HardwareX • Volume 12 • October 2022 • Article number e00358

Document type
Article

Source type
Journal

ISSN
24680672

DOI
10.1016/j.ohx.2022.e00358

Publisher
Elsevier Ltd

Original language
English

CAREDAQ: Data acquisition device for mechanical ventilation waveform monitoring

Arn Ng, Qing[a]; Yew Shuen Ang, Christopher[a] ; Shiong Chiew, Yeong[a] ; Wang, Xin[a];
Pin Tan, Chee[a]; Basri Mat Nor, Mohd[b]; Salwa Damanhuri, Nor[c]; Geoffrey Chase J.[d]
Save all to author list

[a] School of Engineering, Monash University Malaysia, Selangor, Subang Jaya, 47500, Malaysia

[b] Kulliyah of Medicine, International Islamic University Malaysia, Pahang, Kuantan, 25200, Malaysia

[c] Faculty of Electrical Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, 13500, Permatang Pauh, Pulau Pinang, Malaysia

[d] Center of Bioengineering, University of Canterbury, Christchurch, 8041, New Zealand

Abstract

Mechanical ventilation (MV) provides respiratory support for critically ill patients in the intensive care unit (ICU). Waveform data output by the ventilator provides valuable physiological and diagnostic information. However, existing systems do not provide full access to this information nor allow for real-time, non-invasive data collection. Therefore, large amounts of data are lost and analysis is limited to short samples of breathing cycles. This study presents a data acquisition device for acquiring and monitoring patient ventilation waveform data . Acquired data can be exported to other systems, allowing users to further analyse data and develop further clinically useful parameters. These parameters, together with other ventilatory information, can help personalise and guide MV

treatment. The device is designed to be easily replicable, low-cost, and scalable according to the number of patient beds. Validation was carried out by assessing system performance and stability over prolonged periods of 7 days of continuous use. The device provides a platform for future integration of machine-learning or model-based modules, potentially allowing real-time, proactive, patient-specific MV guidance and decision support to improve the quality and productivity of care and outcomes. © 2022

Author keywords

Data acquisition device ; Mechanical ventilation ; Ventilator waveform data

Indexed keywords

Metrics

Funding details

References (21)

View in search results format >

All

Export Print E-mail Save to PDF Create bibliography

1 Emrath, E.

The Basics of Ventilator Waveforms (Open Access)

(2021) *Current Pediatrics Reports*, 9 (1), pp. 11-19. Cited 3 times.
https://www.springer.com/journal/40124
doi: 10.1007/s40124-020-00235-4

View at Publisher

2 Kipnis, E., Ramsingh, D., Bhargava, M., Dincer, E., Cannesson, M., Broccard, A., Vallet, B., (...), Thibault, R.

Monitoring in the intensive care (Open Access)

(2012) *Critical Care Research and Practice*, 2012, art. no. 473507. Cited 29 times.
doi: 10.1155/2012/473507

View at Publisher

3 Blanch, P.B., Banner, M.J.

A new respiratory monitor that enables accurate measurement of work of breathing: A validation study

(1994) *Respiratory Care*, 39 (9), pp. 897-905. Cited 42 times.

4 Blanch, L., Sales, B., Montanya, J., Lucangelo, U., Oscar, G.-E., Villagra, A., Chacon, E., (...), Murias, G.

Validation of the Better Care® system to detect ineffective efforts during expiration in mechanically ventilated patients: A pilot study

(2012) *Intensive Care Medicine*, 38 (5), pp. 772-780. Cited 85 times.
link.springer.de/link/service/journals/00134/index.htm
doi: 10.1007/s00134-012-2493-4

View at Publisher

5 Kohli-Seth, R., Oropello, J.M.

The future of bedside monitoring

(2000) *Critical Care Clinics*, 16 (4), pp. 557-578. Cited 19 times.
http://www.elsevier.com/inca/publications/store/6/2/3/1/3/2/index.htt
doi: 10.1016/S0749-0704(05)70134-2

View at Publisher

6 Jassas, M.S., Qasem, A.A., Mahmoud, Q.H.

A smart system connecting e-health sensors and the cloud

(2015) *Canadian Conference on Electrical and Computer Engineering*, 2015-June (June), art. no. 7129362, pp. 712-716. Cited 37 times.
http://ieeexplore.ieee.org/xpl/conhome.jsp?punumber=1000225
ISBN: 978-147995827-6
doi: 10.1109/CCECE.2015.7129362

View at Publisher

7 Gupta, M.S.D., Patchava, V., Menezes, V.

Healthcare based on IoT using Raspberry Pi

(2015) *Proceedings of the 2015 International Conference on Green Computing and Internet of Things, ICGCIoT 2015*, art. no. 7380571, pp. 796-799. Cited 69 times.
ISBN: 978-146737909-0
doi: 10.1109/ICGCIoT.2015.7380571

View at Publisher

8 Dudas, R., VandenBussche, C., Baras, A., Ali, S.Z., Olson, M.T.

Inexpensive telecytology solutions that use the Raspberry Pi and the iPhone

(2014) *Journal of the American Society of Cytopathology*, 3 (1), pp. 49-55. Cited 23 times.
doi: 10.1016/j.jasc.2013.09.005

