

Original Article

Restaurant Ordering System using AR, Website Development and Recommender system using ML

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Abstract - The major goal of the system is to increase the efficiency of customer interaction and overall customer satisfaction of a restaurant. The system will provide functionalities to the end-user in order to book a table, to get a virtual view of the dish along with the specifications and to verify credibility after going through customer reviews. This system will also recommend the most favourable dishes to the customer from the menu using machine learning, and this is implemented with the information on previous orders made by them. This will help the restaurant to establish an online presence and build new customer relations while improving the already existing ones.

Keywords - online-branding, app, machine-learning, augmented-reality, website development,

I. INTRODUCTION

Around the world, an unattended elephant of the room is the restaurant industry's incompleteness when it comes to booking a table and creating an impactful online presence. The lack of it directly affects the sales and branding of a restaurant business. In order to encounter this inefficiency and to adversely increase an online presence, a website design is proposed with the functionality to suggest its users and returning customers relevant dishes and offers.

The goal of the system is to increase the efficiency of placing an order, booking a table, checking customer reviews and promoting overall customer satisfaction. Thus, it is a key tactic that will promote small-scale businesses to grow.

Considering various aspects of recommender systems and Point-to-scale technologies, we have tried to eliminate the previous shortcomings in the researched systems and provide an all-around one-stop solution on the same.

II. RELATED WORK

In recent years, the growth of technology has given way to establishing more datasets that are reliable and include the most approximate way to deduce the likings of the user.

Online reviews are often accessed by the users to buy products, see a movie or go to a restaurant. However, online reviews are a useful resource for sentiment analysis; therefore, it is easier to work with them for classification problems. We can identify the work in two ways. Some works have been done just for answering the positive and negative class levels. Some work with the stars. Many of the work has gone through both^[1]. At the same time, the online activity of users is easier to track and implement in the business strategies of a growing business.

Among some of the mobility features of E-commerce, recommendations systems also play a very important role as they are an indispensable part of personalization. The term 'recommender systems' or 'recommenders' has extensively evolved from the term 'collaborative filtering' since the latter is a specific algorithm for the recommendation. Recommender systems take into account the reviews and experiences of a community to produce for the user mapping of scores to items, a ranking of items, a set of recommended items, or these three combined.^[2]

A few problems that the recommender system faces are the 'cold start' problem that arises when a new user or a new item is introduced, 'excessive user participation' wherein a user randomly rates all the products that have not yet been used by them and leads the system confused as to what exactly is the user preference.

III. LITERATURE SURVEY

The methods used before for placing an order in a restaurant were manual. The manual restaurant ordering system relies on a lot of manpower. To handle all the table and taking the order which is lot hectic. According to The Developing of Self-service Restaurant Ordering System



(SROS) (2012) ^[3]. this paper was about the manual restaurant ordering system which relies on a lot of manpower to handle all the customers and tables, which is more hectic and sometimes wrong order might get served to another customer. To avoid this chaos, they developed a system to reduce the number of manpower in ordering tasks. Research has been done to benefit the customer as well as owners to place orders efficiently through the system provided by the restaurant and can view the menu and can proceed to make their order and can simply add or remove the item from their desired menu and the total cost can be reflected on the system and their table number as well. As we come across many new restaurants, it becomes difficult for a customer to order as the menu is not familiar, and they are not able to know the quantity and size of the dish or item. This can cause complications to the customer to place an order.

To display the products to customers, Augmented Reality is used. In an Augmented Reality Mobile System for Products Display (2013) ^[4] this paper, they developed an Android application on their mobile system and web service to provide product information. Augmented reality technology employed marker-based using QR codes. As the QR code is read via the device's camera, the 3D virtual objects would appear in the estimated position and display the product information. The customer can have a glance at the ordered item/product and view the product details, and can show what the dish/product looks like. They have also implemented a web service that provides product information in case the designated websites that provide product information are not available.

A recommendation is now frequently used in our day to day life. Whenever customers go to some new restaurants, they look for recommendations from the customers who have been there before and according to that, customers review and rate the customer places their order.

In the Foody - Smart Restaurant Management and Ordering System (2018) ^[5]. in this project, they have developed a Foody app in which they handle table reservations and place orders properly. They have also integrated the recommendation management system to provide recommendations to a new customer or familiar customers. For the food recommendation part, they have used users' social media data. For that graph, API is used, which is a primary way to get data into and out of the Facebook platform. It's a low-level HTTP-based API that apps use to programmatically query data, post new stories and perform a wide variety of other tasks. E-commerce websites mostly use recommendation systems to improve the user interface and make it easier to use.

