EXTENDED ABSTRACT

SHOPPING WITH AUGMENTED REALITY

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Abstract

Augmented Reality (AR) applications compatible with modern smartphones have become a recent trend. In the context of grocery shopping, the effectiveness of mobile AR technology to keep track of the customer's shopping history, total estimated bill amount, personal recommendations, and special offers for items while shopping. Supermarket retailers may inform regarding the special deals and discounts applicable to their loyal customers and hence attract more customers. In particular, more fascinating features such as assisting consumers with special needs such as health concerns can be integrated to AR systems. For example, the sugar, fat, and salt amount of the collected food items can be estimated and warned if exceeding the maximum threshold. To achieve the above requirements, an AR-enabled grocery shopping mobile application has been implemented. This application mainly focuses on three (3) scenarios; Product identification, displaying product details using pop-up windows and generating health advices using color tags considering the sugar, fat and salt levels of individual items as well as the total accumulated so far. For that, the user's diet plan is also referred. ARToolKit and similar approaches were employed to implement and evaluate application comparing installation time and object detection distance range. Therefore, this Shopping with the AR innovative application will be a smart solution for Sri Lankan supermarket customers.

Keywords: Augmented reality, super market, health tips, nutrition levels.

1. Introduction

1.1 Background

In the present day, the majority of the Sri Lankans used to accomplish their day-to-day necessities with supermarkets or glossaries. They don't like to commit more time while shopping due to their hectic schedule. The way retailers interact with their customers is changing as a result of technological advancements. Augmented reality apps provide a one-of-a-kind opportunity to create convincing offline and online shopping experiences (Rafaeli et al. 2017). As a result, once they enter the market, they choose to use their mobile devices to check the in-store facilities. There is a real concern about integrating the advantages of internet shopping with those of in-store shopping. To overcome this problem, Augmented Reality (AR) apps for digital smartphones have recently gained popularity. Notably, Augmented Reality technology has its benefits, the most notable of which is the ability to enable and apply virtual elements to the physical world (Javornik and Ana 2016). AR will incorporate digital elements into the retail environment in real-time, contributing to a potential immersive shopping experience (Bulearca, Tamarjan, and Daniel 2010). In today's grocery shopping, the effectiveness and competitiveness of mobile AR technology are becoming more significant.

1.2 Research Problem

While shopping, the main problem that consumers face is the difficulty in finding the product item price, expiration date, production date, and offers of the product, etc. For instance, consumers who are having non-communicable diseases face that problem because that kind of consumer mainly considers their diet plan.

1.3 Broad Objective

Minimize the time wastage incurred in shopping by enhancing the convenience of accessing product details.

1.4 Specific Objectives

1. SAR application provides a way to prevent the spreading of COVID-19 by reducing unnecessary touching of the products in the supermarkets.
2. Based on the consumer's healthy level and their diet plans this method supports the customer to select the most suitable items.
3. The system supports the consumer to select the products based on budget.

2. Methodology

This section illustrates the methodology of the application that describes the process of the development. The first step includes the preceding investigation and data collection, and selected the Vuforia Software Development Kit (SDK) as the development tool for this application.

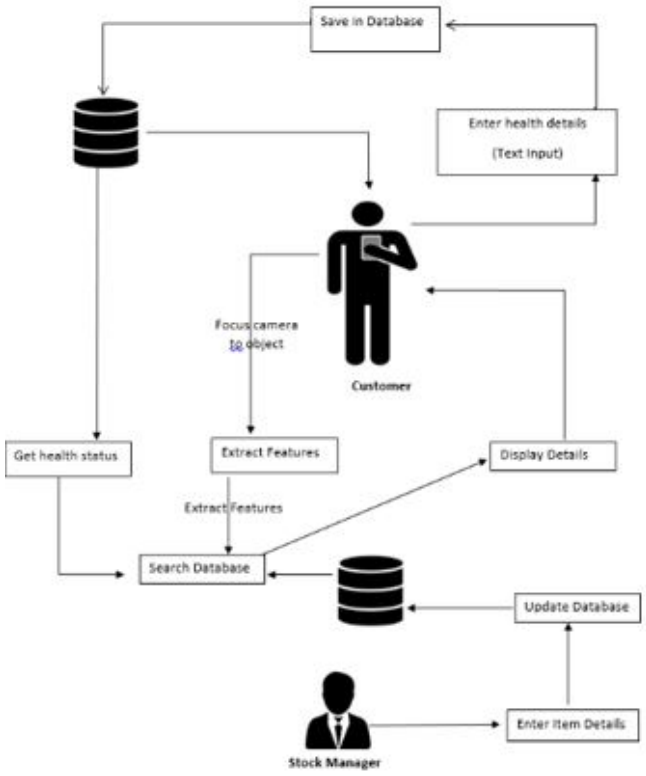

Figure 1. Process of the system.

Using the image target technology in Vuforia Software Development Kit (SDK), it can provide a flexible SDK library to recognize the real product by comparing the target captured with a camera device. Based on the input images Qualcomm's Target management system provides a convenient

web-based tool to create a known database for Vufoira SDK developers and it can be distributed with the application.

