
AeroTec
Your shield
Your sword

PROJECT REPORT

Aerotec *Your shield & Sword*

Submitted by

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Under the Guidance of

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DES 111

Introduction to Product Design

18th May 2020

ACKNOWLEDGEMENT

We would like to acknowledge our instructor, Prof. Prakash Kumar for providing us his valuable guidance and support throughout the course of the project. We thank him for all his interactive sessions and his comments and suggestions which helped us to work in the right direction throughout the project and make it a successful one.

This project on a real-life problem has given us a better understanding of the design process through repetitive brainstorming, ideation and prototype creation. All of this wouldn't have been possible without constant support and consideration from his side. We thank him for all suggestions and additions to our ideas for better optimization.

We would also like to thank our family members for supporting us constantly throughout the making of this project, as we have all been working on this from home. They have been of great help in telling us the problems that they are facing in wearing the existing available masks while going out to buy or collect bare essentials during the lockdown.

We would also thank all sources and references from where we derived necessary authenticated information for studying in detail and understanding the existing scenario and problems associated which gave us a deep insight into what is the need of the current situation, what can be done to solve them and how we can incorporate a large variety of solution and integrate them into one in order to optimize the product and enhance user experience.

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BACKGROUND

Current situation and its need

In December 2019, a novel coronavirus called SARS-CoV-2 resulted in the outbreak of a respiratory illness known as COVID-19. It is a deadly disease that has taken the lives of lakhs of people already across the world and at the present day, there isn't any vaccination or treatment available yet to cure COVID-19 in spite of many ongoing clinical trials evaluating potential treatments. As the number of deaths and affected people continues to exponentially increase day by day, nobody today knows when this spread of infection will cease.

The virus that causes COVID-19 is mainly transmitted through droplets generated in air when an infected person coughs, sneezes, or exhales. These droplets are too heavy to hang in the air, and quickly fall on floors or surfaces. A person can be infected by breathing in the virus if he/she is within close proximity of someone who is infected by the virus, or by touching a contaminated surface and then his/her eyes, nose or mouth. Governments and health ministries all over the world are taking precautions to fight against this deadly disease. Many countries are under lockdown, and it is being advised that people should wash their hands regularly and keep themselves and their surroundings as sanitised as possible. It has also been made mandatory for everyone to wear masks whenever they go out for any essential needs.

Idea implantation

We initially were planning to solve some existing problems in daily life and had initiated several ideas. But soon we all got stuck at home due to the currently ongoing crisis and were unable to return back to university. It did not take us very long to realize that with this pandemic, the world we know has changed more than we could think in a span of a few days. We realized that this is the need of the hour and this Covid19 might need us to invent products that keep us protected. Hence, we decided to completely turn the progress of our project towards developing something that would help in solving a problem related to the ongoing pandemic.

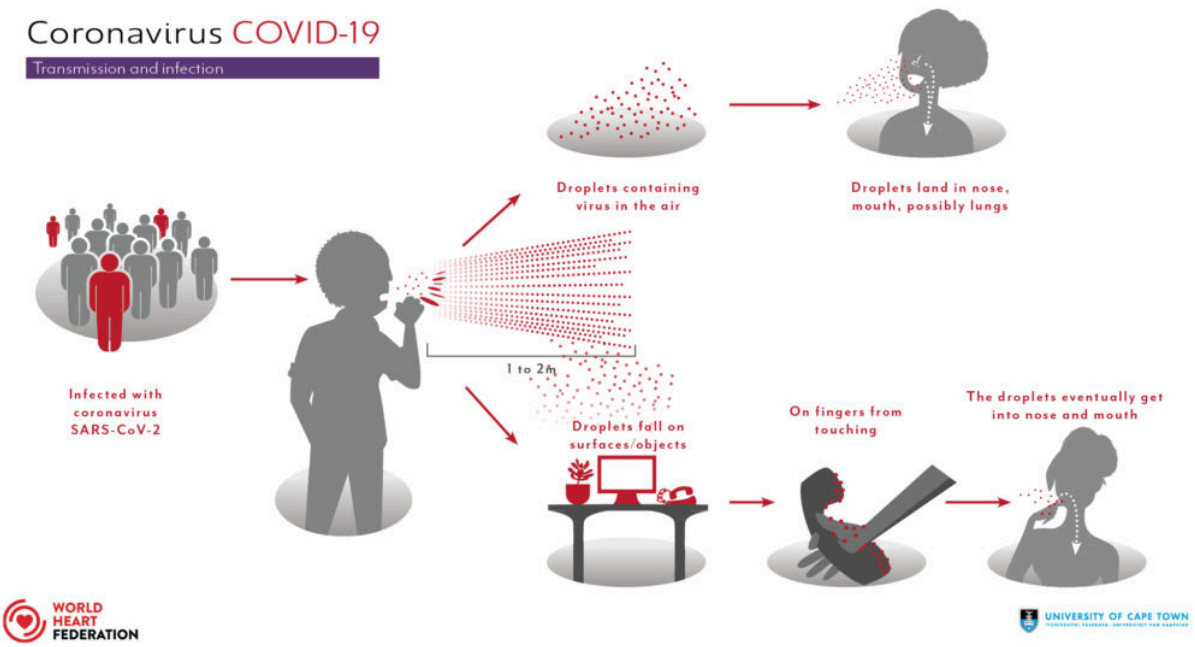
So, how can we adapt ourselves and our products to this 'new normal?' How do we make sure we stay protected in many changing situations in our daily routine even after lockdown is ceased and we go back to work? Shall we have to wear a mask to keep ourselves from inhaling contaminations every day from now on? How should we incorporate assured protection along with comfort? Can we develop something which we would be able to bear on our faces throughout the day?

Problem statement

Soon we figured out that one of the main problems that lie forth us in the future is that even after lockdown ends and we all are asked to get back to work, be it offices for the working professionals or educational institutions for the students, be it our household helps to come to our houses and to resume their jobs or us going to the grocery shop to pick the monthly ration, we need to develop a product that takes care of protecting our face which is the main entry point for the virus to enter a human and also a solution to protect us after touching surfaces in public areas that may be contaminated even after the virus is declared to be eradicated from humans. Hence we chose our problem statement, after the approval of our instructor to be--creating a mask cum shield that is enough comfortable, affordable and protectant for anyone to wear during daily life activities and would not interfere or make us incapable of performing any task which we do, outside the home.

