

SaveMORE: An Automated System to Reduce Food Wastage in the Field of Hospitality

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Abstract- Tourism has become one of the main incomes in Sri Lanka where food is the highlight which makes the standards among the field of hospitality. At the same time the wastage of food in these hotels is a hidden bitter truth which cause a huge loss silently. In a time where people die starving, tons of food is being thrown away without hesitation in the same so called high class society. As this is a crisis with less attention around the world, it is now high-time to consider it with some given weight because food is an essential for all the living being. Considering the classy hotels which maintain a procedure, an automated system which would take control from ordering to give suggestions to reduce wastage was proposed as a solution for the above problem. Though there are systems to make the ordering efficient and gives the customer a better experience, none of them has the concern about the wastage which occur every day without limitations. That is where SaveMORE has a major role to play where it measures the weight of the wastage and keep the hoteliers alerted other than the functionalities of an existing system in a better way. This system which has eliminated the manager and being a Business Intelligence (BI) that identifies the reasons for this loss of food, provides relevant suggestions and beneficial solutions as a result, is the only product existing to reduce the food wastage in the field of hospitality.

Index Terms- Android application, field of hospitality, automated system, Data mining, opinion mining

I. INTRODUCTION

The wastage of food which is a hidden crisis around the world has reached a point where it can no more be ignored. Though this loss occurs almost everywhere, the field of hospitality tops the ranks of relativity as food is its main component of serving. Food that is initially produced for human consumption is only measured as food waste, which means non-edible food and parts of products are excluded in consideration. According to the United Nations Environment Programme (UNEP) and the World Resource Institute (WRI), about 1 in 4 calories purposive for consumption is never actually eaten which is about one-third of all food produced

worldwide, worth around US\$ 1 trillion get lost or wasted in food production and consumption systems. [1] These statistics showcases that in a world full of hunger, rapidly changing food prices and social disturbance, these facts are being environmentally, organizationally and economically excessive. To overcome this massive wastage, the proposed system could be a better approach, may be not in a huge scale but of course to begin with in the field of hospitality.

When the perspective of the organization is considered, the system is mainly focused on reducing the food wastage in the field of hospitality by providing the analyzed daily usage, wastage and suggestions to the management of the organization through building and prompting the analyzed data. The system maintains the expenses of the organization by tracking the wastage including the weight of the leftovers, provide suggestions to control and reduce unwanted expenses in a daily routine. The mechanism that is used to calculate the amount of the daily wastage is identifying the ordering patterns accordingly (seasons, day/night) and getting the statistics of the usage of the ingredients from the supervisor/manager of the kitchen through an interface which identify the quantitative data by using the Data mining algorithms, making the system to perform intelligently.

Considering the customers of the organization/hotel, the ordering process of the customers' favorite menu is determined through a tablet with the Android application installed, which is provided to him/her for food placements so that it saves time spent to order and to make the ordering efficient. To ensure that the customers get a better service, the orders are distributed among the various chefs by considering their expertise, workload and availability by displaying the orders to the chefs through an interface so that they can select the orders accordingly. As every organization rely on their customers' feedback/satisfaction which is qualitative data, SaveMORE is also designed to get

the customer feedback through the Android application and decide whether the comment/review is positive or negative by analyzing through opinion mining.

This research paper contains the Background of the product, SaveMORE where it emphasizes the need of such system and then the Methodology will clarify the stages which SaveMORE has followed to reach be a product. The chapter of Results will contribute the final output of the project whereas the Discussion will summarize the limitations it had. Finally the Conclusion part will revise all what is explained before and there will be suggestions to focus on in future work.

II. LITERATURE REVIEW

Since the technology came into play, people have developed and experimented various techniques to improve customer satisfaction, to manage the service in different business communities and for so many more. There are a number of researches that have been done related to the area which the project team is in. Before commencing the research project, the whole project team went through a deep study of literature to seek better ideas to bring life to the proposed system – SaveMORE under the existing automated ordering systems, similar applications (mobile/standalone/web), Data mining and opinion mining and effective waste management and solutions.

