Magic Eyewear

Farida Hesham, Ragaa Moustafa, Samiha Hussein, Yara Amr

May 4, 2021

Table 1: Document version history

Proposal Version	Date	Reason for Change
1.0	25-April-2021	Proposal First version's specifications are defined
2.0	4-May-2021	Final edited proposal version

GitHub: https://github.com/yaraamrsalah/Magic-Eyewear.

Abstract

Magic Eyewear is a virtual smart mirror (virtual try-on software) implementation that allows customers to view glasses virtually on themselves. It is not the foundation of virtual smart mirrors. However, it shall be the first Egypt-based virtual eyewear try-on software. This web application aims to tackle the issue of requiring to visit a physical store to find suitable glasses. In addition to that, this project ought to deliver Software Requirements Specification and Software Design Description documents. Magic Eyewear is an advanced application to develop. The main challenges of this project are creating a face-recognition software with accurate glasses-fit, the tight delivery timeline, and introducing Egyptians -especially adults- to an unfamiliar shopping method..

1 Introduction

Online shopping has recently become a necessity, especially with the presence of the Covid-19 pandemic. As helpful as shopping online is, it can put a barrier between the customer and having a real-life experience of the product. That is where virtual try-on software offers a helping hand.

1.1 Background

When it comes to purchasing apparel, eyewear, accessories, etc. it can be difficult to figure out which item will be most suitable. Hence why some E-Commerce websites are starting to implement aforementioned software as they provide an-almost hands-on experience of desirable items as well as the ability to try a variety of products. Within this context, eyewear is especially complicated and risky to buy online because to find a pair of glasses that perfectly fits the face, a person has to personally see how they look on them to decide whether they are suitable. Several international eyewear websites, such as EyeBuyDirect, [1] have already adopted a smart-mirror to allow customers to try glasses on before purchasing them. However, as for now, there are not any Egyptian stores that offer such a tool, making Eyecare Optics the first optics company in Egypt to provide customers with the ability to try-on glasses without the hassle of going to the physical store.

1.2 Problem Statement

There are countless physical eyewear shops. Nonetheless, visiting an on-ground store has become more of a hassle rather than helpful. It can be a waste of time to visit shops without the certainty of finding a suitable pair of glasses. And even with online shopping, more often than not, photographed products may not match the customer's expectations upon delivery, which wastes money -minimally the delivery fees-, and waiting time for the product to be delivered. This project aims to save time -and possibly money- by providing a virtual try-on software and ultimately making the users' online shopping experience a lot easier. In addition to making glasses more accessible without the obstacle of being unable to visit the store.

1.3 Motivation

1. This is an intriguing problem since despite it being so common, there have not yet been any solutions offered by Egyptian eyewear stores to fix it.
2. This issue occurs when people would like to buy glasses but do not want to go through the trouble of traditional shopping or are not sure if the frame they buy online will suit them.
3. The current solution is an at-home try-on option by Happy Vision. The customer can choose up to three frames to try them on at home.
4. A more convenient solution is introducing the Egyptian optics market to virtual try-on software and eventually encouraging all companies to provide more accessible products.

2 Project Description

Magic Eyewear mainly targets those looking to buy glasses, allowing them to try different frames through their laptops to know which glasses suit them the best without going to the store. Also, this feature will benefit the client and users by applying social distance, especially in this pandemic.
The following figure explains this project's architecture:

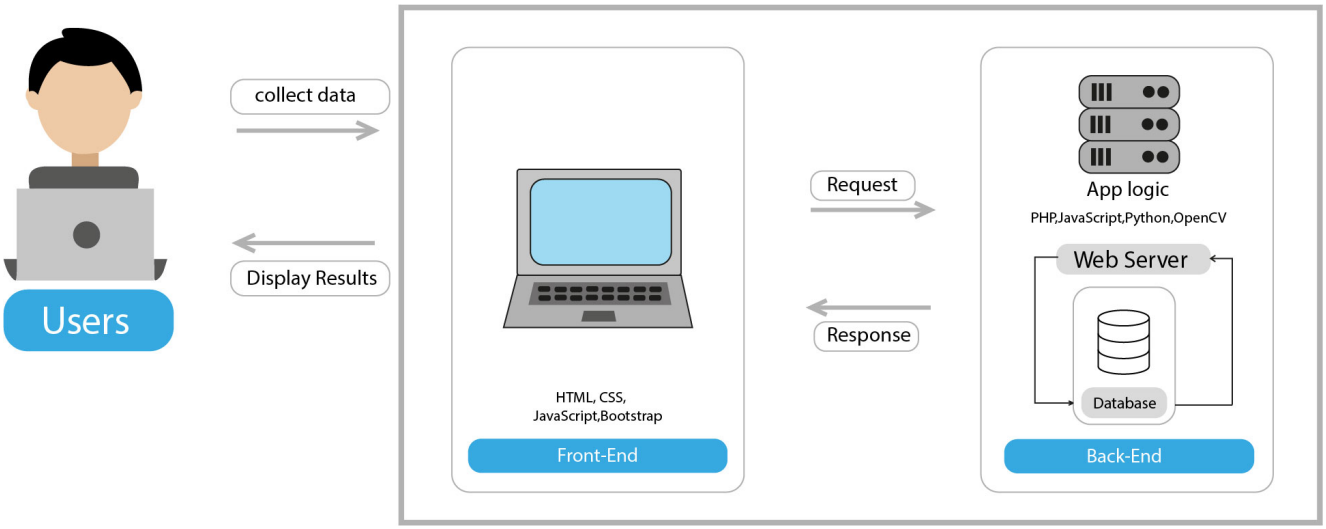

Figure 1: Magic Eyewear architecture

2.1 Objectives

- To help users find a suitable pair of glasses through virtually trying them on.
- To make finding specific glasses easier, the Navigation bar will have categories like Sunglasses, Eyeglasses, Sports, a guide to choose the right glasses based on the user's face shape, and About us.
- To reduce the time of searching, we will add filters to be easier for the user to reach the glasses he wants.

2.2 Stakeholder

2.2.1 Internal

The team's workflow will be based on the collective ownership technique while working on this project, which means all members will work on every part of the project. Moreover, every section in the proposal is divided equally among all team members, and the whole team will proofread it to provide a professional outcome. That said, the primary roles for each team member are:

Name	Role	Tasks
Yara Amr	Team Leader	Developing the face recognition feature
Farida Hesham	Team Member	Developing the face recognition feature
Samiha Hussein	Team Member	Developing the live try-on and adjusting frames on face
Ragaa Moustafa	Team Member	Developing the live try-on and adjusting frames on face

2.2.2 External

- Client: Eyecare Optics.
- End-Users: Online shoppers interested in buying frames and lenses online.

3 Similar Systems

3.1 Academic

Zhang, Qian, Yu Guo, [2] et al. discussed the issue of how eyeglasses frames are likely to look different after being equipped with prescribed lenses. The problem statement of this journal is that the frames available in stores are equipped with demo lenses that do not have corrective power. Therefore, they do not accurately deform the eyes due to unattainable refraction provided by glasses with corrective lenses. The team gathered preferences votes, and the results showed that SmartBuy Glasses (used in the software) prevailed over the other options. (see in Figure 3)

Algorithm 1 Shading Estimation

Input: intersection points p between camera rays and face geometry; color $I_{\text{noGlasses}}(\mathrm{p})$ from RGB image.
for each point p **do**
    $S_{\text{noGlasses}} = (0, 0, 0)$;
    $S_{\text{withGlasses}} = (0, 0, 0)$;
    Sample the hemisphere at p with weight w_i;
    for each sample point q_i in the hemisphere **do**
        ray direction $\vec{\mathrm{d}}_i = (\overrightarrow{\mathrm{pq}_i}) \,/\, \|\overrightarrow{\mathrm{pq}_i}\|$;
        $\mathrm{S}_i = \mathrm{w}_i$ * EnvMap($\vec{\mathrm{d}}_i$);
        $S_{\text{noGlasses}}$ += S_i;
        if ray $\overrightarrow{\mathrm{pq}_i}$ does not hit eyeglasses frame **then**
            $S_{\text{withGlasses}}$ += S_i;
        end if
    end for
    $I_{\text{withGlasses}} = (S_{\text{withGlasses}} \,/\, S_{\text{noGlasses}})$ * $I_{\text{noGlasses}}$;
end for
Output: color $I_{\text{withGlasses}}(\mathrm{p})$ at each intersection p.

