Wireless Customizable Food Recommendation System Using Apriori and K-Means Algorithm

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***Abstract*— The use of software has reached even in day to day activities of life. Even going to a restaurant, receiving home-delivery of food. Many start-ups such as Box8, Zomato and Foodpanda have emerged in the restaurant business. In this paper we plan to accomplish major activities in a restaurant such as ordering, billing with the help of technology. We replace paper-based menu with an android application to facilitate the automation of these major activities which will give the restaurant manager to alter the menu. Another aim which our system achieves is giving insight about the customer's ordering habits and using the obtained knowledge for designing business strategies. For gaining insight about the customer's behaviour we use the Apriori and k-means clustering algorithms.**

***Keywords*— Apriori Algorithm, K-means Algorithm, Wireless system, Automation.**

I. INTRODUCTION

Traditionally a restaurant has a number of employees to carry out tasks of taking down the order and conveying it to the kitchen, maintaining a record of ordered items, etc. Technology can be used to completely automate a majority of the tasks in a restaurant. Because of the unavailability of labor at reasonable rates this automation can be seen as necessary. "Wireless customizable food recommendation system using Apriori and k-means algorithm" will be equipped with a user-friendly touch screen and software for completing the process at the backend [1]. The menu of the restaurant will be centrally located in the administrator module database. The restaurant owner or manager can alter the menu contents and can perform sales analysis on previous transactions. This administrator database will be password protected.

Now when the customer enters the restaurant, instead of a menu card he will be handed a tablet mobile device. The graphical UI on the tablet will give the complete menu of dishes with detailed description of each dish. He can browse through the items one by one choosing the appropriate dish of his choice. He will have the option of paying the bill by cash in this proposed system. The admin module will maintain the database of current order details and a receipt will be generated when the customer does not wish to order anymore items. The customer will give rating to each dish he has tasted. Then the dishes will also be categorized on the basis of the rating.

II. RELATED WORK

There were some early efforts made to automate conventional food ordering processes using wireless technology. The project by Tee You Suan in 2004 was designed to develop a wireless food ordering system to increase the quality and performance. Unified Software Development Process (USDP) methodology has been chosen as a software development methodology for the project. The system has been analysed and designed using Unified Modelling Language (UML). The customer has been required to use their handheld device such as Personal Digital Assistant (PDA) to connect to server through wireless Bluetooth technology. The drawback found in this system was that there was a limited Bluetooth range and customer feedback was also not available. No proper database was developed that can link directly to both client and server interface. For the easy use of users for client and server Proper Graphical User Interface was not included. Another PDA-based wireless food ordering system is by Colour by the Bay (CBTB), Singapore. These wireless food ordering systems enable customers or waiters to key in order using mobile devices, namely, Personal Digital Assistants (PDAs). PDAs based systems are prone to some limitations as follows: Restaurant owners have to arrange enough number of PDAs to accommodate the number of customers to be served especially during peak hours. This may ultimately result in increase of the restaurant expenditures [2-3-4].

To make orders the customers are required to be present physically using the PDA-based system. Thus, no other alternatives than to make early order before coming to the restaurant is available before the customer. This implies that customers have to consider the waiting time for food preparation. The PDAs based systems do not support the real-time feedback between restaurant owners and customers. Thus, customers are not provided with billing details and their order status feedback. This is because the systems allow customers to send ordering details only using the PDA. The customization of the existing systems according to restaurant owners' need is difficult. The restaurant owners must have the

technical knowledge for the purpose of update or modify the menu information. Also the user interface was unattractive and uninformative due to the lack of images in it [5].

Focusing on these described limitations, we proposed to implement a customizable wireless food ordering system with real-time customer feedback using smart phone (CWOS-RTF). Smart phones are extremely popular and have revolutionized the use of mobile technology to support automation of routine tasks in wireless environment. There are a substantial number of smart phone applications in existence for healthcare purposes, such as monitoring medicine intake, detecting heart failure, and confronting obesity challenges. Motivated by the usage of smart phone technology in healthcare and other applications, this paper presents a development of smart phone technology in a business application, namely food ordering system to be used in restaurants [5].

This will minimize the number of employees at the back of the counter.

