

# **AUGMENTED REALITY ORDERING SYSTEM WITH DATA ANALYTICS TO SUPPORT DECISION MAKING IN THE RESTAURANT CHAINS**

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## **ABSTRACT**

Restaurants are really dependent on the experience and engagement of their customers in which customer satisfaction is the core part for the growth of the organization. It was revealed that bad experience comes in numerous reasons that can really affect customer experience. The main objective of the study was to create a modern ordering system using augmented reality with data analytics to enhance customer experience by providing an interactive way of ordering. The study utilized descriptive method to describe the behavior or assessment of the respondents about the study and developed software application. The study intended to provide a kind of experience that will be enjoyed by a customer and also, to give an easy-to-use application that can help the establishment in boosting not just their sales but also, their morale as a business in restaurant industry.

## **KEYWORDS**

Augmented Reality, Human-Computer Interaction (HCI), Big Data, Data Mining, Apriori Algorithm

## **1 INTRODUCTION**

In an occupied, crowded, and speedy casual dining environment, offering a customized experience for customers is incredibly challenging in restaurant industry. Restaurants are really dependent on the experience and engagement of their customers in which customer satisfaction is the core part for the growth of the organization. Better customer satisfaction keeps up the high profit of the organization and for this reason, they continuously set objectives to grow their business in the competitive market by giving the product and services according to the needs of their customers [1]. Customer's experience requires a combination of individualized insights, associated with interactions and an agile method to deal with customers in the channel of their personal preferences. It requires better method in looking for customer trends, patterns and preferences, and being smarter in responding to these components [2]. Conveying an incredible customer experience is immensely significant for any business. The better customer experience gain, the more positive reviews the business can get

while simultaneously decreasing the customer complaints. Similarly, customer services refer to particular touch points inside the customers experience when they request and receives assistant help in which for instance calling an administrator to demand for a refund or associating through email with a service provider [3].

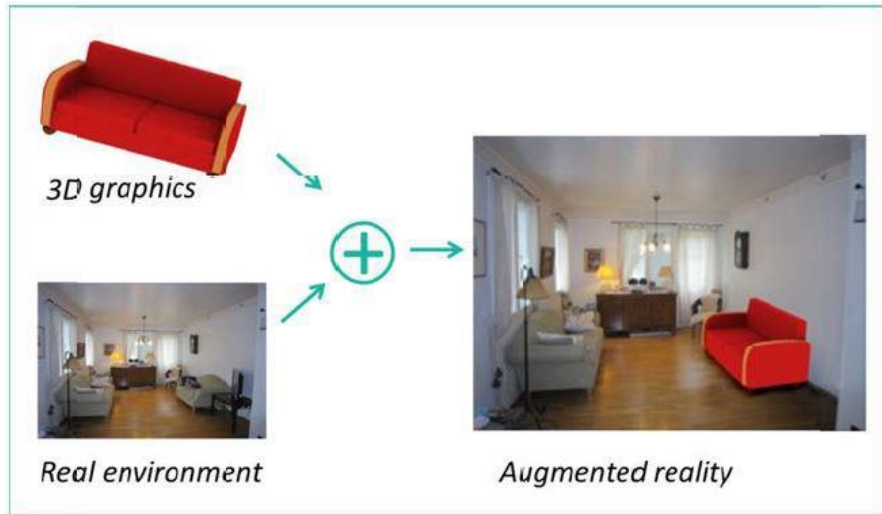
The manual way of ordering became the way to reveal that there were issues being encountered by customers from choosing food up to willingness to order that can really affect customer experience. The identified current issues that affects every customer's experiences and satisfaction when they visit a restaurant are the following: (1) customer lacks idea about the menu because of a large number of dishes which consumes time in choosing their order that resulted to having bad orders; (2) based on every customer's experiences, they order the same dishes every time they visit a restaurant due to lack of knowledge about other meals; (3) failing to know the specialty of a particular restaurant; (4) it has also happened to every customer's experiences that they see a very tasty image of food on the paper-based menu but the food does not look same on the image once the orders are served to them that can give negative feedback to the brand of the restaurant. This gives negative impression in customers side since the visual composition of food is the key element that really affects customers perception; (5) no information about primary ingredients of the meal to know if it's appropriate to their health in which there are instances that customers are concern about the diet and nutrition and food allergies; (6) there was no information if the meal they ordered is available or not. This will consume time because the waiter will return to the customer and will ask again the replacement. (7) and lastly, customers spending long time standing on the queue to order.

