# Project Report

## Introduction

Imasenic is a fab-less semiconductor company driven by innovation. Since 2017, Imasenic has been dedicatedly providing global customers from different fields with innovative custom products to solve their problems. Innovation is one of the main advantages of Imasenic, making it easy for the company to adapt its product to the clients' needs. Thanks to the expertise, Imasenic can also provide advisory services and the best solution for the client.

This report is carried out by a multidisciplinary group composed of 5 students from business, technology, and design background aiming to find the best application for the technologies of Imasenic. As is mentioned, Imasenic is capable of adapting to any field, leading to a very challenging task to search for the best solution having such a big potential market.

## Research

We were presented with two different technologies to potentially work with. One is capable of counting single photons and the other one is a hyperspectral camera. We started looking for potential markets for both technologies, analyzing the viability in those markets, and interviewing people from relevant fields - not only experts and companies, but also end-users that could give us a better understanding of their needs and difficulties in their daily routine.

After a thorough analysis, we decided whether a market was reachable or not, depending on the data we were able to collect from internet research, interviews, and potential applicability. Of course, part of the research involved understanding the technology that is used nowadays in every market, the actual and future competitors, how big the final market is, if we need a business ally to succeed in the market, et cetera. Without entering deeply into each market, we went through, we came up with several ideas, from aquatic cameras applied in dark water or oceans to the detection of bank notes counterfeit, rotten food detection, or art fraud detection. Among all the possibilities that we found, one between all caught our attention in the end: customizable glasses for color vision deficiency.

## Context

In the following chapter, first of all, we would explain the reason why we chose this market by introducing a normal day of Ine's life. Ines is a 23-year-old girl who lives in Barcelona, and she is color blind.

She gets up in the morning, and the first problem she encounters is choosing her outfit. She keeps it very simple, so that there would be little room for error and embarrassment.

She likes using lipliners and eyeliners from the same brand. However, once she mixed the two products and used lipliner on her eyes for the whole day, until a colleague asked if her eyes were bleeding. It was such an embarrassment for her. From that day, she always chooses different brands for her lipliners and eyeliners and confirms with a friend or family member if the color she uses is the correct one.

In commuting, although people like Ines are now allowed to drive in most countries, she does not feel safe doing it because she cannot rely on her eyesight. As a result, she prefers to take public transport or simply walk. When crossing the street, she waits for other passengers just to be safe.

At work, Ines has to ask colleagues for help frequently, because the pie charts and line graphs are always colored. Shopping is also an issue for her. She must reach out to strangers to ask what color it is. “Is it green, red, or violet? When it comes to cooking, Ines tends to overcook, just to ensure avoiding raw meat.

But she is just one example among over 350 million people who have the same struggle as her. Color vision deficiency affects every 1 in 12 men and 1 in 200 women. 75% of color-blind people ask co-workers to verify colors on a weekly or daily basis, more than 50% are worried about making mistakes at work because they are color-blind and finally, 80% believe that certain solutions can make them do their job better.

**Current solutions and technology**

Currently, there exist 3 major solutions in the color vision deficiency market.

The most interesting solution is gene therapy, which is still in the trial phase. It is to inject a virus that carries a specific gene into the body and hopefully, the body can retain it. There have been experiments showing that this therapy already works on monkeys – which means after the injection, the monkeys were able to see more colors. But the possible side effects are unknown, and it is unclear whether it would work safely on the human body. Besides, many people are reluctant to this kind of invasive therapy or needles.

The second solution is the apps. These apps can work on both smartphones and tablets. By scanning the items, users can get color names, select a color to highlight, and conduct a color vision test. The apps seem easy to use and helpful, but surprisingly, the colorblind people that we interviewed find the apps quite annoying because to use the apps, they have to take out their phones all the time, which leads to people’s attention and moments of embarrassment.

