

Foody – Smart Restaurant Management and Ordering System

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Abstract—Customers play a vital role in the contemporary food industry when determining the quality of the restaurant and its food. Restaurants give considerable attention to customers' feedback about their service, since the reputation of the business depends on it. Key factors of evaluating customer satisfaction are, being able to deliver the services effectively to lessen the time of consumption, as well as maintaining a high quality of service. In most cases of selecting a prominent restaurant, customers focus on their choice of favorite food in addition to available seating and space options. Long waiting times and serving the wrong order is a common mistake that happens in every restaurant that eventually leads to customer dissatisfaction. Objectives of this online application "Foody" is to address these deficiencies and provide efficient and accurate services to the customer, by providing unique menus to each customer considering their taste. This concept is implemented as a mobile application using latest IT concepts such as Business Intelligence, Data Mining, Predictive Analysis and Artificial Intelligence. This includes graphics and 3D modeling that provide existent physical information related to food such as colors, sizes and further user can view the ingredients of the meal as well as the available tables. In addition, the app shows the real-time map to the restaurant. Current table reservation status is indicated by the color change of the table. Unique food recommendation and it's order for each customer is generated by analyzing their social media information and the system notifies the customer the wait time by calculating it. Preparation of food and allocation is done subjectively. The expected outcome of the research is to develop a fully automated restaurant management system with the mentioned features as well as to avoid confusions between orders, provide better view of food and allow the customer to choose the menu according to their taste in a minimum time.

Keywords— *Restaurant Management; Handling Reservations; Machine Learning; 3D Menu; Food Recommendation; Data Retrieving; Tasks Allocate; Business Intelligence; Genetic Algorithm; Sentiment Analysis; Unique menu.*

I. INTRODUCTION

Food and beverage industry is a fast growing industry nowadays. Because food is a basic need, the industry never runs out of customers. However, because of the large number of customer's restaurants sometimes face huge difficulties when satisfying the customers because of the rush. Also, the customers face a lot of difficulties when reserving a table and ordering food. Because of the rush, wrong orders can be

served to the customers and there is a high possibility of losing the customer base because of the poor customer service. Foody is the solution to minimize these problems and maximize the efficiency of the restaurants. Though there are systems like Zonate, Foodie.lk and Pizza Hut website, they do not address the problem completely. Foody is not only an order management system, but also a business intelligence system which handles the business requirements as well as the customer requirements. There are four primary components that are handled in Foody.

1. Handling reservations and handling orders properly
2. Recommendation Management System
3. Modeling a 3D menu and retrieving data
4. Sentiment analysis and summarizing

These four components are what gives Foodie a competitive advantage over the other restaurant management systems. Basically, Foody is a mobile app where customers can find nearby restaurants, find available tables, make a reservation, order food online, read reviews, and it has a 3D menu if each restaurant, so the customer can get a better idea of what the food items are. Also, by using Foody customers can find ingredients of the food they are ordering at the restaurant and even customize the food they are ordering. Foody lets the customers add reviews on the menu items and it will analyze the ratings and allow the restaurants to decide if they are keeping food items on the menu or replace with a different food item. Also the order handling part will consider all orders and make a queue of orders so the orders can be handled properly. This paper will explain the method implemented and the results obtained throughout the research.

II. LITERATURE REVIEW

According to the conducted Literature Survey on pre-existing software platforms, functionalities and technologies that has been done prior to the proposal on our research are some of them,

The simplicity and ease of access of a menu are the main things that facilitate ordering food in a restaurant. A Tablet menu completely revolutionizes the patron's dining experience. In **Intelligent e-Restaurant using Android OS**

(2015) [1], they aim to provide the restaurants with a tablet menu that would recommend dishes based on a recommendation algorithm, which has not been implemented elsewhere. In addition to this, they run the app on an Android based tablet & not on an iOS based tablet, which is more expensive alternative. They use a cloud-based server for storing the database, which makes it inexpensive & secure. [1]

