SDG 3 Project Report

Healthspotting's Instascan

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Project report

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Abstract

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The Healthspotting project addresses the global burden of breast cancer in the developing world by developing Instascan, a portable, noninvasive screening solution utilizing HipMed and H-Cube technologies. This project, part of the ATTRACT initiative, combines Design Thinking and Service Design methodologies. Practical implementation includes extensive research, workshops, and a social awareness campaign to overcome cultural barriers. The primary goal is to make cancer screening accessible and affordable, increasing early detection and improving survival rates. Further development and collaboration with NGOs and local governments are planned to ensure broader impact and sustainability.

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1 Introduction

The group's Sustainable Development Goal (SDG) 3 focuses on ensuring healthy lives and promoting wellbeing for all at all ages (United Nations). A significant challenge within this goal is the global burden of cancer, particularly breast cancer, which continues to escalate despite advances in medical technology (International Agency for Research on Cancer). In 2020 alone, there were 19.3 million new cancer cases worldwide, leading to 10 million deaths. By 2040, these figures are projected to rise dramatically to 27.5 million new cases and 16.3 million deaths annually. This alarming trend underscores the urgent need for effective cancer screening and treatment solutions, especially in low-and-middle-income countries (LMICs), where 7 out of 10 breast cancer deaths occur (Dosanjh & Ige 2024).

The identified problem centers on the accessibility and affordability of cancer screening. Traditional methods are often prohibitively expensive and require specialized medical personnel and advanced infrastructure. For instance, the current cost per breast cancer scan can reach approximately US$ 300 per patient, and entry-level high-tech diagnostic devices can cost between US$ 55,000 and US$ 75,000. These financial barriers make regular screening and early detection unattainable for many individuals, leading to late-stage diagnoses and lower survival rates.

Additionally, there is a significant lack of awareness and education about breast cancer, further heightened by cultural stigmas and negative perceptions. Many people, particularly in the developing world, view cancer as a death sentence, resulting in fear, denial, and avoidance of screening. This lack of knowledge and awareness worsens the problem, as early detection is crucial for successful treatment outcomes.

To address these challenges, the group proposes implementing Instascan, a portable, noninvasive breast cancer screening solution. Instascan will use the ATTRACT technologies HipMed and H-Cube. Instascan aims to make cancer screening more accessible, affordable, and culturally acceptable, particularly in underserved regions. By reducing costs and eliminating the need for specialized medical personnel, Instascan has the potential to increase screening rates significantly, enable early detection, and ultimately improve survival rates and quality of life for millions of people worldwide.

2 Development approach

As a human-centric approach Design Thinking is valuable when converting a need into a demand. The methodology is based on multidisciplinary collaboration, and complex problem-solving is done by applying design knowledge. This process meets technically visible needs and combines them with strategies in more creative and innovative ways. The Design Thinking process does not have to be linear, providing more flexibility. (Magno Mendonca de Sá Araújo, Santos, Canedo & Araújo 2019)

Design Thinking has three core pillars: empathy, collaboration, and experimentation. Its iterative, cyclical process consists of five evaluation phases: discovery, interpretation, ideation, experimentation, and evolution. After the last evaluation phase, the results can be refined by starting the cycle again as many times as necessary. (Magno Mendonca de Sá Araújo et al. 2019)

According to Stickdorn, Hormess, Lawrence and Schneider (2018, chap. 1), Service Design is ingrained in Design Thinking. This approach to designing services enables companies and organizations to implement customer perspective while developing new value propositions or improving and learning to understand their services end-to-end. Service Design focuses on solving the right problem by investigating the users' needs, adopting designers' approaches of prototyping and quick experimenting, using visual, fast and comprehensible tools for even cross-functional collaboration and mobilizing a vast range of stakeholders.

Service Design can be seen as a mindset, process, toolset, cross-disciplinary language or management approach. Each of the previously named is just a part of the bigger picture. Service Design does have principles that need to be implemented: user-centeredness, co-creativeness, adaptive approach iterating toward implementation, sequencing interrelated actions, researching and prototyping in digital or physical reality and considering the entire service environment and stakeholder chain as holistic. (Stickdorn et al. 2018, chap. 2)

There are straightforward methods and tools to be used in Service Design. Methods can be described as specific procedures on how to accomplish the work to be created, while tools are those that are used in the creation process. Conducting interviews and desktop walkthroughs for prototyping are methods where research data is a core tool in Service Design among tangible models, like storyboards, systems or journey maps. (Stickdorn et al. 2018, chap. 2)

One innovative approach to solving complex problems is Jake Knapp's idea of Sprint, which presents an intense five-day, step-by-step, mixed process of innovation, business strategy, design, and behavioral science, to mention a few characteristics. Sprint aims to answer critical questions by testing and prototyping ideas with customers and end-users. Before starting the sprint, having the right team with the proper challenge is essential. (Knapp, Zeratsky & Kowitz 2016, chap 1)

The sprint breaks the problem-solving process into sections per day. Sprint begins from the end by setting a long-term goal with sprint questions, mapping, requiring the needed expertise and deciding on the target. Continuing with remixing and improving ideas and sketching them, sprint moves towards final decisions by rumbling or voting. At this point, the meaning of storyboarding is to notice problems and points of confusion regarding the prototype. Building a quickly realistic but disposable prototype requires making it appear authentic. The prototype should last for a trial run. Lastly, collecting small data and conducting possible interviews with the end-users is for learning purposes. Thus, the sprint has run its course and possibly revealed an innovation that improves lives. (Knapp et al. 2016, chap. 1-17)

Magno Mendonca de Sá Araújo et al. (2019) state that as methodologies Design Thinking and Design Sprint resemble so much each other that they could be mistaken as identical, since Design Sprint method is based on Design Thinking. Design Thinking and Service Design are unlike Design Sprints, which provide structured formation, predetermined roles, and a focus on a specific problem. All these methodologies have a strong power of innovation, but the process should be clarified for participants by defining reasons for doing so and aligning expectations. This is what we eventually achieved in our team.

Our team's approach to this United Nations Sustainable Development Goal 3 (later SDG 3) project was nonlinear service design based tightly on Design Thinking mixed with parts from the design sprint. We began with gathering research data to narrow down the challenge, to understand the operational environment and the subgoals of SDG 3 and the given ATTRACT technologies. We started to gather research information as a collaborative multi-skilled team and used the service design's practical approach research wall to visualize data and to identify patterns (Stickdorn et al. 2018, chap. 4). When the challenge was defined to breast cancer and developing countries by analyzing and interpreting the collected data, collecting and specifying the data continued throughout the process with interviews and literature reviews such as scientific articles, reports, blogs and statistics. Creating insights happened gradually when the data was collected and analyzed. By using democracy in voting for decisions, other assignments and roles were quite easily allocated between the team members. Therefore, there was no need for a Decider or two like in the sprint process, especially since we were a team of five (Knapp et al. 2016, chap. 1).

Before CERN week, our group used service design “How might we...?” questions on ATTRACT technologies to find the application possibilities of those technologies regarding our project and challenge. We also used the 5 Whys root cause analysis method to narrow the challenge and better understand the underlying causes.

During the intensive CERN week, empathy mapping of Design Thinking and service design was used to identify user behaviors and attitudes. We used service design tools such as journey maps with actors, stages, and steps to visualize the overall experience of the main actor using the Instascan service. The channels, which help to understand the cross-channel experiences of the main actor, were addressed separately outside the mapping but widely, nonetheless. For example, two storyboards were also explicitly created to visualize the Instascan service event from the customer’s point of view and to create scenes for the roleplay (Stickdorn et al. 2018, chap. 2). Storyboard technique is also part of the sprint process, just like mapping. Interviewing the experts is a Service Design method and an integrated part of the sprint process. We conducted interviews throughout the whole intensive CERN week. Due to the target group and solution, actual end-users were not interviewed as in the sprint process. (Knapp et al. 2016, chap. 6; 12)

3 Evolution of the design

The group used Miro to plan, workshop, and store ideas for the future. Teams was used as a chat tool and to store files and meeting notes. Signal was used for quick communication between the group. We also scheduled weekly meetings, and meeting notes were taken to OneNote. Tasks within the group were in Planner inside Teams.