Figure 2: Shading Estimation

The researchers aimed to solve this issue through **three** primary solutions:
- Generating a 3D representation of corrective lenses that fit the user's eyeglasses prescription and chosen frame. The algorithm followed can be viewed in Figure 2.

- Describing an image-based rendering technique for virtually inserting prescription glasses into the input video while taking into count the effects of refraction, reflection and shading
- Performed a user study that highlights the importance of refraction and reflection in the perceived realism of virtual try-on results

The journal is not only informative and detailed, but it is also straightforward, making it easy to understand despite not having prior knowledge about the topic. It covered one of the issues that face glasses wearers when purchasing a new frame -which is the lens problem. However, a limitation of this paper is that it only covered one side of the difficulties faced by people who wear glasses. To explain, it did not discuss how their software can save both time and money by allowing users to try optical glasses at home, which also fixes the accessibility problem.

TABLE II
VOTING RESULTS FOR VIRTUAL TRY-ON VIDEOS.

Preferences	with refraction, with reflection	without refraction, with reflection	with refraction, without reflection	without refraction, without reflection	SmartBuy-Glasses
with refraction, with reflection	-	62.50%	86.67%	87.50%	99.17%
without refraction, with reflection	-	-	74.17%	89.17%	100.00%
with refraction, without reflection	-	-	-	66.67%	97.50%
without refraction, without reflection	-	-	-	-	98.33%
SmartBuyGlasses	-	-	-	-	-

Figure 3: Voting Results

3.2 Business Applications

There are multiple applications in the software market that aim to provide the virtual eye-wear try-on experience, some of which are sophisticated, and others are of simpler structure;

Advanced Software Examples:

- Virtooal [3]
  Virtooal is a virtual try-on software for different wearables, one of which is eyewear. It accurately detects the face and provides a live fit of the glasses. (Figure 4)

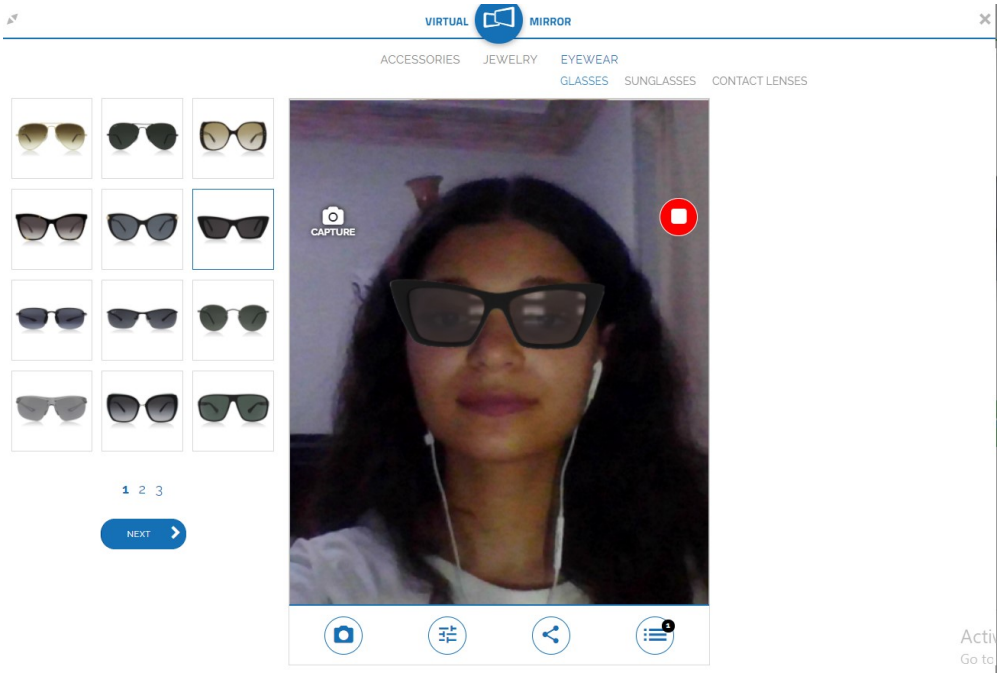

Figure 4: Virtooal

- Zenni [4]
  Zenni Optical is an online optics store that provides the virtual try-on feature. Users can record a short video of their face moving in different directions and the software places the chosen glasses on them, as demonstrated in Figure 5.

