Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

Review of Internet of Wearable Things and Healthcare based Computational Devices

Joy Iong-Zong Chen
Professor, Department of Communication Engineering, Da-Yeh University, Chang-Hua, Taiwan.
E-mail: jchen@mail.dyu.edu.tw

Abstract

Wearable computing have variety of applications in healthcare ranging from muscle disorders to neurocognitive disorders, Alzheimer's disease, Parkinson's disease, and psychological diseases, such as cardiovascular diseases, hypertension and so on. Different types of wearable computing devices are used, for example, bio fluidic-place on wearables, textile-place on wearables, and skin-place on wearables including tattoo place on wearables. In drug delivery systems, the wearable computing systems have shown promising developments, increasing its use in personalized healthcare. Wearable contain experiments, which need to be addressed before their consumerist as a fully customized healthcare system. Distinct types of wearable computing devices currently used in healthcare field are reviewed in this paper. Based on various factors, the paper provides an extensive classification of wearable computing devices. Additionally, limitations, current challenges and future perspective in health care is reviewed.

Keywords: Wearable devices, Health care wearables, Classification, Privacy, Security, Information and Communication Technology (ICT), Internet of Things (IoT), Internet of Wearable Things (IoWT)

1. Introduction

Wearable computing device, wearables, or wearable technology, are referred to small mobile devices, computer devices, or small electronics with wireless communication capability [1] that are incorporated in to accessories, gadgets or cloths. It can be worn on human body in the form of smart tattoos or micro-chips. Various motorizing and sensor features that includes bio information feedback and other physiological sensor functions and biometry can be

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

provided in that wearable devices while comparing to today's smartphone and tablets. Wearable computing device can measure values continuously, they are seamless, convenient, and portable and it offers hand free access to electronics but it is restricted by battery constraints.

New services and growing user demands have increased rapidly over the recent years. From year to year, the number of wearable intercommunication device been growing massively, due to this, both gain of Internet of Things (IoT) and trades are more empowered. Internet of Things (IoT)[2] have magnificent influence in the progress of telecommunication fields, catering to the latest requirements in terms of availability, reliability and also thrust vendors and network designers to redesign every switching from standard human generated traffics to Internet of Things (IoT) and ecosystem. Incredible impact on Internet of Things (IoT) and fabrication of the Information and Communication Technology (ICT) allows the designers to bring their attention to a completely new division in market. A sustainable part of Internet of Things (IoT) is developed as Internet of Wearable Things (IoWT) that carries new advancements to the research community and numerous technology viewpoints.

For improving supervision of patients with illness, diabetes, heart diseases and neurology complaints, ceaseless and instantaneous intensive care is essential. Long-lasting diseases account for 75% of deaths all around the world that execute high financial problems is observed according to the World Health Organization (WHO). For the judgement and specialist care of such diseases and active approach in respect is Health care Wearable Devices (HWDs)[3] the different policy are required. Wearable computing device is well-defined as policies which can wear on the human body and clothing. It be made up of transducer and receptor. Receptor diagnose the responds and examine accordingly. Transducer translate response of the receptors into valuable form. Studies reported wearable devices in different fields and applications, by the result, wearable devices presented hopeful results in the health care field as a result of their compliance and capability of disfigure. The Health care Wearable Devices (HWDs) provide better accepting in the changes inside a human body and it can support treating diseases and stopping from diseases.

