Linnæus University
Sweden

Report: Module 2 Project

The COPCube

A campaign to make COP conferences virtual

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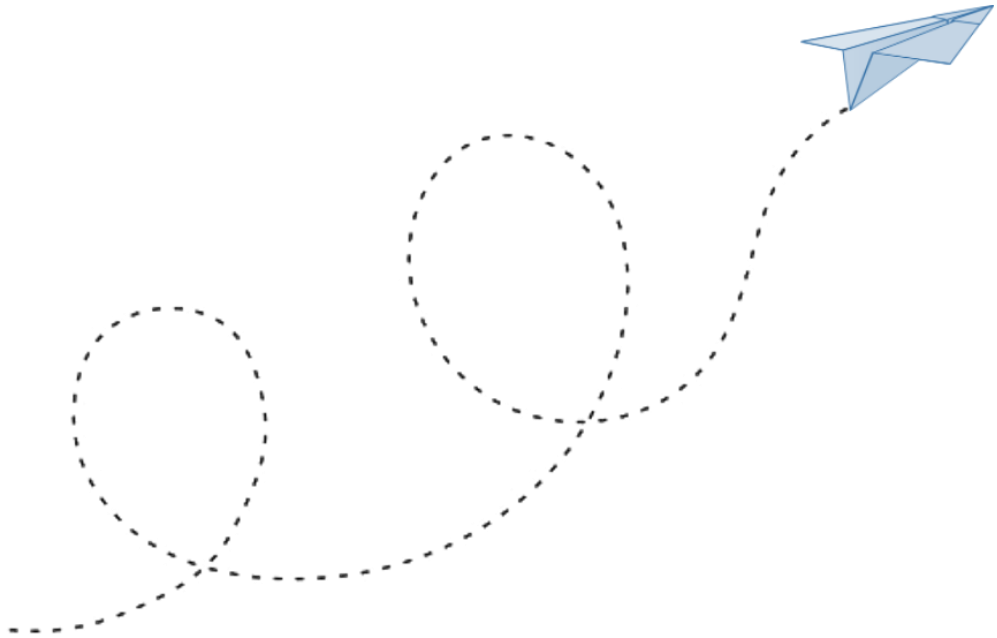


Abstract

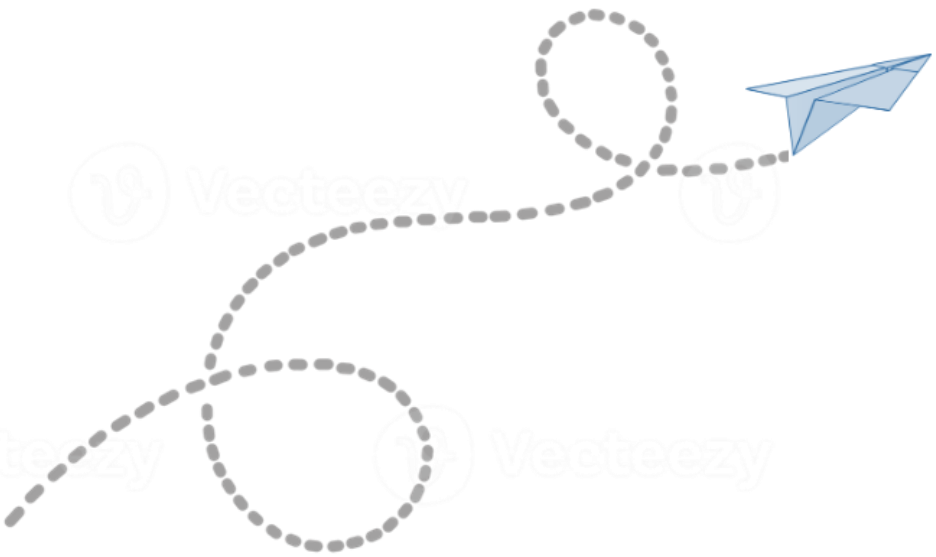
The increasing number of registrations and usage of private airplanes have an outside impact of aviation emissions. This paper describes a design intervention to reduce private aviation specifically, and business travel in general, by use of holographic video conferencing technologies that seek to address deficiencies in current videoconferencing technologies. With an open-source technology roadmap for an interoperable holoconferencing system in mind, a campaign object – the COPCube – was created that will be used to lobby policymakers at the upcoming COP28 conference in Dubai, UAE, to reduce private travel, by example and regulation, and to invest in development of alternative technologies such as described in the paper.

Key words

COP28, aviation emissions, business travel, private aviation, videoconferencing, holographic videoconferencing

Acknowledgments

I would like to thank my instructors Anthony Wagner, for his patient guidance throughout this project; Daniel Gustafsson, for helping me realise and explore my ideas as tangible creations; my examiner Matilda Tham, for feedback that helped me question my work and improve it; and my faculty Åsa Ståhl, Kristina Bengtsson, Vera Maeder and Zeenath Hasan for all the support they have given me, in my transition to a new academic rhythm and student life in Sweden.
I was inspired in this project by the visionary depiction of holographic messaging in George Lucas's Star Wars (1977) and the holographic videoconferencing scene in Star Wars: Episode III – Revenge of the Sith.



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1 Introduction

1.1 COP26 sets record for CO2 emissions.

The genesis for this project was a news item about COP26 in Glasgow (Newburger 2021). COP26 occurred during the COVID19 pandemic when air travel was severely restricted. It is ironic that a conference focused on saving the planet from climate change, attended by global leaders who are the policy makers, creates so much damage to the planet.
I started to look at COP28, which is being hosted in my home city, Dubai, in November 2023, and came across various articles discouraging travel to the conference if attendees were sincere in reducing impact to the climate.

1.2 Reduction in aviation emissions

This led me to explore how we could reduce global warming caused by aviation. Aviation impacts the climate in four major ways:

1. Carbon dioxide emissions from the jet engines
2. Nitrogen oxide emissions
3. Aerosols (soot, sulphates) emissions
4. Water vapor emissions causing contrails (Stockholm Environment Institute (SEI) and Greenhouse Gas Management Institute (GHGMI), n.d.)

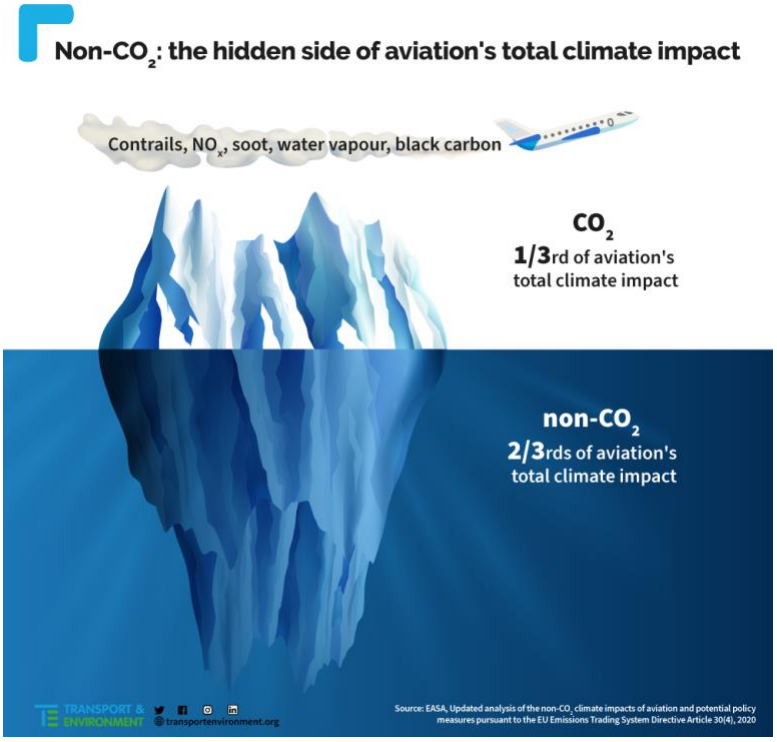


Figure 1: CO2 & non-CO2 emissions of aviation (Transport & Environment 2020).

As governments consider how to craft a comprehensive climate plan for aviation, there are five primary lines of action (World Wildlife Fund 2010) for them to build on:

1. Promoting alternatives to air travel
2. Increasing aircraft fuel efficiency
3. Developing more sustainable aviation fuels, both liquid fuels and electricity
4. Removing carbon from the atmosphere through investment in renewable energy, carbon credits, and nature-based climate solutions
5. Mitigating the effects of non-CO2 exhaust in the atmosphere

2 My design intervention

Of these five lines of action, I felt I could contribute to promoting alternatives to air travel. According to the Air Transport Action Group (ATAG), n.d.), aviation is one of the largest industries in the world and about 87.7 million people are dependent on this industry (Air Transport Action Group (ATAG) 2019). It is also one of the safest ways to travel (ICAO 2019). At this scale, trying to reduce air travel on a universal basis is not a feasible project. I started looking at the various segments of the industry and their impact on emissions.

All aviation is not the same when it comes to emissions (Finlay 2022). Aviation is broadly classifiable into commercial aviation (which includes scheduled passenger flights and cargo flights); general aviation (which includes private air travel and aviation for specialized functions such as medical evacuation, law enforcement and so on), and military aviation. Private aviation – travel in jet aircraft by world leaders and the rich – accounts for more than half of all aviation emissions, making 1% of the population responsible for over 50% of all aviation emissions (Murphy et al. 2021).

Wanting my intervention to address as large a problem space as possible, I focused on addressing three areas:

- **Corporate travel** – I looked at interventions that would keep corporate travel to the minimal, essential levels that businesses see as absolutely necessary by creating viable alternatives for travel.
- **Private aviation** – there is a huge expansion in private aviation. I looked at interventions that create viable alternatives to travel.
- **Conference of the Parties (COP)** – COP is a very visible platform that combines private travel and actions for reducing emissions. I intend to use this as a platform to address policymakers to make a difference.

