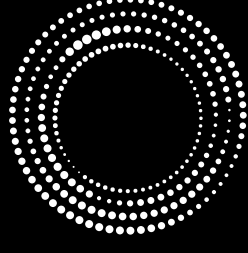
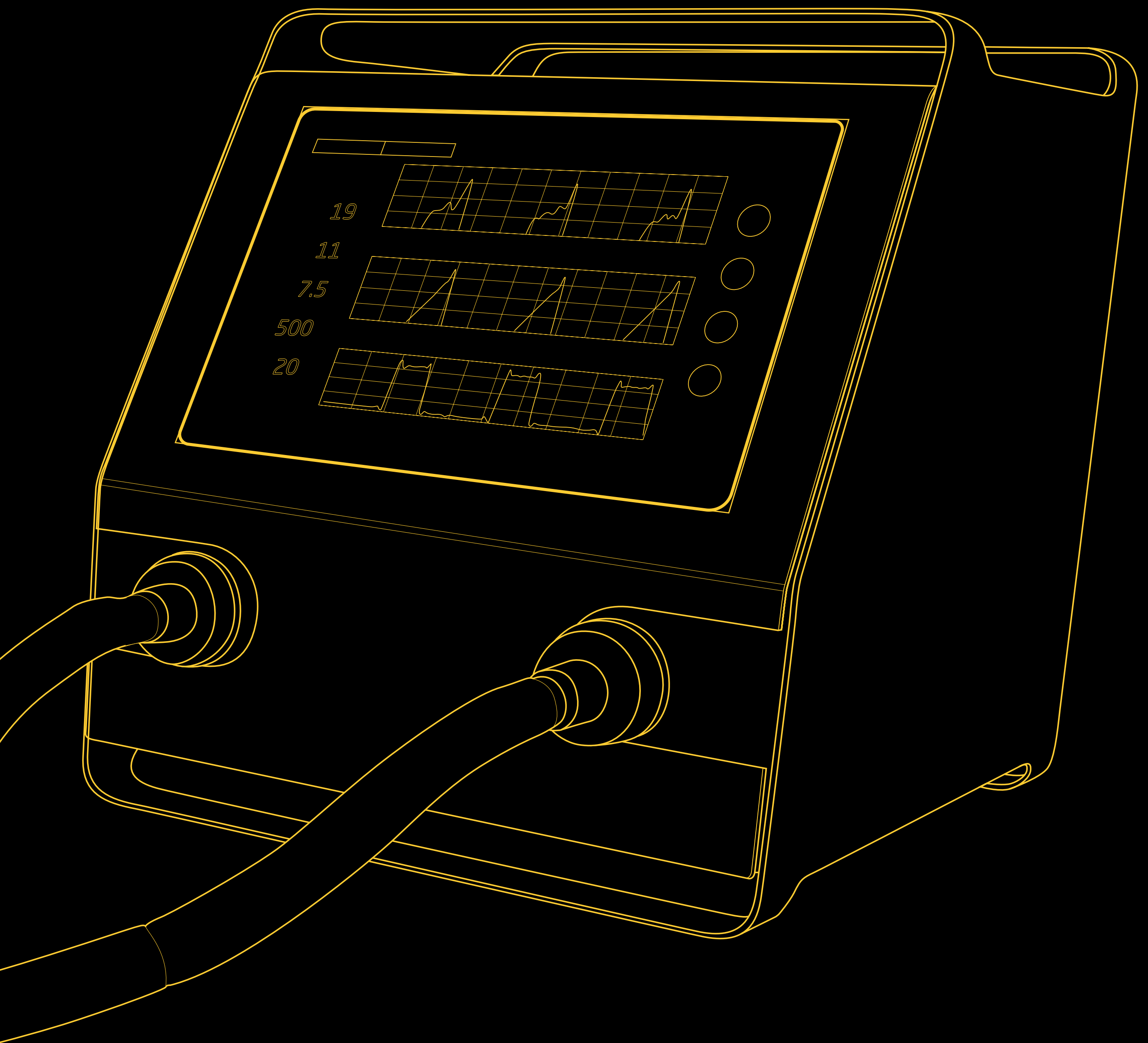