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

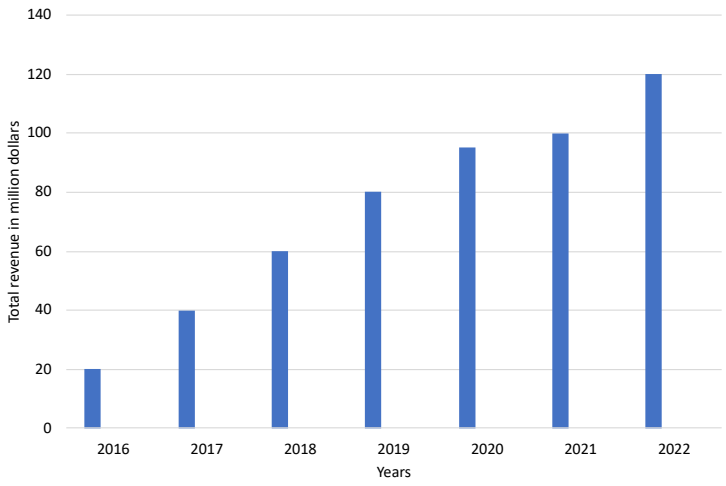

Figure 1: Wearable computing device market growth

Figure 1 shows the growth of wearable computing devices in the market. It shows that the wearable sensor users are increasing every year and the application is wide. Point of Care (POC) Wearable procedures have revolution in the healthcare organization that by reducing the hospital masses and it provides more sensible and dependable information. Altered types of wearable devices have is active for this purpose. Example, textile founded wearables, stretchy wearables, skin wearables. Wearable computing devices are active for altered body parts, example, eye constructed wearable computing devices, head constructed wearable computing devices and wrist constructed wearables. Individual wearables will observe altered physical and emotional parameters it can be used for analyses of altered diseases. Wearable computing devices can combined with different stages for identifying different types of organic factors from body liquids, example, blood, saliva, sweat, urine etc. Those wearable computing devices can castoff for transporting drugs in a well-organized and measured way while relating with old drug distributing systems.

1.1 Skin based wearable devices

Figure 2 shows the classification of health care wearable devices. Furthermost of the human body is covered [4] it function as a finest mode for non-aggressive healthcare wearable computing devices. These kind of skin grounded wearable devices is used for emotional and

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

physical observing and it is important for handling altered diseases like neuro-muscular and cardiac sicknesses. In total, it can furthermore be used for analysis of altered varieties of diseases using measurable and quality examination such as sweat, skin discharges. Founded on skin type the skin founded wearable devices can be epidermal constructed or textile constructed. Epidermal based wearable computing devices consist of the direct affections to the skin like tattoo, it is commonly known as microelectronic skin or e-skin, whereas textile constructed wearable computing device include vital sensors in clothes.

1.1.1 Tattoo based or E-skin based wearable computing devices

Figure 3 (a) and (b) shows glucose monitoring tattoo device. Tattoos supposed as a form of drawing in a body since passivity and flexibility. These belongings of tattoo constructed device can be used for analytical and observing drives. E-skins are using broadly for sensing bodily and electrical factors such as EMG, ECG and EEG. Amongst this ECG is stress-free observing device since great amplitude.