Out of all these reasons, the study focuses on enhancing the quality of customer experience in ordering in which the study suggested to develop a human-computer interaction (HCI) interface using augmented reality (AR) with data analytics to provide customers a wonderful dining experience in ordering by easily seeing the food in a 3-dimensional (3D) model, helping them to have a better idea of what the food would be like in reality. The proposed solution will design, implement and use interactive interfaces to encompasses not only for ease of use, but also new interaction techniques for supporting customer experiences, tasks and providing better access to information of meals which will create more powerful form of communication. The proposed solution can suggest best combination of food while browsing on the menu screen with the help of apriori algorithm. The algorithm will help customers to know best menu-pairings from different menu categories which will be based from the customers past preferences. In order to improve customer's convenience in ordering that instead falling in line and waiting, customers can place their orders on the proposed AR application which will be sent directly to the kitchen in real time to save their time and effort.

## **2 LITERATURE REVIEW**

### **2.1 Augmented Reality**

Augmented reality was identified in a broader idea called mediated reality, in which the perspective of the reality is altered by a computer [4]. As shown in figure 1, the augmented reality combines digital elements with the real-world environment where elements perceive as part of the real environment [5].



**Figure 1. Augmented Reality Combines Reality with Digital Content (3D Graphics)**

Augmented reality enables customers to see an advanced overlay of virtual objects in a 2D or 3D image into their surroundings through specialized devices such as the smartphone or AR glasses. In the most recent decade, touchscreen changed the world of technology. It was predicted that in the future, using augmented reality could soon be the next “touch-screen” of a person’s future multi-touch main screen [6]. Augmented reality can be used on different devices such as: glasses, screens, mobile phones, handheld devices and head-mounted displays. The following components of AR are: (1) cameras/sensors, (2) processing, (3) projection, and (4) reflection. Cameras or sensors are the first component who interacts to the user’s needs and collects data for processing. Camera that built on a device are scanning the environment which can pinpoint physical objects and generate 3D models. Processing has an algorithm on how to process correctly the collected data from user’s interaction. Like a mini computer, it depends to the device specifications to be able to measure up angle, speed, orientation in space, etc. Projection is said to be the result of processing. It can now display the result in digital content form onto the screen view. Reflection refers to the reflection of light to camera and to the user’s eye which help to view virtual objects. The objective of such reflection paths is to play out an appropriate image alignment [7].

## 2.2 Human Computer Interaction (HCI) with Augmented Reality

Human computer interaction is considered as a field of research when it comes in behavioral science, computer science, etc. It requires knowledge support from the machine that has techniques embedded with operating systems, computer graphics and programming languages while human in the side are cognitive psychology, linguistics, etc. to improve the interaction between human and computer.

One of the applications of HCI in different fields is the augmented reality. In the current technological innovations, AR is rising as one of the most dominant advances in the field of computer science. It has included another dimension in the world of computing. With its capacity of superimposition, it has been adding to sciences, sports, commercial and so many more fields [8].

An attractive technique in providing human computer interaction is by the use of hand as an input device. Utilizing of hand is likewise extremely efficient in the fact that it offers computer to be controlled with high level of freedom by means of hand motions or gestures. AR provides Interaction with a computer that allows user to interact with the virtual images using real objects in a seamless way. As shown in figure 9 is the flow of different technologies which goes from real environment to totally computer-generated virtual reality. AR supplements this present reality with virtual (computer-generated) objects that seem to exist together in a similar space as this present reality or the real world [9].

