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Virtual Optics Fitting System: An Innovative System Offering a New Shopping Experience for Optical Products

Sami Miniaoui, Sudad Muamar, Ayo Hamzat, Yasir Al Yassiri
University of Dubai,
sminiaoui@ud.ac.ae, smuamar@ud.ac.ae, s0000000303@ud.ac.ae,s141136@ud.ac.ae

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Abstract
Radio frequency Identification (RFID) technology is used in retails for the main goal of inventory management. We are proposing in this paper a novel case study of RFID technology for providing a new marketing and sale's user experience. Coupled with Augmented reality, these technologies are the main pillars of our system Virtual Optics Fitting System (VOFS). The main purpose of VOFS is to provide a new marketing and sale tool that will assist retails in offering a new shopping experience for consumers of eyewear products. A detailed product description (material of the frame, brand, etc) will be displayed on the screen once the RFID reader will detect the tag fixed on a specific eyeglass. User also can stand in front of the camera in order to virtually try several frame shapes on his face which can facilitate his choice in finding a suitable eyeglass that fits his face. VOFS is used as a recommendation system providing trustworthy information of eyeglasses as well as a virtual fitting system that offers a new user-experience boosting sales in an interactive way.

Keywords*: RFID, Augmented reality, NFC, user-experience*

I. Introduction

Making a purchase decision involves gathering and assessing multiple elements of information about product such as alternatives, features, reviews, availability, cost, size, and colors, such information needs continued expansion of information technologies for online shopping [1]. Consumer behavior is a dynamic ongoing process involving problem recognition (corresponding to the development and perception of a want or need), search (pre-purchase planning and decision making), evaluation of alternatives (during which the consumer uses information to evaluate alternatives in the choice set), choice, purchase (stage of the buying decision process in which the consumer actually buys the product or service) and post purchase outcomes (which may lead to satisfaction or dissatisfaction, in terms of repeat buying [2]. Both online and offline Retailers take advantage of consumers' constantly increasing use of technology to try and influence their purchasing behavior through the different stages of the consumer decision-making process [2].

Arduino is an open-source physical computing platform used in several interesting projects[3]. For example, Arduino was used to create shopping assistant system. Indeed,Sharivas in his research [4] proposed

November-December 2019
ISSN: 0193-4120 Page No. 2024 - 2028

shopping assistant system to be used in supermarkets, primarily for helping handicapped or elderly people for carrying a big load in hand. The proposed system is based in three main components: mobile devices, a set of mobile robots to assist supermarket users, and the robotic assistant [4].

Radio-frequency identification (RFID)as a type of automatic identification and data capture technology is used to identify and instantly track objects or people automatically by acquiring their related information wirelessly [5]. Thus, RFID is used to track every move of a garment in store from a distance [2]. Muammar in his research [5] proposed a smart card to respond to the emerging demand for quick and easy payment of bills in supermarkets by using RFID technology for shopping and payment, using Arduino microcontroller for peripheral interfacing and inventory management.

Rallapalli in his research [6] proposed a system called ThirdEye for tracking physical browsing (provide insight into shoppers' behavior during the shopping process) by users in retail stores as a user might walk to a section of interest, dwell there for a while, gaze at specific items, and reach out for the ones that they wish to examine more closely. ThirdEye can be used to track each of these elements of physical browsing using a combination of a first-person vision enabled by smart glasses, and inertial sensing using both the glasses and a smartphone [6]. Another technology used in retail sector is Smart Mirror. ACEP sells a product called Smart Mirror that consisting of a camera that takes images of a shopper wearing different eyeglass frames and displays them side-by-side [1].

Many purchases today occur in physical shops, while many retailers track shoppers' purchases (e.g., as part of customer loyalty programs) in order to perform analytics [6]. Eye tracking technology, facial recognition and video analytics are used to track what consumers' mood is through the use of sophisticated cameras with sharper lenses and data-processing capabilities[2]. Sunglasses and try-on eyewear products are becoming an extensive part of accessories that are now more involved in individual lives. Moreover, optical marketplace is growing at a rapid rate with consumer interest of keeping-up with trends and technological achievements are becoming more demanding than before .Therefore, Virtual Optics Fitting System (VOFS) aims to allow the end user to try sunglasses virtually with provision of detailed product description and attraction to such new technology.

II. SYSTEM IN ACTION

The primary intent of our system is to provide an in-depth description of an optical product with the added option of virtual fitting of other product variants that are not available in the Sales Outlet. The Flow of Actions is explained in more details in the figure below (see Figure 1).

