A SIMPLE LOW-TECH VENTILATOR, ON A NOT-FOR-PROFIT BASIS

WE AT OPENVENT-BRISTOL ARE A VOLUNTEER ENGINEERING GROUP WHO CAME TOGETHER IN RESPONSE TO THE COVID-19 CRISIS.

OUR AIM IS TO CREATE A SIMPLE 'LOW-TECH' VENTILATOR TREATMENT OF COVID-19 FOR DEVELOPING COUNTRIES ON A NOT-FOR-PROFIT BASIS.

OUR KEY FOCUSES ARE ON SAFETY, USE OF READILY AVAILABLE COMPONENTS AND PROCESSES AND OPEN SOURCING OUR WORK; WE WILL MAKE ALL DESIGNS PUBLICLY AVAILABLE FOR THE WORLD TO BENEFIT FROM OUR LEARNINGS. THERE WILL BE NO COPYRIGHTS, PATENTS OR SECRETS.
Ambu-bags exist readily in most countries healthcare systems with pre-existing medical approval for manual ventilation. OpenVent-Bristol mechanically squeezes the bag.

**Advantages of our design**

- **Based on an Ambu-Bag**: Ambu-bags are readily available in most healthcare systems with pre-existing medical approval for manual ventilation.

- **Rapid Manufacture**: Made from readily available materials and production processes to enable rapid manufacture at low cost.

- **Can be Used Anywhere**: Not dependent on compressed airline which may not be available in hospitals with less resources (oxygen is separate).

- **Visual Monitoring**: Bag compression can be monitored through transparent panel for feedback.
KEY ACHIEVEMENTS

TESTING
Our device has been tested to the “ventilation” requirements by the National Physical Laboratory (NPL) in London using their test lung, with good results. It was tested to the MHRA V4 RMVS REQUIREMENTS.

INTERNATIONAL RECOGNITION
Our 1st open sourced design was adopted by HELPFUL ENGINEERING, a large US based volunteer engineering group.

SUPPORT & ASSISTANCE
We have received interest and assistance from AmboVent - Israel based open source ventilator.

DOMESTIC & FOREIGN INTEREST
Contact from multiple countries around the world who are interested in manufacturing, buying and using our device including; Saudi Arabia, Ukraine, Israel & the UK.

FINAL PROTOTYPE
We are currently designing our third, and hopefully final prototype, which we hope will meet all the MHRA requirements. Our Version 2 design can be found HERE.
TEAM

**DARREN LEWIS**
Project Lead & Mechatronics
Darren is a Design Manager working in Dyson’s New Product Concepts team in R&D. With 10 years industry experience developing complex electro-mechanical systems into products, Darren has an extensive multidisciplinary engineering skill set in mechanical, electronic & software engineering.

**ROSS GOODWIN**
Mechanical
Ross is an Associate Principle Engineer working in Dyson’s motor development team. He has over 10 years of experience developing high speed turbomachinery to meet performance, durability, safety and functional requirements. Ross’s engineering skill set includes structural and thermal simulation, design for manufacturer, and experimental testing of complex electro-mechanical systems.

**ANGUS THOMSON**
Electronics
Angus is the founder of CircuitBuilder - a web-based platform designed to simplify the process of creating custom electronics. He has nearly 20 years experience working across a wide range of industries, from consumer electronics to defence, in companies ranging from 2 people to 200,000.

**DONALD ROBSON**
Software
Donald is an Embedded Development Engineer at Graphcore, with a varied career encompassing mechanical design, mechatronics and firmware development. During his time at Dyson he influenced a number of flagship products in environmental control, floorcare and lighting.

