



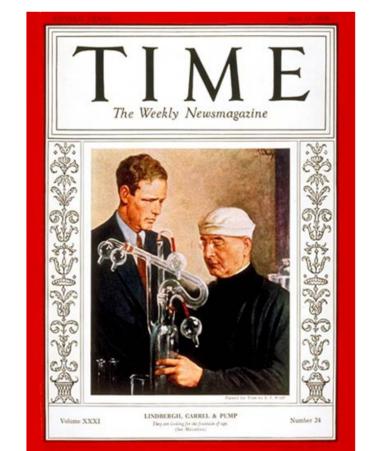
Genoa Organ Perfusion System





An open-source and low cost project

Background

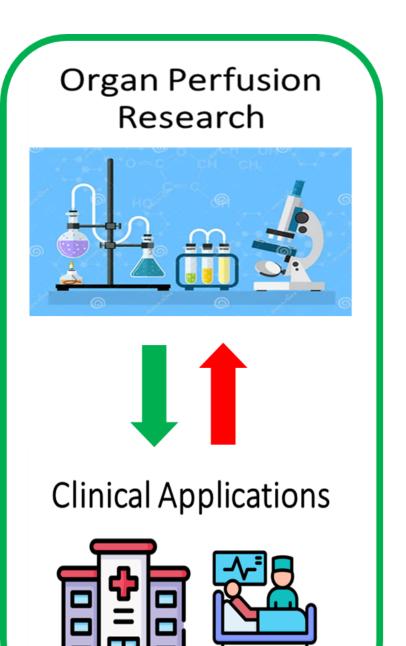


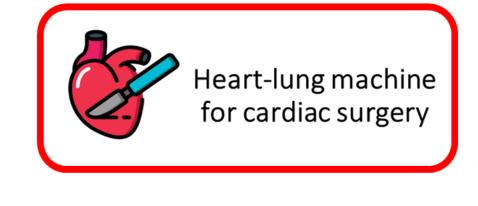
Charles Lindbergh and Alexis Carrel . with their perfusion apparatus

best model for studying the physiology and

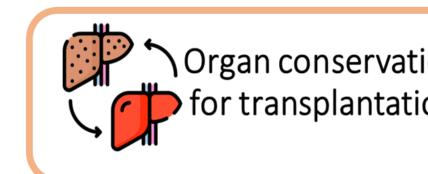
Technologies allowed the **development of several** clinical applications such as dialysis, heart-lung machine, and chemo-hyperthermic treatments.

More recently, isolated organ perfusion is gaining a fundamental role in **organ preservation and** recondition for transplantation.

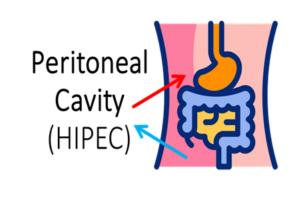


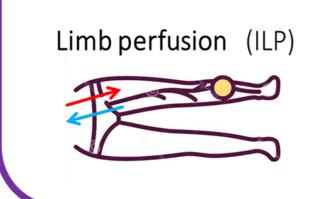






Locoregional Chemo-Hyperthermic





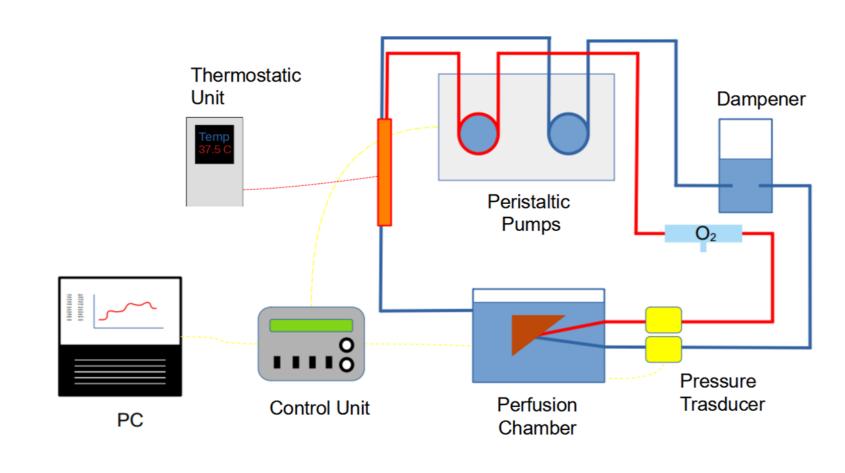
The **renewed clinical interest** on isolated organ perfusion accounts for the exponential development of basic and translational researches.

