Airwal

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COVID-19 DESIGN INNOVATION GRANT BY

IDA DESIGN AWARDS

EUROPEAN PRODUCT DESIGN AWARD

introduction

Who We Are We are a team of two talented designers from Italy who are passionate about creating sustainable change. We decided to collaborate motivated by the will to help people staying healthy in this uncertain times marked by the spreading of Covid-19 which is affecting billions of lives every day, not just physically but also economically and mentally.

Federica Marrella Italian, recently graduated at the Master Industrial Design from the Royal Academy of Arts in Den Haag. Interested in the intersection between the design field and social activism.

Cecilia Polonara Italian, recently graduated at the Master Industrial Design from the Royal Academy of Arts in Den Haag. Interested in the discovery of new sustainable materials which can lead to surprising innovative applications.

Selected Design Category The team decided to welcome the IDA's and ePDA's call to work to find new solutions to combat this global crisis with our passion, talent and professionalism. The team decided to participate in the Covid-19 Design Innovation Grant within the Architecture and Interior Design category as we found attractive the idea of helping people to stay healthier and safe within their household environment and to give them back the feeling of a recovered interaction with co-habitants people affected by Covid-19 .

Project Challenge "A big challenge facing many during this pandemic is isolating a sick person from the healthy members of their family when they have to remain under the same roof. This $5,000 grant will be for a simple, practical, innovative solution for an in-home isolation pod that would allow those with COVID-19 symptoms and others to safely co-habit without transmitting the virus."

Research question To work towards the above design challenge , a research question was developed to guide the team's research. This research question is: "*Which product , system or technology should we develop in order to allow people affected by Covid-19 a safe and enjoyable cohabitation with others from a physical and psychological perspective?*" As such, this research question drives all of the diverse research methods used by the team.

Methodology Overview The team were aware they must gain an understading of the models of transmission of virus causing Covid-19 to find a simple and innovative solution to the design challenge, . Furthermore, the team continued the research focusing on the current solutions adopted to contain the spread of Covid-19, which include collective and individual safeguards devices. The analysis of all these different factors has been supported by consultations with biologists and engineers and by informations gained through articles and literature reviews. In conclusion, after having excluded various hypotheses , the team decided to develop the best solution to be embedded within the interior of the houseld.

1_project brief

Airwal As the novel coronavirus outbreak has intensified worldwide, public health authorities have urged people to practice social distancing, self-quarantine and self-isolation as appropriate. During this pandemic, the lockdown is making it impossible to ignore the problems faced by the cohabitation between positive patients and other persons, not to mention thousands of families living in overcrowded or bad housing, issues which are making the current social distancing advice almost impossible for them to follow. In particular, poor indoor ventilation has been linked to asthma, one of the condition which seems to be linked to some cases of coronavirus. Bahnfleth, a professor of architectural engineering, says a new report published by Chinese researchers shows how poor ventilation can spread Covid-19 and encourage droplets transmissions. In response to this problem and after having analyzed other possible solutions, the team decided to work on the subject of air circulation and sanification having in mind the human-safety centred design principles. **With the project Airwal , the team wants to take advatage of sterile and sanitised air flow in such a manner that can create an invisible pod and act as a purified barrier between Covid-19 positive persons and other cohabitants within daily household interactions.**

From a technological perspective, the team took inspiration from the operating system of the biological safety cabinets and the cooking hoods; the first ones are intended to protect laboratory workers, laboratory environment and work materials from exposure to infectious and work with HEPA (High Efficiency Particulate Air) filters; the second ones are the devices containing a mechanical fan that hangs above the stove or cooktop in the kitchen and are meant to remove airborne grease, combustion products, fumes, smoke, heat from the air by evacuation of the air and filtration. The use of HEPA filters in combination with the kitchen exhaust system results to be the perfect solution for purifing the vertical area of interaction created by two persons talking or sitting at the table to have dinner or lunch together. Indeed, while the hood systems performs excellent suction in extreme silence through the ventilator, the HEPA filters, part of the "absolute filters" so called category, can guarantee a filtration efficiency between 85% and 99.995% .