The obvious viable alternative to air travel is remote conferencing. During the pandemic, video conferencing achieved a level of ubiquity that it never had before, and previously obscure companies providing these services became household names (Tudor 2022). However, travel has started growing again after pandemic restrictions were lifted, and video conferencing growth

is slowing. My user surveys highlight one of the primary reasons being limitations in video conferencing technology, such as “zoom fatigue” – psychological stress caused by looking at close up views of faces of other persons for long times; lack of non-verbal communication cues by body language and posture; and limitations of technology such as audio and video issues. This is corroborated by research (Bennett et al. 2021). My design intervention seeks to address this by:

- Presenting a technology roadmap to create ubiquitous holographic telepresence systems that address current frustrations with video conferencing and create an interoperable standard for future use.
- Create user demand for these technologies by an accessible demonstration (in simulation) of holographic videoconferencing, and
- Lobby world leaders and influential businesspersons attending COP28 with a kit that encourages them to demand these technologies and create policies that limit the growth of private aviation.

2.1 Corporate Travel

When one thinks about reducing aviation emissions, corporate travel is one of the first segments that come to mind. When reviewing travel data, however, I learnt that corporate travel is not a significant contributor to emissions, and in fact, has not recovered as much as other segments after the pandemic (Bouwer, Saxon, and Wittkamp 2021). To confirm this, I interviewed executives from a global financial services company, TerraPay.

2.1.1 About TerraPay

Table 1: Data about TerraPay, from company sources collated by me.

Sector	Financial Services – Real time global payments			
Website	terrapay.com			
Based in	London, UK			
Founded in	2015			
Offices / Employees in	32 countries			
Number of Employees	500+			
Payment services offered in	205 transaction origination countries 108 transaction receiving countries			
Air Travel statistics	**2022**		**2023 (till Feb19 – 50 days)**	
	Domestic:	187 trips	Domestic	24 trips
	International:	864 trips	International	119 trips

I chose to work with TerraPay because with a company this size, I had access to employees in all departments, and travel is the single largest expense head for this company. All employees in TerraPay, from founders to staff, are entitled to the same class of travel – economy for travel and six hours, and business for travel over six hours. This is documented in their internal travel policy which I was allowed to view and confirmed in discussions with their travel team.

I discussed ways to reduce travel with employees from different departments. I learnt that businesses have a natural incentive to reduce travel, as it is a cost. TerraPay, because of its global coverage, has a lot of travel for a company its size, with travel being the single largest expense. Like everyone else, they had completely stopped travel during the pandemic, and resumed in the second quarter of 2022. They have not reached their pre-pandemic levels of travel, and are restricting travel to revenue-generating functions, such as business development, while back-office and support functions such as legal, finance, operations, technology, etc., have largely shifted to virtual meetings.

Figure 2: Workshop with TerraPay employees. Photograph by me, published with permission from people pictured.

Their feedback on virtual meetings corroborated my earlier findings. They were interested in making online meetings more productive, more interactive, and were keen on exploring new technologies in the field.

2.1.2 Initial product development

Based on this feedback, I started to develop a technology reference architecture for my proposed holographic conferencing system, which I refer to as *holoconferencing* in this paper. This is an ongoing area of academic research, an example being the HoloKinect open-source 3D platform (Siemonsma and Bell 2022).

A holographic conferencing system consist of several components, some of which are hardware, and the others software. My design uses existing hardware devices and creates a reference architecture for the software that will integrate these devices and enable my enhancements to remote conferencing. My intent is to start a process, following COP28 in November 2023, of creating an open-source architecture for the system that can be

implemented by any technology company in the space to provide an interoperable, standardized holoconferencing service.
Existing hardware devices I use are:

- Webcams: I specify the use of multiple webcams for capturing multiple angles. I do not define the number of cameras as the system should be able to handle any number of cameras, with more devices producing a higher resolution. The minimum number of cameras required is three, with each providing a 120° angle of view. I also visualized an architecture where everyone would be able to get a high resolution (i.e., with more cameras) mapping of themselves done in specialized studios, and get an *avatar* file, which would be used in holoconferencing systems with fewer cameras, which would provide live video integrated with the avatar. I use the word *avatar* here to mean a realistic, highly detailed, model of the subject that can be used as the representation of the subject in the holoconference without having to continuously transmit the detailed imagery of the subject. This means that fewer cameras can be used, with less data transmission, to map the expressions and postures of the subject in real time on the avatar.
- Motion sensors: I also visualized the usage of integrated motion detectors to position the avatar file to mimic the live position of the participant in the holoconference.
- Viewing device: The basic principle of holoconferencing is capturing the image of the subject from every possible angle of view and then displaying to the viewer the angle of view that corresponds to the viewer's position with respect to the subject. Typically, this has required specialized headsets that monitor the viewer's location, angle of view and posture. However, wearing a headset introduces a barrier to a natural interaction. As I researched options, I was introduced by my instructor, Daniel Gustafsson, to a smartphone miniature hologram projector that is used by enthusiasts online to simulate a hologram using an acetate prism. I explored how this device can be used as an alternative to headsets and have identified specific channels of enquiry for further development on these lines.

Software components required for the service are:

- Firmware for the camera controllers that allows them to position the cameras spatially and interlace their feeds into a seamless feed.
- A file format and application programming interface for the avatars that allow integration of the avatars with camera and motion sensor inputs.
- Plugins for videoconferencing systems that upgrade them to holoconferencing capabilities.

Component	**Purpose**	**Design Feature**	**Possible Vendors/Systems**	**Existing / New development**
Multi-camera system	Record video feed from multiple points of view	Stitched together seamlessly to feed into holographic projector device.	Cameras: Any standard webcam Systems: NVIDIA *Fastvideo SDK*	Technology well-developed. Needs standardisation.

Motion-sensing input devices	Record body position and movement	Cameras to track body movement and map it on to the virtual avatar	Microsoft Kinect	Exists, needs integration
Viewing device	Project AR hologram, such as through a headset	A VR/AR headset to view and interact with the holograms	Microsoft HoloLens II Prism	Exists but not fully functional. Needs research.
VC system with plugins	To enable these devices and formats in video conferencing tools	Connections via the internet allowing long distance communications	Zoom, Microsoft Teams, Google Meet	Possible.
Controller	To integrate camera, motion sensor and viewing device	The mouse and keyboard equivalents of this system	To be designed - from this project	Possible.

2.1.3 Principal collaborator

For validation of these product development ideas, and for further insight into the state of technology in *holoconferencing*, I wanted to identify a collaborator. From my research, I saw that a lot of work in these areas was done by private companies such as Alphabet (formerly Google) and Microsoft.

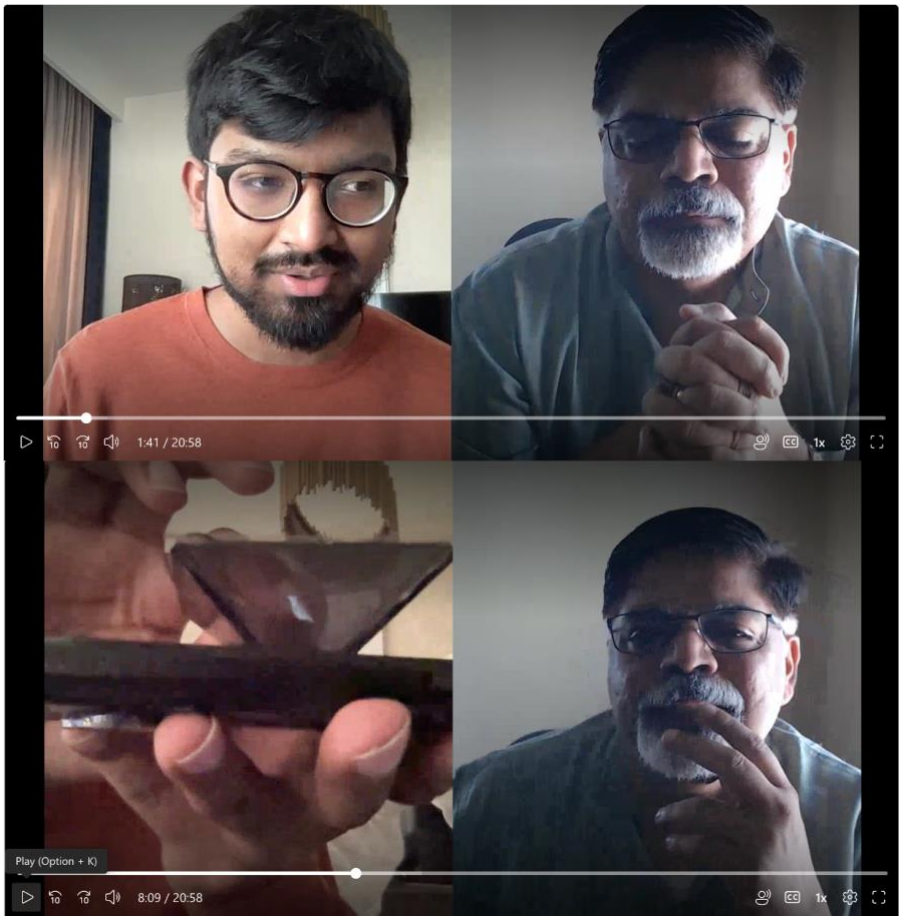


Figure 3: Interview with Sanjay Anand. Screen capture by me.

I was able to reach out to Sanjay Anand, who is the former Managing Director of Google's India Engineering team and the former General Manager of Engineering and Product Management at Microsoft USA and has managed teams working in these areas. He kindly agreed to be my collaborator and oversee the entire project with me.

2.2 Private air travel

2.2.1 Industry dynamics – increased when the world shut down

However, what did not reduce as much as other travel, and in fact increased during the pandemic, and which has since then exponentially increased beyond pre-pandemic levels, is private air travel.

