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Online Platform for Excess Food Management

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***Abstract*—Wastage of food is a growing concern in modern society, as is reflected by estimates from the FAO about the 30 percent of wasted food manufactured in India. Hence accurately estimating the demand for food is essential for this area of industry.Consequently, in this study, consideration has been given to creating a ML-based excess food management model for restaurants that will forecast the restaurant's daily food intake derived from historical data. To anticipate food waste, many machine learning algorithms will be used, and the best one will be selected. This will enable the restaurant to adjust the amount of food served in accordance with the forecast.**

***Index Terms*—Accurate estimation, mobile application, ML-based model, forecasting**

I. INTRODUCTION

The Food and Agricultural Organization[FAO] estimates that each year, over 30 percent of the food manufactured in India is wasted as a result of disorganized food systems and inadequate supply chains. A restaurant with too much food runs the danger of wastage, while one with too little could experience out-of-stocks. Restaurants, when reaching the end of their raw material's lifespan, often throw away their materials without considering the alternative or mitigating procedures. Because the overwhelming amount of the basic ingredients used by a meal delivery business are perishable, accurately estimating the demand for food is essential for this area of industry.

One of the most difficult problems that humanity is now dealing with is food wasting. It is believed that between 1/3rd of the food that is generated is lost before it enters a person's mouth, which speaks volumes about how ineffective the food production practices are at the moment. The Sus- tainable Development-Goal:12 created by the UN in 2015 has a particular aim for waste minimization- cut in half the per capita world food spoilage at levels of retail before 2030. It also has the more broad goal of decreasing food spoilage throughout food supply systems. In order to accomplish the aforementioned goals, it is therefore anticipated that there will be a rise in the amount of activities, events, and policy developments.

However, Food waste management must go hand in hand with a decrease in the prevailing amounts of food waste be- cause there will always be some waste disposal. Additionally, some components of the processed foods are indigestible and must naturally end up on the waste stream. Although there are many substitutes to land-filling that are extremely harmful to the environment and dangerous to human hygiene while offering no advantages, land-filling is still the most often used method globally. Even while industrialized countries have made strides in past years toward finding viable substitutes, there is still a need for production lines to handle waste disposal of food more effectively.

Food waste management is a significant subject of research that has expanded rapidly in the last decade. There are plenty of excellent cases of research that seeks to manage food waste sustainably, however these studies typically focus on just one aspect of sustainability, such as its effects on the environment, the economy, or society. New research tries to go in-depth and broaden the focus and take into account 2 of, or possibly all 3, of the sustainability concerns outlined previously.

A useful method for ranking disposal methods by effec- tiveness in terms of sustainability is the waste hierarchy applied to processed foods. The idea of a waste hierarchy was initially applied to European trash policy, and it has since been regularly employed in Directives that have been put into place ever since. It has been included into United Kingdom law and is also utilized there by authorities. Many of the scientific articles that have been published in esteemed research papers on waste minimization have a strong emphasis on food scraps. The choice of which waste treatment strategy to use to handle food waste is typically determined based only on financial considerations and the accessibility of dump sites. Regulation also restricts the array of choices that can be used to handle various forms of food waste, thus decisions are frequently made after carefully weighing a small number of options.

The paper has been divided into various sections.The in- troduction to excess food management and wastage disposal of food has been provided in the initial section of the paper. Along with the need for excess food management in present day India, and the various techniques that have been used earlier for this domain. The second section is the literature survey which comprises the related work in this field, explain- ing the different models of machine learning that have been implemented. The following section presents the proposed system, along with a detailed description of the

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working model, the implementation of the mobile application, and the usage of technologies.

II. LITERATURE SURVEY

In this section, we study and elucidate the work pertaining to the subject. There have been various studies regarding excess food management in restaurants, which consists of restaurant food waste prediction, demand forecasting, a platform provision to connect producers and distributors, classification of the types of food waste, using machine learning to get automated results.