Another solution and the most accepted one by far are the glasses. They seem convenient, but the problem is that at the current stage, there are no glasses for all types or different degrees of color vision deficiencies. Also, the lenses are static and may not adjust perfectly to different environments, for example, between indoor and outdoor, day and night. But overall, people are satisfied with the idea. Some of them have already heard of the glasses and are willing to have a try.

Based on our research, we decided to find a solution that applies to everyone and benefits every type of color vision deficiency with the same product. Therefore, we opt for the idea of the glasses, that everyone loves, and improve the performance by using the app. To help our friend Ines and other 350 million people suffering from the same problem, we would install a hyperspectral camera on the glasses. This camera can capture shorter light spectrum intervals, so it has a higher sensitivity when detecting the contrast among different colors. Meanwhile, the images captured by the camera would be re-adapted and reproduced on the smart lenses. Since the glasses are connected to the app automatically, users can use the app to set their types and degrees of color vision deficiency, store images, and access the report showing how much their vision has been improved by our technology.

With this integrated solution, we can avoid the disadvantages that people mentioned regarding existing technologies. We are creating a pair of glasses that can solve the problem for everyone with color vision deficiency and help people in need to see the world efficiently and colorfully.

**Competition**

Traditional glasses for color vision deficiency use more than 100 layers of special optical coatings on the lenses. The role of these coatings is to interfere with the light entering the users' eyes, filtering photons of colors such as red and green to varying degrees based on different wavelengths, amplifying specific light waves, and allowing the colors seen to be brighter and more saturated, thus achieving the effect of enhanced color vision. The current mainstream competitor is Enchroma, whose glasses' prices are around $300. The advantage of our smart color-blind glasses is that they are highly customizable, which can use machine learning to continuously adjust the color presentation based on the customer's information and ultimately provide the most suitable color-blind glasses for the customer. Another advantage is the expandability of the

glasses, which can be equipped with more functions in the future due to their intelligent chip. Of course, the disadvantage is the charging and display problems. The current technology cannot achieve long life and lightweight. The future opportunities lie in the huge market and lower competitors. The future threat comes from Google and other technology companies that may use its powerful technology to directly manufacture smart glasses with the same function based on their existing intelligent devices.

**Prototype**

In order to tackle the challenges, we designed a futuristic smart glasses prototype. Currently, there is a growing demand for wearable devices, more specifically, smart glasses [1].

As is mentioned, there are already several companies that have decided to bet on this product, hence, our team decided to adopt a similar design. This way, our smart glasses are composed of two smart lenses, a small camera with a hyperspectral sensor, two speakers, and a frame that allows the integration of all the components previously described. Additionally, the glasses have three buttons, two to regulate the volume intensity of the sound that comes out of the speakers and the third that is used to turn on/off and reset the system.

These glasses were designed to be a very practical solution, as in the following example: I go shopping for clothes, I have doubts in relation to the shade of some trousers, I put on the glasses, select the most appropriate setting for my visual condition in the mobile application and by Bluetooth connection, the smart lenses adapt in order to show me the image with all the contrasts visible to the human eyes.

**Future Outcomes**

Although we designed this solution for a niche market, the population suffering from color vision deficiency, we decided to build a development plan for this technology in order to reuse it for other areas. In ten years, this technology could be used to allow the best allocation between different color tones and thus extract the best information from our surroundings. For instance, tomato farmers. When they put on the glasses and detect the ideal shade of red, they realize that it is time to harvest the tomatoes [2] . The glass could also help the doctors. By using the glasses, doctors can detect the tone of red presented in a patient’s tissue, accordingly

establishing the degree of oxygenation of the cells in real-time, allowing better monitoring of a surgical procedure [3].

In twenty years, through these sensors, we would be able to capture and perceive radiation invisible to the human eye, such as UV. In a first approach, our solution aims to correct the visual deficiency of part of the population, but in a more general perspective, having technology capable of distinguishing more tones than those that we are biologically able to perceive, we can revolutionize the world and expand our most frequently used sense, vision.

## References


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