DELFT/CERN IdeaSquare's Summer School

PROGRESS REPORT

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1. Team background

Karla Rojas

I am a master's student in Physics and Astronomy, pursuing the Astronomy & Astrophysics track at the University of Amsterdam and Vrije Universiteit (joint degree). Before that, I followed a bachelor's in Liberal Arts and Sciences with a major in Physics and a minor in Art History at Amsterdam University College, an honors interdisciplinary program. Hence, my area of expertise is Physics and Astronomy. However, I also have another bachelor's in Marketing & Communications from the Monterrey Institute of Technology and Higher Education in Mexico, which gives me valuable business insights. I'm originally from Mexico, but currently, I study in the Netherlands. Professionally, I'm interested in projects that allow me to deepen my knowledge in R&D and interdisciplinarity, such as CERN's IdeaSquare summer school.

Jozef Šaranko

I am a master's student in Economics but also have some academic background in Business and Law. It was always enjoyable for me to go the extra mile with honors programs, teaching assistant positions, or student associations. Professionally, I mostly come from a consulting background (McKinsey, Accenture, or Mastercard), but my current tenure at Google is an exception from consulting.

Alexandru Dumitriu

I am a bachelor's student in Computer Science and Engineering, one of the most popular research areas used by every other domain nowadays. I plan on following the branch related to data management and decision-making. So, I get to fully understand the data and the most optimized manner to store and use it. I am from Romania and am currently located in Milan, where I follow an excellent exchange program provided by TU Delft. Also, I enjoy sports, gaming, and prototyping.

Pleuntje Brons

I am a bachelor's student in Nanobiology, a relatively new research area that, in an interdisciplinary way, combines physics and biology, also using mathematics, to understand, among other things, the complexity of living systems. So, I get to dive into multiple fields and applications. I am originally from Rotterdam and am currently located in Delft, where I get to enjoy student life through several associations. Furthermore, I enjoy sports and art.

2. Innovation Process

The innovation process defines the management of an idea from the strategic search to the successful market launch and its transfer to the operative management [1]. The process is the heart of innovation management. It makes sense to understand innovation goals as superordinate components of an innovation process and to align the strategy with the objectives [1]. The decision for certain innovation milestones marks the starting point of the innovation process and defines the process steps derived from it.

Therefore, our team, *The Fast and The Curious*, followed a lengthy yet fruitful process to come up with what turned out to be the winning idea of CERN Summer School in the end. During this project, the team accomplished the following milestones:

1. Discovering the "We know how to"
2. The Domain Wheel
3. Narrowing down the Domain List
4. Adjusting the "We know how to" for specific Domains
5. Application Ideation
6. Ripple Effect Consideration & Creation of Concrete Concepts
7. Prototyping

2.1 Discovering the "We know how to"

The first and most crucial step to getting to any successful idea is understanding where you start from, begin the thinking process, and form opinions. In our case, this meant understanding what makes our technology, H3D-VISIOnAiR, unique. Therefore, we followed specific steps to discover what our technology is best at and whether it can improve the activities happening in many domains.

First, we came up with multiple thoughts and possible features of the technology, which were all related to improving human vision in one way or another. Afterward, we started researching and understanding the concepts behind the technology by reading papers about it and getting answers to many essential questions from the researcher herself. Now, knowing more about the working principles and design, we were more aware of the spread of possibilities of the technology and also its limitations.

So before getting to a final "We know how to" statement, we thought of some physical remarks, such as the weight of the glasses and the limitations of the present AI. We then considered the massive potential this technology has in many other domains.

Therefore, we came up with our final "We know how to": "We know how to enhance vision beyond normal eyesight via AR technology." This is not very specific as we were made aware from the beginning of the vast world-changing potential this technology has in multiple fields.