[1] The primary motive of this paper was to create models for forecasting food requirements based on [NARXNN] neural networks. It primarily concentrated on problems with the utilization of data analytics to forecast food needs. Based on the study's findings, it can be said that the artificial intelligence-based NARXNN models can been designed to produce projections of food demand that are extremely precise. The main goal of this study was on problems with the utilization of machine learning to forecast food production need. Speculations pertaining to supply chains was handled as a complementary concern. This paper had some shortcomings which are discussed below. Lack of ability to analyse sparse datasets i.e. the ones with less than hundred rows is the primary drawback of proposed method. It has been suggested that the proposed system may be integrated into an organization's integrated smart control system for the logical supervision of stocks and food production, however more specifics pertaining to the practical implementation of the same hasn't been provided in greater depth.

[2] In order to decrease manufacturing ambiguity and providing guidance into the food manufacturing operation, this study shows how machine learning may be used to the food industry. It illustrates creative approaches to handling unpredictability in demand forecasting by integrating cutting- edge techniques in the area of industrial engineering. These technologies enhance conventional approaches and give industry supervisors useful data to weigh the financial advantages of better equipment or operating procedures. Coming to the limitations of this research, Despite the fact that claimed that the machine learning techniques surpass the conventional methods in terms of estimating the quantity of food waste, no specific justifications are given for this. Statistics on waste creation that was in line with real production was gathered. However, no data was collected in a poor environment. Data from previous batches was removed, significantly reducing the dataset's unpredictability.

[3] In order to anticipate the sales per day of perishables in a bargain storefront, this research's primary objective is to construct a Seasonal-autoregressive-Integrated-Moving Average with External-Variables [SARIMAX] model that attempts to take in consideration for all the impacts caused by the variables controlling consumption. The everyday market data collected of fresh produce, from a bargain storefront were examined to determine the appropriateness of this methodology. Now for the limitations in this study

- the predicting inaccuracy could have been reduced had the developed framework been properly adjusted with more broadly impacting parameters. The outcomes of the method demonstrate that for out-of-sample data, SARIMA accomplishes worse than SARIMAX without concrete reasoning. Holidays and price reductions are not taken into consideration by the SARIMA model, so this component is essentially ignored, decreasing predicting precision.

[4] This paper presents a recommendation for an approach in the form of an application that allows users to view the amount of food that was neglected at the restaurants. Consequently, a directional strategy has been demonstrated in this software, allowing the user to get in touch with the restaurant and collect the extra food. Restaurants may use the app to sign in, submit photos of the dishes they have as remains, describe each dish, and specify where customers can collect it. Whenever they submit a appeal to the program, clients may enroll in, select the dish of their preference, and collect it. The authors of this research have found the usage of mobile software tech to supervise food waste minimisation and therefore have developed an android based software program that enables eateries to contribute and give their surpluses and meals to those who need them. Customers can sign-in, enroll, see goods, append units, add units to basket, delete units from baskets, and sign out by using the software. The proposed software with the help of a realtime DB and firebase. Every client that really needs it is able to view every one of the food pictures contributed by various people and append them to their cart.

[5] This study covers how to use ML features to identify and characterise different food categories. By allowing hotels to give this foodstuff to nonprofits, who can then serve the hungry, the software offers a solution to eliminate the discrepancy between excess and shortfall. 15 percent of the meal waste disposal, as reported by the EPA, originates from eateries. Food loss is currently the main type of garbage that is dumped there. This study had some limitations as well. The user who is explicitly utilising the app is not clearly identified; the user could be an NGO or another similar entity in this case. The app that has been mentioned doesn't have many different donors, whether they are families, lone users, or businesses like eateries. The recipient of the food should be informed of how long it will stay fresh and be suitable for consumption, as this detail is not currently provided in the software.

