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Contents

Self-Powered Wearable IoT Devices for Health and Activity Monitoring

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ABSTRACT

Wearable devices have the potential to transform multiple facets of human life, including healthcare, activity monitoring, and interaction with computers. However, a number of technical and adaptation challenges hinder the widespread and daily usage of wearable devices. Recent research efforts have focused on identifying these challenges and solving them such that the potential of wearable devices can be realized.

This monograph starts with a survey of the recent literature on the challenges faced by wearable devices. Then, it discusses potential solutions to each of the challenges. We start with the primary application areas that provide value to the users of wearable devices. We then present recent work on the design of physically flexible and bendable

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devices that aim to improve user comfort. We also discuss state-of-the-art energy harvesting and security solutions that can improve user compliance of wearable devices. Overall, this monograph aims to serve as a comprehensive resource for challenges and solutions towards self-powered wearable devices for health and activity monitoring.

1

Introduction

About 15% of the world's population lives with a disability according to the annual world report on disability (World Health Organization, 2011). Moreover, 100 to 190 million individuals face significant difficulties in functioning. State-of-the-art methodologies for diagnosis, treatment, and rehabilitation of this population rely on evaluations by medical professionals in a clinical environment (Espay *et al.*, 2016). Monitoring their symptoms is not possible after the patient leaves the clinic due to the lack of standard approaches (Espay *et al.*, 2016). The quality of life of this population can be improved significantly with the help of *wearable internet-of-things (IoT) devices* that combine sensing, processing, and wireless communication (Dimitrov, 2016; Hiremath *et al.*, 2014).

Wearable sensors and mobile health applications are emerging as attractive solutions to augment clinical treatment and enable telepathic diagnostics (Daneault, 2018; Espay *et al.*, 2016). The use of wearable devices has been recently demonstrated for monitoring patients in a free-living home environment (Lee *et al.*, 2015). This capability allows doctors to understand the progression of symptoms over time (Contreras *et al.*, 2016). Wearable devices have also shown promising results in the diagnosis and management of many movement disorders. For instance,

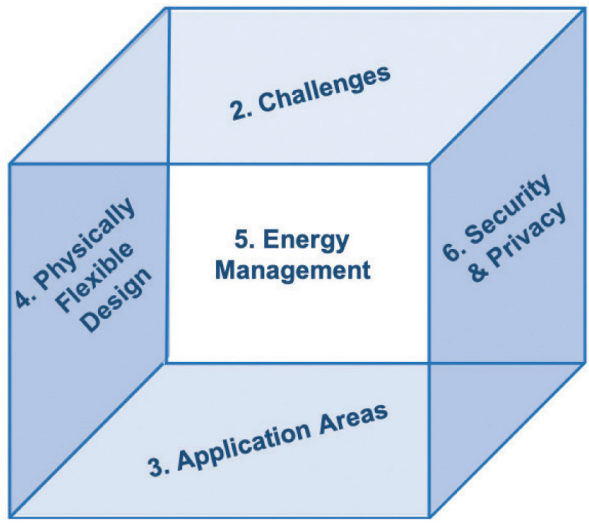

Figure 1.1: Organization of rest of the sections. The challenges and application requirements determine the design needs. Design- and run-time approaches to address these needs are presented in Sections 4 and 5, respectively, while security and privacy are discussed in Section 6.

studies in Woods *et al.* (2014) and Pulliam *et al.* (2014) use wearable sensors and machine learning algorithms to identify essential tremor in patients. Wearable technology has also been widely used in the diagnosis and treatment of Parkinson's disease patients (Chomiak *et al.*, 2017; Zhang *et al.*, 2018). Despite these promising results, practical use of wearable sensors and devices is still largely limited to research prototypes.

Recent research has studied the challenges that hinder the widespread adoption of wearable devices despite their potential to improve healthcare (Espay *et al.*, 2016; Ozanne *et al.*, 2018). Addressing these challenges can transform existing pioneers and research prototypes into mainstream wearable technology that routinely improve the quality of life. To this end, this monograph is organized to analyze these challenges and discuss potential solutions, as illustrated with related facets of the system design problem in Figure 1.1.

- Challenges: Recent studies show that users and technology developers face a variety of adaptation and technology challenges, which obstruct broad acceptance of wearable devices (Ozanne *et al.*, 2018). Understanding these challenges can drive research effort towards effective and practical solutions. To this end, Section 2 discusses these challenges and potential solutions.

- Driver application areas: Driver applications and standard hardware-software (HW-SW) platforms are needed to achieve a scalable solution. They can demonstrate the value of wearable devices and expedite their adoption (Espay *et al.*, 2016). Hence, they help build a large user base and stimulate demand for wearable solutions. At the same time, driver applications determine the processing power, sensing, communication, and energy requirements. This data, then, can drive the design of hardware–software platforms and energy management frameworks. Therefore, Section 3 introduces potential high-impact application areas.

- Physically flexible and stretchable designs: User studies show that conventional rigid devices are uncomfortable and awkward to wear for long periods of time. Therefore, users prefer not to wear them in public (Ozanne *et al.*, 2018). Physically flexible and stretchable electronics offer a great potential for sensor-rich wearable applications that can conform to the user's body (Khan *et al.*, 2016a). Section 4 presents physically flexible design techniques and overviews existing prototypes that can pave the way to commercial devices.

- Powering wearable devices: One of the major limitations of wearable devices is the limited battery capacity that can be obtained within a wearable form-factor. Therefore, small-form-factor wearable devices must operate under extreme energy constraints and ideally sustain on their own energy. More specifically, self-powered devices can harvest energy and optimally manage the available energy to maximize its utilization (Bhat *et al.*, 2017). To this end, Section 5 presents energy harvesting and management techniques for wearable devices.

- Security and privacy for wearable devices: Security and privacy are two leading concerns of the users of wearable health monitoring devices (Ozanne *et al.*, 2018). Most users do not feel comfortable sending private data to the cloud for processing and storage. At the same time, it is not possible to process the data and infer clinical decisions locally without network connectivity. Therefore, practical solutions must be secure and protect the privacy of their users. Section 6 discusses these considerations and survey existing solutions.

References

Aggarwal, V. (2019). "Solar panel efficiency: What panels are most efficient?: EnergySage". URL: https://news.energysage.com/what-are-the-most-efficient-solar-panels-on-the-market/.

Ahmed, K. Z. (2016). "Efficient power management circuits for energy harvesting applications". *PhD thesis*. Georgia Institute of Technology.

Alippi, C. and C. Galperti (2008). "An adaptive system for optimal solar energy harvesting in wireless sensor network nodes". *IEEE Transactions on Circuits and Systems I: Regular Papers*. 55(6): 1742–1750.

Almaslukh, B., J. AlMuhtadi, and A. Artoli (2017). "An effective deep autoencoder approach for online smartphone-based human activity recognition". *International Journal of Computer Science and Network Security*. 17(4): 160–165.

Alshurafa, N. and J. Hester (2017). "Personalized medicine in the wearable era: Translational barriers and call to action". In: *Proceedings of the First International Workshop on Human-Centered Sensing, Networking, and Systems*. 37–42.

American Semiconductor Inc. (2017). "FleX-SoC™ programmable system-on-chip". https://www.americansemi.com/uploads/1/0/8/4/108441507/flex-cy8c20_soc_datasheet.pdf.

American Semiconductor Inc. (2020). "FleX™ silicon-on-polymer™". https :// www . americansemi . com / flex-ics . html. Accessed 19 February 2020.

Amft, O. (2010). "A wearable earpad sensor for chewing monitoring". In: *SENSORS, 2010 IEEE*. IEEE. 222–227.

Amoli, N. A., S. Sivapurapu, R. Chen, Y. Zhou, M. L. Bellaredj, P. A. Kohl, S. K. Sitaraman, and M. Swaminathan (2019). "Screen-printed flexible coplanar waveguide transmission lines: Multi-physics modeling and measurement". In: *Proceedings of the IEEE Electronic Components and Technology Conference*. 249–257.

Ananthanarayan, S., M. Sheh, A. Chien, H. Profita, and K. A. Siek (2014). "Designing wearable interfaces for knee rehabilitation". In: *Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare*. 101–108.

Andrenko, A. S., X. Lin, and M. Zeng (2015). "Outdoor RF spectral survey: A roadmap for ambient RF energy harvesting". In: *TENCON 2015–2015 IEEE Region 10 Conference*. 1–4.

ANSYS HFSS (2020). "FEM tool by ANSYS". https://www.ansys.com/. Accessed 18 February 2020.

Aoudia, F. A., M. Gautier, and O. Berder (2018). "RLMan: An energy manager based on reinforcement learning for energy harvesting wireless sensor networks". *IEEE Transactions on Green Communications and Networking*. 2(2): 408–417.

Arias, O., J. Wurm, K. Hoang, and Y. Jin (2015). "Privacy and security in internet of things and wearable devices". *IEEE Transactions on Multi-Scale Computing Systems*. 1(2): 99–109.

Arif, M., M. Bilal, A. Kattan, and S. I. Ahamed (2014). "Better physical activity classification using smartphone acceleration sensor". *J. Med. Syst.* 38(9): 95.

Astrin, A. (2012). "IEEE standard for local and metropolitan area networks part 15.6: Wireless body area networks". *IEEE Std. 802.15.6*.

Avci, A., S. Bosch, M. Marin-Perianu, R. Marin-Perianu, and P. Havinga (2010). "Activity recognition using inertial sensing for healthcare, Wellbeing and sports applications: A survey". In: *23th International Conference on Architecture of Computing Systems 2010*. 1–10.

Bachy, Y., F. Basse, V. Nicomette, E. Alata, M. Kaâniche, J.-C. Courrège, and P. Lukjanenko (2015). "Smart-TV security analysis: Practical experiments". In: *2015 45th Annual IEEE/IFIP International Conference on Dependable Systems and Networks*. IEEE. 497–504.

Badawi, A. A., A. Al-Kabbany, and H. Shaban (2018). "Daily activity recognition using wearable sensors via machine learning and feature selection". In: *2018 13th International Conference on Computer Engineering and Systems (ICCES)*. IEEE. 75–79.