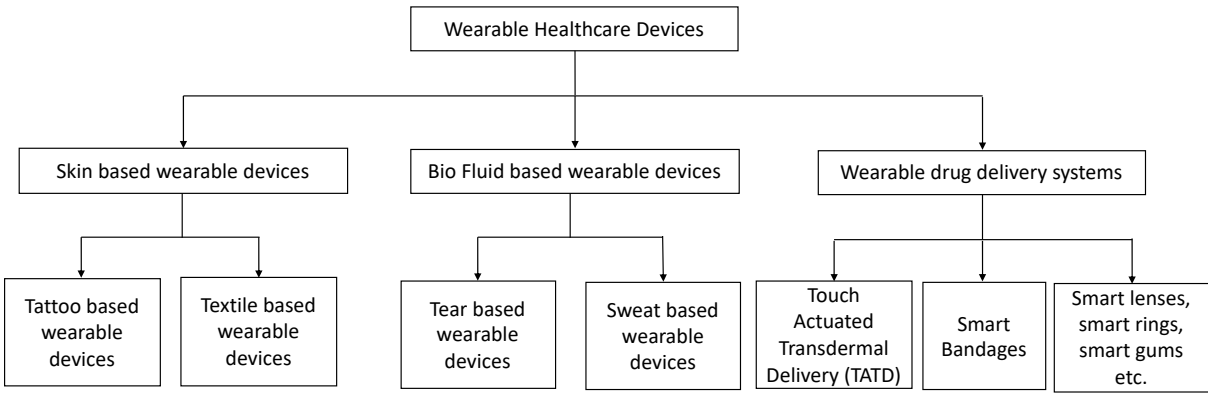

Figure 2: Classification of Health care wearable devices

It agrees non-invasive and exact recognition of indications [5] from heart over skin. ECG is the opinion of orientation for analysis and usage in cardio arrhythmias similar bradycardia, tachycardia. Predictable ECG observer need the accessory of gel constructed conductor cables

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

with visibly associated microelectronic equipment for gaining of signal and it will be rough for exhausting.

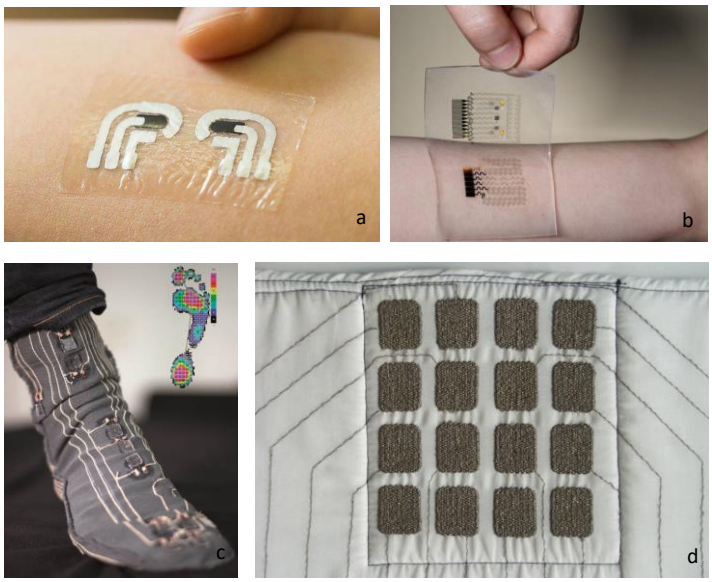

Figure 3: (a) Glucose monitoring sensor, (b)tattoo sensor, (c) & (d) pressure monitoring textile sensor

1.1.2 Textile based wearable devices

Figure 3 (c) and (d) shows pressure monitoring textile sensor. Textile constructed wearable devices remained voluntarily presented for periods. Wear and materials have remained using by human being for protection warm and esthetics. Since of their relaxation capacity and availability, it can be used for observing and detecting significant constraints, such as heart percentage, respiration frequency and body heat recognizing. Hence it is usually identified as e-textiles or microelectronic textiles. They are the devices and conducting resources that implanted with clothes. Large scale skin communication and stretchable nature creates textiles constructed wearable device is an optimal intermediate for Health wearable devices (HWDs). The arrival of carbon nanotubes, nanowires and grapheme, the quantity of struggles been made to trade sensors into cloth for observing always. ECG can observed by using gel constructed Agcl/Ag conductor restraints, which is not easy to wear. This textile-constructed ECG

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

observing, grapheme functionalized cloth is implanted with ECG sensor. Graphene is using for this purpose since the high association with the predictable gel-based ECG observing and material things.

1.1.3 Sensors including smart rings, vests and earphones

Further than textile and [6] tattoo constructed skin biosensors are there, like smart watches, wrist bands, skin patches, wearable vests and implantable wearable devices, which uses different monitoring biomarkers. For many cardiovascular and respiratory diseases, the respiratory rate is monitored by using alternative wearable devices, it is proposed. The chest constructed wearable sensor for observing respiratory frequency by pulse oximeter is suggested. Likewise, heart disappointment is extra clinical condition that need non-stop observing of the system. Globally 26 million people are affected by this problem. It need real time and non-stop observing system which increases financial drain. Health care wearable device can simplify this daily observing tasks for the patients. Number of Health Wearable Devices (HWDs) been informed that do further than observing and detecting heart functions, it can calculate it before it even gets failure.