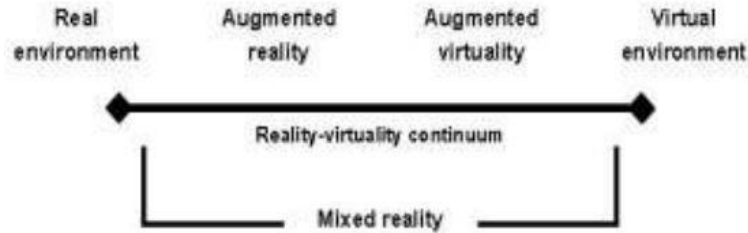
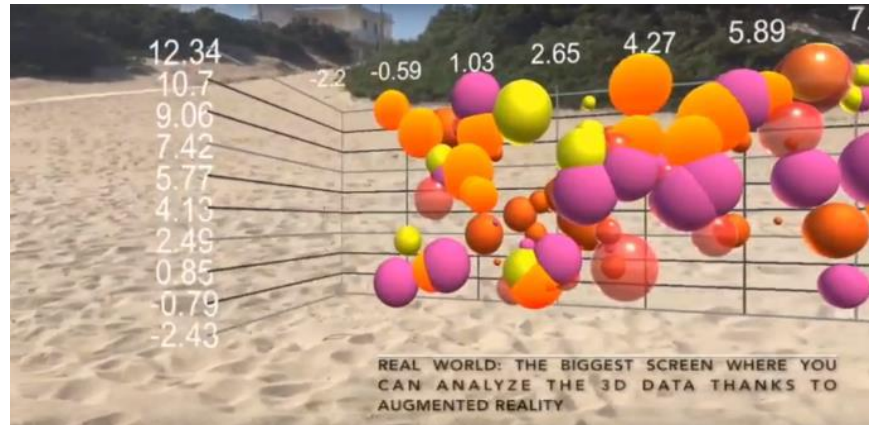


Figure 2. Flow from Real to Virtual Environment

### 2.3 Big Data Visualization using Augmented Reality

Conveying data in a visual format is constantly a better method to deliver useful information. There are numerous methods how to visualize data, however, picturing an enormous amount of data has consistently been a challenge. With ongoing headways in the advancement of technology, there are numerous better approaches that have been developed when it comes representing data. Augmented reality empowers users to visualize the developing torrent of information in an interactive way. Through visualization, we can transform big data into a scene that we can investigate with our eyes. Data visualization can transform those complex theoretical data symbols into a much simpler visual concepts that we can easily understand. It is simpler to gain understanding from the data if the visualization is added into the physical world. Big data visualization can be improved if an augmented reality layer is overlaid real-time [10].

Figure 3 is a screenshot of a 3D visualization of big data using augmented reality. Based from the figure above, augmented reality stands out when it comes in data visualization embedded in a real-world environment using smart devices to gain greater insights from the data. Augmented reality has a capacity to process, improve and visualize the data with no any external distractions. Big Data can be improved if augmented reality layer is added, blended with interactive information and perspectives. Augmented reality applications are requiring bigger number of data than some other visual applications to process and visualize it in the most intuitive manner. The combination of augmented reality and big data is presently a major research point for some specialists.



**Figure 3.** Augmented Reality Big Data 3D Visualization

## 2.4 Data Mining in Restaurant Industry

Data mining in restaurant can identify customer patterns and behavior, examine the productivity, re-engineering the menu and for marketing promotions. Data mining has a large amount of data in which the goal is to analyze and to pick out relevant information [11]. The objective is to gather unique information sources and extract data to make good decision making. Attracting customers, maintenance and prediction are indispensable in the restaurant business. Restaurants can offer more campaigns when they are better furnished with the right tools for data mining. Large databases contain hidden patterns were the source of gaining insights to enable the restaurant to improve consumer experience, sales forecasting and guaranteeing the success of marketing promotions. Mining data allows the restaurant to understand what pertinent making better use of that information is and to make more informed and better decisions faster in real time [12].

## 2.5 Apriori Algorithm

Apriori algorithm is an algorithm for mining frequent item sets and relevant association rules that operates on a database containing a lot of transactions brought by customers which helps to reveal buying patterns of customers, to find the groups of items that co-occur together frequently [13]. When it comes to association rule mining, apriori algorithm is the most popular algorithm used in mining frequent itemsets in data mining [11]. Apriori algorithm analyzes a dataset considering with a minimum support threshold that helps to identify individual item with a frequency greater or equal than the threshold and creates candidate datasets by combining all those items. This algorithm is useful in the process of association rule mining and it keeps track the user's behavioral data which is an indication of what items does the user normally purchase together and how frequently is done by the user [14].