A. Automated Ordering Systems

According to the research done by, Dhore .et.al [3], the system is been planned to design as such the first function for the customer who can book tables and place orders. Second, the kitchen unit in a restaurant, which enables the staff to view current orders. Third, the manager of that restaurant in order to keep track of all the transactions. The uniqueness within this system is that there is no application in use today that enables customers to book tables of their choice, place prior orders, and also make payments. No application today supports order placing from remote locations and view of customer's current location with the help of GPS service. The following are the features which can be a part of the proposed system: Ordering, Waiting, Billing, Table Reservation, Home Delivery, KOT, and Advertisement.

B. Similar Applications

Sarkar .et.al in [7] discuss the integration of touch technology in restaurants using Android. In hospitality industries showcased that various applications based on wireless technologies are already in use enabling partial automation of the food ordering process. This system is a basic dynamic database utility system which fetches all information from a centralized database. The tablet at the customer table contains the Android application with all the restaurant and menu details. The customer table, kitchen display, and the cashier counter connect directly with each other through Wi-Fi.

C. Data mining and Opinion Mining

Data mining which is also called as Knowledge Discovery in Data (KDD) performs an automatic search in large stores of data to discover patterns and trends that go beyond simple analysis. Advanced mathematical algorithms are used to segment the data and evaluate the probability of future events. Data mining can generate answers to the questions that cannot be addressed through simple query and reporting techniques [19]. Opinion mining is a type of natural language processing which is used to track the mood (opinion) of the consumer about a particular product. Sentiment analysis is a synonym to opinion mining as automated opinion mining normally uses machine learning, which is a type of artificial intelligence (AI) to mine text for sentiment [20]. Ahmed and Elarby in [11] have discussed various Data mining algorithms and techniques. Clustering was mentioned as one of the algorithms which is used to find groups of objects such that the objects in one group will be similar to one another and different from the objects in another group. Classification accuracy, data sparsity, and sarcasm are discussed as the primary issues in previous techniques of sentiment analysis because they classify most of the tweets with a very high percentage as neutral [14]. To overcome them, an algorithm for tweeter feeds classification based on a three-way classification (data acquisition, pre-processing and classification and evaluation) was introduced by Khan .et.al. [14].

D. Effective Waste Management and Solutions

Food loss occurs in each phase of food chain [16]. This is a survey conducted in Swiss food service to show the potentiality of the food waste to

the economy and the environment and conducted on as survey done in two departments in a specific time period. It's not ethical to justify results of waste. Two sectors of companies (educational department and business department) were used to provide estimates under storage losses, preparation losses, serving losses, and plate waste which was conducted for 5 days. The customer has evaluated with a set of questioners.

Within our research topic, the system itself has included eliminating human interference within the hotel by automating food ordering system. By providing a proper customer service to the current and future customers, making reservations, undertaking customer orders, sending the particular customer order to the kitchen department, collecting payment bills and receiving the evaluation through the customers all will be automated according to this research topic. Also introducing the wireless device to the customers towards more user-friendly, personalized and for a flexible service. That effect of eliminating the human errors, introducing new technology to the customers while getting the maximum use from modernizing technology to the business. Collecting the customer evaluations and providing a finalized report to the management that effects on making managerial decisions regarding the restaurant development, expansion, future planning and customer loyalty, restaurant popularity enhancement are the added advantages.

III. METHODOLOGY

Food is wasted due to over food preparations, late meal serving, lack of knowledge in customers about meal quantities which will lead to more plate leftovers of food and less quality in food as the chefs do not get any feedback about the meals they prepare daily. The four components discussed in this research paper are reducing wastage from the meals ordering process, food quantity estimation process, dividing the workload among the team, wastage measuring, generating report to enhance the business value for the management and the feedback analyzing process.

A. Planning

SaveMORE required the following hardware and software facilities (shown below in Table 1) with the programming and technical skills to work with Arduino to proceed with the Prototype methodology.

Table 1: Resources Required

Hardware	Software
Computers - 2 Processor: CORE i5 2Ghz Free Space: 80GB RAM: 4GB	Android Studio
	SQL Management Studio 2014/ PHP MyAdmin
	SQL Server Business Intelligence Development Studio 2014
Tablets - 1 Android OS V4.0 WIFI supported	NetBeans IDE
	Microsoft Word 2013
	Microsoft Project 2013
Electronic scale	Arduino IDE

SaveMORE does not conflict with any legal procedure under any circumstances. Therefore it was legally feasible to carry on. The project team did have well and clear vision towards the scope and was scheduled feasible as it could be completed within the scheduled time frame according to the submissions and all the project functionalities.