Airwal system is designed taking into account the physical and mental safety of the users, the infected and the healthy ones, together with the air sterilization of their interaction area. Furthermore, with this solution, the team wants to address the importance of a rediscovered contact and interaction between a Covid-19 positive person and the others cohabitants within daily rituals such as dining together, which can greatly increase pshycological well-being. Indeed, people in quarantine face the psychological and physical effects of isolation. In this situation it means a lot having the possibility to experience a genuine interaction with the others cohabitants, with the necessary precautions. This is a precious element that would be instead limited if the design of physical pods or panels as their fabrication materials would represent physical constraints for the users, making the interaction unnatural and not very spontaneus.

2_theoretical frame

How does the virus spread? In order to develop the best solution, the team has gained information about the spreading procedures of the virus. Experts believe the virus that causes COVID-19 spreads mainly from person to person. There are several ways this can happen. The virus most often spreads through people who have symptoms. But it may be possible to pass it on without showing any signs. Some people who don't know they've been infected can give it to others. This is called *asymptomatic* spread. You can also pass it on before you notice any signs of infection, called *presymptomatic* spread.

Droplets When an infected person coughs, sneezes, or talks, droplets with the virus fly into the air from their nose or mouth. Anyone who is within 5 feet (152 cm) of that person can breathe those droplets into their lungs.

Airborne transmission Laboratory research shows that the virus can live in the air for up to 3 hours. When you breathe air that has the virus floating in it, it gets into your lungs.

Surface transmission Another way to catch the new coronavirus is when you touch surfaces that someone who has the virus has coughed or sneezed on. The virus can live on surfaces like plastic and stainless steel for 2 to 3 days.

Fecal-oral Studies also suggest that virus particles can be found in infected people's poop. But experts aren't sure whether the infection can spread through contact with an infected person's stool.

Photo by Glen Wexler on glenwexlerstudio.com

3_personal protective equipement

WHO recommended different methods for the use of personal protective equipment (PPE) in health care and home care settings.

PPE mask Medical authorities recommended that everyone, regardless of whether or not they are exhibiting symptoms or believe they may have contracted the virus, should wear a face mask in public.

Surgical mask This is a mask intended to be worn by healthcare professionals during surgery to catch the bacteria shed in liquid droplets and aerosols from the wearer's mouth and nose

Other PPE When caring for patients with suspected or confirmed infectious respiratory virus, all healthcare workers need to – prior to any patient interaction – assess the infectious risk posed to themselves and wear the appropriate personal protective equipment (PPE) to minimise that risk.

- Apron
- Gloves
- Eye protection (if risk of contamination of eyes by splashes or droplets).

Alcohol-based sanitizers Aside from inhaling droplets, you can also get respiratory viruses by touching anything contaminated with the virus and then touching your face, in particular your mouth or nose

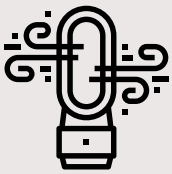
Antimicrobial curtains or PVC panel They can be used to create an air-tight seal from harmful pathogens. While these devices do not kill the virus on contact, it has the least chance to spread with a contained area, and a short life if transferred to this material.

Photo by Michael Jasmund on Unsplash

4 _ comparing different solutions

POSSIBLE SOLUTIONS

The team has considered different technologies before approaching the final solution.

UV light	description	pros ✔	cons ✘
	is a type of electromagnetic radiation transmitted in waves or particles at different wavelengths and frequencies	artificially produced UVC has become a staple method of sterilisation and studies have shown that it can be used agains viruses	germicidal UV light is a human health hazard and can lead to skin cancer and cataracts, which prevents its use in public and private spaces
antibacterial cloth	**description**	**pros ✔**	**cons ✘**
	is a type of fabric treated with or infused with one or several substances to keep microbes such as bacteria, fungi, and viruses from flourishing within its fibers	it is used for preventing the spread of disease, particularly in a healthcare setting, but its use is not a substitute for good hygiene.	enormous difficulties in the maintenance as the product need to be washed in order to be sterilised and sanitised; otherwise it can represents an infected surface
air purifier	**description**	**pros ✔**	**cons ✘**
	it is a device which removes contaminants from the air in a room to improve indoor air quality	air purifiers with HEPA filters can efficiently capture particles the size of (and far smaller than) the virus that causes Covid-19	these devices can purify the air but they are not able to instantly remove or aspire droplets expelled through coughing and sneezing