At the start of the project, everyone had an action point to learn more about the subgoals of SDG 3 and to plan and write one or more intent statements to Miro. The intent statements were covered in a call within the group, during which we first delved deeper into statements of intent. Finally, we agreed to vote on the intent statements using the voting system inside Miro. Everyone had three votes, and the rules were that each had to vote for at least two intent statements. Based on the voting, sub-target 3.4 was chosen for the group, and the intent statement below was chosen for the project.

Intention:

- To find ways of using easily accessible low-tech accessories to solve medical imaging needs related to high-tech solutions such as MRI, CT, PET, and X-ray.

- To increase the accessibility to medical screening for detectable noncommunicable diseases, i.e. cancer, in less privileged societies.

Opportunities

- To massively increase access to early treatment due to earlier detection of i.e. cancer.
- To decrease the cost of the screening globally by cheap alternative technology.
- To encourage further development of such low-tech dual-use solutions in medical care.

New value:

- Earlier access to treatment and a decreasing mortality rate.
- Scalable and affordable solution.

Public:

- Less privileged societies and people in vulnerable positions without access to detective and preventable healthcare.
- Medical examiners in the communities described above.

Risks:

- Inadequate processes and resources for the treatment after the detection.
- Would a reliable enough technological solution be available to be used in practice?
- False positives and reaction to them.
- Resources for training and maintenance.
- Commitment to the practice by medical examiners and the wider public.

After the intent statement, we investigated the ATTRACT technologies included in the project. Since we were a group of 5 and there were 5 ATTRACT technologies, everyone was assigned one technology to investigate on a more detailed level and find ways to link it to our problem so we could prioritize the technologies to get in touch with for interviews. The distribution was based on the technology groups we were involved in at the kickoff — the investigation results were documented to Miro inside a table. Everyone had to at least document the possible use cases of their assigned technologies to the Miro board, and many group members also contributed to other technologies and their possible use cases. Based on this, we had a preliminary idea that H-Cube and HipMed would probably be of the group's highest interest. Random Power was seen as an encryption tool that could be linked to our technology if nothing else could be used.

1. **High interest**: H-Cube and HipMed.

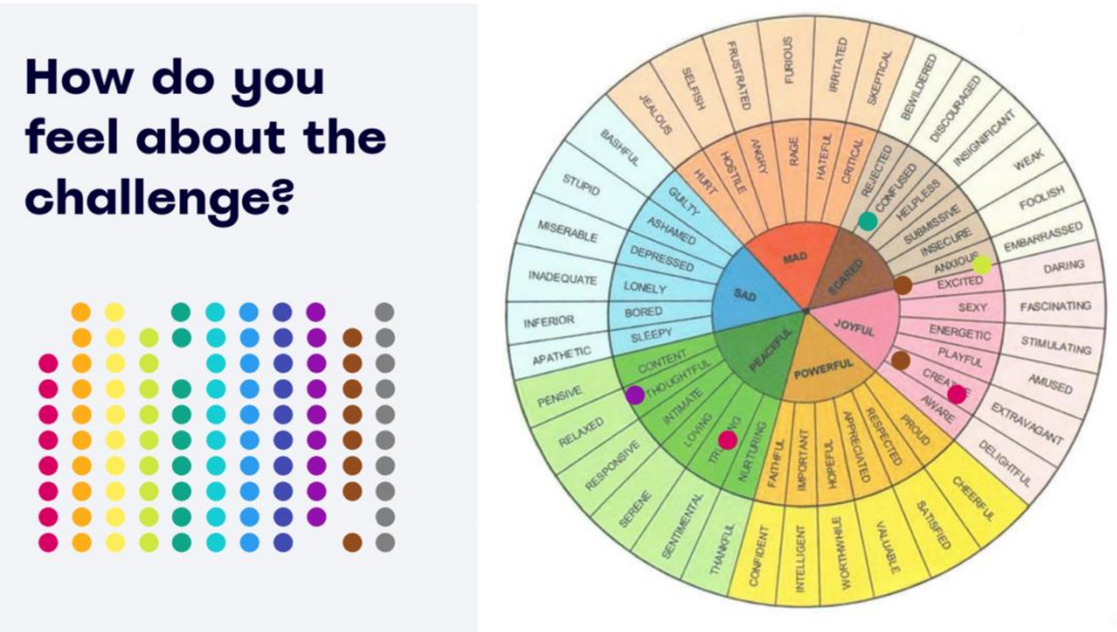
2. **Medium interest**: MicroQuaD and SNIFFDRONE.
3. **Low interest**: Random Power.

3.1 Workshop

A virtual workshop in Teams was arranged before the CERN Bootcamp to discuss our challenge and plan it in more detail. One of the team members facilitated the workshop, which the entire group attended. Before we started, he gave a brief explanation of each step.

3.1.1 Feelings on the challenge

The first part of the workshop involved the whole group's feelings about our chosen issue and current state of mind. The activity was chosen because the group was going through a moment of discomfort about the process and the topic. Feelings were mixed within the group, but no one felt overly pessimistic about the problem. Feelings seemed to be more on the positive side than the opposing side.



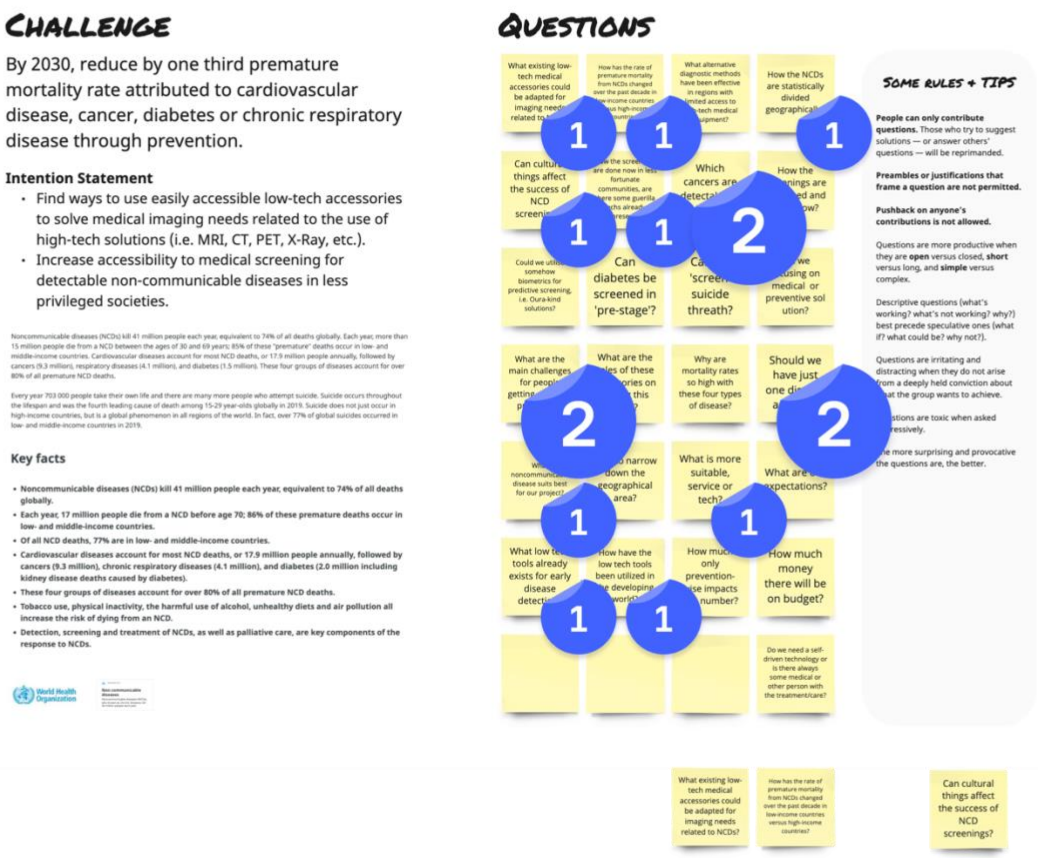
Picture 1: Feelings of the group at the start of the workshop

3.1.2 Question burst

In our workshop, we used a question burst method to tackle the challenge of reducing premature mortality from NCDs by 2030. A *question burst* is a brainstorming technique to generate many questions about a specific problem or challenge. The aim was to uncover new perspectives and ideas by focusing on asking questions rather than immediately seeking solutions. We rapidly posed as many questions as possible during the question burst and documented the results to the Miro board. Our goal was to find low-tech medical imaging solutions and increase accessibility to screenings in less privileged areas.