STUDY

We researched how communicable the virus is and whether the existing masks are giving enough protection to people. We found that: People can catch COVID-19 from others who have the virus- the disease spreads primarily from person to person through small droplets from the nose or mouth, which are expelled when a person with COVID-19 coughs, sneezes, or speaks. These droplets are relatively heavy, do not travel far and quickly sink to the ground. People can catch COVID-19 if they breathe in these droplets from a person infected with the virus. This is why it is important to stay (at least 1 to 2 meters ~ approximately 6 feet) away from others. These droplets can land on objects and surfaces around the person such as tables, doorknobs and handrails. People can become infected-by touching these objects or surfaces, then touching their eyes, nose or mouth. This is why it is important to wash your hands regularly with soap and water or clean with an alcohol-based hand rub.



Recommendations by the World Health Organisation include:

WHO recommends keeping at least 1-metre distance from others and has a complete set of guidelines on how to wear masks and their disposal:

WHO also recommends regular and thorough cleaning of hands with an alcohol-based hand rub or wash them with soap and water. Why? Washing your hands with soap and water or using alcohol-based hand rub kills viruses that may be on your hands.

Existing solutions

There are a lot of innovative masks that we're constantly seeing on the internet and it is indeed ironic because there is a global shortage of PPE for healthcare workers. So why are we designers still creating masks? Because the lockdown may end after sometime but the vaccine won't be ready so soon and therefore we need to develop creative ways for mass adoption of wearing masks as a part of everyday fashion. This way, we stay safe as we enter a 'new normal' and leave the surgical masks for the health workers.

Broadly, the currently existing face masks are of three types:

- Surgical mask
- N95 respirator
- Homemade cloth mask
- Gas masks
- Snorkelling masks

One of the existing solutions that has been widely adopted by medical professionals, especially nurses while treating Covid-19 patients is coupling a surgical or N95 mask with a transparent face shield that has its grip on the head or complementing it with protection spectacles.

A few of the other variations in snorkelling masks are:

Ultra Elite CBRN gas mask adapter

Retrofit snorkel mask

Decathlon respirator mask

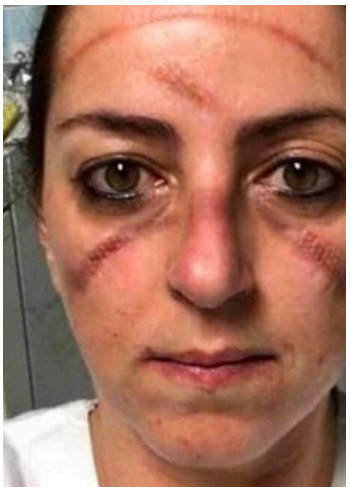
Half face cartridge mask, Double cartridge masks, Twin/single filters half and full masks:

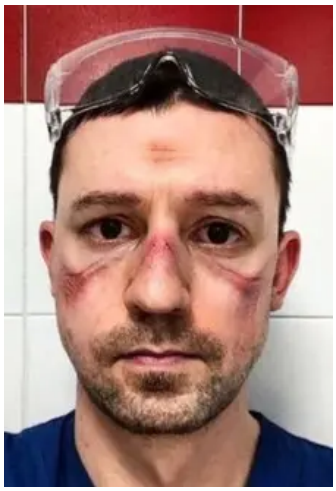
DIY homemade cloth masks:

Problems related to existing solutions

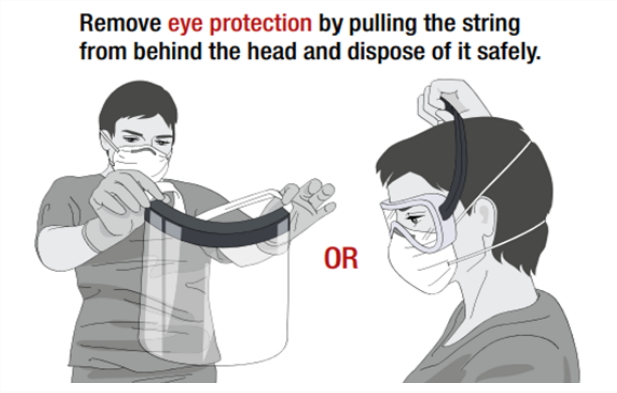
1. **Difficulty in prolonged wearing**

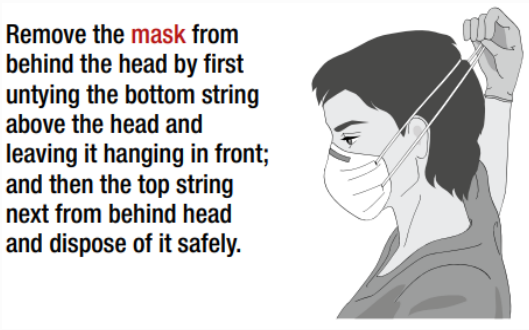
People with pre-existing respiratory illnesses may face health issues with prolonged use of tight-fitting masks, such as respirators as CO2 can slowly build up in the mask over time. In addition, wearing masks for many hours a day is known to cause pressure ulcers, a phenomenon which can lead to pain and infection. The N-95 respirator is characterized by it's tight facial fit, which forms a seal around the mouth and nose. While those characteristics make it effective at filtering out airborne particles, it also creates a frictional force and pressure load. All of us have lately seen pictures of nurses go viral on the internet depicting how their faces have bruises from wearing masks throughout the day while treating infected patients. These also cause soreness and itching behind the ears from wearing masks for longer times.





2. **Shield with mask- difficult to wear, remove and carry**





With the introduction of shields and masks as precautionary wear for protection from coronavirus, there are some problems associated with the design- the steps involved to first wear the mask, then the shield, tightening them and keeping them in place for a long time. As masks are becoming the new normal, it is important to make this entire process hassle-free, convenient and time-efficient. But the existing designs seem to be really complicated in terms of comfortability.

3. Small kids find it difficult to keep the mask on

A lot of people find it difficult to convince their children to wear the masks. The innocent beings do not understand the gravity of the situation and how one mistake can affect the entire family and further, more people. It was basically due to the look of the protective items that did not seem very pleasing and attractive.

There is no doubt how the look of a product can have a large impact on how consumers use it. The challenge was to make it look appealing along with them being able to serve the basic purpose. Constant itching and discomfort were observed to be the other contributing factors. Especially to children, who usually would refuse to wear something as uncomfortable as a mask unless they find it interesting enough or have their superheroes or favourite cartoon character element on it.

4. **No see-through**

All the masks available in the market currently are opaque or translucent, and very close to the mouth, thus making it difficult for users to speak and for others to understand exactly what the user has to communicate. They cover more than half the face, making it difficult to read a person's face and get their expressions right.


Expressions are very natural to humans, and them getting devoid of such basic human gifts can have adverse impact in the long run, especially in the way people communicate. The challenge was to design a see- through mask that would serve two basic functions- a) Providing ability to speak properly without discomfort and, b) Making the face expressions visible.

