Springer Link

IEEE1451 Smart Sensors Architectures for Vital Signs and Motor Activity Monitoring

Advanced Interfacing Techniques for Sensors pp 291-314 | Cite as

- Octavian Postolache (1) Email author (opostolache@lx.it.pt)
- Vítor Viegas (2)
- João Freire (3)
- José Miguel Dias Pereira (2)
- Pedro Girão (3)

1. Instituto de Telecomunicações/ISCTE-IUL, , Lisboa, Portugal
2. Instituto de Telecomunicações/ESTSetúbal-IPS, , Lisboa, Portugal
3. Instituto de Telecomunicações/DEEC-IST, , Lisboa, Portugal

Chapter
First Online: 05 April 2017

Part of the Smart Sensors, Measurement and Instrumentation book series (SSMI, volume 25)

Abstract

The chapter presents a set of smart sensing systems, compatible with IEEE1451 standard, intended to unobtrusively monitor the vital signs and motor activity of a wheelchair user. The IEEE 1451 standard was considered to add smartness to transducers: clause 1451.4 adds plug-and-play and self-identification capabilities to the sensors, and clause 1451.1 provides the information model used to share data and functionalities across the network. The .NET Framework was considered to implement the 1451.1 information model as it provides a rich development environment. The .NET's implementation of the 1451.1 information model, including the customization efforts to meet application-specific requirements, is described. Referring to the measurement channels considered in the present approach, photo-plethysmography (PPG), skin conductivity (SKC), ballistocardiography (BCG), and electrocardiography (ECG) were chosen to monitor cardiorespiratory activity, while a simple 3D accelerometer was used to monitor motor activity.

Keywords

Measurement Channel Smart Sensor Wheelchair User Biomedical Sensor Conditioning Circuit

References

1. T. Tamura, M. Sekine, Z. Tang, M. Yoshida, Y. Takeuchi, M. Imai, Preliminary study of a new home healthcare monitoring to prevent the recurrence of stroke, in *Proceedings of 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC)*, pp. 5489–5492, Milan, Italy, August 2015
Google Scholar (https://scholar.google.com/scholar?q=T.%20Tamura%2C%20M.%20Sekine%2C%20Z.%20Tang%2C%20M.%20Yoshida%2C%20Y.%20Takeuchi%2C%20M.%20Imai%2C%20Preliminary%20study%20of%20a%20new%20home%20healthcare%20monitoring%20to%20prevent%20the%20recurrence%20of%20stroke%2C%20in%C2%A0Proceedings%20of%2037th%20Annual%20International%20Conference%20of%20the%20IEEE%20Engineering%20in%20Medicine%20and%20Biology%20Society%20%28EMBC%29%2C%20pp.%205489%E2%80%935492%2C%20Milan%2C%20Italy%2C%20August%202015)

2. S. Hossain, Patient status monitoring for smart home healthcare, in *Proceedings of IEEE International Conference on Multimedia & Expo Workshops (ICMEW)*, pp. 1–6, Seattle, USA, July 2016
Google Scholar (https://scholar.google.com/scholar?q=S.%20Hossain%2C%20Patient%20status%20monitoring%20for%20smart%20home%20healthcare%2C%20in%C2%A0Proceedings%20of%20IEEE%20International%20Conference%20on%20Multimedia%20%26%20Expo%20Workshops%20%28ICMEW%29%2C%20pp.%201%E2%80%936%2C%20Seattle%2C%20USA%2C%20July%202016)

3. J. Ma, M. Dong, R&D of versatile distributed e-home healthcare system for cardiovascular disease monitoring and diagnosis, in *Proceedings of International Conference on Biomedical and Health Informatics (BHI)*, pp. 444–447, Valencia, Spain, June 2014
Google Scholar (https://scholar.google.com/scholar?q=J.%20Ma%2C%20M.%20Dong%2C%20R%26D%20of%20versatile%20distributed%20e-home%20healthcare%20system%20for%20cardiovascular%20disease%20monitoring%20and%20diagnosis%2C%20in%C2%A0Proceedings%20of%20International%20Conference%20on%20Biomedical%20and%20Health%20Informatics%20%28BHI%29%2C%20pp.%20444%E2%80%93447%2C%20Valencia%2C%20Spain%2C%20June%202014)