The questions were then ranked based on Miro voting. Everyone had three votes, and each had to separate the votes amongst the raised questions. Three different questions each got two votes.

- Which cancers are detectable in the early stages?
- Should we have just one disease as the focus?
- What are the main challenges for people getting access to prevention?



Picture 2: Question burst and vote distribution

3.1.3 5 Whys

In our workshop, we followed the question burst with the “5 Whys” method to explore the root causes of problems in healthcare, especially access to prevention. The “5 Whys” technique involves asking “Why?” multiple times to resolve an issue.

First, we identified the main problem: people face challenges in accessing prevention. We asked, "Why are there challenges?" The answers pointed out that health is often not a priority because people need to fight for survival. This led us to ask further, "Why do they need to fight for survival?" and found reasons like lack of belief in medicine and inadequate infrastructure. Asking "Why?" again showed that the system does not provide basic infrastructure due to political issues and power structures.

Another branch of questions started with “Why is prevention a solution?” The answers highlighted that prevention is poorly integrated into the health system and that disease education is lacking. We then asked, “Why is it not integrated?” and “Why is there a lack of education?” These questions revealed gaps in the health system and the critical role of education. By repeatedly asking "Why?" we uncovered deeper issues such as political problems, socio-economic conditions, and lack of infrastructure. This method helped us see the nature of these challenges and pointed to the need for comprehensive solutions.

Identifying a Quest

Study the questions we wrote down, looking for those that suggest new paths. Select three that intrigue you, seem different from how you deal with things, or even make you feel uncomfortable.

Now let's try to expand these few into sets of related or follow-on questions

5 Whys

Picture 3: 5 why's covered in the workshop

3.1.4 The Job-To-Be-Done

In the next step in the workshop, we analyzed to define and refine the “job-to-be-done” within the healthcare sector, specifically focusing on various personas and their core functional jobs to be done (JTBD). We set aside the more comfortable or straightforward conclusions, adopting an innovator’s mindset instead.

We began by identifying and categorizing the essential job executors or personas involved in healthcare. These personas included patients, medical examiners in less privileged societies, doctors, and other healthcare providers. An additional, unspecified category was also acknowledged, suggesting the need for further exploration in this area.

Once the personas were established, we outlined the core functional JTBD. This stage involved clustering various tasks and responsibilities these personas handle daily. The sticky notes captured these tasks but still needed to be detailed in our initial visual representation.

The most detailed section of our analysis involved mapping out the desired outcomes. We aimed to comprehensively understand what these personas ultimately looked to achieve through their roles and actions. The desired outcomes included early access to treatment, affordable solutions, earlier detection of noncommunicable diseases (NCDs), and improved quality of life, among others.

During this phase, we faced several critical questions and considerations. For instance, we questioned the statement’s validity that earlier detection generally leads to cheaper treatment for cancers and tumors. Given their treatable nature, this reflection made us ponder whether focusing on those with NCDs was more relevant.

Additionally, we considered the point of diagnosis if treatment was beyond the scope of our analysis. This contemplation brought forth the idea that while diagnosis is crucial, the ultimate goal is to provide pathways to treatment, possibly integrating the treatment aspect into future stages of our project.

The outcomes desired by the personas ranged from self-driven solutions and functional processes to happier patients and reduced mortality rates. We identified the need for tools to detect diseases, enabling comprehensive healthcare, and providing proper training and tools to healthcare providers. Also, the desired outcomes highlighted the importance of improved quality of life, raising levels of consciousness and knowledge, and reducing suffering, such as fewer deaths and suicides.

The analysis during the workshop underlined the need for scalable solutions and a reduction in mortality rates, aiming to create a more efficient healthcare system. This step of the workshop was an insightful journey into understanding the needs and jobs of the personas we like, patients and doctors, guiding us toward more impactful solutions.

Picture 4: The job-to-be-done

3.1.5 How might we (HMW)

"How Might We" (HMW) is a brainstorming technique for reframing challenges as opportunities. It involves creating open-ended, optimistic questions that start with "How might we..." to spark creative thinking and generate innovative solutions. This approach encourages out-of-the-box thinking and helps the team explore multiple ways to address a problem.

Our workshop explored the "How Might We" approach to brainstorm solutions for early disease detection and prevention using the given ATTRACT technologies HipMed, H-Cube, SNIFFDRONE, Random Power, and MicroQuaD. We aimed to learn how to use these technologies to address our challenges.

HipMed:

- HipMed could be adapted to create portable screening devices to detect diseases like breast cancer early. Making this technology affordable and easy to use in remote areas would enhance accessibility.
- Utilize HipMed technology to speed up mass screenings, allowing for early detection and diagnosis without specialized medical staff.

H-Cube:

- Combining H-Cube with HipMed could enhance diagnostic capabilities, providing a comprehensive solution for early detection.
- Portable device not protected by a patent.
- Using H-Cube to detect skin and breast cancer at early stages.

SNIFFDRONE:

- SNIFFDRONE technology could detect infections remotely through breath analysis. This could be particularly useful for early lung cancer detection, diabetes detection, and respiratory disease monitoring.

Random Power

- Use Random Power as a data encryption tool. Our project aims to help detect diseases, and patient data is very sensitive and should be encrypted.

MicroQuaD

- Early detection of diseases through the detection of changes at the cellular level, such as cancer.
- More robust materials mean better survivability in rough conditions (a very distant link to our project).

3.1.6 Summary of the workshop

After the workshop, we better understood our project and how we could use the ATTRACT technologies in our scope. We agreed that all of the ATTRACT technologies could be linked to our problem, so we agreed to contact all of the technology providers. A template email was created and shared with the group for comments. The email was sent to each provider to request an interview to learn more about the technologies.

3.2 Interviews

As a group, we identified use cases for all 5 ATTRACT technologies in our project, with some in higher priority and some in lower priority. We identified HipMed and H-Cube as the highest priority interest for our use case, SNIFFDRONE and MicroQuaD as medium priority, and Randonpower as the lowest priority. The relevance for each technology and approach was set during our workshop, where we used the “How might we” method to ideate how we might use each technology for our use case.

Technology	Relevance	Approach
h-cube	▲ High	Primary technology
HipMed	▲ High	Primary technology
MicroQuaD	■ Medium	Primary technology
SNIFFDRONE	■ Medium	Secondary technology
Random Power	▼ Low	Secondary technology

Picture 5: ATTRACT technologies, relevance and approach for each technology

As a group, we agreed to get in touch with each technology provider as we recognized some use cases for our intention that we could not think of and that could be learned during an interview. A template email was created following the instructions given by the teachers, and an interview request was sent to all the technology providers. Random Power and MicroQuaD interviews were arranged based on the first email communication, but other technology providers did not answer.

Before the interviews, we agreed that at least two group members should attend the interview, one focusing on the discussion and the other on writing notes. The interviewees were agreed separately per interview and everyone had the change to participate in at least one interview. We also created a set of questions to go through in the interviews, and freedom was given to the interviewees to use other questions as well (Appendix 1). A separate OneNote folder and a new page per interview were created for the interviews. At the start of each interview, we also asked permission to record the interview with transcription enabled.