However, **the perfusion systems** are very expensive, limiting the opportunities for researchers with scarce financial resources to undertake new studies and test new hypotheses.

To overcome these limitations, we designed and built an open-source, scalable and low-cost organ perfusion system for research purposes, based on **Arduino** boards.

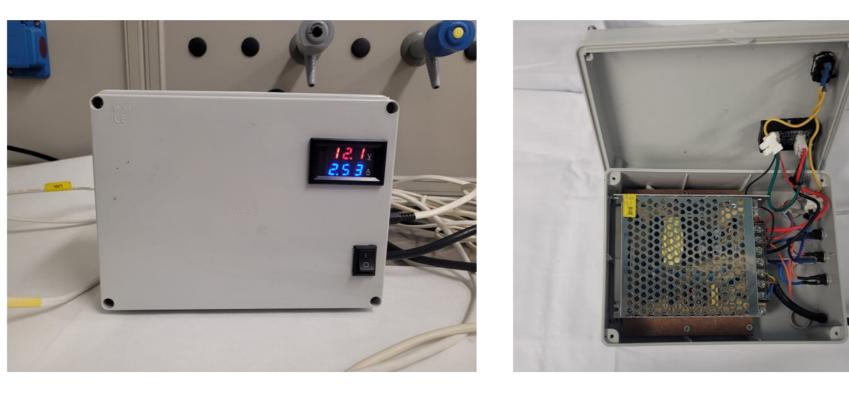


The Organ Perfusion System



The basic perfusion system is composed by a **power supply**, a **control unit**, two peristaltic pumps, two pressure transducers, an oxygenator, a thermostatic unit, and a chamber where the organ is perfused.

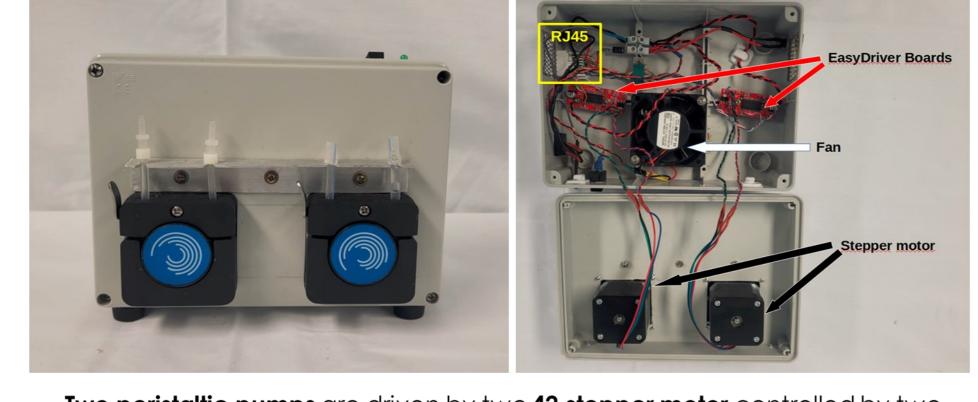
The Power Supply



A commercial 220V AC to 12V DC 10A switching power supply is connected to a **digital voltmeter** and encased in a junction box.