Vuforia Engine can detect and track the images which are represented by the image targets and it's created online TMS12 from JPG or PNG input images. Vuforia Software Development Kits (SDK) will use the natural feature marker-based detection method to tracking the features of the image. The image target will be extracted by considering the three aspects including the percentage of deforming, character's shape, and the probability of deform. After extracting features from the image that details store in the database and used to run time comparison. In the detection process, the tracker uses the computer vision algorithm which can detect the real-world object in-camera video frame by the Vuforia SDK. Before storing the results in the state object that is used by the video renderer and accessible by the application code, it will handle the detection for the image target in the device database based on the image that has been detected. If the state of the object match with features of the target image application provide the relevant details based on the target image ID from the product details database. The application is comprised of mainly three (3) parts. This app provides a solution to choose the most suitable product based on their health status and their diet plan. Furthermore, providing product information in a unique way helps consumers to quickly capture product information and application also helps to handle the consumer budget.

3. Results and Discussions

The result of the designing process of the application will be put forward with screenshots taken from our application. The first scene in the application shows the information of the particular product (Figure 2). The UI presents details of the product such as the expiry date, price, ingredients, and special offers until the camera focus on the product. It's an advantage to obtain the information quickly for people who can't read small letters and offers of the product. The main advantage is the ability to display item details without touching the item.

Figure 2. Displaying item details and special offers.

As a result, this application provides health tips in two ways. If consumers suffering from non-communicable diseases, they can provide that details to the system product (Figure 3). Based on that details, the system will provide warning messages about the product's preference. The second method is to send warning messages according to the user's meal plan product (Figure 3). Application has the ability to display the summary of nutrition of all the goods which are expected to purchase.(Ahn et al. 2015) has explored the effectiveness of the Augmented Reality in grocery shopping and also they have suggested a solution for customers to select healthier food items. The objective of the researcher was to help improve the ability of shoppers to find healthy food products in a grocery store aisle. They display healthy food by using the two-color tags (green and red), but it does not include the amount of the nutritional level. In SAR application provides more information to customers to select the suitable product based on their health condition. Another consequence is that the customer can choose the product to suit their budget. The application will always display the budget on the screen which is entered by the consumer at the beginning of the process. When consumers purchase

Figure 3. Displaying warning messages based on their non-communicable disease and diet plan data.

the items it will deduct the cost of the item by the budget. So customers can easily maintain the budget (Figure 4).

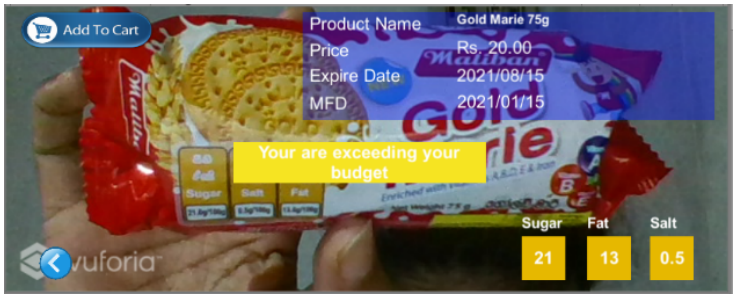

Figure 4. Displaying warning message based on the user's budget.

3.1 Evaluate the result based on the questionnaire

The application has been tested involving real consumers who like to do shopping within the supermarket. A questionnaire was used to obtain feedback from customers who suffer from non-communicable diseases and who want to save their shopping time. The answers to the questionnaires were collected and organized afterward. Using that questionnaire, 90 customer responses were considered to measure system output. The response from the questionnaire shows that the system gives consumers a greater advantage when shopping.

According to the response of the questionnaire, 94.7% of the consumer think using this application made their work much easier. In addition, 84.2% of the consumer think using this application allow to save their shopping time (Figure 5). According to the responses of the questionnaire, 84.2% of the

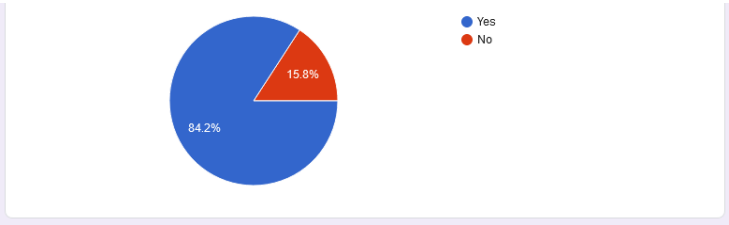

Figure 5. Percentage of the consumers who think SAR application was able to save their time.

consumers were able to choose the product according to their health condition using this application and 89.5% of customers were able to manage the money they expect to set aside for shopping. One of the issues that most affect consumers when they shop is how they get the goods based on their budget. According to the response of the questionnaire, this percentage has a significant level, which reveals that using this application has enabled the customer to get the goods with handling their

budget. According to this response illustrates the 89.5% of the consumers were able to view the item details very easily by using SAR application (Figure 6). Considering the response of new features

