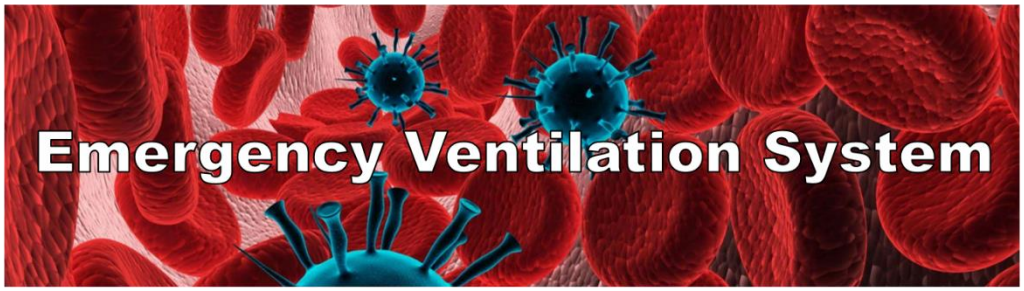
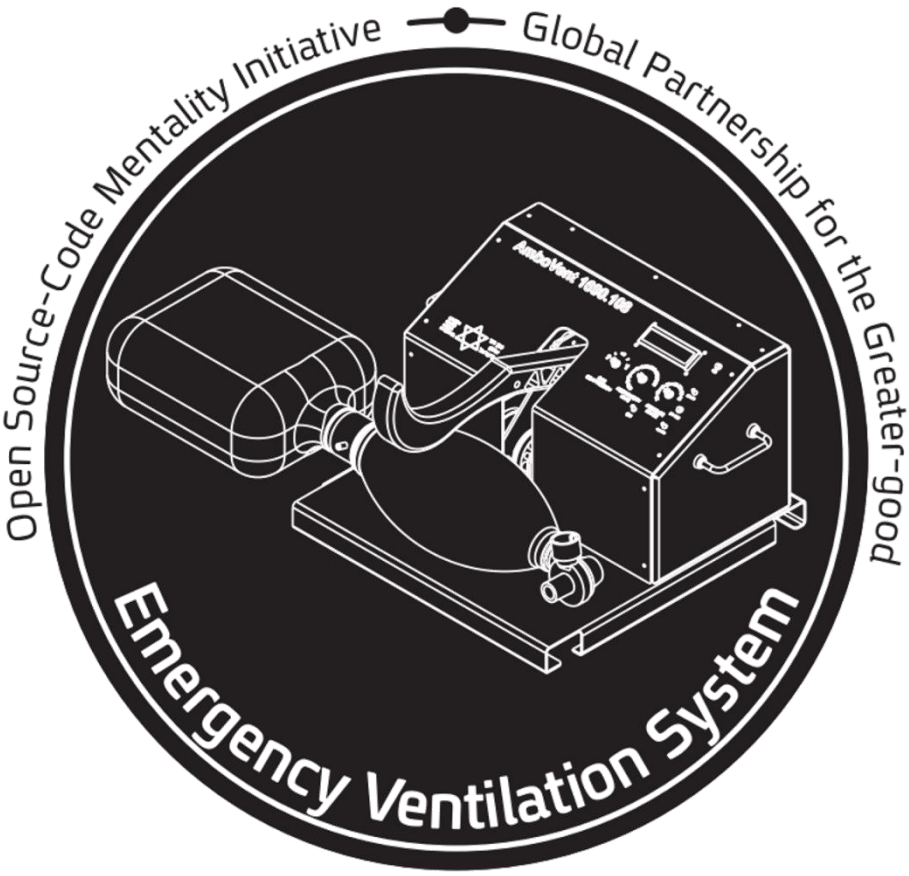