November-December 2019
ISSN: 0193-4120 Page No. 2024 - 2028

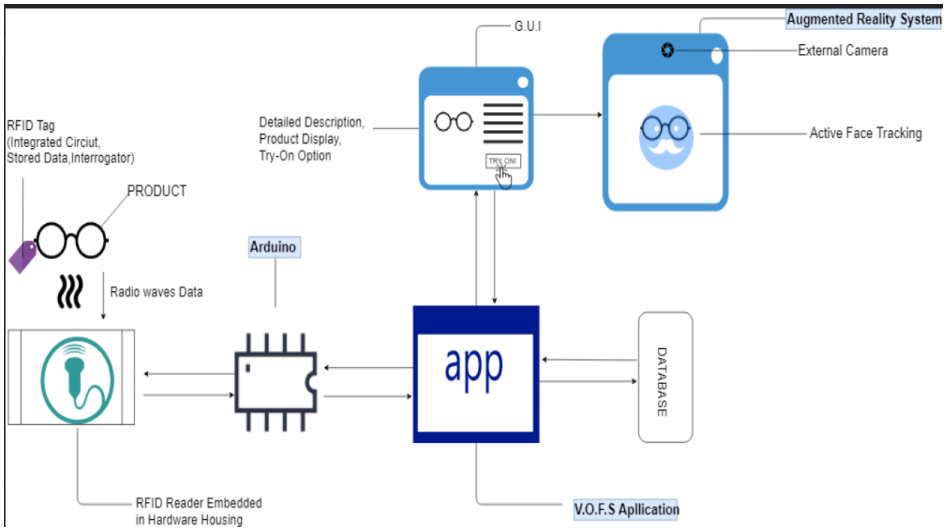

Figure 1:V.OF.S. Flow of Action

For VOFS to operate, the following stepswill be performed:

- Product with attached RFID tag is placed on RFID reader
- The microcontroller (Arduino) equipped with an RFID/NFC card will read the data form the Tag and transmit it to the VOFS application through the USB port.
- VOFS application accesses database of listed products to retrieve information about current product
- VOFS application will display a detailed description about the product
- Face detection algorithm is used to detect the person's face then an animated version of the product is placed on the user's face using the augmented reality module.
- VOFS application gives the customer the option of trying virtually several eyewear products based on their shapes (circular, etc).
- User can choose among several brands which save a lot of his time

III. SYSTEM DESIGN

The main functionalities of VOFS can be summarized in one major use-case (see figure 2). Three main sub use-cases can be identified in the figure below namely Data Entry, Product Search, and Face detection.

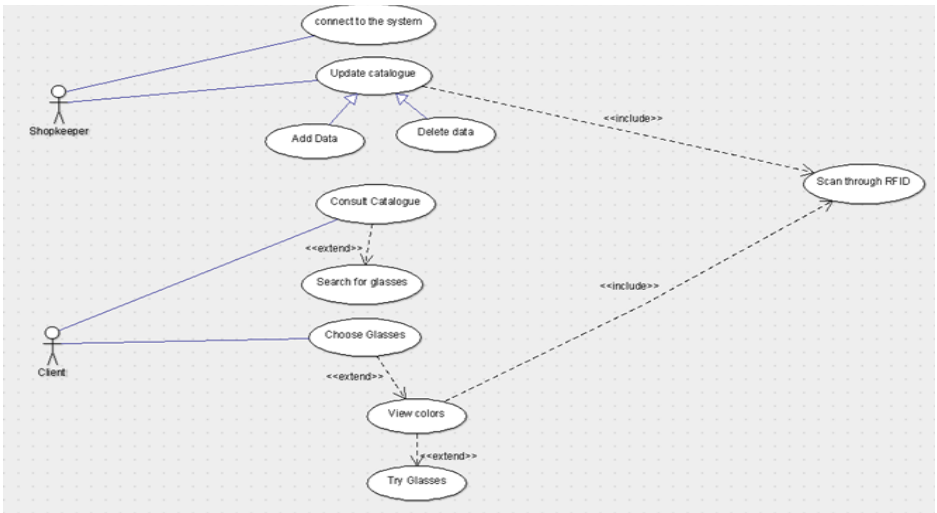

Figure2: Combined Use case diagram of full-partial system

November-December 2019
ISSN: 0193-4120 Page No. 2024 - 2028

A. *Update Catalogue*: in this use-case the admin will enter description of the eyewear then add its tag Id (tag to be placed on the product) by using Scan through RFID feature.

B. *Search for eyeglasses*: in this use case the user will place the eyewear product on the RFID/NFC reader, the system will search in the products database then display its full description

C. *Try eyeglasses:* in this use-case, a face detection feature will be used then according to the shape of the eyewear an augmented reality rendering will be applied making the user visualizing the eyewear on his face.

IV. IMPLEMENTATION

The VOFS is mainly based on two modules namely the tracking module and the virtual fitting module.