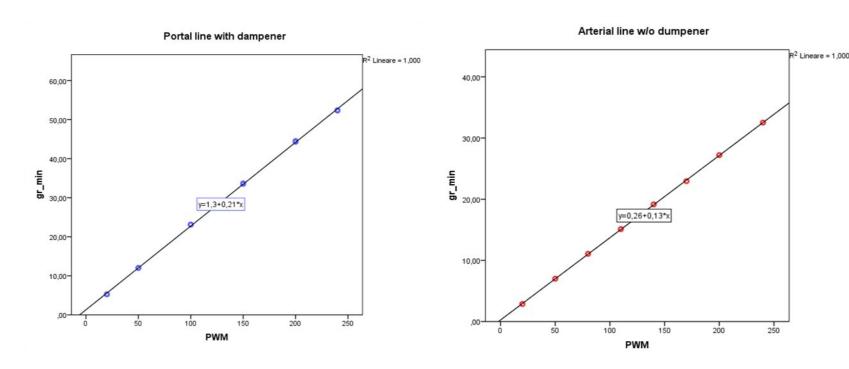
It supplies the control unit, the peristaltic pump, and the thermostatic unit by three jacks.

Peristaltic Pumps



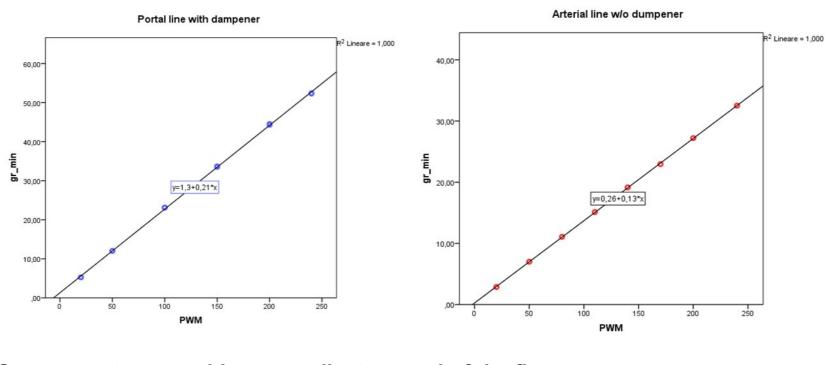
Two peristaltic pumps are driven by two 42 stepper motor controlled by two Easy-Driver boards. Each Easy-Driver boards receive from arduino nano a 0-5v square wave

signal with duty-cycle 50% at 10-5000Hz for rotational speed control. Tubes within the pump compartment has been sized to achieve a flow rate of **0-50 ml/min for portal** perfusion and **0-15 ml/min for arterial** perfusion.



Stepper motors provide an excellent control of the flow rate produce a 50% duty cycle 10-5000Hz signal proportional to the PWM value. The rotational speed a and the flow rate is proportional to the frequency signals directed to

