

# Apparatus and method for sampling and detecting pathogen air.

## Priority Number

n. 102020000018409\_29.07.2020

## Patent Type

Patent for invention.

## Co-Ownership

Istituto Nazionale di Astrofisica 56%, Sapienza 25%, Alma Mater Studiorum - Università di Bologna 10%, Università degli Studi di Milano 6%, Politecnico di Milano 3%.

## Inventors

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## Industrial & Commercial Reference

Companies for biomedical equipment. Clinical analysis laboratories. Safety control in working environments.

## KEYWORDS

- ❑ COVID 19
- ❑ Safety at work
- ❑ Air quality control

## AREA

- ❑ BIOMEDICAL

## CONTACTS

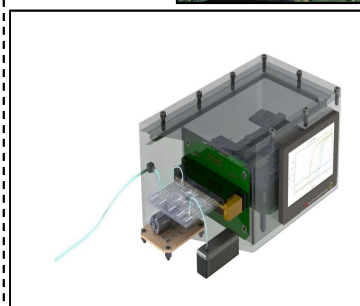
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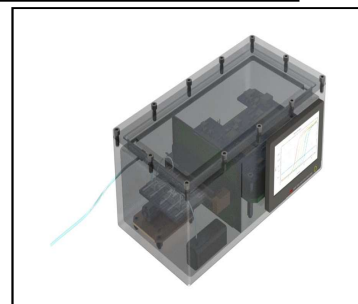


**Fig. 1** Environment for use of the invention: waiting room.

**Fig. 2** Environment for use of the invention: public transportation.



**Fig. 3** Rendering of the prototype: view of the lab-on-chip for the DNA amplification.



**Fig. 4** Rendering of the prototype: view of the closed box.

## Abstract

The proposed system aims to sample the air present in closed spaces (hospital rooms, supermarkets, offices, elevators, subways, etc.) and to verify the possible presence of pathogens, and in particular of SARS-CoV - 2 virus. The system is based on a chain of three modules, to be interfaced and integrated into a compact system, specific for the following functions:

- 1) air suction and sampling;
- 2) microfluidics for pre-treatment and analyte selection;
- 3) lab-on-chip device for the amplification and detection of virus nucleic acids through real-time Reverse Transcriptase Polymerase Chain Reaction (RT-PCR).

## Time to Market

TRL 3 - Experimental proof of concept - Minimum time for system prototyping and its placement on the market: 3 years

## Availability

Research, Development, Experimentation and Collaboration.



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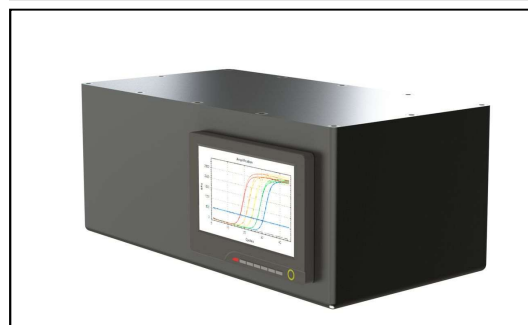
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## Technical Description

The virus detection system proposed here consists of 3 modules developed, in the terrestrial and space fields, by Italian research institutes and universities, adapted for the above purposes. The first module consists of an air suction and sampling system; the second module consists of a system for the selection and distribution of the sample collected from module 1 to module 3; the third module consists of a lab-on-chip device for virus detection and quantification. Module 1 sucks the air and the solid or liquid material present in the air is deposited inside the mod.2, which transfers it to the lab-on-chip device. This last module detects the presence of the virus by the real-time Reverse Transcriptase Polymerase Chain Reaction (RT-PCR) molecular amplification technique.



**Fig. 5** Rendering of the prototype: view of the display showing the DNA amplification.

## Technologies & Advantages

Patent and scientific literature report on devices that distinctly perform air sampling and the detection of pathogens contained therein. However, the devices described require that the collected sample be transported to an equipped laboratory. Consequently, the analysis of the sampled air cannot take place on-site, and the sampling and detection of pathogens are carried out in distinct phases and with different devices.

This two-step process requires the intervention of an operator and / or sophisticated instrumental equipment.

Aim of the present invention is to provide a compact and easily transportable device, which integrates optical and thermal thin film sensors, transparent resistive heaters and a disposable microfluidic network, capable of carrying out, automatically and without intervention of a specialized operator, all phases of the analysis: sampling of the air, recovery of pathogens from the sample, extraction, amplification and detection of nucleic acids.

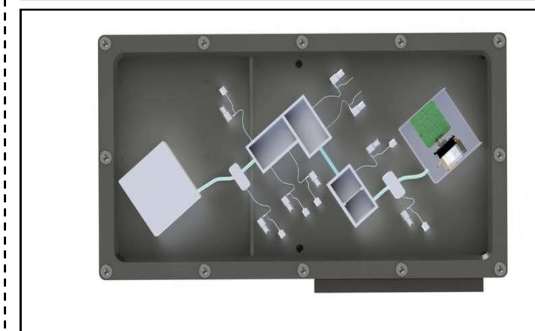
The device therefore allows to shorten the time and reduce the costs of the analysis of air samples.

## Applications

The invention proposes the development of a device capable of carrying out in an automated way the air suction from a closed environment, or from the breath of a patient, for the detection of pathogens, such as the SARS-CoV-2 virus.

The invention finds its preferred forms of application in the control of air quality finalized to the detection of pathogens in the sampled air in emergency rooms, hospital rooms, supermarkets, offices, elevators, subways, etc., as well as in the aerosol emissions produced directly by the airways of a patient, in the breathing and aeration systems.

The proposed system could be used to search for any type of virus or bacterium simply by using appropriate reagents within the lab-on-chip.



**Fig. 6** Top view of the prototype showing the three modules.

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