A Portable BVM-based Emergency Mechanical Ventilator

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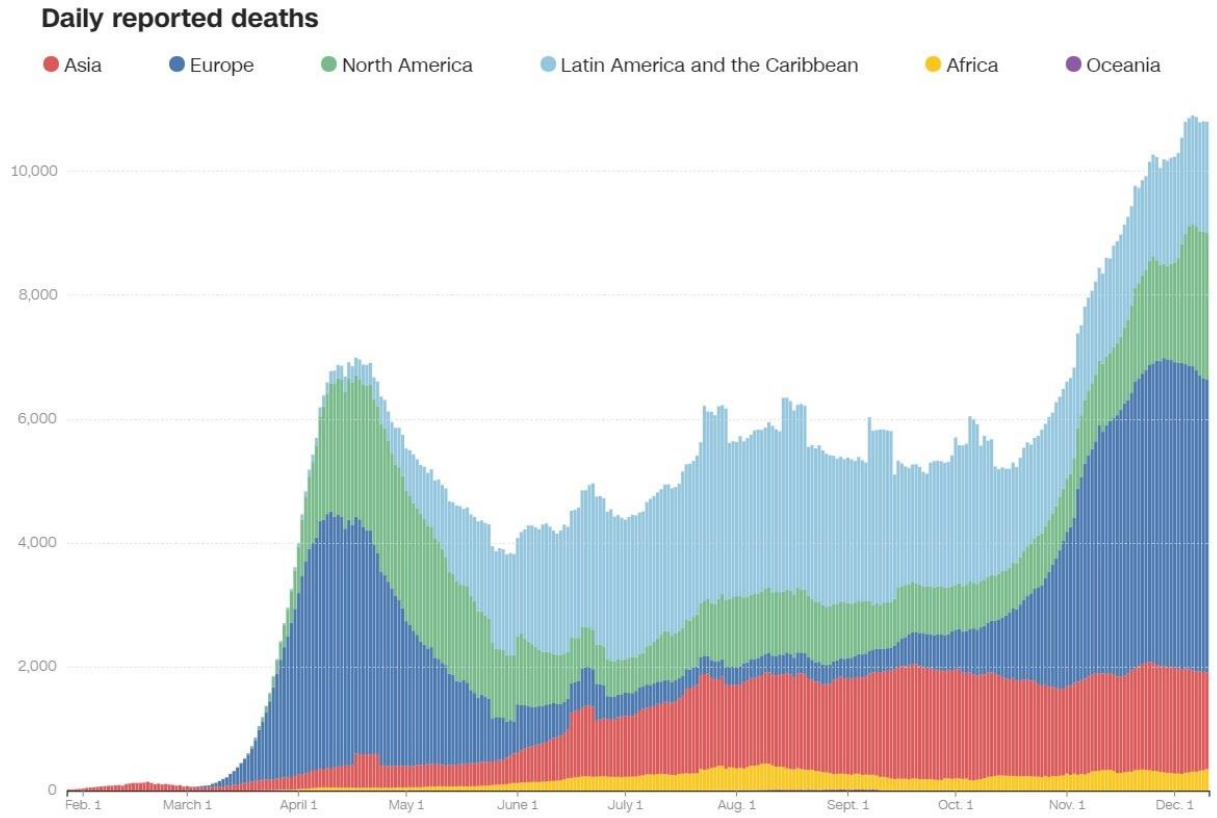
Contents

Introduction

COVID-19 (**Co**rona**vi**rus **d**iseas 20**19**)

- Mortality of COVID-19 up to October 2020 – 2,98 %
- Artificial lung ventilation
  - Required by 1.5 mil. (USA – 2013)
  - Mortality of patients undergoing of ALV 31 – 37%



Principle of Artificial Lung Ventilator

Conditions of utilization

- Incorrect application - destruction of a lung - VILI (ventilatorinduced lung injury)

- Next factors affecting affecting VILI:
  - Lung capillary pressure
  - Respiratory rate
  - Genetic predisposition

- Groups of artificial ventilation
  - positive pressure ventilation
  - negative pressure ventilation
  - jet ventilation
  - high-frequency ventilation