AmboVent

1690.108

Emergency ventilation alternative system

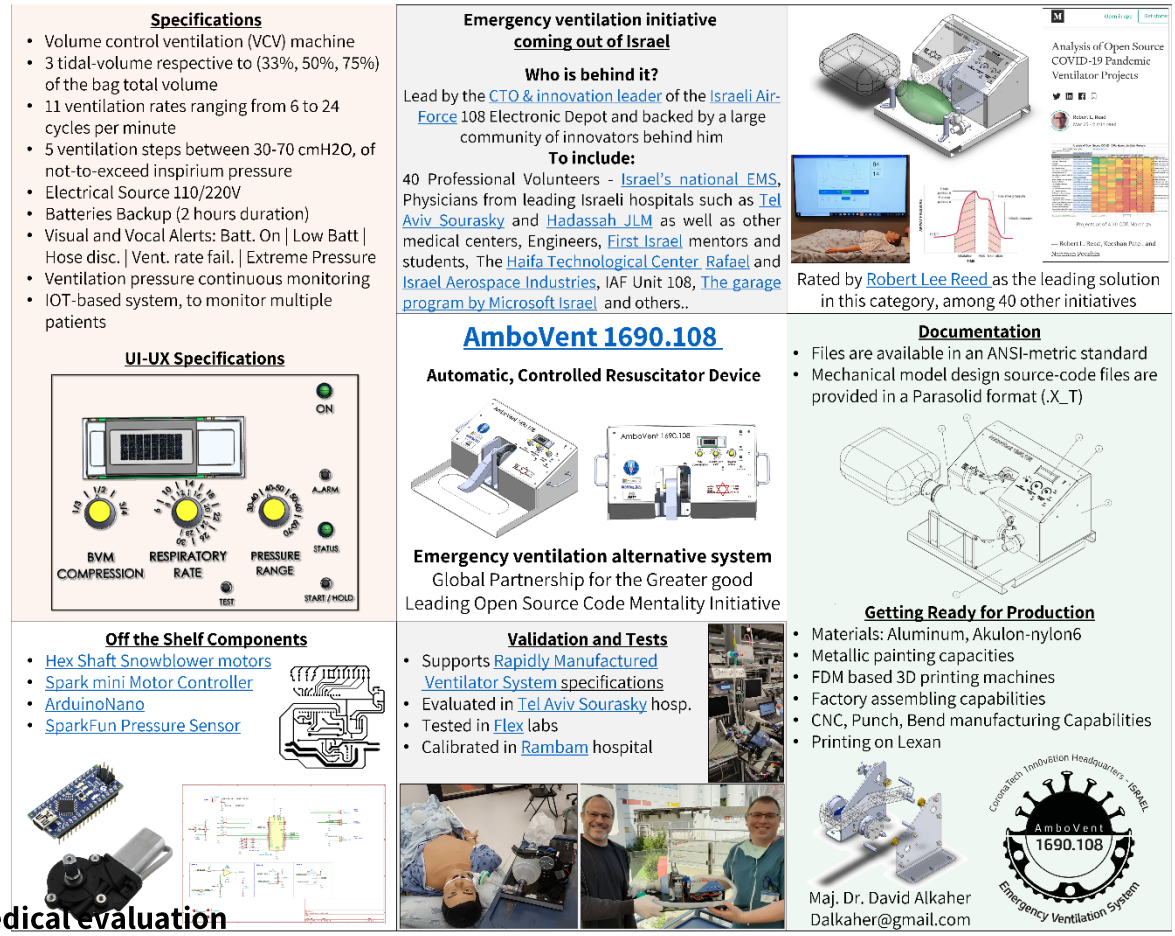


Open-Source Code Mentality Initiative
Global Partnership for the Greater-good

AmboVent 1690.108 for COVID-19 ventilation machines shortage challenge

1. **Emergency Alternative Ventilation System: An open Source Initiative**

   Created by teams of Israeli volunteers: First Israel Robotics team, IAI Unit 108, Magen David Adom, Rafael, Microsoft R&D Israel, IDC Herzliya, and many mentors. Designed as an alternative automatic, controlled, ventilation system for adults, to be used only in emergency situations when no other approved ventilation machines are available.



