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Augmented Reality Based Restaurant Menu

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Article History	Abstract
	In this paper, we propose an Augmented Reality-based Android framework that will assist restaurants in providing better service to their customers. It provides the users with features such as 3D view of the food item, description containing the origin of the dish and recipe along with calorie information and price. When the application is launched, category wise menu will pop up, the user will have to choose the desired category and the food items in that category will be in displayed for them to view. An android smartphone or tablet can be used to find more 3D dishes on your table. Calorie labeling on menu will assist patrons in making educated and healthy food and snack choices. Calories will be described on the menu, allowing customers to better understand their choices and making it easier to eat healthily when dining. So that whenever a new user visits that restaurant, all details regarding the dish can be viewed. The application was designed with an aim to help users to visualize the dish that they crave for by implementing 3D models of food items.

1. Introduction

Augmented Reality (AR) is one technology that is flourishing apace in almost all around the globe. In real time, augmented reality merges visual objects or a virtual universe into the real-world exhibit. Virtual Reality (VR) and Augmented Reality (AR) are two great examples of visualization approaches that are exploding in this digital age, either by immersing users in a simulated virtual environment or by introducing a new level of interaction between digital devices and the physical world [16]. In contrast to virtual reality, which replaces reality entirely, augmented reality just adds to or completes it. The aim of augmented reality technology is to create a system in which customers can't tell the difference between the virtual augmentation world and the real world. Entertainment, military and defense training, engineering design and development, robots, manufacturing, and other industries all use augmented reality. Over the last decade, this technology has begun to color the world of technology, and it is now ready to draw the attention of consultants, researchers, and IT creators with technology models designed to build actual virtual objects [17-24].

If handled correctly, the restaurant industry is the most profitable. Old, unsightly methods of attracting new customers are no longer efficient. What works these days is combining cutting-edge technology with a substitution approach to tame customers. In accordance with Statista, the global augmented reality market is

expected to expand to about 198 billion dollars by 2025. Restaurants are integrating virtual reality technologies and this technology into their company to take advantage of the benefits of this new technology.

According to Mashable's concept, augmented reality is a live, direct or indirect display of actual, real-world setting elements that are enhanced by machine-generated sensory input such as sound, video, graphics, or GPS data. Thus, basically computer has tampered with reality. Menus can be moved to a whole new surface with the advent of digital tablets and user-friendly touch screen technology [12]. As

a result, the person using it sees the object in a more realistic light. As a result of the advanced AR technology, the knowledge encompassing the user's real-world experience becomes inactive and digitally manipulated. In simple terms, augmented reality refers to images created by a computer.

In existing system, more focus was given on paper-based restaurant menu. Food products list with their respective prices are available in the menu in this system module, so users can simply order their food product. However, some users are picky about what they want to eat, so calorie information is provided for those users. Description of food items are not mentioned in the existing system.

In this research work, an augmented reality digital menu application is designed for restaurant or hotel that displays its content digitally via screen instead of printed on paper. This digital menu app deals have five main components as described below:

• **Modeling a 3D menu:** 3D models have proven to be extremely valuable to 3D food menu owners. It creates enticing visuals for dishes and helps restaurants to effectively promote new cuisine. Users will be able to see delicious dishes from all sides and angles thanks to 3D food models for AR menus. Users should be assured that the food they are about to order will look as good as the cake or salad on the menu.

• **Calorie labelling** on menus will assist patrons in making educated and healthy food and snack choices. Calories will be described on the menu, allowing customers to better understand their choices and making it easier to eat healthily when dining out. They can be aware of calorie needs, look for nutrition information and make informed eating decisions at restaurants.

• **Description** of the food product along with source of recipe and when a dish or ingredient has a regional origin, it sounds more expensive and of higher quality.

• **Category wise menu:** These days, the vegan, vegetarian, and even raw-vegan movements are gaining popularity. As a result, we made certain that at least one dish item from each group is available to supply to clients who observe these dietary restrictions.

• **Price** of the food item

The primary objective is to eliminate paper-based menu used in current restaurant businesses. Hence in the proposed system in addition to digital menu containing all the description regarding the dishes, implementation of augmented 3D models is done to make the menu attractive to the customers. In this system the user can have an interactive display of food item he/she desires to view in 3D. The current restaurant menus lack in-depth information about the food item, to remedy this, the new system includes calorie labelling that provides a description of the specific food item. Furthermore, the proposed method includes the definition and price of the chosen food.