مؤسسة دبي للمستقبل  
DUBAI FUTURE FOUNDATION



# THE M061 PROJECT

A VENTILATOR DESIGNED TO  
ADDRESS THE INCREASING GLOBAL  
DEMAND AMID COVID-19 PANDEMIC



**The COVID-19 pandemic, caused by the SARS-CoV-2 coronavirus, has placed enormous pressure on healthcare systems worldwide. Shortages in critical medical supplies resulted in a global call to action to develop lifesaving equipment to assist medical professionals and support the patients in their care.**

**The significant lack of mechanical ventilators was of particular concern as these critical devices have a direct impact on the ability of medical professionals to successfully treat patients with severe SARS-CoV-2 viral infections, and save lives.**





## **What is a ventilator?**

Mechanical ventilators are machines that artificially support respiratory processes when patients are unable to breathe on their own. This is achieved by pushing air into the lungs to ensure that the patient receives an adequate supply of oxygen and, at the same time, that carbon dioxide is expelled from their system.

## **Why are ventilators important?**

Ventilators stabilize patients suffering from SARS-CoV-2 and allow time for the body to fight infection and recover.



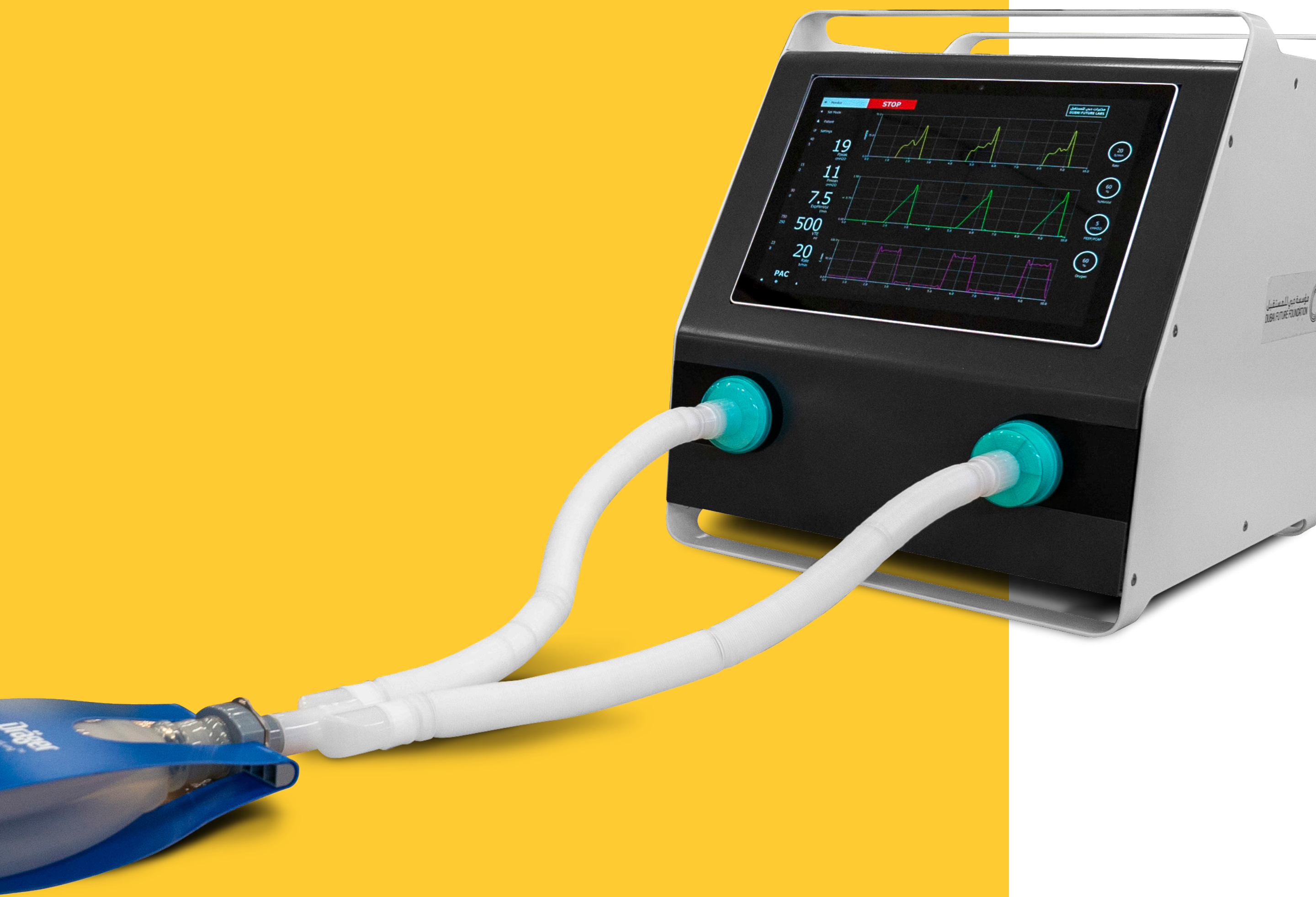


## **How is Dubai Future Foundation contributing to the global demand for ventilators?**

In response to UAE government efforts to combat SARS-CoV-2, Dubai Future Foundation assembled an interdisciplinary team of engineers, programmers, industry experts and healthcare specialists to develop a robust rapid prototype mechanical ventilator and contribute to the international open source network that has emerged to tackle the device shortage.

**The result of these collaborative efforts is the M061 Project.**





# THE M061 PROJECT

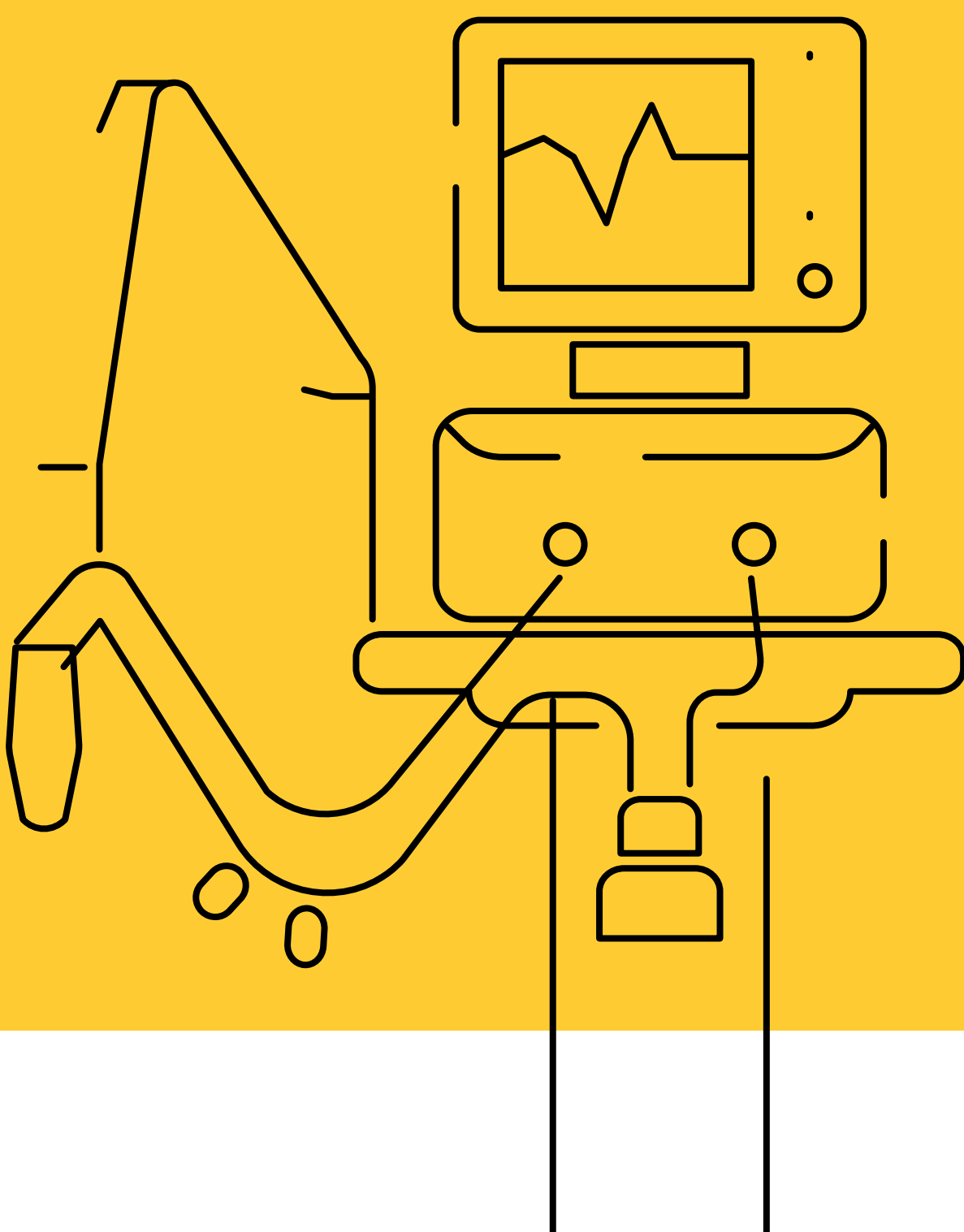
Over a period of eight weeks, the team worked to build a system that was based on readily available components in existing supply chains that could be easily assembled and scaled according to need.