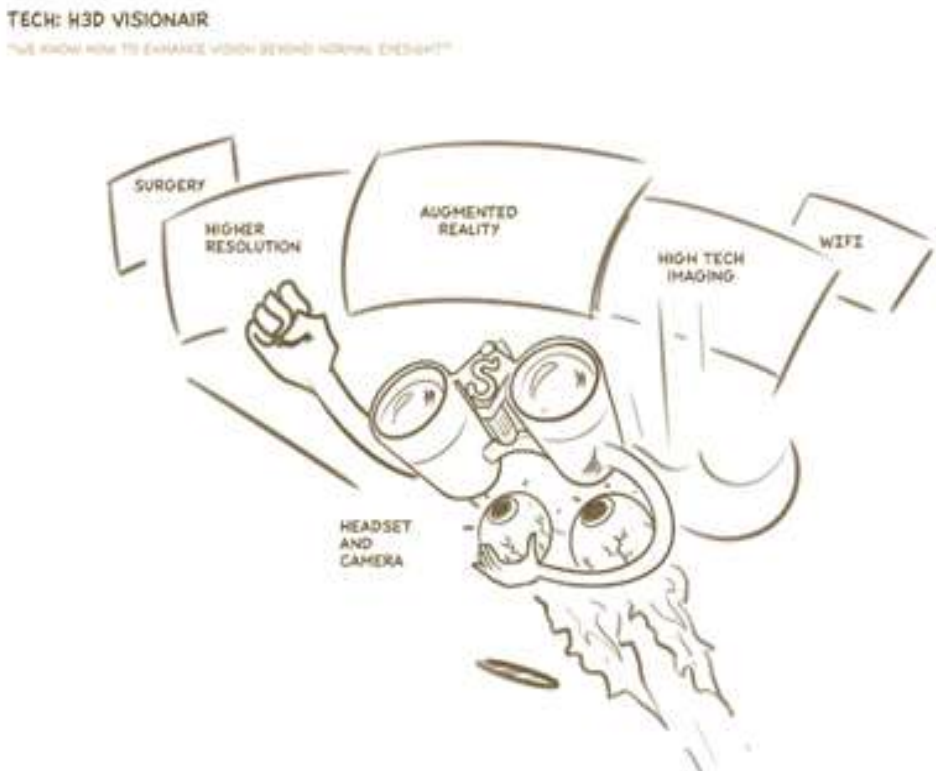

FIGURE 1. AN ILLUSTRATION OF OUR TECHNOLOGY, H3D-VISIONAIR, HIGHLIGHTING ITS UNIQUE FEATURES. THIS NOT YET APPLIED TO ANY BUSINESS CASE IN SPECIFIC.

2.2 THE DOMAIN WHEEL

The next significant phase was developing a domain wheel following a strict set of steps. First, we came up with 100 domains where we could see our technology make a difference, which was surprisingly enjoyable due to H3D-VISIOnAiR's versatility. As expected, the range of the domains was quite broad, with plausible and some other crazy ideas. Out of those, we selected the 30 most exciting ones and distributed 12 promising sub-domains within the team to work on. We extensively researched these domains and came up with thoughts related to the interaction in the field, the stakeholders, and the pains. Ultimately, we fortified our knowledge by contacting multiple persons with expertise in those domains and came to this final form of the wheel, which helped us massively further down the road. After this, we had more information on the practicalities and the performances in the domains, giving us more insight into the current problems and how our technology could be a solution. We also encountered occasions when our idea was discarded due to impossibility or redundancy.

This experience represented only one of the first steps in our selection process for a winning idea. Still, it gave us a taste of what was about to come and the hard decisions that awaited us by researching many fields to conclude that they were not the best application of our technology.

FIGURE 2. OUR DOMAIN WHEEL, WE CAME UP WITH +100 DOMAINS AND APPLICATIONS FOR H3D-VISIONAIR. THE DOMAINS RANGED FROM AGRICULTURE TO FORENSICS.

2.3 Narrowing down the Domain List

Having so many promising domains meant it was quite a challenge to find the best one, so we started narrowing down the list with different techniques taught to us by the Summer School staff.

First, we used a technique based on our imagination. During a creative exercise, we drew the background of a very well-known James Bond movie and tried to find domains out of our list that would apply to the various elements of the drawing. Some of the domains noticed were: Automotive, Military, and Drinks & Alcohol. Our technology could have been used in such fields, which was a surprise to us because, before this, we didn't even consider that possibility. This helped us to see some of the contenders for the winning idea. Still, more importantly, it helped us develop our ideation process and improve the selection procedures, which were followed in multiple ways.

