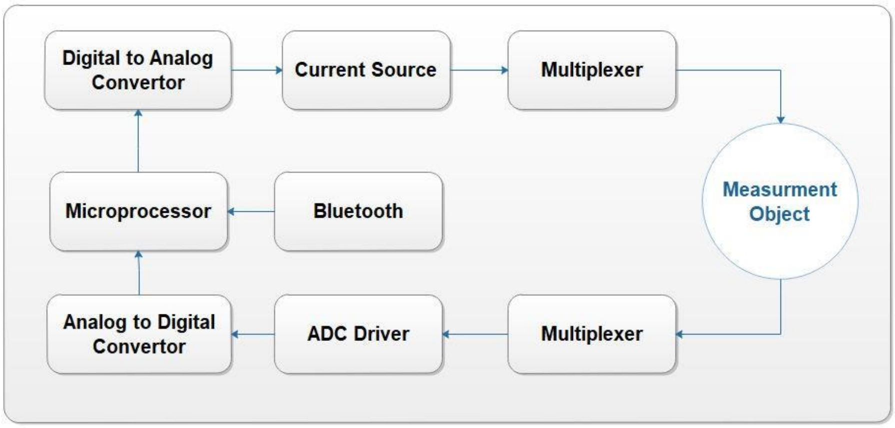


Figure 8: Block Diagram for EIT System

The next step is to use multiplexers [5] to transport two load currents to the appropriate active electrodes, and then repeat the process. The microprocessor controls the multiplexers based on the received measurement pattern. The measurement pattern can be altered at any stage in the process by modifying the multiplexer wire (e.g. adjacent, opposite). There are separate electrical circuits for each active electrode for the feed-in input and for the measured signal. Direct reception of the feeding signal occurs when the electrode directly receives it. By utilising a bandpass filter to filter out the active electrode's voltage, a second electrode can measure the voltages. There are filters that remove any interference impulses and DC components created by the skin electrode transition.

## 4. Results

As an illustration 9, consider the concept of a simulation, which is a model for solving or illustrating various systems. In electronic systems, simulation is used for a variety of different activities. These procedures make use of mathematical and physical methodologies, among other things. The objectives of simulation are to do system study and forecast virtual output. It is a collection of hardware and software systems that are used for the testing and verification of theoretical models.

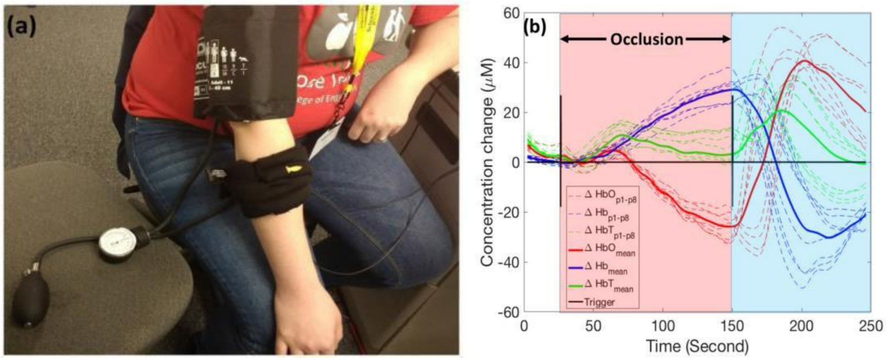


Figure 9: Experimental Setup and forearm muscle response during arterial occlusion experiment.

With a simulator, engineers have the assurance that their use of numerical data is sound. Only a few of the various simulation approaches can be utilised in simulation, such as physical simulation, interactive simulation, hybrid simulation, and distributed simulation, to mention a few examples. In addition to lower costs, increased realism, and the ability to run quicker than in real time are some of the advantages of using these simulations.

ECG and PPG readings were taken using the flexible wireless sensor module on the left wrist during the hybrid-sensor experiment. For an ECG measurement of one input of the electrometric differential channel and the module's ground reference, two flexible electrodes with sticky transparent films wrapped around them were used. Direct contact between index finger of the right hand and printed electrode on sensor module was required for input number two. A PPG was captured when the middle finger was put against an LED-photodiode pair.