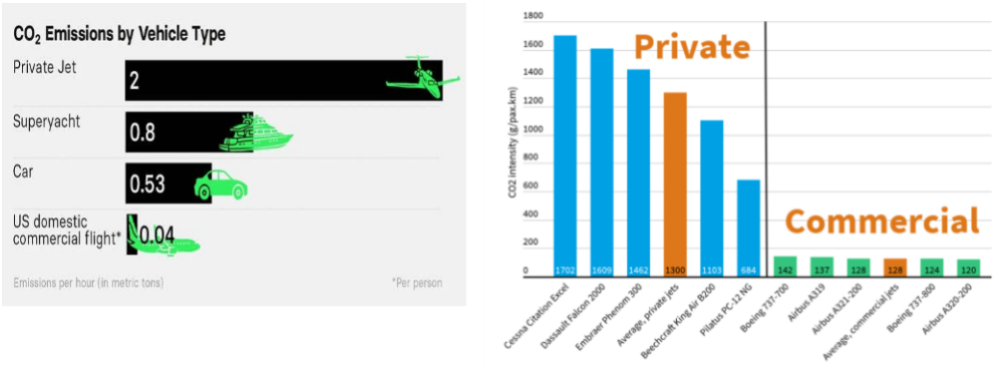


Figure 4: Private jets are highly polluting. Graphs from (Finlay 2022) and (Murphy et al. 2021)

Private jets are highly polluting, 5 to 14 times more than commercial jets. As a percentage of all aviation emissions, private jets contribute more than half (Murphy et al. 2021). Moreover, industry data shows that relatively efficient aircraft such as the Pilatus PC-12 are the exception rather than the norm, and that all the other popular models pollute much more. As a result, private jets are on average 10 times more carbon intensive than commercial flights (Murphy et al. 2021).
Therefore, focusing on reducing corporate travel by substituting in-person meetings with virtual meetings would be akin to green washing. Even a small reduction in private air travel, by convincing private jet travellers to reduce their air travel or switch to commercial aviation, would contribute more to reducing emissions than a larger reduction in corporate travel.

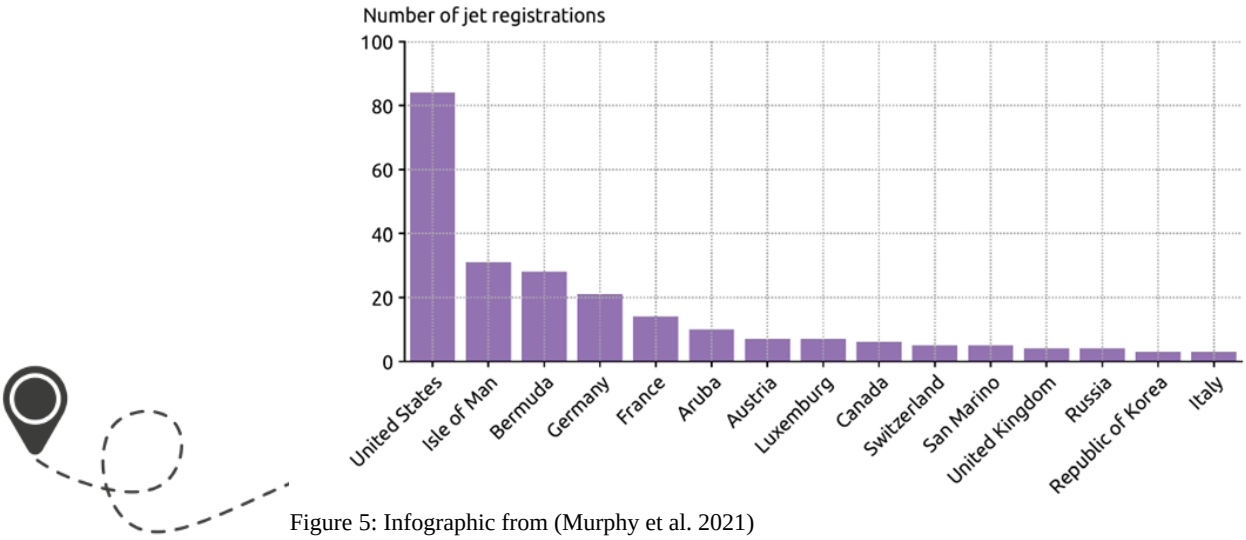


Figure 5: Infographic from (Murphy et al. 2021)

2.2.2 Collaborators

To understand the dynamics of private air travel, and from the perspective of the USA being the largest market for private jet travel, I interviewed two people who use private jets, and who live in the USA.

Figure 6: Ajit Sivadasan on call with me, and with colleagues on private aircraft. Images provided by Mr Sivadasan.

Ajit Sivadasan, President & Global Head of DTC at Lenovo, based in North Carolina, uses private (shared) aircraft chartered by Lenovo for business meetings.

Figure 7: Dr Vidyasagar, with biomedical equipment that cannot be carried on commercial aviation. Images provided by Dr Vidyasagar.

Dr Sadasivan Vidyasagar, MD, PhD, Associate Professor at the University of Florida, is the Founder, and Chairman of the Advisory Board, of Entrinsic Bioscience, which commercializes his patented formulations for gastrointestinal treatments. He uses his company's private aircraft.
Both are individuals who are concerned about global warming and were interested in the idea of better video conferencing technologies as an alternative to travel.

2.2.3 Learnings from collaborators

Many of their reasons to travel in private aviation were similar:

- For private companies and individuals, private aviation is not necessarily expensive. Jet fuel is tax free, and aircraft can be written off as corporate expenses. There are no laws mandating sustainable aviation fuels (SAF) which are more expensive.
- These individuals value the flexibility of private air travel, which can be organised at very short notice, unlike commercial aviation which may involve significant delays depending on the schedules available. Private aircraft can access smaller airports which are closer to their destinations than the large commercial airports.
- They have easier boarding procedures, often being able to drive up right to the aircraft, and thus significantly faster total journeys.
- Interestingly, both mentioned the humiliating and invasive security checks as an added incentive to fly private.
- In Dr Vidyasagar's case, private travel is sometimes unavoidable as he carries materials that are not allowed on commercial airlines, such as biohazardous or radioactive material.

2.2.4 Expansion of private travel industry

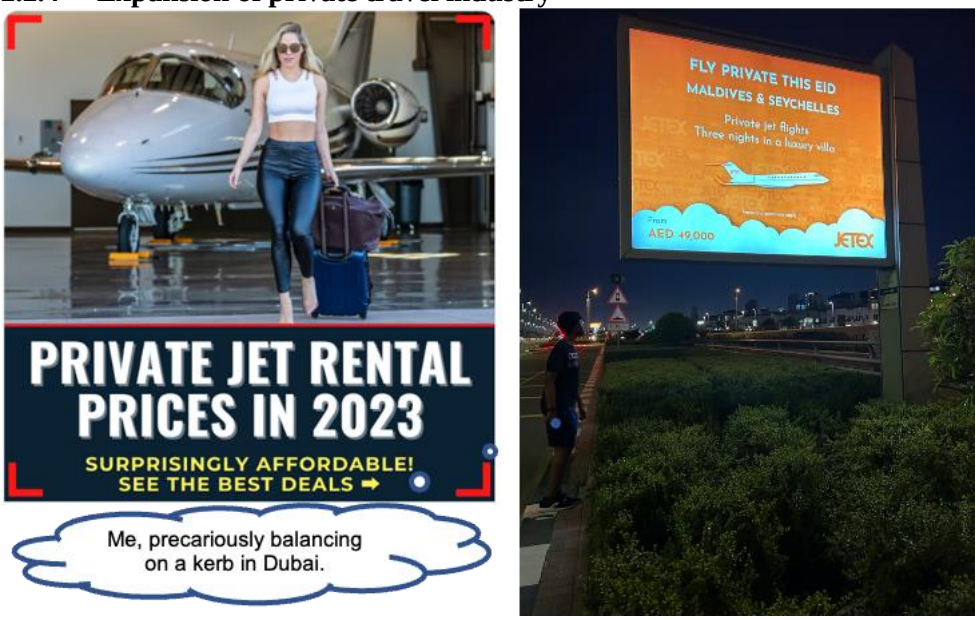
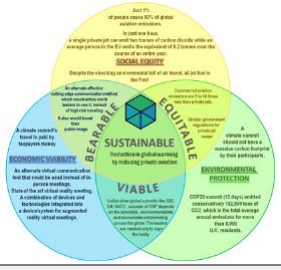


Figure 8: Twitter advertisement (left) and roadside advertisement in Dubai, picture by me.

Increasingly, private aviation operators are targeting a wider market by playing up these concerns and presenting private aviation as commercially attractive to a larger population.



	Commercial Economy Class Traveller	Private Jet Traveller
Social factors	Commercial airline often the only option for economy class travellers: • Meet family / Holiday • Study • Business • Miscellaneous	Private jets are an option for • high schedule flexibility • smoother boarding procedures • faster journeys • no risk of flight disruptions caused by strikes.
	Travel to conferences or on work is not a perquisite, or attractive, but unavoidable and essential to their job	They are mostly chairing the event so their time is valuable
	Air travel unaffordable for economy class travellers	1% of people cause 50% of global aviation emission
	Approachable - since they are approachable, they are green shamed.	Unapproachable so they get away with it.
	The travel they perform may not be optional	The travel they perform is frequently optional.
Ecological factors	Economy class passenger carbon footprint is relatively far less	Private jets are 10 times more carbon intensive than commercial flights
	Commercial airlines are not the main contributors of aviation emissions as generally perceived	Private jets are 5 to 14 times more polluting than commercial planes.
Economical factors	The pandemic has devastated the airline industry - $100+ billion loss	The pandemic boosted the private aviation industry
	Post pandemic, travel still 44 percent less than 2019	Business jet industry is booming, 7600 jet deliveries over the next decade
	SAF costs 2-4 times more than any aviation fuel	Prefer using aviation fuel rather than SAF as jet fuel for international flights are exempted from excise duty
	Commercial planes decreased in number post pandemic	Private jet manufacturing demand increased
	Increase in cost of average flight ticket	Private jets travels are becoming affordable

Table: Summary of my study of commercial and private aviation users from direct interviews, group discussions and surveys, and secondary sources.

