

# An Android Augmented Reality Application for Retail Fashion Shopping

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**Abstract**—This report will exhibit an outline of the basic features of Mobile Augmented Reality (MAR) and the key concepts of this technology in the Fashion Retail Industry. Several obstacles such as the necessity of putting on the garments to experience its actual view have been tackled by customers throughout the process of clothes shopping. The goal is to constringe these obstacles by creating an Augmented Reality based application that will directly solve these problems. The methodology was conducted by questioning shoppers about the different holdbacks faced during shopping. Solutions for the issues are expected to be achieved by developing an easily utilizable MAR application for targeted customers. The design of this paper involved the utilization of handed questionnaire and semi structured interviews with several store managers to gather sufficient about their sales strategy and proposing the solution of Augmented Reality utilization within the market. Augmented Reality Technology have a great potential to be utilized efficiently inside the fashion market as it will meritoriously improve the shopping experience of consumers across multiple fashion related industry channels.

**Keywords**— Fashion, Augmented Reality, Mobile Augmented Reality, AR, MAR, Mobile Retailing, Information Technology.

## 1 Introduction

Despite being a developing industry, it is claimed that Augmented Reality technology is going to highly innovate the retail experience. Fashion retail subsists of the selling of accessories, footwear and garments. Fashion has always been a critical matter in our lives which is often done to look new every now and then; however, there exists certain daunting challenges that ought to be overcome with the aim of getting the full asset of clothes shopping. The background of this paper is based on fashion retail shops that sell all different kinds of outfit products.

An android augmented reality technology based application (Mobile Augmented Reality) will be developed, targeted to overcome obstacles faced by shoppers' to facilitate

the garments shopping tradition. The user friendly mobile application will be utilized in the garments personal testing in a way to benefit both the customers (shoppers) and the shop owners in the product selling-purchasing procedure.

### **1.1 Problem Statement**

Customers who would like to buy new clothes often desire to test the products before purchasing them in order to decide whether or not it perfectly satisfies their needs. On one hand, the current onerous, time consuming method is usually done by putting on the garments/accessories and reflecting the view on a mirror for the actual absolute outlook of the worn outfit. By the means of this sentence, we can conclude that this long utilized procedure is a serious disadvantage in the fashion retailing market as customers ought to perform this process whenever they wish to test a garment product on themselves.

Despite this procedure being the nature of shopping, this drawback from the perspective of several customers ought to be solved in order to enhance the shopping experience.

On the other hand, this is could also be a drawback for the shop owners. Numerous customers enter the shop daily to purchase new garment products; however, these products should be personally tested by the customer for their personal evaluation. Thus, this testing procedure would definitely have several disadvantages for the shop owners as a daily bulk of products are tested and not purchased due to different inclination which might damage the products and cause the loss of their state of art. Another issue could be faced by the staff members as they have to repeatedly return the garment product to its original place in order to be displayed to other customers.

Generally speaking, this tradition detracts the business itself and leads to time and effort improvidence for the customers. Moreover, another existing problem suffered by customers is the debilitating progression of searching for a desired garment in several branches without precisely knowing the existence of the desired garment in several stores.

For instance, a specific garment size is wanted by a customer yet it is not available in the current store. Hence, it is requisite that the customer should find the specified garment in another store which might be a tiresome repugnant process.

### **1.2 Objectives**

This paper scope will be evaluating the prospected advantages of the utilization of Augmented Reality in Fashion Retailing from both a consumer and a business perspective. The objected purpose of the Mobile Augmented Reality Application in the fashion retail shop-ping is to help enhance the customer's in-store experience. The developed application is intended to help diminish problems faced by customers in fashion shopping experience by the valuable utilization of the Augmented Reality Technology.

The objective for the targeted customers on one hand is to cut off effort by testing the garment product in the real world environment through the virtual world on top of it. This resides on a great effortless experience and entirely benefitting from the testing

technique which also provides full evaluation of the product without the need of the real world testing (putting on the garment/accessory).

It is a fast unique procedure with a minimal cost which will only require a mobile device to test the garment virtually. This analyses how the augmented reality utility would influence the customer’s behavior in retail setting. On the other hand, the objective for the business owners is to cut off the costs of garment damage lead by frequent testing and cutting off effort wasting on returning the garment products to its original shape after its use. This could evaluate an effective business channel to reduce the cost of traditional fashion purchasing approach.