Alzheimer's illness is utmost common form of the dementia . Almost 70% of the dementia patients are analyzing with Alzheimer's disease. By observing substantial instants will help to maintenance care of dementia patients and Health Wearable Device can be active for this. Intelligent Assistive Technology (IAT) is a wearable technology proposed. Where it is an assist, adaptive technology, which is combined with advanced atmosphere of the artificial intelligence (AI).

1.2 Bio fluid bases wearable devices

Human body secretions like saliva, tears, urine and sweat contains important biomarkers that are very essential for diagnostic and monitoring purpose. Health Wearable Devices (HWDs) can be directly used through the integration with some other platforms, example, useful information from different biofluids can be integrated by microfluidic platforms.[7][8]

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

Different materials can be used in microfluidic platforms, Health Wearable Devices (HWDs) example, paper based microfluidic devices, micronized needles and polymer based microfluidic devices.

1.2.1 Sweat based wearable devices

Fluids similar sweat is significant pointer of the modifications that happens in human body, thus it work a vital part for accumulating parameter for the genetic and organic recognizing. Sweat self-possessed of altered biomarkers, for example electrolytes such as sodium and chlorine and metabolites (example, urea, lactate and glucose), nucleotides, proteins. Having significant analytic effects. Sweat is accessible item for organic identifying and it is spread through skin more than 100 glands. Sweat is used for removal of altered genetic and biochemical factors expending Health Wearable Devices (HWDs) that to afford analytic and observing. A soft, stretchy and stretchable device is developed based on microfluidic. Health Wearable Devices is accomplished of succeeding hydronium and chloride that act as electrolytes.

1.2.2 Tear based wearable devices

Tear is an important bio-fluid for monitoring and diagnosis for altered diseases. One of the illness is diabetes, Health Wearable Device (HWDs) using this diagnosis is more. It is disease that seriously damage eye, nerve, blood vessels and heart, it is a chronic metabolic disease. Patients with diabatic is increased to 463 million in the year of 2020. World Health Organization (WHO)[9] proposed a healthy life style by monitoring glucose levels continuously. Old and traditional measuring method is to monitor the concentration of glucose levels in the blood. This involve rough for the patients, it may lead to infections in blood pathogens. Health Wearable Device (HWDs) offer the most relaxed and suitable wearable for measuring blood sugar, [10] tear is used for monitoring the glucose measurement.

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

1.3 Wearable drug delivery systems

Biocompatible and biodegradable are available for advancements for materials. These materials is using for the drug delivery systems, it can be used to deliver the drug in controlled manner. One of the applications is bimatoprost, it is a ring prepared of polypropylene for considering glaucoma. It is situation that effects eye that will damage eye nerve and it is the important effect for loss of sight. Medication generally used is bimatoprost, but some fluctuations in its usage is minimizing its efficiency. Self-moldable and healable gum is developed by Al-shahbazi et al, for personalizing drug delivery. That gum is made up to two materials, tannic acid (TA) and polyvinyl alcohol (PVA). It is a human friendly material group and it is bio active material.[11] The gum developed has high flexibility, stretch ability, high strength, self-healing and toughness properties. The gum is found anti-inflammatory and antibacterial properties and it is flexible enough for molding in to shape suitable for wearable usage.