The rest of the paper is organized as follows: Section II presents study on related work. Section III presents a general overview of our approach including the software requirements and workflow of the system. Section IV details how the system is developed showing its different parts. Section V presents the results of the application. Section VI presents the applications of using augmented reality-based restaurant menu. Finally, conclusions are presented in Section VII.

LITERATURE SURVEY

The following are some of the pre-existing software frameworks, functionalities, and technologies that have been reviewed prior to the proposal on our study. Digital menus have a wealth of modulation and personalization options for enhancing the user experience through interaction. In comparison to traditional printed paper menus, digital menus help restaurants increase profit by making food more available, selling more, and requiring less labor. "Designing Restaurant Digital Menus to Enhance User Experience "[1] written by Yun Wang discusses the History of menu, Menu Design Terminologies, Color Schemes, User interface design principles. This paper also provides analysis on how typography, alignment, arrangement, and columns work for digital menus, as well as effective ways to arrange all of the elements like images, graphic elements and descriptions in digital menus that would help to communicate with viewers.

In "A Survey of Augmented Reality Technologies, Applications and Limitations" [2] by Rick Van Krevelen, Ronald Poelman is a comprehensive survey was conducted to emphasize the value of augmented reality, which is a modern way of augmenting our understanding of reality with synthetic elements that we can see, hear, and sound. AR is used in a variety of areas, including education, medicine, the military, and a variety of others. This paper discusses augmented reality, including its concept, a brief history, and the numerous implementations in various fields that are currently in use in modern trends. It reviews the state of the art by analyzing some recent applications in the field of AR

technology, as well as the weaknesses that developers would have to address in terms of human factors in the use of AR systems.

In "Smart Restaurant System using android" [3] by Akash Patil, Rinkesh Kalane, Bhavesh Patil, Sachin Shinde points that customers may choose their desired food from a menu displayed on a Tab monitor using the Smart Restaurant System. The customer's choices will be sent to a kitchen assistant. Menu, food ordered, confirm, and bill request are all available on the digital menu. If the menu is chosen, the customer will be taken to the food menu screen, where they can pick the type of food they want, that is food (Veg. or Non-Veg.), dessert, drinks. When you click on an item, the images and definition of that food will appear. The architecture of their system consists of Admin Application which has varied responsibilities of administrator, user application provides user friendly GUI to customers, the kitchen unit is a desktop program that shows instructions to the kitchen team. Paybill module is a desktop-based program that handles a variety of cashier and manual paper-based menu responsibilities.

In [4] This paper titled "A Review paper on smart restaurant ordering system" by Sharaddha G Malviya, Nikita D Deshpande, Shivani Mahalle, Prof Sharvani Tantarpale describes that people nowadays are searching for a framework that can more comprehensively meet their needs while obviating the need for all conventional methods to give more dining experience to customer using Arduino, TFT display, touch screen, RFID technology. The system is made up of a microcontroller that acts as an interface between the input and output modules, and a controller that acts as an intermediary between them. The input module is a touch screen sensor that is mounted on a TFT monitor to allow for graphical image display, and it takes input from the user and sends it to the microcontroller. The RF module is an output module that creates a connection between the table and the ordering system's menu items. The order will be put on the kitchen market, and the customer will pay the bill using RFID card, and the sum will be detected for the user account, and the order will be verified. This is a fantastic breakthrough in technology because of its low cost and ease of use. This technology would make it easier for the consumer.

In [5] This paper title with "Smart restaurant" by Tuhin Ghosh, Shbhambhoir, Prashant Patel Nikhil Mehta, the author notes that in today's world people are increasingly moving towards a modern world with the introduction of smart cities. With the aid of smart technology, restaurant management can be more effective. This system has four modules: customer, server, kitchen, and home delivery. Wireless fidelity is used by the customer and kitchen modules, while internet connectivity is needed for the home delivery and reservation modules. The author of this paper has been working on an integrated food ordering system with real-time customer input that is still in the development process.

In [6] The paper title "An augmented reality interactive menu that e-menu that elevates the gourmet food experience" by Emili Koui states the proposed solution is aimed at gourmet restaurateurs and aims to improve a customer's gourmet food experience through raising their standards visually through augmented reality. It discusses the advantages of integrating a digital menu into a gourmet dining experience. It implies that visual representation may aid in the development of trust between the customer and the restaurant owner. Dietary preferences, portion sizes, food awareness, and language barriers are among them. It is to make a contribution to the field of architecture by combining design technology and culinary arts. Its aim is to take advantage of current or emerging design technology and show how to easily use and create a cost-effective, profitable, and visually appealing menu through a proof of concept.

PROPOSED WORK

We have used the following tools and software to build the system.