2.3 COP28 as a platform to reach policymakers.

To reach the primary consumers of private aviation – global leaders and businesspersons – effectively, I decided to focus on the COP28 conference in Dubai, UAE. COP is the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC) and is the ultimate decision-making body of the Convention. The COPs serve to assess progress in fighting climate change and to negotiate protocols such as the Kyoto Protocol (1992) and the Paris Agreement (2015).

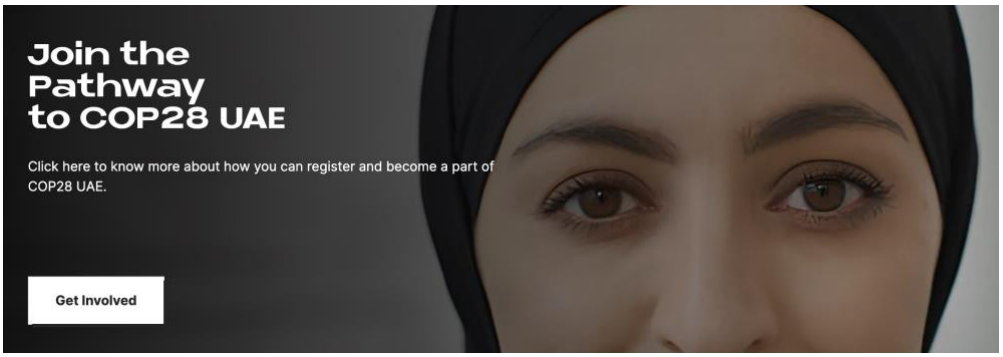


Figure 9: Image from COP28 website (https://www.cop28.com/en/)

As a UN Convention, participants are states that are a party to the convention, and the delegations from the states reflect the policies of their governments in the negotiation. However, because of its importance in the survival of the planet, COP also attracts non-state observer delegations, both non-governmental organizations (NGOs) and corporates, which seek to influence and lobby the participant delegations. World leaders – heads of state – and very influential businessmen also attend the COP conferences and often present keynote addresses.
As a gathering of such leaders, there is a significant amount of private aviation around these conferences, and this has drawn criticism in the past. I thought it would be an ideal occasion to campaign for a reduction in private travel. I wanted to create a campaign object to present at the conference, with sponsorship from participating observers, at their booths in the exhibition area. I call this campaign object the COPCube.

2.3.1 I'm no Greta

I am inspired by Greta Thunberg and her campaign challenging world leaders to take immediate action for climate change mitigation.
Other than both of us being on the autism spectrum, I am no Greta. She is outspoken and fearless and a fantastic orator, while I have a high level of social anxiety and find it difficult to communicate orally.
However, I am a hyper focused problem solver. People who know me are always willing to invest in my projects as I find a way to get results.
I cannot front a campaign like Greta does. I am good at research and understand technology well enough to do the backend work.

So, what's my role in this campaign? The fight against climate change needs both frontline activism and back-office execution. I am comfortable in doing the backend work where I am the most productive.
All my collaborators in my workshops have suggested that using social media like Twitter and Facebook to spread awareness is unavoidable for any campaign. I have created the properties – the website and the social media handles – so that branding is consistent.

2.3.2 Collaborator

For a campaign that promotes a technology that is not yet completely developed, it is important for potential sponsors to know that there are technology leaders who have validated the project and will help ensure that it remains focussed on its core mission.

Figure 10: One of my interviews with Simon Skaria. Screen capture by me.

Figure 11: Simon Skaria. Image used under fair use. © Microsoft, Inc.[1]

The collaborator guiding me in this aspect is Simon Skaria, former Director of Product Engineering - HoloLens and Azure AI at Microsoft. The HoloLens was one of the first commercial product lines using augmented reality and virtual reality to solve business problems.

[1] https://learn.microsoft.com/en-us/shows/mixed-reality/microsoft-mesh-hands-on-demo

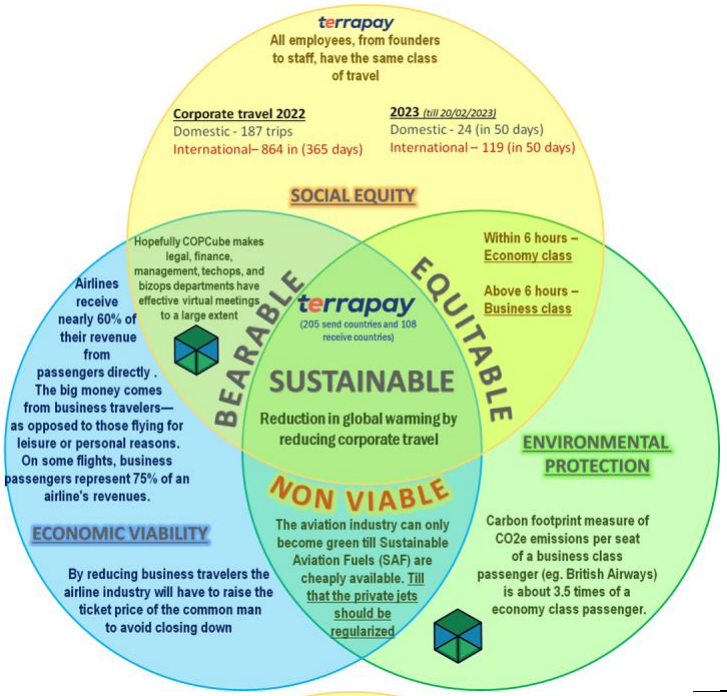
3 The COPCube

3.1 Sustainability

The COPCube is built on top of the 4 sustainability pillars. To be successful and not just green washing; environmental protection, social equity, cultural tolerance, and economic profitability need to coexist without one pre-empting the others. I did an initial evaluation on COPCube sustainability targets, and I found:

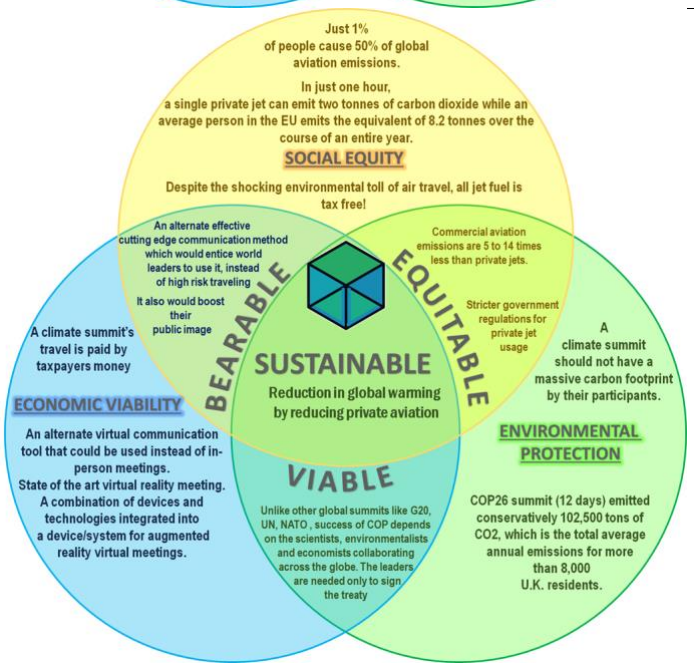
Corporate Travel:

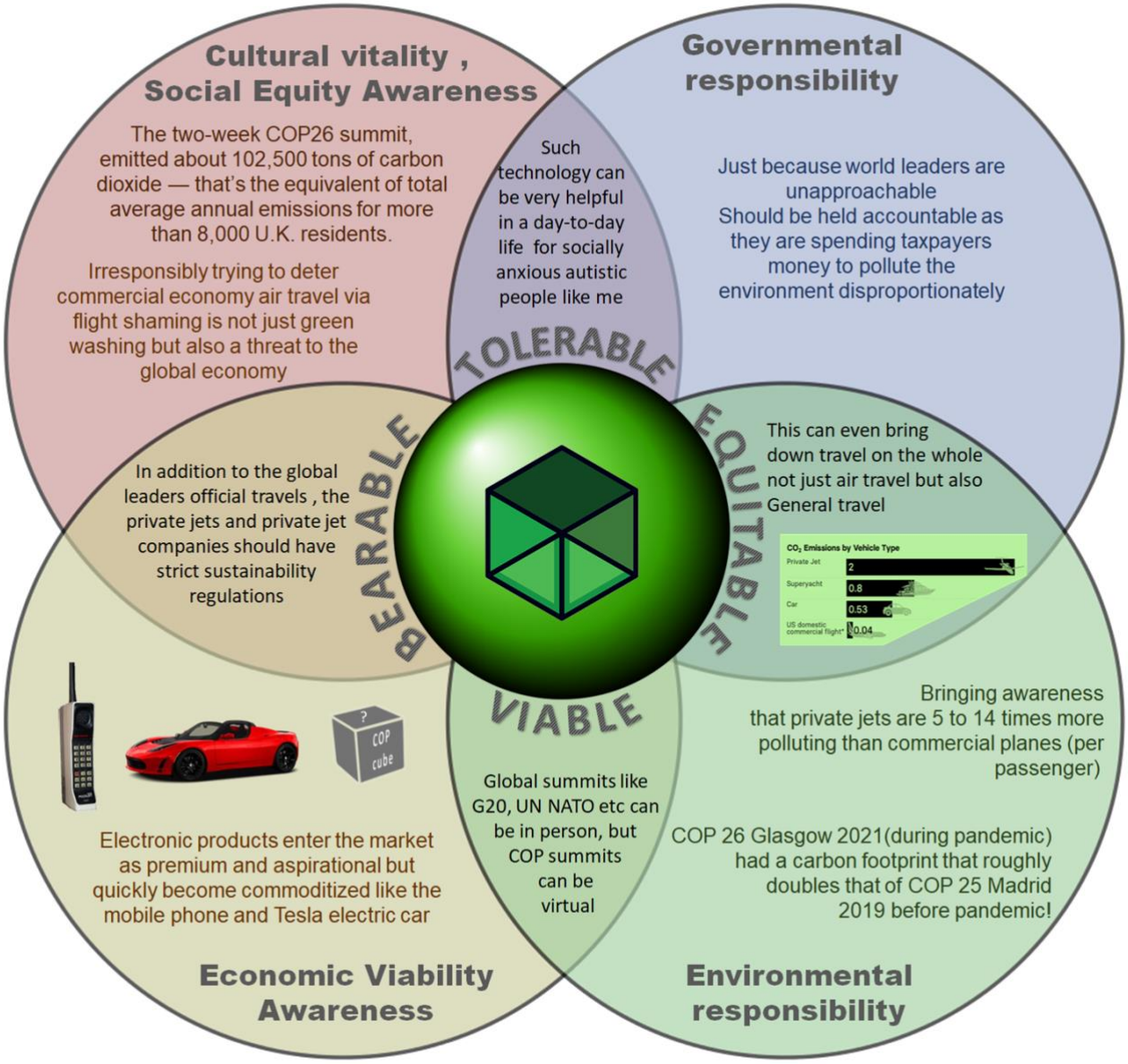
- Corporates have reduced travel post pandemic.
- This reflects in aviation reports – business travel is 44% below 2019 and commercial airlines have cut routes.
- Emissions from aviation is increasing so commercial airlines are lessor contributors.
- Reducing commercial aviation will not affect emissions significantly.
- What, then, contributes to increasing emissions?
- COPCube will promote holoconferencing, which will help reduce growth in business travel.