2. **Medical evaluation**

   AmboVent 1690.108 is currently being tested by the Israeli Regulatory Authority. We work around the clock to complete both clinical performance and safety evaluation, including electromagnetic compatibility (EMC). So far, the testing shows the device can serve, in case there is no other regulatory-approved ventilator available, as an effective alternative ventilator for patients who require mechanical ventilation.

3. **Technical requirements:**

   a. Manual selection of tidal volume, by choosing % of squeeze from full (100%) bag squeeze. For example, choosing 60% means the device pushes out every cycle, 60% of its full (100%) capacity.

b. Enable selection of 9 different respiratory rates, from 6-24 cycles per minute, increasing by steps of 2.
c. Compatible with Ambu (and other manufacturers) commonly used self-inflating bags, ranging between 1100 to 1475 cc.
d. Maximum inhalation pressure setting, ranging between 30 to 70 cmH2O, increasing by steps of 10.
e. Works with standard Positive End-Expiratory Pressure (PEEP) valves.
f. Standard 110-220V Powerline feed + two-hours battery backup.
g. In events of resistance during inhalation (abnormal rise in air pressure), the bag squeezing process stops and regains inhalation in the following cycle.
h. Insulation of electrical and electronic parts to prevent the chance of sparking (in a pure oxygen-rich ventilation environment).

4. Functionality:

a. Compliance with the use, connection, parts and integration of ventilation piping available in medical facilities.
b. Compact and lightweight. Can be positioned with flexibility around the patient's bed, up to 1.5 meters away with no fear of increasing the dead space.
c. Wide options of tidal volume selection, ranging from 30% to 100% of full squeezing capacity.
d. Nine different respiratory rates, ranging between 6 to 24 cycles per minute.
e. A predetermined I:E time ratio of 1:2. Can be changed in the program.
f. Positive End-Expiratory Pressure (PEEP) control, using a standard PEEP valve.
g. 110-220V power supply
h. Two hours of continuous operation on backup batteries in case of external power supply failure.
i. Simple, durable and intuitive structure and operation.
j. Capable of choosing Peak Inspiratory Pressure (PIP) sensing threshold, ranging between 30-70 cmH20.
k. Compatible with standard ventilation oxygen bags.
l. Can be connected to hospital’s clean air supply. Useful for ventilating fresh and clean air in crowded rooms.