- Paint 3D

- Unity 3D

- Android studio

- Adobe XD

- **Paint 3D:** Paint 3D is a graphics and 3D modeling application that is a brush up of Microsoft Paint. This is one of several 3D modeling with printing applications improved with the Windows 10 Creators Update, along with 3D viewer, Windows Mixed Reality, Hologram, and 3D and 2D Builders.

- **Unity 3D:** This is a powerful game engine which allows to build 2D and 3d scenes, games and stimulation. They help to save a huge amount of development time and make the experience more convenient.

- **Android Studio:** Android Studio is a Google-created integrated development environment based on IntelliJ software and designed specifically for Android development designs. It can be downloaded for Linux, MacOS, and Windows operating systems.

- **Adobe XD:** It is a vector-based user interface design platform developed and released by Adobe Inc. for web and mobile applications. They have animation and a repeat grid prototype, among other things. Components can be used to build icons, buttons, and other assets that can be reused. Their appearance varies depending on the context in which they are used.

The application is designed using Kotlin as coding language to provide category wise menus as planned. The customer just has to hold the application on the menu, select the category you want and the items in that category will be popped. Then choose any item from the list to see how it appears in 3D, as this application provides a 3D view of the item selected. On the panel below the 3D view, you will find information about the recipe such as its price, ingredients and nutrients value.
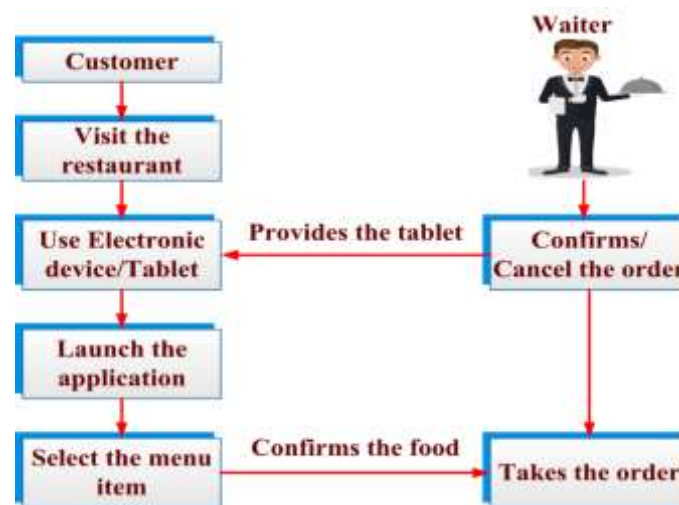

Fig 1: Overall working of our AR based 3D restaurant menu

The user visits the restaurant, he is provided with a tablet to access the menu, the image a 3d model is popped after selecting the desired menu item. The user will be able to rotate the model and zoom in to have a closer look at the food item before placing the order. If the user is unaware of the dish, he can have a look at the description of the unknown food which includes the source of recipe and if any exotic ingredient is a part of it. After the desired food is finalized by the user, the order is confirmed by the waiter.

There are 5 modules used in the proposed system:

Module 1: User can see the user interface model.

This module allows the user to open the application and display the restaurant's category-based menu.

Module 2: Choosing food items from a specific category. In this module, if the user selects a specific food category, it should appear in the food item category list, and the device should not change its path. For example, if a user selects vegan, the device module should be located in the vegan category and not in any other food categories.

Module 3: Displaying the food item list.

In this module user can view the food item image can view the calories of food item description of the food item and can also swipe left to right to see more details of the food items.

Module 4: Displaying 3D model of food item

After viewing the 3D model of the picture in this module, it must trace back to module 3 after which the user can place their food orders.

Module5: Confirmation of order.

In this Module order button is available to the user by clicking on it after which the module should trace back to module 3. The data must be sent to payment gateways; after the payment is completed, the

customer receives notice that their transaction was completed successfully, as well as an order id and a payment bill.

Algorithm: Proposed system

Step1: user launches the application.

Step 2: displaying the category wise menu of the restaurant.

Step3: user can choose their preferred category.

Step4: user gets the list of food items in the specific category.

Step5: by clicking the respective food item, user can get details of description of food item and calorie included in that food item.

Step6: user can view 3D model of food item.

Step7: user is provided with order button by clicking on which the order is placed.

Step8: when the user has completed the food ordering process, they will receive a confirmation status, indicating that their order has been completed successfully.