Through the careful study of existing ventilator designs, the team identified the two key elements that would come to define the M061 Project: **functionality and durability.**

# The Mechanics of Ventilation

The M061 ventilator consists of various subsystems that have been tightly integrated to provide the required medical intervention. A typical ventilation process is a cycle of precisely controlled inhalation and exhalation phases. During the inhalation phase, the ventilator takes in air and compressed oxygen and blends them in a mixing chamber to achieve the oxygen concentration required for the selected ventilation mode, normally between 21% and 100%. This mixture is then released into the patient's lungs according to a specific ventilation profile.

Pressure controlled ventilation profiles focus on precisely controlling pressure during inhalation to avoid causing a ventilator associated lung injury (VALI), while volume-controlled profiles attempt to deliver the required volume precisely. During the exhalation phase, the air expelled from the lungs is released in a controlled manner to maintain positive end-expiratory pressure (PEEP) in order to avoid alveolar collapse. The ventilation profiles also take into consideration whether the patient is sedated and requires a timed controlled cycle or only requires a spontaneous breathing assistance.

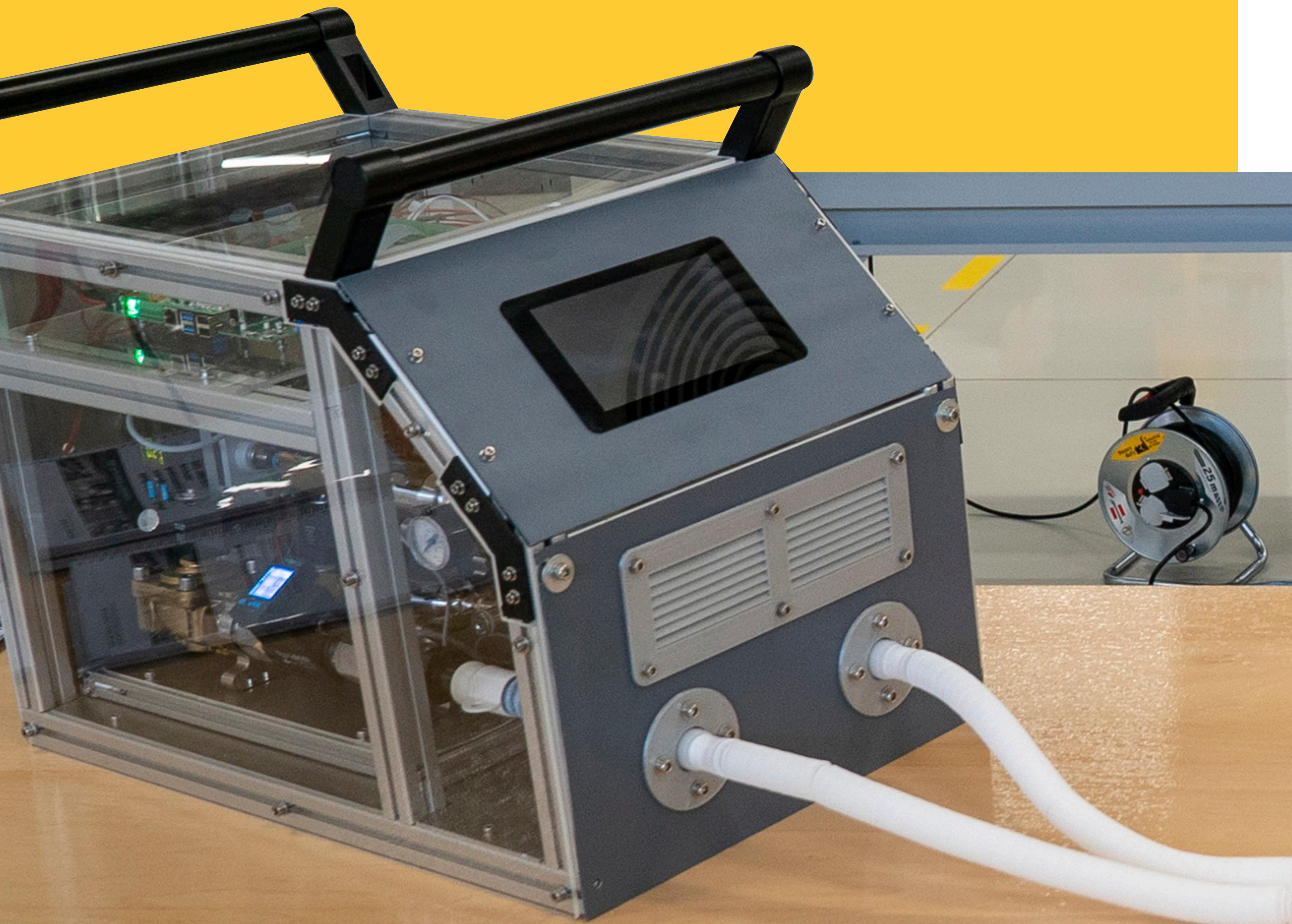




# Considerations

There are many aspects that should be considered while developing a mechanical ventilator. Parameters, such as the maximum allowed inspiratory pressure, the volume of air to be delivered, the ratio between the inspiration and expiration phases in each ventilation cycle, the PEEP value, the maximum air flow required per minute and the various ventilation modes to support, influence the design of the ventilator and the selection of the components to use in the system.