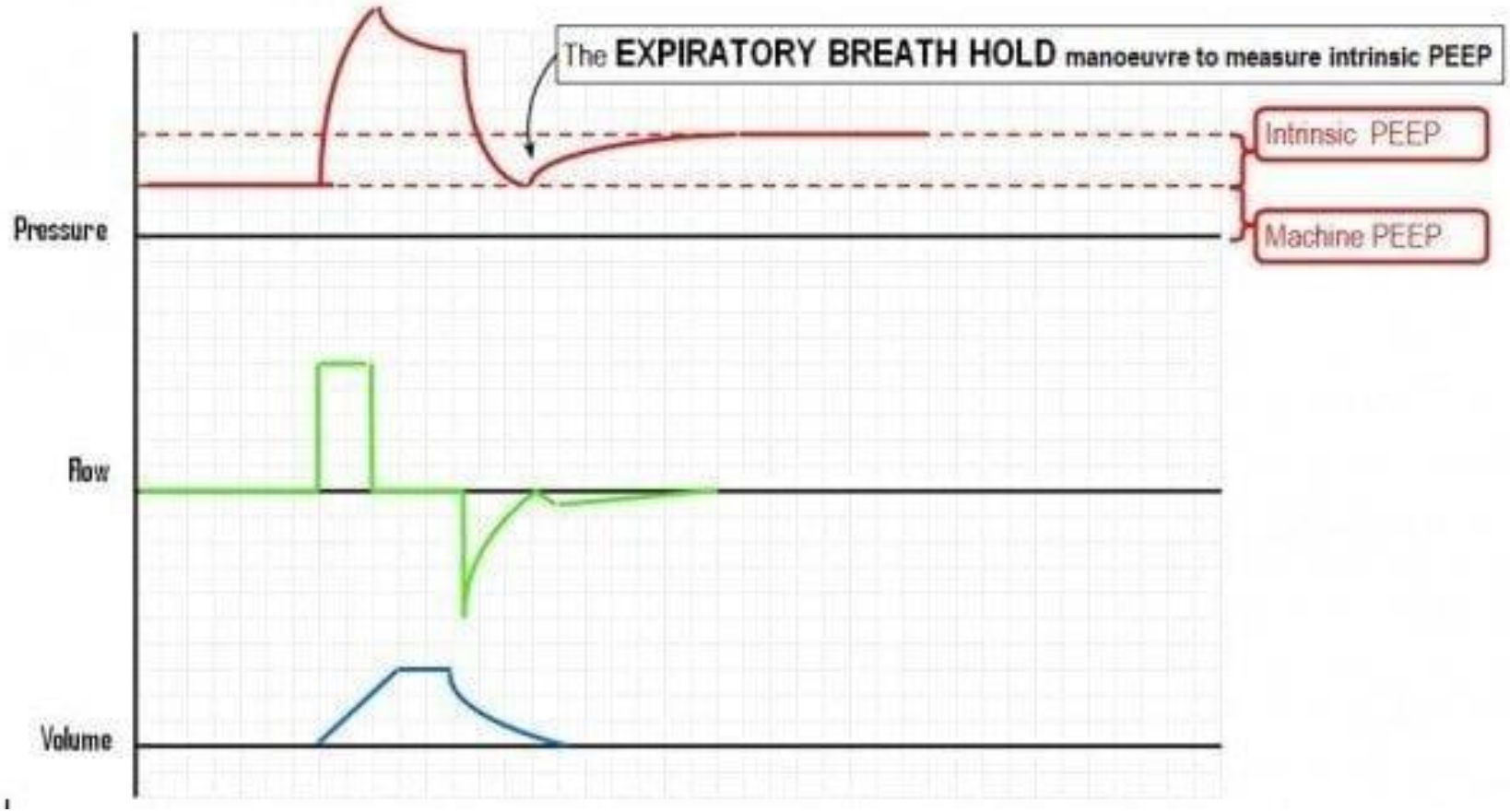
Principle of Artificial Lung Ventilator

Phases of PPV

- Inspiration phase
  - Controlled by control parameter like pressure or gas flow
- Inspiration pause
  - Standstill of gas flowing through an airways and intrapulmonary redistribution of tidal volume is in a progress
- Expiration phase
  - Passive phase of respiratory cycle
- Expiration pause
  - A phase started by ending of air flowing from patient up to next respiratory cycle