OUR SOLUTION

After having analysed different technologies in consultation with experts, the team has came to a conclusion.

bio-safety aspirator	description	pros ✔	cons ✘
	product combining aspirator system together with HEPA filters to sterilise the contact area between two person interacting each other while removing saliva droplets	*Airwal* bio-safety aspirator not only helps to freshen the treated area but can also instantly eradicate airborne droplets carrying bacterias and viruses	

*Final decision made after consultation with Alice Gambelli, Molecular Biomedicine PhD Researcher at University of Trieste, Department of Molecular Oncology. CRO, Centro di Riferimento Oncologico IRCCS, Aviano.

5_bio-safety aspirator system study

When we are heating, talking, sneezes, etc, droplets of saliva coming out from out body and is a problem if you need to stay with an infectect covid-19 person inside of your house for this reason, **the team, in collaboration with experts, has calculated the required capacity and power of the fan to aspire medium-large saliva droplets.**

REQUIRED CAPACITY AND POWER OF THE FAN TO ASPIRE MEDIUM-LARGE SALIVA DROPLETS*

For the droplet of saliva to be captured, the speed of the air stream must be > di VT

Cd=1

A=∏/4 d2

V=∏/6 d3

ρ air =122,5 g/m3

ρ saliva=1 g/ml=106 g/m3

$F_d = 1/2\rho\ U2CdA$

$F_g = m\ g = \rho Vg$

$F_d = F_g \longrightarrow 1/2\rho_{air} V^2 C_d A = \rho_{saliva} V_g$

$\longrightarrow V^2 = \frac{2\ \rho_{saliva}\ V_g}{\rho_{air}\ C_d A} = \frac{\cancel{4/3}\ \rho_{saliva}\ \pi/6\ d^3}{\rho_{air}\ \pi/2\ d^2}$

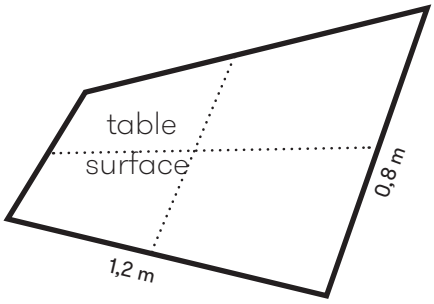
$\longrightarrow V_T = \sqrt{\frac{4}{3}\ \frac{\rho_{saliva}}{\rho_{air}}\ g\ d}$ ②ρ_{saliva} g ∏/6 d^3

DATA SALIVA:

For the droplet of saliva to be captured, the speed of the air stream must be > di VT