View at Publisher

9 Milenkovic, A.M., Markovic, I.M., Jankovic, D.S., Rajkovic, P.J.

Using of Raspberry Pi for data acquisition from biochemical analyzers

(2013) *2013 11th International Conference on Telecommunications in Modern Satellite, Cable and Broadcasting Services, TELSIKS 2013*, 2, art. no. 6704405, pp. 389-392. Cited 5 times.
ISBN: 978-147990902-5
doi: 10.1109/TELSKS.2013.6704405

View at Publisher

10 Mansfield, S.G.
(2021)
“PIMAP: A System Framework For Patient Monitoring,” ed.

11 Rehm, G.B., Kuhn, B.T., Delplanque, J.-P., Guo, E.C., Lieng, M.K., Nguyen, J., Anderson, N.R., (...), Adams, J.Y.

Development of a research-oriented system for collecting mechanical ventilator waveform data (Open Access)

(2018) *Journal of the American Medical Informatics Association*, 25 (3), pp. 295-299. Cited 12 times.
http://jamia.oxfordjournals.org/content/22/e1
doi: 10.1093/jamia/ocx116

View at Publisher

12 Van Drunen, E.J., Chiew, Y.S., Pretty, C., Shaw, G.M., Lambermont, B., Janssen, N., Chase, J.G., (...), Desaive, T.

Visualisation of time-varying respiratory system elastance in experimental ARDS animal models (Open Access)

(2014) *BMC Pulmonary Medicine*, 14 (1), art. no. 33. Cited 31 times.
http://www.biomedcentral.com/1471-2466/14/33
doi: 10.1186/1471-2466-14-33

View at Publisher

13 Lucangelo, U., Bernabè, F., Blanch, L.

Lung mechanics at the bedside: Make it simple

(2007) *Current Opinion in Critical Care*, 13 (1), pp. 64-72. Cited 58 times.
doi: 10.1097/MCC.0b013e32801162df

View at Publisher

14 Morton, S.E., Knopp, J.L., Chase, J.G., Docherty, P., Howe, S.L., Möller, K., Shaw, G.M., (...), Tawhai, M.

Optimising mechanical ventilation through model-based methods and automation (Open Access)

(2019) *Annual Reviews in Control*, 48, pp. 369-382. Cited 24 times.
https://www.journals.elsevier.com/annual-reviews-in-control
doi: 10.1016/j.arcontrol.2019.05.001

View at Publisher

15 (2021) , p. 105022.
Q. Sun "Over-distension prediction via hysteresis loop analysis and patient-specific basis functions in a virtual patient model," Computers in Biology and Medicine

16 Zhou, C., Chase, J.G., Knopp, J., Sun, Q., Tawhai, M., Möller, K., Heines, S.J., (...), Desaive, T.

Virtual patients for mechanical ventilation in the intensive care unit (Open Access)

(2021) *Computer Methods and Programs in Biomedicine*, 199, art. no. 105912. Cited 18 times.
www.elsevier.com/locate/cmpb
doi: 10.1016/j.cmpb.2020.105912

View at Publisher

17 Loo, N.L., Chiew, Y.S., Tan, C.P., Mat-Nor, M.B., Ralib, A.M.

A machine learning approach to assess magnitude of asynchrony breathing

(2021) *Biomedical Signal Processing and Control*, 66, art. no. 102505. Cited 5 times.
http://www.elsevier.com/wps/find/journalbibliographicinfo.cws_home/706718/description#bibliographicinfo
doi: 10.1016/j.bspc.2021.102505

View at Publisher

18 Ang, C.Y.S., Chiew, Y.S., Vu, L.H., Cove, M.E.

Quantification of respiratory effort magnitude in spontaneous breathing patients using Convolutional Autoencoders

(2022) *Computer Methods and Programs in Biomedicine*, 215, art. no. 106601.
www.elsevier.com/locate/cmpb
doi: 10.1016/j.cmpb.2021.106601

View at Publisher

19 Chong, T.C., Loo, N.L., Chiew, Y.S., Mat-Nor, M.B., Ralib, A.M.

Classification patient-ventilator asynchrony with dual-input convolutional neural network (Open Access)

(2021) *IFAC-PapersOnLine*, 54 (15), pp. 322-327.
http://www.journals.elsevier.com/ifac-papersonline/
doi: 10.1016/j.ifacol.2021.10.276

View at Publisher

20 , pp. 1-16.
J. W. W. Lee Aug 25 2021, 10.1007/s10439-021-02854-4. “Stochastic Modelling of Respiratory System Elastance for Mechanically Ventilated Respiratory Failure Patients,” (in eng), Ann Biomed Eng

21 Marchuk, Y., Magrans, R., Sales, B., Montanya, J., López-Aguilar, J., de Haro, C., Gomà, G., (...), Blanch, L.

Predicting Patient-ventilator Asynchronies with Hidden Markov Models (Open Access)

(2018) *Scientific Reports*, 8 (1), art. no. 17614. Cited 16 times.
www.nature.com/srep/index.html
doi: 10.1038/s41598-018-36011-0

View at Publisher

Yew Shuen Ang, C.; School of Engineering, Monash University Malaysia, Selangor, Subang Jaya, Malaysia; email:Christopher.Ang@monash.edu

About Scopus

What is Scopus

Content coverage

Scopus blog

Scopus API

Privacy matters

Language

日本語版を表示する

查看简体中文版本

查看繁體中文版本

Просмотр версии на русском языке

Customer Service

Help

Tutorials

Contact us

ELSEVIER