1.4 Wearable devices in sports

Athletes are aiming to increase their effects by applying better observing to progress training. [12] Small worn devices in the superior vest pouches in the back and it can make outdoor, indoor localization and it will check heart rate. Special software perform the examination established on data collection and it permit to observe development of athlete. Introduced wearable device that used for record data. Wearable observing device can collect data while motion from. The composed data will analyze for defining that matches to the motion. In such cases, the existence cast is recorded and time printed. Xsens created a real-time motion capturing system, MVN analyze, that will give proper tracking and observation of the movements by athletes during high intensity activity. [13]

1.5 Security in wearable devices

Research for the wearable is related to data safety domain.[14-18] wearable device will allow safe transactions established on wearable security tokens. Not only perform and achieve

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

security managements from the device, has it also compact the risk relay attacks and impersonation. Wearable combines biometric information and advanced encryption technology to perform secured transactions with the corresponding device or system [19]. These wearables not only used for information storage or transactions, automatically it will manage other smart devices and sends alerts with response to any critical situation according.

2. Wearable data processing life cycle

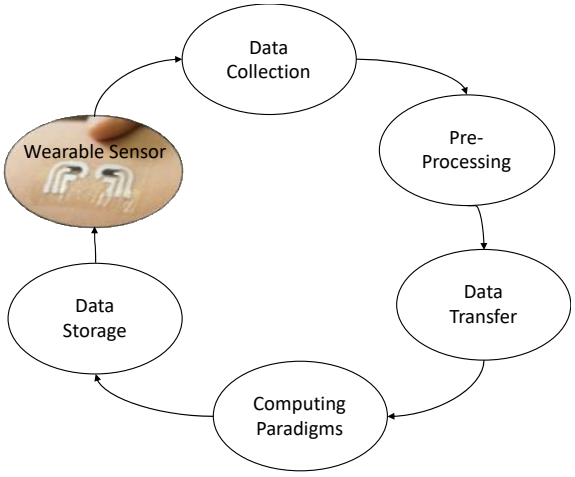

Figure 4: Wearable data processing chart

The figure 4, shows the data handling life cycle, Data collection in wearable computing device will assemble and development the operator created data and composed data is normally mentioned as boasted sourcing, it is a great tool for collaborating huge quantity of data. Pre-processing is the important stage and it is essential for IoT and wearable, they do not have storage resources and computational to process unwanted data. Data transmission phase a vital part of the wearable computing data transfer mechanism. Many wearable mechanisms limit the power using amount during data transformation while pre-processing the real amount. Calculating patterns is[20-22] based on architecture expansion. It is direct to understand the condition of wearable computing device data handling [23]. Data processing is a different technique or method that to input the data for obtaining meaningful information. ML technology is broadly applied for analyzing and processing the data, such as sorting, bunching and reversion among others and this ML technique is used for online handling, real-time

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

processing and batch processing [24]. After data handling, the valuable statistics is shown to the user over illustrations, boards and reports. It is obtainable for more presentation, storing and progress. Data storage is the final process of the data research and reformed that data for additional analysis.

3. Challenges and future perspective

The most important experiment that the effectiveness of wearable computing devices, with a non-stop supply of power [25]. Batteries used in this wearable device have restricted space, they are required to make even with architecture of wearable devices. To overwhelm this problem, efficient power source with improved power managing system is needing. Own-powering sensor like Triboelectric Nanogenerator (TENG) and Piezoelectric Nano Generator (PENG) is used [26, 27]. The mechanical is converted in to electrical and ensure reduction and relief of Health Wearable Devices (HWDs). Limited submission for monitoring the physiological disease available like AD, PD and other mental disorders [28]. An improved consumption of Health Wearable Devices (HWDs) for mental diseases can prove constructive in near future.

4. Conclusion

Wearable Computing Devices (WCDs) are widely using in health care, sports and other industrial applications. Various wearable devices are presently used on different parts of the body. In this modern world, modern device like sensors are used for observing the health and physical condition of a person based on the vital parameters. Wearables that are found today use short distance wireless communication technology, based on the infrastructure of the system. This condition is due to the battery limitations, as they can’t carry high power. Most of the wearable devices are still utilized for collecting data. A highly efficient and modern technology is required for further development of the system. One of the most challenging aspect of wearable technology is the lack of a strong connection of different systems that is provided by different vendors. Even in lack of best practices, with proper standardization and interoperability efficient wearable computing systems are enabled. Wearable computing device is the important aspect of the future ICT system. Several critical challenges including security and privacy aspects are currently observed. Limitations in hardware and human adoption is still to be addressed. This paper reviews developments in wearable devices and the architecture is

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

discussed. Future perspective and the challenges or limitations in Wearable Computing System (WCS) is also discussed.