d_1= 1 um = 10^{-6}m
d_2= 100 um= 100.10^{-6}m
d_3= 1500 um= 1500.10^{-6}m

VT ^{1} ≅ 0,1 m/s
VT ^{2} ≅ 1 m/s
VT ^{3} ≅ 4 m/s

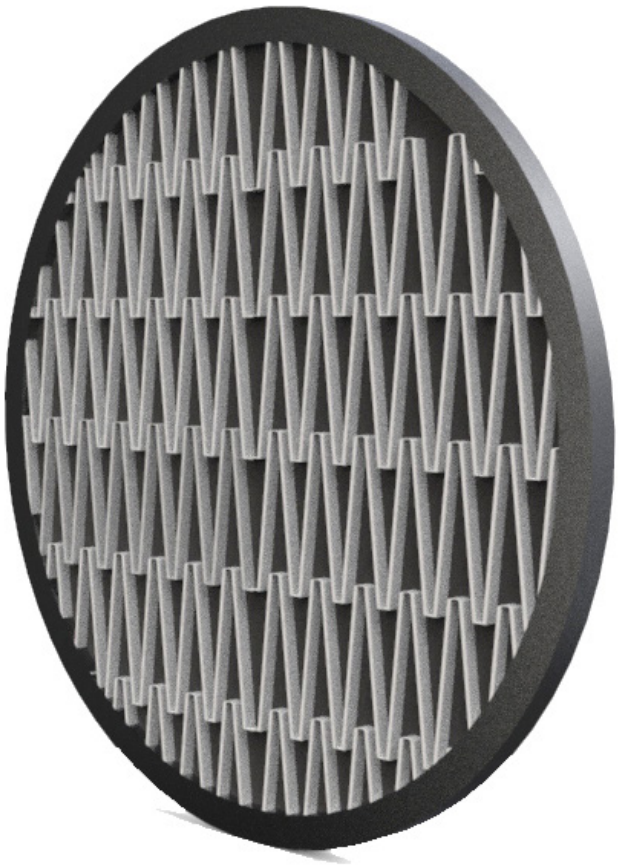


capacity = A.V =(0,8.1,2).4 = **3,84 m³/s=13824 m³/h**

Considering the larger size of the particles (1500 um) the aspiration capacity must be greater than 3,84 m³/s for an area of 1,2mX0,8

*Calculation made by Ilaria Corinaldesi, chemical engineer at Riva Consulent

5.1_technical data



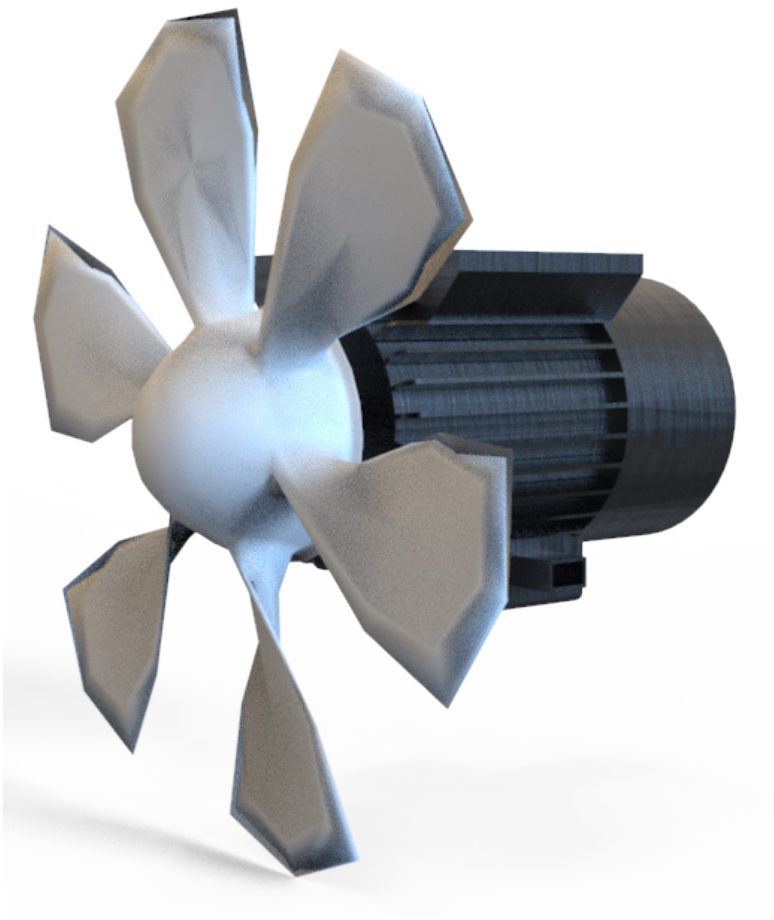
HEPA FILTER is a type of pleated mechanical air filter. It is an acronym for “High Efficiency Particulate Air” (as officially defined by the U.S. Dept. of Energy). This type of air filter can remove at least 99.97% of dust, pollen, mold, bacteria, and airborne particles The virus that causes COVID-19 is approximately 0.125 micron (125 nanometers) in diameter. It falls squarely within the particle-size range that HEPA filters capture with extraordinary efficiency: 0.01 micron (10 nanometers) and above. the coronavirus is primarily transmitted by person-to-person contact and by contact with virus-laden droplets expelled through coughing and sneezing. Although coughs and sneezes certainly suggest “airborne” to most people, the droplets travel only about 1.5 meters before dropping out of the air and settling on surfaces.