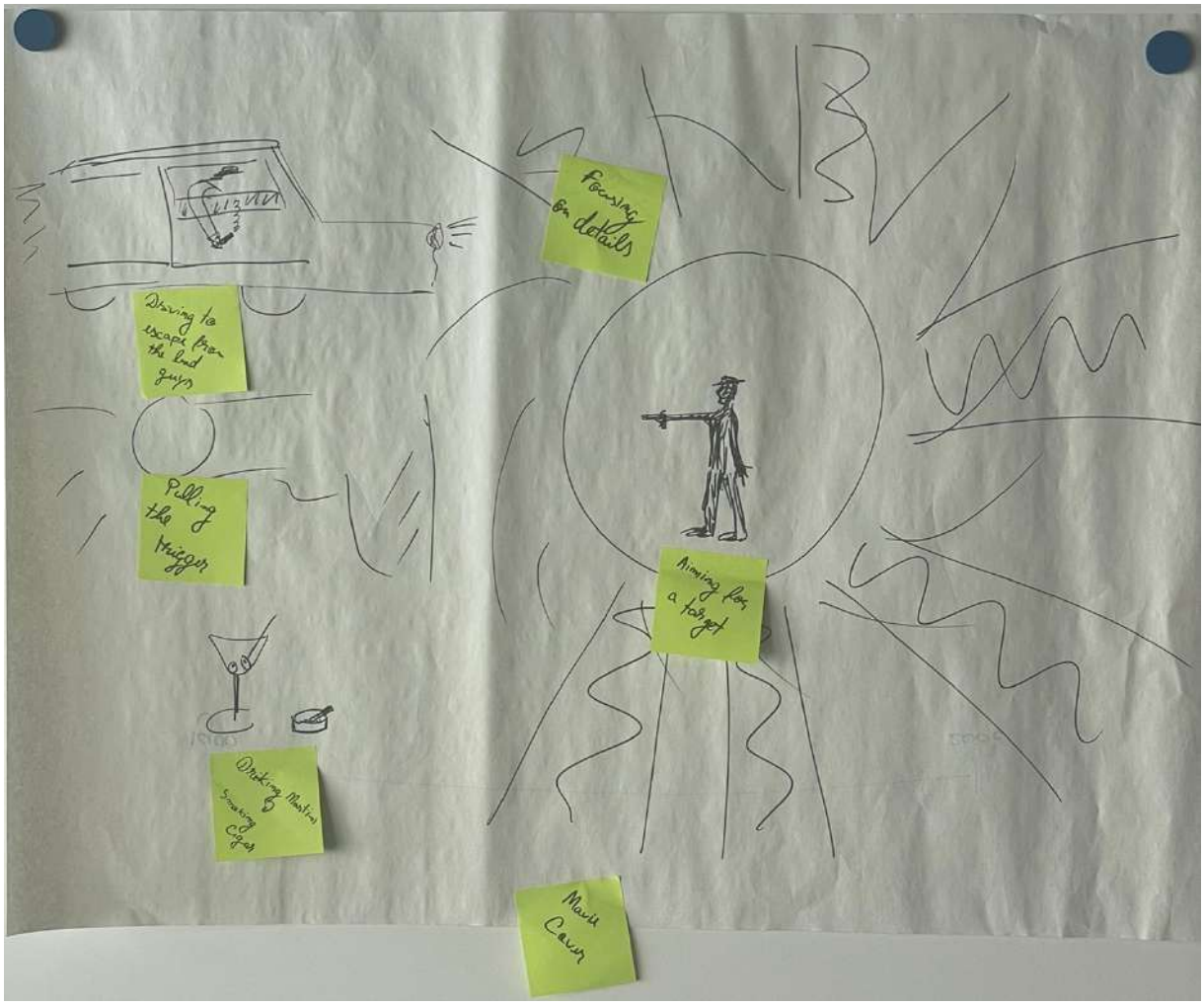

FIGURE 3. TO COME UP WITH MORE IDEAS, WE USED CREATIVE APPROACHES, SUCH AS APPLYING OUR TECHNOLOGY TO A CLASSIC MOVIE: JAMES BOND. WE WERE ABLE TO COME UP WITH NEW DOMAINS: AUTOMOTIVE, MILITARY, AND DRINKS & ALCOHOL.

Afterward, we completed a one-day brainstorming session in Rotterdam, where we used many materials and had much fun while narrowing down the domain list to 10. We used many Lego characters with many jobs and tried to develop a story for each one of them about what they are doing and how we can help them do their job better with the H3D-VISIOnAiR.

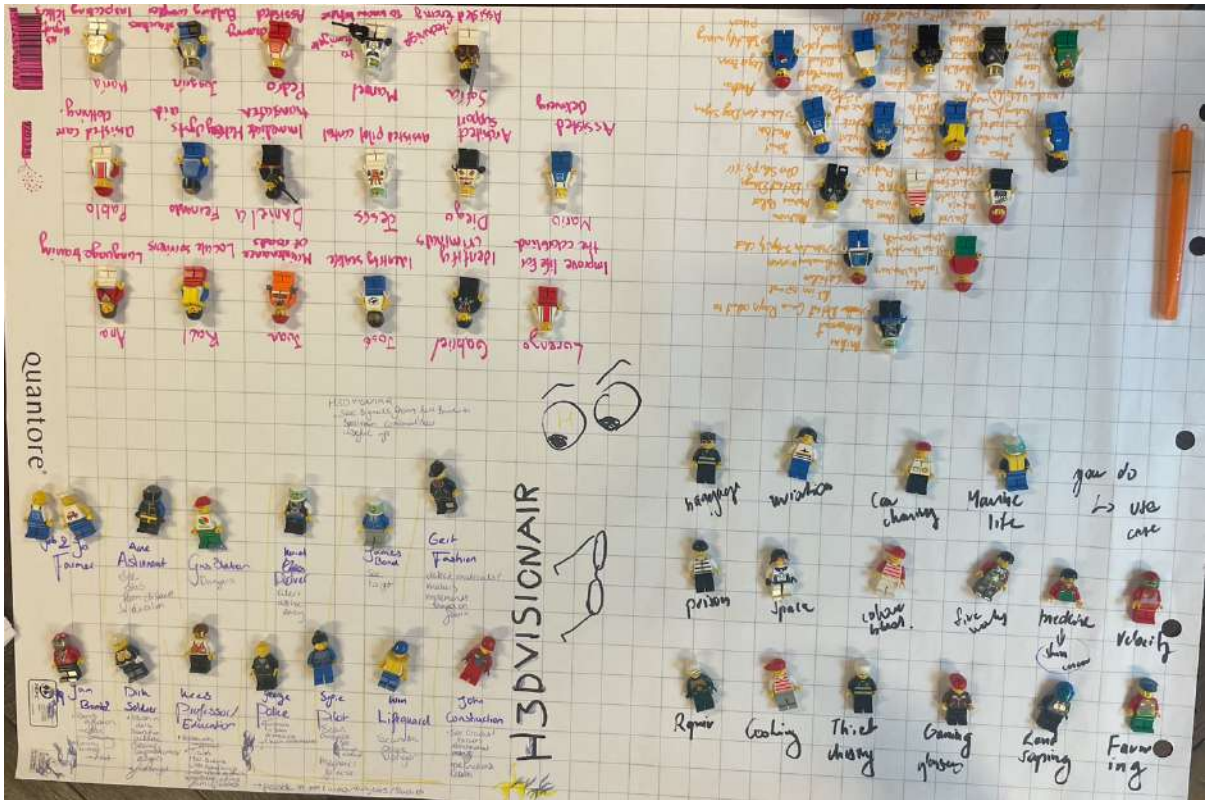

FIGURE 4. A CREATIVE WAY TO DEVELOP THE IDEATION PROCESS: GETTING INSPIRATION FROM LEGO FIGURES. WE ASSIGNED A JOB TO EACH LEGO CHARACTER AND THIS ALLOWED US TO COME UP WITH +20 ADDITIONAL APPLICATIONS.