5. **Problems with people having eye power and wearing spectacles**

People wearing spectacles are found constantly complaining about how their lenses collect mist on exhalation. Most masks have a hole for air circulation. But due to the presence of gaps right beside the nose and the mask, the exhaled air gets a room to escape out and collect on the lenses. One primary solution to this problem is to seal those gaps. But they have their own challenges, for example, itching on prolonged wear.

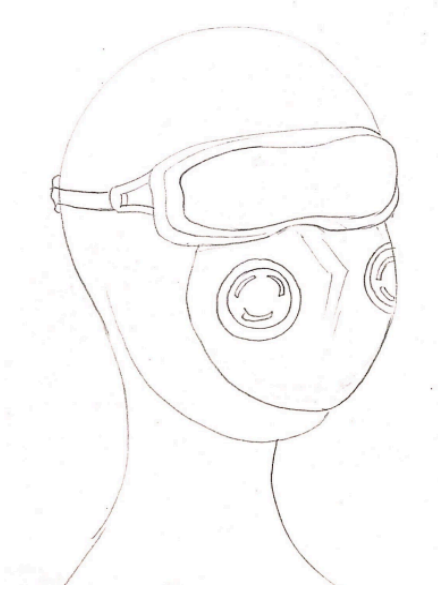

CONCEPTUALIZATION

Proposed ideas and their comparative study

The designing of a mask that could overcome all the above-mentioned problems involved a series of iterative steps – Empathise, Define, Ideate and Prototype. These ideas were proposed keeping in mind various problems observed in the study phase that had to be addressed.

The subsequent sections list the ideas and a comparative study that led to the final design.

1. **Eye protection inspired from swimming goggles**



This was our first ever prototype. Since the virus can spread by touching fluid from an infected person's eyes, or from objects that carry the fluid. Advisories are being issued so that people take proper care of their eyes, and prevent entering of the virus via them. These include– substituting glasses for lenses, using sunglasses, and avoiding rubbing of eyes.

We tried to look for situations where eyes have to be protected and how it is done. The most basic scenario that one might think of is swimming. Wearing swimming goggles protects eyes from all sorts of things during your time in the pool. Be it chlorine water, or any other potential pathogens in water, they take care of everything. The airtight goggles prevent any water from flowing in and reduce chances of getting pink eyes.

Based on this idea, we decided to club the existing masks with a swimming goggle that would provide 100% protection from the virus.

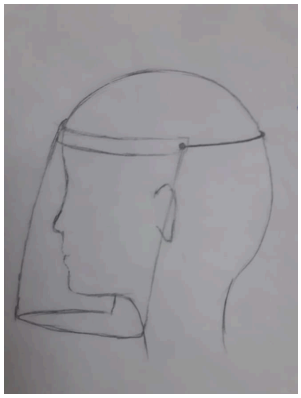
Although it seemed to be a great idea in the first place, the idea had some flaws-

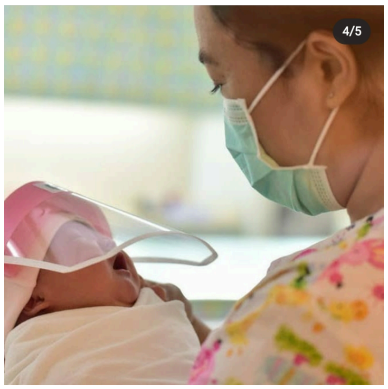
a. The swimming goggles are especially designed for conditions under water. Wearing them in daily life can cause irritation and discomfort.

b. People who wear glasses would not be able to use such a product. They are too close to eyes and hence an obstruction in view.

c. For a country like India where temperature in summers can go as high as 50℃, sweat can cause irritation to the skin and rashes.

2. Making a transparent protective shield



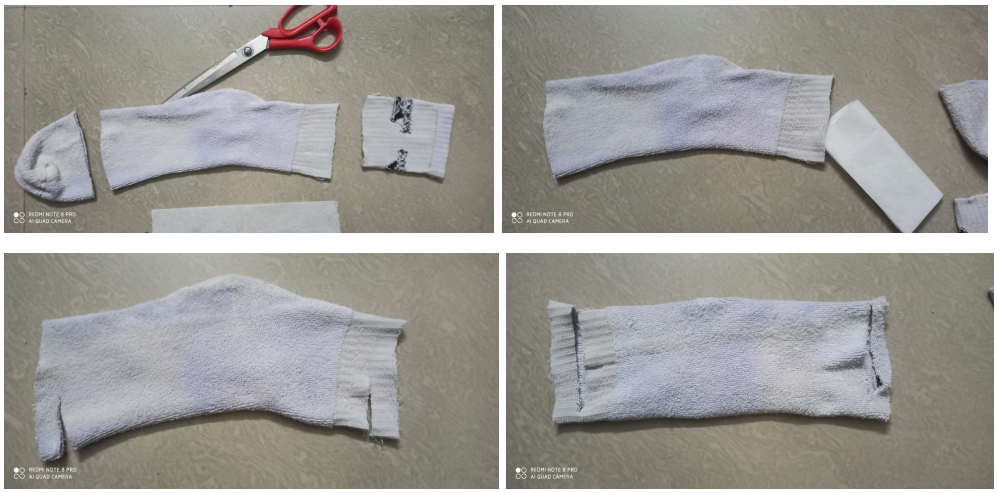


The idea originated from the picture above. At a hospital in Thailand, new born babies were being given face shields to protect them from contamination from coronavirus. The visors not only stop any droplets from reaching the baby's face but also give new parents peace of mind.

The idea was to make a transparent protective shield that could cover the entire face and ears on sides. It turned out though, that this idea had already become so famous that everyone had such shields and also their homemade variants. But with all the types out there, none of them was a permanent solution. They also had wearing and removal problems.

3. DIY Homemade masks

With the news of shortage of masks all over the world, it was a challenge to make masks available to every person. So, we decided to make some easy DIY masks at home that would not require any stitching and could be made within no time. The picture below shows one such mask tried at home.



The mask is made using an old sock and cutting both its ends. A filter paper has been inserted (tissue paper here as a prototype) that can protect the mouth from any harmful bacteria and virus around. It does not require any stitching and is easy to wear and is reusable.

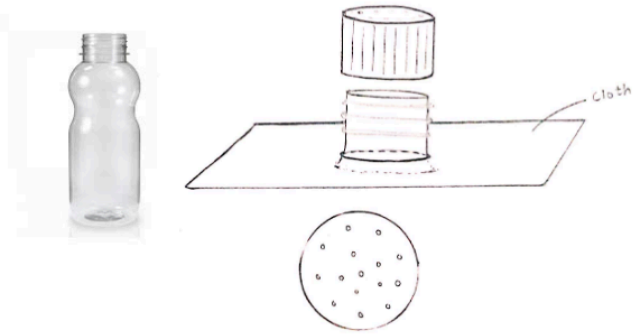
This idea, even after having various advantages, failed on the following parameters-

a. The problem of spectacles becoming misty still continues.
b. It is way too close to mouth and thus a hindrance while speaking.
c. Not enough room for air to circulate.
d. Aesthetically, it is not very pleasing.