The filter medium in the Hepa H13 filters is made of high-quality micro glass fiber. The spacers are made with a thermoplastic adhesive. As a result, the distance between the folds is perfectly adjusted so that an optimal flow and yield is created. Each Hepa H13 filter is tested after production and provided with a certificate to guarantee the EN1822 standard.

Hepa Filter Specifications

Filter Class	Class H13
Dimensions	Ø 720,20 mm
Depth	70 mm
Frame Type	Aluminium
Material	Medium Micro Fiberglass
Initial Resistance	110 PA
Replacement Resistance	600 PA
Maximum Operating Temperature	80 ° C
Brand	Wiltec

5.2_technical data



MOTOR AXIA AI HP 60 6T-P High-performance ducted axial fans, designed for industrial and tertiary ventilation plants with round normalized ducts. Impeller with high efficiency airfoil blades, variable pitch angle in still position, in plastic material or in die-cast aluminum alloy. Hub in die-cast aluminum alloy. Balancing according to UNI ISO 1940.

Axial Duct Fan Dimensions

Fan Diameter Ø	68 cm
Fan Height	15 cm
Motor Diameter Ø	30 cm
Motor Height	40 cm

Axial Duct Fan Specifications

Model	AXIA AI HP 60 6T-P	Max press (PA)	165
Motor	Three phase 6	Power (W)	0,75
Rev. per min. RPM	900	Nom. Curr. (A) 230 V	3.8
Tension (Volt)	400	Nom. Curr. (A) 400 V	2.2
Frequency (Hz)	50	IP Motor protection	IP55
Max flow rate (m3/h)	14400	Noisiness dB(A)2m	75
Max press. (mm H2O)	17	Weight (kg)	37

5.3_technical data

TABLE HOUSING Aluminium is one of the most abundantly avaialble metals on earth. Given its low density, impressive strength and, more importantly, excellent resistance to wet corrosion, aluminium is one of the most widely used and inexpensive engineering materials. A magor benefit of aluminium is its recyclability. It is a relatively easy metal to recycle and requires little energy. Aluminium is arguably the most sustainable building material in the world and is also highly recyclable

Housing

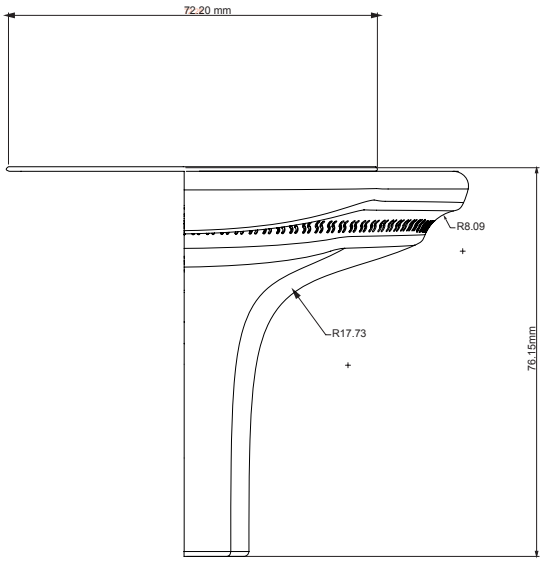
Housing Material	Black lacquered aluminium
HEPA Housing Material	Aluminium
Production Method	Aluminium casting moulding

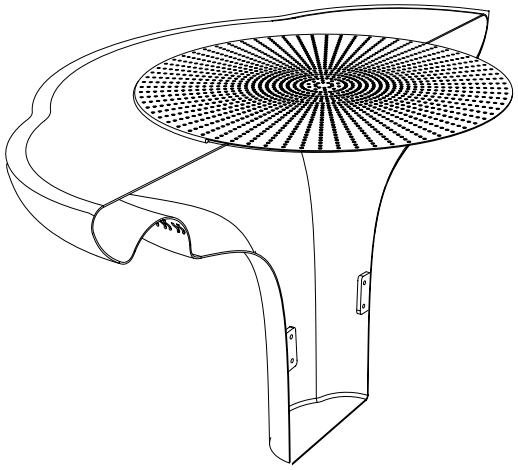
REMOTE CONTROL Easily switch on and switch off the aspirator when you start eating with the wireless remote control.