We were on the same page when discussing what domains to reject and which to keep. Doing the exercises was a great way to discover which domains and related ideas were precious and exciting and which were not that full of potential.

2.4. ADJUSTING THE "WE KNOW HOW TO" FOR SPECIFIC DOMAINS

Since we were still considering many great applications, we decided to narrow the domain list to 8 domains that would fit our "We know how to" best. In order to do that, a table was created where we thought for each one of the domains what are the key players and users, the opportunities and pains, and the potential ground-breaking applications. This step provided us with further insight. With the help of many discussions with the people at CERN, we started to tackle the problem of narrowing down the domains differently, considering many more economical and ethical aspects.

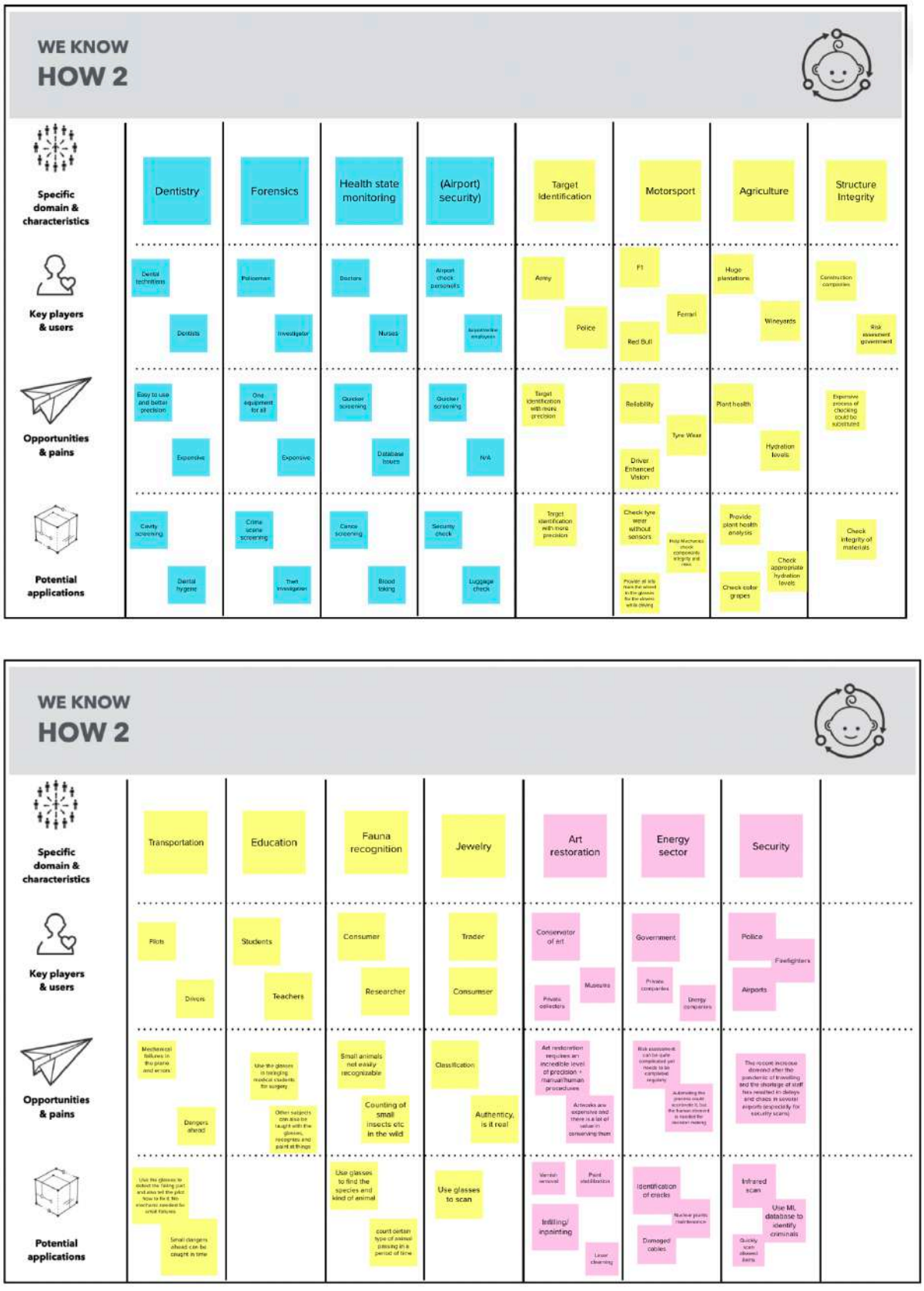

FIGURE 5. THE SECOND, MORE REFINED, WE KNOW HOW TO TABLE. WE TOOK INTO ACCOUNT SPECIFIC DOMAINS & CHARACTERISTICS, KEY PLAYERS & USERS, OPPORTUNITIES & PAINS, AND POTENTIAL APPLICATIONS.

We noticed that this exercise helped us form structured ideas and thoughts and decide their value. Before, we were a bit lost in random suggestions within the domains, such that there wasn't any clarity on the actual idea and whether it was worth continuing with it. Having a clear overview that is written down was needed here.