Principle of Artificial Lung Ventilator

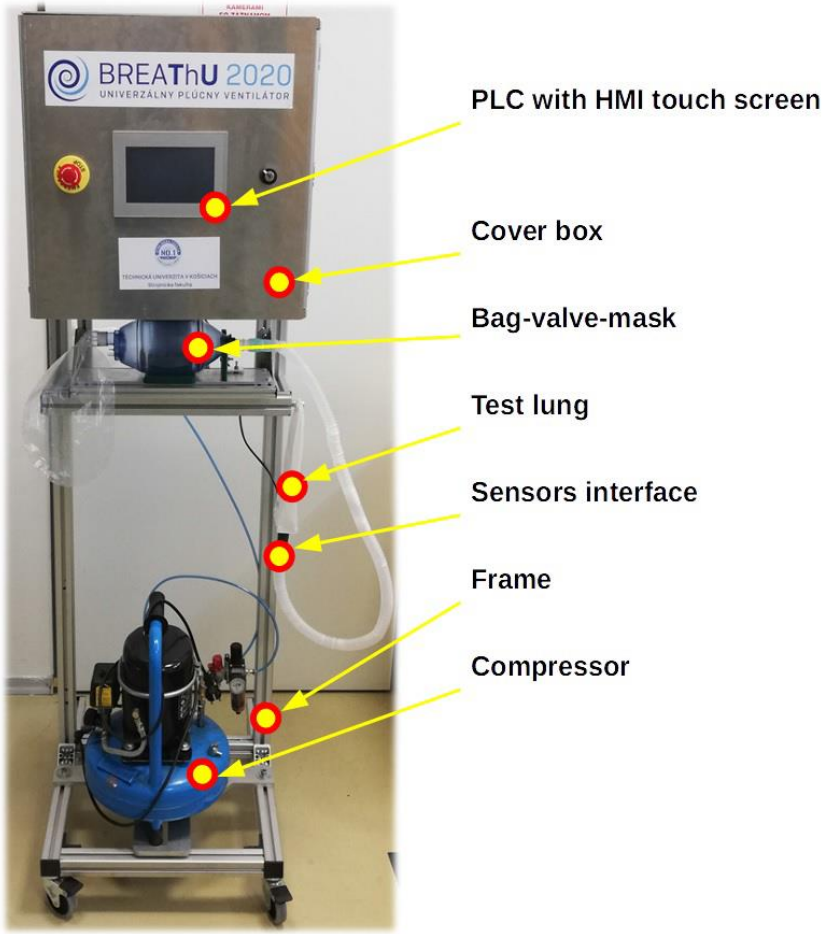
Phases of PPV



Design of Mechanical Ventilator

Requirements on Mechanical Ventilator

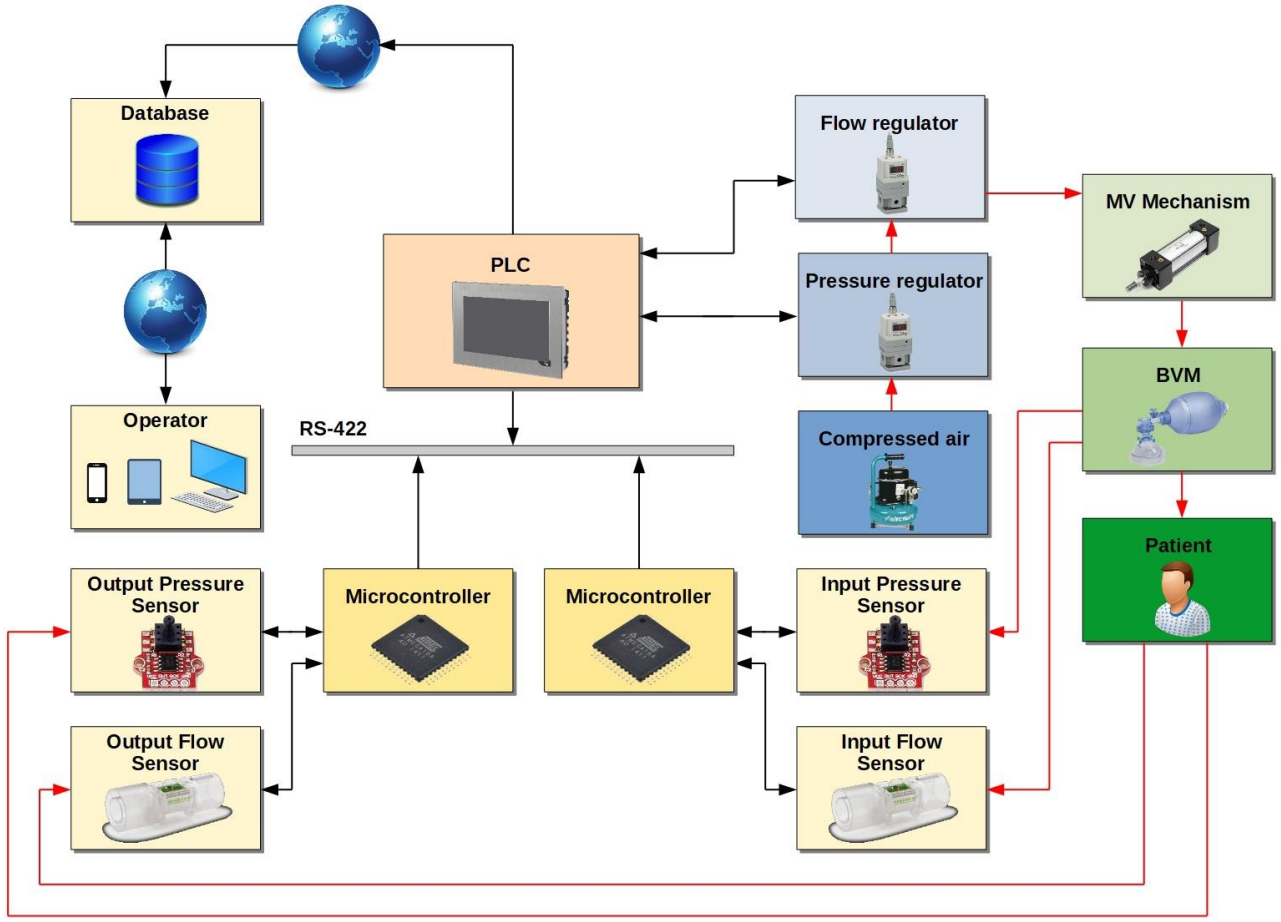
- ❑ Portability
- ❑ Simplicity
- ❑ Fast reproducibility
- ❑ Robustness
- ❑ Hospital - Household utilization
- ❑ IoT