The interviews started with an elevator pitch about who we are and what we are doing. The pitch was not written anywhere, and we agreed that one of the team members should do it before the interview.

3.2.1 Random Power

Two Healthspotting team members interviewed Random Power technology representatives Massimo Caccia, Professor of Experimental Physics at the Universita'à dell'Insubria and CEO of Random Power, and Wojciech Kucewicz, Professor at AGH University of Science and Technology, on May 16, 2024 before the Bootcamp. Before the interview, a pre-study on existing Random Power applications and the basics of the technology was held. The interview was recorded and transcribed using Teams. Also, a summary of the transcription was produced using AI.

The pre-study had already pointed out some significant features and how applicable they might be to our solutions. Since we already had an idea of a process and how new technology might be usable in developing a solution for the early detection of noncommunicable diseases to prevent premature deaths caused by them, we concentrated on Random Power's medical solutions. However, the background information retrieved from Random Power did not raise high expectations of medical solutions.

Prof. Caccia mainly directed the interview run-through; no strict questionnaires were used to coordinate the interview. However, we had a list of questions to structure the interview and to use as additional questions if needed. Prof. Caccia started with the history and basics of Random Power and how the need and research for truly randomized numbers have evolved over time. The presentation was very detailed and deep-cutting, considering the relatively short time addressed for the interview.

During the interview, it became evident that the main applications of Random Power would be among such solutions where an extremely high level of data protection, privacy governance or otherwise high level of randomity is needed. When asked about different possibilities, prof. Caccia explained how Random Power might be used to randomize user information in access management to protect personal data, e.g., in governmental systems. Also, when asked about other business solutions coming up in the future, he told us about gambling and casino branches and how they are very interested in using genuinely randomized numbers to ensure no outsider might influence gambling results.

Finally, at the end of our interview, we asked how they see the possible applications of Random Power in the healthcare business. As we discovered in advance, no solutions had been implemented, but we briefly discussed using Random Power to protect customer data. Our idea was to use it to encrypt customer data sent from a mobile unit from field conditions to a central system, e.g., a hospital. However, their opinion was more like using Random Power on high-level privacy encryption in the central system instead of using it on a data transfer system since there are cheaper and more easily adaptable systems. Random Power also needs a relatively significant amount of energy to be applied in mobile units. One possible solution in healthcare might be using Random Power in imaging since they have discovered an unexpected finding that could be utilized to enhance the image quality of CT scanning and other similar technologies.

We also briefly discussed ethics and the ethical challenges Random Power has faced among customers. Many governments have been interested in Random Power due to its possibilities and applications in the military industry. However, Prof. Caccia told us they have made a strict principle that Random Power will not be sold to military organizations or industry representatives.

3.2.2 MicroQuaD

Benedetta Valerio, Astrophysicist representing MicroQuaD, was interviewed before the CERN Bootcamp on 30 May by three team members from team Healthspotting. Before the interview, we discussed possible use cases for MicroQuaD, including using it as an imaging device to detect cancer or to make stronger materials for use in more demanding environments.

During the interview, we learned that MicroQuaD currently is not a portable device but could fit in a server rack, so the size of the technology would not be ideal. We also learned that MicroQuaD requires freezing temperatures of 2.5 Kelvin, which would mean very high operating costs. Due to the temperature requirements, the startup time of MicroQuaD will also be approximately 6 hours. The power consumption of MicroQuaD depends on the type of compressor; for example, the F20L is ~2.3 kW, and CNA-11 is ~1.3 kW. MicroQuaD had not tested the solution with an uninterruptable power supply (UPS).

The cost of MicroQuaD technology depends on the setup of MicroQuaD, such as how many detectors are used or if microscopes are included. The cheapest price range quoted by Benedetta was €40,000 – €70,000, and the most expensive setup delivered was €500,000 with the best detectors. Benedetta estimated the average market price would be around €300,000. Benedetta estimated that an uninterrupted power supply (UPS) would also add approximately €100,000 – €150,000 to the cost of the technology.

In summary, from the interview, we learned that the MicroQuaD technology would be too expensive for our intended use case, both as a one-time and operational cost. The size of the machine could be better, but since the device could be rack-mounted, it could be used in a mobile unit. Also, due to the long setup time and high power requirements, it would not be suitable for operations in the developing world, where the energy supply could be more reliable, especially with the added cost of using a UPS to run the solution.

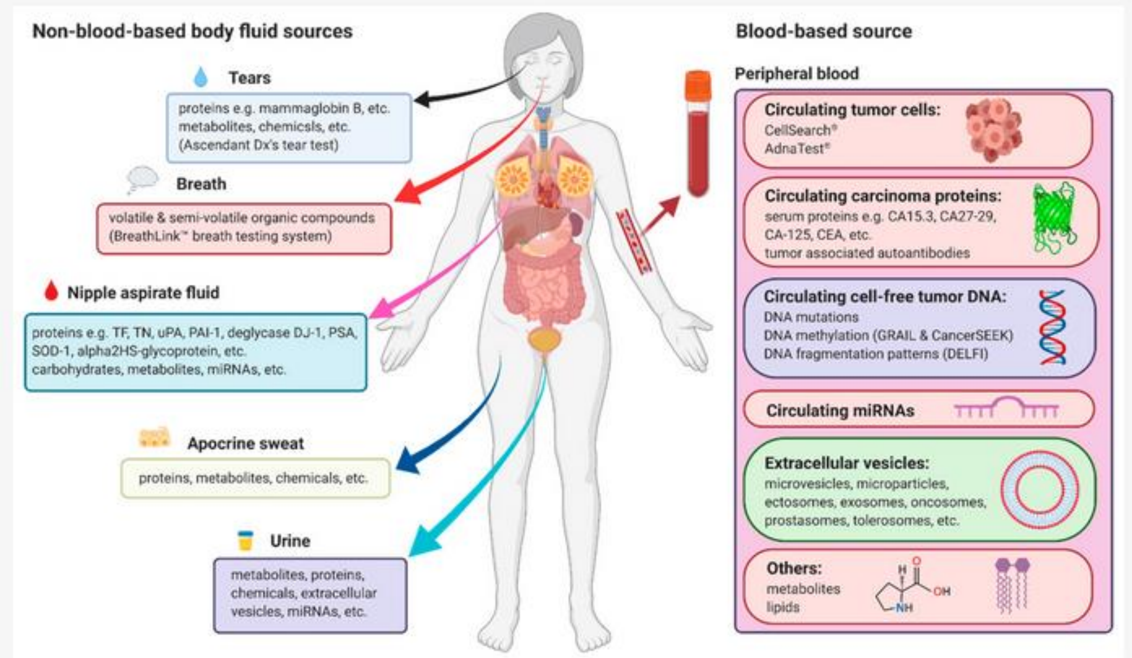
3.2.3 HipMed

Professor Yuval Garini at Technion and BINA, founder and scientific advisor at HipMed/Pentaomix, was interviewed before CERN week. Three team members arranged the interview on 30 May, which was done in Teams.

HipMed offers a cutting-edge solution for cancer prognosis using advanced optical systems based on spectral imaging. Integrating a specialized kit containing multiple probes to detect specific proteins or genes in biopsies, the HipMed system provides a comprehensive profile of cancer cells, aiding personalized drug matching and treatment decisions. Innovative lens revolutionizes cancer visualization by colorizing multiple biomarkers on a single sample slide, enabling rapid hyperspectral scanning and AI-based decision-support tools for fast, accurate diagnosis.

Before the interview, we thought that possible usages of this technology for our project were early detection and diagnosis, facilitated research and innovation to support efforts to understand the underlying mechanisms of cancers and other diseases, personalized treatment matching based on a detailed profile of cancer cells, improved disease monitoring and management to treat more effectively by adjusting treatment regimens, adaptation of HipMed for integration with low-tech accessories, such as smartphones or basic digital cameras, make analysis technology available on open-source medical imaging platforms and promote creating low-cost imaging solutions, remote diagnosis equipped with HipMed technology can extend diagnostic capabilities to underserved areas, equip community health centres and mobile clinics with portable versions of HipMed technology to enable on-site diagnosis in remote or rural areas and integration of HipMed with existing cancer screening programs, such as mammography or cervical screening, to increase their effectiveness.