These days advanced technologies the mobile phone is brilliant smarter usage product one. With the help of this smart gadget, we can make our usages as smart as possible. Some products are commercially available in market, which allows restaurant food ordering through internet, android applications, GSM, Bluetooth, RFID, and Wi-Fi wireless technologies. Food ordering is a process of ordering food from a local restaurant or food cooperative through a web page or app. Much like ordering consumer goods online, many of these allow customers to keep accounts with them in order to make frequent ordering convenient. The main purpose of **E-Restaurant: Online Restaurant Management system for Android (2015) [2]** to design an advanced e-restaurant online management system using android smart mobile with Bluetooth wireless technology. The menu will be displayed automatically using android application on the table and we can directly order the food items with the help of Android Phone. The controller also takes the responsibility to display the menu items selected on the LCD display unit. At the Kitchen section, using wireless RF communication the selected items will be display on LCD along with user table number.

In most of the restaurant meal ordering is relying on the interaction with waiters to place order into the kitchen. In busy hours of restaurant, this coordination is a challenge result in un-satisfaction to the customer. To realize this, **Intelligent Restaurant – Menu Ordering System (2015) [3]** is design. This Restaurant uses modern innovation such as multi-touch module, RF module, Meal Serving Robot and database to improve quality of services of Restaurant and to enhance customers' dining experience. A meal-serving robot is a line following robot, which is design-using sensor to track the black line path predetermined for serving. Android Application - PayPal is use for online payment.

Natural Language Processing (NLP) directed to ambiguous representation for software requirements. Ambiguity at different levels creates different representation and meaning. This paper reduces the issues of ambiguity levels for the Software Requirements Specification (SRS) using formal methods. In **Formal Specification for Online Food Ordering System using Z language (2017) [4]** end result shows the effectiveness in specifications through Z language. The Z specification is created for the commercial application of online food ordering system to improve the order details accuracy and efficiency. The stakeholder needs for food

ordering system are gathered from the project goal. The system is designed using Unified Modelling Language (UML) illustration of use case diagram. The specification is created for the system behavior to remove the ambiguity. Along with this, Z/EVES tool is used for the evaluation of Z specifications for the demonstration.

In **Near-Field Communication Sensors and Cloud-Based Smart Restaurant Management System (2017) [5]**, we introduce an efficient and user-friendly Smart Restaurant Management System. This system will solve key problems faced by restaurants today through the use of technologies such as Mobile and Web applications, Internet of Things (IoT), Near-Field Communications (NFC) sensors, and cloud computing. Restaurants have many inefficiencies due to human limitations that can be resolved through automation and device-to-device communication. This Smart Restaurant Management System accomplishes this by providing two interfaces for the two types of users in restaurants; an Android mobile application for customers and a web application for restaurant staff members. The Android mobile application allows customers to have a seamless dining experience with features such as finding available parking spaces easier through internet connected infrared proximity sensors in the parking lot, finding available tables at the restaurant easier through NFC sensors, ordering dishes through an interactive menu, and being able to pay the bill from their NFC equipped phones. The web application provides staff members benefits such as collecting data and statistics on the restaurant's performance in real time and automating the order placement system for waiters and cooks via IoT technology.

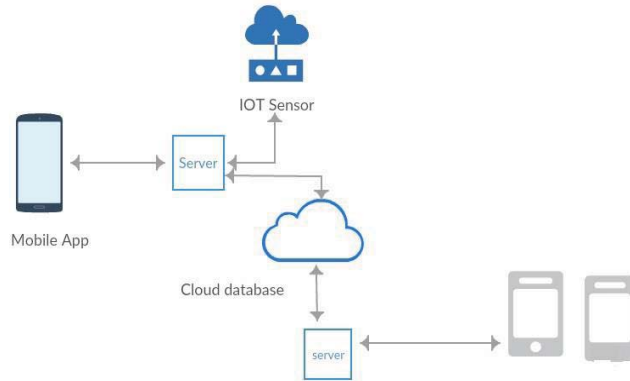
Index Terms —

Smart Restaurant,
Restaurant Automation,
Device-to-Device Communication,
Near Field Communications based
Smart Cities,
Cloud Computing,
Mobile application. 130

Among the important benefits of mobile applications are portability and accessibility. Integrating a native mobile application with a Web portal increases the value and quality of the final system. A developer of the **Experiencing Native Mobile Health Applications Development (2017) [6]** is perspective is presented in this paper discussing about the main motivational factors and decision criteria in the selection of the most appropriate mobile ecosystem. Also the main software design decisions associated to the required functionality are analyzed and taken into consideration for the implementation and validation of a mobile application in the mHealth domain.

