A REVIEW ON MOBILE BASED IOT TECHNOLOGY FOR HEALTH MONITORING

Kumaresan, Associate Professor, Department of Computer Science & Engineering, Galgotias University

ABSTRACT

The new Internet of Things paradigm enables the construction of compact sensing, processing, and communication devices, enabling the creation of sensors, embedded devices, and other 'things' capable of understanding their surroundings. The purpose of this research is to present a distributed system based on the internet of things paradigm for monitoring human biological signals during physical exertion-related activities. The suggested system's primary benefits and novelties are its flexibility in computing health applications by using resources from the user's accessible devices inside his or her body area network. This architecture may be adapted to different mobile contexts, particularly ones with significant data collecting and processing requirements. Finally, we give a case study to demonstrate the feasibility of our concept, which involves monitoring players' heart rates throughout a match. The real-time data collected by these devices demonstrates a clear societal aim of predicting not just unexpected death scenarios, but also probable injuries.

Keywords: IOT, Communication, Security.

Introduction

Our lives are being transformed by the advancement of Information and Communication Technologies (ICT). They have a considerable influence on the economy [1, 2], public policy [2, 3], and other spheres of society. In this sense, healthcare has always been heavily reliant on technology. Over the previous two decades, this bond has become stronger. One of the primary reasons for this is the spread of a variety of devices that are readily placed in the majority of health care facilities. Additionally, telemedicine, which was initially discussed some decades ago, is now a reality and has advanced significantly, with this progress spreading to other fields of healthcare [3].

The growing Internet of Things (IoT) paradigm is particularly focused on gathering and analysing data in real time and everywhere [4–7]. This development of the IoT enables the usage of all types of items beyond their essential tasks, or at the very least those for which they were created. Consider energy management [8] or accessibility analysis in smart cities [9]. In the field of healthcare, devices are being developed for a variety of reasons, including patient monitoring to assist with the management of chronic illnesses [10], injury recovery [11], and the creation of Ambient Assisted Living (AAL) settings [12]. In relation to this notion, mobile health items (m-health) is a novel concept that entails the use of intelligent mobile devices to provide effective healthcare services and solutions [13]. In recent years, a slew of gadgets and smart devices have been introduced that use sensors to gather data.

Development of information

The development of information from many regions of the human body has occurred [14]. Biomedical sensors are devices that are capable of detecting human biosignals. Their design was motivated by the desire to make them lighter, less invasive to human activities, and capable of providing value-added services to the user. These design principles have aided in their incorporation into new wearable gadgets and increased their popularity among people [15,16]. Additionally, mobile devices have matured enough that they can currently interface with biological data and perform health-related applications [17,18]. Thus, contemporary applications have been created around the aforementioned notions, with the sensing capabilities of the 'things' playing a critical part in the analysis of human behaviour and health [19,20]. Numerous apps and gadgets are becoming more significant in the collection of personal health data. Their ability to collect electrocardiogram (ECG) data through wearable devices and integrate it with users' mobile devices enables the monitoring of heart health indicators for a variety of reasons including medical treatment, training, and wellness monitoring.

However, sensors and other 'things' should be able to interpret the physical environment on their own [21,22]. Current advances in cognitive science continue to provide difficulties since they need a high degree of interdisciplinarity. With changing social models and the use of new technology in telemedicine and across the healthcare industry, classic procedures seem inappropriate for this new circumstance. This new situation necessitates the use of novel strategies to resolve the issue. While old methodologies are still important, they must be combined to create new architectural models. The study undertaken in this study focuses on the use of these technologies for sensing and data processing in order to imbue gadgets with intelligence and participate in giving sophisticated applications to the user. Additionally, this article includes a prototype for demonstrating and validating the suggested approach. The proposal is evaluated by examining the system's overall performance in terms of processing power delivered. Additionally, a case study is provided to illustrate how to reduce the health concerns linked with physical exercise. Thus, if a medical expert system could identify these reasons in real time during a sports competition by evaluating biosignals gathered by wearable sensors, medical personnel might handle the situation and attempt to avoid health hazards associated with sport. As a striking illustration of these dangers, the sudden arrhythmic death syndrome was the leading cause of Sudden Death (SD) among athletes [23]. Real-time monitoring and analysis of the electrocardiogram has been shown to be an effective technique for detecting major anomalies in professional athletic practise [24].