[6] In this paper, there is a recommended strategy for opportunities to integrate various forms of food wastage that might be handled more sustainably. The method for managing commercial excess food is discussed, along with a novel way to incorporate Internet - of - things and deep-learning methodologies to guarantee an ideal waste disposal management solution. Other innovations include the architectural development

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of an intelligent garbage can using a sensor module, load detecting system powered by sensor, and micro - controller, as well as a clever system for monitoring the garbage can's contents. There ought to have been a capability to anticipate the closest eateries and Nonprofits instead of just predicting the NGO's that are present in that locality (like the Geolocation Feature). Given that the prototype given in the study specifies the food supply method for a particular area, incorporation with the GPS system ought to have been done in this case. Because the provided information only delivers a basic understanding, it is insufficient to understand how the software will function over the foreseeable future. Therefore, comprehensive insights regarding the actual score and forecast score of the meal ought to be presented.

[7] This paper focuses heavily on private occupations, particularly those that take place in the restaurant sector. According to Euromonitor (2016), this segment comprises comprehensive vendors (such as eateries), food stalls, take-out and distribution, processed food, cafeterias (found in organisational or educational settings), to retail locations and foodservice services. Excess food supervision methodologies also have an impact on the economy in addition to ecological and societal sustainability. According to a latest report, eateries on aggregate saved 7 dollars in operational expenses for every 1 dollar of equity in initiatives to decrease organic waste in the kitchen. The drawback of this paper were as follows: The proposed framework can only be used with five different types of perishable goods, and it only includes 2 sensors, and this might also result in lower accuracy results. The method's identification of different kinds of holes in the box, in which the mass of the excess food must be calculated, is a shortcoming as well.

[8] This work offers two ML models(MLP , ANFIS) , to forecast agricultural production. The findings of performance measures showed that perhaps the ANFIS model has more forecasting power compared to the MLP because of its higher forecast accuracy. The study's findings offer authorities a useful method for planning upcoming food safety and produce for the upcoming future by allowing them to utilise this method to forecast future food output. Predictions can also help administrators to prepare for importing the food they require. The fact that the ANFIS beats the MLP cannot be extrapolated since the research's results are constrained to manufacturing and export in Iran.

III. METHODOLOGY

The main aim is to create an appropriate machine learning model to forecast then number of orders to gather raw mate- rials for next ten weeks. To achieve this, we should know the information about of fulfilment center like area, city etc., and meal information like category of food sub category of food price of the food or discount in particular week. By using this data, we can forecast the quantity for 10 weeks. A web application is built which is integrated with the model built.

A. Forecasting Method

The number of customers is calculated using Machine Learning with internal and external data . For this, a dataset with the information of fulfilment center like city, region etc. and meal info like category, sub category, etc. is used We thus make use of XGBRegressor , Linear Regression , Lasso Regression , Decision Tree Regressor , KNN and Gradient Boosting Regression are used and we are calculating the Regression Evaluation Metrics RMSE(Root Mean Square Error) that is the averaged squared difference between the target value and the value predicted by the model.

B. Model Evaluation

A technique for evaluating models is called RMSLE. It is the RMS [Root Mean Square] of the expected and actual values after applying the log transformation. The fraction of predicted to actual data is measured by RMSLE. The assessed outcome shows that rate of error 0.6. And this is a good value. Target data, such as population figures and mean commodity sales for some timespan, exhibit exponential growth. This makes RMSLE the best suitable method to eval- uate them. RMSLE is concerned with percentage inaccuracies, there is no importance to the absolute values of errors. Target variables come in a variety of lengths. In some cases where the estimated and the actual variables are numbers of large magnitude, RMSLE doesn't penalise large differences. In this evaluation method, under-estimations suffer more penalties than over-estimations. This method of penalizing is frequently extra crucial for predicting inventory needs and sales.