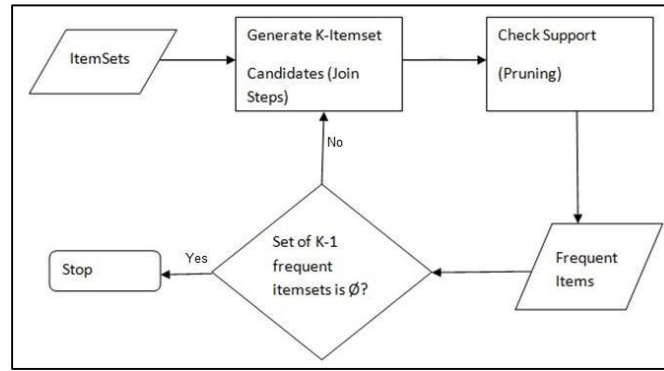


Figure 4. General Process of Apriori Algorithm

In figure 4 shows the bottom-up approach of extending frequent itemset of the apriori algorithm. The itemsets in the figure above are simply the table that contains support count for each item. The process of apriori algorithm can be entirely divided into two steps: (1) first apply the minimum support count to discover all frequent sets with k-items in a database, (2) then secondly, this is called self-join rule in which to find the frequent sets with k+1 items with the help of frequent k-itemsets. This include checking all subsets of an itemset if it is frequent or not based from the threshold support count. The itemset will be remove from the candidate sets if the itemset is not frequent. Repeat this step again from k=1 until the moment that it cannot do the self-join rule.

### 3 METHODOLOGY

#### 3.1 Sources of Data

Sampling refers to the method of measuring a small portion of something and then making a general statement about the whole thing. Homogeneous purposive sampling was used for this study as a sampling technique. Homogeneous purposive sampling is one in which everyone in the population of the inquiry has been selected for having a shared or common characteristic [15]. In this case, the common characteristics of the respondents are customers experience when they visit and order in the café. Customers of the café was given a chance to assess the application based on their common experience in ordering.

#### 3.2 Respondent’s Profile

	Frequenc	Percenta	Rank
15 to 20 years old	5	16.67	4
21 to 25 years old	8	26.67	2
26 to 30 years old	7	23.33	3
31 and above	10	33.33	1
<b>Total</b>	<b>30</b>	<b>100</b>	

Table 1. Frequency and Percentage Distribution of Respondents as to Age

Out of 30 respondents, majority were in the 31 and above years old with the frequency of 10 and percentage of 33.33%.

Gender	Frequenc y	Percentage (%)	Rank
Male	12	40.00	2
Female	18	60.00	1
<b>Total</b>	<b>30</b>	<b>100</b>	

**Table 2.** Frequency and Percentage Distribution of Respondents as to Gender

The frequency and percentage distribution of respondents according to gender shows that 18 or 60% of the respondents are female. 12 or 40% of the participants are Male.

### 3.3 Data Case Analysis

The data collected from survey questionnaire were recorded, analyzed, interpreted and summarized using measurements such as frequency, percentage and weighted mean. These are the following descriptions on how statistical measurements applied in this study.

1. **Percentage** – this statistical measurement was used to know that ratio of distribution and translating the frequency counts for comparison. The rank of the responses will be based on the result of the percentage.

Where:

$$p = \frac{f}{n} \times 100$$

p = percentage

f = frequency

n = total number of respondents

2. **Weighted Mean** - this statistical technique was used to weigh the answers of the respondents pertaining to every question that was asked on the survey questionnaire except from the respondent's profile.

$$\sum = \frac{fx}{n}$$

Where:

f = frequency

x = corresponding verbal interpretation

n = total number of respondents

## 4 RESULTS AND DISCUSSION

1. The issues and/or challenges encountered by the respondents in ordering meal that affects customer experience.

Among all the issues and/or challenges encountered by the respondents in ordering meal, there are two which ranked as first with a percentage of 22.95%: first (1) is the image of food in paper-based menu is different from the reality when the meal served to customers; and (2) taking long time standing on the queue to order. It has happened to every customer in all times that they saw a tasty meal in the paper-based menu, but then, when the meal was served, the meal does not look like in the picture presented on the paper-based menu. Also, taking long time standing on the queue gives damage on the customer's view on the restaurant's brand. Next in the list of issues and/or challenges encountered in ordering meals is lacking of knowledge on other meals so they order same dishes again with a percentage of 13.93%. Ranked third is due to the large number of dishes on the paper-based menu, it consumes time in selecting food with a percentage of 13.11%. Fourth is having no idea about the restaurant's best menu pairings and which food are the most being sold with a percentage of 12.30%. Fifth ranked is lack of understanding on the primary ingredients of the meal so that customer will know if the meal is appropriate or good to his/her health. And lastly, the sixth ranked is an incomplete served orders caused by misunderstanding of the waiter in writing orders that might be turned into wrong or incomplete orders.