III. METHODOLOGY

This section describes how Foody was designed and implemented explaining the process of each functionality, their flow in the system and technologies used. In order to develop the system first, a requirement analysis was done and according to those requirements Foody is developed. Users can install this mobile app on their devices and register to the app. It will contain the restaurant availability pop up, a map, table reservation feature, meal ordering facility, ability to view past food reviews, view customized menu and the ability to view meal preparing time. Orders are managed for kitchen staff through the admin section of the mobile app.



Foody is created with many popular technologies like Google maps, sensor and Signal handling, graph API, 3D max and Natural Language Processing. Foody shows table availability with the best accuracy using real-time data in a map. Reservation status of the tables are collected using a sensor and status is showed using color changing lights. To create a unique food recommendation, data is fetched from Facebook using Graph API. Mainly user's public data is collected using 'user's posts', 'user's likes', and 'user's events' to create this up to date dataset. The 3D modeled menu is created using 3D max software and every food item can be viewed as a rotatable image. For the data retrieving part, it uses special food ingredient API to get the details from the google. It will filter the ingredient Fat percentage, calorie percentage, carbohydrates percentage and protein percentage. And to sort the orders according to the priority an algorithm is defines considering the priority and preparation time of orders. For the Natural Language Processing (NLP) part identify idea and tokenize the customer review sentence and give the score to each sentence. Then summarize each food item review is positive or negative by using NLP.

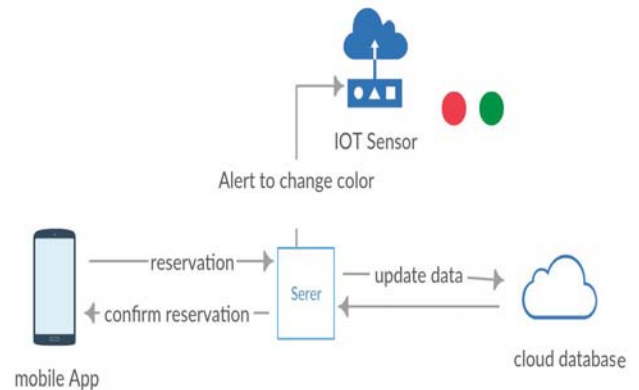
Foody app is a smart restaurant and food ordering system. The propose Foody mobile application very useful to current society. Using this app people can easily order their food items without any delay. Especially, customers can check table availability through the mobile app before entering the restaurant. It will help to reduce the time delay in ordering foods. The mobile application will use ionic, python, firebase

as a database among a few other technologies. In this mobile app, users may login as a user or as an admin. When logged in as an admin, manager role and food ordering processes can be managed. When logged in as a customer, they can check availability, order food items and manage payments through the mobile application.

When comparing Foody with other applications, it has many advantages over existing systems in the current market. It increases the number of customers that can be satisfied in a given time period and handles the processes within the restaurants properly.

A. Ability to check available reservation tables and color changing tables

By tracking the user's location, a Google map is loaded and the restaurants in the chain are showed with the number of available tables. In each table, a device with two LED lights, a nodeMCU and a push button is placed and the color of the lights are changed according to the reservation status. For each table a separate device is placed. Each device is configured with the restaurants Wi-Fi ID. This device can communicate with the database using the Wi-Fi system of the restaurant. When a reservation is made through the mobile app, it will change the table status in the database. The node MCU will catch the signal and change its color accordingly. If we consider a table, it's initial color will be green. If someone reserves that table through the mobile app instantly the table will receive a signal and its status will become reserved. Then that table will be shown as reserved for other users and the color of the table will turn to red. By using the push button the reservation status can be changed manually by the customers who are not using the mobile app. After dining when a customer press the push button the database will change the tables status back to available and the color of the light will change back to green. So in the app, the relevant table in that restaurant will be marked as a table which is available for reservations. After a reservation is made, another user won't be able to make a reservation for the same table till the table is available again. By using this method, restaurants can manage the number of guests they can accommodate at any given time and the customers can get the service they need easily.