2.5 Application Ideation

We then decided to get more in-depth with the promising applications for the remaining subdomains, considering their feasibility. In order to do so, each one of us selected two technologies to do research on and argument why they should remain on our shortlist. It was an interesting process because we all wanted "our" technologies to stay, and out of 8, we needed to remain with 4; therefore, it was a tough decision. We decided upon this shortlist by individually grading multiple aspects of each application and selecting the Top 4 highest averages, and it turned out that we each had one of "our" chosen technologies. This led to a shortlist of 4 domains in which we would apply the technology: Agriculture, Art, Health, and Motorsport.

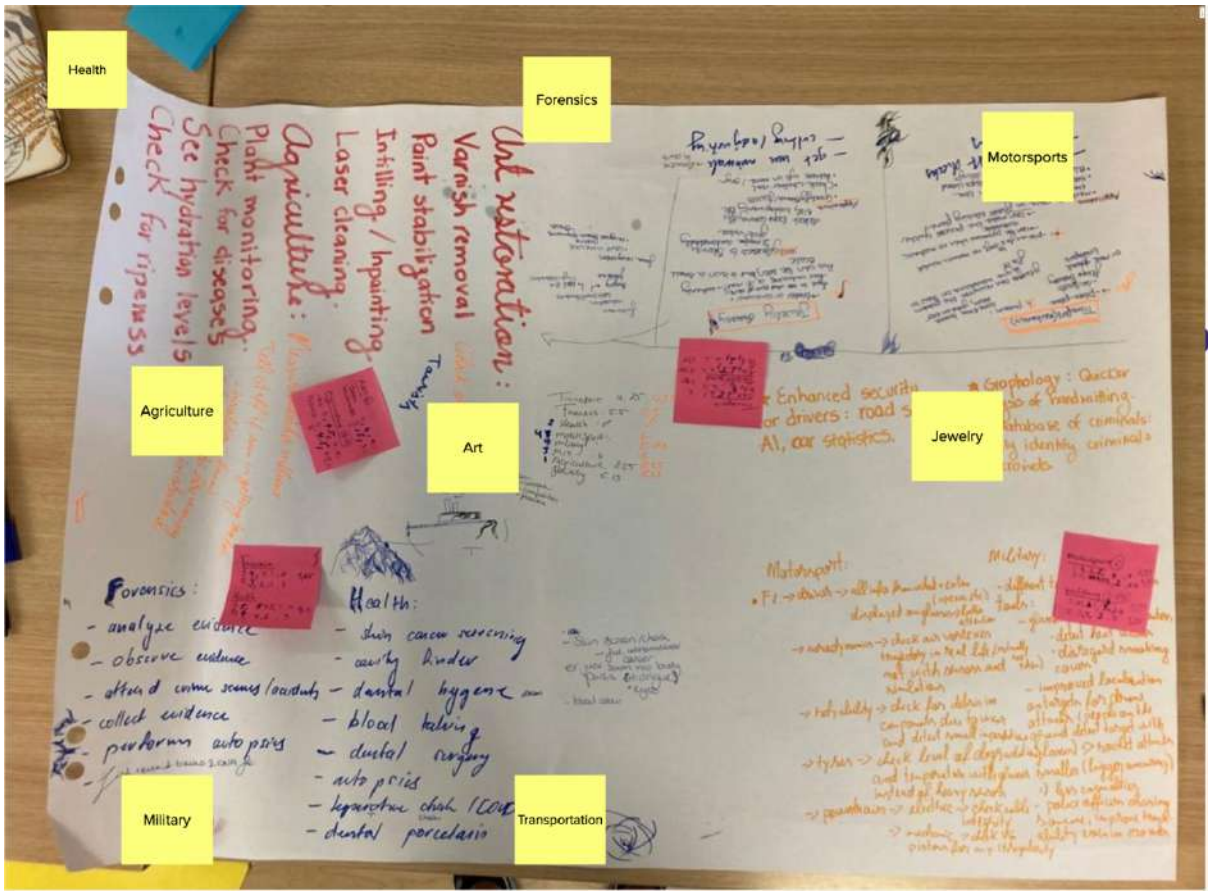

FIGURE 6. AFTER GRADING THE POTENTIAL OF OUR DOMAINS, WE SHORTLISTED THE FOUR BEST DOMAINS: AGRICULTURE, ART, HEALTH AND MOTORSPORTS. FOR EACH ONE OF THESE, WE CAME UP WITH SPECIFIC APPLICATIONS OF OUR TECHNOLOGY.

2.6 Ripple Effect Consideration & Creation of Concrete Concepts

One of the essential purposes of this process was to find a domain where the technology could affect the whole world, so, after a couple of lectures on climate change and other very complex problems the world is facing nowadays, we considered the ripple effect of our applications. This led us to observe all the benefits it would have on a larger scale but also the devastating downsides. After considering all the discovered aspects, the domain list was reduced again to 3, having discarded the Motorsport industry since this technology could have a much more significant impact on the other subdomains.