Private Aviation:

- I found that a reduction in private aviation will bring down aviation emissions.
- To make this happen, governance – the fourth sustainability sphere – needs to be brought in.





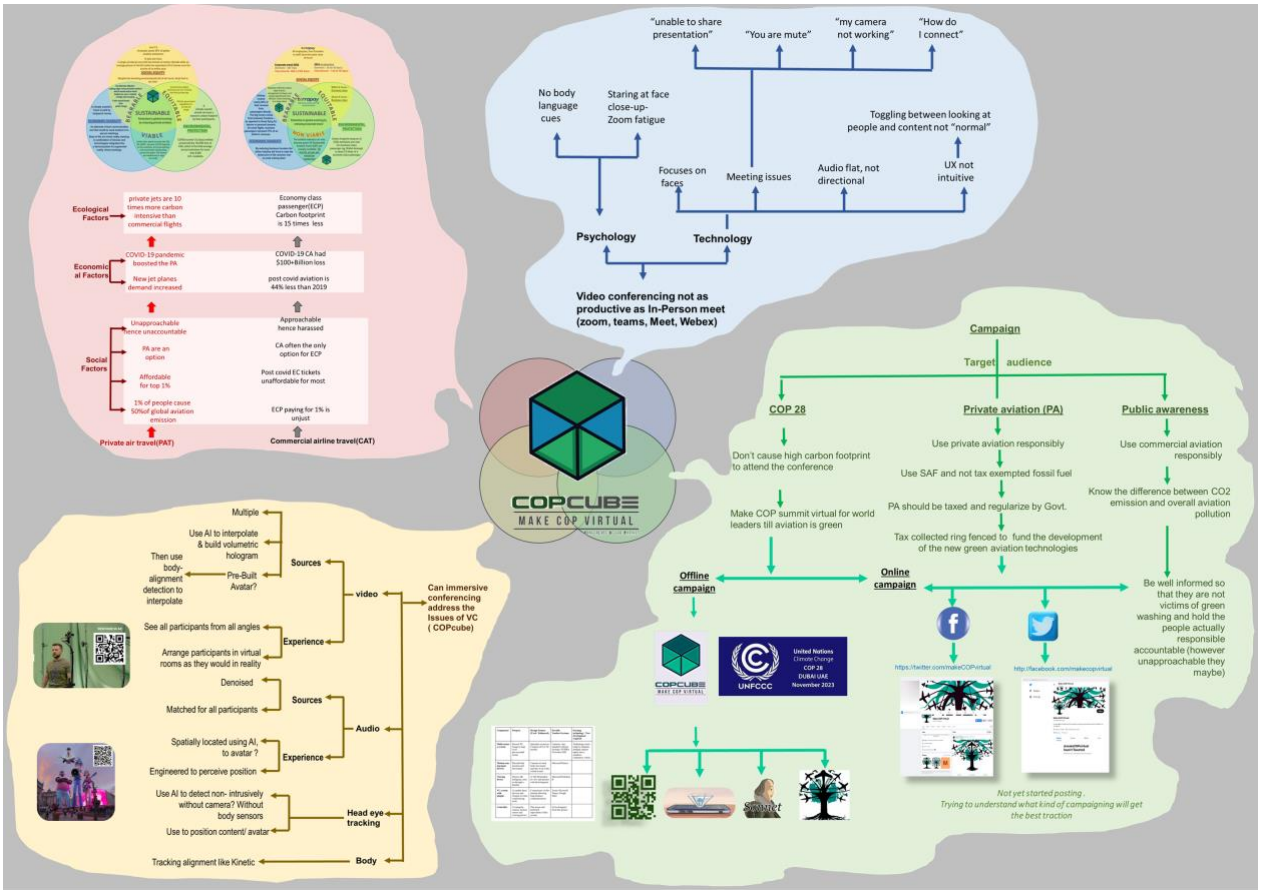
I looked at four spheres of sustainability. In addition to the social, economic, and environmental spheres, which constitute the triple bottom line on sustainability development, I looked at the governmental responsibility as the fourth sustainability sphere. It is also regarded as one of four pillars of sustainability, as it is a determining factor for social, economic, and environmental improvement.

Figure 12: (Shen and Pena-Mora 2018)

3.1.1 Mind Map

As per Tony Buzan's guidelines for the best visual presentation of complex problems, I have started my map in the middle, and divided it into four clouds that:

- Identify the target group keeping in mind social equity and proportionality of impact.
- Ensure the intervention has the cultural awareness to be usable by diverse groups regardless of barriers of language, social hierarchies, power structures, neurodiversity, and personal identity.
- Uses technology that will become ubiquitous and accessible if successful, and
- Identifies the campaign elements required to promote this concept, get mindshare and funding to build the initial open source community and proof of concept, and launch the service.



3.1.2 Paradigm and Nest diagram of the COPCube

In my paradigm and nest diagramming process, I considered the micro field – the impact technology has on personal communication, how the rise of tools like Zoom during the pandemic created new vocabulary and norms for communication, but which also exposed their lack of support for diversity. Volumetric holographic projections, which President Zelensky of Ukraine used to great impact, may help overcome these barriers. Meanwhile, President Biden arrived at the G20 and COP26 summits in 5 jets and 85 cars, which sparked outrage. In the macro field, COP26, happening at the height of the pandemic, with limited attendees, still generated an enormous carbon footprint.

The band Gorillaz staged acclaimed virtual holographic concerts in New York and London, proving that holographic projection could generate a similar energy as live concerts. A concert is an activity that feeds off the energy between the artists and the audience, and the fact that a concert could be staged holographically in relation to specific geographical locations, is in my view a significant validation of the ability of holographic projection to connect people.

These events used new software platforms such as Google's ARCore, which may help bridge the gap between physical and virtual reality.

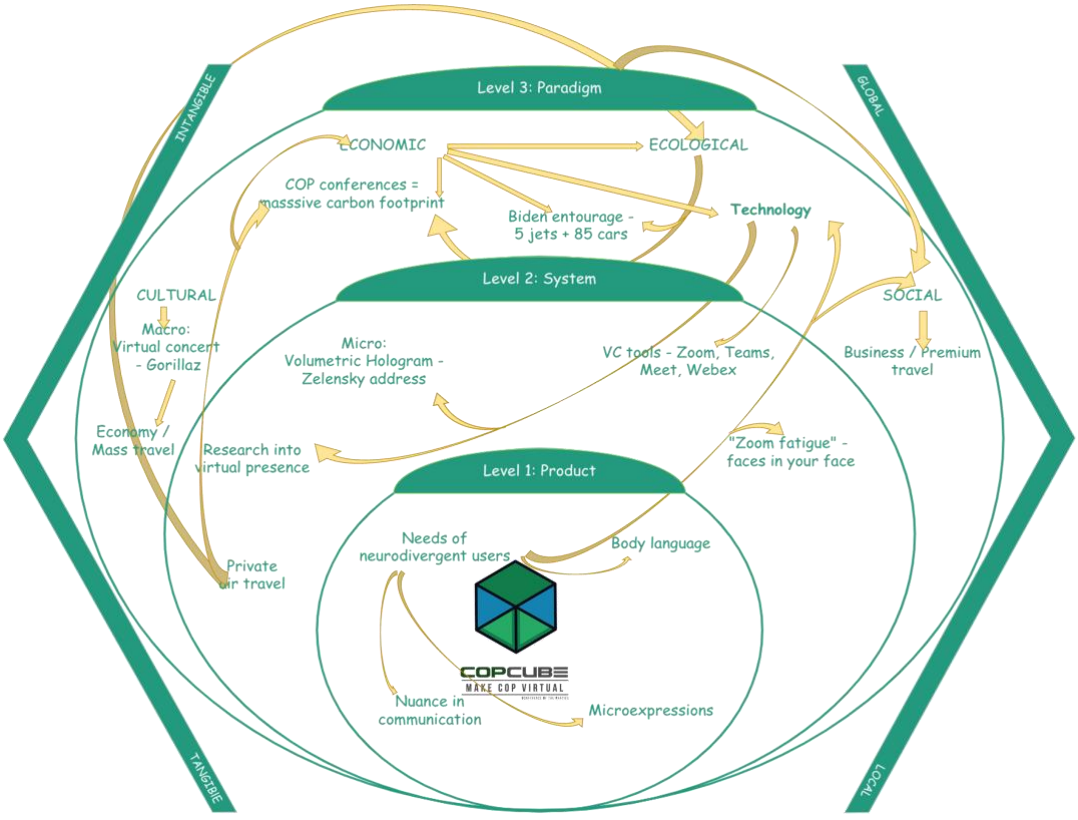


Figure 13: Gorillaz concert (left) and President Zelensky address (right). Images used under fair use from a press release at oceanoutdoor.com[2] and from a BTS video at youtube.com[3].