4. O. Postolache, P.M. Girão, H. Ijaz, IEEE 1451.4 embedded smart sensors architecture for wheelchair user monitoring, in *Proceedings of IEEE International Workshop on Medical Measurements and Applications*, vol. 1, pp. 1–5, Budapest, Hungary, May 2012)
Google Scholar (https://scholar.google.com/scholar?q=O.%20Postolache%2C%20P.M.%20Gir%C3%A3o%2C%20H.%20Ijaz%2C%20IEEE%201451.4%20embedded%20smart%20sensors%20architecture%20for%20wheelchair%20user%20monitoring%2C%20in%C2%A0Proceedings%20of%20IEEE%20International%20Workshop%20on%20Medical%20Measurements%20and%20Applications%2C%20vol.%201%2C%20pp.%201%E2%80%935%2C%20Budapest%2C%20Hungary%2C%20May%202012%29)

5. I. Korhonen, J.E. Bardram, Guest editorial introduction to the special section on pervasive healthcare. IEEE Trans. Inf. Technol. Biomed. **8**(3), 229–234 (2004)
Google Scholar (https://scholar.google.com/scholar?q=I.%20Korhonen%2C%20J.E.%20Bardram%2C%20Guest%20editorial%20introduction%20to%20the%20special%20section%20on%20pervasive%20healthcare.%20IEEE%20Trans.%20Inf.%20Technol.%20Biomed.%208%283%29%2C%20229%E2%80%93234%20%282004%29)

6. O. Postolache, P.M. Girão, E.C. Pinheiro, J.M. Pereira, R. Madeira, G. Postolache, J.G. Mendes, M.C. Moura, Multi-usage of microwave Doppler radar in pervasive healthcare systems for elderly, in *Proceedings of Instrumentation and Measurement Technology Conference (I2MTC)*, pp. 1–5, Hangzhou, China, May 2011
Google Scholar (https://scholar.google.com/scholar?q=O.%20Postolache%2C%20P.M.%20Gir%C3%A30%2C%20E.C.%20Pinheiro%2C%20J.M.%20Pereira%2C%20R.%20Madeira%2C%20G.%20Postolache%2C%20J.G.%20Mendes%2C%20M.C.%20Moura%2C%20Multi-usage%20of%20microwave%20Doppler%20radar%20in%20pervasive%20healthcare%20systems%20for%20elderly%2C%20in%C2%A0Proceedings%20of%20Instrumentation%20and%20Measurement%20Technology%20Conference%20%28I2MTC%29%2C%20pp.%201%E2%80%935%2C%20Hangzhou%2C%20China%2C%20May%202011)

7. O. Postolache, P. Girão, J.M. Joaquim, E. Pinheiro, G. Postolache, Physiological parameters measurement based on wheelchair embedded sensors and advanced signal processing. IEEE Trans. Instrum. Meas. **59**(10), 2564–2574 (2010)
CrossRef (https://doi.org/10.1109/TIM.2010.2057590)
Google Scholar (http://scholar.google.com/scholar_lookup?title=Physiological%20parameters%20measurement%20based%20on%20wheelchair%20embedded%20sensors%20and%20advanced%20signal%20processing&author=O.%20Postolache&author=P.%20Gir%C3%A30&author=JM.%20Joaquim&author=E.%20Pinheiro&author=G.%20Postolache&journal=IEEE%20Trans.%20Instrum.%20Meas.&volume=59&issue=10&pages=2564-2574&publication_year=2010)

8. M.R. Ribeiro, O. Postolache, P.M. Girão, Modular platform architecture for fast prototyping of vital signs and motor activity monitors, in *Proceedings of IEEE International Instrumentation and Technology Conference (I2MTC)*, pp. 1–6, Minneapolis, US, May 2013
Google Scholar (https://scholar.google.com/scholar?q=M.R.%20Ribeiro%2C%20O.%20Postolache%2C%20P.M.%20Gir%C3%A30%2C%20Modular%20platform%20architecture%20for%20fast%20prototyping%20of%20vital%20signs%20and%20motor%20activity%20monitors%2C%20in%C2%A0Proceedings%20of%20IEEE%20International%20Instrumentation%20and%20Technology%20Conference%20%28I2MTC%29%2C%20pp.%201%E2%80%936%2C%20Minneapolis%2C%20US%2C%20May%202013)

