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ETH zürich



ABOUT US

VISION

Preventing brain damage in infants due to inaccurate settings of heart-lung machines has remained to be an unresolved challenge in the field of heart surgery for many years. Solving this problem and being able to maintain and guarantee life quality without having to fear any side effects for our young patients, is a most fulfilling mission and our main driver.

PROJECT

“byPulse” is a Focus Project at ETH Zurich. In a team of eight bachelor students in the fields of mechanical and electrical engineering, we use our skills and knowledge to develop a MRI-conditional heart-lung machine for in-vivo applications. To finalize a functioning prototype by the end of June 2023, we build upon the expertise of the Product Development Group Zurich (pd|z) at ETH Zurich and leading heart surgeons and perfusionists from the University Hospital Zurich (USZ).

OUR TEAM



ANDRES HELNWEIN
SYSTEM AND TESTING
ENGINEER



CHRISTIAN VALMAGGIA
ELECTRICAL
SYSTEMS ENGINEER



ANGELA TELLI
SYSTEM AND TESTING
ENGINEER



CHELSEY HOCHSTRASSER
SYSTEM CONTROL AND
SOFTWARE ENGINEER



ERIC BRÄNDLI
SYSTEM CONTROL AND
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JAKOB SIEMER
FLOW PROCESS
ENGINEER



JAKOB KOCH
DRIVETRAIN
ENGINEER



JASPER HÜCHTING
FLOW PROCESS
ENGINEER

SUPPORT

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Chair in Product Development
and Engineering Design

Dr. Marianne Schmid Daners
Senior Scientist at pd|z

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Technical Director MR at Institute
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Dr. Martin Schmiady
Senior Consultant
at Cardiac Surgery USZ

Dr. Michael Hoffmann
Senior Consultant
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Tobias Aigner
Head of Cardiatechnology
at Cardiac Surgery USZ

Dominik Schulte
Project Supervisor

Rosina Weiss
Project Coach



GOALS & OBJECTIVE



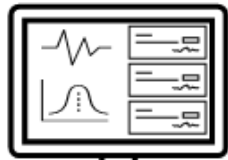
PROBLEM

Every year in Switzerland alone 200 neonates need surgery due to congenital heart disease. In these cases, a heart-lung machine (HLM) is used to maintain blood flow and oxygenation during surgery. Since plasticity differences between the brains of adults and infants exist, perfusion behaviour in the brain of neonates is a topic of ongoing research. Hence, for these cases the optimal settings of the HLM are still unknown. As a consequence, the young patients may suffer from long-term brain damage and lifelong trauma.

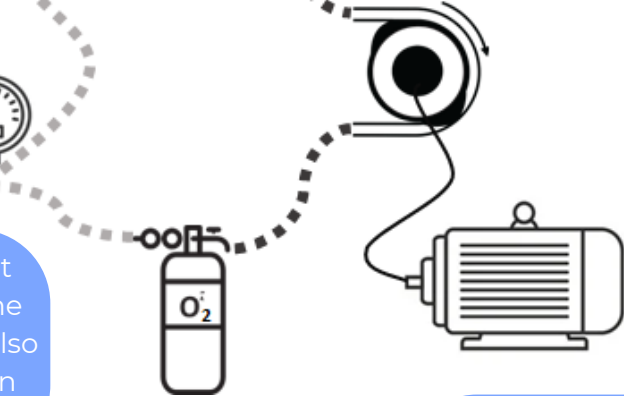
SOLUTION

To ensure accurate perfusion of the brain, perfusion measurements in an MRI environment would help adjusting the settings of the HLM according to the patient's need. Therefore, the development of an MRI-conditional HLM is required.

The **control** unit processes the signals of the sensors, displays the values and ensures well-functioning of the machine.



The **pump** is the heart of our machine. It is responsible for the blood flow through the extracorporeal circuit and the patient.



The **sensors** measure important values like the blood flow and the blood pressure. The sensors are also responsible for bubble detection and other safety mechanisms.

The **oxygenator** is the lung of our machine. Here is where the gas exchange occurs.

The **motor** drives the pump. Since the motor has to be MRI-conditional, a pneumatic motor is used.