- The system will help to reduce the cost of labor. Reduction in labor will also lead to a considerable monetary saving.
- The system will be less likely to make a mistake.
- This will avoid long queues at the counter due to the speed of execution and number of optimum screens to accommodate the maximum throughput.
- The system will be available 24 hours for 365 days, as there would not be any irregularity in work due to sick leave or vacation.

III. SYSTEM ARCHITECTURE

The proposed system combines and automates various system of hotel management such as Kitchen Order Ticket (KOT),Billing system and Customer Relationship Management(CRM).Integrating these systems in a single software gives a complete solution for managing the restaurant. This system increases quality and speed of service. This system also increases the customer's appreciation of the efficiency of the restaurant. Implementing this system helps the customer to make well informed choice of a dish based on the description provided by this system. In current formal dining environments, some form of physical static menu is used from which the user picks an item of his choice. As there is limited space in the paper-based menu, only the name of the dish can be known and not the detailed description. Secondly no new items can be added to this static menu. This system is useful in replacing the paper based static menu and making it more dynamic. This system also aims at reducing efforts and manpower in the current ordering system. Three related concepts are encompassed in the proposed system by the general scope of the Restaurant Menu and Ordering System. The first pertains to the replacement of paper-based menus using an electronic format, the second relates to providing a front-end for the customer's order and the third surrounds the process of conveying the said orders to the kitchen for preparation. The proposed system incorporates the use of hardware components such as tablet mobile devices ,multiple computers acting as servers but the presented SRS also emphasizes constituent software elements which are discussed in the next section.

A. Overview of The Target Final System

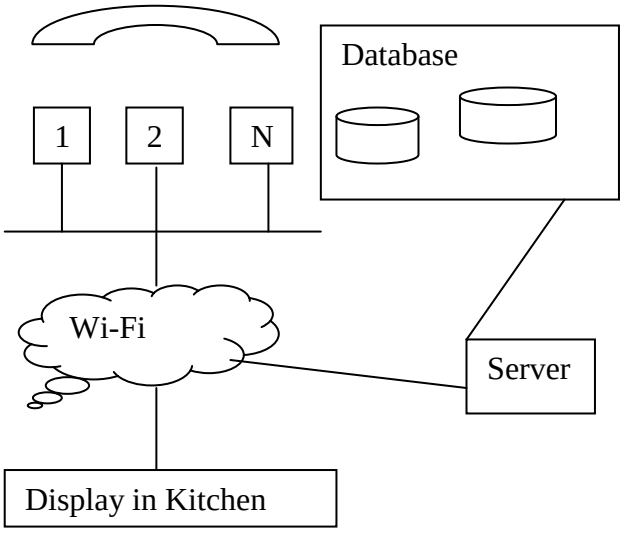
We are going to implement the system in restaurants to ease the management of the Restaurant, provide insights into the sales of the restaurant and also give a technical touch which would help atomize the working of restaurant.

B. Overview of The Technical Area

The technologies which are used to implement the system are:

- Android version 2.2.3 (Smart Phone) and Android version 2.2 – 4.0 for Tablets is required.
- Java SE 6 Programming Language is used to develop the software.
- Eclipse Indigo is used as a Rapid Application Development Tool (RAD) or as an Integrated Development Environment (IDE) for coding the software.
- JSP/SERVLET is used for Remote Database Access from the main system of the restaurant.
- SQLite is a light weight Database which is going to be used for database access from handheld device or the tablet.