Bahadori, S., T. Immins, and T. W. Wainwright (2018). "A review of wearable motion tracking systems used in rehabilitation following hip and knee replacement". *Journal of Rehabilitation and Assistive Technologies Engineering*. 5. DOI: 10.1177/2055668318771816.

Bahk, J.-H., H. Fang, K. Yazawa, and A. Shakouri (2015). "Flexible thermoelectric materials and device optimization for wearable energy harvesting". *Journal of Materials Chemistry C*. 3(40): 10362–10374.

Banda, C., R. W. Johnson, T. Zhang, Z. Hou, and H. K. Charles (2008). "Flip chip assembly of thinned silicon die on flex substrates". *IEEE Transactions on Electronics Packaging Manufacturing*. 31(1): 1–8.

Banos, O., M. Damas, H. Pomares, and I. Rojas (2012). "On the use of sensor fusion to reduce the impact of rotational and additive noise in human activity recognition". *Sensors*. 12(6): 8039–8054.

Bao, L. and S. S. Intille (2004). "Activity recognition from user-annotated acceleration data". In: *International Conference on Pervasive Computing*. 1–17.

Bariya, M., H. Y. Y. Nyein, and A. Javey (2018). "Wearable sweat sensors". *Nature Electronics*. 1(3): 160–171.

Basnight, Z., J. Butts, J. Lopez Jr, and T. Dube (2013). "Firmware modification attacks on programmable logic controllers". *International Journal of Critical Infrastructure Protection*. 6(2): 76–84.

Bassani, G., A. Filippeschi, and E. Ruffaldi (2018). "Nonresonant kinetic energy harvesting using macrofiber composite patch". *IEEE Sensors Journal*. 18(5): 2068–2076.

Bayés, À., A. Samá, A. Prats, C. Pérez-López, M. Crespo-Maraver, J. Manuel Moreno, S. Alcaine, A. Rodriguez-Molinero, B. Mestre, P. Quispe, A. Correia de Barros, R. Castro, A. Costa, R. Annicchiarico, P. Browne, T. Counihan, H. Lewy, G. Vainstein, L. R. Quinlan, D. Sweeney, G. ÓLaighin, J. Rovira, D. Rodriguez-Martin, and J. Cabestany (2018). "A 'HOLTER' for Parkinson's disease: Validation of the ability to detect on-off states using the REMPARK system". *Gait & Posture*. 59: 1–6.

Bedri, A., D. Li, R. Khurana, K. Bhuwalka, and M. Goel (2020). "FitByte: Automatic diet monitoring in unconstrained situations using multimodal sensing on eyeglasses". In: *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. 1–12.

Bellaouar, A. and M. Elmasry (2012). *Low-Power Digital VLSI Design: Circuits and Systems*. Springer Science & Business Media.

Bencsáth, B., L. Buttyán, and T. Paulik (2011). "XCS based hidden firmware modification on embedded devices". In: *SoftCOM 2011, 19th International Conference on Software, Telecommunications and Computer Networks*. IEEE. 1–5.

Benjamin, E. J., S. S. Virani, C. W. Callaway, A. M. Chamberlain, A. R. Chang, S. Cheng, S. E. Chiuve, M. Cushman, F. N. Delling, R. Deo, S. D. de Ferranti, J. F. Ferguson, M. Fornage, C. Gillespie, C. R. Isasi, M. C. Jiménez, L. Chaffin Jordan, S. E. Judd, D. Lackland, J. H. Lichtman, L. Lisabeth, S. Liu, C. T. Longenecker, P. L. Lutsey, J. S. Mackey, D. B. Matchar, K. Matsushita, M. E. Mussolino, K. Nasir, M. O'Flaherty, L. P. Palaniappan, A. Pandey, D. K. Pandey, M. J. Reeves, M. D. Ritchey, C. J. Rodriguez, G. A. Roth, W. D. Rosamond, U. K. A. Sampson, G. M. Satou, S. H. Shah, N. L. Spartano, D. L. Tirschwell, C. W. Tsao, J. H. Voeks, J. Z. Willey, J. T. Wilkins, J. H. Y. Wu, H. M. Alger, S. S. Wong, and P. Muntner (2018). "Heart disease and stroke statistics-2018 update: A report from the American Heart Association." *Circulation*. 137(12): e67.

Bhardwaj, K., N. Suda, and R. Marculescu (2019). "EdgeAI: A vision for deep learning in IoT era". *IEEE Design & Test*.

Bhat, G., U. Gupta, N. Tran, J. Park, S. Ozev, and U. Y. Ogras (2016). "Multi-objective design optimization for flexible hybrid electronics". In: *Proceedings of the International Conference on Computer-Aided Design*.

Bhat, G., R. Deb, V. V. Chaurasia, H. Shill, and U. Y. Ogras (2018). "Online human activity recognition using low-power wearable devices". In: *Proceedings of the International Conference on Computer-Aided Design*. 1–8.

Bhat, G., J. Park, and U. Y. Ogras (2017). "Near-optimal energy allocation for self-powered wearable systems". In: *Proceedings of the International Conference on Computer-Aided Design*. 368–375.

Bhat, G., R. Deb, and U. Y. Ogras (2019). "OpenHealth: Open source platform for wearable health monitoring". *IEEE Design & Test*.

Bhat, G., H. Gao, S. K. Mandal, U. Y. Ogras, and S. Ozev (2020). "Determining mechanical stress testing parameters for FHE designs with low computational overhead". *IEEE Design & Test*.

Bletsch, T., X. Jiang, V. W. Freeh, and Z. Liang (2011). "Jump-oriented programming: A new class of code-reuse attack". In: *Proceedings of the 6th ACM Symposium on Information, Computer and Communications Security*. ACM. 30–40.

Bonaci, T., L. Bushnell, and R. Poovendran (2010). "Node capture attacks in wireless sensor networks: A system theoretic approach". In: *49th IEEE Conference on Decision and Control (CDC)*. IEEE. 6765–6772.

Bonomi, A. G., A. H. Goris, B. Yin, and K. R. Westerterp (2009). "Detection of type, duration, and intensity of physical activity using an accelerometer". *Medicine & Science in Sports & Exercise*. 41(9): 1770–1777.

Boutelle, K. N. and D. S. Kirschenbaum (1998). "Further support for consistent self-monitoring as a vital component of successful weight control". *Obesity Research*. 6(3): 219–224.

Brook, R. A., A. Forsythe, J. E. Smeeding, and N. Lawrence Edwards (2010). "Chronic gout: Epidemiology, disease progression, treatment and disease burden". *Current Medical Research and Opinion*. 26(12): 2813–2821.

Bryant, D., J. Boyd, J. Harris, M. Smith, S. Garcia-Vergara, Y.-P. Chen, and A. Howard (2017). "An infant smart-mobile system to encourage kicking movements in infants at-risk of cerebral palsy". In: *2017 IEEE Workshop on Advanced Robotics and Its Social Impacts (ARSO)*. IEEE. 1–5.

Bulling, A., D. Roggen, and G. Tröster (2009). "Wearable EOG goggles: Seamless sensing and context-awareness in everyday environments". *Journal of Ambient Intelligence and Smart Environments*. 1(2): 157–171.

Carreon-Bautista, S., L. Huang, and E. Sanchez-Sinencio (2016). "An autonomous energy harvesting power management unit with digital regulation for IoT applications". *IEEE Journal of Solid-State Circuits*. 51(6): 1457–1474.

Casamassima, F., E. Farella, and L. Benini (2014). "Context aware power management for motion-sensing body area network nodes". In: *2014 Design, Automation & Test in Europe Conference & Exhibition (DATE)*. 1–6.

Chang, J., X. Zhang, T. Ge, and J. Zhou (2014). "Fully printed electronics on flexible substrates: High gain amplifiers and DAC". *Organic Electronics*. 15(3): 701–710.

Chin-Wang, T. (2017). "Mechanics and materials science". In: *Proceedings of the International Conference on Mechanics and Materials Science*. World Scientific.

Choi, Y.-M., M. G. Lee, and Y. Jeon (2017). "Wearable biomechanical energy harvesting technologies". *Energies*. 10(10): 1483.

Chomiak, T., A. Watts, N. Meyer, F. V. Pereira, and B. Hu (2017). "A training approach to improve stepping automaticity while dual-tasking in Parkinson's disease: A prospective pilot study". *Medicine*. 96(5).

Chong, Y.-W., W. Ismail, K. Ko, and C.-Y. Lee (2019). "Energy harvesting for wearable devices: A review". *IEEE Sensors Journal*. 19(20): 9047–9062.

Chou, C.-L. and R. Marculescu (2010). "Designing heterogeneous embedded network-on-chip platforms with users in mind". *IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems*. 29(9): 1301–1314.

Chou, C.-L., A. M. Miron, and R. Marculescu (2010). "Find your flow: Increasing flow experience by designing 'human' embedded systems". In: *Proceedings of the 47th Design Automation Conference*. 619–620.

Chow, J. H., J. Meth, and S. K. Sitaraman (2019). "Twist testing for flexible electronics". In: *2019 IEEE 69th Electronic Components and Technology Conference (ECTC)*. IEEE. 785–791.

COMSOL Multiphysics© (2015). "The platform for physics-based modeling and simulation". https://www.comsol.com/comsol-multiphysics, 7 July 2015.

Conti, M., R. Di Pietro, L. V. Mancini, and A. Mei (2008). "Emergent properties: Detection of the node-capture attack in mobile wireless sensor networks". In: *Proceedings of the First ACM Conference on Wireless Network Security*. ACM. 214–219.

Contreras, R., M. Huerta, G. Sagbay, C. Lumiguano, M. Bravo, A. Bermeo, R. Clotet, and A. Soto (2016). "Tremors quantification in Parkinson patients using smartwatches". In: *Proceedings of the IEEE Ecuador Technical Chapters Meeting (ETCM)*. 1–6.

Cornacchia, M., K. Ozcan, Y. Zheng, and S. Velipasalar (2016). "A survey on activity detection and classification using wearable sensors". *IEEE Sensors Journal*. 17(2): 386–403.

Costanzo, A. and D. Masotti (2013). "Design of RF energy harvesting platforms for power management unit with start-up circuits". *J. Phys., Conf. Ser.* 476(1): 012043.

Costin, A., J. Zaddach, A. Francillon, and D. Balzarotti (2014). "A large-scale analysis of the security of embedded firmwares". In: *23rd USENIX Security Symposium (USENIX Security 14)*. 95–110.