IMPLEMENTATION

Step 1: Generating 3D Models

To generate 3D models of food items 3D Scanning was done using 3D Scanner and a technique called Photogrammetry was used. Photogrammetry is performed by capturing a sequence of photographs of a single object in our case food items are collected, analyzed and converted into accurate 3D models by utilizing specialized AR software like Unity 3D. The software acquires measurements from conventional digital photographs to find the exact position of surface points of the object. Paint 3D was used to add colors, shadings and textures to the 3D models.

All models were later exported for integration with a smartphone application. The models were exported to GLB format were all the assets are stored in a single file. GLB format is intended to be a streamlined, interoperable format for the delivery of 3D assets by reducing the file size and runtime processing by the App.

Fig 2: Augmented 3D model

Available online at: https://jazindia.com

Fig 3: Augmented 3D model of Sushi

Step 2: Adobe XD design of prototype

The prototype was initially designed and prototyped using Adobe XD. It is a software which is used to create designs for the posts, android apps and for other requirements. The design files are then exported to the application repository. The exported file names are renamed as per the Android Studio specifications.

Step 3: Implementation of the software

The design is to develop a recycler view based displayable items which should be clicked by the user. When particular image or the path is chosen, then the sub child items under the main item will be displayed as items, implemented using Recycler View. When the user clicks on any further item the item description and its respective image source URL must be fetched through few asynchronous calls and store it as cache. The images are then displayed as a colossal. The button is placed at the bottom center position. and a 3D image rendering button is placed above the order button.

Step 4: 3D Rendering of the model using Sceneform

Sceneform makes it easy to render realistic 3D scenes in AR and non-AR apps, without having to learn OpenGL. It comprises of a high-level scene graph API, a realistic physically based renderer provided by Filament, an Android Studio plugin for importing, viewing, and building 3D assets. This API is used to render the .GLB file. These .GLB files are placed in the assets folder, which is shipped along with the app when the APK is built using Android Studio.

RESULT

Table 1, shows the comparison of various schemes designed for restaurant menu. As compared to schemes mentioned, our proposed VR based 3D restaurant menu is more realistic and provides attraction to the customers as if they are seeing the items in real time.

Table 1: Comparison of different schemes for restaurant menu

Reference	Purpose	Technology	Remark
[1]	To provide interactive design layout of restaurant menu	Android application	User cannot visualize food item
[2]	To enhance user perception using VR	VR	Extensive testing need to do on real time
[3]	To design smart restaurant menu	Android application	Large amount of data to be stored in the database so update of data is time consuming
[6]	To make proper ordering and management of food items	AR	Ordering food items and manage the customer feedback need large amount of database so managing data is difficult task.
Proposed system	Viewing the food items in 3d model by the customer and increasing marketing standards by the restaurant	AR	Food items are available in 3D models and it is available only for android user.

Fig 4: Category wise menu is displayed to the user

Fig 5: Description containing the origin of the dish and source of recipe

Fig 6: After selecting desired category and food item, the user is displayed with augmented model of food, description, calorie labelling and price

Taking four reference paper outlining the key aspects of exsting project ie.title of references ,purpose, technology and limitation of their work.

VI.   APPLICATIONS

Engaging users with interactive menu items Offer AR Food Menu

- **Locate Niche Customers:** A brilliant way to eliminate language barrier and connect distant customers. Customer retention improves when nutrition knowledge is included.

- **Endorsement of the Restaurant:** For many years, an advertising has been the driving force behind running a successful company. However, when combined with cutting-edge approaches and technology, it gives businesses a huge boost in the right direction. The incorporation of virtual reality into the techniques provides consumers with a much-needed boost. It displays the delicious food stuffs served at the restaurants. Therefore, there are never ending prospect AR technology can bestow to the business.

- **False orders can be ruled out:** Ordering performance improves with digital menus. The probability of making a mistake is significantly reduced when a user can directly pick an item from the menu rather than attempting to communicate it over the phone. This saves money by avoiding the expense of sending out a replacement order or, worse, losing a customer.

- **Elimination** of paper- based menus.

4. Conclusion

By replacing the conventional paper-based menu system with an augmented reality app, restaurants can engage more customers, add more value, and produce more sales. With the help of this AR application, diners visiting the restaurant will have an immersive dining experience. Besides the digital menu it also provides them with ingredients and nutrition information for any selected menu item. Its main objective is to help the user visualize the food before placing the order. The restaurant popularity can be increased leading to a productive business. Depending upon the current scenario the restaurants are lacking in the presentation of the food which eventually affects their revenue, doing so the restaurants can have a better impact on customers and can increase their growth. This application also aids in the removal of all language barriers as well as the issue of oddly named dishes.

Overall, incorporating augmented reality into your restaurant can be profitable. Restaurant application growth brings in new clients and raises the company's profile.

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