There are difficulties in efficiently adopting this concept. Simultaneous monitoring of several athletes may exceed the computational capability of the in-situ medical staff's wearables and mobile devices. This difficulty might be resolved by deploying a centralised system that does a deeper analysis and makes use of big data approaches on past aggregated data, however communication bottlenecks and delays may occur between the worn sensors and the centralised expert system.

Health Monitoring

A significant difficulty for scientific healthcare applications is the streaming of data acquired by several sensors distributed throughout the body. This current situation creates novel scenarios in which the Internet of Things (as measured by the quantity and quality of newly available wearables), Big Data (as measured by the enormous amount of data collected from numerous heterogeneous sources), and real-time environments collide due to the unique characteristics of healthcare applications [4]. This new condition is unmanageable using conventional approaches, necessitating the development of new computer paradigms.

All of the sensors coupled together form a networked Cyber-Physical System (CPS) [25] capable of monitoring a person's health [5]. Numerous solutions have been presented for various objectives. For instance, [26] describes a method for long-term monitoring of respiration and pulse. This device comprises of four non-contact sensors incorporated into a shirt that are used in the laboratory to explore sensitivity and depth measurement. The authors of [27] design an unique adaptive multi-sensor system to avoid venous stasis. This novel method enhances and enriches conventional therapy choices by stimulating the muscular pump using pulse synchronised electrostimulation.

Recently, many methods have aimed to establish adaptable monitoring systems by using the communication capabilities of smart phones in conjunction with wearable gadgets. Below are descriptions of a few typical works.

Muaremi et alstudy .'s [28] demonstrates the efficacy of these devices in recognising activities and phases, analysing group behaviour, detecting stressful circumstances, and monitoring overall health. Arsand et al. [29] propose bidirectional connection between a smartphone and a wristwatch in order to expand options for diabetes self-management by allowing for simpler monitoring of Blood Glucose (BG), insulin injections, physical activity, and food information straight from the wrist.

Conclusion

The computational requirements for monitoring and sophisticated analysis of data collected in IoT settings may exceed the capability of sensors and personal computers installed by professionals. Typically, more specialised hardware is necessary to satisfy the application's specifications. To solve this difficulty, this study proposes a distributed architecture that integrates sensing and processing at several network levels in order to divide the computational burden among accessible devices. It may improve IoT systems comprised of wearables and other biosensors by enabling collaborative processing of sophisticated applications constrained by real-time restrictions.

The suggested system's primary benefit and novelty is its ability to execute applications with a high degree of flexibility by using resources from many accessible devices. Thus, BAN devices may share computational resources, enabling real-time monitoring and analysis of all gathered data. Sport-related health monitoring and SD detection is an excellent example of how the suggested system can handle demanding data processing applications. In this case study, we demonstrate how to meet athletes' real-time cardiac information demands by implementing a real-time heart telemetry system capable of collecting the major cardiac parameters.

References

1. Al-Hamadi, H., & Chen, I. R. (2017). Trust-Based Decision Making for Health IoT Systems. *IEEE Internet of Things Journal*, *4*(5), 1408–1419. https://doi.org/10.1109/JIOT.2017.2736446

2. Almotiri, S. H., Khan, M. A., & Alghamdi, M. A. (2016). Mobile health (m-Health) system in the context of IoT. In A. I. El Haddad J. Younas M. (Ed.), *Proceedings - 2016 4th International Conference on Future Internet of Things and Cloud Workshops, W-FiCloud 2016* (pp. 39–42). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/W-FiCloud.2016.24

3. Anawar, M. R., Wang, S., Azam Zia, M., Jadoon, A. K., Akram, U., & Raza, S. (2018). Fog Computing: An Overview of Big IoT Data Analytics. *Wireless Communications and Mobile Computing*, *2018*. https://doi.org/10.1155/2018/7157192