Crawford, G. (2005). *Flexible Flat Panel Displays*. John Wiley & Sons.

Cui, A., M. Costello, and S. J. Stolfo (2013). "When firmware modifications attack: A case study of embedded exploitation". In: *20th Annual Network and Distributed System Security Symposium*.

Dai, S., D. Chen, F. Xiong, and Z. Chen (2018). "Motion artifact reduction in electrocardiogram using adaptive filtering based on skin-potential variation monitoring". In: *EAI International Conference on Body Area Networks*. Springer. 465–472.

Daneault, J.-F. (2018). "Could wearable and mobile technology improve the management of essential tremor?" *Frontiers in Neurology*. 9: 1–8.

Deb, R. (2019). "How does technology development influence the assessment of Parkinson's disease? A systematic review". *MA thesis*. Arizona State University.

Debes, C., A. Merentitis, S. Sukhanov, M. Niessen, N. Frangiadakis, and A. Bauer (2016). "Monitoring activities of daily living in smart homes: Understanding human behavior". *IEEE Signal Processing Magazine*. 33(2): 81–94.

Dimitrov, D. V. (2016). "Medical internet of things and big data in healthcare". *Healthcare Informatics Research*. 22(3): 156–163.

Dini, M., M. Filippi, A. Costanzo, A. Romani, M. Tartagni, M. Del Prete, and D. Masotti (2013). "A fully-autonomous integrated RF energy harvesting system for wearable applications". In: *2013 European Microwave Conference*. 987–990.

Dong, L., C. Xu, Y. Li, Z.-H. Huang, F. Kang, Q.-H. Yang, and X. Zhao (2016). "Flexible electrodes and supercapacitors for wearable energy storage: A review by category". *Journal of Materials Chemistry A*. 4(13): 4659–4685.

Dong, Y., J. Scisco, M. Wilson, E. Muth, and A. Hoover (2013). "Detecting periods of eating during free-living by tracking wrist motion". *IEEE Journal of Biomedical and Health Informatics*. 18(4): 1253–1260.

Duflot, L., Y.-A. Perez, and B. Morin (2011). "What if you can't trust your network card?" In: *International Workshop on Recent Advances in Intrusion Detection*. Springer. 378–397.

Dunne, A., S. Do-Lenh, G. Ó'Laighin, C. Shen, and P. Bonato (2010). "Upper extremity rehabilitation of children with cerebral palsy using accelerometer feedback on a multitouch display". In: *2010 Annual International Conference of the IEEE Engineering in Medicine and Biology*. IEEE. 1751–1754.

Durgun, A. C., C. A. Balanis, C. R. Birtcher, and D. R. Allee (2011). "Design, simulation, fabrication and testing of flexible bow-tie antennas". *IEEE Transactions on Antennas and Propagation*. 59(12): 4425–4435.

El-Kady, M. F. and R. B. Kaner (2013). "Scalable fabrication of high-power graphene micro-supercapacitors for flexible and on-chip energy storage". *Nature Communications*. 4: 1475.

Espay, A. J., P. Bonato, F. B. Nahab, W. Maetzler, J. M. Dean, J. Klucken, B. M. Eskofier, A. Merola, F. Horak, A. E. Lang, R. Reilmann, J. Giuffrida, A. Nieuwboer, M. Horne, M. A. Little, I. Litvan, T. Simuni, E. R. Dorsey, M. A. Burack, K. Kubota, A. Kamondi, C. Godinho, J.-F. Daneault, G. Mitsi, L. Krinke, J. M. Hausdorff, B. R. Bloem, and S. Papapetropoulos on behalf of the Movement Disorders Society Task Force on Technology (2016). "Technology in Parkinson's disease: Challenges and opportunities". *Movement Disorders*. 31(9): 1272–1282.

Estrada-López, J. J., A. Abuellil, Z. Zeng, and E. Sánchez-Sinencio (2018). "Multiple input energy harvesting systems for autonomous IoT end-nodes". *Journal of Low Power Electronics and Applications*. 8(1): 6.

Farooq, M. and E. Sazonov (2016). "Segmentation and characterization of chewing bouts by monitoring temporalis muscle using smart glasses with piezoelectric sensor". *IEEE Journal of Biomedical and Health Informatics*. 21(6): 1495–1503.

Gabbett, T. J. (2010). "GPS analysis of elite women's field hockey training and competition". *The Journal of Strength & Conditioning Research*. 24(5): 1321–1324.

Gabbett, T. J. and A. J. Seibold (2013). "Relationship between tests of physical qualities, team selection, and physical match performance in semiprofessional rugby league players". *The Journal of Strength & Conditioning Research*. 27(12): 3259–3265.

Gao, X., H. Luo, Q. Wang, F. Zhao, L. Ye, and Y. Zhang (2019). "A human activity recognition algorithm based on stacking denoising autoencoder and lightGBM". *Sensors*. 19(4): 947.

Gaudette, B., V. Hanumaiah, S. Vrudhula, and M. Krunz (2012). "Optimal range assignment in solar powered active wireless sensor networks". In: *Proceedings of the IEEE Infocom*. 2354–2362.

Gowrisanker, S., M. Quevedo-Lopez, H. Alshareef, B. Gnade, S. Venugopal, R. Krishna, K. Kaftanoglu, and D. Allee (2009). "A novel low temperature integration of CMOS devices on flexible substrates". *Organic Electronics*. 10(7): 1217–1222.

Gu, F., K. Khoshelham, S. Valaee, J. Shang, and R. Zhang (2018). "Locomotion activity recognition using stacked denoising autoencoders". *IEEE Internet of Things Journal*. 5(3): 2085–2093.

Guo, Z., I. G. Harris, Y. Jiang, and L.-F. Tsaur (2017). "An efficient approach to prevent battery exhaustion attack on BLE-based mesh networks". In: *2017 International Conference on Computing, Networking and Communications (ICNC)*. IEEE. 1–5.

Gupta, U., S. Jain, and U. Y. Ogras (2015). "Can systems extend to polymer? SoP architecture design and challenges". In: *28th IEEE International System-on-Chip Conference (SOCC)*.

Gupta, U., J. Park, H. Joshi, and U. Y. Ogras (2017). "Flexibility-aware system-on-polymer (SoP): Concept to prototype". *IEEE Transactions on Multi-Scale Computing Systems*. 3(1): 36–49.

Haladjian, J., Z. Hodaie, H. Xu, M. Yigin, B. Bruegge, M. Fink, and J. Hoeher (2015). "KneeHapp: A bandage for rehabilitation of knee injuries". In: *Adjunct Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2015 ACM International Symposium on Wearable Computers*. 181–184.

Hanyu, S. and C. Xiaohui (2017). "Motion artifact detection and reduction in PPG signals based on statistics analysis". In: *2017 29th Chinese Control and Decision Conference (CCDC)*. IEEE. 3114–3119.

Happonen, T., J.-V. Voutilainen, and T. Fabritius (2014). "Reliability study on adhesive interconnections in flex-to-flex printed electronics applications under environmental stresses". *IEEE Transactions on Device and Materials Reliability*. 14(4): 1005–1012.

Harris, K., A. Elias, and H.-J. Chung (2016). "Flexible electronics under strain: A review of mechanical characterization and durability enhancement strategies". *Journal of Materials Science*. 51(6): 2771–2805.

He, H., Y. She, J. Xiahou, J. Yao, J. Li, Q. Hong, and Y. Ji (2018). "Real-time eye-gaze based interaction for human intention prediction and emotion analysis". In: *Proceedings of Computer Graphics International 2018*. 185–194.

Hei, X., X. Du, J. Wu, and F. Hu (2010). "Defending resource depletion attacks on implantable medical devices". In: *2010 IEEE Global Telecommunications Conference GLOBECOM 2010*. IEEE. 1–5.

Herbert, R., J.-H. Kim, Y. S. Kim, H. M. Lee, and W.-H. Yeo (2018). "Soft material-enabled, flexible hybrid electronics for medicine, healthcare, and human-machine interfaces". *Materials*. 11(2): 187.

Hester, J. and J. Sorber (2017). "The future of sensing is batteryless, intermittent, and awesome". In: *Proceedings of the 15th ACM Conference on Embedded Network Sensor Systems*. ACM. 21.

Hiremath, S., G. Yang, and K. Mankodiya (2014). "Wearable internet of things: Concept, architectural components and promises for person-centered healthcare": 304–307. DOI: 10.4108/icst.mobihealth.2014.257440.

Hong, Y. J., H. Jeong, K. W. Cho, N. Lu, and D.-H. Kim (2019). "Wearable and implantable devices for cardiovascular healthcare: From monitoring to therapy based on flexible and stretchable electronics". *Advanced Functional Materials*. 29(19): 1808247.

Hu, Y., L. Huang, W. S. Rieutort-Louis, J. Sanz-Robinson, J. C. Sturm, S. Wagner, and N. Verma (2014). "A self-powered system for large-scale strain sensing by combining CMOS ICs with large-area electronics". *IEEE Journal of Solid-State Circuits*. 49(4): 838–850.

Huang, H. (2013). "Flexible wireless antenna sensor: A review". *IEEE Sensors Journal*. 13(10): 3865–3872.

Huang, T.-C., J.-L. Huang, and K.-T. Cheng (2011). "Robust circuit design for flexible electronics". *IEEE Design and Test of Computers*. 28(6): 8–15.

Huang, T.-C. J., J.-L. Huang, and K.-T. T. Cheng (2015). "Design, automation, and test for low-power and reliable flexible electronics". *Found. and Trends in Electronic Design Automation*. 9(2): 99–210.

Huang, T.-C., L. Shao, T. Lei, R. Beausoleil, Z. Bao, and K.-T. Cheng (2017). "Robust design and design automation for flexible hybrid electronics". In: *2017 IEEE International Symposium on Circuits and Systems (ISCAS)*. 1–4.

Huang, T.-C., T. Lei, L. Shao, S. Sivapurapu, M. Swaminathan, S. Li, Z. Bao, K.-T. Cheng, and R. Beausoleil (2019). "Process design kit and design automation for flexible hybrid electronics". In: *2019 Design, Automation & Test in Europe Conference & Exhibition (DATE)*. 36–41.