The input of this interview and technology was that we looked more into noninvasive measurements presented in picture 6 and saw the potential this technology offered to our project since one of its applications could be to measure different cancers and other noncommunicable diseases from bodily fluids. Also, although the production of the optical lens would cost around US$ 200, the rest of the machine could be produced from cheap materials, and the technology provided the possibility of a portable size. This technology fits well with our original thoughts about the possibilities we needed to consider in our project.



Picture 6: An overview of current sources and main measurement types of noninvasive biomarkers for early detection of breast cancer (Li, Guan, Fan, Ching, Li, Wang, Cao & Liu 2020).

3.2.4 Christopher “Kit” Vaughan

Christopher Vaughan is an Emeritus Professor of Biomedical Engineering at the University of Cape Town in South Africa and the CEO of CapeRay. We read his journal article published in the Medical Engineering and Physics in 2019 titled “Novel imaging approaches to screen for breast cancer: Recent advances and future prospects”. As the article is very much linked to the scope of our research projects, we decided to contact Prof. Vaughan. He agreed to be interviewed for the project. Also, he made it clear that he does have a conflict of interest as he is also the CEO of the medical technology company CapeRay.

In the interview, we concentrated on technological solutions for breast cancer detection. We wanted to know about current mammography equipment and promising novel technologies. We learned that mobile handheld devices can link to ultrasound technology and fully automated breast ultrasound systems with large and robust structures. The price range of the devices on the market was between US$ 5,000 and US$ 200,000.

The most exciting technologies Prof. Vaughan mentioned were the Intelligent Breast Exam (IBE) and BlueBox – solution. The IBE solution uses mechanical movement to measure the stiffness of the breast tissue and, this way, tries to locate the abnormalities. This device can be used to locate the cancer if there are other indications of cancer present. BlueBox is urine sampling, which detects cancer-related proteins from the body fluid. We concentrated on the analysis of the body fluids for cancer detection. The accuracy of the BlueBox solution was measured to be higher than that of traditional mammography examinations. Blood would give the best protein detection results, but other bodily fluids, such as tears, could be used for the analysis. We briefly talked about breath analysis, which could also have potential.

After going through the technologies, we briefly discussed the process of breast cancer screening, from diagnosis to treatment. Prof. Vaughan described it as having three main phases: diagnosis, biopsy and pathology, and treatment (surgery, chemotherapy, radiation). We were talking about the possible alternative technologies for the treatment of breast cancer. There are no natural alternatives for the traditional treatment on the market. Technological development is making the biopsy related equipment smaller and more straightforward. For the treatment there are no cheap alternatives, but with a highly qualified surgeon it could be possible to treat breast cancer also in field-like environments.

3.2.5 Scope Impact

Scope Impact Oy is a Finnish-based company that aims to promote and protect health in an unstable and changing climate by designing and scaling new climate-resilient and community-based health solutions. They are mainly focused on developing countries in Africa and South-East Asia. The Interview was held during CERN Bootcamp on 5 June via Teams, and participants were the CEO and Co-Founder of Scope Impact, Mari Tikkanen, who is also the Co-Founder and Innovation Advisor of The Missing Billion Initiative, a health system-change organization, and three team members from our team Healthspotting. Paula Tanhuanpää, our team's contact in the Finnish Institute for Health and Welfare's International Affairs Team, supported the interview.

Instead of a technology-oriented approach, with Scope Impact, we were more interested in how healthcare services and solutions are implemented in developing countries. Mrs Tikkanen started with her career story and how she ended up working as a social worker in developing countries. That was an excellent introduction to our actual discussion and topic. Then she moved to the founding of Scope Impact and how it was, from the very beginning, missionary to help everybody have the right to live a healthy, dignified and fulfilling life. Mrs Tikkanen pointed out the essence of gathering and analyzing the existing scientific data when starting implementation in the target country. She also mentioned the importance of stakeholder analysis, e.g. considering the governmental situation and political environment and a need for ethnographic research. Next, we were told more about their service design system or "micro trial", as they call their concept in Scope Impact. That process contains different design stages, from background information collection and analysis to scope definition and implementation.

The interview with Scope Impact was conducted from our group's point of view due to the aspects and understanding we learned from Mrs Tikkanen. She led us to consider the cultural differences between different countries and how they should be tackled before heading too far with a solution. We also learned that the differences between countries and their cultures do not mean the solutions will be non-scalable since treatment or a cure may rather easily be transferred from one country to another when cultural things are considered in advance. One major thing which came up in our interview was the idea of localization for our solution. In this idea, we should start in a country with some healthcare infrastructure since implementing new processes and technology will be challenging, if not impossible, in countries with very immature healthcare systems. As a result of this thinking, we ended up focusing our project on Sri Lanka, which already has some level of (public) healthcare system but still has a big difference in income and living standards between the poorest and wealthiest part of the population.

3.2.6 H-Cube

The H-Cube interview was during the Bootcamp on 4 June. Three team members and Patrizia Lamberti, Professor of Electrical Engineering at Università degli Studi di Salerno, representing H-Cube, attended the interview. Before the interview, possible use cases for H-Cube were in imaging to detect noncommunicable diseases in early stages and that the device seemed portable based on our research.

During the interview, we learned from Patrizia that cancer detection was a use case they had been researching, but the primary focus was on food sciences and material properties. The estimated cost for an H-Cube device was €1,000, but Patrizia emphasized that this is a very early estimate and that they currently have no competitors. H-Cube is a portable device that does not require high energy. No climate testing was done on H-Cube devices, so how they would operate at this stage in different climates is unknown. However, we did learn that it does not require a specific temperature to operate like MicroQuaD. Power consumption of the technology is low, and no accurate numbers were given in the interview. The device can see through objects as long as it is within 1 centimeter of the measured unit. Currently, the technology has not been used to analyze fluids like tears or blood, and the velocity of fluid might be an issue for the technology.

Based on the interview, we learned that H-Cube shows promise in detecting breast cancer at its early stages for imaging purposes. However, further research on the technology is required, and it has yet to be ready for this purpose. The price, portability, and energy requirements fit well within our intended use case for the technology.

3.2.7 Prof. Bettina Borisch

Professor Bettina Borisch works at the University of Geneva's Institute of Global Health. Her speciality is breast cancer and global health. We found contact information for Prof. Borisch due to information research regarding breast cancer treatment in Europe. She is also the president of the European breast cancer forum Europa Donna and the CEO of WFPHA. We contacted the Institute of Global Health, including Prof. Borisch and three other faculty researchers. Our wish was to get some insight from the Swiss institute. To our surprise, Prof. Borisch was happy to talk with us.

The interview turned into an intensive conversation which went from the North Karelia Project and the success story of the Finnish Public Healthcare System to more or less grim details of breast cancer. Prof. Borisch also has an educational background in pathology, so she could very well explain how cancer looks and feels in concrete examples. The link to the SDG 5, which is related to the equality of the genders, was one of the main guidelines in the interview. We learned a lot about the reality of breast cancer and how it is affecting the lives of millions of women.

Breast cancer is a systemic problem. The solution for this is not technical but political, as has already appeared in our group workshop. There are all the means for cheap screening and detection if the pricing would have a social factor on it. The interview, which turned into a conversation, circled fundamental ethical issues. The core medical ethical consideration is the difference between rich and poor. This fundamental issue of medical poverty can be scaled up into societies or down to the micro-level. As we learnt earlier, in many parts of the world, breast cancer diagnosis is a death sentence. In other parts of the world, it can be as devastating and mean personal bankruptcy.