4. Making minimalistic design with mask and shield together

The "Bottle cap filter":

This idea was aimed at making the combo of mask and shield minimal. The main problem with homemade masks was that it did not give enough room for air to circulate while breathing and also does not have eye protection. The bottle cap idea could overcome this problem.



A bottle is cut from the neck portion and put into a hole in mask cloth. Some holes are pierced in the cap and an appropriate air filter is put inside the cap. The cap is then closed, and the mechanism acts as a filter cartridge. This mechanism was a very good DIY analogue to the following type of manufactured masks:

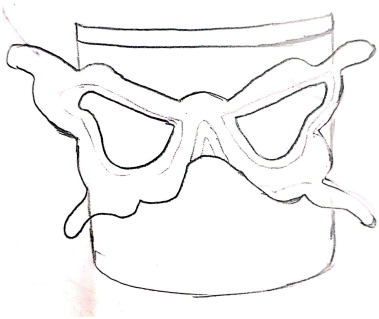
The “Bent comb grip”:

This idea for holding the mask to our face with a bent comb grip like sunblock caps was to solve the problem of withered skin and itching behind the ears due to prolonged wearing of masks fastened behind the ears.

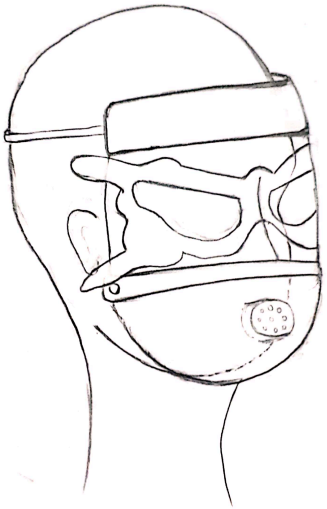
The idea included bending a comb that would hold on to hair and attaching it to the two ends of the elastic strings which would together in turn act as a support to hold the mask on the lower half of the face.

Further, the pictures below were the inspiration to make the shield small and aesthetic - “Superman/Krrish style” - especially to attract kids to wear it.

Combining all the above ideas led to the following sketches:



The minimal sketch with both the mask and shield keeping in mind the aesthetic criteria, especially for kids:

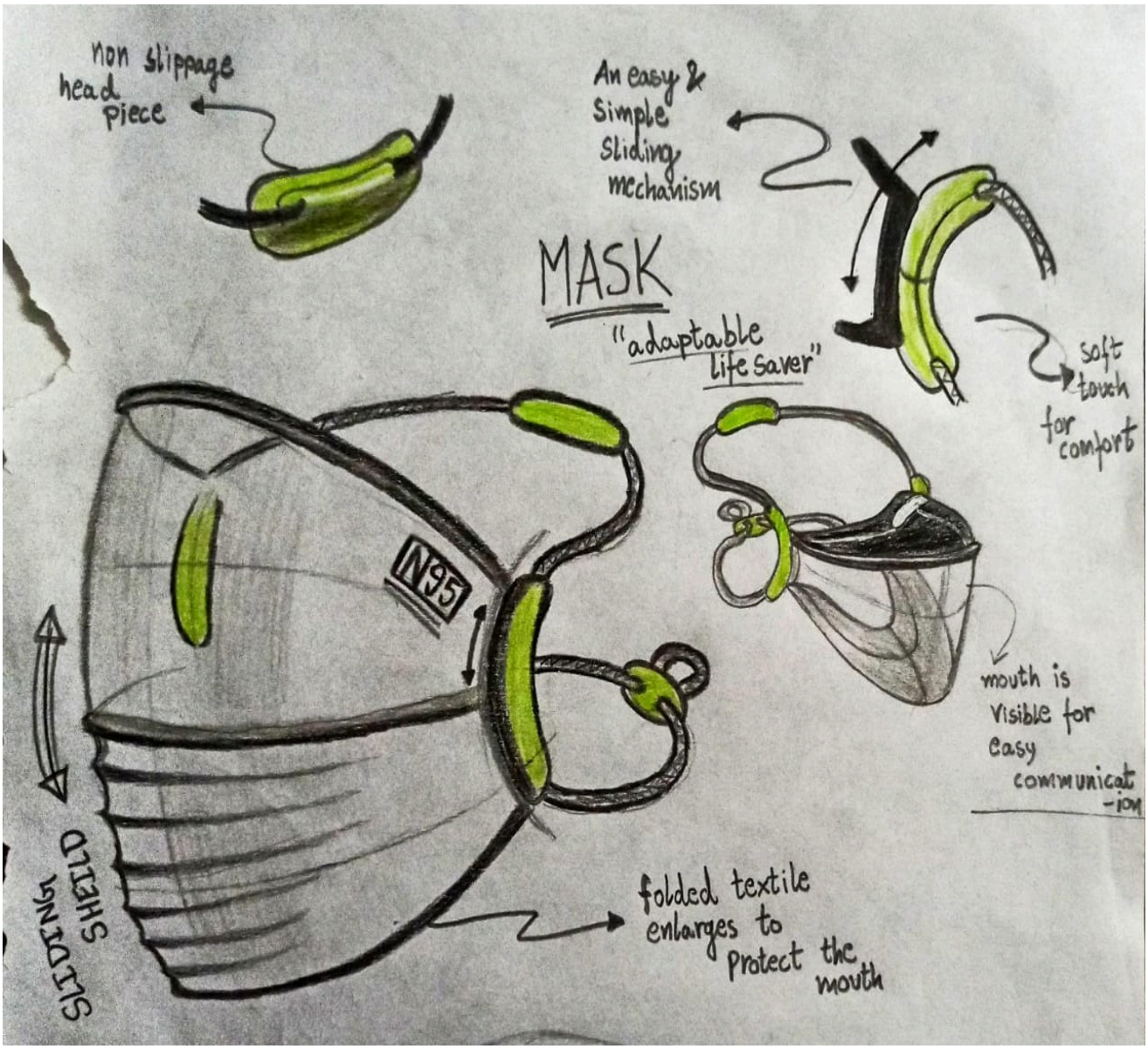


Advantages and disadvantages of the above design:

- Advantages- aesthetically pleasing, amusing for kids, minimal design, all round protection including eyes, nose and mouth
- Disadvantages- Sharp edges, uncomfortable during summers, sweat build-up, mist on spectacles, not very easy to clean, lower part of bottle can hurt the user, needs proper care, difficult to wear and remove.