Hussain, M. M. and N. El-Atab (2019). *Handbook of Flexible and Stretchable Electronics*. CRC Press.

Huu, T. N., T. N. Van, and O. Takahito (2018). "Flexible thermoelectric power generator with Y-type structure using electrochemical deposition process". *Applied Energy*. 210: 467–476.

Hyland, M., H. Hunter, J. Liu, E. Veety, and D. Vashaee (2016). "Wearable thermoelectric generators for human body heat harvesting". *Applied Energy*. 182: 518–524.

Ibarra, E., A. Antonopoulos, E. Kartsakli, J. J. Rodrigues, and C. Verikoukis (2015). "QoS-aware energy management in body sensor nodes powered by human energy harvesting". *IEEE Sensors Journal*. 16(2): 542–549.

Jaimes, A. and N. Sebe (2007). "Multimodal human–computer interaction: A survey". *Computer Vision and Image Understanding*. 108(1–2): 116–134.

Jensen, M. D., D. H. Ryan, C. M. Apovian, J. D. Ard, A. G. Comuzzie, K. A. Donato, F. B. Hu, V. S. Hubbard, J. M. Jakicic, R. F. Kushner, C. M. Loria, B. E. Millen, C. A. Nonas, F. X. Pi-Sunyer, J. Stevens, V. J. Stevens, T. A. Wadden, B. M. Wolfe, and S. Z. Yanovski (2014). "2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: A report of the American college of Cardiology/American heart association task force on practice guidelines and the obesity society". *Journal of the American College of Cardiology*. 63(25 Part B): 2985–3023.

Jeong, H., L. Wang, T. Ha, R. Mitbander, X. Yang, Z. Dai, S. Qiao, L. Shen, N. Sun, and N. Lu (2019). "Modular and reconfigurable wireless E-tattoos for personalized sensing". *Advanced Materials Technologies*. 4(8): 1900117.

Jeong, S. H., F. J. Cruz, S. Chen, L. Gravier, J. Liu, Z. Wu, K. Hjort, S.-L. Zhang, and Z.-B. Zhang (2017). "Stretchable thermoelectric generators metallized with liquid alloy". *ACS Applied Materials & Interfaces*. 9(18): 15791–15797.

Jia, C., M. Shao, S. Li, H. Zhao, and Y. Fu (2017). "Stacked denoising tensor auto-encoder for action recognition with spatiotemporal corruptions". *IEEE Transactions on Image Processing*. 27(4): 1878–1887.

Johansson, D., K. Malmgren, and M. Murphy (2018). "Wearable sensors for clinical applications in epilepsy, Parkinson's disease, and stroke: A mixed-methods systematic review". *Journal of Neurology*: 1–13.

Johnston, R. J., M. L. Watsford, M. J. Pine, R. W. Spurrs, A. Murphy, and E. C. Pruyn (2012). "Movement demands and match performance in professional Australian football". *International Journal of Sports Medicine*. 33(2): 89–93.

Jokic, P. and M. Magno (2017). "Powering smart wearable systems with flexible solar energy harvesting". In: *2017 IEEE International Symposium on Circuits and Systems (ISCAS)*. 1–4.

Jung, W.-S., M.-J. Lee, M.-G. Kang, H. G. Moon, S.-J. Yoon, S.-H. Baek, and C.-Y. Kang (2015). "Powerful curved piezoelectric generator for wearable applications". *Nano Energy*. 13: 174–181.

Kang, S., A. Paul, and G. Jeon (2017). "Reduction of mixed noise from wearable sensors in human-motion estimation". *Computers & Electrical Engineering*. 61: 287–296.

Kansal, A., J. Hsu, S. Zahedi, and M. B. Srivastava (2007). "Power management in energy harvesting sensor networks". *ACM Transactions on Embedded Computing Systems*. 6(4): 32.

Karabacak, F., U. Ogras, and S. Ozev (2018). "Remote detection of unauthorized activity via spectral analysis". *ACM Transactions on Design Automation of Electronic Systems (TODAES)*. 23(6): 1–21.

Karaki, N., T. Nanmoto, H. Ebihara, S. Inoue, and T. Shimoda (2005). "43.1: A flexible 8-bit asynchronous microprocessor based on low-temperature poly-silicon (LTPS) TFT technology". In: *SID Symposium Digest of Technical Papers*. Vol. 36. Wiley Online Library. 1430–1433.

Kazemi, R., R. Vesilo, E. Dutkiewicz, and R. Liu (2011). "Dynamic power control in wireless body area networks using reinforcement learning with approximation". In: *2011 IEEE 22nd International Symposium on Personal, Indoor and Mobile Radio Communications*. 2203–2208.

Keoh, S. L., S. S. Kumar, and H. Tschofenig (2014). "Securing the internet of things: A standardization perspective". *IEEE Internet of Things Journal*. 1(3): 265–275.

Khamis, M., F. Alt, and A. Bulling (2018). "The past, present, and future of gaze-enabled handheld mobile devices: Survey and lessons learned". In: *Proceedings of the 20th International Conference on Human-Computer Interaction with Mobile Devices and Services*. 1–17.

Khan, M. A. and K. Salah (2018). "IoT security: Review, blockchain solutions, and open challenges". *Future Generation Computer Systems*. 82: 395–411.

Khan, S., L. Lorenzelli, and R. S. Dahiya (2014). "Technologies for printing sensors and electronics over large flexible substrates: A review". *IEEE Sensors Journal*. 15(6): 3164–3185.

Khan, Y., M. Garg, Q. Gui, M. Schadt, A. Gaikwad, D. Han, N. A. D. Yamamoto, P. Hart, R. Welte, W. Wilson, S. Czarnecki, M. Poliks, Z. Jin, K. Ghose, F. Egitto, J. Turner, and A. C. Arias (2016a). "Flexible hybrid electronics: Direct interfacing of soft and hard electronics for wearable health monitoring". *Advanced Functional Materials*. 26(47): 8764–8775.

Khan, Y., A. E. Ostfeld, C. M. Lochner, A. Pierre, and A. C. Arias (2016b). "Monitoring of vital signs with flexible and wearable medical devices". *Advanced Materials*. 28(22): 4373–4395.

Kim, S.-H., K.-H. Choi, S.-J. Cho, S. Choi, S. Park, and S.-Y. Lee (2015). "Printable solid-state lithium-ion batteries: A new route toward shape-conformable power sources with aesthetic versatility for flexible electronics". *Nano Letters*. 15(8): 5168–5177.

Kim, S. J., H. E. Lee, H. Choi, Y. Kim, J. H. We, J. S. Shin, K. J. Lee, and B. J. Cho (2016). "High-performance flexible thermoelectric power generator using laser multiscanning lift-off process". *ACS Nano*. 10(12): 10851–10857.

Konstantinou, C. and M. Maniatakos (2015). "Impact of firmware modification attacks on power systems field devices". In: *2015 IEEE International Conference on Smart Grid Communications (SmartGridComm)*. IEEE. 283–288.

Konstantopoulos, C. and E. Koutroulis (2013). "Global maximum power point tracking of flexible photovoltaic modules". *IEEE Transactions on Power Electronics*. 29(6): 2817–2828.

Korzeniewska, E., M. Walczak, and J. Rymaszewski (2017). "Elements of elastic electronics created on textile substrate". In: *Proceedings of the Inernational Conference of Mixed Design of Integrated Circuits and Systems*. 447–450.

Kos, M. and I. Kramberger (2017). "A wearable device and system for movement and biometric data acquisition for sports applications". *IEEE Access*. 5: 6411–6420.

Kwak, Y. H., W. Kim, K. B. Park, K. Kim, and S. Seo (2017). "Flexible heartbeat sensor for wearable device". *Biosensors and Bioelectronics*. 94: 250–255.

Lall, P., J. Narangaparambil, A. Abrol, B. Leever, and J. Marsh (2018). "Development of test protocols for the flexible substrates in wearable applications". In: *2018 17th IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems (ITherm)*. IEEE. 1120–1127.

Leber, D. E., B. N. Meek, S. D. Leija, D. G. Wilson, R. L. Chaney, and D. R. Hackler (2016). "Electromechanical reliability testing of flexible hybrid electronics incorporating flex silicon-on-polymer ICs". In: *2016 IEEE Workshop on Microelectronics and Electron Devices (WMED)*. 1–4.

Lee, H., C. Upright, S. Eliuk, and A. Kobsa (2018a). "Personalized visual recognition via wearables: A first step toward personal perception enhancement". In: *Personal Assistants: Emerging Computational Technologies*. Springer. 95–112.

Lee, S. I., M. Y. Ozsecen, L. Della Toffola, J.-F. Daneault, A. Puiatti, S. Patel, and P. Bonato (2015). "Activity detection in uncontrolled free-living conditions using a single accelerometer". In: *2015 IEEE 12th International Conference on Wearable and Implantable Body Sensor Networks (BSN)*. 1–6.

Lee, S. I., C. P. Adans-Dester, M. Grimaldi, A. V. Dowling, P. C. Horak, R. M. Black-Schaffer, P. Bonato, and J. T. Gwin (2018b). "Enabling stroke rehabilitation in home and community settings: A wearable sensor-based approach for upper-limb motor training". *IEEE Journal of Translational Engineering in Health and Medicine*. 6: 1–11.

Li, C.-Y., Y.-C. Chen, W.-J. Chen, P. Huang, and H.-H. Chu (2013). "Sensor-embedded teeth for oral activity recognition". In: *Proceedings of the 2013 International Symposium on Wearable Computers*. 41–44.

Li, H., Z. Tang, Z. Liu, and C. Zhi (2019). "Evaluating flexibility and wearability of flexible energy storage devices". *Joule*. 3(3): 613–619.

Li, L., Z. Wu, S. Yuan, and X.-B. Zhang (2014). "Advances and challenges for flexible energy storage and conversion devices and systems". *Energy & Environmental Science*. 7(7): 2101–2122.

Li, R. T., S. R. Kling, M. J. Salata, S. A. Cupp, J. Sheehan, and J. E. Voos (2016). "Wearable performance devices in sports medicine". *Sports Health*. 8(1): 74–78.

Li, S. and B. H. Calhoun (2020). "Sub-microAmp energy harvesting and power management units for self-powered IoT SoCs: Analog vs. digital implementations". In: *IEEE Custom Integrated Circuits Conference (CICC)*. 1–8.