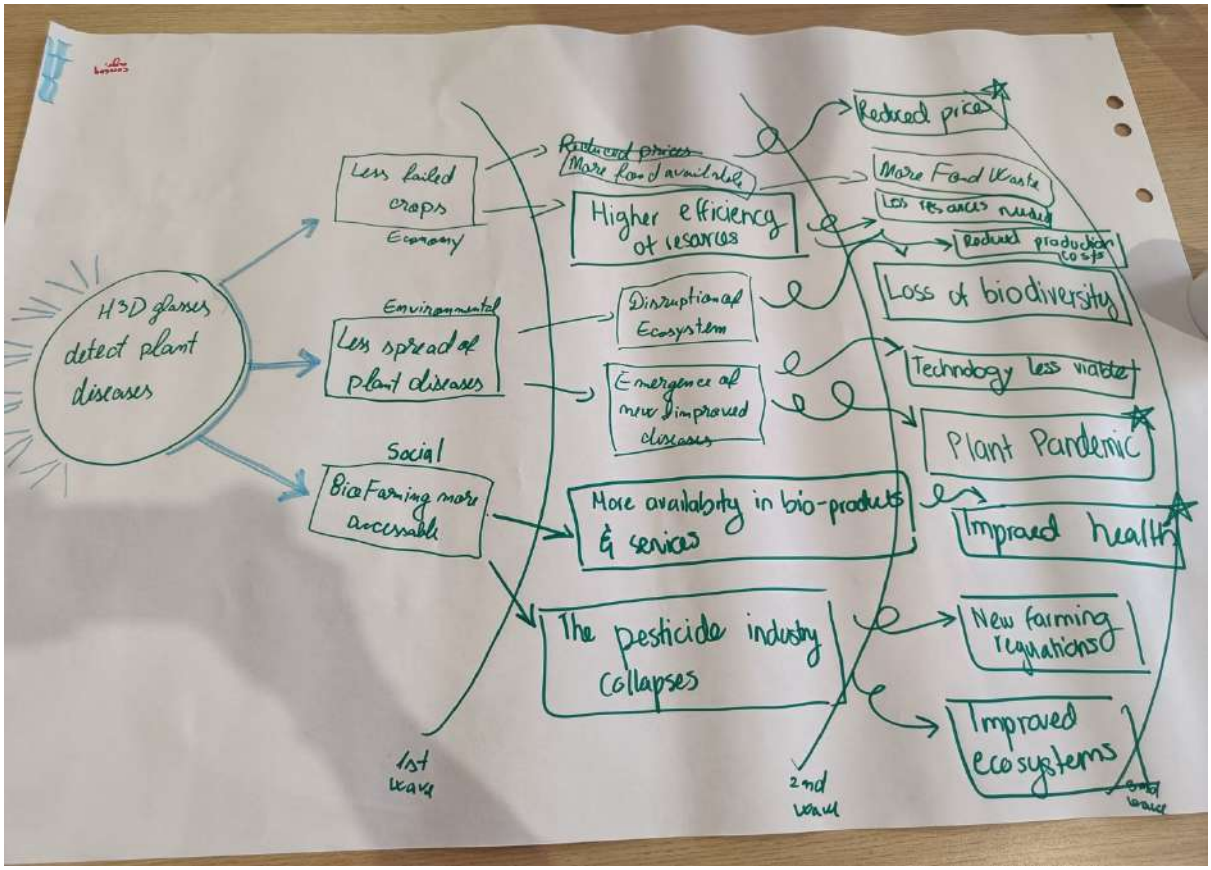

FIGURE 7. THE RIPPLE EFFECTS OF HD3-VISIONAIR FOCUSED ON THE AGRICULTURE DOMAIN, WITH THE APPLICATION OF DETECTING PLANT DISEASES. WE CONSIDREDED THE SOCIAL, ENVIRONMENTAL AND ECONOMIC IMPACTS FOR THE 1ST, 2ND AND 3RD WAVE.

Immediately after, the team started to make concrete product concepts that would be used in the remaining fields. This led to the discovery of multiple new benefits and pains, which followed the discarding of another domain, Art since the market for such an expensive tool would be very small. Now the last two remaining domains were Agriculture and Health.

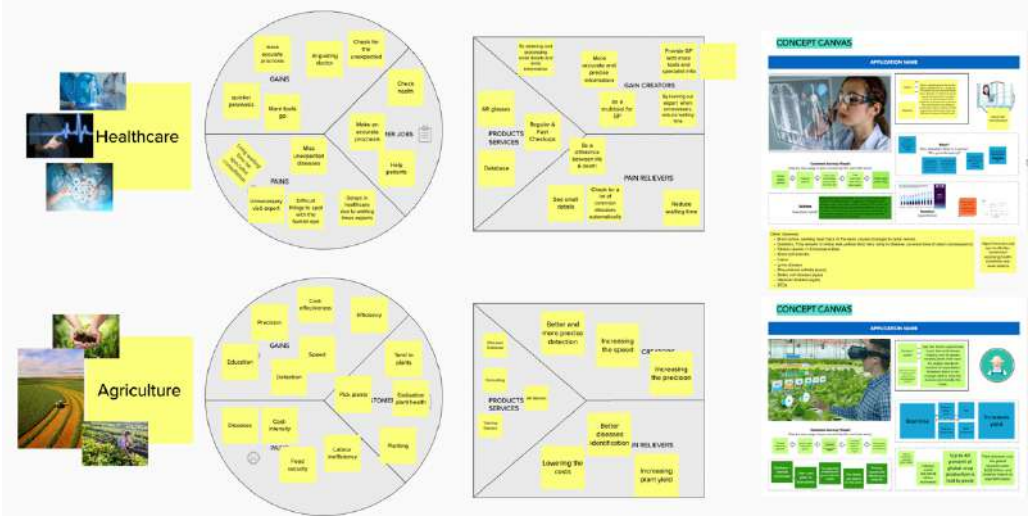

FIGURE 8. WE DEVELOPED THE PRODUCT CONCETS OF THE TWO WINNING DOMAINS: AGRICULTURE AND HEALTHCARE. WE TOOK INTO ACCOUNT THE PAINS, GAINS, CUSTOMER JOBS, PRODUCTS & SERVICES, GAIN CREATORS, PAIN RELIEVERS, AND CUSTOMER JOURNEY FOR BOTH OF THEM.