THE FINAL DESIGN

Keeping in mind all the above-mentioned challenges, we finally arrived at the final design after a lot of brainstorming. We designed "**Aerotec — Attack and Protect**", the 'new normal' for all after lockdown is ceased and regular life resumes.



How is this mask any different and unique from the other cool masks we've already had and seen?

Aerotec combines the benefits of a mask and a face shield with a simple sliding mechanism- a folded textile structure below a round protective shield. The mask enlarges when the shield is slid up. This way one doesn't have to constantly wear the traditionally obtrusive face shield but can be 'guarded up' as great protection while around people in a rather petite area of space and cannot maintain the prescribed 6 feet distance. Along with head straps that ensure comfort and perfect fit, it also keeps the mouth visible to keep the window of human expression open, something we crave so deeply and will not take for granted when this pandemic ends. The shield is round and clear with an open top for allowable ventilation as coughed virus droplets won't move up against gravity to enter into the structure, so our user has optimized protection for all facial organs.

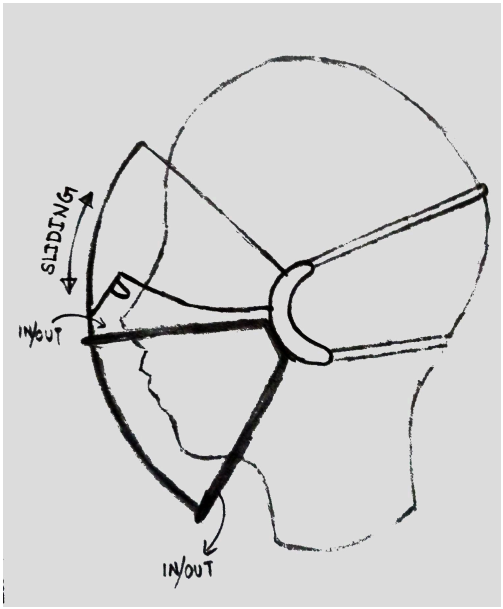
We also complement our product with a potable sanitizer spray, which could be worn, hassle-freely by the user and would provide all-round protection in a jiffy as after touching surfaces in a public area that might be contaminated.

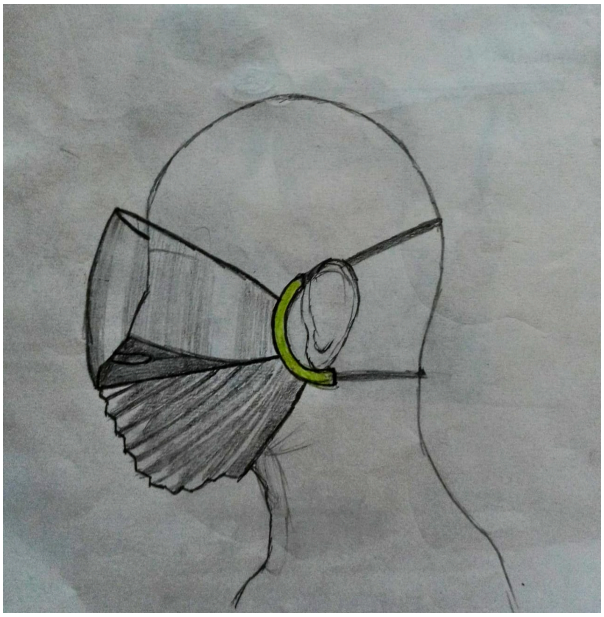
Product details

Aerotec is composed of mainly two components — A mask and shield that protect, and a sanitizer that attacks.

PROTECT — THE SHIELD AND THE MASK

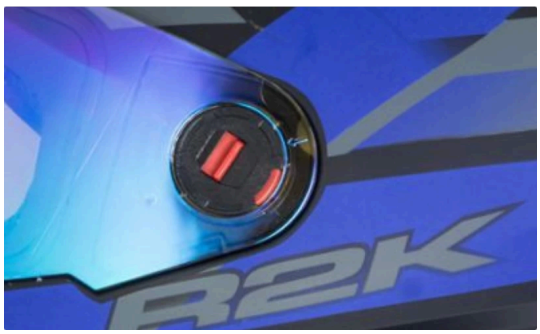
The mask and shield are combined together, both of them movable. On the nose rests a separate fabric that consists of micro holes for easy breathing. This does not cover the mouth too like many conventional masks that we see.



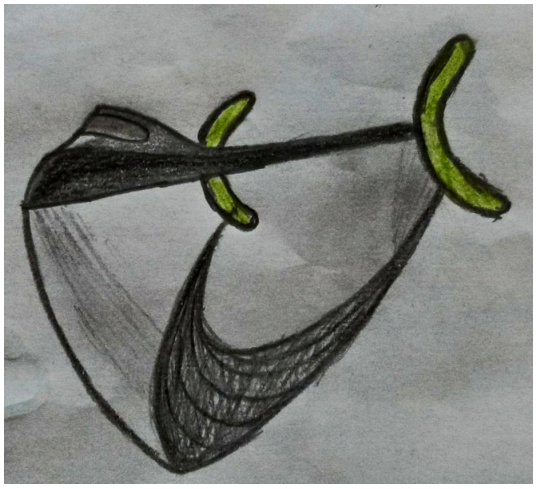


The masks and shield have the same curvature and are approximately an inch away from the nose, i.e., about two inches away from the eyes. The shield is transparent to allow viewing. The sliding and resting principle of shield and masks are similar to what we see in helmets in everyday life.

The picture below shows a closer view of how the glass protection in helmets is made to slide. It can rest at various steps while sliding up according to the user's need as to how much he/she wishes to keep it open.

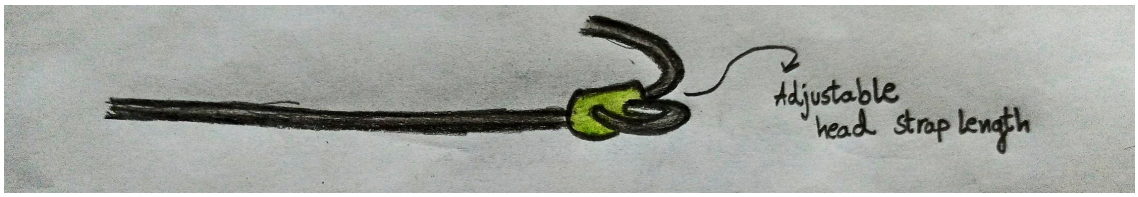


When worn, Aerotec is designed such that the shield is in front of the eyes, the mask right below it and on the nose rests the nose cover. The foldable textile structure has the ability to collect at the neck area and as this happens, the shield slides down in front of the face, revealing facial expressions. It depends upon the user's choice to do so as and when he is in a conversation. The structure can be put back in place by sliding up. In this manner, the user doesn't need to constantly wear the historically obvious face defence but can 'shield up' if he is in a crowd and can't keep distance. All this while, the nose cover remains constant. The nose cover is made of cotton with micro holes in it, that allow the user to breathe easily.