Linz, T., C. Kallmayer, R. Aschenbrenner, and H. Reichl (2006). "Fully untegrated EKG shirt based on embroidered electrical interconnections with conductive yarn and miniaturized flexible electronics". In: *International Workshop on Wearable and Implantable Body Sensor Networks*. 4pp.

Liu, H., Y. Wang, D. Mei, Y. Shi, and Z. Chen (2017a). "Design of a wearable thermoelectric generator for harvesting human body energy". In: *Wearable Sensors and Robots*. Springer. 55–66.

Liu, H., J. Zhong, C. Lee, S.-W. Lee, and L. Lin (2018). "A comprehensive review on piezoelectric energy harvesting technology: Materials, mechanisms, and applications". *Applied Physics Reviews*. 5(4): 041306.

Liu, K.-C., C.-Y. Yen, L.-H. Chang, C.-Y. Hsieh, and C.-T. Chan (2017b). "Wearable sensor-based activity recognition for housekeeping task". In: *2017 IEEE 14th International Conference on Wearable and Implantable Body Sensor Networks (BSN)*. IEEE. 67–70.

Liu, X., F. Hu, M. Shao, D. Sui, and G. He (2017c). "Power allocation for energy harvesting in wireless body area networks". *China Communications*. 14(6): 22–31.

Lu, Z., X. Chen, Q. Li, X. Zhang, and P. Zhou (2014). "A hand gesture recognition framework and wearable gesture-based interaction prototype for mobile devices". *IEEE Transactions on Human-Machine Systems*. 44(2): 293–299.

Lucia, B., V. Balaji, A. Colin, K. Maeng, and E. Ruppel (2017). "Intermittent computing: Challenges and opportunities". In: *2nd Summit on Advances in Programming Languages (SNAPL 2017)*. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik.

Maetzler, W., J. Klucken, and M. Horne (2016). "A clinical view on the development of technology-based tools in managing Parkinson's disease". *Movement Disorders*. 31(9): 1263–1271.

Magalhaes, F. A. d., G. Vannozzi, G. Gatta, and S. Fantozzi (2015). "Wearable inertial sensors in swimming motion analysis: A systematic review". *Journal of Sports Sciences*. 33(7): 732–745.

Magno, M. and D. Boyle (2017). "Wearable energy harvesting: From body to battery". In: *2017 12th International Conference on Design & Technology of Integrated Systems in Nanoscale Era (DTIS)*. 1–6.

Magno, M., D. Brunelli, L. Sigrist, R. Andri, L. Cavigelli, A. Gomez, and L. Benini (2016). "InfiniTime: Multi-sensor wearable bracelet with human body harvesting". *Sustainable Computing: Informatics and Systems*. 11: 38–49.

Mancinelli, C., S. Patel, L. C. Deming, M. Schmid, B. L. Patritti, J. J. Chu, J. Beckwith, R. Greenwald, J. Healey, and P. Bonato (2009). "Assessing the feasibility of classifying toe-walking severity in children with cerebral palsy using a sensorized shoe". In: *2009 Annual International Conference of the IEEE Engineering in Medicine and Biology Society*. IEEE. 5163–5166.

Mann, S. (2001). "Wearable computing: Toward humanistic intelligence". *IEEE Intelligent Systems*. 16(3): 10–15.

Mao, L., Q. Meng, A. Ahmad, and Z. Wei (2017). "Mechanical analyses and structural design requirements for flexible energy storage devices". *Advanced Energy Materials*. 7(23): 1700535.

Marculescu, D., R. Marculescu, N. H. Zamora, P. Stanley-Marbell, P. K. Khosla, S. Park, S. Jayaraman, S. Jung, C. Lauterbach, W. Weber, T. Kirstein, D. Cottet, J. Grzyb, G. Troster, M. Jones, T. Martin, and Z. Nakad (2003). "Electronic textiles: A platform for pervasive computing". *Proceedings of the IEEE*. 91(12): 1995–2018.

Marras, C., J. Beck, J. Bower, E. Roberts, B. Ritz, G. Ross, R. Abbott, R. Savica, S. Van Den Eeden, A. Willis, and C. M. Tanner on behalf of the Parkinson's Foundation P4 Group (2018). "Prevalence of Parkinson's disease across North America". *NPJ Parkinson's Disease*. 4(1): 21.

Martin, C. K., H. Han, S. M. Coulon, H. R. Allen, C. M. Champagne, and S. D. Anton (2008). "A novel method to remotely measure food intake of free-living individuals in real time: The remote food photography method". *British Journal of Nutrition*. 101(3): 446–456.

Matthew, D. and A. Delextrat (2009). "Heart rate, blood lactate concentration, and time–motion analysis of female basketball players during competition". *Journal of Sports Sciences*. 27(8): 813–821.

McGuire, M., U. Ogras, and S. Ozev (2019). "PCB hardware trojans: Attack modes and detection strategies". In: *2019 IEEE 37th VLSI Test Symposium (VTS)*. IEEE. 1–6.

McLaughlin, S., C. Konstantinou, X. Wang, L. Davi, A.-R. Sadeghi, M. Maniatakos, and R. Karri (2016). "The cybersecurity landscape in industrial control systems". *Proceedings of the IEEE*. 104(5): 1039–1057.

Medjahed, H., D. Istrate, J. Boudy, and B. Dorizzi (2009). "Human activities of daily living recognition using fuzzy logic for elderly home monitoring". In: *2009 IEEE International Conference on Fuzzy Systems*. IEEE. 2001–2006.

Miller, C. (2011). "Battery firmware hacking". *Black Hat USA*: 3–4.

Min, C.-H., N. F. Ince, and A. H. Tewfik (2008). "Early morning activity detection using acoustics and wearable wireless sensors". In: *2008 16th European Signal Processing Conference*. IEEE. 1–5.

Mitcheson, P. D., E. K. Reilly, T. Toh, P. K. Wright, and E. M. Yeatman (2007). "Performance limits of the three MEMS inertial energy generator transduction types". *Journal of Micromechanics and Microengineering*. 17(9): S211.

Mlinac, M. E. and M. C. Feng (2016). "Assessment of activities of daily living, self-care, and independence". *Archives of Clinical Neuropsychology*. 31(6): 506–516.

Molex (2020). "Molex manufacturing for flexible electronics". https://www.molex.com/molex/home, 18 Feb. 2020.

Mosavat-Jahromi, H., B. Maham, and T. A. Tsiftsis (2016). "Maximizing spectral efficiency for energy harvesting-aware WBAN". *IEEE Journal of Biomedical and Health Informatics*. 21(3): 732–742.

Mosenia, A., S. Sur-Kolay, A. Raghunathan, and N. K. Jha (2017). "Wearable medical sensor-based system design: A survey". *IEEE Transactions Multi-Scale Computer Systems*. 3(2): 124–138.

Movassaghi, S., M. Abolhasan, J. Lipman, D. Smith, and A. Jamalipour (2014). "Wireless body area networks: A survey". *IEEE Communications Surveys and Tutorials*. 16(3): 1658–1686.

Moy, T., W. Rieutort-Louis, Y. Hu, L. Huang, J. Sanz-Robinson, J. C. Sturm, S. Wagner, and N. Verma (2014). "Thin-film circuits for scalable interfacing between large-area electronics and CMOS ICs". In: *Device Research Conference*. 271–272.

Muncuk, U., K. Alemdar, J. D. Sarode, and K. R. Chowdhury (2018). "Multiband ambient RF energy harvesting circuit design for enabling batteryless sensors and IoT". *IEEE Internet of Things Journal*. 5(4): 2700–2714.

Muztoba, M., R. Voleti, F. Karabacak, J. Park, and U. Y. Ogras (2018). "Instinctive assistive indoor navigation using distributed intelligence". *ACM Transactions on Design Automation of Electronic Systems (TODAES)*. 23(6): 1–21.

Myny, K., E. Van Veenendaal, G. H. Gelinck, J. Genoe, W. Dehaene, and P. Heremans (2012). "An 8-bit, 40-instructions-per-second organic microprocessor on plastic foil". *IEEE Journal of Solid-State Circuits*. 47(1): 284–291.

Nathan, A., A. Ahnood, M. T. Cole, S. Lee, Y. Suzuki, P. Hiralal, F. Bonaccorso, T. Hasan, L. Garcia-Gancedo, A. Dyadyusha, S. Haque, P. Andrew, S. Hofmann, J. Moultrie, D. Chu, A. J. Flewitt, A. C. Ferrari, M. J. Kelly, J. Robertson, G. A. J. Amaratunga, and W. I. Milne (2012). "Flexible electronics: The next ubiquitous platform". *Proceedings of the IEEE*. 100: 1486–1517.

Nguyen, S. and R. Amirtharajah (2018). "A hybrid RF and vibration energy harvester for wearable devices". In: *2018 IEEE Applied Power Electronics Conference and Exposition (APEC)*. 1060–1064.

Nguyen, V.-L., P.-C. Lin, and R.-H. Hwang (2019). "Energy depletion attacks in low power wireless networks". *IEEE Access*. 7: 51915–51932.

Nishimura, J. and T. Kuroda (2008). "Eating habits monitoring using wireless wearable in-ear microphone". In: *2008 3rd International Symposium on Wireless Pervasive Computing*. IEEE. 130–132.

Noh, J., M. Jung, Y. Jung, C. Yeom, M. Pyo, and G. Cho (2015). "Key issues with printed flexible thin film transistors and their application in disposable RF sensors". *Proceedings of the IEEE*. 103(4): 554–566.

Noori, F. M., M. Riegler, M. Z. Uddin, and J. Torresen (2020). "Human activity recognition from multiple sensors data using multi-fusion representations and CNNs". *ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM)*. 16(2): 1–19.

Noubir, G. and G. Lin (2003). "Poster: Low-power DoS attacks in data wireless LANs and countermeasures". In: *Proceedings of Poster MobiHoc*. Vol. 3. 1–3.

Nozariasbmarz, A., H. Collins, K. Dsouza, M. H. Polash, M. Hosseini, M. Hyland, J. Liu, A. Malhotra, F. M. Ortiz, F. Mohaddes, V. Padmanabhan Ramesh, Y. Sargolzaeiaval, N. Snouwaert, M. C. Ozturk, and D. Vashaee (2019). "Review of wearable thermoelectric energy harvesting: From body temperature to electronic systems". *Applied Energy*: 114069.

