GEVE Ventilator
Emergency ventilator to fight COVID-19
Nicola Giandomenico

Brief description

How did HEPIA reply to the HUG request to produce an Emergency Ventilator in an extremely short delivery time? By gathering the necessary multidisciplinary engineering expertise to automate a manual ventilator, commonly used by emergency services to transform it into an autonomous ventilation system.
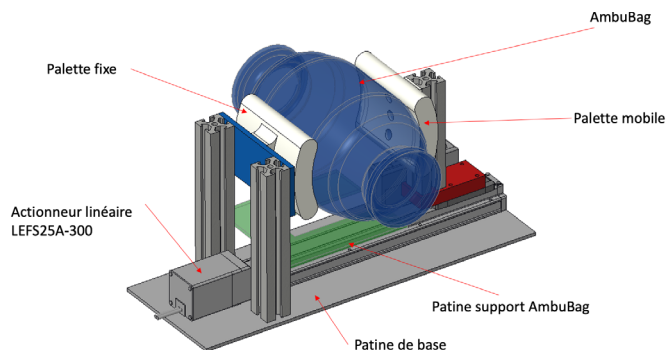

GEVE prototype overall system

Key points

The COVID-19 epidemic is spreading at an alarming rate, with the risk of specific medical material shortage. This is especially the case for the invasive ventilators used to help sedated patients to breath.
In order to respond to the extreme urgency of local needs, HEPIA studied and developed in less than 3 weeks a simple and reliable invasive ventilator for respiratory assistance of intubated patients.

HEPIA set up a team of professors and research assistants in the fields of design, mechanics, automation, electronics, IT... but also integrated into this team the start-up ANGARA Technology; specialized in measurement, control and automation. For reliability and timing reasons, the team decided to start from industrial equipment, rapidly available, and above all extremely reliable in terms of operation and lifespan. Under time constraints, the team studied various technical possibilities and the one that quickly emerged was: the automatization of AmbuBag manual fans.
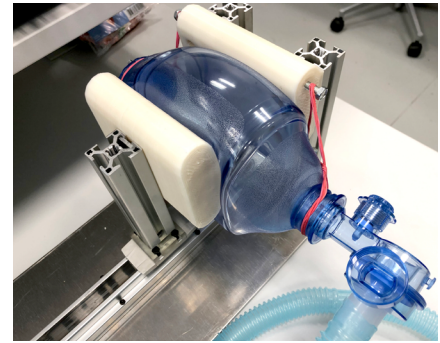
The system is managed by an Arduino-type microcontroller, with 3 user-adjustable parameters as input: the number of breaths per minute BPM, the volume of air VT (in liters) and the IE inspirations / expirations ratio. These parameters are adjustable thanks to physical potentiometers. In addition, the pressure measurement is monitored as close as possible to the patient. At all times, the setup of the operating diagnostic signals and other parameters are measured, to check if everything is working correctly. If a fault is detected, an alarm is triggered and a command to the motor is sent in order to release the AmbuBag. After that it can be activated manually. A small display is used to indicate the parameters set up driven by the potentiometers and the measured pressure. The system also displays the «plateau pressure» between inspiration and expiration, necessary for diagnosis.

An informatic communication through a USB connector allows a graphical interface on a computer. This interface developed in LabVIEW environment allows the visualization of different parameters such as the instantaneous pressure, the plateau pressure, the motor position,… as well as the graph pressure. Note that this interface is optional and that stopping or starting can be done at any time without interfering with the operation of the system.

Project leader: Prof. Nicola Giandomenico. **Have made an exceptional contribution to the project:** Harley Stoeckli (HEPIA), Bassem Sudki (HEPIA), Antoine Benoit (Angara), Ralf Rossel (Angara). **HEPIA:** Prof. Stéphane Bourquin, Florian Chays, Prof. Michel Lauria, Prof. Gilles Triscone.
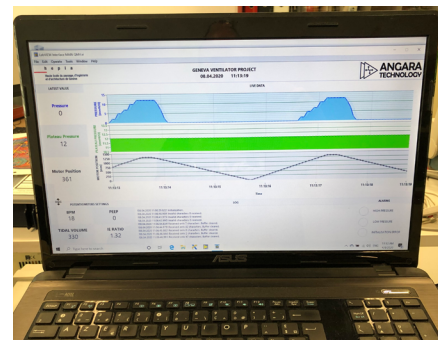
Palette fixe
AmbuBag
Palette mobile
Actionneur linéaire LEFS25A-300
Patine support AmbuBag
Patine de base

1

2

3

4

Output

This development was made at the preliminary request of the HUG (Hôpitaux universitaires de Genève), in the case of an urgent need, but the device was not used.

- ICT journal, 16.04.2020 : www.ictjournal.ch/articles/2020-04-16/a-geneve-professeurs-et-assistants-creent-des-respirateurs-de-fortune-en
- Link HEPIA : www.hesge.ch/hepia/recherche-developpement/projets-recherche/en-cours/ventilateur-durgence-lutter-contre-covid-19

Special equipment

Partenaires:
- Hôpitaux universitaires de Genève (HUG) : Dr Georg Ehret
- ANGARA Technology : Antoine Benoit, Gary Boorman, Adriaan Rijllart, Ralf Rossel
- Société SMC for the linear motor and the driver : Pierre-André Borne, Joël Faivre
- 3D parts printing : Michael Jaussi

Legends

1 - Mechanical architecture modeling
2 - Ambubag and test lung
3 - Control Box
4 - Monitoring