9. O. Postolache, P. Girao, J.M. Dias Pereira, J. Pincho, C. Maia Moura, G. Postolache, Smart walker for pervasive healthcare, in *Proceedings of International Conference on Sensing Technology (ICST)*, pp. 1–5, Parlmerston North, New Zealand, December 2011
Google Scholar (https://scholar.google.com/scholar?q=O.%20Postolache%2C%20P.%20Girao%2C%20J.M.%20Dias%20Pereira%2C%20J.%20Pincho%2C%20C.%20Maia%20Moura%2C%20G.%20Postolache%

2C%20Smart%20walker%20for%20pervasive%20healthcare%2C%20in%C2%A0Proceedings%20of%20International%20Conference%20on%20Sensing%20Technology%20%28ICST%29%2C%20pp.%201%E2%80%935%2C%20Parlmerston%20North%2C%20New%20Zealand%2C%20December%202011)

10. N. Ulivieria, C. Distanteb, T. Lucaa, S. Rocchia, P. Sicilianob, IEEE1451.4: A way to standardize gas sensor. Sens. Actuators B Chem. 114(1), 141–151, 2006. (30 March 2006)
Google Scholar (https://scholar.google.com/scholar?q=N.%20Ulivieria%2C%20C.%20Distanteb%2C%20T.%20Lucaa%2C%20S.%20Rocchia%2C%20P.%20Sicilianob%2C%20IEEE1451.4%3A%20A%20way%20to%20standardize%20gas%20sensor.%20Sens.%20Actuators%20B%20Chem.%20114%281%29%2C%20141%E2%80%93151%2C%202006.%20%2830%20March%202006%29)

11. National Instruments, An Overview of IEEE 1451.4 Transducer Electronic Data Sheets (TEDS). http://standards.ieee.org/develop/regauth/tut/teds.pdf (http://standards.ieee.org/develop/regauth/tut/teds.pdf) (accessed March 2017)

12. Transducers Techniques, TEDS IEEE 1451.4 Plug & Play Smart Load Cell. https://www.transducertechniques.com/teds-ieee-1451-4-plug-and-play-smart-load-cell.aspx (http://www.transducertechniques.com/plug-and-play-teds.aspx) (accessed March 2017)

13. R. Wang, K. Deevy, Reconfigurable adaptive wireless sensor node technology using IEEE 1451.4 standard, in *Proceedings of 39th Annual Conference of the IEEE Industrial Electronics Society (IECON)*, pp. 3988–3993, November 2013
Google Scholar (https://scholar.google.com/scholar?q=R.%20Wang%2C%20K.%20Deevy%2C%20Reconfigurable%20adaptive%20wireless%20sensor%20node%20technology%20using%20IEEE%201451.4%20standard%2C%20in%C2%A0Proceedings%20of%2039th%20Annual%20Conference%20of%20the%20IEEE%20Industrial%20Electronics%20Society%20%28IECON%29%2C%20pp.%C2%A03988%E2%80%933993%2C%20November%202013)

14. E.Y. Song, K. Lee, Understanding IEEE 1451—networked smart transducer interface standard. IEEE Instrum. Meas. Mag. 11(2), 11–17 (2008)
Google Scholar (https://scholar.google.com/scholar?q=E.Y.%20Song%2C%20K.%20Lee%2C%20Understanding%20IEEE%201451%E2%80%94networked%20smart%20transducer%20interface%20standard.%20IEEE%20Instrum.%20Meas.%20Mag.%2011%282%29%2C%2011%E2%80%9317%20%282008%29)

15. V. Viegas, J.M. Dias Pereira, P. Silva Girão, A brief tutorial on the IEEE 1451.1 standard. IEEE Instrum. Meas. Mag. 11(2), 38–46 (2008)
Google Scholar (https://scholar.google.com/scholar?q=V.%20Viegas%2C%20J.M.%20Dias%20Pereira%2C%20P.%20Silva%20Gir%C3%A3o%2C%20A%20brief%20tutorial%20on%20the%20IEEE%201451.1%20standard.%20IEEE%20Instrum.%20Meas.%20Mag.%2011%282%29%2C%2038%E2%80%9346%20%282008%29)

16. D.S. Platt, *Introducing Microsoft .NET*, 3rd ed. (Microsoft Press, WA, USA, 2003). ISBN 9780735619180
Google Scholar (https://scholar.google.com/scholar?q=D.S.%20Platt%2C%20Introducing%20Microsoft%20.NET%2C%203rd%20ed.%20%28Microsoft%20Press%2C%20WA%2C%20USA%2C%202003%29.%20ISBN%209780735619180)