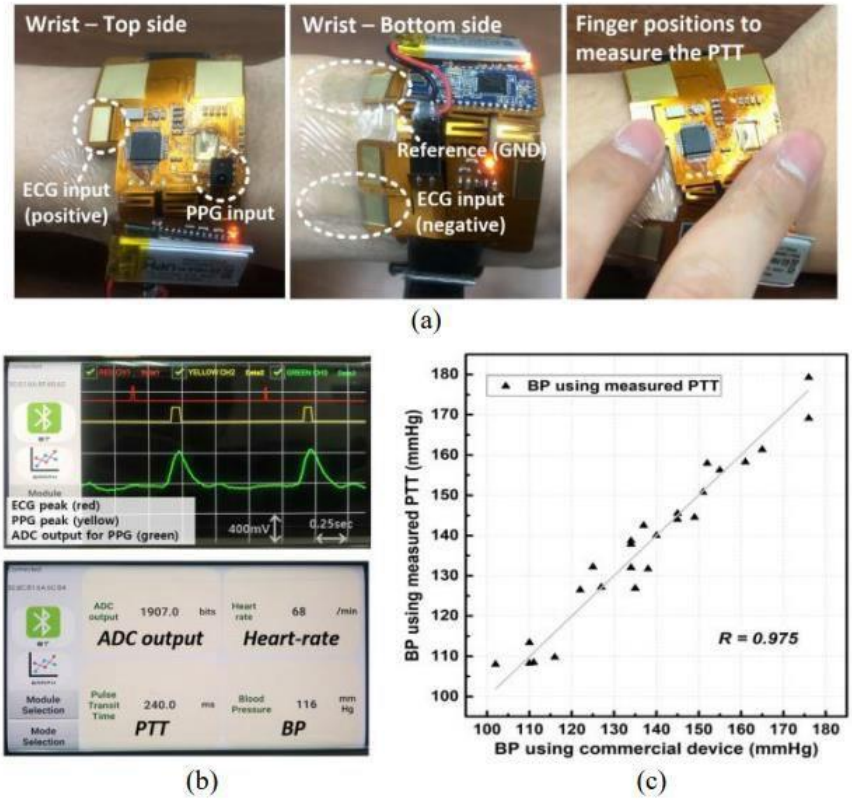


Figure 10: Sensor Module of wrist band, Real time Smart display and the correlation coefficient

ECG and PPG peak-detector outputs are simultaneously monitored by using the two electrometric readout methods in Fig. 10(b), which depicts wireless physiological monitoring of the PTT and BP using real-time smartphone display interfaces. An experiment with a commercial blood pressure monitor (HEM-7120 of Omron) was carried out to verify the association between the PTT and the BP under various activity circumstances, including a comfortable sitting state, weak motion, and severe motion. The PTT can also be presented numerically. This figure shows the correlation coefficient, maximum error, and standard deviation for blood pressure readings between 102 millimetres of mercury and 176 millimetres of mercury in figure 10(c).

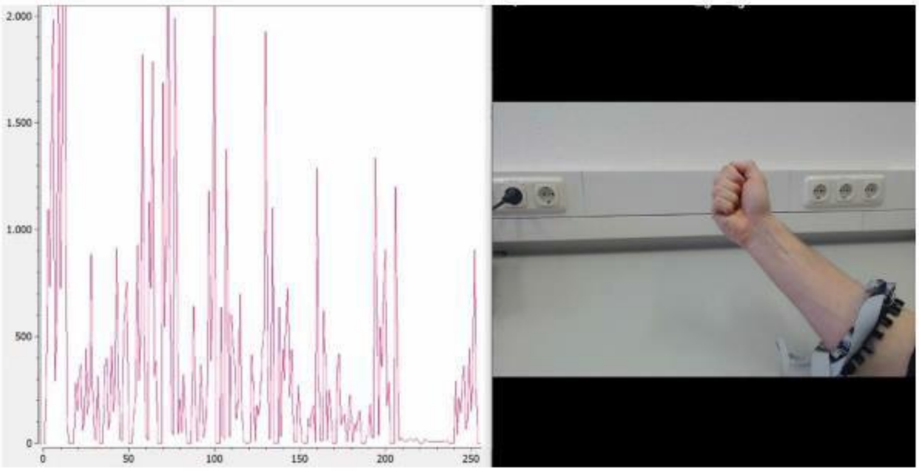


Figure 11: gesture fist and the data collecting and carrying apparatus

Following the evaluation, a practical research study with a diverse group of persons was done to determine the repeatability of the measurements. The experimental study conducted by the University of Siegen is in accordance with the Helsinki Declaration of 1975. Accordingly, the following research design was developed with this objective in mind: Each patient's EIT bracelet is affixed to the right arm, 5 cm below the elbow, on the right side of the body. Due to the fact that the electrodes must be placed exactly the same for each participant, considerable care must be taken when aligning them. This prevents the measurement data from being polluted by additional sources of inaccuracy throughout the measurement process. In order to examine the cross-user part of the study, a total of five individuals were assessed. Figure 11 displays a gesture fist and the data collecting and carrying apparatus that was used to capture and transport the data associated with it. The X-axis in the left picture represents the measurement of current (Figure 11). The height of the values that were measured is represented on the y-axis.