2.7 PROTOTYPING

Having just two domains remaining meant that we could start developing our prototype and decide upon the best one after seeing it work in practice. This was one of the most fun activities of the innovation process. We became aware of many aspects of the production; we were even able to estimates the production costs. Having this information turned out to be crucial, since it helped us decide between the two rivaling applications. In the end, the application for agriculture was too expensive: for the same amount of money, hundreds of workers could have been hired to do the same job or even worse, sometimes business would prefer to let parts of their crops die rather than to treat them because it was cheaper to do so.

The process of developing this showcase prototype was long and, at times, challenging, but when the final details came together and it was working, it meant the world to us because we managed using a 3D printer, some wood, and a lot of glue to create a product which would present to an outside party what the functions of a full-fledged pair of H3D-VISIOnAiR glasses could do. The prototype had the following parts:

1. A flashlight, made out of LEDS, to create a well-light environment
2. A minicomputer to detect the diseases, comprised of an Arduino with a microphone that detected the word “Disease” and turned the red LEDS on
3. A live view of the doctor’s vision, this was represented with a phone support and a phone both installed in the lateral part of the glasses, the phone had a camera filter with infrared

Therefore, the final application was decided. In the health domain, we decided to have the tool used in dentistry by doctors since it incorporates multiple of their current tools and massively improves time efficiency.

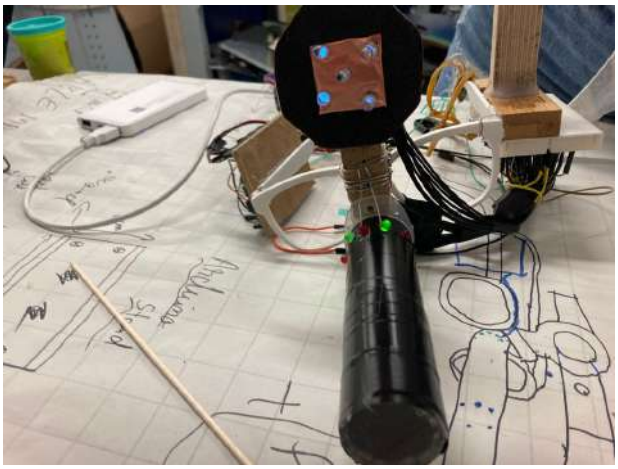

FIGURE 9. THE PROTOTYPE OF OUR EYEDOT GLASSES. WE RECORDED OUR PITCH USING THIS MODEL.

FIGURE 10. THE PROTOTYPE IN USE: THE DENTIST WOULD SIMPLY PUT ON THE GLASSES AND COULD PERFORM HIS TASKS. IN THE FINAL PRODUCT, THERE WOULD BE NO PHONE, BUT A PROFESSIONAL CAMERA.

3. CLEARLY DEFINED PROBLEM SOLUTION DESCRIBED

We had now placed our focus on the dentistry domain, and we started looking for pain points to solve here. We did this using a thorough search on the internet and by contacting and calling dentists. With that, we arrived at the problems and solutions described below.

Problem

Performing dentistry is labor intensive and requires a lot of precision work by dentists. They work in areas that are often difficult to see and hard to reach. Dental treatment in the oral cavity is mostly based upon operating with the naked eye or with the help of magnifying glasses. Small abnormalities can be hard to spot and can easily be missed. This leads to dentistry being a very time-consuming job that brings a lot of pressure and a high workload for the dentist. Meanwhile, many dentists experience a lot of stress as they work under time pressure yet must give attention to detail.

Solution

We propose the Eyedot as the solution, using the H3D Visionair glasses to guide dentists. The glasses give augmented reality techniques extra information regarding the state of the teeth and the oral cavity to the dentist. This guides dentists in real-time and allows them to spot diseases quicker and more precisely. The quality of the treatment will go up, and the workload of the dentists will go down.

User story

As a dentist, I want to provide good care and thorough examination during oral treatments within a limited amount of time so that I can help many patients.

4. IMPACT (NUMBERS)

Based on interviewing dentists and looking at average times consumed, we estimate that the dentist will save on average 15 minutes per patient. The average per appointment is now 52.1 minutes, and the average number of patients per day is 20. Having five workdays, this can go to 100 per week and 5200 patient visits per year, after considering vacations. 78000 minutes will be saved; dividing this by 24, the new appointment duration in minutes, we get to 3250 extra appointments with patients the dentist can have every year.

The majority of dentists, 54.9%, say they experience high-stress levels with and around their work [2]. Also, GDPs reported the highest stress levels in their field of practice. Most of the stress reported originates from time pressure, unsatisfied patients and complaints, and the NHS work.

43.8% of dentists have confirmed that the stress paired with their job is beyond their coping ability [2]. This is all clearly concerning; since dentistry is an essential branch of healthcare, we must protect the practitioners.