The interview with Prof. Borisch was highly inspiring, and having this insight at the beginning of the project would have been beneficial. Although we did not know where to look for this kind of insight at that time. All in all, the last interview was very meaningful for the project, and it also steered the solution. Before the interview, we changed our scope on the economic dimension of our solution to more of a socio-political issue from a rather monetary approach.

3.3 Unsuccesful interviews

3.3.1 WHO

World Health Organization (WHO) has headquarters in Geneva, Switzerland. Interviewing WHO about our portable and affordable cancer detection tool for the developing world was important for many reasons. Firstly, it would help us ensure that our planned portable device aligns with global health standards and regulatory requirements. Learning from WHO experts could provide valuable technical advice and expert opinions to improve our device's effectiveness. Additionally, understanding WHO's assessment of health priorities could teach us about the geographical targeting we should focus on at the start and help us ensure our device addresses the region's most pressing cancer detection needs.

Moreover, engaging with WHO would help us understand the challenges and barriers to implementing such solutions in the developing world. This knowledge would allow us to anticipate and address potential issues early on. By understanding the specific obstacles, whether they are related to infrastructure, cultural acceptance, or logistical constraints, we could adjust our proposal to be more practical and effective.

Learning about WHO's point of view on the challenges of early cancer detection solutions will help us understand and plan that our approach is both realistic and impactful.

On 29 May, we sent an interview request to WHO to the only contact found on their website, proposing an interview at any time on Tuesday, 4 June, or Wednesday, 5 June. Only an automated response was received from the email address. Ultimately, we reached out too late for an interview with WHO.

3.3.2 Optical Imaging Laboratory, University of Michigan, USA

We discovered the Optical Imaging Laboratory at the University of Michigan in the USA during our data-gathering steps. This was explicitly interesting for our intended project to learn more about the technical possibilities for low-tech and affordable solutions for breast cancer screenings. The lab is focused on developing innovative optical and ultrasound-based imaging and sensing technologies for biomedical applications. One area of particular interest is photoacoustic imaging, also known as optoacoustic imaging. This technique combines the benefits of light and sound, enabling high-sensitivity imaging in deep biological tissues with excellent spatial resolution. Potential clinical applications for this technology include inflammatory arthritis, breast cancer, prostate cancer, liver conditions, eye conditions, bowel disease, bladder cancer, and brain disorders. (Wang 2024)

The professor of the lab, Xueding Wang, PhD, was contacted via email on 29 May, and a short explanation of our team and project was given with a proposal for an interview at any time on 4 June or 5 June, but unfortunately, no response was received. No reminders were sent as we already had scheduled an interview with Christopher Vaughan, who could provide similar expertise for us to advance on our project.

3.3.3 NGOs in Africa

Throughout the project, we were in contact with several NGOs working in Africa on women's health, newborns, cancer and noncommunicable diseases. The list is long: Maternity Africa, Diabetes South Africa, Doctors with Africa, Africa Cancer Foundation, Healthy Newborn Network, ChooseLife, and Save The Mothers, among others that we lost track of.

Among these attempts, only Amref Health Africa showed solidarity in helping us. Hope Ahipeaud responded to some of our emails and recommended someone at the NGO whom we could interview. However, this other person said that because it was a small and busy team, they did not have enough time to commit to an interview or answer any questions.

Through shared connections, we also contacted some other professionals without much success, such as Dr. Cary Adams, CEO of the Union for International Cancer Control, and Soumya Swaminathan, Chief Scientist at the World Health Organization. Among these contacts, we quickly talked to Audrey Midavaine, Health Coordinator at the International Committee of the Red Cross. However, we could not schedule an interview in time as it was short notice.

3.3.4 SNIFFDRONE

SNIFFDRONE was identified as a secondary technology of low relevance to our use case. During our workshop, before we had set the scope as breast cancer, we identified that SNIFFDRONE could be used to detect noncommunicable diseases like diabetes from breath and to help prevent lung cancer from forest fires that SNIFFDRONE could detect. Also, the drones used in the SNIFFDRONE could be used to deliver our planned portable solution, but any drone could achieve the same, so the electric nose technology would not bring us any value in this use case. Agustín Gutiérrez-Gálvez from SNIFFDRONE Technology was reached out to twice before the Bootcamp in CERN, but we never received any response. During the Bootcamp, we discussed the possibility of this technology with the teachers, and since the technology was so distant from our use case, we as a group agreed not to follow up on SNIFFDRONE any further and decided to drop it from the technology considerations for our project.

4 Final solution

4.1 Technical solution

Our project's final technical solution is based on a mobile screening capability. The core of the solution is proteins related to cancers. By understanding and defining the different proteins' qualities, they can be detected by various means. For the ATTRACT technologies we evaluated toward our needs, we selected the two most promising ones, HipMed for protein detection and H-Cube for physical examination. Proteins can be detected from various bodily fluids, such as urine, blood, tears, and even breath. As one of our scopes was to find a painless solution for the screening, we decided to sort out all invasive methods, which reduced our consideration of whether urine and tears should be used as the source for analysis.

Our choice was to proceed with tear sampling as the method. The technical solution would require the capability to detect specific cancer-related proteins from the tear samples. We approached the HipMed solution after interviewing the research team. HipMed technology could provide a low-cost solution for imaging the samples and finding the markers on a microscopic level. The solution would require learning artificial intelligence to develop the analysis further with growing samples. The sample analysis could be done in field environments and would not need any expensive machinery or highly qualified staff to operate it. Once the sample is given, it will be pictured by a handheld device capable of microscopic-level imaging. The image would then be sent to the cloud, where it would be analyzed, and the result would be given relatively quickly.

The first phase of our technical solution concentrates on detecting the presence of cancer-related proteins in the body. It can recognize specific proteins linked to, for example, breast cancer, which, in our case, is the relevant link, so it can examine where the cancer is located. Once we know that there are breast cancer-related proteins in the body, we have to physically examine both of the breasts. Once a positive result is detected, the next step is to locate the cancer.

For the physical examination, we are considering utilizing the H-cube technology. Much like the Intelligent Breast Examination machine mentioned in the Kit Vaughan interview, we could use THz technology to examine the breast, looking for differences in tissue density. The methodology of the solution is quite straightforward. Both breasts would be wave-examined by a handhold THz emitter, which could also receive the bouncing waves and create an image from them.

Together, these two technical solutions could provide a reliable basis for the subsequent phases of the treatment. Once we get the pre-screening with the body fluid analysis and then after a positive sample, we could use the H-cube technology-based solution to locate the source for the detected proteins. Both technologies are based on imaging, so with the use of learning artificial intelligence solutions, the accuracy of the diagnosis would get better with higher numbers of samples.