### 1.3 Work Methodology

The user friendly developed android mobile augmented reality application will completely be a beneficial approach for the customer during the fashion retailing process. In brief, the application will start using the rear camera of the mobile device to capture the real world product and transforming it into a virtual world object, then comes the Augmented Reality key role where the user views the virtual object on their body using the front/rear camera to evaluate its manifestation on themselves, look at Figure 1 and Figure 2.

For instance, the user captures a photograph of a wrist watch in front of them; the application will then process the captured image, extract’s the item and turns it into a virtual object. After that, the rear camera will be placed on top of the user’s arm, and the wrist watch will be augmented into their wrists displaying how the hand watch will actually appear without the need to essentially put it on. The same methodology will be applied for other fashion related products such as footwear, head wear, arm wear, makeup, etc. Thought-provoking developed features can be utilized such as changing the color of the product after capturing a picture of its real world state in order for the user to view its different colors, displaying all information related to the product (i.e. reviews, rate and costs), displaying similar products, comparing between similar products, save virtual objects for future testing, adding them to their wish list, etc.

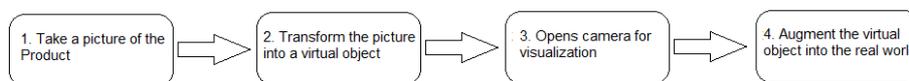


Fig. 1. Application Flow

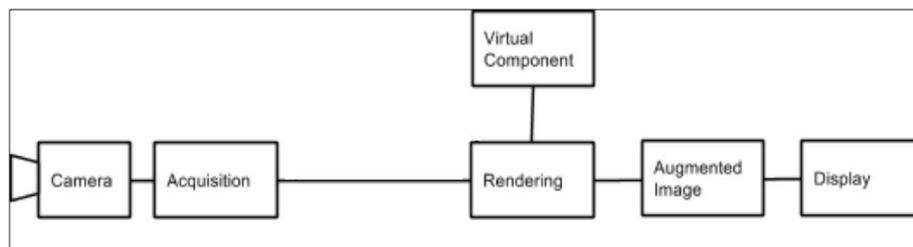


Fig. 2. Augmented Reality Flow

## **2 Related Work**

### **2.1 Background**

Fashion retail subsists of the selling of accessories, footwear and garments. The fashion re-tailing market has been identified as one of the most trending lucrative industries among several other markets. In 2014, the clothing retail industry in United Kingdom has been worth £50 billion [1]. It is believed that fashion is a large global market as not only does clothing represents a rudimentary product, however it reflects human culture and is used to demonstrate individualism explicitly. As indicated by Euro monitor [2] individualism is a decisive shopper orientation since shoppers are progressively basing their utilization and acquiring choices, upon merchandise and ventures that are customized and one of a kind to them. On a research held by Euro monitor in 2015, Omnichannel retailing has been a symbolic retail shopping incline that has affected upon the fashion retailing marketing. In addition, it has brought about an obscure amongst virtual and physical stores. It has appeared as an aftereffect of hyper-network among shoppers that has brought about many fashion retailers being available and offering client benefit by means of web-based social networking all day long [3].

This exhibits how changing buyer patterns and innovation is influencing the manner in which fashion retailers' work. Augmented Reality is a bilateral technology. It has the prospect of promoting the consumer's experience of shopping in the fashion industry. Utilizing the Augmented Reality Technology to establish paramount encounters could assist the shoppers in a wide range of ways, especially retailers at fashion industry. They have shops on the high-road. A statement's market updates reported by [1] shows that the development in virtual retailing has been of great benefit to the fashion retailers. Posteriorly, this recommends that fashion retailers need to concentrate after improving in-store experience; so as to amplify accomplishment from all channels. This illustration is predictable with researches that investigate strategies for Augmented Reality application inside fashion retailing through MAR. Additionally, it is proposed that Mobile Augmented Reality Technology will have a huge effect upon fashion eventually [4].