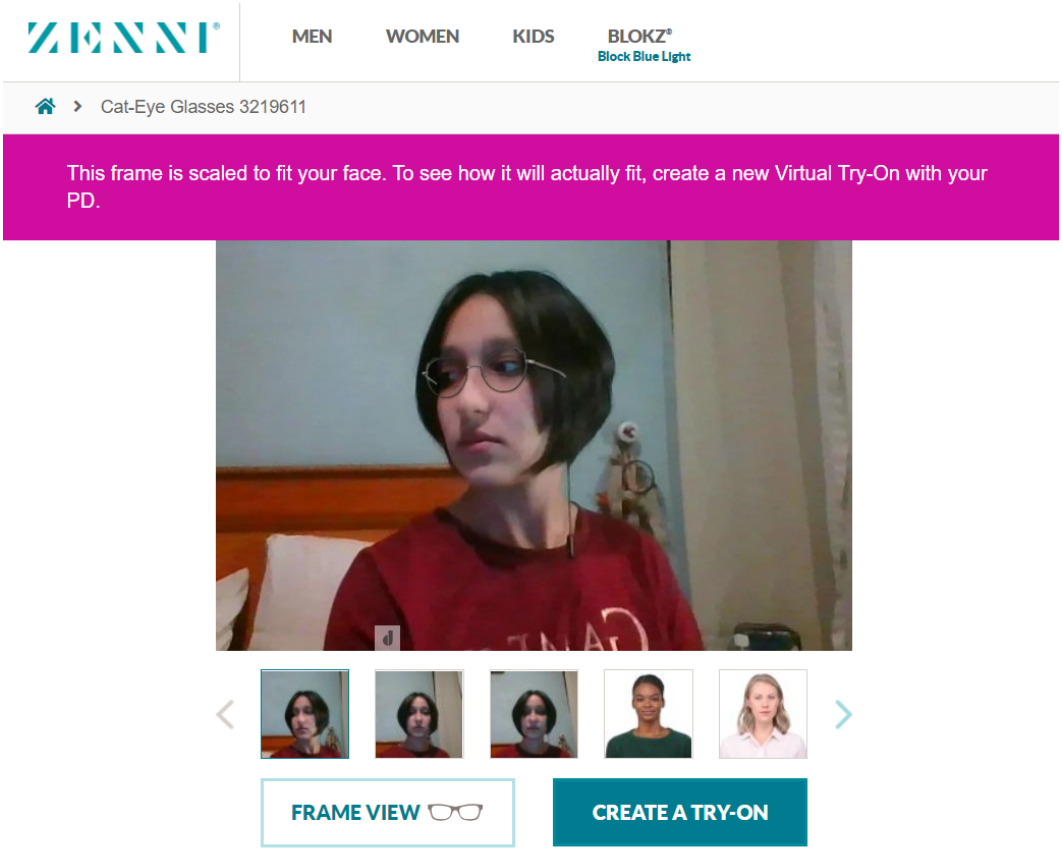

Figure 5: Zenni Try On

Basic Software Examples:

- Virtual Eyewear Try-on [5]
  Figure 6 shows a WooCommerce/WordPress plugin; it has fewer features and is not visually as pleasing. It is also quite simple, both in design and functionality.