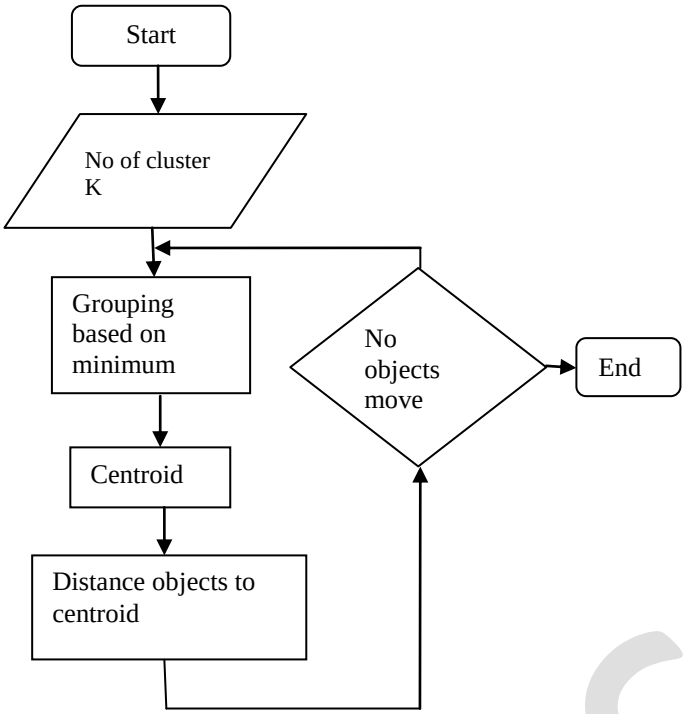
In this system customer orders the food by using android based touchpad. Figure shows the system architecture, which cover three main areas of the restaurant: the serving area, the restaurant owner's working desk (cashier table), and the kitchen .Customer first orders the food from the touchpad looking at various combination of food which is further carried to the kitchen for fulfilling the order and the same is passed for billing at the each customers tablet.



1. System Architecture

C. Mathematical Concepts

i) *K-means Clustering*



2. K-means clustering

What is K-Means Clustering?

This is an algorithm to classify or to group your objects based on attributes/features into K Number of group. K is positive integer number. The grouping is done by minimizing the sum of squares of distances between data and the corresponding cluster centroid. Thus, the purpose of K-mean clustering is to classify the data.[1-7]

ii) Apriori Algorithm

Association rule generation is usually split up into two separate steps:

1. First, minimum support is applied to find all *frequent itemsets* in a database.
2. Second, these frequent itemsets and the minimum confidence constraint are used to form rules.

Apriori uses breadth-first search and a tree structure to count candidate item sets efficiently. It generates candidate item sets of length k from item sets of length $k-1$. Then it prunes the candidates which have an infrequent sub pattern. According to the downward closure lemma, the candidate set contains all frequent k-length item sets. After that, it scans the transaction database to determine frequent item sets among the candidates.[1-6]

IV. SUMMARY OF SYSTEM FUNCTIONALITY

i. Tablet on table

- There will be a tablet on each table.
- This will allow the customers to browse the food items as many times as they wish.
- Customer can view the suggestions for a particular menu item generated by the system.
- Customer can enter his/her details during bill payment. This helps the Restaurant owner to analyze the service and can notify the customer regarding different offers through messages or emails. Suggestions for Customer
- The Restaurant owner can post various combinations of menu items on tablet. This will help the customer to place the best order.

ii. Attractive Presentation

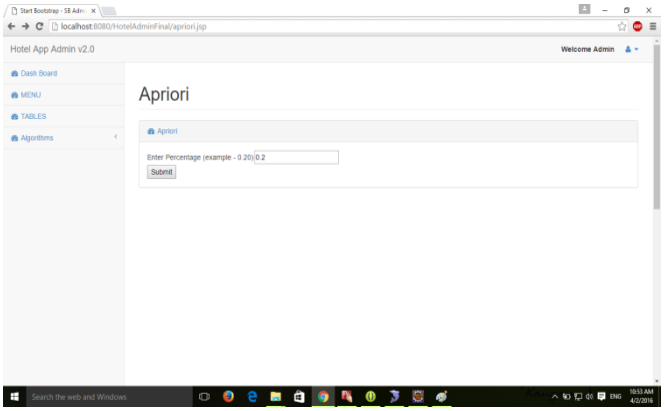
- The Menu is organized in an attractive way. There are images of every food item which will make the view of customers more clear about how the food will look like after delivery.
- There is an attractive use of various themes and color schemes.

iii. *Modifiable Menu*

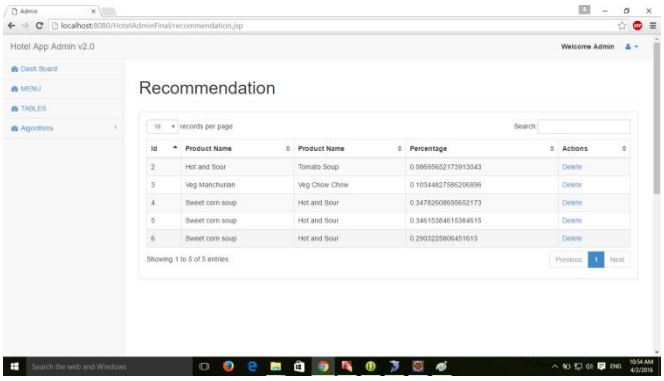
The menu can be modified by the Admin manager. Admin manager can add, update, delete menu items.