An alternative research has likewise investigated the utilization of Mobile Augmented Reality, notwithstanding; there has all the earmarks of being a crevice in past research in terms of evaluating the adequacy of Augmented Reality as a multi-channel alternative for enhancing encounters by affecting customer conductance. However, this recommends undertaking further research into the different routes in which Augmented Reality can be connected into the fashion retailing market, could be gainful for the necessities of shoppers and brands in addition.

### **2.2 Literature Survey**

The traditional try on clothes in fashion retail shops has been known as one of the most time consuming tasks that includes long waiting periods of the fitting rooms and taking on and off garments. However, this survey will express the use of Augmented

Reality in the Virtual Try-On to help reduce time and effort. Augmented Reality Virtual Try-On was launched in 2009 providing an impressive excitement to fashion retailers from the utilization of this technology [6]. Virtual Try-On innovation utilizing Augmented Reality can give many fascinating use cases and be deployed in various situations as in fashion retail stores.

In 2014, Augmented Reality Virtual Try-On technology was utilized in some locations which led to an incline in the targeted customers' engagement that influenced a potential transformation. The commitment was particularly high with different use cases particular to Virtual Try-On. In 2015, WSS for Kiosks add up to client sessions expanded to 128,000 from 29,000 aggregate client sessions in 2014. This was a 441% expansion year over year [5]. By utilizing Augmented Reality technology; virtual fashion retailing can be composed onto the customer's mirror image. While the innovation for this may appear to miss the mark regarding the genuine shopping knowledge of actual wear of an outfit, it empowers quicker turnaround times for busy customers and with upgraded information catch conceivable out-comes, a curated style encounter that could possibly match any genuine individual customer [7]. Ever since this technology was debuted, it provided retailers with several solutions for their faced obstacles such as determining a customer's body fit, display various inventories which virtually correspond to their size, and provide the facility to purchase directly from the Virtual Try-On mirror/kiosk [8].

To sum up, it has been claimed that nowadays, Virtual Try-On technology has been deployed in several fashion related retail stores. Moreover, in light of the kind of organization, there are distinctive engagements strategies that can be utilized with Virtual Try-On innovation to move the customer through the buy channel towards change. As Virtual Try-On innovation develops and 3D displaying costs diminish and turn out to be more computerized, there will be more occurrences of how Augmented Reality innovation can help shoppers reduce time wasting and benefit retailers drive sales. Previous reviews have demonstrated that Virtual Try-Ons are most astounding evaluated use case for retail and late Augmented Reality ponders have indicated respondents rate to "See items in real form and size without putting them on" [8] as one most noteworthy appraised Augmented Reality use cases. The fate of retail is going towards an augmented world. Until further notice however, like early phases of other innovation, for ex-ample, online networking, retailers can influence current elements of Virtual Try-On innovation to target more improved engagement with their item or brand.

### **2.3 Analysis of the Related Work**

The methodology of the Virtual Try-On works as follows; when a customer decides to purchase a garment, the VTO mirror provides the dressing facility rather than doing it manually. The customer's body surface is scanned using a Kinect sensor to display the user on the mirror in addition to essential data needed such as user's body dimensions and feature points with respect to the garment simulation in relation to the virtual human body. By perusing through an intuitive and virtual catalogue the user is then able to list intriguing pieces of garments. In order to uphold the preselection, the chosen garments are displayed in a quick preview mode, presenting the Virtual body wearing

the different sort of clothes. Despite showing how the garments would appear on them, it doesn't offer critical information that includes fitting and sizing. Hence, to have a full aspect look at desired combinations of garments, virtual assembly procedure is applied, based on the given body dimensions and garment data (i.e. material, col-our, configuration and model type), it will develop a separate, adapted 3D models of the chosen clothes. Additional handling of the outcomes will dress the virtual object (avatar) by using augmented, physically-based recreation systems. After that, the virtual mirror is utilized to present the new output which delivers a life-size exhibition of the user's virtual match dressed up in the selected garments from random viewing angles. Through this process, color changing, configuration and modifications with respect to size can be tested virtually in a short measure of time.