4. Asplund, M., & Nadjm-Tehrani, S. (2016). Attitudes and Perceptions of IoT Security in Critical Societal Services. *IEEE Access*, *4*, 2130–2138. https://doi.org/10.1109/ACCESS.2016.2560919

5. Bagheri, M., & Movahed, S. H. (2017). The Effect of the Internet of Things (IoT) on Education Business Model. In C. R. G. L. Y. K. De Pietro G. Dipanda A. (Ed.), *Proceedings - 12th International Conference on Signal Image Technology and Internet-Based Systems, SITIS 2016* (pp. 435–441). Institute of Electrical and Electronics Engineers Inc. https://doi.org/10.1109/SITIS.2016.74

6. Bertino, E., Choo, K.-K. R., Georgakopolous, D., & Nepal, S. (2016). Internet of things (IoT): Smart and secure service delivery. *ACM Transactions on Internet Technology*, *16*(4). https://doi.org/10.1145/3013520

7. Bietz, M. J., Bloss, C. S., Calvert, S., Godino, J. G., Gregory, J., Claffey, M. P., Sheehan, J., & Patrick, K. (2016). Opportunities and challenges in the use of personal health data for health research. *Journal of the American Medical Informatics Association*, *23*(e1), 1–7. https://doi.org/10.1093/jamia/ocv118

8. Chen, M., Yang, J., Zhu, X., Wang, X., Liu, M., & Song, J. (2017). Smart Home 2.0: Innovative Smart Home System Powered by Botanical IoT and Emotion Detection. *Mobile Networks and Applications*, *22*(6), 1159–1169. https://doi.org/10.1007/s11036-017-0866-1

9. Darshan, K. R., & Anandakumar, K. R. (2016). A comprehensive review on usage of Internet of Things (IoT) in healthcare system. *2015 International Conference on Emerging Research in Electronics, Computer Science and Technology, ICERECT 2015*, 132–136. https://doi.org/10.1109/ERECT.2015.7499001

10. Dogru, N., & Subasi, A. (2018). Traffic accident detection using random forest classifier. *2018 15th*

Learning and Technology Conference, L and T 2018, 40–45. https://doi.org/10.1109/LT.2018.8368509

11. Doukas, C., Maglogiannis, I., Koufi, V., Malamateniou, F., & Vassilacopoulos, G. (2012). Enabling data protection through PKI encryption in IoT m-Health devices. *IEEE 12th International Conference on BioInformatics and BioEngineering, BIBE 2012*, 25–29. https://doi.org/10.1109/BIBE.2012.6399701

12. Fortino, G., Savaglio, C., Palau, C. E., de Puga, J. S., Ghanza, M., Paprzycki, M., Montesinos, M., Liotta, A., & Llop, M. (2018). Towards multi-layer interoperability of heterogeneous IoT platforms: The INTER-IoT approach. *Internet of Things*, *0*(9783319612997), 199–232. https://doi.org/10.1007/978-3-319-61300-0_10

13. Fortino, G., & Trunfio, P. (2014). Internet of things based on smart objects: Technology, middleware and applications. In *Internet of Things Based on Smart Objects: Technology, Middleware and Applications*. Springer International Publishing. https://doi.org/10.1007/978-3-319-00491-4

14. Geller, J., Grudzinskas Jr., A. J., McDermeit, M., Fisher, W. H., & Lawlor, T. (1998). The efficacy of involuntary outpatient treatment in Massachusetts. *Administration and Policy in Mental Health*, *25*(3), 271–285. https://doi.org/10.1023/A:1022239322212

15. Gope, P., & Hwang, T. (2015). Untraceable Sensor Movement in Distributed IoT Infrastructure. *IEEE Sensors Journal*, *15*(9), 5340–5348. https://doi.org/10.1109/JSEN.2015.2441113