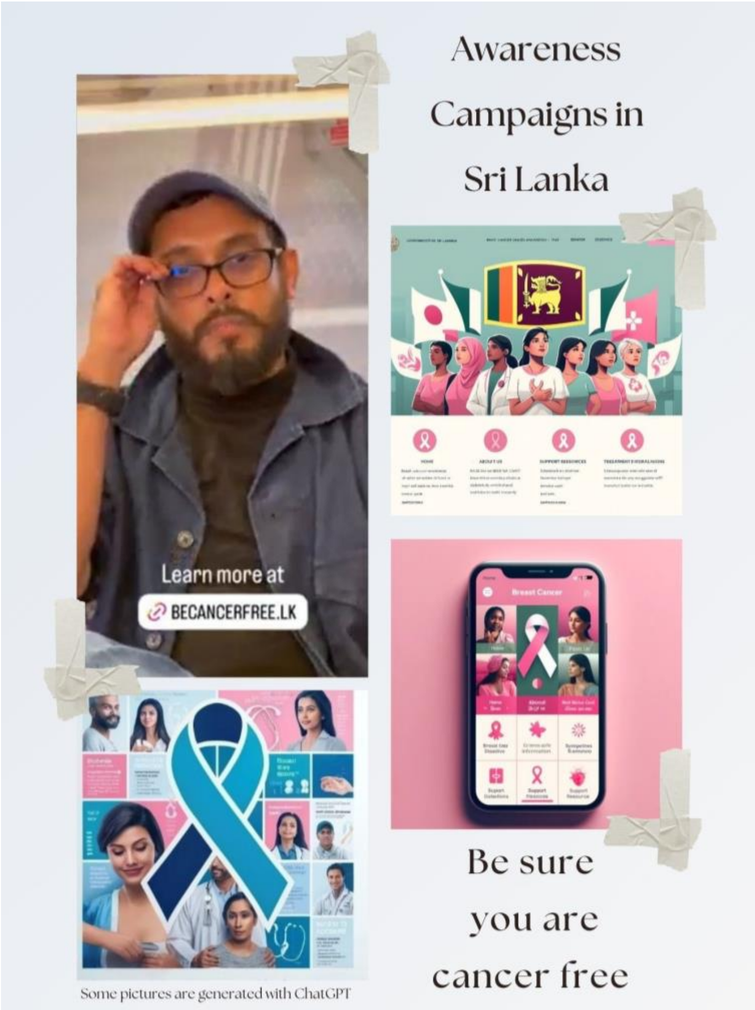
4.2 Social awareness campaign

Due to profound cultural, infrastructural and governmental differences in developing countries, raising awareness plays a crucial part in introducing and implementing innovations or concepts of healthcare to people's lives. After the interview with Scope Impact's CEO, it was clear that raising awareness and concentrating on developing countries and their secondary cities instead of rural areas would be a sensible approach for our project. Approaching rural areas in developing countries directly could create an overpowering conflict between the existing atmosphere of understanding healthcare and the reachable goal of producing healthcare.

Cultures in different continents and countries are structured differently and typically based on religions. Often, outside democratic countries, cultures are very patriarchal. So, reaching men as heads of families, tribes, or villages needs to be a priority, in addition to educating women. Raising awareness addresses fears, lack of knowledge and belief systems based on historical, cultural, religious and tribal traditions. Raising awareness requires tight collaboration with influencers of the communities and educating them first, whether they are social media role models, religious figures, healthcare providers or advisors, healers or any other figures influencing people and increasing trust.

The CEO of Scope Impact recommended our Proof-of-Concept country, Sri Lanka since it still is a developing country but is in the process of development. The Sri Lankan government has implied readiness to improve the lives of its citizens and invest in healthcare. According to the digital statistics presented by Kemp (2024), the total population of Sri Lanka is 21.92 million, of which 80.6% live in rural areas. Sri Lankan people have 32.49 million active cellular mobile connections, 12.34 million of the population are internet users and 7.5 million social media users. According to Countrymeters statistics (2024), 92.64% of the adult population and 98.76% of youth can read and write.

As a part of our project, we designed an awareness campaign for the Sri Lankan government, which included an Instagram influencer video, posters, and the design of the government webpage (Picture 7). We researched different channels from Sri Lanka's point of view, like Instagram, TikTok, Facebook, and other actual web pages and services provided now by Sri Lanka's government, such as the Ministry of Health. We also considered newspapers and magazines, television, and other advertising, such as posters and educative lectures, as channels to raise awareness during these campaigns.



Picture 7: Designed breast cancer campaigns for Sri Lankan people

4.3 Ethical & cultural considerations

Our awareness of healthcare ethical and cultural issues continuously increased during group work. In the very beginning, we already considered the need for exceptional sensitivity when acting with different ethnic cultures and minorities as well as with different genders. Developing awareness started to progress when we analyzed background information, especially throughout the interviews, which were highly comprehensive when considering not only technological solutions but also change management in healthcare business and operations — especially the interviews with Scope Impact's CEO Mari Tikkanen and University of Geneva's Prof. Bettina Borisch were eye-opening in the case of ethical thinking, values and cultural learning.

From our project's point of view, at least three situations were discovered where ethical and cultural considerations were pointed out. Firstly, we started with technology interviews, which taught us to consider different technical solutions and how they can deal with ethics. On a basic level, there is always the concern for customer, end user and patient data when operating inside a healthcare business. When using machines and tools to collect sensitive data, one must ensure the data is handled and stored considering the laws (e.g. GDPR) and data management best practices. We also had this question for every technology provider: have they met any ethical issues during their solution development and productization stages? All the providers were seemingly well aware of possible ethical issues. As shared earlier, Random Power told us they have a clear principle that their technology will not be sold for military purposes. We also learned that new technology is not always a threat but also a possibility since new solutions often make certain healthcare operations easier to proceed, which makes them more adaptable for the customers, e.g. because they are less painful. This was pointed out in our prototype, where a solution for low-tech breast cancer detection was built, and the often painful stage of mammography could be removed from the process.

Secondly, we learned, especially from Scope Impact's experience, how new concepts are implemented in developing countries. New technology itself is not usually very problematic to implement in different cultures. Instead, the focus should be more on implementing a whole new concept in a new environment. Therefore, there are usually many cultural issues to overcome. Among these are religion, the relationship between man and woman, and family hierarchies. A typical issue is a situation where a new treatment is available, but the customer cannot trust medical personnel or treatments and instead is much rather willing to contact the village leader or local non-educated DIY doctor for a cure. This situation can be challenging and be tackled by raising awareness, e.g., by creating advertising campaigns. In our solution, we chose Sri Lanka as our Proof-of-Concept -target country due to the fact that there is already some level of (public) healthcare infrastructure, and people are at least some levels aware of it. Also, in Sri Lanka, there are social media and internet users, which offers some possibilities for easier information delivery and campaigns by using local influencers. However, it is also essential to understand the local culture on many levels, including language, since different kinds of advertising campaigns should use suitable and sensitive language to ensure that the message reaches as many people as possible.

Finally, our learning process expanded on the overall level to consider some basic principles of healthcare ethics. Since our solution was targeting early breast cancer detection among women in developing countries, it was rather evident that we were working on a compassionate challenge. In developing countries, the diagnosis of breast cancer means, most often, a death sentence to the patient, which is psychologically highly depressing. The situation becomes even more complicated since breast cancer is not only a matter of one person's life, but it also will have an effect on the whole family's life in a situation where the mother of the family will most probably die, and this causes a great uncertainty to the family's life. This point of view stood out exceptionally well in our interview with Prof. Bettina Borisch, who first pointed out the fundamental principle in healthcare ethics: we are not allowed to diagnose or detect any diseases if we cannot offer treatment. This principle was one of our main guidelines when understanding the fundamentals of new healthcare ecosystem implementations. Many diseases like breast cancer can also cause a societal stigma on a person who has come down with it, which can make the disease more taboo-like and which, again, therefore, will prevent the willingness to apply a proper treatment. In our case, we also learned about thinking about the problem as a whole and therefore considering the meaning and status of the family in a process, which first-hand was showing up as a problem of one single person, but which then enlarged to consider a much larger part of society.

4.4 Limitations of the approach

The implementation of Instascan relies heavily on the technological reliability and validation of the Attract technologies, HipMed and H-Cube. However, several limitations became apparent during our evaluation.

4.4.1 Technical limitations

Our research with the HipMed scientists revealed an intriguing potential application: analyzing bodily fluids to detect cancer by identifying specific proteins. For instance, proteins found in tears could be analyzed for early cancer detection. However, the AI model designed to work with HipMed has not yet been trained to detect cancer automatically from these samples. This gap in the AI's training is a limiting factor for using HipMed for our intended purpose at this stage. The development and training of this AI model are necessary to realize HipMed's full potential in noninvasive cancer detection.

The noninvasive cancer detection provided by HipMed can only detect if there are cancerous proteins but cannot tell where the cancer would be. For this, an imaging solution will be necessary to locate the cancer and perform further operations. Our plan for this would be to use H-Cube as an imaging tool. However, the capability of H-Cube to detect cancer through noninvasive means requires more validation. Initial research indicated potential, according to the interviews, but the technology had primarily been used for applications in food sciences and material properties. The H-Cube team has considered cancer detection, but it is not their priority currently. Adapting H-Cube for medical imaging and cancer detection required rigorous testing to confirm its effectiveness and reliability.