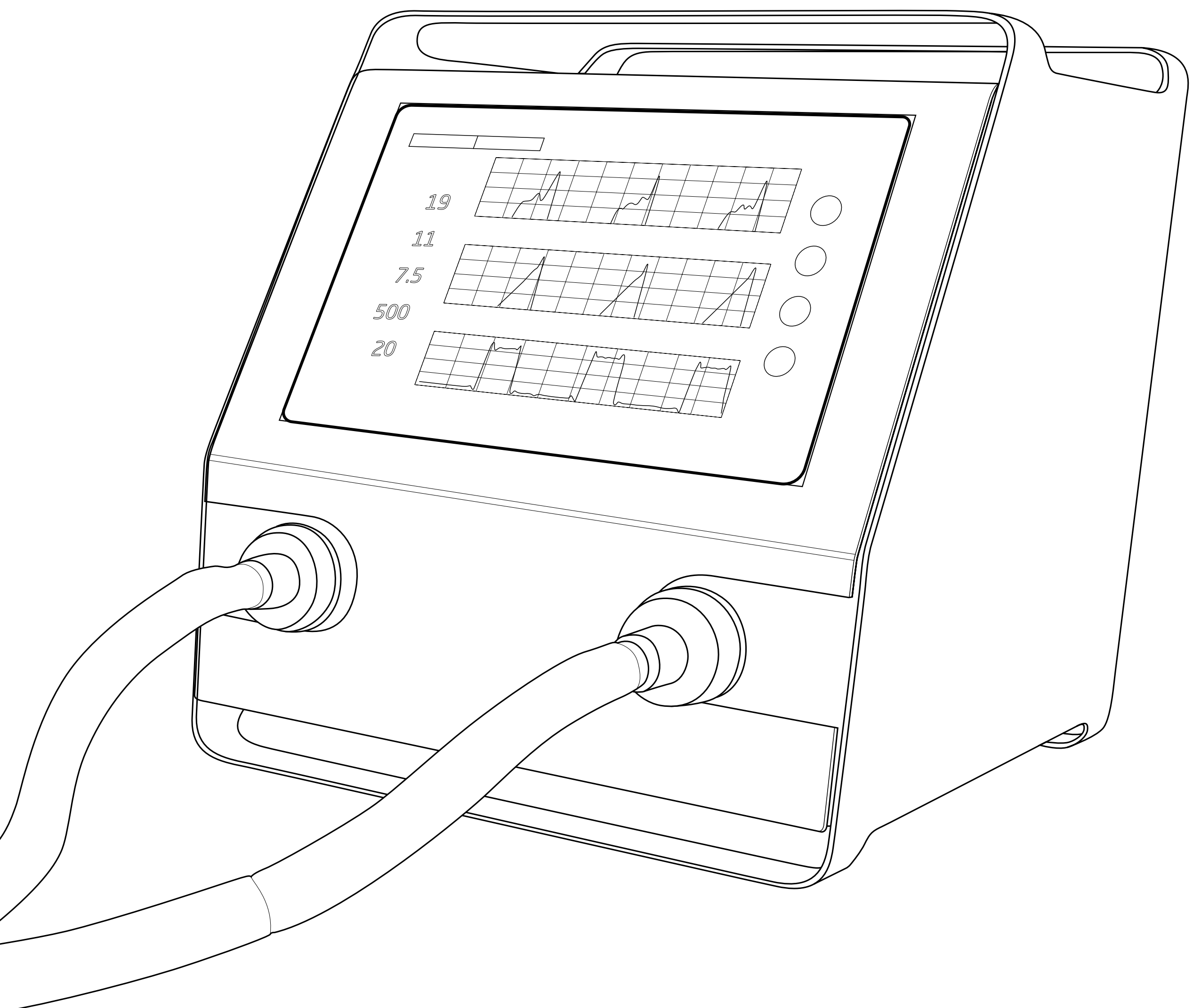
## Early M061 prototype





## The Design

The M061 ventilator consists of a mechanical airway made of tubes of a predetermined diameter size and fitted with various valves, sensors and filters needed to create artificial breathing support. The valves, some of which are proportional valves, are used to open and close airways to control the amount of air volume delivered to the patient. Sensors, such as pressure and flow sensors, provide the feedback needed to perform precise closed loop control of the ventilation cycle, while the air filters ensure that particles above a certain value are filtered out of the air supply.





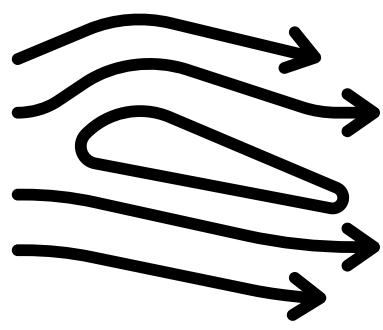
The M061 team designed and manufactured a custom multi-layer printed circuit board (PCB) with an integrated single board computer (raspberry pi) and various analog and digital electronic interfaces to support the development of the ventilator. Additionally, an external touch screen is used to provide a simple and intuitive interface for the clinicians to use while operating the ventilator.

M061 addresses the individual needs of each patient by delivering multiple modes of ventilation such as the pressure, volume and spontaneous mode families with controlled, assisted and supportive functions, depending on the patient's breathing capacity. M061 sustains both invasive and non-invasive mechanical respiratory assistance for both short and long term periods, ranging from several hours to weeks.