References

[1] T. Luczak, R. Burch, E. Lewis, H. Chander, J. Ball, State-of-the-Art Review of Athletic Wearable Technology: What 113 Strength and Conditioning Coaches and Athletic Trainers from the USA Said about Technology in Sports, Int. J. Sports Sci. Coach. 15 (1) (2020) 26–40.

[2] Jagtap, Shrushti, Atharva Kawade, Vikramjit Banerjee, Sharvari Gadiwan, Rajeev Ramesh, Aman Shinde, and Prashant Gadakh. "Detection and Monitoring of Alzheimer's Disease Using Serious Games—A Study." In Proceedings of International Conference on Sustainable Expert Systems: ICSES 2020, vol. 176, p. 69. Springer Nature, 2021.

[3] Chen, J. I. Z., & Yeh, L. T. (2020). Data Forwarding in Wireless Body Area Networks. Journal of Electronics, 2(02), 80-87.

[4] S. Khan, S. Parkinson, L. Grant, N. Liu, S. Mcguire, Biometric Systems Utilising Health Data from Wearable Devices: Applications and Future Challenges in Computer Security, ACM Comput. Surv. 53 (4) (2020) 1–29

[5] Suma, V. "Wearable IoT based Distributed Framework for Ubiquitous Computing." Journal of Ubiquitous Computing and Communication Technologies (UCCT) 3, no. 01 (2021): 23-32.

[6] A. Ometov, Social, Private, and Trusted Wearable Technology under Cloud Aided Intermittent Wireless Connectivity (Ph.D. thesis), Tampere University of Technology, 2018

[7] Sanyal, Hrithik, and Rajneesh Agrawal. "Study of Holoportation: Using Network Errors for Improving Accuracy and Efficiency." In Proceedings of International Conference on Sustainable Expert Systems: ICSES 2020, vol. 176, p. 107. Springer Nature, 2021.

[8] Shakya, Subarna, and Lalitpur Nepal. "Computational Enhancements of Wearable Healthcare Devices on Pervasive Computing System." Journal of Ubiquitous Computing and Communication Technologies (UCCT) 2, no. 02 (2020): 98-108.

[9] Jayathilake, A. M. I. C. K., Lakshika S. Nawarathna, and P. N. P. S. Nagarathne. "Prediction of Malocclusion Pattern of the Orthodontic Patients Using a Classification

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

Model." In Proceedings of International Conference on Sustainable Expert Systems: ICSES 2020, vol. 176, p. 279. Springer Nature, 2021.

[10] Palani, U., Mrs D. Vasanthi, and Ms S. Rabiya Begam. "Enhancement of Medical Image Fusion Using Image Processing." Journal of Innovative Image Processing (JIIP) 2, no. 04 (2020): 165-174.

[11] A. Ometov, Social, Private, and Trusted Wearable Technology under CloudAided Intermittent Wireless Connectivity (Ph.D. thesis), Tampere University of Technology, 2018

[12] Seshadri, D. R. et al. Wearable sensors for monitoring the internal and external workload of the athlete. npj Digit. Med. 2, 71 (2019)

[13] Patil, Prachu J., Ritika V. Zalke, Kalyani R. Tumasare, Bhavana A. Shiwankar, Shivani R. Singh, and Shailesh Sakhare. "IoT Protocol for Accident Spotting with Medical Facility." *Journal of Artificial Intelligence* 3, no. 02 (2021): 140-150.