B. Requirement Gathering and Analyzing

Though the statistical analysis did not give positive results based on the response to the questionnaire which would explain the correlation or regression in between the independent variables and the dependent, the discussions and interview sessions with the industrial personalities expressed that SaveMORE would be a better solution to the existing problem of wasting food which has caused a major impact on the day-to-day life, especially in Sri Lanka considering current affairs. They have mentioned that the fact which SaveMORE will suggest and predict things on the menus, orders and the wastage which would lead to decrease the weight of the bins resulting reduced wastage, makes the difference from the existing systems. While the primary data were gathered through the Questionnaire and the Interview sessions, literature review provided the required secondary data.

application through the Internet. Jason objects carries the data with the use of VOLLY HTTP libraries.

3. Order preparation and work load balancing in kitchen

The time to serve the prepared meal effects the quality of the food as the temperature of a meal plays a major role in the quality of food. Workload is balanced by assigning the new order to the chef who has taken the least number of orders. Once the order is placed through the Tablet, the particular order is displayed on a standalone computer where a java application has been built which would make the service effective and efficient so that the quality of the food could be thoroughly considered. This application is connected over WI-FI to the main hosted MYSQL database to fetch the ordered meals which has been placed through the Android application.

4. Feedback processing

Feedback is taken from the customer to gather the customers' perspective on the quality of food. So that the Management can review them and make relevant decisions to control the quality or the taste of meals. The system is with a unique feature in the system to analyze the opinions or the reviews that the customers have given using the Android application. Opinion mining is performed inside another java application which decides whether the opinion is positive or negative (Yes/No) using an algorithm running inside.

Steps in Algorithm

- Take the reviews from the database and save it in a text file.
- Search for a meal which is taken from a user to analyze the review (in the saved text file).
- Display the reviews for the search word or the meal in a list.
- Find the adjectives in the content and search for negative adjectives and positive adjectives or find verbs that convey the positive or negative idea.
- Count how many of positive ideas and negative ideas.
- Take an average and display the opinion behind the user entered data to search.

5. Measuring Wastage

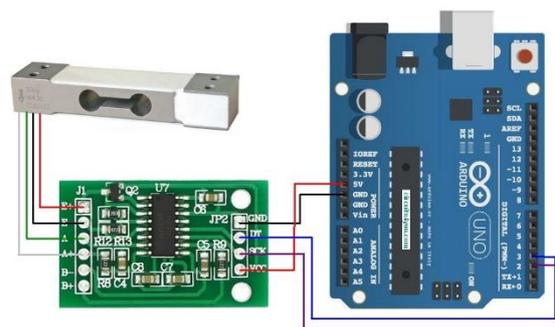


Figure 3: Electronic Scale

Measuring the litter bucket was essential to take a proper numeric measure on the wasted food. For this process, an electronic scale (shown above in Figure 3) was developed using the ARDUINO technology. This electronic device takes the readings which is the weight of the litter bucket and store them in a database through the java application in the kitchen.

E. Testing

Under the testing of the system the research team used unit testing to observe the behavior and the response of separate units developed separately. After each unit's performance was satisfied and confirmed error-free, integration testing was started. The modules were integrated one by one and in each time it was tested separately. Once the integration was completed with the testing, the team took the system as a whole and tested it to check the performance, usability and whether it meets the requirements which were planned initially.

IV. RESULTS AND DISCUSSION

Modern world is at a stage where they cannot control the massive amounts of litter dumped to the environment which heaps up daily. As it is stated previously, the main purpose of the automated software system was to reduce the wastage in the hospitality sector. Prediction accuracy for food preparation caused the most food to be wasted. Through our system we have developed an efficient way to increase the accuracy by reducing the wastage. This wastage could enhance the extra cost spent on food. The managers or the staff should know about the quality of the meals, how the customer feel about the meal or what kind of a service they need likewise. These kind of details would provide a business value to the

company/business. By allowing the customer to have a rough idea of the meal (as shown in Figure 4) he/she is about to get, would help him/her to order according to his/her need and save the food. Interface which is located in the kitchen (Figure 5) would manage the workload and offer the staff a trouble-free environment.