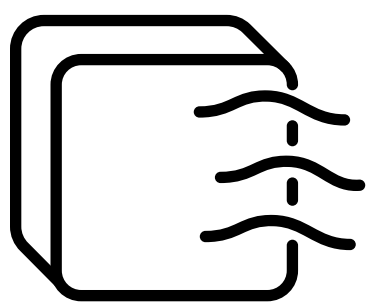


# M061 Ventilator Modes



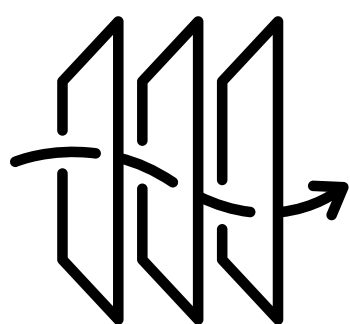
## ① Pressure Modes

- Pressure Controlled Ventilation (PCV)
- Pressure Support Ventilation (PSV)
- Synchronized Intermittent-Mandatory Ventilation (SIMV-P)



## ② Volume Modes

- Volume Control Mode (VC)
- Assist-Control Ventilation (ACV)
- Synchronized Intermittent-Mandatory Ventilation (SIMV)



## ③ Spontaneous Modes

- Continuous Positive Airway Pressure (CPAP)
- Bi-level Positive Airway Pressure (BIP)
- Oxygen Therapy
- High Flow Oxygen Therapy





## **Compatibility**

The M061 ventilator system was designed to be modular, relying on interchangeable components that are easy to source and integrate, in an effort to circumvent the world-wide scarcity of crucial medical supplies. The PCB utilizes Raspberry Pi and was specifically developed to provide a common board capable of interfacing with various types of I/O (input/output) devices (e.g. sensors, power management, and actuators).



# Standards and Regulations

To maintain quality standards, the M061 project abided by the recently established Rapidly Manufactured Ventilator System (RMVS) standards outlined by the Medicines and Healthcare products Regulatory Agency (MHRA) in the UK.

The M061 team closely followed systems engineering practices and received input from pulmonary specialists working closely with SARS-CoV-2 patients to ensure that the ventilator performs essential functions and adheres to the highest quality standards in preparation for the certification process.

Furthermore, the M061 team plans to execute a rigorous testing cycle under the supervision of pulmonary specialists and clinicians in hospitals in Dubai to ensure that the ventilator system complies with established standards and meets international requirements.

The M061 ventilator is specifically designed to address the unique circumstances of the current pandemic and alleviate the pressure on healthcare systems during the crisis. M061 intends to support, rather than replace, existing hospital ventilators which have broader medical applications and are designed to last for significantly longer periods of time.





# The Team



**Khalifa AlQama**  
Head of Dubai Future Labs



**Saqr Bin Ghalib**  
Director of Artificial Intelligence Office



**Dr. Tarek Taha**  
Robotics Lab Lead



**Maryam Buhumaid**  
Analyst



**Layth Mahdi**  
Senior Robotics Researcher



**Alexander Spies**  
Senior Integration Manager



**Julian Ferling**  
Deputy Integration Manager



**Majed Al Khatib**  
Lab Technician



**Rashid Al Suwaidi**  
Software Engineer



**Mohamed Alzahmi**  
Software Engineer



**Hamad Mohamed**  
Software Engineer



# The M061 Platform

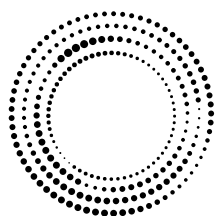


Dubai Future Foundation firmly believes that facilitating collaboration and knowledge exchange is crucial to the global response to the pandemic and, as a result, has created an open source platform where detailed information about the M061 project will be made available online.

We would like to express our sincere gratitude and appreciation to all our collaborators for their invaluable and selfless contributions to the M061 project.

For more information, please visit

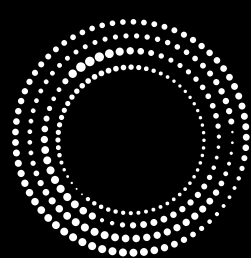
**[M061.dubaifuture.gov.ae](https://m061.dubaifuture.gov.ae)**





# THE M061 PROJECT

مؤسسة دبي للمستقبل  
DUBAI FUTURE FOUNDATION



[M061.dubaifuture.gov.ae](https://m061.dubaifuture.gov.ae)