5. INDIVIDUAL REFLECTIONS

KARLA

The summer school was a very enriching experience. Not only did I get the chance to work in an interdisciplinary team, but also I dived deeply into the Innovation and R&D fields. Coming from a very scientific field, I appreciate these opportunities because, more often than not, the communication between research and society/industry is not the best one. Hence, as multidisciplinary scientists, it is our job to build bridges between the two. And exactly that was what we did while looking for applications for H3D-VisionAIR. In particular, I enjoyed the creative approach to brainstorming; this will also be helpful in my field; it is a very fruitful tool for getting ideas on how to tackle a paper, focus on a grant, or even make connections between data and hypothesis.

I also learned a lot from thinking long-term about the impact of our innovations. Although the future is unpredictable, and you cannot control everything that happens after you put your product out on the market, this was the first time that I was thinking of “waves” and different types of consequences. In my experience with Physics, we are cautious to even suggest that something might be the cause of another phenomenon; hence we rarely discuss about the repercussions or possible secondary or tertiary effects of our data/theories. However, as the summer school showed us, this is key to being better prepared for how the market might react, but this is also applicable to scientistic. If you are aware of the long-term impacts of your data, you might be able to pioneer research in that particular direction but also mitigate any adverse effects.

Lastly, since our application was considered the most promising out of the whole summer school and having won the pitch contest, our team will look forward to continuing with the innovation process and taking the prototyping to the next level. For that aim, we will develop a detailed plan for our prototyping process and have an extra meeting with our ATTRACT technology scientific contact.

JOZEF

There are three crucial things I have learned during the CERN Summer School.

First, and perhaps most importantly, I have learned to work with colleagues from different backgrounds. It was a thought-provoking realization of how siloed business is and other sub-fields such as management or finance. Furthermore, it was also very interesting to see how business students approach tasks compared to others with a more technical background. Business students tend to rush things, whereas more technical

backgrounds evaluate processes and ideas in detail. As such, it was even more absorbing to combine the two approaches and offer new applications for the H3D-VisionAIR together.

Additionally, I have come to appreciate the tools in creative brainstorming. The two tools that stand out the most are exaggeration and talking to a child. In exaggeration, ideas that would be rejected straightway out of pure logic are still considered. This is a great way to hop off these overly unrealistic ideas to come up with something more tangible. The second tool is a great way to simplify the sometimes overly technical solution. It is pivotal that a CEO, as well as a child, understand what the given proposition is about.

Finally, it was wonderful (and sometimes even frightening) to learn the social impact of some innovations. As such, looking forward, I will strive to perform an analysis of the unintended consequences my approach could bring to the planet or local communities. There were very suitable examples during the Summer School that made this concept more salient: global warming, the great decoupling, or the cobra effect.

ALEXANDRU

There are many important aspects I have learned a lot about during the CERN Summer School.

First, and perhaps most importantly, I have experienced working with colleagues from different backgrounds, which helped me discover new aspects of myself and what I enjoy doing. As an example, I have learned that I enjoy what "business" represents and would like to learn more about it through some courses, and I believe this might one day be a step in my future career. Therefore I can wholeheartedly say that working in an interdisciplinary team was an amazing experience, and I am enthusiastic about doing this again as soon as possible.

Additionally, I have come to appreciate the tools in creative brainstorming. The ones that stood out the most to me were the ones related to imagination. I have learned that ideas could truly come from anywhere, even from the most unexpected activities, such as drawing a movie background. I really enjoyed the brainstorming session in Rotterdam, where we used lego characters to come up with new ideas for our concepts. I never expected to do something like that, and I can't wait to use these concepts in my own field, Computer Science, to improve work efficiency and quality.

Finally, it was terrific (and sometimes even frightening) to learn about the impact of some innovations through the Ripple Effect. It was very hard at first to see that something made to solve a very important problem and helps everyone, in your opinion, was creating at least three other issues for humanity that could have been even harder to solve. But now, knowing what this whole ideation process entails, I hope I will be able in the future to generate ideas while taking into consideration all aspects so that I can ensure that the future will be a better place than it is today.

PLEUNTJE

I had relatively little knowledge of the concepts of design thinking and the innovation process prior to the start of the summer school. I come from a scientific background, where these aspects are not really incorporated into the study program, and the amount of creativity required almost goes to zero, which is a pity. Therefore, in the first place, I learned a lot in that area. Among other things, I learned to work while knowing that it is not the most time or energy-efficient way to operate and to realize that it is still very useful for the process. You can go around and look at seemingly unrelated subjects to maybe end up with some new inspiration. You can spend hours on an idea and should still be able to discard it when it does not turn out to be great.

Furthermore, I liked learning about creative thinking tools and how to use them. Also, the steps of going from a chaotic collection of ideas to an organized pain, relief, and user structure, for example, were interesting. Next to the creativity and design side, also the business side was new to me. I learned a lot from

the value proposition lecture, as it was a whole new world to me. I tried approaching subjects from a really different perspective using a business-oriented mindset, which gave me different insights.

Looking back, I am really happy with my team. It is great to see how everyone was really motivated and engaged with the project. I also appreciate how everyone automatically took up the roles fitting with their background and skills, so that everyone could do what they are best at. Noticeable was that people with a different background actually approached ideas in different ways, from the beginning focused on different aspects. This led to some disagreements or misunderstandings. However, an accord was easily reached as people explained their train of thought and point of view so that the others could consider it. This way, the aspect of having teammates with different backgrounds also helps in broadening your perspective, and it really adds up to the summer school experience.

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