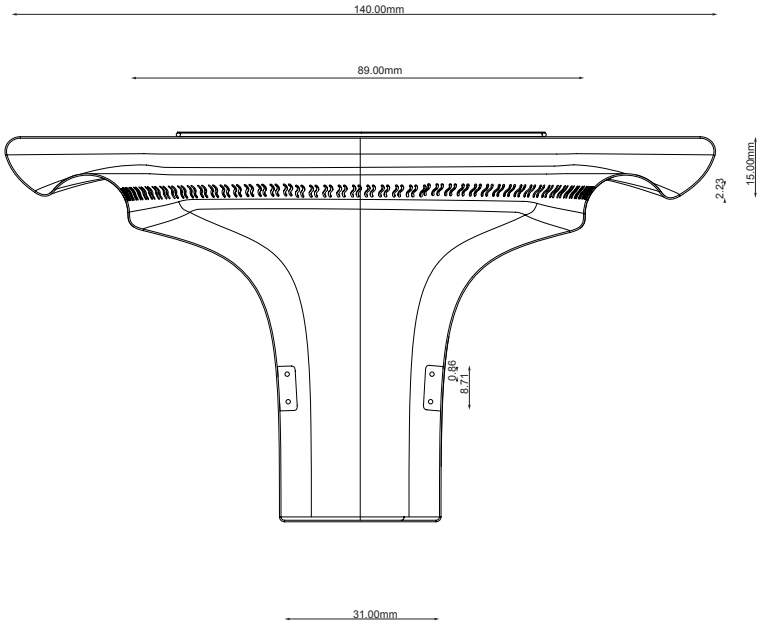
Remote Control

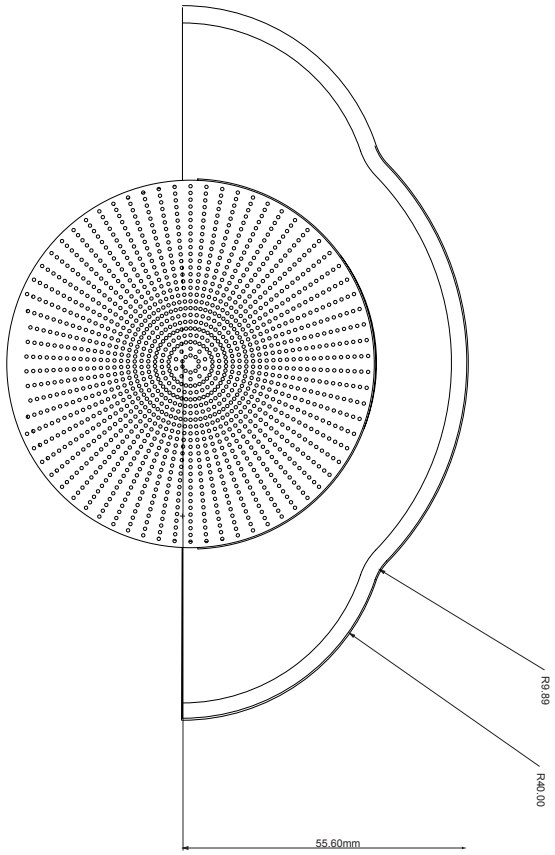
Housing Material	Black lacquered aluminium
Button Material	Rubber
Production Method	Aluminium casting moulding

5.3_technical data









5.4_exploded view

6_final visualization

Airwal bio-safety aspirator not only helps to freshen the treated area but can also instantly eradicate airborne droplets carrying bacterias and viruses . It is combining the aspirator system together with HEPA filters to sterilise the contact area between two person interacting each other, while removing saliva droplets .

6_final visualization

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Airwal wants to address the importance of a re-discovered contact and interaction between a Covid-19 positive person and the others cohabitants within daily rituals such as dining together, which can greatly increase pshycological well-being.

7_budget

Cost Estimation

Motor AXIA AI HP 60 6T-P	600 €*
H13 HEPA Filter	160 €
Aluminium Weight per Kg	1,15€ x 10
Production Cost	Depending on the number of produced items. Estimated price > 100 items 200€

*Estimated cost with O.Erre company

8_resources

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