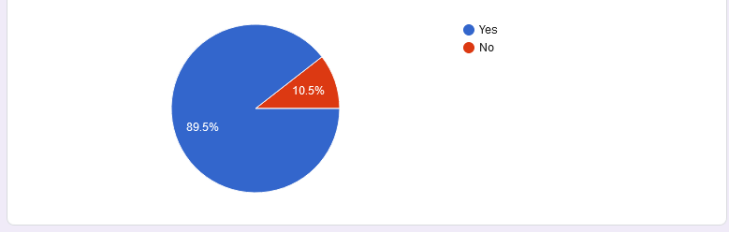

Figure 6. Percentage of the consumers who can view the details of the item very easily.

which are suggested by the consumers, 68.4% of consumers prefer to use functions such as in-store navigation. In addition to that 52.6% of customers prefer to perform tasks such as the item suggestion function, and 47.4% of customers prefer to use functions such as saving shopping history.

3.2 Performance of the application

We used the computer tracking libraries and the type of phone as the independent variables to test the performance of the application. (Figure 7) illustrates how long the user had to wait to use the

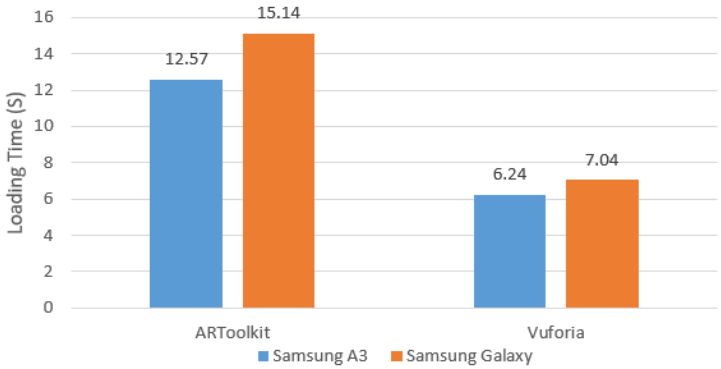

Figure 7. Time taken to run the AR application.

application compared with the initialization time. When compared to Vuforia, ARToolKit takes longer to initialize. The Samsung A3 is arguably the fastest smartphone compared to the Samsung Galaxy. Two smartphones have been used to measure the tracking time with the different distances

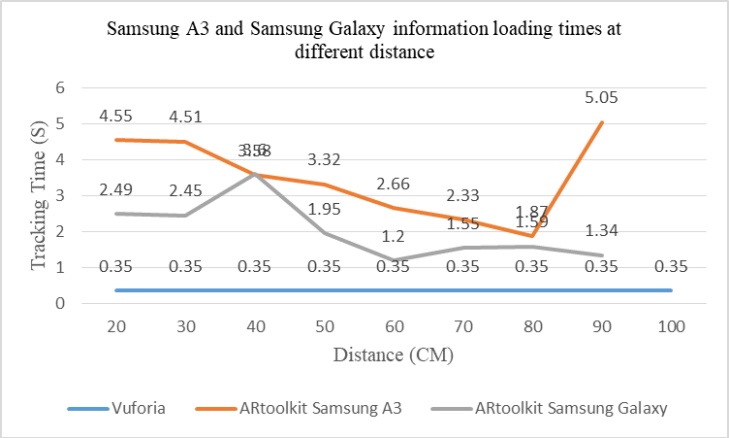

Figure 8. Compare the information loading time of Samsung A3 and Samsung Galaxy based on the distance.

to evaluate the performance of the selected libraries in this study (Figure 8). The tracking time is measured every 10 cm from 20 cm to 100 cm. The maximum distance was 90cm which was the maximum distance to react to the app properly in smartphones with ARToolKit and tacking time measured less than the 5.05s. Samsung Galaxy has taken below 4s as time for load the information. Generally, Samsung Galaxy with ARToolKit experienced a lower loading time than Samsung A3. However, the Vuforia library maintained a constant time for every distance it did not depend on the given distance range. Form this analysis can illustrate the Vuforia the tracking computation is faster than the ARToolKit.

3.3 Conclusion

This research aimed to identify the problems that customers encounter when dealing with the supermarket industry in the Sri Lankan context, increasing customer satisfaction with a competitive shopping environment. Many customers have less understanding of the quality and specifics of a product due to frustration with the method of selecting a product. Furthermore, researchers have seen that consumers aren't aware of the offers and discounts offered due to the lack of information provided by the supermarket. Nowadays, most of the customer's keen on those product details, and researchers hoped to display that information with emphasis. As an outcome of this research, researchers have created a mobile app that addresses all of the above issues and builds and that improves the effectiveness of the shopping process. In future work, researchers plan to develop a function to support indoor navigation and support for other languages. In addition to that researchers plan to develop a component for voice recognition for people who are blind to experience other consumers as researchers as the smart supermarket experience in the future.

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