## 5. Conclusion

Future science Sixth sense seeks to bridge the gap between the digital and physical worlds without the need of hardware technologies. Despite the fact that they are still in their infancy, sixth sense technologies are expected to have a significant impact on how people interact with the digital world. It is possible that, in the future, sixth sense will serve as the ultimate transparent user interface for obtaining access to information about the environment around them. Wearable technology, in addition to being a fashionable field of electronic technology, is also a category that promises value-added services. Certain areas of contemporary life can be made easier as a result of this technological advancement. Aside from that, they can also assist the user in the organisation of their personal data and information. Because it must be used on the go, the system has been designed to be as tiny and wireless as feasible. Additionally, active electrodes have been added to the device in order to improve the signal quality even further. In order to assess the system's operation, phantom measurements were taken with the help of this innovative technology. During the following step, a brief investigation was carried out to determine the reproducibility of various motions.

**Conflict of Interest**

The Author(s) declared no potential conflicts of interest with respect to the research, authorship and/or publication of this article.

**References**

[1] Z. Song, Z. Cao, Z. Li, J. Wang and Y. Liu, "Inertial motion tracking on mobile and wearable devices: Recent advancements and challenges," in Tsinghua Science and Technology, vol. 26, no. 5, pp. 692-705, Oct. 2021, doi: 10.26599/TST.2021.9010017.

[2] L. -P. Tôn, L. -S. Lê and M. -S. Nguyen, "Micraspis: A Computer-Aided Proposal Toward Programming and Architecting Smart IoT Wearables," in IEEE Access, vol. 9, pp. 105393-105408, 2021, doi: 10.1109/ACCESS.2021.3096749.

[3] A. Doulah, T. Ghosh, D. Hossain, M. H. Imtiaz and E. Sazonov, "“Automatic Ingestion Monitor Version 2” – A Novel Wearable Device for Automatic Food Intake Detection

and Passive Capture of Food Images," in IEEE Journal of Biomedical and Health Informatics, vol. 25, no. 2, pp. 568-576, Feb. 2021, doi: 10.1109/JBHI.2020.2995473.

[4] Z. Zhang, X. Cong, W. Feng, H. Zhang, G. Fu and J. Chen, "WAEAS: An optimization scheme of EAS scheduler for wearable applications," in Tsinghua Science and Technology, vol. 26, no. 1, pp. 72-84, Feb. 2021, doi: 10.26599/TST.2019.9010040.

[5] L. Kuang, T. Zhu, K. Li, J. Daniels, P. Herrero and P. Georgiou, "Live Demonstration: An IoT Wearable Device for Real-time Blood Glucose Prediction with Edge AI," 2021 IEEE Biomedical Circuits and Systems Conference (BioCAS), 2021, pp. 01-01, doi: 10.1109/BioCAS49922.2021.9644975.

[6] D. Yang, P. Mehrotra, S. Weigand and S. Sen, "In-the-Wild Interference Characterization and Modelling for Electro-Quasistatic-HBC With Miniaturized Wearables," in IEEE Transactions on Biomedical Engineering, vol. 68, no. 9, pp. 2858- 2869, Sept. 2021, doi: 10.1109/TBME.2021.3082078.

[7] H. Aksu, A. S. Uluagac and E. S. Bentley, "Identification of Wearable Devices with Bluetooth," in IEEE Transactions on Sustainable Computing, vol. 6, no. 2, pp. 221-230, 1 April-June 2021, doi: 10.1109/TSUSC.2018.2808455.

[8] T. Zhao, J. Liu, Y. Wang, H. Liu and Y. Chen, "Towards Low-Cost Sign Language Gesture Recognition Leveraging Wearables," in IEEE Transactions on Mobile Computing, vol. 20, no. 4, pp. 1685-1701, 1 April 2021, doi: 10.1109/TMC.2019.2962760.

[9] H. F. Azgomi, I. Cajigas and R. T. Faghih, "Closed-Loop Cognitive Stress Regulation Using Fuzzy Control in Wearable-Machine Interface Architectures," in IEEE Access, vol. 9, pp. 106202-106219, 2021, doi: 10.1109/ACCESS.2021.3099027.

[10] F. John Dian, R. Vahidnia and A. Rahmati, "Wearables and the Internet of Things (IoT), Applications, Opportunities, and Challenges: A Survey," in IEEE Access, vol. 8, pp.