In this study , data from different restaurants were used , the restaurants are usually a casual dining establishment located in India , the most representative menu items were selected and the seasonal , weekly and monthly patterns were observed further the regressor model like the XGBoost helps us to build a good model from the observed time series data , future sales of food can be affected during festivals or any time wherein customers are willing to visit restaurant , and there is only a single historical sample available in our data instance , thus we are easily able to predict the number of orders of a particular data of that particular region

Steps of the project work flow are as follows:

1. Start
2. User logs in to the system
3. User enters the necessary information like city code ,regioncode , cuisine category
4. User data is feeded to the ML Model
5. A suitable quantity of food that is to be prepared is shown
6. Stop

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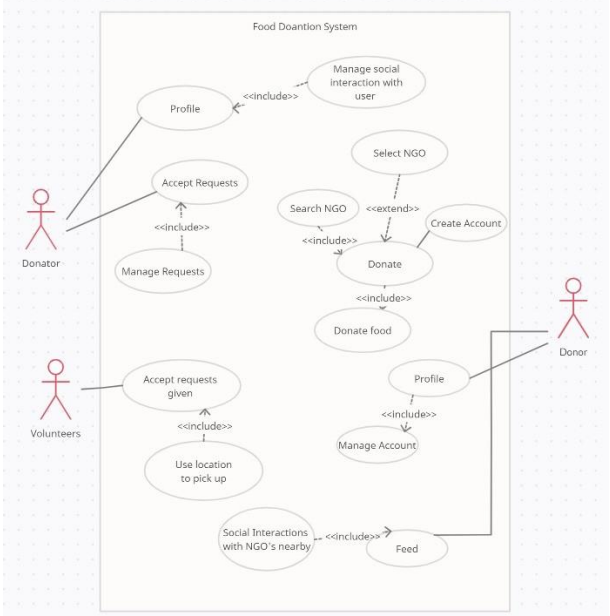

Fig. 1. Use case diagram

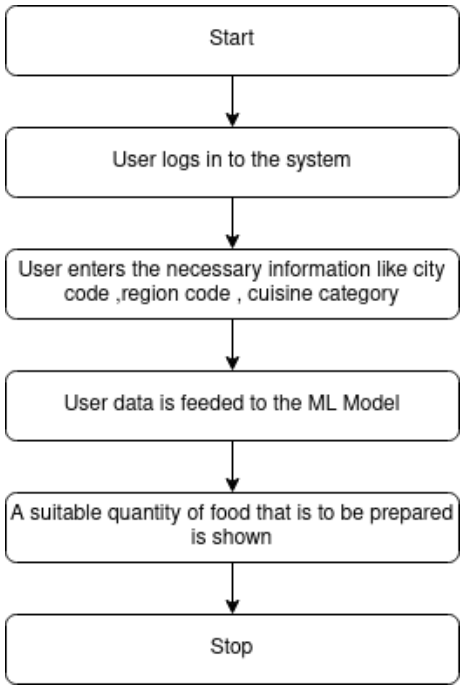

Fig. 2. Flow Chart

IV. RESULTS

Sr.	Model Name	RMSLE
1	XGBRegressor	69.43115
2	LinearRegression	129.4789
3	Lasso	129.2059
4	ElasticNet	131.2584
5	DecisionTreeRegressor	62.6445

Following are the RMSLE values for each the models used. We observe that the model is penalized more if the predicted value is less than the actual value while the model is less penalized if the predicted value is more than the actual value. It does not penalize high errors due to the log.

V. CONCLUSION

We would like to conclude that we could satisfy the main aim of connecting the restaurants having excess food to the needy people with the help of our platform. In a country like India wherein a lot of food is wasted and thrown away and simultaneously we have people who are starving as they don't get adequate amount of food daily, and are not able to satisfy their basic needs.

We came up with another solution for the restaurants wherein the food demand forecast is made for the upcoming days based the previous data , so that the restaurant can predict the number of orders and accordingly make the required amount of food .

Our main motto was to come up with measures to reduce the food wastage in any form which was fulfilled and thus we could come up with the solution for both the platforms.

VI. FUTURE SCOPE

If the food is expired, we can give it to the farmers to produce the manure. Integrate the machine learning model with the app so that it will be easier for restaurants to operate in one app only.

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