2. The features of the developed software that can address the issues and/or challenges identified in ordering meals.

2.1 Using augmented reality technology, meals are viewed in a 3D object form and added to the physical environment using the camera of the tablet device to view dishes in a real size and shape.

2.2 It provides information about the primary ingredients, time preparation, and list of best seller menu meals derived from analytics. The application provides data visualization using bar graphs for the ranking of meals to know the highest number of dishes being sold in the café.

2.3 Enable to determine the availability of each meals. The application can analyze and determine if there was an insufficient ingredient for each meal from inventory that would tell to customers if it's available or not before they proceed to order.

2.4 The application can analyze frequent bought meals that co-occur together with the help of apriori algorithm to suggest or recommend some menu items while browsing foods in the application. Each food has other suggestion which customer might consider or prefer to order.

2.5 It can place orders using the augmented reality application which will then be sent directly to the kitchen screen display in real-time.

3. The respondents' level of acceptance on the developed software.



For the Effectiveness of the application system, it has gathered an overall weighted mean of 4.56 that has a verbal interpretation of Highly Acceptable while the category of Efficiency gathered an overall weighted mean of 4.61 which corresponds to the verbal interpretation of Highly Acceptable. Lastly, the computed overall weighted mean on the category of Satisfaction was 4.60 which corresponds to a verbal interpretation of Highly Acceptable. The overall weighted mean of all categories was 4.59 and that has a verbal interpretation of Highly Acceptable.

4. Suggestions offered by the respondents to improve the developed software.

The respondents have given the freedom to give suggestions for the further improvement of the developed system and such suggestion are (1) customers can tag each dish to leave comments so that whenever new customer visits that restaurant can find those tags. It gives idea about all the reviews and feedbacks about each dish and this suggestion ranked 1st and has a frequency of 20 and a percentage of 66.67. (2) Meal suggestion based from temperature, weather and date and time placed as 3rd rank and has a frequency of 11 and a percentage of 36.67. (3) Can support credit or debit card transaction and this became the 2nd in the rank and has a frequency of 16 and a percentage of 53.33. (4) Can provide video promotion of the food inside of the application and (5) can provide mini game/s (related to the café) in the application to kill waiting time were both ranked as 4.5 having a frequency of 1 and a percentage of 3.33.

## **5 CONCLUSIONS/RECOMMENDATIONS**

1. The proponent concluded that the two most challenging issues when it comes in ordering meal that affects their dining experience were the actual figure of meal in reality is different from the image presented in paper-based menu and taking long time standing on the queue to order meal and waiting; the first (1) recommendation of the proponent is that the restaurant should have the ability to provide a consistent and manageable positive expectation of their customers when it comes presenting their meals on a paper-based menu. By this, the proponent recommends the integration of technology where restaurant should prepare their customers visually by implementing a digital menu that will improve customer's expectation to eliminate portion or size issues that subconsciously connected to pricing. The proponent also suggests that the restaurant should utilize Customer Experience Management (CEM) where a strategy of tracking every interaction between customer and the restaurant to know customers' lifecycle pattern; and, the second (2) recommendation of the proponent is that the restaurant should implement a queue management strategy that will help their customer's desire to conserve their time and effort.

2. As for the features of the developed software, the proponent also recommends that the developed software should perform according to its needed specification to properly work and eliminate technical issues.

3. The developed software was perceived to be highly acceptable by the respondents. But the proponent recommends the use of the developed application system as it addresses the issues and/or challenges of the respondents in ordering meals, to have an application that will improve customers experience.

4. The proponent recommends to adapt the suggested improvements for “Augmented Reality Ordering System with Data Analytics to Support Decision Making in Restaurant Chains” such as the tagging of each dish feature to leave comments, and to improve the developed software by making it more user-friendly.

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