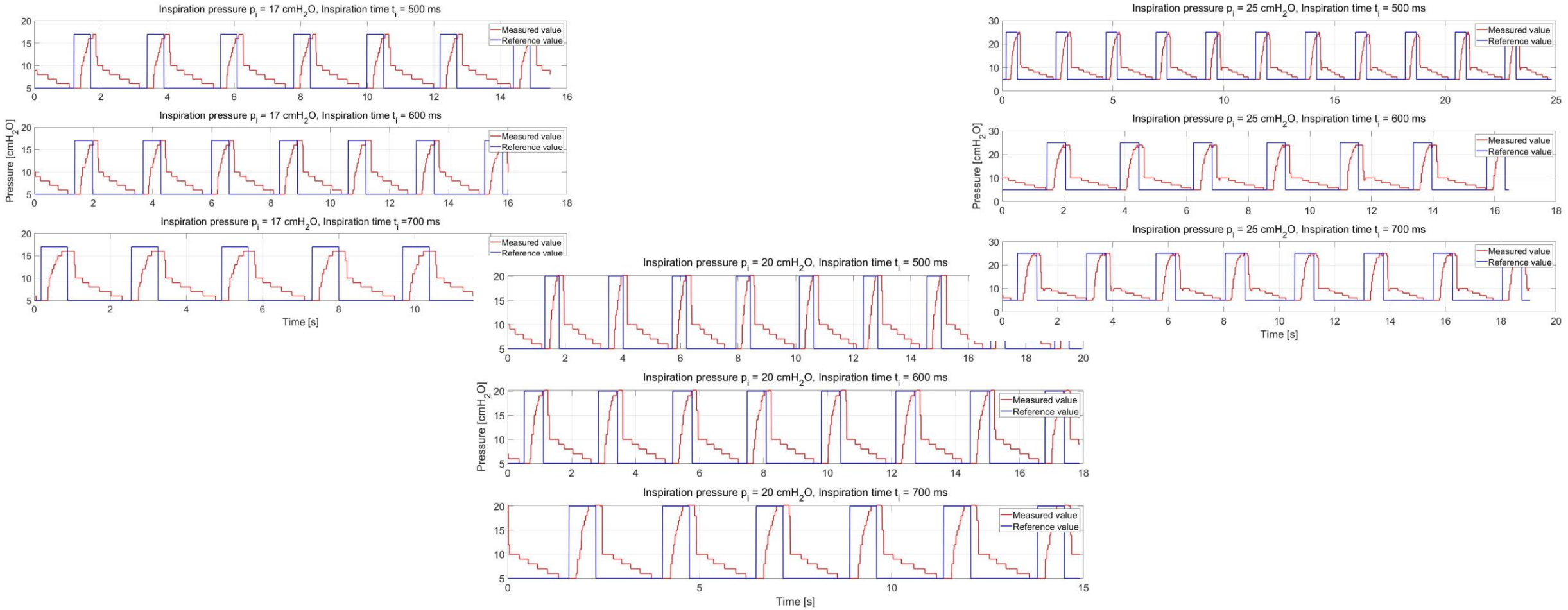
Design of Mechanical Ventilator

Control System of Mechanical Ventilator

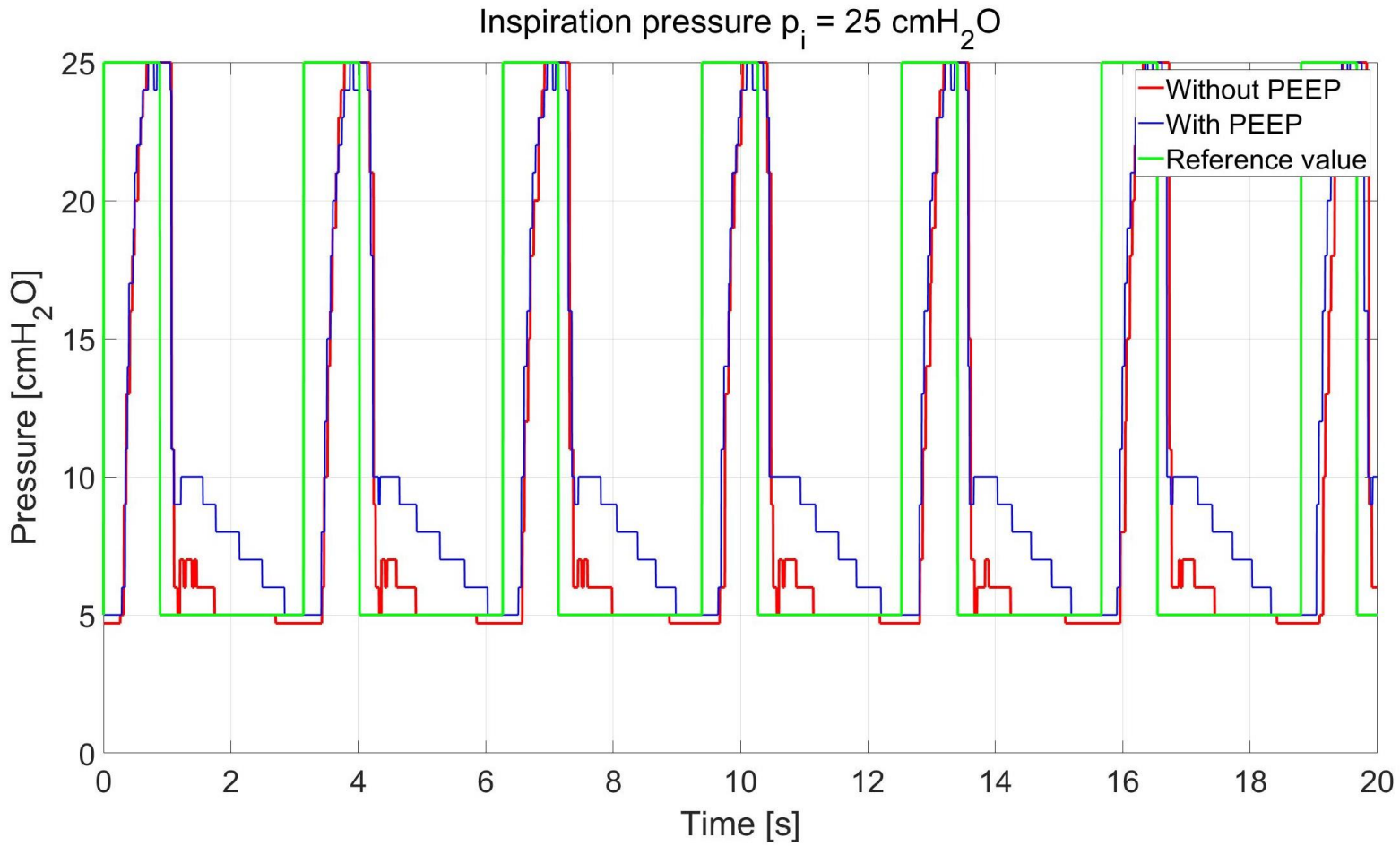
- Low level control
  - Atmel ATxmega16E5
- Sensors
  - pressure sensor SPD005g
  - flow sensor SFM3300-250
- High level control
  - PLC B&R 4PPC70.0702-20W