16. Gupta, P., Agrawal, D., Chhabra, J., & Dhir, P. K. (2016). IoT based smart healthcare kit. *2016 International Conference on Computational Techniques in Information and Communication Technologies, ICCTICT 2016 - Proceedings*, 237–242. https://doi.org/10.1109/ICCTICT.2016.7514585

17. Hashemi, S. H., Faghri, F., Rausch, P., & Campbell, R. H. (2016). World of empowered IoT users. *Proceedings - 2016 IEEE 1st International Conference on Internet-of-Things Design and Implementation, IoTDI 2016*, 13–24. https://doi.org/10.1109/IoTDI.2015.39

18. Hussein, A. F., Arun Kumar, N., Burbano-Fernandez, M., Ramirez-Gonzalez, G., Abdulhay, E., & De Albuquerque, V. H. C. (2018). An automated remote cloud-based heart rate variability monitoring system. *IEEE Access*, *6*, 77055–77064. https://doi.org/10.1109/ACCESS.2018.2831209

19. Jalali, R., El-Khatib, K., & McGregor, C. (2015). Smart city architecture for community level services through the internet of things. *2015 18th International Conference on Intelligence in Next Generation Networks, ICIN 2015*, 108–113. https://doi.org/10.1109/ICIN.2015.7073815

20. Li, C., Hu, X., & Zhang, L. (2017). The IoT-based heart disease monitoring system for pervasive healthcare service. In H. R. J. Z.-M. C. T. C. F. C. J. L. C. J. L. C. Toro C. Hicks Y. (Ed.), *Procedia Computer Science* (Vol. 112, pp. 2328–2334). Elsevier B.V. https://doi.org/10.1016/j.procs.2017.08.265

21. Liu, J., Zhang, C., & Fang, Y. (2018). EPIC: A Differential Privacy Framework to Defend Smart Homes Against Internet Traffic Analysis. *IEEE Internet of Things Journal*, *5*(2), 1206–1217. https://doi.org/10.1109/JIOT.2018.2799820

22. Maharjan, P., Toyabur, R. M., & Park, J. Y. (2018). A human locomotion inspired hybrid nanogenerator for wrist-wearable electronic device and sensor applications. *Nano Energy*, *46*, 383–395. https://doi.org/10.1016/j.nanoen.2018.02.033

23. Mauldin, T. R., Canby, M. E., Metsis, V., Ngu, A. H. H., & Rivera, C. C. (2018). Smartfall: A smartwatch-based fall detection system using deep learning. *Sensors (Switzerland)*, *18*(10). https://doi.org/10.3390/s18103363

24. Sathish Kumar, N., Vuayalakshmi, B., Prarthana, R. J., & Shankar, A. (2016). IOT based smart garbage alert system using Arduino UNO. *IEEE Region 10 Annual International Conference, Proceedings/TENCON*, *0*, 1028–1034. https://doi.org/10.1109/TENCON.2016.7848162

25. Sodhro, A. H., Pirbhulal, S., & Sangaiah, A. K. (2018). Convergence of IoT and product lifecycle management in medical health care. *Future Generation Computer Systems*, *86*, 380–391. https://doi.org/10.1016/j.future.2018.03.052

26. Sood, S. K., & Mahajan, I. (2017). Wearable IoT sensor based healthcare system for identifying and controlling chikungunya virus. *Computers in Industry*, *91*, 33–44. https://doi.org/10.1016/j.compind.2017.05.006

27. Verma, P., & Sood, S. K. (2018). Cloud-centric IoT based disease diagnosis healthcare framework. *Journal of Parallel and Distributed Computing*, *116*, 27–38. https://doi.org/10.1016/j.jpdc.2017.11.018

28. Xu, T., Zhou, Y., & Zhu, J. (2018). New advances and challenges of fall detection systems: A survey. *Applied Sciences (Switzerland)*, *8*(3). https://doi.org/10.3390/app8030418

29. Zhang, X. M., & Zhang, N. (2011). An open, secure and flexible platform based on internet of things and cloud computing for ambient aiding living and telemedicine. *2011 International Conference on Computer and Management, CAMAN 2011*. https://doi.org/10.1109/CAMAN.2011.5778905