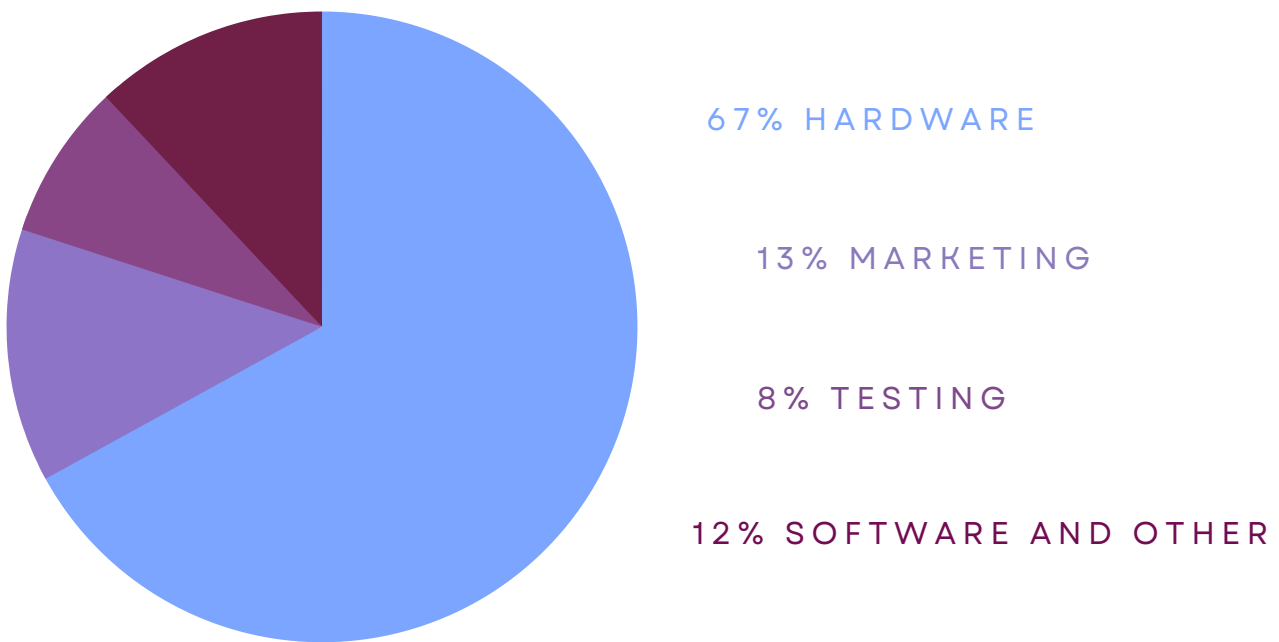
SYSTEM

CHALLENGE

Due to the strong magnetic fields inside an MRI, no magnetic materials can be used for the HLM. The development of a pump following industry standards and a suitable powertrain pose the greatest challenges to our team. Furthermore, all electronic components must be properly shielded to prevent interferences with the MRI and disturbances of the imaging process.

BUDGET

In order to successfully develop and test our prototype, we rely upon the support of sponsors. The estimated cost of the project amounts to about 70'000 CHF. Funding is distributed in the following categories:



HARDWARE

Various pump systems, motors, electronic components and medical grade sensors, need to be acquired to enable proper functioning of our HLM.

MARKETING

A professional appearance at various events, our website and on social media is crucial for the proper representation of our project.

TESTING

Before any in-vivo applications, our medical device has to undergo rigorous testing, especially regarding haemolysis (blood damage). Therefore, proper test equipment is needed and laboratory analysis must be performed.

SPONSORING

Focus Projects of ETH Zurich like "byPulse" have a high standing inside as well as outside of Zurich and often gather a lot of media attention. Not only do we enable sponsors to profit from advertisement via social media and our website, but they also grant a unique opportunity to build up a network in one of the world's leading universities. The quarterly reviews and the final rollout event present the perfect stage to connect with students and researchers eager to pursuit a career in industry.

The following table provides a summary of the sponsorial perks:

	Bronze from 1.000 CHF	Silver from 2.500 CHF	Gold from 5.000 CHF	Diamond from 10.000 CHF
Logo on website	Small	Medium	Medium	Large
Logo on presentation	✓	✓	✓	✓
Special invitation to Rollout		✓	✓	✓
Logo on Banner at official presentations		✓	✓	✓
Social media post		✓	✓	✓
Logo on shirt			✓	✓
Attendance at reviews			✓	✓
Short company description				✓
Project Presentation at company				✓
Job postings on website				✓

Apart from financial support, other forms of sponsoring such as know-how, facility usage or technical components are appreciated. For individual solutions and ideas as well as any questions regarding the project or sponsoring, feel free to contact us.

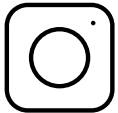
CONTACT

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PARTNERS

ETH zürich

pd|z

USZ Universitäts
Spital Zürich

D MAVT