3.2 The COPCube

In this section I discuss the ideation and development of the COPCube.

3.2.1 Objectives

The objectives of the COPCube are:

- Create user demand for holoconferencing technologies by an accessible demonstration (in simulation) of holographic videoconferencing, and
- Lobby world leaders and influential businesspersons attending COP28 with a kit that encourages them to demand these technologies and create policies that limit the growth of private aviation.

3.2.2 Sponsorship

The COPCube is the kit that will promote use of *holoconferencing* to world leaders and influential businesspersons at COP28. To ensure that it gets into their hands, I needed to:

- Create a kit that would intrigue a sponsor. I will need a sponsor who would have *access as an observer organisation at COP28* and who would *fund the production of my kit* in sufficient quantities to present to decision makers at COP28.
- When I have a sponsor, I need to build social media buzz for the campaign to ensure that the kit generates sufficient curiosity to generate engagement, and to follow up with action plans for the leaders we manage to reach. This will be done in coordination with the social media organisation of the sponsor.
- Once we achieve this traction, I need to generate funding for an open-source organisation that will bring together technology specialists who can detail the technical architecture and start working on software components and specifications.

[2] https://oceanoutdoor.com/ocean-news/news/times-square-and-piccadilly-lights-headline-with-gorillaz-for-ground-breaking-ooh-performances/
[3] https://www.youtube.com/watch?v=zckV1bYrGdQ

3.2.3 Contents

The COPCube needs to do three things:

- Tell the story – in brief.
- Have a call to action – a QR code that leads to a demonstration video of the *holoconferencing* video that can be viewed on the included prism on a smartphone.
- After viewing the video, take the viewer to the main website for more information and action.

3.2.4 Visual language

I started off by finding an appropriate graphics style and colour palette.

3.2.4.1 Logo design

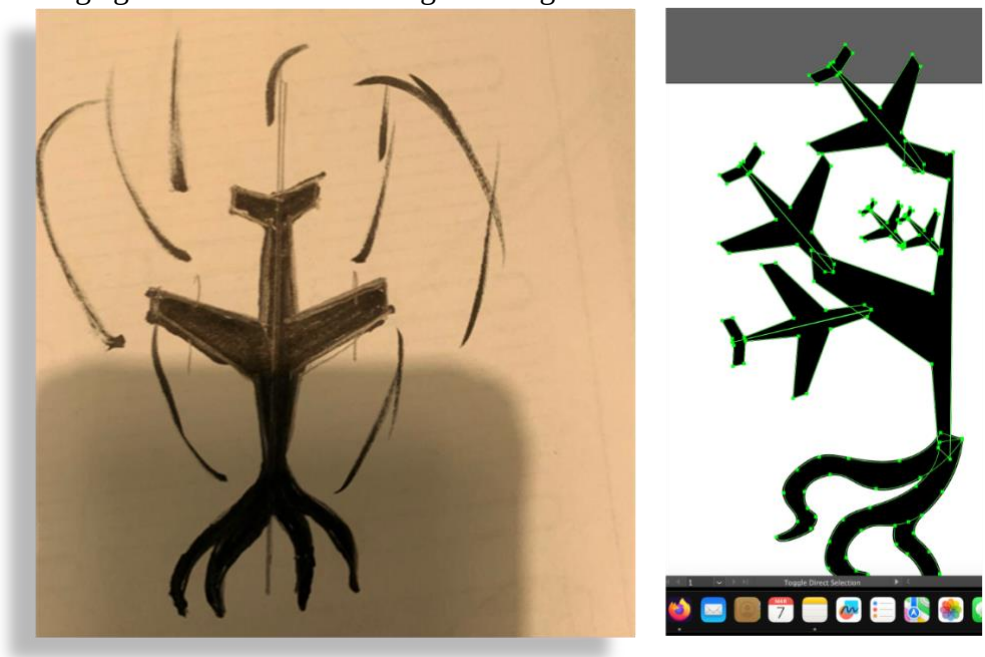
I worked on the design of the logo over the course of the project. Over time, after trying out tests with the shape of the cube and different font styles, I picked a treatment where the letters evoke the shape of the cube, and the letter "E" recalls the menu dropdown icon on websites. In this I was guided by my branding and communication collaborator, Mr Jovan John, a communications professional in the UAE.

Figure 14: Logo development, collage of my work.

3.2.4.2 Styling

I wanted to use the tree as it is a familiar motif for conservation. Combining planes with trees was a challenge. The idea came through a case of word association when I was watching a video about famous fictional characters and their inspirations, and two characters, Xerneas, a stag that was also a tree inspired by the seasonal stags of Yggdrasil, and Dragapult, a Pokémon that was a cross between a dragon and a stealth bomber, lead to me thinking of airplanes and trees, resulting in an idea combining the two together as a logo. I took inspiration from the gothic shadow puppet style used in "The Tale Of The Three Brothers" in the film adaptation of "Harry Potter and the Deathly Hallows". Shadow puppetry also passes on information such as cultural history, social beliefs, oral traditions, and local customs. It spreads

knowledge, promotes cultural values, and entertains the community, especially the youth.
I explored variations on this style, including uploading my sketches to the AI image generator DALL-E and generating variations on them. I wanted to use



DALL-E to see if it could be used as a creative tool, as I had been reading a lot of criticism from creators about its use of unaccredited source material.

Figure 15: My initial sketches exploring the style.

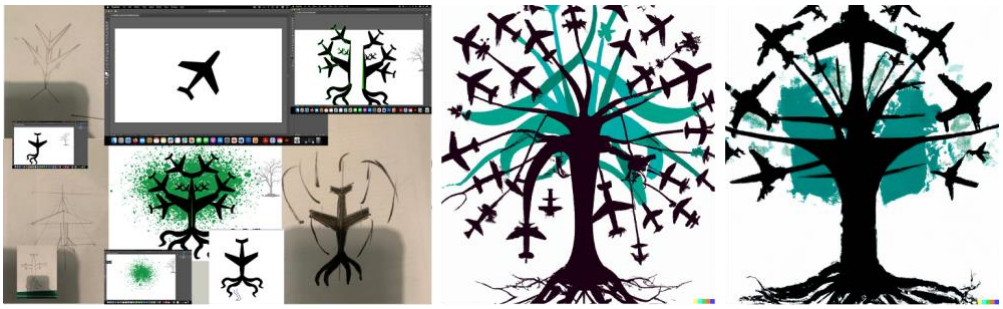


Figure 16: My explorations (left) and DALL-E variations from my sketches.

I workshopped these images with my peers and the general feedback I received was that the imagery was too “dark”, that it was static, and very two

dimensional. Also, such a serious message could benefit from a more light-hearted visual treatment.
Based on this feedback, I reworked the artwork to include elements from one of my interests – origami. I combined the imagery of the tree and a paper plane to create a sensation of movement.

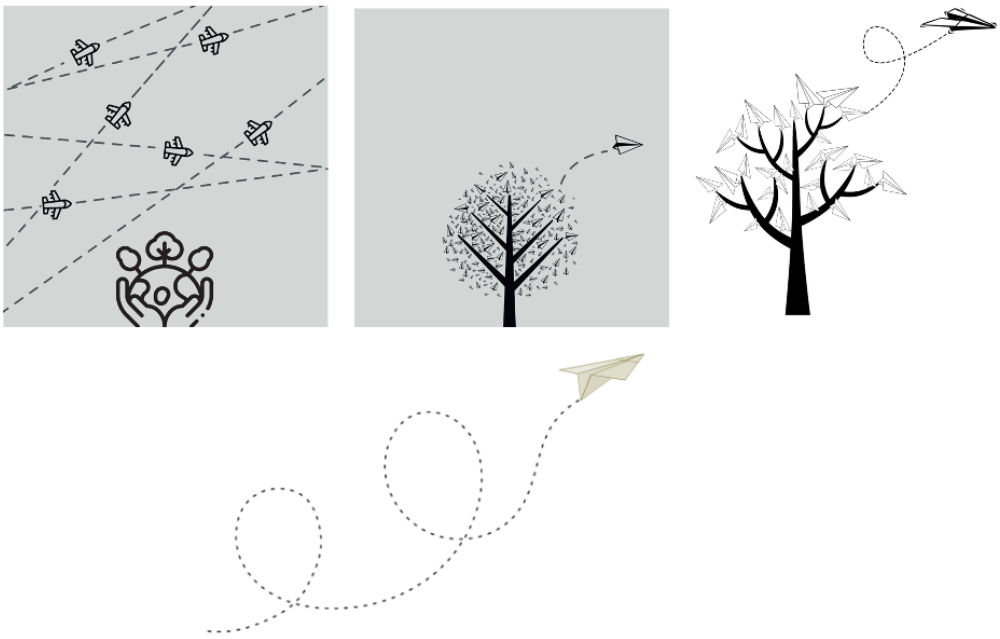


Figure 17: Design development, with changes to style and adding movement. Collage of my work.