B. Task allocation and scheduling orders

After confirming the orders, a task will be allocated and orders will be scheduled using special algorithms based on the arrival time and manual customers ordering time and preparation time. Customers are notified the time they have to wait until they are served. The orders are handled properly and there won't be any misplaced orders. Each chef can confirm their orders through the mobile app. After fulfilling their order preparation, they can complete the order by allowing the waiters to serve food for the relevant table.

Factors,

- Usually, the orders are placed according to the time they were placed. First come first served method is used. Even an order is placed by a call, they start preparing it just considering the time the order took place. But there are many more other factors to consider. Dine-in customers should be given priority and other orders should be managed timely as well.
- In the algorithm used in Foody, orders are sorted according to their priority and placed in an order queue. Then kitchen staff can view the orders and continue preparing them without missing a single order.

C. Creating a unique menu and food recommendation system for customers.

Normally in a menu, food items are placed in alphabetical order or grouped by food types. But in this Foody system, the menu is created uniquely for the customer. User preferences are taken from the user when user registers to the app. The user can edit their preferences anytime. Unique menu is categorized into main, appetizers, dessert and beverages. User's favorite food items are displayed in the first few rows in each category.

Food recommendation part is created by fetching the logged in user's Facebook data. The Facebook dataset is built using 'user posts', 'user like', and 'user events'. Then tokenize the gathered words by removing the stop word. Next, compare the existing food with tokenize words and calculate the most liked food items and recommend to the user. Facebook has real-time and up to date data. Using those data systems, Foody can recommend best matching food item for the user.

D. Model the menu items in 3D

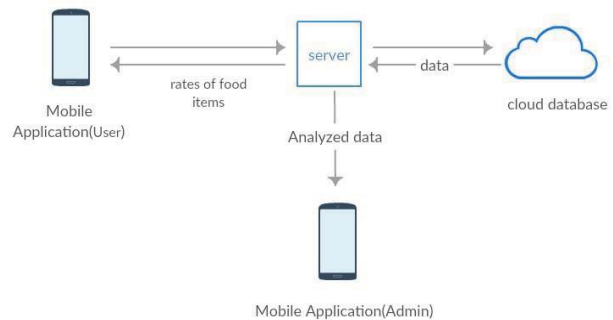
Most items in a menu are foreign to customers and sometimes they have no way of knowing what kind of a food it is by just looking at the menu. Also, since a menu ingredient is never displayed. A person with allergies may face many difficulties when ordering food. So Foody will give the ability to view the food item in 3D and to check ingredients for the customers.

E. Sentiment analysis and Summarization of customer reviews

The system consists a feature to review customer feedback for each food item. Then the system collects star rating reviews to get rating about food items, comments reviews and summarizes them to give a positive or negative rating for each food item. This will be done in 3 main steps,

1. Token every customer review sentences as key words and analyze.
2. Identify opinion sentences in the customer reviews and give a score to each sentence.
3. Summarize the food items as positive or negative using the score and generate a report.

Initially, get customer review sentence tokenized and their semantic orientation is identified. This will be done using the kind of dictionary called WordNet. And then identify customer Opinion sentences in the reviews and give the score to each sentence. Then summarize each food item review is positive or negative by using natural language processing. [14] Then incorporate Part of Speech tagging (POS tagging) methodology in Natural Language Processing will be used to recognize the element of a sentence like verb, adjectives etc. This is help to identify the word types to analyze the grammar of text. Then later on within this set of words, assign some score and identify them as positive or negative. Finally, summarize the positive or negative statement of each food item. The Natural Language Tool Kit libraries of python will be used for this purpose.



Getting feedback from the customer

F. Retrieve the most specific information of ingredients from google.

Usually, the menu only has the name and the price. But alongside the 3D modeled food items Foody will provide the ability to view the ingredients. But sometimes these ingredients may be foreign to the customer. Some customers might have allergy restrictions for some food ingredients. Foody gives the ability to get information of the ingredients from Google. Normally the first few search retrievals may not show the most relevant details. This feature will allow a user to access the most relevant information of the ingredients.