Since the nose cover lies only on the nose and provides ample space for air circulation, in now way upon exhalation, a user wearing spectacles can get his spectacles misty. The shield is made up of reusable and biodegradable grade PET (polyethylene terephthalate) material, and thus is fog- resistant.

Using a head strap with an adjuster for adjusting size is a neat solution for preventing sores behind the ear and also a great customization for person-to-person. Head straps ensure consolation and fit. The mechanism is similar to the one which is given behind necklaces and jewellery for the neck and has a small adjuster to adjust according to a person's wish. In our case it would be the grip and tightness that a person wants.



For keeping up the mask with the current fashion trends across the world, as to achieve our goal of adapting to the 'new normal', we researched various face wears in fashion shows. This helped us to make the mask aesthetically appealing.

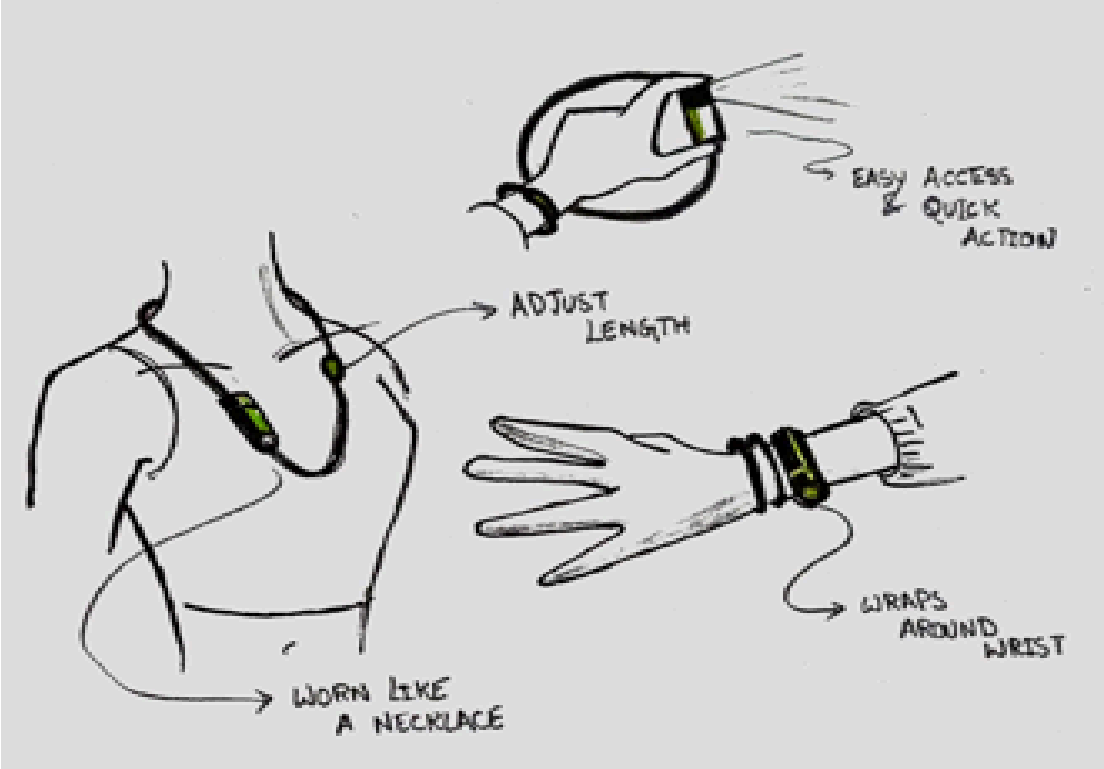
The following image is a photo collage that inspired **Aerotec's** design:

Fashion shows are a great platform to set fashion trends all over the world. This board shows how different designers across the globe are trying to normalise masks and make them a part of our everyday lives. Aerotec design takes its inspiration from all such efforts.

ATTACK — THE AEROTEC SANITIZER

In addition to wearing a mask, how can we maximize our safety all day long? Can we make carrying a hand sanitizer a part of our daily life and attire?

As much as it is important to protect ourselves, 'attacking' it is equally important to win this battle against Coronavirus. So, keeping in mind our idea of the 'new normal', we designed **Aerotec Sanitizer** as a part of our everyday lives.



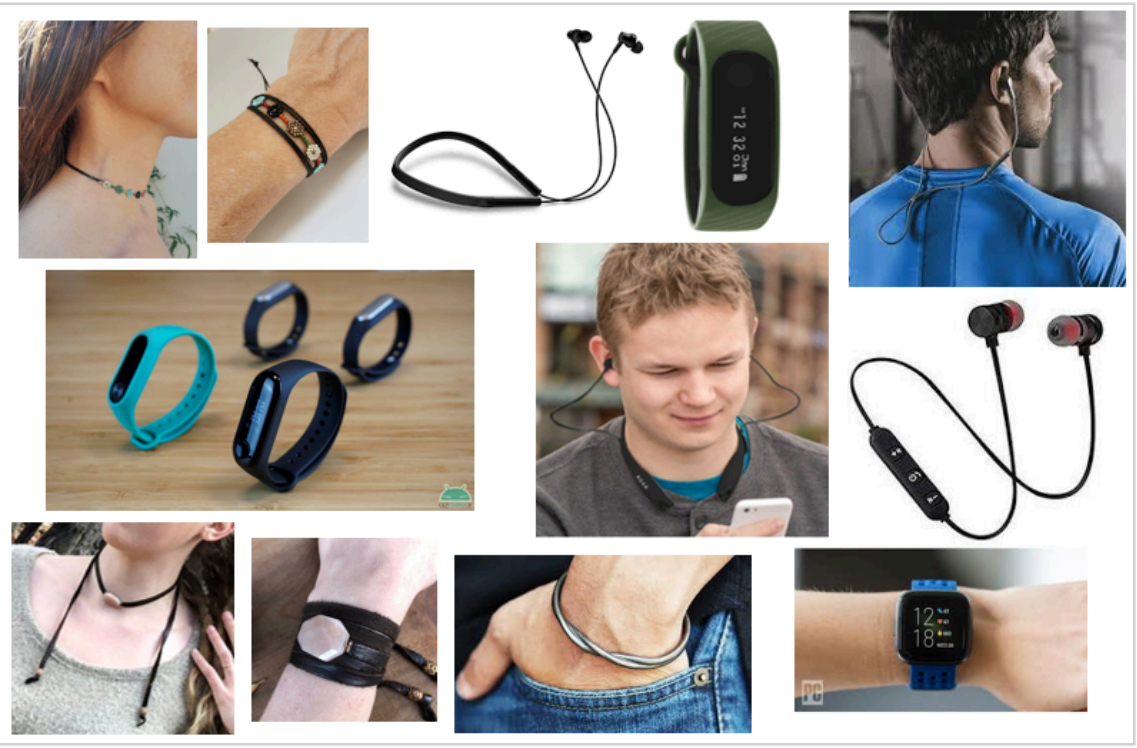
Aerotec includes a hand sanitizer spray bottle concept that aims to make the protection towards germs part of daily life in an effortless way. The design offers an instant solution when washing hands is not an option by making the bottle portable, accessible and refillable.