Nweke, H. F., Y. W. Teh, G. Mujtaba, and M. A. Al-Garadi (2019). "Data fusion and multiple classifier systems for human activity detection and health monitoring: Review and open research directions". *Information Fusion*. 46: 147–170.

O'Brien, M. K., C. K. Mummidisetty, X. Bo, C. Poellabauer, and A. Jayaraman (2017). "Quantifying community mobility after stroke using mobile phone technology". In: *Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers*. ACM. 161–164.

O'Connor, T. F., M. E. Fach, R. Miller, S. E. Root, P. P. Mercier, and D. J. Lipomi (2017). "The language of glove: Wireless gesture decoder with low-power and stretchable hybrid electronics". *PloS One*. 12(7): e0179766.

O'Neill, M. (2016). "Insecurity by design: Today's IoT device security problem". *Engineering*. 2(1): 48–49.

Ostfeld, A. E., A. M. Gaikwad, Y. Khan, and A. C. Arias (2016). "High-performance flexible energy storage and harvesting system for wearable electronics". *Scientific Reports*. 6: 26122.

Ozanne, A., D. Johansson, U. Hällgren Graneheim, K. Malmgren, F. Bergquist, and M. Alt Murphy (2018). "Wearables in Epilepsy and Parkinson's disease—A focus group study". *Acta Neurologica Scandinavica*. 137(2): 188–194.

Panousis, N., J. Prosser, A. Wang, and Y.-N. Yong (1990). "Strength and reliability of ceramic modules soldered to flexible cables". *IEEE Transactions on Components, Hybrids, and Manufacturing Technology*. 13(4): 661–666.

Paradiso, J. A. and T. Starner (2005). "Energy scavenging for mobile and wireless electronics". *IEEE Pervasive Computing*. (1): 18–27.

Parida, B., S. Iniyan, and R. Goic (2011). "A review of solar photovoltaic technologies". *Renewable and Sustainable Energy Reviews*. 15(3): 1625–1636.

Park, J., H. Joshi, H. G. Lee, S. Kiaei, and U. Y. Ogras (2017). "Flexible PV-cell modeling for energy harvesting in wearable IoT applications". *ACM Transactions on Embedded Computer Systems*. 16(5s): Article 156.

Park, J., G. Bhat, C. S. Geyik, U. Y. Ogras, and H. G. Lee (2020). "Energy per operation optimization for energy-harvesting wearable IoT devices". *Sensors*. 20(3): 764.

Parno, B., M. Luk, E. Gaustad, and A. Perrig (2006). "Secure sensor network routing: A clean-slate approach". In: *Proceedings of the 2006 ACM CoNEXT Conference*. 1–13.

Patel, A. A. and S. J. Soni (2015). "A novel proposal for defending against vampire attack in WSN". In: *2015 Fifth International Conference on Communication Systems and Network Technologies*. IEEE. 624–627.

Patel, S., R. Hughes, T. Hester, J. Stein, M. Akay, J. G. Dy, and P. Bonato (2010). "A novel approach to monitor rehabilitation outcomes in stroke survivors using wearable technology". *Proceedings of the IEEE*. 98(3): 450–461.

Pellegrini, C. A., S. D. Verba, A. D. Otto, D. L. Helsel, K. K. Davis, and J. M. Jakicic (2012). "The comparison of a technology-based system and an in-person behavioral weight loss intervention". *Obesity*. 20(2): 356–363.

Petroulakis, N. E., E. Z. Tragos, A. G. Fragkiadakis, and G. Spanoudakis (2013). "A lightweight framework for secure life-logging in smart environments". *Information Security Technical Report*. 17(3): 58–70.

Pielli, C., F. Chiariotti, N. Laurenti, A. Zanella, and M. Zorzi (2017). "A game-theoretic analysis of energy-depleting jamming attacks". In: *2017 International Conference on Computing, Networking and Communications (ICNC)*. IEEE. 100–104.

Pillatsch, P., E. M. Yeatman, and A. S. Holmes (2014). "A piezoelectric frequency up-converting energy harvester with rotating proof mass for human body applications". *Sensors and Actuators A: Physical*. 206: 178–185.

Piñuela, M., P. D. Mitcheson, and S. Lucyszyn (2013). "Ambient RF energy harvesting in urban and semi-urban environments". *IEEE Transactions on Microwave Theory and Techniques*. 61(7): 2715–2726.

Pires, I. M., N. M. Garcia, N. Pombo, and F. Flórez-Revuelta (2016). "From data acquisition to data fusion: A comprehensive review and a roadmap for the identification of activities of daily living using mobile devices". *Sensors*. 16(2): 184.

Ploderer, B., J. Fong, A. Withana, M. Klaic, S. Nair, V. Crocher, F. Vetere, and S. Nanayakkara (2016). "ArmSleeve: A patient monitoring system to support occupational therapists in stroke rehabilitation". In: *Proceedings of the 2016 ACM Conference on Designing Interactive Systems*. 700–711.

Polat, E. O., G. Mercier, I. Nikitskiy, E. Puma, T. Galan, S. Gupta, M. Montagut, J. J. Piqueras, M. Bouwens, T. Durduran, G. Konstantatos, S. Goossens, and F. Koppens (2019). "Flexible graphene photodetectors for wearable fitness monitoring". *Science Advances*. 5(9): eaaw7846.

Poliks, M., J. Turner, K. Ghose, Z. Jin, M. Garg, Q. Gui, A. Arias, Y. Kahn, M. Schadt, and F. Egitto (2016). "A wearable flexible hybrid electronics ECG monitor". In: *Electronic Components and Technology Conference*. IEEE. 1623–1631.

Poliks, M., V. Soman, J. Turner, M. Schadt, M. Shay, and F. Egitto (2018). "Reliability study and finite element modeling of a wearable sensor patch (WSP) to monitor ECG signals". In: *2018 IEEE 68th Electronic Components and Technology Conference (ECTC)*. IEEE. 1871–1878.

Polzien, K. M., J. M. Jakicic, D. F. Tate, and A. D. Otto (2007). "The efficacy of a technology-based system in a short-term behavioral weight loss intervention". *Obesity*. 15(4): 825–830.

Prioleau, T., E. Moore II, and M. Ghovanloo (2017). "Unobtrusive and wearable systems for automatic dietary monitoring". *IEEE Transactions on Biomedical Engineering*. 64(9): 2075–2089.

Proto, A., M. Penhaker, D. Bibbo, D. Vala, S. Conforto, and M. Schmid (2016). "Measurements of generated energy/electrical quantities from locomotion activities using piezoelectric wearable sensors for body motion energy harvesting". *Sensors*. 16(4): 524.

Pulliam, C., J. P. Giuffrida, D. A. Heldman, S. R. Eichenseer, C. G. Goetz, O. Waln, C. B. Hunter, J. Jankovic, and D. E. Vaillancourt (2014). "Continuous in-home monitoring of essential tremor". *Parkinsonism & Related Disorders*. 20(1): 37–40.

Qabulio, M., Y. A. Malkani, and A. Keerio (2016). "A framework for securing mobile wireless sensor networks against physical attacks". In: *2016 International Conference on Emerging Technologies (ICET)*. IEEE. 1–6.

Qi, J., G. Jiang, G. Li, Y. Sun, and B. Tao (2019). "Intelligent human-computer interaction based on surface EMG gesture recognition". *IEEE Access*. 7: 61378–61387.

Rabaey, J. M. and M. Pedram (2012). *Low Power Design Methodologies*. Vol. 336. Springer Science & Business Media.

Radmand, P., A. Talevski, S. Petersen, and S. Carlsen (2010a). "Comparison of industrial WSN standards". In: *4th IEEE International Conference on Digital Ecosystems and Technologies*. 632–637.

Radmand, P., A. Talevski, S. Petersen, and S. Carlsen (2010b). "Taxonomy of wireless sensor network cyber security attacks in the oil and gas industries". In: *2010 24th IEEE International Conference on Advanced Information Networking and Applications*. 949–957.

Raghunathan, V., A. Kansal, J. Hsu, J. Friedman, and M. Srivastava (2005). "Design considerations for solar energy harvesting wireless embedded systems". In: *Proceedings of the International Symposium on Information Processing in Sensor Networks*. 64.

Rahimi, M., H. Shah, G. S. Sukhatme, J. Heideman, and D. Estrin (2003). "Studying the feasibility of energy harvesting in a mobile sensor network". In: *IEEE International Conference on Robotics and Automation*. Vol. 1. 19–24.

Ram, M. R., K. V. Madhav, E. H. Krishna, N. R. Komalla, and K. A. Reddy (2011). "A novel approach for motion artifact reduction in PPG signals based on AS-LMS adaptive filter". *IEEE Transactions on Instrumentation and Measurement*. 61(5): 1445–1457.

Rantala, J., P. Majaranta, J. Kangas, P. Isokoski, D. Akkil, O. Špakov, and R. Raisamo (2020). "Gaze interaction with vibrotactile feedback: Review and design guidelines". *Human–Computer Interaction*. 35(1): 1–39.

Raptis, G. E., C. Katsini, M. Belk, C. Fidas, G. Samaras, and N. Avouris (2017). "Using eye gaze data and visual activities to infer human cognitive styles: Method and feasibility studies". In: *Proceedings of the 25th Conference on User Modeling, Adaptation and Personalization*. 164–173.

Rautaray, S. S. and A. Agrawal (2015). "Vision based hand gesture recognition for human computer interaction: A survey". *Artificial Intelligence Review*. 43(1): 1–54.

Ravi, S., A. Raghunathan, P. Kocher, and S. Hattangady (2004). "Security in embedded systems: Design challenges". *ACM Transactions on Embedded Computing Systems (TECS)*. 3(3): 461–491.

Raya, R., J. Roa, E. Rocon, R. Ceres, and J. L. Pons (2010). "Wearable inertial mouse for children with physical and cognitive impairments". *Sensors and Actuators A: Physical*. 162(2): 248–259.