At this point, I decided to go with the image of a paper plane.

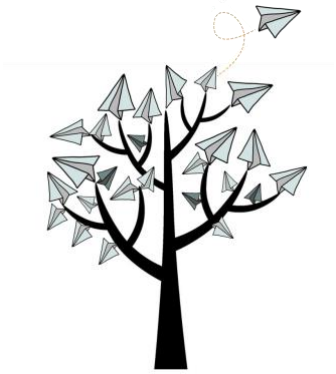


Figure 18: Final imagery. Image by me.

3.2.4.3 Colour palette

Globally relatable colours are black for pollution and green for sustainability. This also matches the colour scheme of heart monitors, giving a sense of urgency.

But I am trying out different shades of green with a mix of aviation blue to give a blend of aviation with keeping the earth green. In peer workshops, everyone had positive feedback about this palette.

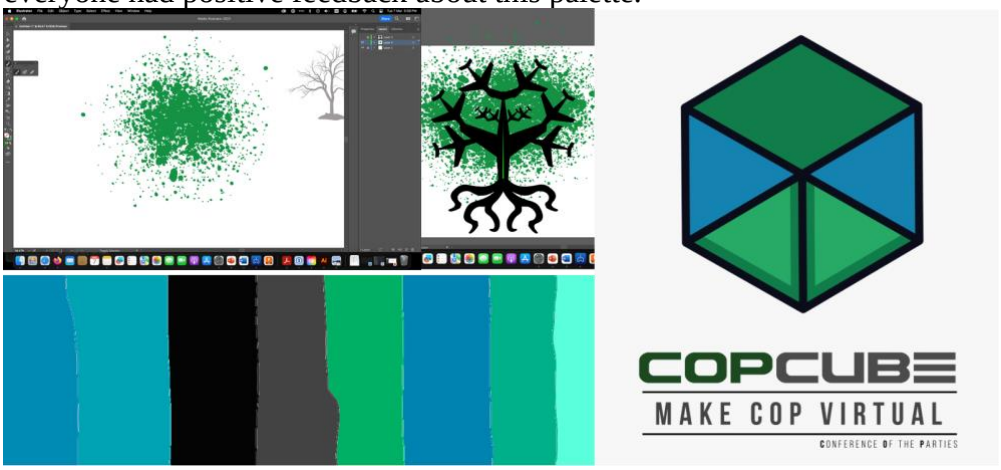


Figure 19: Colour palette development. Collage of my work.

3.2.5 Material

I started working with paper as one of my personal surpluses is origami. Paper is recyclable, as well.

Figure 20: My paper COPCube prototype. Collage of pictures by me.

By this point, I had decided to use the prism as a demonstration for the hologram projector which was in acrylic. I decided to look at materials other than paper, as the acrylic prism did not hold up well inside the paper box. I then tried using acrylic for the COPCube, due to its strength, also because the prism was acrylic too.

Figure 21: My prototype of the acrylic COPCube.

This met with all my requirements, other than it not being a sustainable material. I had considered wood, but it felt anachronistic to use wood as a material for a high technology product showcase.
Finally, I found a source for aluminium (recycled from aircraft, and I found that all aluminium is continuously recyclable) and an agency that could mass produce it for me for COP28. The first prototype was in pure aluminium.

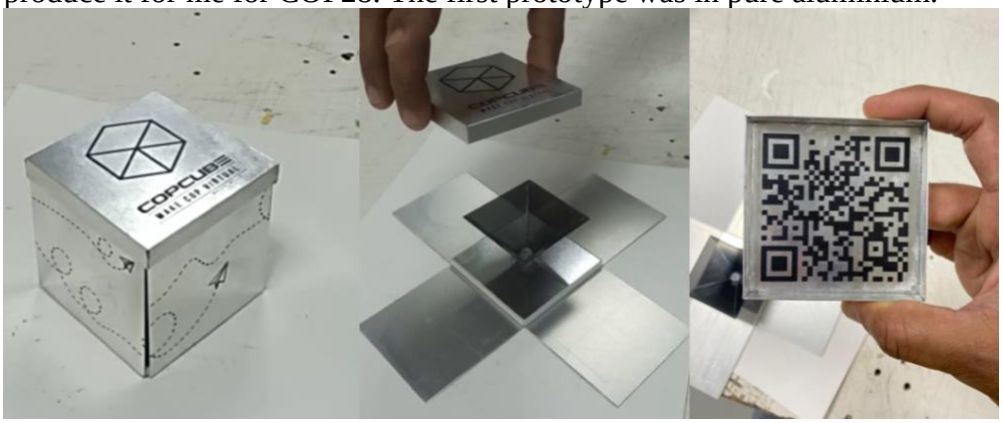


Figure 22: Collage of pure aluminium prototype. Images by me.

With this prototype, I discovered that the thickness of the metal meant that the corners did not fit flush together, and the metal bent easily. The vendor then proposed using an aluminium composite panel (ACP), which is also recyclable as the composite is combustible.

Figure 23: Final prototype COPCube in ACP. Pictures by me.

3.3 The prism

The COPCube contains a pyramidal prism that can be placed over a smartphone to display a specially formatted video input that can be viewed from all four sides as a simple hologram. This came from an idea suggested by my instructor Daniel Gustafsson. I started to design the prism using acetate sheets that were easily available.

3.3.1 The process

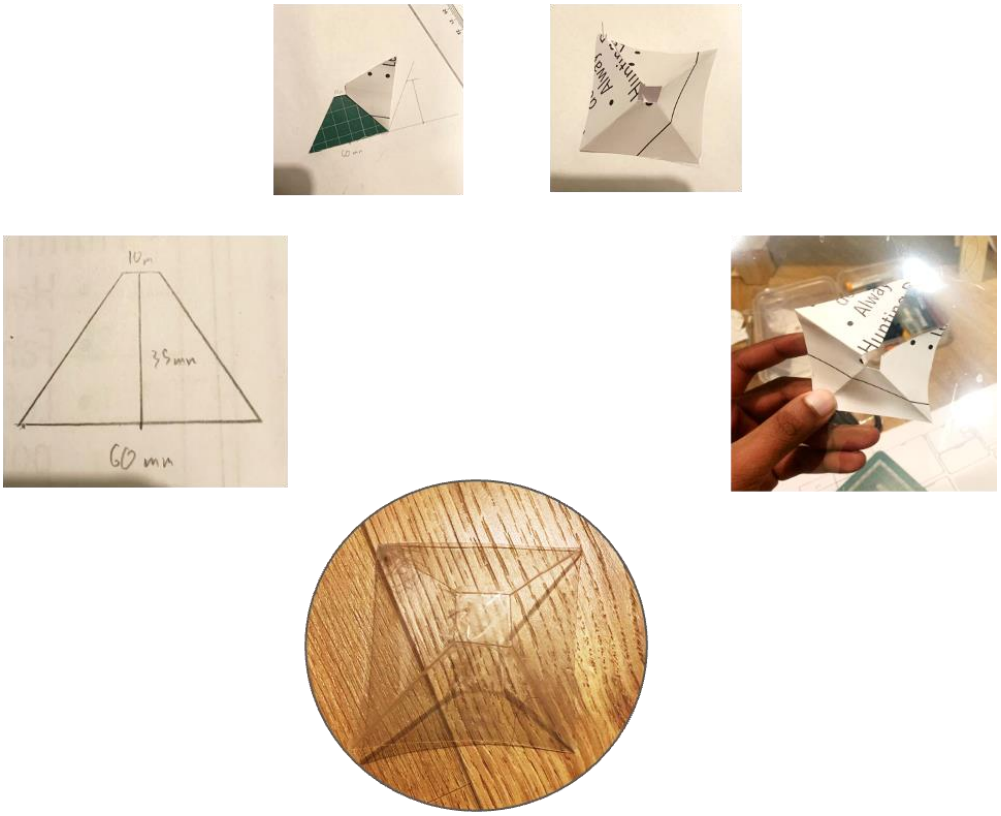


Figure 24: Building the hologram pyramid

Legend, clockwise from centre-left:

- 1:1 scale template on paper.
- Translucent acetate sheets, difficult to mark without spoiling, so stuck on to the paper template with weak glue.
- And complete the pyramid.
- Cut the acetate and remove the paper for a neat pyramid.
- The final pyramid. Works best in a darkened room with a bright smartphone for brilliant 360-degree hologram.

3.3.2 Size

Figure 25: Size of the pyramid

As smart phones function as projectors for the prism hologram, I made the prism 10mm x 60mm x 35mm in proportion to the average width of a phone screen (90mm) in mind to be compatible with all brands of smartphone. It should also be small, durable, and portable.

3.3.3 Operation

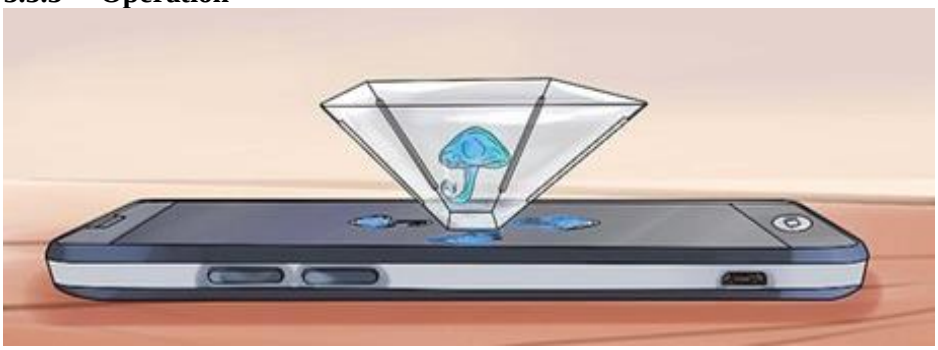


Figure 26: Operating the pyramid

Scanning the QR code in the COPCube leads to a video. Playing the video, placing the pyramid on its tip in the middle of the screen, gets a clear 360-degree image. This works best with dark rooms and bright screens. The four planes project an image of the four angles of the object.