Aerotec sanitizer concept is following the same motivation and design language set by the Aerotec mask, a design that combines a mask and a face shield. Working

together to maximize safety and protection, while the Aerotec mask guards the user like a shield, the Aerotec sanitizer gives an active way to attack back like a sword.

The concept is not only aiming to provide an effective solution, but also turns this bottle into a fashion accessory, so that the user can easily make it part of daily life and attire.

We aim to reply to the questions which have crossed our minds through our work — What if we have to wear a mask every day from now on? How do we live covered as we resume our each day routines out of doors quarantine? Will masks make us feel less friendly when we engage socially? Can we discover a sanitizer that doesn't appear to be sitting inside the middle console of my car for years? Aerotec is your S.H.I.E.L.D (see what I did there?) team when you step back out into the world.



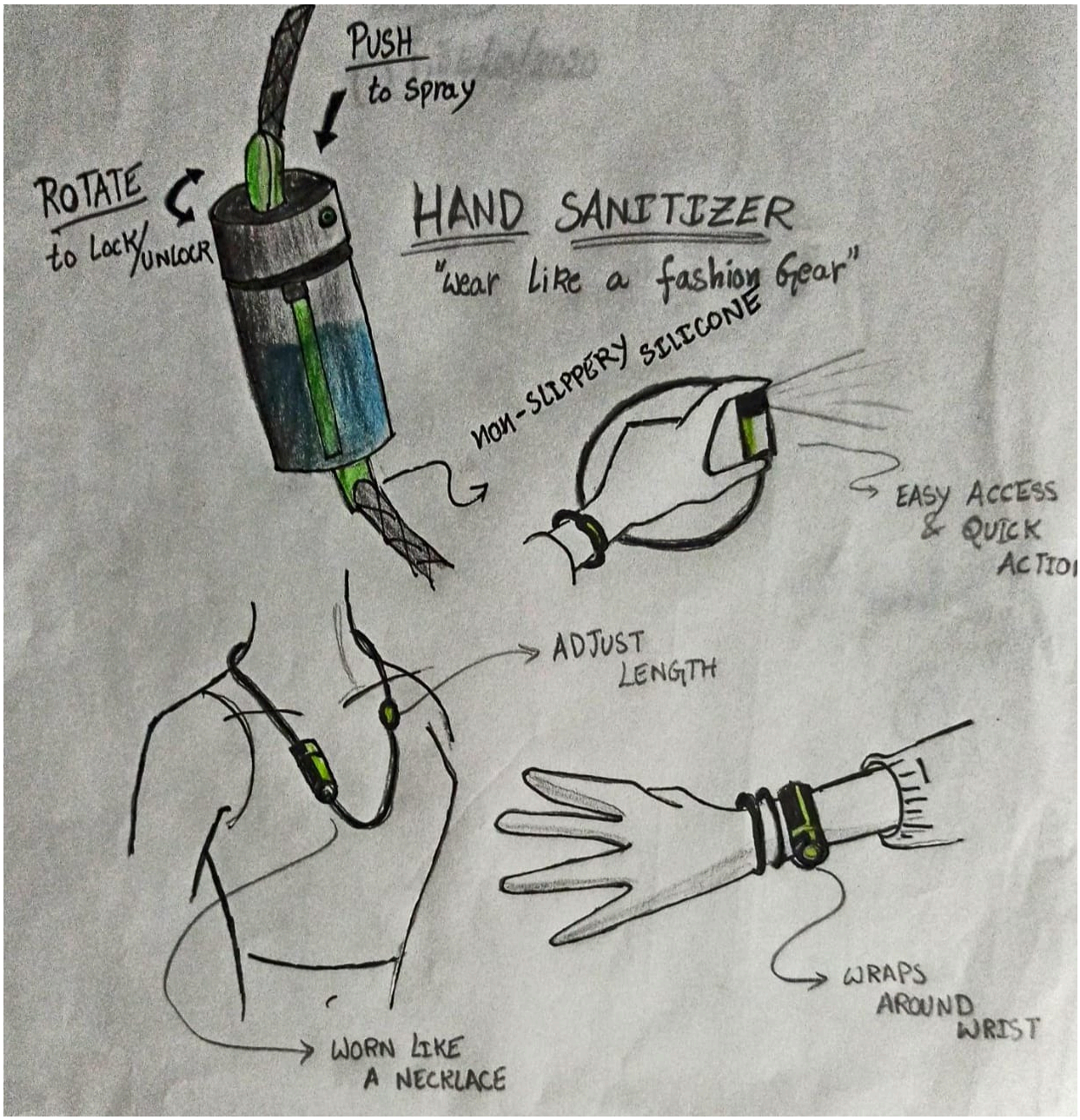
The inspiration collage board for Aerotec sanitizer bottle

The collage shows some accessories of everyday life. The sanitizer bottle was aimed to be an everyday carry along item and hence we took inspiration from the design of bluetooth headphones, etc. and how they are worn so that we could make something

as familiar and analogous for the sanitizer bottle carriers as them.

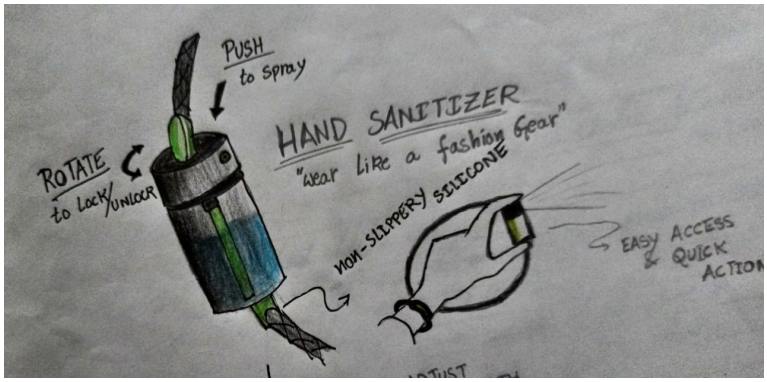
Working of the spray bottle:

The spray bottle is designed to pull liquid from the bottle using a one-way valve. The pump, powered by a trigger, forces the liquid through a nozzle that breaks up the flow of the liquid, turning it into a fine mist or stream.