[14] Min, W. & Jake, L. Wearable technology applications in healthcare: a literature review. Online J. Nurs. Informatics Contrib. https://www.himss.org/resources/wearable-technology-applications-healthcare-literature-review (2019).

[15] Bhalla, N., Jolly, P., Formisano, N. & Estrela, P. Introduction to biosensors. Essays Biochem. 60, 1–8 (2016)

[16] Kim, J., Campbell, A. S., de Ávila, B. E. F. & Wang, J. Wearable biosensors for healthcare monitoring. Nat. Biotechnol. 37, 389–406 (2019)

[17] García Núñez, C., Manjakkal, L. & Dahiya, R. Energy autonomous electronic skin. npj Flex. Electron 3, 1.

[18] Karunakaran, P., and Yasir Babiker Hamdan. "Early Prediction of Autism Spectrum Disorder by Computational Approaches to fMRI Analysis with Early Learning Technique." Journal of Artificial Intelligence 2, no. 04 (2020): 207-216.

[19] Rodgers, M. M., Pai, V. M. & Conroy, R. S. Recent advances in wearable sensors for health monitoring. IEEE Sens. J. 15, 3119–3126 (2015).

[20] Yadav, K. S., Kapse-Mistry, S., Peters, G. J. & Mayur, Y. C. E-drug delivery: a futuristic approach. Drug Discov. Today 24, 1023–1030 (2019)

[21] Jayaneththi, V. R. et al. Controlled transdermal drug delivery using a wireless magnetic microneedle patch: Preclinical device development. Sens. Actuators B Chem. 297, 126708 (2019)

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021

Journal of ISMAC (2021)
Vol.03/ No.03
Pages: 263-275
http://irojournals.com/iroismac/
DOI: https://doi.org/10.36548/jismac.2021.3.007

[22] Vijayakumar, T., Mr R. Vinothkanna, and M. Duraipandian. "Fusion based Feature Extraction Analysis of ECG Signal Interpretation–A Systematic Approach." Journal of Artificial Intelligence 3, no. 01 (2021): 1-16.

[23] Massaroni, C. et al. Smart textile for respiratory monitoring and thoracoabdominal motion pattern evaluation. J. Biophotonics 11, 1–12 (2018)

[24] Alizadeh Meghrazi, M. et al. Multichannel ECG recording from waist using textile sensors. Biomed. Eng. Online 19, 1–18 (2020).

[25] Choudhry, N. A., Rasheed, A., Ahmad, S., Arnold, L. & Wang, L. Design, development and characterization of textile stitch-based piezoresistive sensors for wearable monitoring. IEEE Sens. J. 20, 10485–10494 (2020).

[26] Chen, Joy Iong Zong, and P. Hengjinda. "Early Prediction of Coronary Artery Disease (CAD) by Machine Learning Method-A Comparative Study." Journal of Artificial Intelligence 3, no. 01 (2021): 17-33.

[27] Gong, Z. et al. Wearable fiber optic technology based on smart textile: a review. Materials 12, 3311 (2019).

[28] Someya, T. & Amagai, M. Toward a new generation of smart skins. Nat. Biotechnol. 37, 38

Author's biography

Joy Iong-Zong Chen is currently a full professor in the Department of Communication Engineering Dayeh University at Changhua Taiwan. Prior to joining Dayeh University, he worked at the Control Data Company (Taiwan) as a technical manager from Sep. 1985 toSep. 1996. His research interests include wireless communications, spread spectrum technical, OFDM systems, and wireless sensor networks. He has published a large number of SCI Journal papers on the issues addressed by the physical layer for wireless communication systems. Moreover, he also majors in developing some applications of the IOT (Internet of Thing) techniques and Dr. Joy I.-Z. Chen owned some patents authorized by the Taiwan Intellectual Property Office (TIPO).

ISSN: 2582-1369 (online)
Submitted: 17.06.2021
Revised: 03.08.2021
Accepted: 19.08.2021
Published: 27.08.2021