Reyes-Ortiz, J.-L., L. Oneto, A. Samà, X. Parra, and D. Anguita (2016). "Transition-aware human activity recognition using smartphones". *Neurocomputing*. 171: 754–767.

Rieck, J. (2016). "Attacks on fitness trackers revisited: A case-study of unfit firmware security". *Preprint arXiv:1604.03313*.

Riemer, R. and A. Shapiro (2011). "Biomechanical energy harvesting from human motion: Theory, state of the art, design guidelines, and future directions". *Journal of NeuroEngineering and Rehabilitation*. 8: Article 22.

Rioual, Y., Y. Le Moullec, J. Laurent, M. I. Khan, and J.-P. Diguet (2018). "Reward function evaluation in a reinforcement learning approach for energy management". In: *2018 16th Biennial Baltic Electronics Conference (BEC)*. 1–4.

Rogers, R., W. Lang, B. Barone Gibbs, K. Davis, L. Burke, S. Kovacs, L. Portzer, and J. Jakicic (2016). "Applying a technology-based system for weight loss in adults with obesity". *Obesity Science & Practice*. 2(1): 3–12.

Rollo, M. E., S. Ash, P. Lyons-Wall, and A. Russell (2011). "Trial of a mobile phone method for recording dietary intake in adults with type 2 diabetes: Evaluation and implications for future applications". *Journal of Telemedicine and Telecare*. 17(6): 318–323.

Roundy, S. and S. Trolier-McKinstry (2018). "Materials and approaches for on-body energy harvesting". *MRS Bulletin*. 43(3): 206–213.

Ruonala, V., E. Pekkonen, O. Airaksinen, M. Kankaanpää, P. A. Karjalainen, and S. M. Rissanen (2018). "Levodopa-induced changes in electromyographic patterns in patients with advanced Parkinson's disease". *Frontiers in Neurology*. 9: 35.

Ryu, S.-J. and J.-H. Kim (2011). "Classification of long-term motions using a two-layered hidden Markov model in a wearable sensor system". In: *2011 IEEE International Conference on Robotics and Biomimetics*. IEEE. 2975–2980.

Sadeghi, A.-R., C. Wachsmann, and M. Waidner (2015). "Security and privacy challenges in industrial internet of things". In: *Proceedings of the 52nd Annual Design Automation Conference*. ACM. 54.

Sagayam, K. M. and D. J. Hemanth (2017). "Hand posture and gesture recognition techniques for virtual reality applications: A survey". *Virtual Reality*. 21(2): 91–107.

Samanta, A. and S. Misra (2017). "Energy-efficient and distributed network management cost minimization in opportunistic wireless body area networks". *IEEE Transactions on Mobile Computing*. 17(2): 376–389.

Santini, T., W. Fuhl, and E. Kasneci (2017). "Calibme: Fast and unsupervised eye tracker calibration for gaze-based pervasive human-computer interaction". In: *Proceedings of the 2017 Chi Conference on Human Factors in Computing Systems*. 2594–2605.

Schantz, H. G. (2005). "Near field propagation law and a novel fundamental limit to antenna gain versus size". In: *2005 IEEE Antennas and Propagation Society International Symposium*. Vol. 3. 237–240.

Seneviratne, S., Y. Hu, T. Nguyen, G. Lan, S. Khalifa, K. Thilakarathna, M. Hassan, and A. Seneviratne (2017). "A survey of wearable devices and challenges". *IEEE Communications Surveys & Tutorials*. 19(4): 2573–2620.

Sharma, P., S. P. Duttagupta, and V. Agarwal (2012). "A novel and universal model for accurate prediction of PV module characteristics for power optimization under various design layouts and dynamic environmental conditions". In: *IEEE International Conference on Power Electronics, Drives and Energy Systems (PEDES)*. 1–6.

Shila, D. M., P. Geng, and T. Lovett (2016). "I can detect you: Using intrusion checkers to resist malicious firmware attacks". In: *2016 IEEE Symposium on Technologies for Homeland Security (HST)*. IEEE. 1–6.

Shivakumar, S. J., ed. (2013). *Flexible Electronics for Security, Manufacturing, and Growth in the United States: Summary of a Symposium*. Washington DC: The National Academies Press.

Shuzo, M., S. Komori, T. Takashima, G. Lopez, S. Tatsuta, S. Yanagimoto, S. Warisawa, J.-J. Delaunay, and I. Yamada (2010). "Wearable eating habit sensing system using internal body sound". *Journal of Advanced Mechanical Design, Systems, and Manufacturing*. 4(1): 158–166.

Siboni, S., A. Shabtai, N. O. Tippenhauer, J. Lee, and Y. Elovici (2016). "Advanced security testbed framework for wearable IoT devices". *ACM Transactions on Internet Technology*. 16(4). DOI: 10.1145/2981546.

Smache, M., N. El Mrabet, J.-J. Gilquijano, A. Tria, E. Riou, and C. Gregory (2016). "Modeling a node capture attack in a secure wireless sensor networks". In: *2016 IEEE 3rd World Forum on Internet of Things (WF-IoT)*. IEEE. 188–193.

Someya, T., Y. Kato, T. Sekitani, S. Iba, Y. Noguchi, Y. Murase, H. Kawaguchi, and T. Sakurai (2005). "Conformable, flexible, large-area networks of pressure and thermal sensors with organic transistor active matrixes". *Proceedings of the National Academy of Sciences of the United States of America*. 102(35): 12321–12325.

Soyata, T., L. Copeland, and W. Heinzelman (2016). "RF energy harvesting for embedded systems: A survey of tradeoffs and methodology". *IEEE Circuits and Systems Magazine*. 16(1): 22–57.

Srbinovski, B., M. Magno, F. Edwards-Murphy, V. Pakrashi, and E. Popovici (2016). "An energy aware adaptive sampling algorithm for energy harvesting WSN with energy hungry sensors". *Sensors*. 16(4): 448.

Statista (2019). "Apple dominates global smartwatch sales". Online. https://www.statista.com/chart/15035/worldwide-smartwatch-shipments/. Accessed 16 January 2020.

Street, R., T. Ng, D. Schwartz, G. Whiting, J. Lu, R. Bringans, and J. Veres (2015). "From printed transistors to printed smart systems". *Proceedings of the IEEE*. 103(4): 607–618.

Su, C., P. Wang, and R. Chai (2013). "Joint power allocation and coordinator deployment for wireless body area network". In: *2013 International Conference on Wireless Communications and Signal Processing*. 1–6.

Sudevalayam, S. and P. Kulkarni (2010). "Energy harvesting sensor nodes: Survey and implications". *IEEE Communications Surveys & Tutorials*. 13(3): 443–461.

Summary, P. (2009). In: *WTEC Workshop on Int. R&D in Flexible Hybrid Electronics*. World Technology Evaluation Center, Inc. (WTEC). http://www.wtec.org/flex/documents/AllContent-FLEX-finalWS-Proceedings-30June2009.pdf. Accessed 16 July 2015.

Sztyler, T. and H. Stuckenschmidt (2017). "Online personalization of cross-subjects based activity recognition models on wearable devices". In: *2017 IEEE International Conference on Pervasive Computing and Communications (PerCom)*. IEEE. 180–189.

Tamura, T., Y. Maeda, M. Sekine, and M. Yoshida (2014). "Wearable photoplethysmographic sensors—Past and present". *Electronics*. 3(2): 282–302.

Tekeoglu, A. and A. Ş. Tosun (2016). "A testbed for security and privacy analysis of IoT devices". In: *2016 IEEE 13th International Conference on Mobile Ad Hoc and Sensor Systems (MASS)*. IEEE. 343–348.

Thilarajah, S., R. A. Clark, and G. Williams (2016). "Wearable sensors and Mobile Health (mHealth) technologies to assess and promote physical activity in stroke: A narrative review". *Brain Impairment*. 17(1): 34–42.

Thomaz, E., A. Parnami, I. Essa, and G. D. Abowd (2013). "Feasibility of identifying eating moments from first-person images leveraging human computation". In: *Proceedings of the 4th International SenseCam & Pervasive Imaging Conference*. 26–33.

Tommy Hilfiger (2014). "Tommy Hilfiger solar clothing". Online. http://www.pvilion.com/solar-clothing, accessed 28 February 2020.

Tong, G., Z. Jia, and J. Chang (2018). "Flexible hybrid electronics: Review and challenges". In: *Proceedings of the IEEE International Symposium on Circuits and Systems*. IEEE. 1–5.

Toprak, A. and O. Tigli (2014). "Piezoelectric energy harvesting: State-of-the-art and challenges". *Applied Physics Reviews*. 1(3): 031104.

Tran, L.-G., H.-K. Cha, and W.-T. Park (2017). "RF power harvesting: A review on designing methodologies and applications". *Micro and Nano Systems Letters*. 5(1): 14.

Trappe, W., R. Howard, and R. S. Moore (2015). "Low-energy security: Limits and opportunities in the internet of things". *IEEE Security & Privacy*. 13(1): 14–21.

Tuncel, Y., S. Bandyopadhyay, S. V. Kulshrestha, A. Mendez, and U. Y. Ogras (2020). "Towards wearable piezoelectric energy harvesting: Modeling and experimental validation". In: *Proceedings of the ACM/IEEE International Symposium on Low Power Electronics and Design*. 55–60.

Ullah, S., P. Khan, N. Ullah, S. Saleem, H. Higgins, and K. S. Kwak (2010). "A review of wireless body area networks for medical applications". *Preprint arXiv:1001.0831*.

Vasserman, E. Y. and N. Hopper (2013). "Vampire attacks: Draining life from wireless ad hoc sensor networks". *IEEE Transactions on Mobile Computing*. 12(2): 318–332.

Verma, N., Y. Hu, L. Huang, W. S. Rieutort-Louis, J. S. Robinson, T. Moy, B. Glisic, S. Wagner, and J. C. Sturm (2015). "Enabling scalable hybrid systems: Architectures for exploiting large-area electronics in applications". *Proceedings of the IEEE*. 103(4): 690–712.

Viana, P., T. Ferreira, L. Castro, M. Soares, J. P. Pinto, T. Andrade, and P. Carvalho (2018). "GymApp: A real time physical activity trainner on wearable devices". In: *2018 11th International Conference on Human System Interaction (HSI)*. IEEE. 513–518.

