Data acquisition from Datex-OhmedaAestiva/5 7900 ventilator using an open-source Python project

Modern ventilators provide an array of outputs for integration into centralized monitoring systems. Datex, for example, provides optional ventilator integration into their monitors (i.e., GE® Datex-Ohmeda S/5) and a variety of other commercially available monitors. In our translational research laboratory, we utilized a Philips® Intellivue MP90 hemodynamic monitor with a GE® Datex-Ohmeda Aestiva/5 7900 ventilator in swine models of shock. To automate data collection, we modified a high-fidelity data logging software platform (VSCaptureMP), in which continuous data are streamed out of the Phillips® monitor and associated gas analyzer into a database.[1] However, our monitor and ventilator did not communicate and therefore ventilator data were not available through the monitor. Proprietary systems provide data capture for a fee, there is also a free project called Vital Recorder.[2] Vital Recorder is well supported, has a user-friendly interface, and has documentation on hardware connection to Datex-Ohmeda machines. However, Vital Recorder's source code (C++) is difficult to find and does not permit advanced configuration. Not only does real-time ventilator data capture reduce the cognitive burden and personnel time for management, but increases the fidelity of anesthesia records.[3] Real-time data capture would be necessary to build autonomous resuscitation protocols. To meet the unique needs of a large animal translational lab, we developed and implemented the Datex-Ohmeda COM 1.0 Serial Protocol (Supplemental File 1) for automated data extraction from an Aestiva/5 7900 ventilator with real-time logging to a REDCap database.[4]

A standard Raspberry PI computer (4B) was used to develop and deploy an automated ventilator logging device.[5] There are two RS-232 serial ports on the rear of the Aestiva/5 7900. The 15-pin header (DB15) interface provides the RS-232 bi-directional communication for logging ventilator data. A custom hardware connector was built to change the DB15 to a DB9 connector, the cables were connected as follows: pin 13 to pin 2 (TX to RX), pin 6 to pin 3 (RX to TX), and pin 5 to pin 5 (ground). The Raspberry PI was then connected to the DB9 connector using an RS-232 to universal serial bus (USB) adapter (BENFEI Prolific Chipset, Commerce, CA, USA).

A Python (Version 3.7) program was built and developed to run autonomously, check the USB for availability, test ventilator connections, and monitor for a positive acknowledgment from the ventilator. Once the handshake has been completed, the ventilator will send two messages (measured data and ventilator settings) at the end of the respiratory cycle (i.e., at end-expiration). The data packets are then parsed and sent to a stand-alone database (REDCap, Vanderbilt University, Nashville, USA) over the wireless internet connection.

The software and connection guide may be used to integrate data from the ventilator with the anesthesia workstation or transport monitors for automated, real-time data logging from an Aestiva/5 7900 ventilator [Figure 1]. At a minimum to

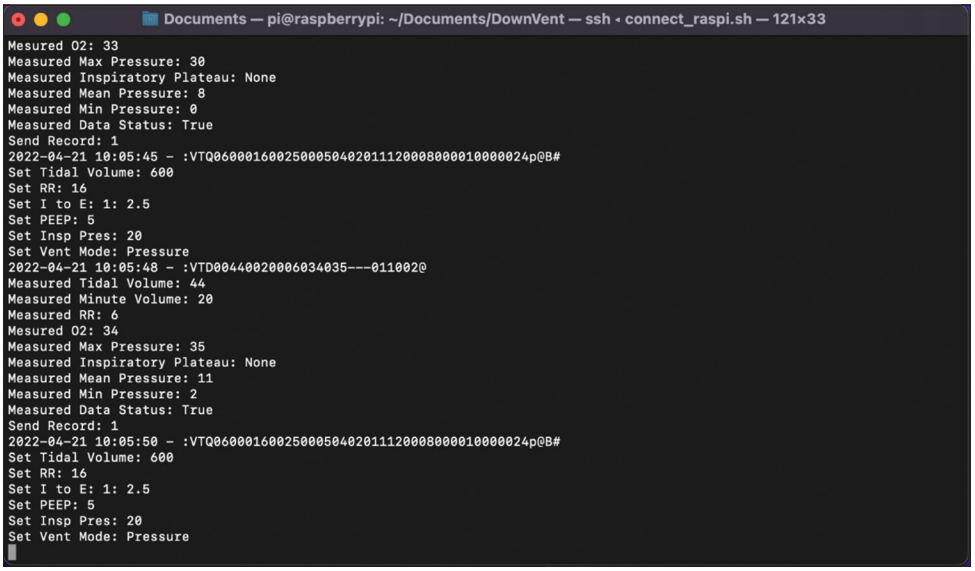

Figure 1: A screenshot of the command line interface during data capture. The ":VTD" is the prefix for the measured ventilator response after a breath. The ":VTQ" is the prefix for the ventilator settings response after a breath

get started, the steps include building a connector as described above with a standard desktop computer with Python installed, then the code can be downloaded from GitHub (https://github.com/patnatha/DownVent) to start recording.

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Conflicts of interest

L.P.N. and T.K.W. are co-founders of Certus Critical Care, Incorporated. N.T.P.P. is a paid consultant for Certus Critical Care, Incorporated.

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