17. J. Ritcher, *Applied Microsoft .NET Framework Programming* (Microsoft Press, WA, USA, 2002). ISBN 9780735614222
Google Scholar (https://scholar.google.com/scholar?q=J.%20Ritcher%2C%20Applied%20Microsoft%20.NET%20Framework%20Programming%20%28Microsoft%20Press%2C%20WA%2C%20USA%2C%202002%29.%20ISBN%209780735614222)

18. J. Lowy, *Programming WCF Services* (O'Reilly, USA, 2007). ISBN 9780596526993
Google Scholar (http://scholar.google.com/scholar_lookup?title=Programming%20WCF%20Services&author=J.%20Lowy&publication_year=2007)

19. J. Smith, *Inside Windows Communication Foundation* (Microsoft Press, WA, USA, 2007). ISBN 0780735623064
Google Scholar (https://scholar.google.com/scholar?q=J.%20Smith%2C%20Inside%20Windows%20Communication%20Foundation%20%28Microsoft%20Press%2C%20WA%2C%20USA%2C%202007%29.%20ISBN%200780735623064)

20. K. Lee, Sensor networking and interface standardization, in Proceedings IEEE Instrumentation and Measurement Technology Conference (IMTC), pp. 147–152, Budapest, Hungary, May 2001
Google Scholar (https://scholar.google.com/scholar?q=K.%20Lee%2C%20Sensor%20networking%20and%20interface%20standardization%2C%20in%C2%A0Proceedings%20IEEE%20Instrumentation%20and%20Measurement%20Technology%20Conference%20%28IMTC%29%2C%20pp.%20147%E2%80%93152%2C%20Budapest%2C%20Hungary%2C%20May%202001)

21. P. Doyle, D. Heffernan, D. Duma, A time-triggered transducer network based on an enhanced IEEE 1451 model. Microprocess. Microsyst. 28, 1–12 (2004)
CrossRef (https://doi.org/10.1016/S0141-9331(03)00088-7)
Google Scholar (http://scholar.google.com/scholar_lookup?title=A%20time-triggered%20transducer%20network%20based%20on%20an%20enhanced%20IEEE%201451%20model&author=P.%20Doyle&author=D.%20Heffernan&author=D.%20Duma&journal=Microprocess.%20Microsyst.&volume=28&pages=1-12&publication_year=2004)

22. R. Madeira, O. Postolache, G. Postolache, Development of therapeutic serious game for a pervasive assistive environment, in *Proceedings of IEEE International Conference on Serious Games and Applications for Health (SEGAH)*, pp. 1–11, Braga, Portugal, November 2011
Google Scholar (https://scholar.google.com/scholar?q=R.%20Madeira%2C%20O.%20Postolache%2C%20G.%20Postolache%2C%20Development%20of%20therapeutic%20serious%20game%20for%20a%20pervasive%20assistive%20environment%2C%20in%20Proceedings%20of%C2%A0IEEE%20International%20Conference%20on%20Serious%20Games%20and%20Applications%20for%20Health%20%28SEGAH%29%2C%20pp.%201%E2%80%9311%2C%20Braga%2C%20Portugal%2C%20November%202011)

23. IEEE Standards, IEEE 1451.4™ Manufacturer ID Public Listing. http://standards.ieee.org/develop/regauth/manid/public.html) (http://standards.ieee.org/develop/regauth/manid/public.html)) (accessed March 2017)

Copyright information

About this chapter

Cite this chapter as:

Postolache O., Viegas V., Freire J., Pereira J.M.D., Girão P. (2017) IEEE1451 Smart Sensors Architectures for Vital Signs and Motor Activity Monitoring. In: George B., Roy J., Kumar V., Mukhopadhyay S. (eds) Advanced Interfacing Techniques for Sensors. Smart Sensors, Measurement and Instrumentation, vol 25. Springer, Cham. https://doi.org/10.1007/978-3-319-55369-6_10

- First Online 05 April 2017
- DOI https://doi.org/10.1007/978-3-319-55369-6_10
- Publisher Name Springer, Cham
- Print ISBN 978-3-319-55368-9
- Online ISBN 978-3-319-55369-6
- eBook Packages Engineering Engineering (R0)

Personalised recommendations