In E-commerce Personalized Recommendation System Based on Multi-Agent (2010) ^[6]. this paper presents a Multi-Agent-based e-commerce personalized recommendation system. Its general design idea is to use Agent technology to build intelligent agents from the functional modules in a personalized recommendation system. Under intelligent

control mode, the offline email recommendation and online hybrid recommendation techniques are used to build the core of recommendation modules. A good e-commerce recommender system usually uses a combined recommender system like Hybrid recommendation, which is a combination of content-based filtering and collaborative filtering recommendation technology.

But in this paper, they have not used a fixed recommendation system. They have used a condition through which the recommendation control agent will decide which recommendation technology to be used. The condition depends on two values: the number of users in existing user models and the number of products evaluated by the users. When these two values are greater than their respective thresholds, collaborative-based filtering recommendation technology should be used. Otherwise, content-based filtering recommendation technology should be adopted. To obtain accurate and precise personalized recommendation results, the important components of the recommendation system are inseparable from the data mining technology. Data mining is the key to developing an efficient recommendation system. In order to make frequent ordering convenient.

The main purpose of E-Restaurant: Online Restaurant Management System for Android (2015) ^[7] is to make placing orders easy. They have designed an advanced e-restaurant online management system using android smart mobile and Bluetooth wireless technology. The menu will be displayed on android mobile or else on a tablet, and an order can be placed through that. A recommendation algorithm is also applied, which will suggest dishes to the patrons based on previous orders, which makes it easier for a customer to build his/her order and view the most popular dishes. As an order is placed through android mobile, that request goes to the kitchen server, and the order gets under preparation process.

IV. PROBLEM STATEMENT

In our traditional service industry, branding and customer interactions play a major role in devising the success of the restaurant as a business. Traditional branding, however efficient in limited proximity, does not help achieve the growing needs of technology and competition.

The lack of user provisions is a gap that needs to be bridged in small-scale restaurants while ensuring that it stays relevant for end-users and provides a trustworthy experience to new guests.

Acquisition of new customers in modern times requires brand building, and encountering this challenge with the help of technology is the need of the hour. Recommender systems are complex to be built by restaurant business owners or managers; as a result, this paper's outcome will provide a solution to these targeted demographics.

V. METHODOLOGY

The proposed solution in this paper includes 3 integral components that will be implemented in a small-scale restaurant adapting to this solution:

A. AR-Viewing Application

AR app is developed by using Vuforia and Unity 3D. Vuforia enables users to create an AR application and helps to position or orient virtual objects, such as 3D models. This AR app utilizes user’s smart-phone to enable smart 3D viewing of the dish that they want to order.

AR app - Screenshots



Fig. 1 Screenshot of AR Application

The most important factor that decides the branding of a business is its online presence and popularity. The purpose of a responsive website is to promote the creation of a community that will be in close touch with the business. This website will also create an impact on those internet users who are yet to experience the restaurant first-hand.

C. Recommender System using ML

The recommendation system uses 2 approaches to detect the kind of products to be recommended to the end-user:

- Collaborative Filtering
- Content-based filtering
- PCY Algorithm
- Hybrid Filtering

The data sets used to train the system to have the following attributes:

- Age Group
- Gender
- Ratings
- Frequency of ordering/visits

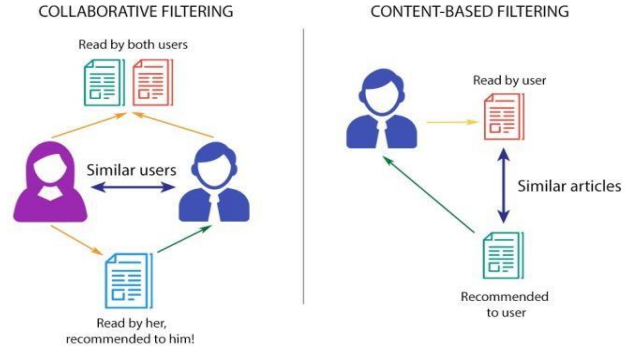


Fig. 2 Visual Representation of recommendation approach.^[8]

a) Collaborative Filtering

Collaborative filtering applies an algorithm that searches the most closely related users and suggests to each other the products the other uses but hasn’t been used by both.