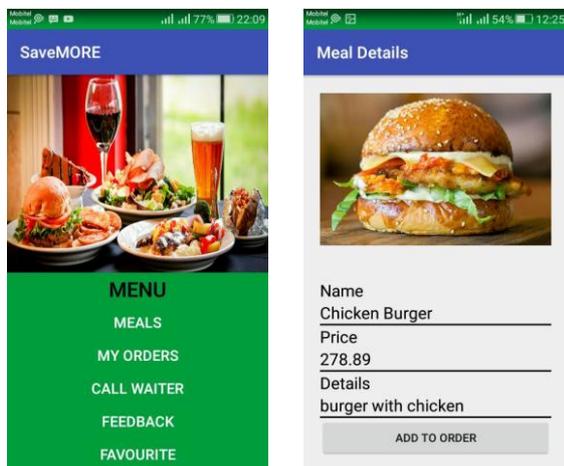


Figure 4: Interfaces of the Android application



Figure 5: An Interface of Kitchen UI

Following are some of the major challenges faced by the research group.

- Build/adjust algorithms to achieve accurate results.
- Decide between an app installed tablet and a public Android application for the customers to download and install themselves.
- Compatibility of the software tools used. (SQL Server Business Intelligent Studio, Android Studio and Arduino IDE.)
- Building the Data mining model was not easy as the exactly required data sets could not be found. Therefore data had to be pre-processed and adjusted in order to perform the mining.

To avoid the listed problems, the team had to seek for support from other individuals who are working as Software Developers in the industry and to refer tutorials, YouTube videos, books etc. related to algorithm development and to develop the Android and Java applications. The system was initially planned only to reduce the food wastage by providing a summary with suggestions to the management. After the interviews and the Questionnaire were carried out, the research group learned that the meal or dish served in time to preserve the quality (freshness and taste) is important as well (shown below in Figure 6).

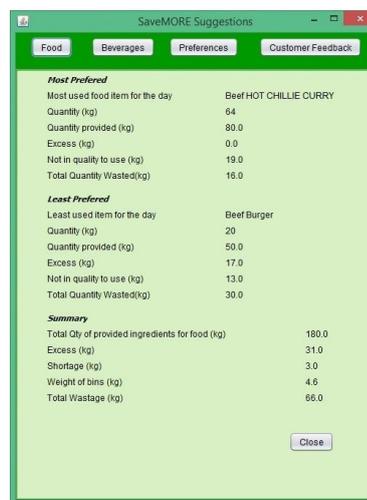


Figure 6: Suggestions Interface

After additional research the group decided to give a Tablet to the customer without giving making them to install the application themselves, otherwise an additional limitation would have been created as such every customer of the hotel has to have the app installed. In addition, if the application was to be installed by the customers themselves, the application would have to reconsider its compatibility with the other platforms like iOS and Windows. The system was changed accordingly to support the changes.

The accuracy of the SaveMORE varies according to the amount of data used for data mining. The database contains the data of orders completed in more than three years of time which prediction accuracy.

Limitations

- When measuring the weight, all the plate waste was taken as the waste of weight

though they may contain the bones, covers, etc. which cannot be consumed further.

- Practically it is impossible to take ingredients waste weight separately though it is taken separately from the time of meal preparation.
- To some extent the attitude of people will change the amount would be consumed such as some people might not have intentions to waste food but they might not be interested in ordering food according to their need. Such situations could increase the wastage of food which is impossible to prevent by our system.

V. CONCLUSION AND FUTURE WORK

Waste of food which is a hidden crisis around the world will be reduced by the implemented automated system to reduce the food wastage in the field of hospitality- SaveMORE, through delivering efficient suggestions on how to reduce the wastage to the management on a daily-basis. Future research directions for this research paper would include a web application so that the customer may not need to worry to come to the hotel/restaurant to have their favorite meal but to order online. In addition the customers may then be identified separately and will be able to provide customer intimacy which will be a better option from the business perspective as well as the technical perspective. As the main objective, this paper has introduced a solution for the food wastage in the field of hospitality.

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