Vidgren, N., K. Haataja, J. L. Patino-Andres, J. J. Ramirez-Sanchis, and P. Toivanen (2013). "Security threats in ZigBee-enabled systems: Vulnerability evaluation, practical experiments, countermeasures, and lessons learned". In: *2013 46th Hawaii International Conference on System Sciences*. 5132–5138.

Vidya, V., P. Poornachandran, V. Sujadevi, and M. M. Dharmana (2017). "Suppressing Parkinson's diseases induced involuntary movements using wearables". In: *2017 International Conference on Technological Advancements in Power and Energy (TAP Energy)*. IEEE. 1–4.

Vigorito, C. M., D. Ganesan, and A. G. Barto (2007). "Adaptive control of duty cycling in energy-harvesting wireless sensor networks". In: *4th Annual IEEE Communications Society Conference on Sensor, Mesh and Ad Hoc Communications and Networks*. 21–30.

Walters, J. P., Z. Liang, W. Shi, and V. Chaudhary (2007). "Wireless sensor network security: A survey". *Security in Distributed, Grid, Mobile, and Pervasive Computing*. 1: 367.

Wan, S., Z. Gu, and Q. Ni (2019). "Cognitive computing and wireless communications on the edge for healthcare service robots". *Computer Communications*. 149: 99–106.

Wang, Q., P. Markopoulos, B. Yu, W. Chen, and A. Timmermans (2017). "Interactive wearable systems for upper body rehabilitation: A systematic review". *Journal of Neuroengineering and Rehabilitation*. 14(1): 20.

Wang, S., T. Tuor, T. Salonidis, K. K. Leung, C. Makaya, T. He, and K. Chan (2018). "When edge meets learning: Adaptive control for resource-constrained distributed machine learning". In: *IEEE INFOCOM 2018–IEEE Conference on Computer Communications*. IEEE. 63–71.

Wang, X., C. Konstantinou, M. Maniatakos, and R. Karri (2015). "ConFirm: Detecting firmware modifications in embedded systems using hardware performance counters". In: *2015 IEEE/ACM International Conference on Computer-Aided Design (ICCAD)*. IEEE. 544–551.

Wang, X., X. Lu, B. Liu, D. Chen, Y. Tong, and G. Shen (2014). "Flexible energy-storage devices: Design consideration and recent progress". *Advanced Materials*. 26(28): 4763–4782.

Wang, Y.-J. and P.-C. Hsu (2010). "Analytical modelling of partial shading and different orientation of photovoltaic modules". *IET Renewable Power Generation*. 4(3): 272–282.

Wang, Z. L. (2015). "Triboelectric nanogenerators as new energy technology and self-powered sensors—Principles, problems and perspectives". *Faraday Discussions*. 176: 447–458.

Wang, Z., W. Zhang, X. Li, and L. Gao (2016). "Recent progress in flexible energy storage materials for lithium-ion batteries and electrochemical capacitors: A review". *Journal of Materials Research*. 31(12): 1648–1664.

Weenk, M., H. van Goor, B. Frietman, L. J. Engelen, C. J. van Laarhoven, J. Smit, S. J. Bredie, and T. H. van de Belt (2017). "Continuous monitoring of vital signs using wearable devices on the general ward: pilot study". *JMIR mHealth and uHealth*. 5(7): e91.

Wei, S., W. Guan, and K. R. Liu (2015). "Power scheduling for energy harvesting wireless communications with battery capacity constraint". *IEEE Transactions on Wireless Communications*. 14(8): 4640–4653.

Weigel, M., T. Lu, G. Bailly, A. Oulasvirta, C. Majidi, and J. Steimle (2015). "Iskin: Flexible, stretchable and visually customizable on-body touch sensors for mobile computing". In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. 2991–3000.

Wile, D. J., R. Ranawaya, and Z. H. Kiss (2014). "Smart watch accelerometry for analysis and diagnosis of tremor". *Journal of Neuroscience Methods*. 230: 1–4.

Wired (2015). "The future of wearable tech". Online. https://www.wired.com/insights/2015/02/the-future-of-wearable-tech/. Accessed 28 February 2020.

Wong, W. S. and A. Salleo (2009). *Flexible Electronics: Materials and Applications*. Vol. 24. Springer.

Woods, A. M., M. Nowostawski, E. A. Franz, and M. Purvis (2014). "Parkinson's disease and essential tremor classification on mobile device". *Pervasive and Mobile Computing*. 13: 1–12.

World Health Organization (2011). "World report on disability". Online. http://www.who.int/disabilities/world_report/2011/report/en/.

World Health Organization (2013). "Obesity and overweight. Fact sheets, 2013". Online. http://www.who.int/mediacentre/factsheets/fs311/en/. Accessed 22 March 2018.

Wright, D. N., A.-S. B. Vardøy, B. D. Belle, M. M. V. Taklo, O. Hagel, L. Xie, M. Danestig, and T. Eriksson (2017). "Bending machine for testing reliability of flexible electronics". In: *2017 IMAPS Nordic Conference on Microelectronics Packaging (NordPac)*. IEEE. 47–52.

Wurm, J., K. Hoang, O. Arias, A.-R. Sadeghi, and Y. Jin (2016). "Security analysis on consumer and industrial IoT devices". In: *2016 21st Asia and South Pacific Design Automation Conference (ASP-DAC)*. IEEE. 519–524.

Xia, M. and S. Aissa (2015). "On the efficiency of far-field wireless power transfer". *IEEE Transactions on Signal Processing*. 63(11): 2835–2847.

Xu, L., C. Rabotti, Y. Zhang, S. Ouzounov, P. J. Harpe, and M. Mischi (2018). "Motion-artifact reduction in capacitive heart-rate measurements by adaptive filtering". *IEEE Transactions on Instrumentation and Measurement*. 68(10): 4085–4093.

Yagi, I., N. Hirai, Y. Miyamoto, M. Noda, A. Imaoka, N. Yoneya, K. Nomoto, J. Kasahara, A. Yumoto, and T. Urabe (2008). "A flexible full-color AMOLED display driven by OTFTs". *Journal of the Society for Information Display*. 16(1): 15–20.

Yang, G., J. Deng, G. Pang, H. Zhang, J. Li, B. Deng, Z. Pang, J. Xu, M. Jiang, P. Liljeberg, H. Xie, and H. Yang (2018). "An IoT-enabled stroke rehabilitation system based on smart wearable armband and machine learning". *IEEE Journal of Translational Engineering in Health and Medicine*. 6: 1–10.

Yang, S.-H., J. Pyo, Y. Shin, and J. C. Son (2013). "A 1.6 GHz quad-core application processor manufactured in 32 Nm high-K metal gate process for smart mobile devices". *IEEE Communications Magazine*. 51(4): 94–98.

Yang, Y., Y. Song, X. Bo, J. Min, O. S. Pak, L. Zhu, M. Wang, J. Tu, A. Kogan, H. Zhang, T. K. Hsiai, Z. Li, and W. Gao (2019). "A laser-engraved wearable sensor for sensitive detection of uric acid and tyrosine in sweat". *Nature Biotechnology*: 1–8.

Yilmaz, T., R. Foster, and Y. Hao (2010). "Detecting vital signs with wearable wireless sensors". *Sensors*. 10(12): 10837–10862.

Yin, H., A. O. Akmandor, A. Mosenia, and N. K. Jha (2018). "Smart healthcare". *Foundations and Trends in Electronic Design Automation*. 12(4): 401–466.

Yin, H., B. Mukadam, X. Dai, and N. Jha (2019). "DiabDeep: Pervasive diabetes diagnosis based on wearable medical sensors and efficient neural networks". *IEEE Transactions on Emerging Topics in Computing*.

Ylli, K., D. Hoffmann, A. Willmann, P. Becker, B. Folkmer, and Y. Manoli (2015). "Energy harvesting from human motion: Exploiting swing and shock excitations". *Smart Materials and Structures*. 24(2): 025029.

Yoneyama, M., Y. Kurihara, K. Watanabe, and H. Mitoma (2013). "Accelerometry-based gait analysis and its application to Parkinson's disease assessment—Part 2: A new measure for quantifying walking behavior". *IEEE Transactions on Neural Systems and Rehabilitation Engineering*. 21(6): 999–1005.

Yun, T. G., M. Park, D.-H. Kim, D. Kim, J. Y. Cheong, J. G. Bae, S. M. Han, and I.-D. Kim (2019). "All-transparent stretchable electrochromic supercapacitor wearable patch device". *ACS Nano*. 13(3): 3141–3150.

Zhang, B., F. Huang, J. Liu, and D. Zhang (2018). "A novel posture for better differentiation between Parkinson's tremor and essential tremor". *Frontiers in Neuroscience*. 12.

Zhang, D., Z. Chen, M. K. Awad, N. Zhang, H. Zhou, and X. S. Shen (2016a). "Utility-optimal resource management and allocation algorithm for energy harvesting cognitive radio sensor networks". *IEEE Journal on Selected Areas in Communications*. 34(12): 3552–3565.

Zhang, J. and V. Varadharajan (2008). "A new security scheme for wireless sensor networks". In: *IEEE GLOBECOM 2008-2008 IEEE Global Telecommunications Conference*. 1–5.

Zhang, Q., D. Zhou, and X. Zeng (2016b). "A novel machine learning-enabled framework for instantaneous heart rate monitoring from motion-artifact-corrupted electrocardiogram signals". *Physiological Measurement*. 37(11): 1945.

Zhang, S., M. Ang, W. Xiao, and C. Tham (2008). "Detection of activities for daily life surveillance: Eating and drinking". In: *HealthCom 2008–10th International Conference on e-health Networking, Applications and Services*. IEEE. 171–176.

Zheng, X., A. Vieira Campos, J. Ordieres-Meré, J. Balseiro, S. Labrador Marcos, and Y. Aladro (2017). "Continuous monitoring of essential tremor using a portable system based on smartwatch". *Frontiers in Neurology*. 8: 96.

Zheng, Y.-L., X.-R. Ding, C. C. Y. Poon, B. P. L. Lo, H. Zhang, X.-L. Zhou, G.-Z. Yang, N. Zhao, and Y.-T. Zhang (2014). "Unobtrusive sensing and wearable devices for health informatics". *IEEE Transactions on Biomedical Engineering*. 61(5): 1538–1554.