The advantages of the Virtual Try-On are the following:

- Significant Enhancement of consumer experience.
- Decision on various colors of the product based on their appearance and liking.
- Users can simply add other products to compliment the main product, like accessories.
- Additional efficient ways of choosing garments
- No actual piece of cloth is damaged or experimented.
- Adequate view of how garments look on a person.
- Enables the user to make a right choice when they are confused about the look of the clothes.
- User can change the attire conveniently within seconds

### **3 Proposed Solution**

#### **3.1 Solution Methodology**

Augmented Reality technology can be accessed through mobile devices such as smart phones and tablets as they have durable processing power, which allows users to utilize Augmented Reality without the requirement of exterior appendages such as sensor bars or webcams.

A solution proposed for the fashion retail issues as stated above will be developed as an android platform application. The application will be user friendly for the ease of its utilization by any type of user. However, the application will only be based on static type garments such as foot-wear, headwear, arm wear, makeup, etc. in order to be implemented on application type software. 3D dynamic objects will hence be difficult to be implemented on an application as it will require a Kinect sensor and a smart mirror to display tops and bottom related garments.

The solution methodology is adequate as customers will require nothing but their smart phone/ Tablets devices rather than waiting on a queue to test their garments on the Virtual Dressing Rooms. The user will take a photo of their desired garment such as sunglasses using the rear camera, the object on the photo will converted into a virtual

object, and then augmented into the user’s face (Real world) to visualize how would it look on them. In addition to other adds on features after the role of the Augmentation.

### 3.2 Solution Design

Mobile Application Design Definition -“As a major aspect of the advancement procedure, mobile user interface (UI) design is likewise fundamental in the production of portable applications. Mobile user interface considers imperatives, settings, screen, info, and portability as frameworks for design. The client is frequently the concentration of cooperation with their device, and the interface involves segments of both hardware and software. Client input takes into consideration the clients to control a framework, and device's output enables the frame-work to demonstrate the impacts of the clients' control. Mobile user interface design imperatives incorporate restricted consideration and shape components, for example, a mobile device's screen measure for a client's hand(s). Generally speaking, mobile user interface design's objective is for the most part for a reasonable, user-friendly interface. The user inter-face of mobile applications ought to consider clients' constrained consideration, limit keystrokes, and be errand arranged with a base arrangement of capacities” [9].

“In recent years, mobile phones have increasingly been consumed as fashion items. Studies of young people’s purchasing and use of mobile devices show that these items are used to ex-press identity and desire in a way similar to how they use clothing”[11].

To implement a satisfying design for a fashion related mobile application, the design research will involve two mixed approaches. The design method implicates the merge of both qualitative and quantitative research procedures. The quantitative method involves questionnaire approach to gather information of what a customer need in a fashion mobile app would. While qualitative method will involve the conducting of semi structured interviews with mobile application developers to extract the opinions, views and ideas on how a fashion mobile application should be designed. Hence, the utilization of both methods will be the most applicable technique to develop an application that ought to reach consumer full satisfaction, look at figure 3.

