COVID-19 Projects
Ventilator + 3D Printing for Hospitals

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This project is evolving. Most up-to-date presentation at:

www.standagainstcovid.com
COVID-19 Ventilator: Background & Motivation

ICU Equipment for severe COVID-19 patients

- Ventilators
- anesthetic machines with ventilator features
- Ventilator splitting systems (with their limitations)
- Self-inflated (“AMBU”) bags

Professional ventilation equipment, limited resources

Widely available, but manually operated
Affordable, mass-produced COVID-19 Ventilator

**Need:**
- hospitals potentially overwhelmed with severe COVID-19 patients
- insufficient number of professional mechanical ventilation equipment
- insufficient number of healthcare workers able to manually ventilate the patients

**Value:**

**Hospital:**
- Better use of basic, ubiquitous medical infrastructure (AMBU bags)
- Better work effectiveness while serving patients in need

**Patient:**
- Temporary ventilation device before real ventilator is available

**Approach:**
- Device for automated, repeatable ventilation with an AMBU bag
- Using pressure, O2 and CO2 sensors to monitor patient state
- Intuitive device use with little training, one person monitoring a few patients

**Competition:**
- Portable ventilators used for patient transport
- Other DIY solutions
- Ventilator splitting systems
COVID-19 Ventilator Prototype
Prototype Mechanical Design

- AMBU Bag
- Bag pressing surface
- Aluminum moving frame
- Aluminium extrusion (and linear guide)
- Endstop sensor
- Stepper motor & belt drive
- Frame extrusion
- V-slot bearings
System infrastructure

- Oxygen Input
- Oxygen flow regulator
  - Air
    - Self-inflated AMBU BAG
    - Safety pressure valve
      - Bi-directional air valve
        - Measuring device input
        - Analog pressure sensor; Electronic pressure, CO2 sensor module
          - External devices for temporary air quality measurements
  - PEEP valve
    - Periodic patient blood measurements
  - Intubation tube
    - Air filter
      - Patient lungs
  - COVID-19 Ventilator
    - Sensor feedback
      - Ventilation parameters control
Core Ventilator Features

- **Cost-effectiveness:** 250 USD production cost
- **Mass production ready:** majority of parts can be laser-cutted and are available in large quantities
- **Patient safety:** existing, certified hospital infrastructure is used, the device mainly automates the squeezing process

Differentiation with other ventilator projects:
- More sensing modules for patient state monitoring, better process control
- Full-metal, durable and compact design for the device actuation unit
- Ability to provide mechanical protection for the volume of inflated air
- Reduced the number of 3D printed, potentially fragile components
3D printing for Local hospitals

Using my 3D printers to support local hospitals with PPE

Printing snorkeling mask adapters for air filters

Printing face mask holders