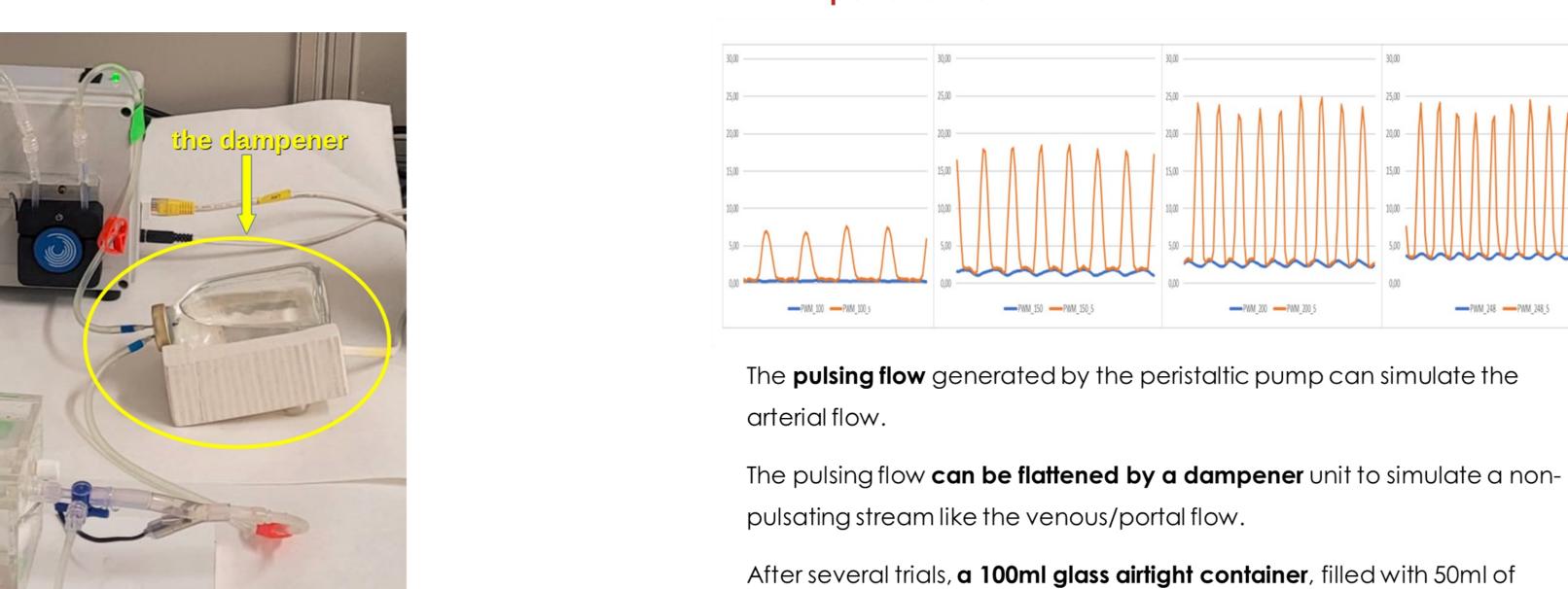
Arterial and Portal flow



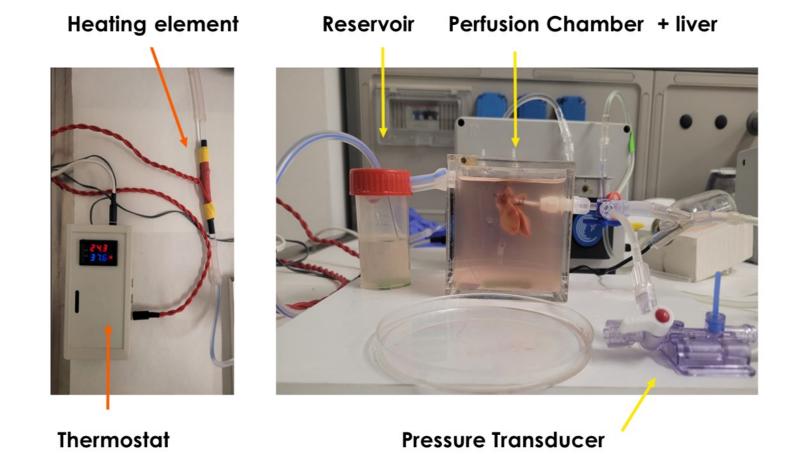
CLOCK DESCRIPTION OF THE PROPERTY OF THE PROPE

The Dampener effect

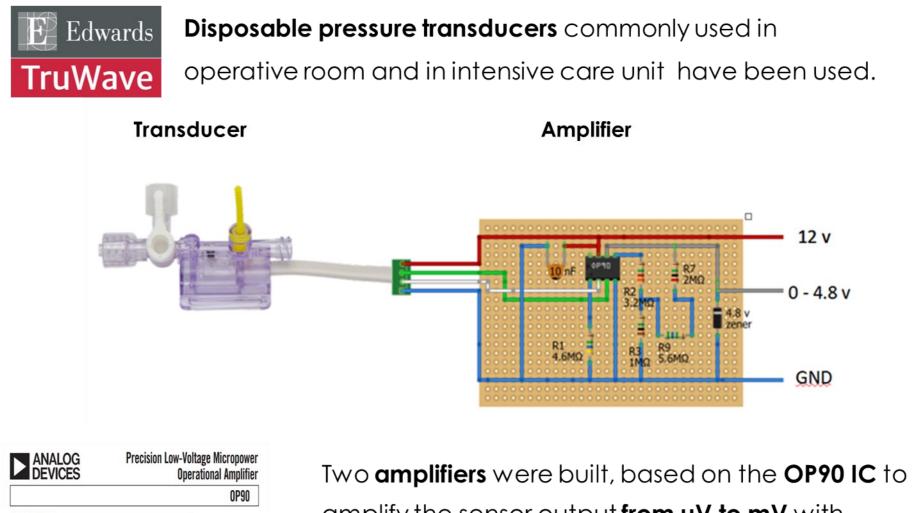
perfusate showed the best cost-effectiveness.