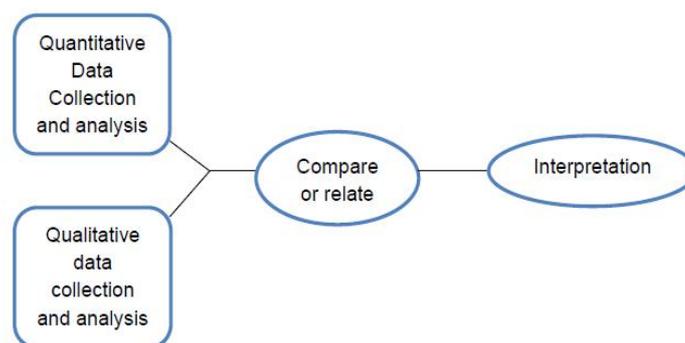


Fig. 3. Concurrent parallel blended techniques research design

The saturating of fashion into the design of different item propels mobile application developers to study further the impact of fashion in mobile application design. The Design process started with conducting several researches about how a fashion related application would look like in recent smart phones. In addition, as mentioned above, the brief interview was conducted with a mobile application expert developer on the constraints on the essential entities that should be available on a mobile application for customer satisfaction. Exceeding two weeks of effective researches that also included other famous fashion applications downloaded on the developer's smart phone such as (H&M, Polyvore, The Hunt, Stylect, Wear, ShopStyle) to study their attractive design pattern, extracting similar features available on all the applications listed above and coming up with a different design closely related to the similarities found on the previous applications. Moreover, for more design quality assurance, simple and short interviews were held with several individuals testing the design of the previously mentioned application to discover which application took the highest vote on best design. Thus, "Stylect" received the highest vote as the application's design is simple and eye-catching regarding a simple fashion application which furthermore is user friendly. Consequently, the design process development had to be in some way similar to "Stylect" application as the developer lacked design experience which would consume much time and learning process to come up with a precisely unique design. The design of the application was the initial phase of the application development which was brainstormed in the beginning then sketched on a paper to be patterned-followed exactly. The division of the application contents, background colors, texts and pictures were then opinion accepted by several mobile application designers which guaranteed customer satisfaction and overall success of the mobile application design stage.

### **3.3 Solution Implementation**

The development of the Android application and Augmented Reality will be implemented and tested. Languages used are (Java, XML, OpenGL)[10]. The application is developed to work as follows, look at figures 4 to 12:

- User launches the app
- User captures a photo of the garment (ex. Shoes)
- User points the camera at their feet
- Shoes (digital-information) is augmented into their feet displaying a live view of the garment on their feet (real-world environment)

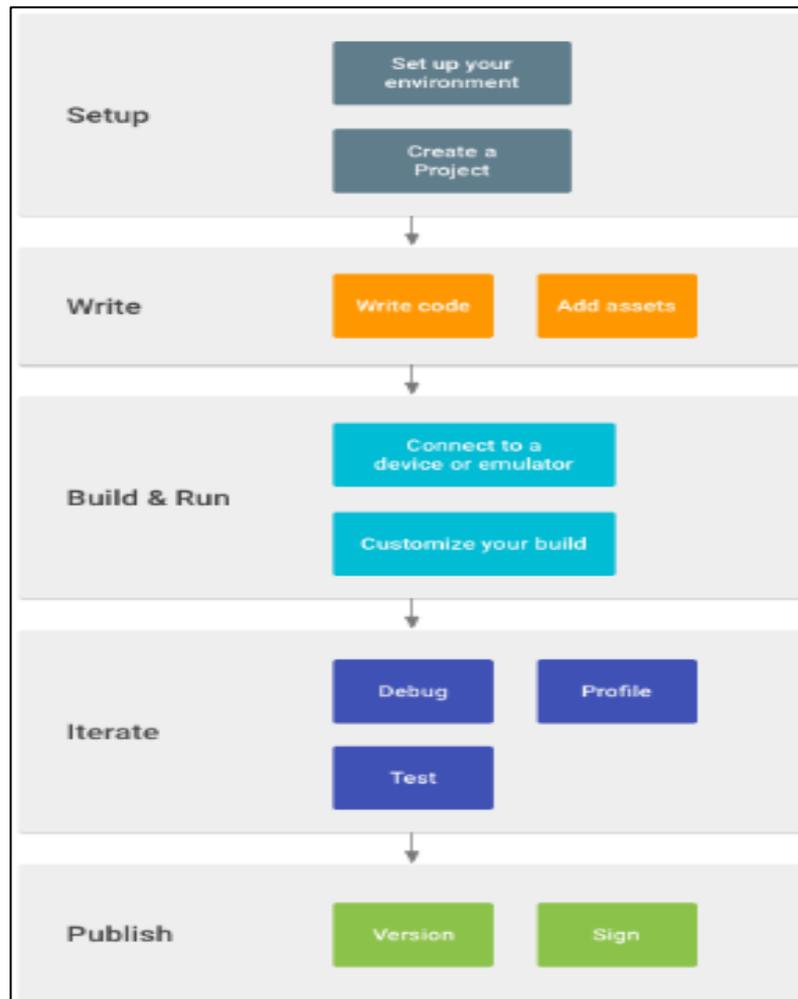


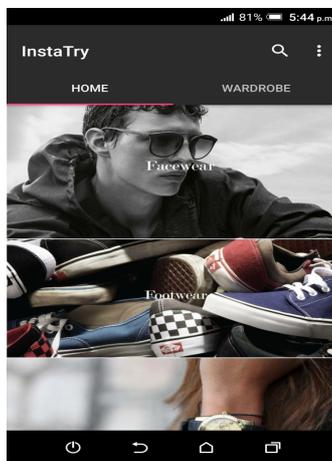
Fig. 4. Android Application Development Steps