In most the recommendation system where items with features are involved, Collaborative filtering is used. In this type of filtering, the system recommends certain items to consumers based on preferences collected from many other consumers.

We have used this filtering method for recommending food items to consumers. The idea behind using this method is that the Algorithm collects ratings from many users, and based on that data, systems check different preferences for the current consumer. In our Algorithm, we have formed a matrix from the dataset, which includes dish names and ratings from every user. To negate all the zero ratings so that those ratings can be used without having any errors while calculating similar dishes.

Formula used for standardization is:

$$\text{now} = (\text{prev_row} - \text{prev_row.mean()}) / (\text{prev_row.max()} - \text{prev_row.mean()})$$

As a result of this, our previously formed data matrix is updated with standardized values.

b) Content-based Filtering

The content-based filtering applies the apriori Algorithm to create a relation between frequently bought items and establish a correlation between them.

This is done based on the features of items bought by the consumer. This method is mostly found in the movie recommendation system, as each movie can be categorized based on genre, and with the user’s previous preferred movie genre, another movie with a similar genre is recommended to the user.

c) PCY Algorithm

P-C-Y Algorithm was developed by three Chinese scientists, sparks, Chen and Yu. It is an algorithm used in the field of big data analytics for the mining of frequent itemsets when the dataset is very large.

When we have a huge collection of data, each record has a certain number of transactions. Say, if we buy any product online, its transaction is being noted. Further, we would see the website advise us to buy a particular product that is often associated with the one we just bought.

The main purpose of this algorithm is to make frequent itemsets as accurate as possible.

Transaction Items bought	
Transaction 1	fries + coke
Transaction 2	fries + coke + burger
Transaction 3	fries + milkshake
Transaction 4	fries + coke + pizza

So, it can be seen that fries are most frequently bought along with coke and thus considered as a frequent itemset.

PCY Algorithm

- ◆ PCY Pass 1:
 - ◆ Count items.
 - ◆ Hash each pair to a bucket and increment its count by 1.
- ◆ PCY Pass 2:
 - ◆ Summarize buckets by a *bitmap* : 1 = frequent (count $\geq s$); 0 = not.
 - ◆ Count only those pairs that (a) are both frequent and (b) hash to a frequent bucket.

Fig.3 Steps of PCY Algorithm.^[9]

d) Hybrid Filtering

Hybrid filtering for recommendation systems is a combination of multiple recommendation algorithms like combining Collaborative filtering and content-based filter to combine benefits of both recommendation systems.

This filtering method is mainly used in E-commerce sites to recommend a best-selling product based on its rating, and also products that other users bought together are recommended too. This is a combination of two different filtering methods to give maximum benefits from both methods.

VI. SYSTEM ARCHITECTURE

A. Overview of System Architecture

The 3 Integral Components of our system:



Fig. 4 Modules of the proposed solution

B. AR App block diagram

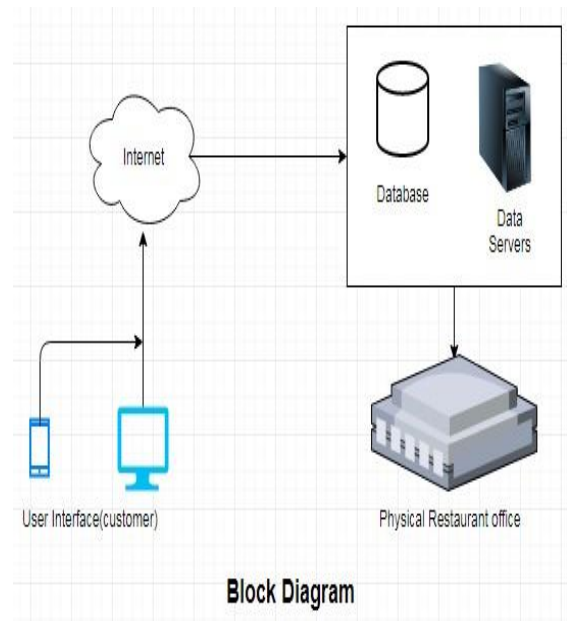


Fig. 5 Block diagram of AR app

C. Recommender System Architecture

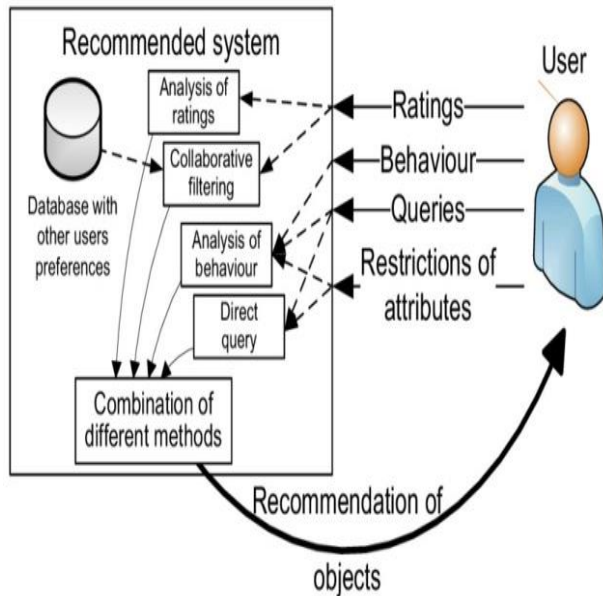


Fig. 6 Recommender System Architecture^[10]

Customer compatibility with Dishes

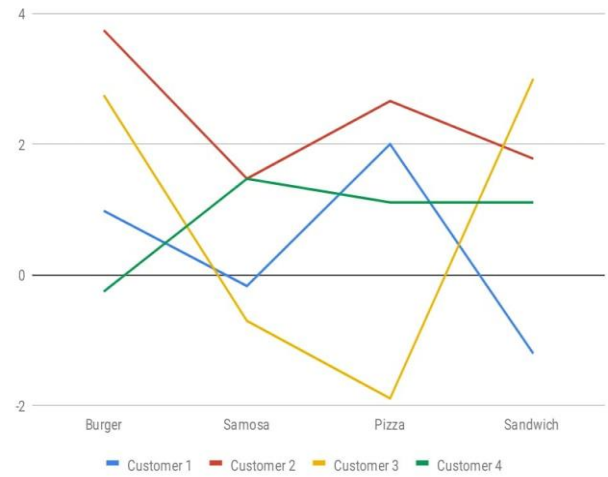


Fig.8 Visualization of results of collaborative filtering algorithm using data acquired from four users.

According to a rating system, we generate the relativity of content. After applying a certain threshold, we get the recommendable items.

VII. ANALYSIS

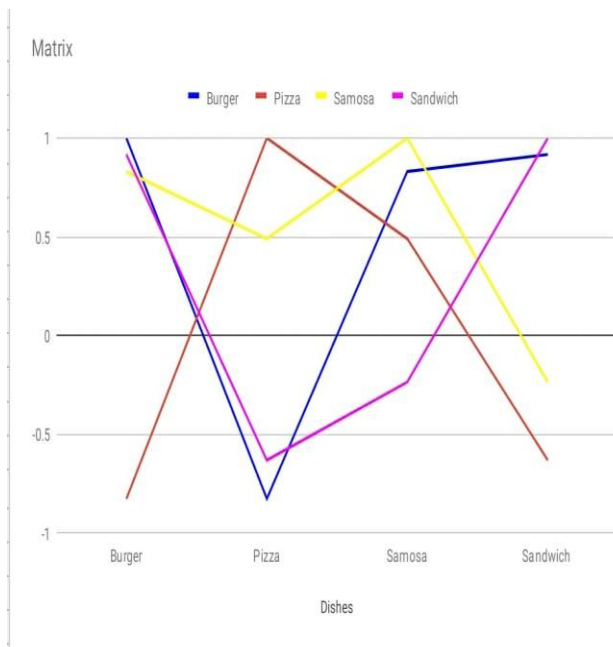


Fig. 7 Visualization of Distance Matrix based on content compatibility.

VIII. CONCLUSION

This paper gives a simple restaurant ordering system for a customer as well as the management staff of the restaurant. This research work has been mainly developed so that the customer gets a better and unique restaurant experience which also benefits the restaurant's popularity. Based on the results gained from the machine learning algorithms, a customer gets to try and explore a new variety of dishes.

Also, by keeping an option of table booking on the website, customers can avoid standing in the queue. Therefore, the Restaurant ordering system using augmented reality and recommender system with ML is one of the most effective online restaurant management and food ordering system.

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