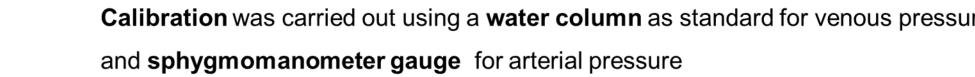
Heating element and Perfusion Chamber

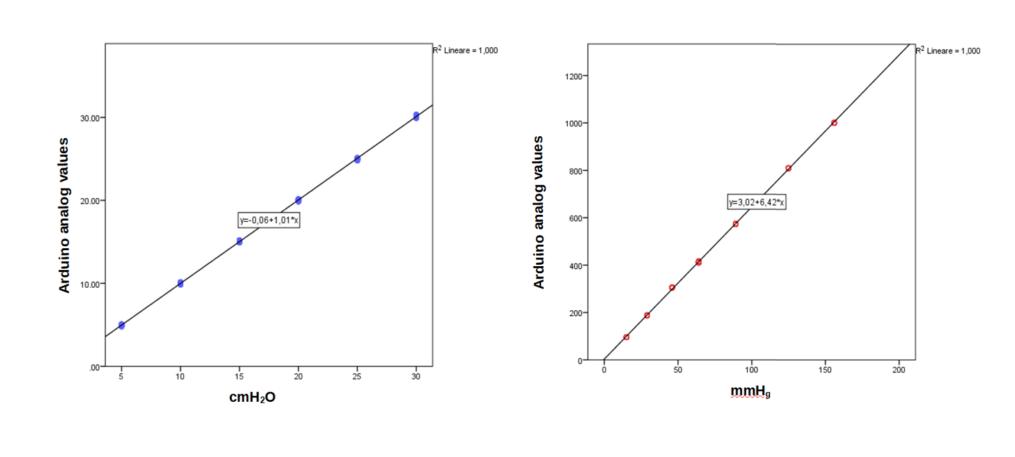


Thermostatic unit consists of resistive elements controlled by a thermostat **Perfusion chamber is** a Plexiglas container where the organ is placed



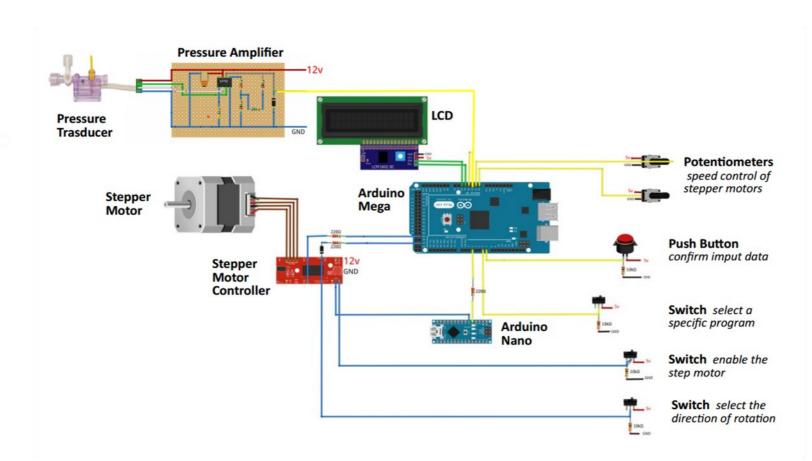
amplify the sensor output **from µV to mV** with ange 0-45 mmHg for venous pressure, and 0-145 nmHg for arterial pressure