V. RESULT

The K-means clustering algorithm and Apriori algorithm work at the admin module. For implementing Apriori algorithm the admin needs to enter the maximum threshold. The screen below asks the admin to enter the maximum threshold.The threshold field is called "Percentage". Threshold is the minimum number of itemsets that are expected to be present in the database for



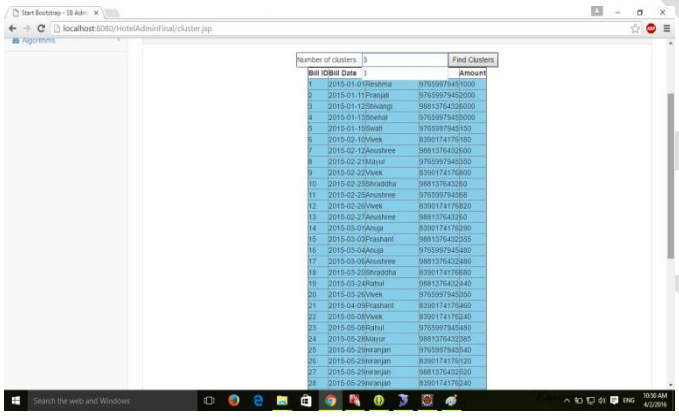
1.Input for Apriori



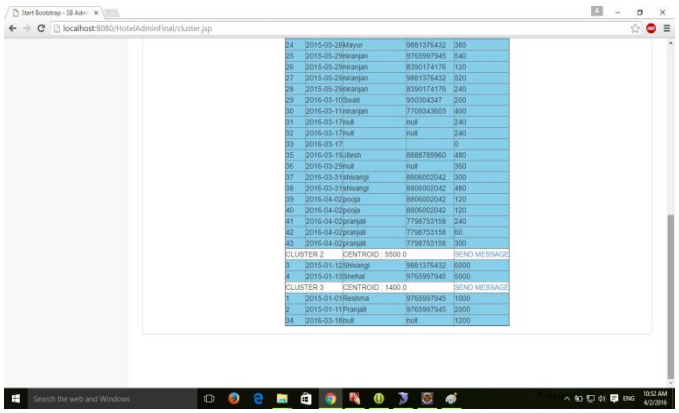
2. Recommendations generated

The pairs of most frequently ordered items is generated along with the percentage or frequency of their occurrence. These recommendations are generated at the admin module. These same recommendations can be viewed by the customer on the android tablet.

The K-means algorithm categorizes all the customers according to the bill generated in the name of the particular customer. The clusters are generated in the form of a table as shown in the screenshots shown below.



3. Cluster in the lo-medium expenditure



4. Cluster formed in the high-expenditure range

VI. CONCLUSION

The proposed system would attract customers and also adds to the efficiency of maintaining the restaurant's ordering and billing sections. This system successfully over comes the drawbacks in earlier Personal Digital Assistant (PDA) based food ordering system and is less expensive and more effective than the multi-touchable restaurant management systems. The proposed system also includes Customer Royality and Clustering features to acknowledge the frequency of customer in restaurants so that the various facilities can be offered and the suitable combinations of menu for convenience while ordering food. The Tablet PC's are design using android application. The proposed system discusses the design and implementation of a customizable wireless food ordering system with real-time customer feedback for a restaurant (CWOS-RTF). The CWOS-RTF enables restaurant owners to setup the system in wireless environment and update menu presentations easily.

VII. FUTURE SCOPE

- To enable card payment.
- To add kitchen raw material management to the existing system.
- To extend the existing system to a chain of multiple restaurants.

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