69200-69211, 2020, doi: 10.1109/ACCESS.2020.2986329.

[11] T. Zhu et al., "RiskCog: Unobtrusive Real-Time User Authentication on Mobile Devices in the Wild," in IEEE Transactions on Mobile Computing, vol. 19, no. 2, pp. 466-483, 1 Feb. 2020, doi: 10.1109/TMC.2019.2892440.

[12] P. K. Sharma, J. Park, J. H. Park and K. Cho, "Wearable Computing for Defence Automation: Opportunities and Challenges in 5G Network," in IEEE Access, vol. 8, pp. 65993-66002, 2020, doi: 10.1109/ACCESS.2020.2985313.

[13] E. Mencarini, A. Rapp, L. Tirabeni and M. Zancanaro, "Designing Wearable Systems for Sports: A Review of Trends and Opportunities in Human–Computer Interaction," in IEEE Transactions on Human-Machine Systems, vol. 49, no. 4, pp. 314-325, Aug. 2019, doi: 10.1109/THMS.2019.2919702.

[14] A. Rowen, M. Grabowski and J. Rancy, "Through the Looking Glass(es): Impacts of Wearable Augmented Reality Displays on Operators in a Safety-Critical System," in IEEE Transactions on Human-Machine Systems, vol. 49, no. 6, pp. 652-660, Dec. 2019, doi: 10.1109/THMS.2019.2944384.

[15] Z. Zhang, Z. Zhu, B. Bazor, S. Lee, Z. Ding and T. Pan, "FeetBeat: A Flexible Iontronic Sensing Wearable Detects Pedal Pulses and Muscular Activities," in IEEE Transactions on Biomedical Engineering, vol. 66, no. 11, pp. 3072-3079, Nov. 2019, doi: 10.1109/TBME.2019.2900224.

[16] K. Yu, S. Rich, S. Lee, K. Fukuda, T. Yokota and T. Someya, "Organic Photovoltaics: Toward Self-Powered Wearable Electronics," in Proceedings of the IEEE, vol. 107, no. 10, pp. 2137-2154, Oct. 2019, doi: 10.1109/JPROC.2019.2929797.

[17] J. R. Blum et al., "Getting Your Hands Dirty Outside the Lab: A Practical Primer for Conducting Wearable Vibrotactile Haptics Research," in IEEE Transactions on Haptics, vol. 12, no. 3, pp. 232-246, 1 July-Sept. 2019, doi:

10.1109/TOH.2019.2930608.

[18] M. Golkarifard, J. Yang, Z. Huang, A. Movaghar and P. Hui, "Dandelion: A Unified Code Offloading System for Wearable Computing," in IEEE Transactions on Mobile Computing, vol. 18, no. 3, pp. 546-559, 1 March 2019, doi: 10.1109/TMC.2018.2841836.

[19] Z. Zhang, Z. Zhu, B. Bazor, S. Lee, Z. Ding and T. Pan, "FeetBeat: A Flexible Iontronic Sensing Wearable Detects Pedal Pulses and Muscular Activities," in IEEE Transactions on Biomedical Engineering, vol. 66, no. 11, pp. 3072-3079, Nov. 2019, doi: 10.1109/TBME.2019.2900224.

[20] J. Heikenfeld, A. Jajack, J. Rogers, P. Gutruf, L. Tian, T. Pan, R. Li, M. Khine, J. Kim, J. Wang, and J. Kime, “Wearable sensors: modalities, challenges, and prospects,” Lab. Chip, vol. 18, no. 2, pp. 217–248, 2018.

[21] S. P. Lee, et al., “Highly flexible, wearable, and disposable cardiac biosensors for remote and ambulatory monitoring,” npj Digital Medicine, vol. 1, pp. 2, 2018.

[22] J. Xu, et al., “A 665 μW silicon photomultiplier-based NIRS/EEG/EIT monitoring ASIC for wearable functional brain imaging,” IEEE Trans. Biomed. Circuits Syst., vol. 12, no. 6, pp. 1267–1277, Dec. 2018.

[23] S. Choi, et al., “A three-step resolution-reconfigurable hazardous multigas sensor interface for wireless air-quality monitoring applications,” Sensors, vol. 18, pp. 761, 2018.

[24] S. W. Kim, et al., “A triple-mode flexible E-skin sensor interface for multi-purpose wearable applications,” Sensors, vol. 18, pp. 78, 2018.

[25] Q. Hua, et al., “Skin-inspired highly stretchable and conformable matrix networks for multifunctional sensing,” Nat. Comm., vol. 9, pp. 244 (2018).