The HDvent Emergency Ventilator System

A team of physicists, anesthesiologists, mechanical and electrical engineers from Heidelberg University has developed the prototype of a low-cost mechanical ventilation device. The system can perform life-saving mechanical ventilation for patients suffering from respiratory diseases such as COVID19 and provides a low-cost alternative to commercial devices. The design is available as an open-source project to help developers worldwide fight the worst impact of the coronavirus and future pandemics.

The coronavirus pandemic has revealed a painful truth: In the event of a global health emergency, healthcare systems around the world can be overwhelmed by a sudden increase in demand for staff, materials, and medical devices. The complexity and high regulatory standards for medical technology make it difficult to quickly respond to large-scale emergencies. Under such circumstances, the way forward may be alternative, rapidly developed prototypes that can be manufactured and operated by non-experts.

In the spring of 2020, during the early phase of the coronavirus pandemic, a shortage of mechanical ventilators was anticipated in most European countries. To help the situation in Heidelberg, a group of physicists and engineers from the Physics Institute teamed up with anesthesiologists from Heidelberg University Hospital and IT developers from Rommelag iLabs GmbH (Karlsruhe) to develop a ventilator that could be manufactured at the Physics Institute workshops and cover emergency cases at Heidelberg University Hospital.

Taking inspiration from other teams worldwide, the team built a prototype based on manual resuscitators: Their motorized device compresses a resuscitator, a silicone bag connected to the intubated patient, to deliver breaths with adjustable frequency, volume and pressure. To help medical staff assess a patient's health, all relevant parameters are displayed on an external monitoring unit

“Our design has some really unique features: There are very few moving parts, such that our device can be made in large quantities even if precision machining is not available. Our software design allows for many different ventilation modes and can provide the functionality of a professional device” says David Grimshandl, one of the authors of the project.

Philipp Preiss, who has been coordinating the project, adds “We are relieved that enough commercial ventilators have been available throughout the pandemic and that our rapid-development prototype has not been needed. We hope that, together with the progress made by other teams working on open source solutions, our insights can help develop low cost ventilators to prepare for future emergencies.”

The research supporting the prototype ventilator is available at:
Website
Publication
Github

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