**SAM RILEY**
Verification
Sam is a Safety Critical Programmable Elements Certification Engineer. He works as part of MoD Software and cyber security Certification team, working to assure the safety and airworthiness within aviation.
CONSULTANTS
Lead consultant anesthetist working in a UK Intensive Care Unit

NURSES
2 nurses who are working to treat COVID patients in Intensive Care

MANUFACTURERS
P3 Medical; who manufacture ventilation devices (e.g. intubation tubing)
TIMELINE

2020

MARCH 31
Our first open source basic mechanical design concept is published

MAY 4
Version 2.0 design is tested at National Physical Laboratory

MAY 8
Version 2 open source design is published

MAY 31
Build two Version 3.0 prototypes using 3D printed flow sensors

JUNE 8
Software written for PCV and adaptive ventilation modes

JUNE 15
Testing of the final design at NPL to MHRA requirements

JUNE 22
Build 10 prototypes & receive CNC machined prototype flow sensor

JUNE 29
Begin 24/7 life test on prototypes, document design and post PR/press articles to gather interest in final design

ONGOING PROCESSES
We continue seeking medical product approval & manufacturers. Once these are established the next phase can begin.
OpenVent-Bristol
Version 3.0

CONSTRUCTION
Laser cut sheet stainless steel for good strength, water drip resistance, bio compatibility and quickly scalable

VISUAL MONITORING
For visual feedback of bag compression

VISUAL AIRWAY PRESSURE MONITOR
Airway pressure displayed with horizontal bar graph

PEEP VALVE
Adjustable PEEP valve, to maintain positive pressure at all times

AIR OUTLET
Standard 22mm tapered push-fit air outlet, compatible with existing tubing

LCD USER INTERFACE
To display measured values and set values for example; airway pressure, tidal volume, I:E ratio & ventilation mode

MEMBRANE BUTTON PANEL
To minimise crevices for germs to hide

AMBUBAG / BMV
Based on an Ambubag, which are already medically approved for manual ventilation and are readily available in most countries health

SIMPLE MECHANISM
1 moving part, simply an arm mounted to a motor

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"So far we have been relying on funding from family and friends via our [GoFundMe](#) page, however funds from this have dried up and I am now funding the project myself, however I am unable to continue doing this."

Our lack of financial support is restricting our progress from Version 2.0 to Version 3.0. We require funds to produce our next - and likely final - batch of prototype ventilators, and to get these further tested at NPL.
From prototype to manufacturing

Cost to manufacture large quantities (at least 1000 units) approx. £500 each

Each prototype will need a flow sensor (these will be made as there is no availability of off-the-shelf flow sensors currently):

- To 3D print 10 flow sensors from medical approved plastic £20 each (inconsistent quality)
- To CNC machine £400 each (reliably high quality)

Version 3.0 prototype manufacture £600 each (we aim to build at least 10 to test reliability). Costs will reduce with higher volumes: £6000 total

All costs are approximate and subject to change once final supplier quotes are received.
With your support, your organisation can benefit from:

Part of the OpenVent-Bristol website dedicated to you including logo and brand message.

Special thanks in publications of the open source design, including web-based documentation, GitHub, YouTube videos, and any future academic conference papers.
Sponsorship can consist of

- **PARTS** to help us build our ventilators
- **SERVICES** to aid and advise our work
- **FUNDING** to financially support our project

CURRENT SPONSORS

At this stage we currently have one sponsor on the project, and are looking to bring more companies on board with us. Sponsorship is really important to us as it can help in so many different ways, and is never a ‘one-size-fits-all’ relationship. We are delighted to be supported by our sponsor CircuitBuilder.

CircuitBuilder is a brand new way to create professionally designed circuit boards. Upload your requirements, see a detailed breakdown of costs and watch in real-time as your project progresses to completion.
COMPETITIVE

There are many great engineering teams out there working on open source ventilators. This is a huge positive for example:

- To increase chances of success
- To provide buyers with more choice
- Component availability will limit how far one design can be deployed

INTELLIGENT

There is an increasing need for an adaptive ventilation mode where the system senses the person trying to breath before delivering air

SAFETY MEASURES

PCV (Pressure Controlled Ventilation) mode is recognised as safer than VCV (Volume Control Ventilation) mode, reducing likelihood of lung damage through over pressure.

ONE VENTILATOR DESIGN IS NOT THE SOLUTION