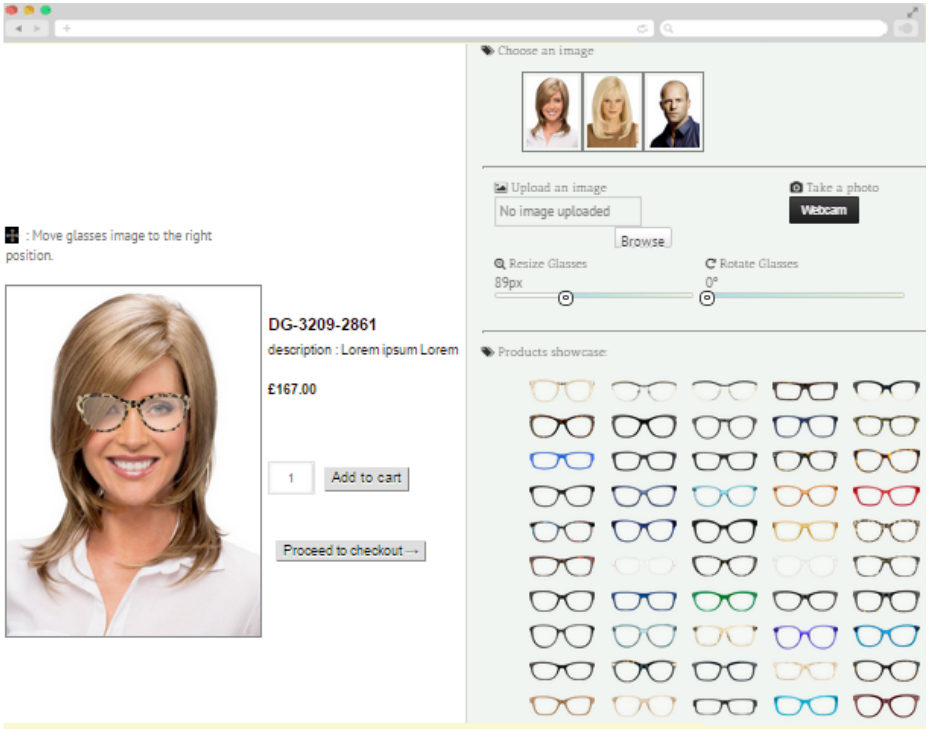

Figure 6: Virtual Eyewear Try-on

- Prestashop Virtual Try-On [6]

  Prestashop also offers a simple virtual try-on. It has limited features and the glasses may not fit properly, as shown in Figure 7.

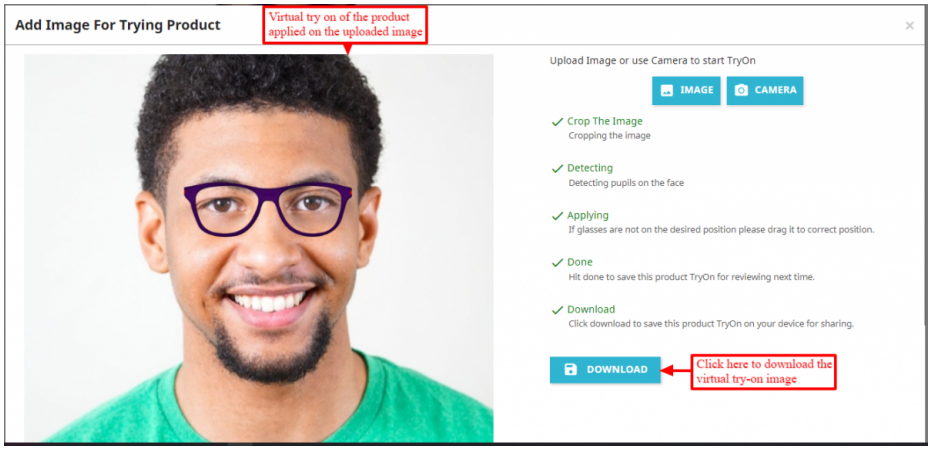

Figure 7: Prestashop Virtual Try-On

4 Project Management and Deliverables

4.1 Deliverables

- Software Requirements Specification document.
- Software Design Description document.
- A smart mirror that allows users to try on different eye-wear products.
- An interactive website that displays the client's products.
- A detailed guide on how to use the web application.
- Brief market research documentation.
- Feedback from client (post-publication) .
- User experience survey (post-publication).
- Web application will be published online.

4.2 Tasks and Time Plan

Figure 8 describes the project's time plan:

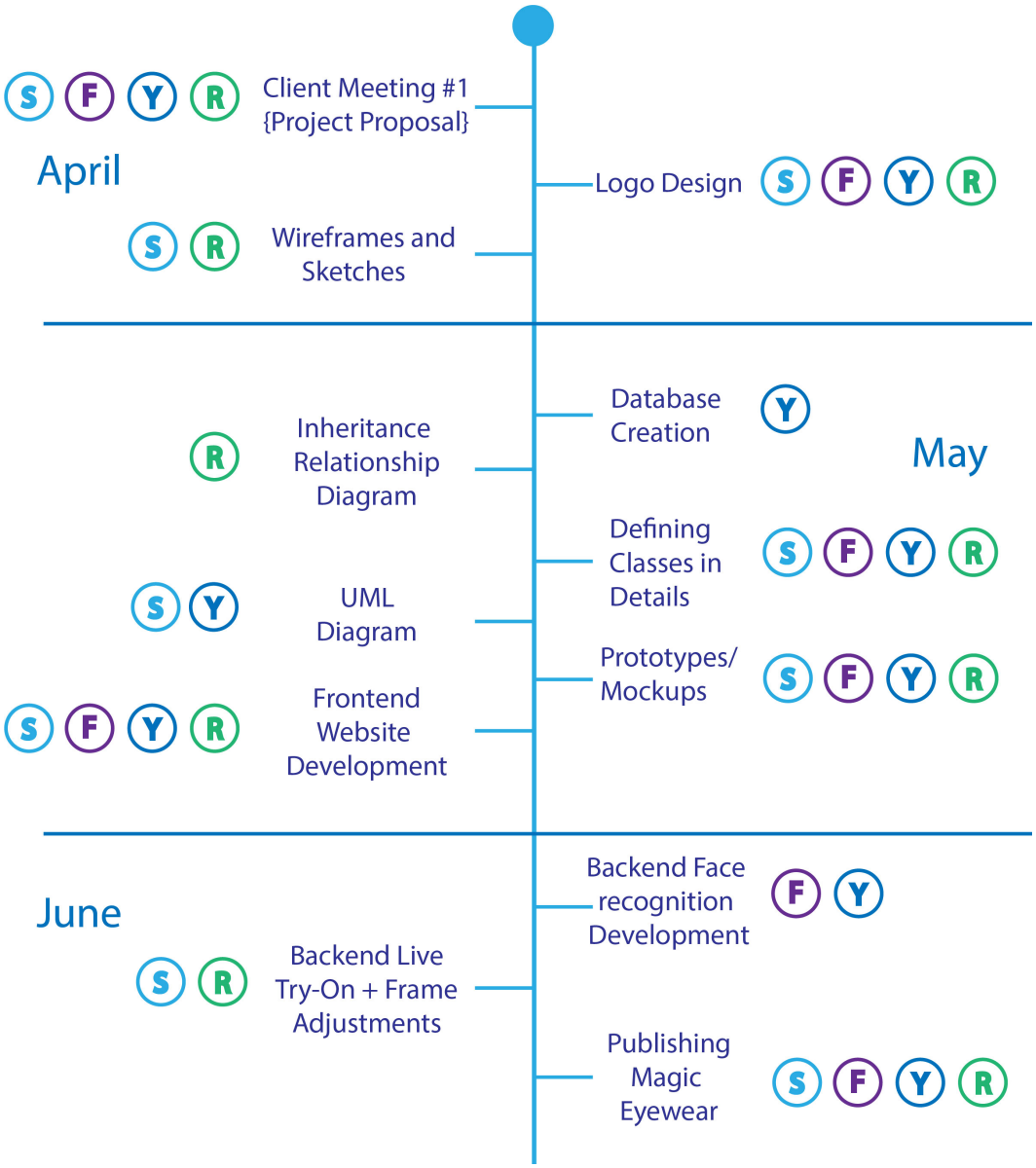

Figure 8: Project time plan

References

[1] *Prescription Eyewear - Online Eyeglasses and Sunglasses Store: EyeBuyDirect*. URL: https://www.eyebuydirect.com/.

[2] Qian Zhang et al. "A virtual try-on system for prescription eyeglasses". In: *IEEE computer graphics and applications* 37.4 (2017), pp. 84–93.

[3] *World's Nr. 1Virtual Try-On for Retailers*. URL: https://try.virtooal.com/en/.

[4] *Glasses – Glasses Online – Prescription Glasses*. URL: https://www.zennioptical.com/.

[5] *PR-09RV-1AB-1O1*. URL: https://woocoplugins.com/Eyewear/product/pr-09rv-1ab-1o1/.

[6] *Prestashop Virtual Try-on: Product trial in virtual environment*. Sept. 2020. URL: https://webkul.com/blog/prestashop-virtual-try-on/.