Cost considerations also played a significant role in evaluating H-Cube. The estimated cost of an H-Cube device was around €1,000, which was a rough early estimate. In the interview, the

H-Cube team also emphasized that they currently have no competition so that prices can increase substantially. Alternative solutions also exist in the market, like iBreastExam, with the price currently set at US$ 4,800, including 400 scans, so US$ 12 per scan (IBreastExam 2024). According to our interviews with Christopher Vaughan, the current on-market device IbreastExam requires medical expertise for effective diagnosis. Our plan to overcome this would be to utilize the HipMed model to detect the cancer, but the model is currently not ready and has not been tested.

The deployment of Instascan would need to consider the logistical and infrastructural challenges of delivering healthcare in remote and underserved areas. Ensuring a reliable power supply, maintaining the devices and providing the necessary infrastructure for widespread screening would be significant hurdles. This is why we planned to do the Proof-of-Concept in a limited setting of secondary cities in Sri Lanka before a more extensive deployment to the rest of the country and eventually the rest of South East Asia. These logistical issues must be resolved during the multistep deployment process to ensure consistent and effective use of the screening technology. Without addressing these challenges, implementing Instascan could lead to inequitable healthcare access, where only certain regions or populations benefit from the technology.

4.4.2 Cultural and ethical considerations

One of the primary cultural challenges identified was the stigma associated with cancer in many developing regions. In these areas, cancer is often viewed as a death sentence, leading to fear, denial, and avoidance of screening. This cultural stigma would make it difficult to encourage individuals to participate in cancer screening programs. Overcoming these beliefs would require a pathway for the patients to get treatment for the cancer if it is detected and also substantial education and awareness campaigns. Currently, there is a substantial lack of radiotherapy devices in the developing world, which is the most common way to treat breast cancer. In our proposed Proof-of-Concept country, Sri Lanka, there is less than one radiotherapy device per 1 million people available, and the situation is even worse in some parts of the developing world. (Dosanjh & Ige 2024)

Another significant ethical consideration identified was whether screening for cancer in regions where treatment options are limited or non-existent would be appropriate. In many developing countries, even if cancer is detected early, there might not be adequate facilities or resources to provide effective treatment. This raises a critical ethical dilemma: is it ethical to diagnose a disease if no treatment is available? Screening for cancer without the means to treat it could lead to increased anxiety and despair among patients and their families. The knowledge of having an untreatable disease might worsen the psychological and emotional wellbeing of individuals, potentially causing more harm than good. This ethical issue would require careful consideration and planning. It would be imperative to ensure that screening programs are accompanied by efforts to improve treatment infrastructure and access. Collaborating with governments and non-governmental organizations to develop treatment facilities and train healthcare providers would be essential to address this ethical concern.

4.5 Need for further development

As our project's solution is based on cancer diagnosis, we recognize the need for further development regarding the solution. Our solution can help hundreds of millions of women who are not screened currently. Nevertheless, for the screening to be reasonable, there has to be a healthcare system which can treat the diagnosed cancer. Our solution is only partial to the problem at hand. Further technological development is needed to provide higher access rates to cancer treatment. Technological solutions make the medical devices needed for the treatment cheaper.

One prominent development area is the awareness and knowledge regarding breast cancer. The disease is mainly women's disease, with only 1% of the diagnoses given to men. It might be ironic to think that on this issue, the solution lies behind the 1% if we think the breast cancer mortality rates among women population are not changing without a change in the patriarchal global political system. This does not mean revolution or anything radical. The change needed is proper funding for the breast cancer problem and a determined will to solve the problem.

Technology can help and support decision-making, but still socio-political problems cannot be solved by technology. They need political determination and funding. The leading further development on the SDG 3 regarding breast cancer would be lobbying the political decision-makers to understand the situation and reality which millions of women are facing. And as Prof. Borisch stated in our interview, "If you could solve the SDG 5, then nine other SDGs would be solved as well". Inequality is a social phenomenon, and technological solutions can only help specific points, after which the actions have to be political.

5 Conclusion and reflection

Our project aimed to address a critical issue in global health: the accessibility and affordability of breast cancer screening in developing countries. Our proposal, Instascan, leverages advanced technologies from HipMed and H-Cube to create a portable, noninvasive breast cancer screening solution that is also pain-free. While the project presents promising potential, several vital conclusions and reflections emerged throughout our research and development process.

Firstly, the project's foundation rests on the integration of sophisticated technologies. HipMed's spectral imaging and H-Cube's imaging capabilities offer a unique combination for early cancer detection. However, the readiness of these technologies for practical application remains a concern. HipMed's AI model, which is crucial for detecting cancer from bodily fluids, is not yet fully trained for automatic cancer detection. This limitation highlights the need for further development and validation to ensure reliable and accurate results. Similarly, H-Cube, primarily used in food sciences, requires extensive testing to confirm its efficacy in medical imaging for cancer detection. These technological gaps underline the necessity for continued research and development before Instascan can be effectively deployed.

The project also confronted significant cultural and ethical challenges. In many developing countries, cancer carries a substantial stigma, often viewed as a death sentence. This perception can deter individuals from participating in screening programs, fearing the worst outcome. Addressing these cultural barriers requires extensive awareness campaigns and education to change negative perceptions and encourage early detection. Additionally, the ethical dilemma of screening for cancer when treatment options are scarce or non-existent poses a critical question: is it ethical to diagnose a disease if no treatment is available? Screening without accessible treatment can lead to increased anxiety and despair among patients. Thus, screening programs must be accompanied by efforts to improve treatment infrastructure and access, ensuring that patients diagnosed with cancer have a pathway to effective care.

The logistical and infrastructural challenges of deploying Instascan in remote and underserved areas also demand careful consideration. Significant hurdles are ensuring a reliable power supply, maintaining the devices, and providing the necessary infrastructure for widespread screening. Our plan to implement a Proof-of-Concept in secondary cities in Sri Lanka before a more significant deployment reflects a pragmatic approach to addressing these challenges. This phased deployment strategy allows for identifying and resolving logistical issues in a controlled environment before scaling up.

Financial considerations play a crucial role in the project's feasibility. While the estimated cost of an H-Cube device is around €1,000, the actual expenses could be higher. Ensuring that the technology remains affordable is essential for its scalability and accessibility in low-resource settings. The comparison with existing solutions like iBreastExam, which costs US$

4,800 for 400 scans, highlights the importance of developing a cost-effective alternative that does not require specialized medical expertise for diagnosis (IBreastExam 2024).

In conclusion, the Instascan project offers a promising approach to improving breast cancer screening in developing countries. However, the successful implementation of this proposal hinges on addressing several key challenges: the technological readiness of HipMed and H-Cube, cultural and ethical considerations, logistical and infrastructural constraints, and financial feasibility. By focusing on these areas, the project can move closer to its goal of enhancing early cancer detection and improving healthcare outcomes in underserved regions. This project's journey underscores the complexity of translating innovative technologies into practical solutions that can impact global health.

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Appendix

Appendix 1: ATTRACT technology interview questions

1. What is the best application of your technology?
2. Are there any existing technologies provide similar solutions? What is the benefit of your technology over the existing solutions?
3. What kind of medical or healthcare applications can your technology have?
4. What measures are you implementing to make your solution affordable for the developing world?
5. How do you see non-commercial partnerships (like governments and NGO's) in developing your technology?
6. How do you plan to establish these collaborations?
7. Can you share examples of unexpected applications or impact of your technology that have emerged during its development or deployment?

To be skipped if no time

8. How do you envision your technology evolving in the next five to ten years?
9. How can your technology help in screening noncommunicable diseases?
10. Any ethical considerations that should be taken into mind?
11. How does your technology integrate with existing health and environmental monitoring systems in underserved areas?