Experimental Analysis

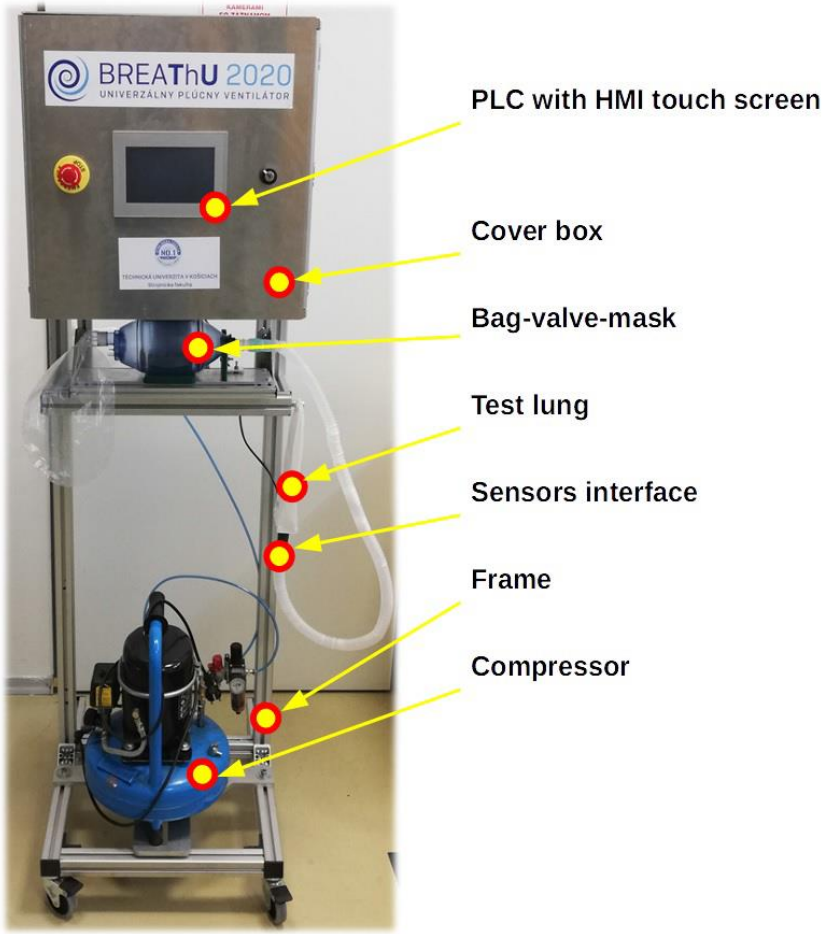


Experimental Analysis



Conclusion and Future Work

- ❑ Timeliness of the topic
- ❑ Suitable requirements and mechanical design
- ❑ Control system design
- ❑ Suitable experimental results
- ❑ Future work
  - Improvement of control algorithm
  - Fully assisted ventilation



Thank you for your attention

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