A. *Tracking module*

The tracking module is implemented using Java language. The application is getting its input from the ARDUINO microcontroller equipped with RFID/NFC card through USB port. All product data are stored in MySQL Database which is activated upon direct request from the VOFS application after RFID product'sscanning. The main GUI of VOFS is shown in Figure 3. Indeed, product description (price, technical specification, etc) as well as a high resolution picture are retrieved from the database then displayed every time the user place a different eyewear on the reader. Four additional buttons representing several shapes (round, aviator, square and all) are used by the user to narrow-down his search on existing brands. By clicking on one of the buttons (shapes) he can browse brand's models offering similar shape. The button Try it will forward the user to the virtual fitting module.

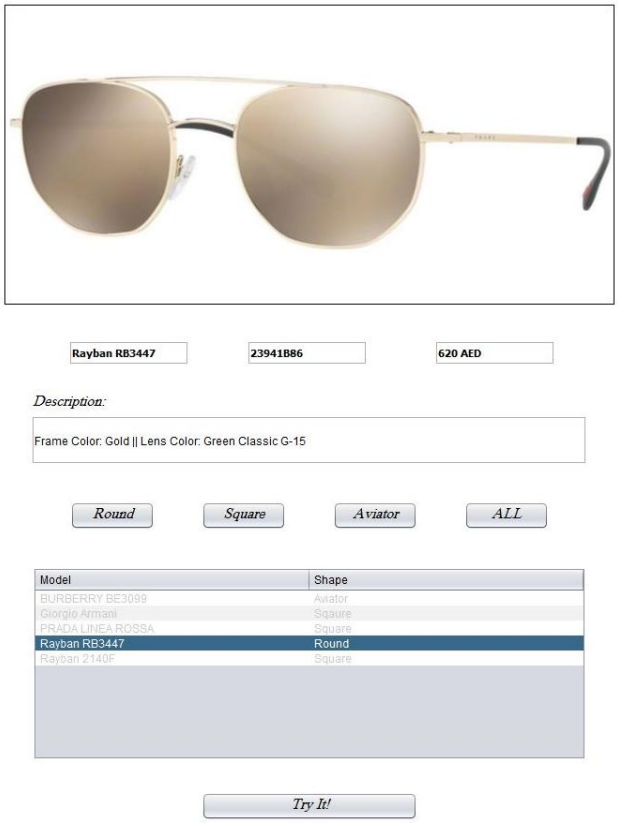

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Figure 3 V.O.F.S. Graphical User Interface

B. *Virtual fitting module*

This module is using augmented reality (AR) technology to provide user with a new virtual try-on experience. This technology does (1) face detection for the client and also (2) displays a virtual animated version over the clients face with the selected frame shape. The AR system is activated upon the user's preferred selection of the try it feature on the VOFS GUI.

The Augmented reality feature is an overlay or integration of digital and graphical information such as (filters, animation) in a natural user environment. This would display an animated version of the product on the screen overlaying the user's face after facial detection has been executed (see figure 4).

November-December 2019
ISSN: 0193-4120 Page No. 2024 - 2028

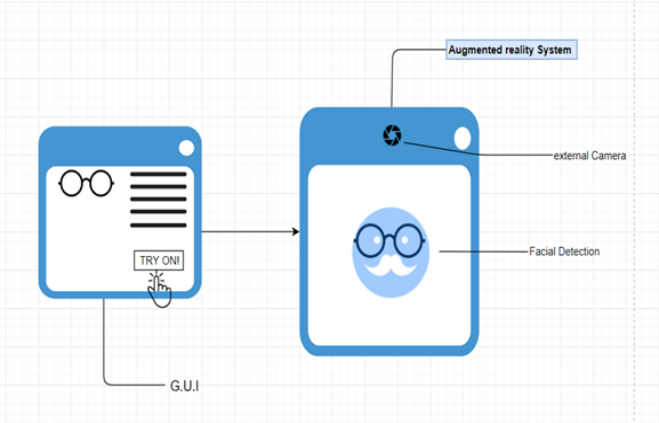

Figure 4 V.O.F.S. Virtual Fitting System interface

V. Conclusion and Future work

We presented in this research an application (VOFS) providing a new user experience of eyeglasses customers. RFID/NFC technology was used for providing users with detailed information about a specific eyeglass placed on the RFID/NFC reader. User can browse technical specification regarding the product which can help in taking a decision to buy the product. A virtual try-on feature based on a camera and face detection feature is assisting the customers to choose among several eyeglass shapes which can narrow down their search based on brand or price. This application is drastically changing the way users buy eyewear products and could be used as a self-service eyewear shopping machine or stand.

Our future works will focus on integrating our application with online catalogues of the eyewear shops to provide a wider range of products to display to consumers. Using a high resolution cameras will also enhance user experience and make the product more attractive for customers while trying it virtually.

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