3.3.4 Improvements

Improvements that I am working on are:

- Final durable high-quality material with a tinted film for easier visibility in in rooms that are not completely dark.
- Stability when placed on the mobile phone. I am looking at suction cups which will fit my pyramids.
- Design that minimizes the ring grain effect and vibration.

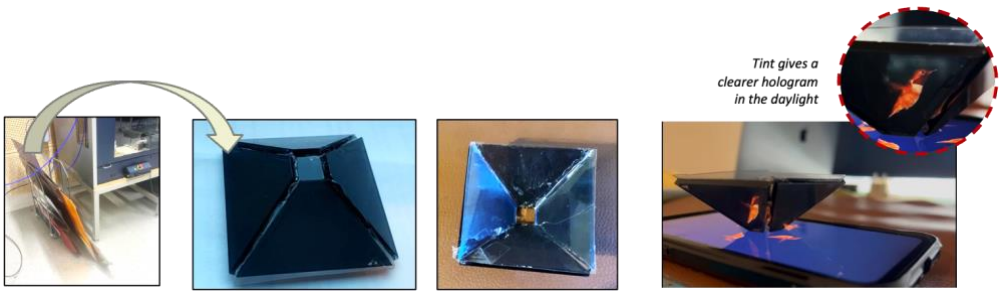


Figure 27: Improvements

I was looking for thicker material, In the 3D workshop surplus bin I found some grey tinted acrylic scrap. Acrylic being thicker and heavier, does not blow away like acetate. It was difficult to cut the trapezoids. The standard glues could not hold it together. I finally used hot glue gun to make the 3D pyramid. The pyramid did not look neatly finished but the hologram was cleaner and crisper so I will be using this in my final product.

3.3.5 Peer reviews

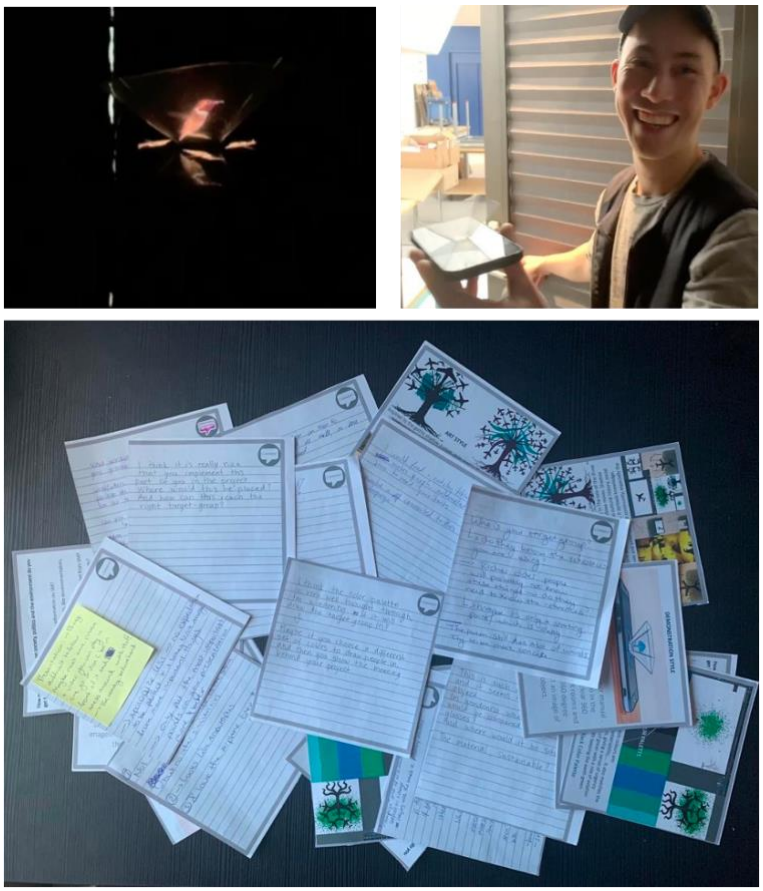


Figure 28: Demo, and user feedback

Initial feedback was that viewers liked it, and were surprised at how simple it was, as holograms are commonly associated with being futuristic and high tech. The drawbacks were that the prism was quite delicate, easy to lose and had no way of staying on the screen without tape.

3.3.6 Video sources

A prism projector that requires four video feeds placed in a particular way is not particularly good for anything other than gimmicks. To make it usable for holoconferencing, the video should be generated on the fly so that any conferencing system can use them until such time as my technology architecture is implemented and *holoconferencing* is available without a prism projector.
To demonstrate this capability, I worked with Open Broadcast Studio (OBS) an open-source software. Using this, I can take a webcam feed and output it properly formatted for the prism. This means that live holographic projection is now possible using a prism projector. The prism can be scaled up as long as a suitable video source is available. I am building a larger prism that can be used on a television monitor to demonstrate this.
Additionally, the demonstration videos today show the same image on all four sides. I see no reason why with four video cameras connected to a laptop running OBS, the hologram cannot be a fully surround hologram where one can view all sides of the projected image. I am trying to get more video cameras to test this.

3.3.7 Further development

The prism has potential for further development as a holographic projector. I am continuing research, and I hope to inspire others on the following lines:

- A four-sided prism can only project four viewpoints. Could more realistic holograms be achieved with an eight-sided prism, perhaps? This would need complex input video formatting.
- Taking this further, would a conical prism present a seamless 30-degree view? This would require the creating of a complex video formatting algorithm that can take 360° video and format it in a circular output.

3.4 Campaign and social media

The COPCube project needs online and social media support in order to achieve its goals.

3.4.1 Website and social media

I do not have the skills to create and maintain a sustained social media campaign. After discussion with my collaborators, I have concluded that my sponsors would be best placed to create and manage these properties with their professional communications teams.
I have registered the domain makecopvirtual.com and blocked the handles on Facebook and Twitter.

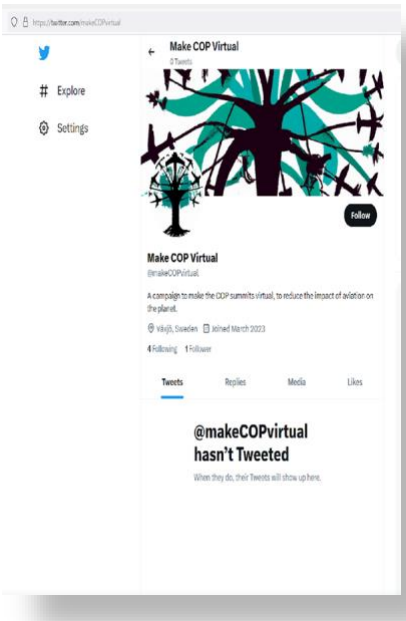


Figure 29: Twitter @makeCOPvirtual

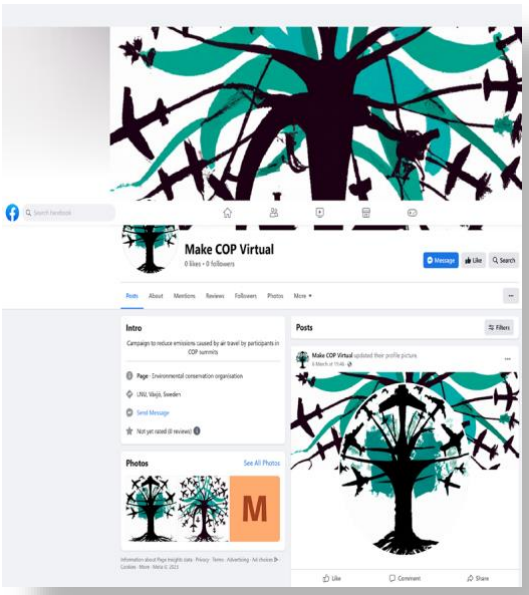


Figure 30: http://facebook.com/makecopvirtual

4 Further development

If I am able to find sponsor interest in developing the open-source technology architecture for this product, there are a few separate projects that can be initiated:

- The controller software and hardware specification. This is a hardware device that accepts multiple camera inputs and stitches the incoming video into a spatially aware seamless 360° video. This output needs to have inline spatial encoding to signal correct alignment to the projector devices. The controller hardware and software also need to be available in a range of configurations, from simple 3 camera setups for home or office use, to dozens of cameras for *avatar* capture.
- The definition of *avatar* files, as an interoperable file format.
- Application Programming Interfaces (APIs) to enable interoperability between various proprietary systems using this technology.
- Hologram projector technologies. Head-mounted systems provide the best immersive experience today, but the headset interferes with the naturalness of the experience. Prism projectors are limited in functionality and do not scale. This is an area where substantial research is needed, with support for existing technologies today, and ongoing R&D with emerging possibilities.

5 Conclusion

The challenge of reducing private aviation is an ongoing one, with climate summits other than COP facing the same issue of a high number of attendees travelling by private aircraft.
We need to find solutions to address this urgently, whether it be mandated Sustainable Aviation Fuels, higher taxes on private aviation, restriction on private aviation airspace usage or by alternative methods such as *holoconferencing*.
In my project, I seek to promote alternatives to private aviation by:

- Creating an open-source technology roadmap for ubiquitous holographic telepresence systems, by collaborating with researchers, professionals and companies working in related areas.
- Create user demand for these technologies by an accessible demonstration (in simulation) of holographic videoconferencing, and
- Lobby world leaders and influential businesspersons attending COP28 with a kit that encourages them to demand these technologies and create policies that limit the growth of private aviation.

Holographic technologies are in active development. Just as I conclude this paper, news reports suggest that Apple is about to launch its head-mounted virtual reality headset soon. The way we communicate is clearly about to change.

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