Sanitizer bottle

The bottle is the reservoir from which the pump pulls liquid when the user presses the trigger on the spray bottle. The liquid moves from the bottle up the tube. Since the liquid is thin, a thinner tube is used. It is extremely handy and can be sprayed on hands or other parts by the user anytime he/she feels that he/she has touched or come in contact with a contaminated surface.

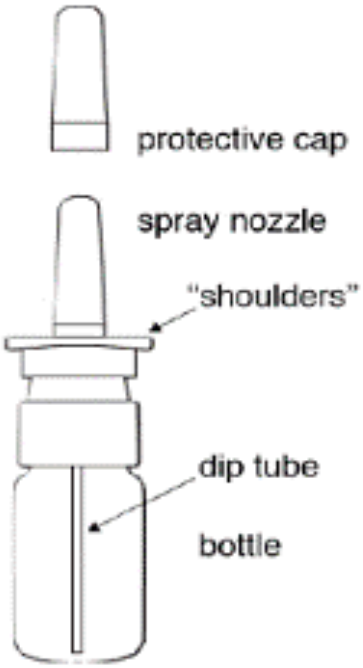


Pump

The pump is the main working part of a spray bottle. The pump consists of the trigger mechanism, a piston, a cylinder and a one-way valve. When the user presses the trigger, it forces the piston into the cylinder, which forces the liquid through the nozzle as a concentrated stream of liquid. When the trigger is released, the piston moves back, pulling liquid back into the cylinder. This liquid is forced out of the

nozzle the next time the trigger is pressed. A one-way valve at the bottom of the pump only allows liquid to flow up the tube into the pump, not back into the bottle.

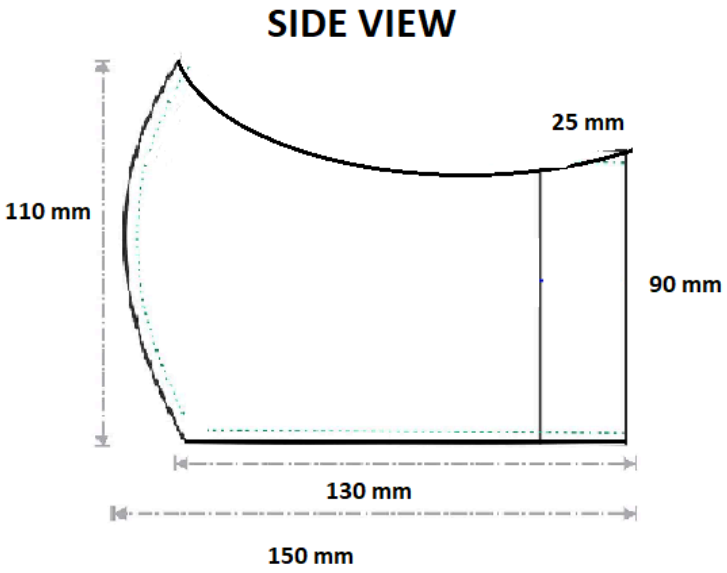
Nozzle



The nozzle of the spray bottle concentrates the liquid into a stream by forcing it through a very small hole. Spray bottle nozzles also have a one-way valve in them that keeps air from flowing back into the pump and allows for suction within the pump so that liquid can be pulled up the tube. Without this valve, the pump would suck air back into the cylinder, instead of liquid up from the bottle.

Specifications of Product

MASK



PARAMETER	SPECIFICATION
Size	26 cm x 11 cm
Thickness	10 mm
Material	Polypropylene
Weight	10 grams
Distance from face	2 inch (approx)

Product Description (Mask):

- Quality filter media which blocks 95% of very small (0.3 micron) test particles
- Surpasses PM 2.0 specifications and meets N95 testing criteria
- Added activated carbon layer provide extra respiratory protection, absorb & remove potentially harmful molecules

SHIELD

PARAMETER	SPECIFICATION
Size	30 cm (width) x 11 cm (length)
Material	PETG + Sponge
Thickness	350 micron
Distance from face	4 cm
Elastic	Woven Elastic

Product description (Shield):

- Made of biocompatible grade PET polymer, provides excellent protection for face from saliva splash, spray and splatter, droplet, dust, oil smoke and more.
- Optically clear: 100% transparent, no distortion free wrap-around face shield.
- Comfortable to wear: Lightweight and comfortable to wear, quick and easy to put on and take off.
- Anti Fog: Double-sided anti fog, ensure clear vision always, no need to worry about the sight.
- Glasses/ Goggles Friendly: The foam strip and fixing device holds the shield away from the face, allowing room for goggles.

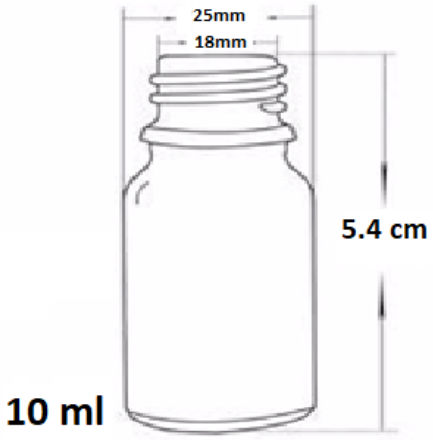
HEAD STRAP

PARAMETER	SPECIFICATION
Material	Silicone rubber
Temperature Resistance	200-250℃
Diameter	4 mm

Product Description

- Thickness can range from 1mm to 5mm .
- Custom colours are available.
- Silicone strips/bands are bio compatible and are free from any kind of toxic material.
- They can be washed in hot water. They can also be sterilized or autoclaved.

SPRAY BOTTLE



PARAMETER	SPECIFICATION
Height	5.4 cm
Neck length	0.4 cm
Neck Diameter	18mm
Bottle Diameter	25mm
Capacity	10ml
Weight	24 g (approx.)
Material	Plastic (low density polyethylene)
Opacity	Low (Translucent)

SCOPE FOR IMPROVEMENT

1. With a lot of innovative masks making headlines, the one in the picture below shows an additional feature of a self controlled lid to insert straws while consuming beverages. Such simple addition can be a part of Aerotec's Mask.

But again there may be a drawback for this design in terms of the accuracy of sealed Protection through the self controlled lid structure. Moreover, a person might not always have a straw available around him/her to insert through this structure abd drink fluids.

2. Addition of a small circular ring on either ends of the spray bottle. A lot of women wear convertible necklaces and bracelets and most of them have a hook in them. Instead of using the same spray sanitizer everyday, hooks can be inserted in the rings thus making the spray bottle adjustable to all fashion accessories.

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