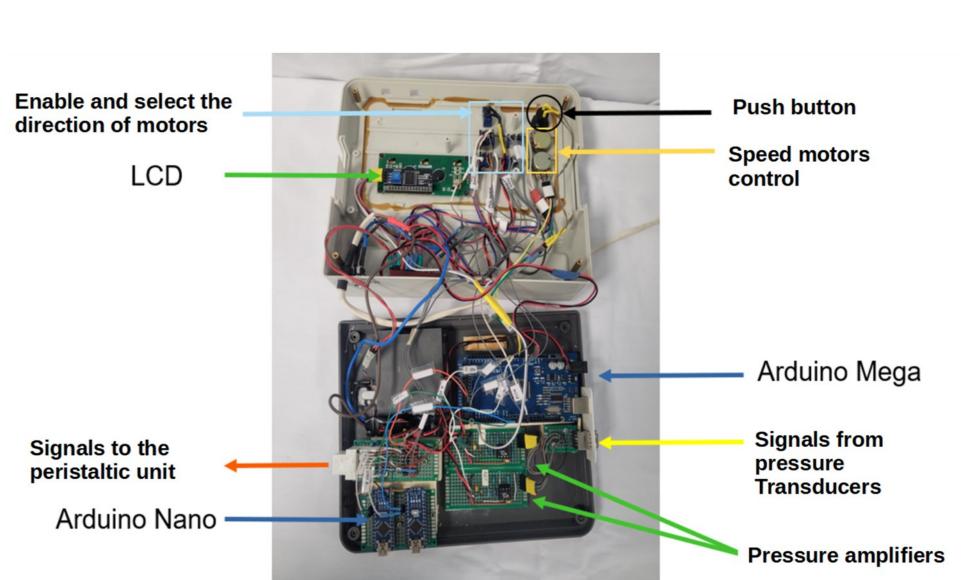
More than 200 measurements for each pressure value were recorded. Statistical analysis shows a linear correlation.

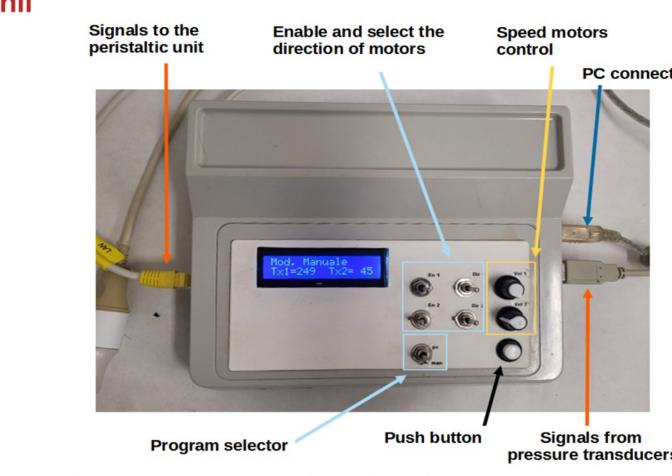
Control Unit



The control unit contains an **Arduino-Mega** board that receives **pressure data** from two amplifiers connected to the commercial pressure transducers. It controls the peristaltic pump unit through signals delivered by two Arduino-

Control Unit





inputs from two potentiometers, and digital inputs from five toggle switches, and one push button.

An **LCD** monitor can visualize the data of interest, while outputs can be recorded on a PC using **CoolTerm**, a free serial port terminal application.

Oxygenator



The mini-oxygenator is based on **hollow fibers** derived from a discharged oxygenator system. The housing consists of two drilled Plexiglas blocks sealed with two-component adhesive and containing the hollow fibers. The **oxygen flows** through the fibers, while the perfusate around them.

The Organ Perfusion System



ONGOING RESEARCH

COMPLIANCE AND VISCO-ELASTIC CHARACTERIZATION OF LIVER TISSUE **DURING POST-RESECTION REGENERATION**