Fig. 5. App's Icon



**Fig. 6.** Splash Screen



**Fig. 7.** Home Screen



**Fig. 8.** About Us



Fig. 9. How to Use

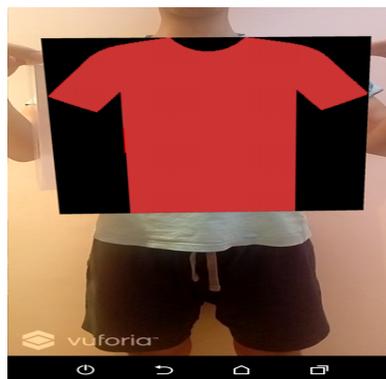


Fig. 10. AR Demonstration

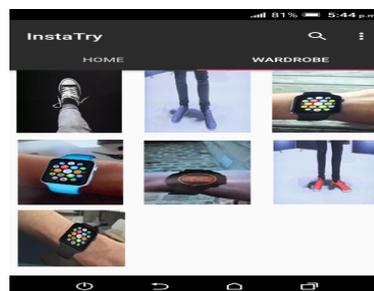


Fig. 11. Gallery

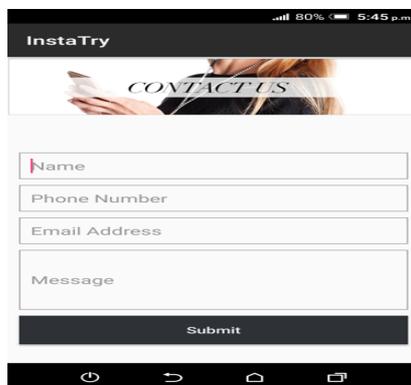


Fig. 12.Contact Us

## 4 Testing and Evaluation

### 4.1 Testing

The testing process is one of the most important stages of the mobile application development progression. The following test case scenario, look at table 1, present possible test case for the developed application.

Table 1. Possible Test Case

| Test Case Identification Number | Test Case 3   |
|---------------------------------|---|
| Test Case Name                  | Augmented Reality Testing   |
| Test Case Objective             | Authenticate that the Augmented Reality functionality is working correctly  |
| Test Case Scenario              | 1) Click on the application<br>2) Wait for application to open<br>3) Click the Augmented Reality Button<br>4) Point Camera at marker to view Augmented Object |
| User Input                      | Touch Start Button  |
| Expected Output                 | Object is rendered and viewed above marker  |
| Actual Output                   | Objectives rendered and viewed above marker   |
| Fail/Pass                       | Pass  |

### 4.2 Evaluation

The evaluation processes of the finished application will emphasize the results of the quantitative research that was undertaken by conducting questionnaires and distributing it over thirty consumers. To begin with evaluation, it was best argued that problem recognition is the first step on the decision making process. Thus, the contributors had to rate their agreement's level on the issues faced while shopping in retail stores.

Question 1: “Does the trying on garments while in retail stores a tiring and time consuming process?”

Question 2: “Does the idea of Augmenting Garments on your body would be effectively helpful?”

Question 3: “Is the design of the application adequate and the user interface is user friendly?”

Question 4: “Is the Augmenting Functionality of the application acceptable and can help in the decision making process?”

**Table 2.** Answer of Questions 1, 2, 3 and 4

| Index | Answer            | Answer of Question 1; Results on whether or not traditional putting on garments is a consuming process Rate in Percent | Answer of Question 2; Evaluating the use of AR in trying on garments Rate in Percent | Answer of Question 3; Evaluating the application's design and user interface Rate in Percent | Answer of Question 4; Evaluation of the overall Application functionality Rate in Percent |
|-------|-------------------|--|--|--|---|
| 1     | Strongly Disagree | 8%   | 0%   | 4%   | 1%  |
| 2     | Disagree          | 20%  | 1%   | 4%   | 2%  |
| 3     | Neutral           | 12%  | 8%   | 3%   | 5%  |
| 4     | Neutral           | 50%  | 37%  | 48%  | 28%   |
| 5     | Strongly Agree    | 10%  | 54%  | 31%  | 64%   |