Ex – For a pasta dish restaurant may be using marjoram as an ingredient. Most of the customers won't know what it is. So foody will give the most specific information on it by just clicking on the ingredient.

IV. RESULT AND DISCUSSION

FOODY System handles all the reservations properly as well as the orders. Because of the use of latest and the most relevant technologies the time wastage is reduced and the accuracy and confidentiality is maximized. When sorting the orders, first the orders are taken in to an array. And each food item is given a preparation time. But to prepare more than two items from the respective item it will not take a time of (Preparation * 2).

Consider an order which have 4 chicken pastas and 1 chicken pizza.

Assume	Chicken Pasta	Chicken Pizza
Preparation time	15 min	10min
Constant Value	10	7

qtn- quantity of order n

PTn- preparation time of order nth order

C.V n- contestant value of n food item

Time to Prepare 1 chicken Pasta = 15 min

Time to prepare four Pastas and one pizza = $(15*1 + ((4-1)*10) + 10)$

Time to prepare = $((PT1*1) (C. V1*(qt1-1))) + ((PT2*1) (C. V2*(qt2-1)) + (PTn*1) (C. Vn*(qtn-1))$

Then the orders array is given a score

If there are five order s as below

Order numbers array [001, 002,003 ,004 ,005]

Score is given as 001 – 5, 002- 4, 003 – 3,004-2, 005-1

Now the sum Preparation score and arrival score is taken for each order and sorted using Sort () function in python. Then the orders are sorted according to the priority level they should be given

Consider about generating the unique menu, the system will add login user food preferences to created food category model and the system generate a unique food category model per user according to the algorithm. Then existing food items are added into created unique food category model and generate the unique menu.

Food recommendation part is based user's social media data. For that graph API is used. The Graph API is the primary way to get data into and out of the Facebook platform. It's a low-

level HTTP-based API that apps can use to programmatically query data, post new stories, manage ads, upload photos, and perform a wide variety of other tasks.

FOODY will collect user's public data (user likes) using above mention graph API. There are lack of nun related words. So first there is filtering part to select only food-related words. Then comparing apart to compare those selective words with unique food category model and enlarge with existing food items. Finally, limited best food items will be appearing in food recommendation part.

When summarization of the food item feedback, food item score generates using the algorithm. For one positive feedback get score "Score>0", negative feedback get score "Score < 0" and others get as a neutral. Then admin user level generates the overall feedback status,

- If positive feedback > negative feedback, It should be overall positive feedback.
- If positive feedback < negative feedback, then it should be overall negative feedback.
- Other ones get as a neutral

Overall rating is get using below method,

Overall rating for one food item = Sum of rating/ length (no of entries)

V. CONCLUSION AND FUTURE WORKS

This paper provides an insight to a suitable online restaurant management system for current society. Foody stands unique from existing online restaurants that have mobile applications, since it is a comprehensive application that includes LED lighting system, 3D modeling menu, task allocation and scheduling order and summarize customer reviews using sentiment analysis and creates a unique menu for each customer. Further, it retrieves the most specific ingredient details of each food item. Even though there are many online restaurant management websites like 'Yelp reservation' which can check availability of the restaurant through a website there is no mobile application which can check availability of tables easily. Foody lets the users Find nearby available tables easily tracking their location and let them reserve tables easily. Therefore, the Foody mobile application can be reckoned as one of the most effective online restaurant management and food ordering systems.

This research work has been developed mainly to make day-to-day life of people, easier. Even though this research focusses on the IT industry, the research team will be focusing on reducing time wastage because customers can check availability of tables before entering the restaurants, increase the accuracy of the food ordering process, maintain the customer feedback provided for each food item and

generate a unique food menu to each user. Furthermore, it is expected that for any person who plans to build a similar system or any other real-time system, results of this research will be an aid and will provide insight on the performance, accuracy and reliability level that can be expected with the combination of tools, technologies and business requirements considered in this paper.

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