5. Automatic alerting upon malfunctioning

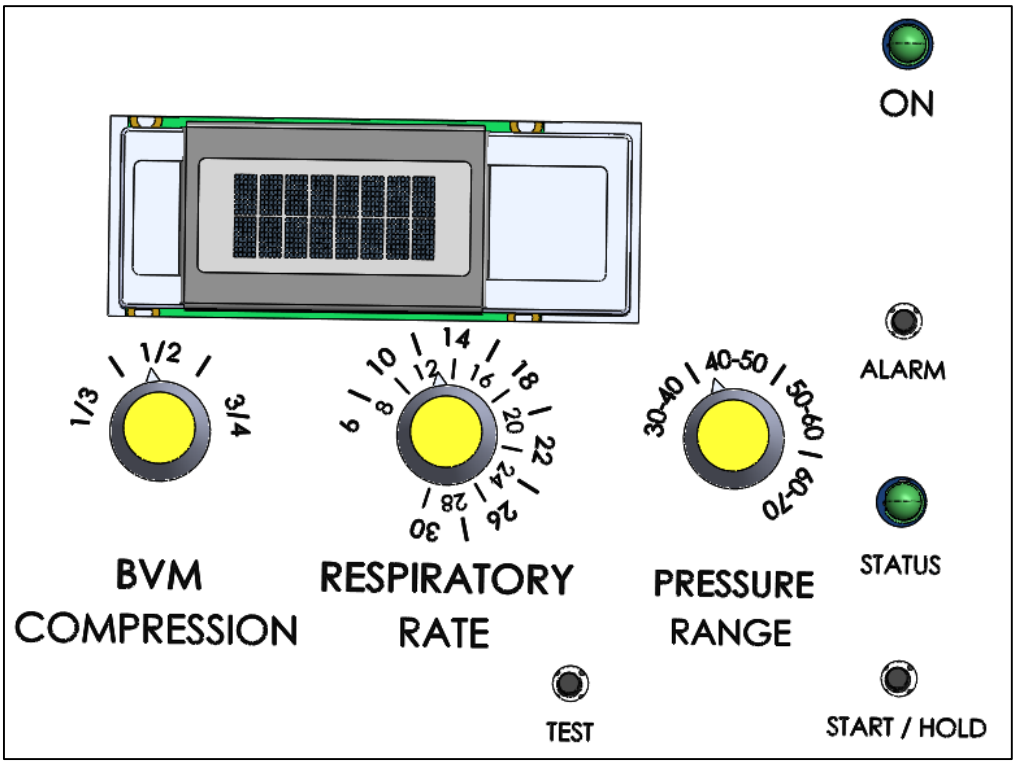
a. Electrical power supply failure (Audio alert (sound alarm) + visual indication by LED).
b. Internal battery voltage drop (a continuous sound alarm that cannot be dismissed before reconnecting to an external power source + a visible led indication).
c. Alerting in case someone tries to turn off the device during active ventilation (will cause a one-minute continuous sound alarm + a visible led indication).

d. Pressure rise above the PIP threshold (one-time sound alarm. In case it continues (repeating events) – (continuous sound alarm with a prominent light indicator).

e. Sudden, unexpected pressure drops (may indicate air tubes disconnect) (continuous sound alarm that stops if pressure is build back to normal within two ventilation cycles. Otherwise, the alarm continues until operator active intervention.

f. Deviation from the user respiration rate setting (continuous sound alarm + a visible led indication).

User Interface and Operation



6. UI: Functionality

Display	Type	Remarks
BVM Compression	Potentiometer 	Pick values ranging from 30% - 100% of full bag squeeze
Respiratory Rate	Potentiometer	Pick values between 6 to 24 (increments of 2).
PIP Range	Potentiometer	Pick values between 30 to 70 cmH_2O (increments of 10).
Start / Hold	Button	Single short press turns the device on / 5 seconds continued press turns the device off.
Test	Button 	Pressing the button runs a one time cycle of 75% bag squeeze.
Alarm	Button	Turns off screen alerts and LED Status
Status	LED 	**LED Indications** The device is on in Hold mode - Green Ventilation is on - Blinking green, synchronized with the respiration rate Malfunction - Blinking orange, synchronized with the respiration rate (error type will be listed on screen) Critical malfunction - Red Transitioning to battery mode (power disconnected) - blinking red in synchrony with the respiration rate

On	LED	Indication of turning on the device - green in operating mode

7. **UI: Feedback for User**

Display	Type	Display	Remarks
Low pressure	Number	**Value of minimum pressure** as measured by the system	Check the system
Ventilation pattern differs from operator settings	Number	**Value of maximum pressure** as measured by the system	Reenter value of preferred ventilation rate
Alert when working on battery power	Potentiometer	"**Batt On**" Indication after disconnecting power source	LED - blinking red
Alert when continually working on battery for 2 hours	Button	"**Low Batt**" Indication of reaching 2 hrs of continuous operation on batteries	LED - malfunction blinking orange
Alert when ventilation hose disconnects	Button	**"Hose Disconnect"** Indication pressure hose disconnected	LED - malfunction blinking orange

Critical malfunction alert	Button	**"Vent. Rate fail"**	LED - malfunction red
Pressure reaching the PIP threshold	Number	**Extreme Pressure**	Alarm

The following has volunteered & contributed to the success of this project

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The success of this project is also attributed to

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