The results of the answer of Question 1 shows that 60% of the participants suffered from the exhausting and time consuming process of trying on garments as by getting more details on the reason, it was claimed that this process consumed time as a result of waiting on a queue of other customers trying on their garments in shared fitting rooms. In addition, it was claimed tiring as customers had to put on the garments to have an actual view on how does it look on their body and whether it fits or not. However, to resolve this issue, the idea of Augmented Reality was introduced to the participants in order to explore its effectiveness on the fashion related industry.

The results of the answer of Question 2 show that 91% of the participants agreed on the idea of viewing the garment on their body through augmentation (smart phone’s camera) and discussed how it will not consume time and that consumers are aware of the augmented reality technology, AR is easy to use, AR is easily accessed and that the technology is of extraordinary quality. Thus, by ensuring the Augmented Reality will have significant effect on the decision making process and would help enhance customer experience in fashion retail stores, the developed application was introduced to be evaluated by the participants.

The results of the answer of Question 3 show that 79% of the participants agreed that the design and the user interface of the developed application is adequate for usage which guarantees perfect efficiency and that users will benefit from the application’s functionalities.

The results of the answer of Question 4 shows that 92% of the participants agreed that the augmented reality function of the application is suitable and will assist on the decision making process while shopping for garments at retail stores. After all, the overall evaluation suggests that the utilization of Augmented Reality does have the possibility to solve consumer's issues faced during the process of garment retail shopping.

## **5 Conclusions and Future Work**

### **5.1 Summary**

Authors had proposed several ideas on many published papers on mobile applications, m-learning and e-learning [12], [13], [14], [15], [16] and [17].

The main aim of this paper is to introduce android augmented reality technology in to the fashion retailing industry and explore its benefits on consumer's behavior that ought to enhance the marketing and sales strategies of different fashion brands.

The research of this paper was carried out by testing three different sections within the fashion retailing industry, which were consumer behavior, consumer experience, and how would augmented reality benefit retail stores.

Firstly, as to the consumer's behavior, after examining on hand the mobile augmented reality application to different consumers, the target was partially met as the user interface de-livered by the application was acceptable and user friendly. However, it the discoveries of the research advocated the utilization of 3D dynamic objects in order to experience an improved decision making process.

Secondly, as to the consumer's experience, the research exhibited the likeliness of Augmented Reality to have a sustainable impact upon consumer experience during the pre-purchase phase as consumers agreed on its effectiveness in the decision making process and how it would replace the traditional trying on methods.

Last but not least, as to retail stores, the research conducted showed that Augmented Reality can be utilized in fashion retailing industry as it will commendably enhance consumer experience in the process of decision making management which will lead to increased footfall of customer's in store, improved brand image which will hence benefit from high sales and great profitability which concludes that the aim of the paper have been met.

### **5.2 Future Work**

After several researches undertaken about several industries, it came into a conclusion to work in the fashion industry as it suffers several issues in Egypt. After working on the paper for five months, the android application was developed and accepted by several expert developers, tested by several users and shown good response.

However, the application have not met the actual desired plan as the time constraint was limited and to develop application like for instance (H&M) requires several developers and much time.

This was one of the obstacles faced during the implementation of the android application. Yet, regarding the android application, it is planned to be enhanced by adding several features, additional functionalities, creating a database for users and uploading it on Google Play Store to be used for testing purposes and rated according to its functionalities.

After that, additional work on the application will be required to actually be used by consumers in Egypt to reduce the problems faced by customers during the decision making process. On the other hand, it was planned in the beginning for the Augmented Reality to have extraordinary features that included more functionality.

Functionalities such as image recognition and body parts recognition, this however required much studies to be undertaken and expertise on the field of object recognition to implement it on the application.

Thus for future references, it is planned that the application will include objects recognition to essentially meet the desired requirements and to be unique. After successfully completing all the planned requirements, the application will be developed for iOS phones and Microsoft phones in order to be available to all smart phone users and hence benefit from its functionalities and hence reduce fashion industry related issues from every retail stores in every possible country.

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