IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 5, Issue 3, January 2025

Optimizing the Redistribution of Edible Food through Machine Learning

Vinay P[1] and Saumya Y M[2]
Department of Computer Science and Engineering[1,2]
Canara Engineering College, Bantwal, Mangaluru, India[1]
St. Joseph Engineering College, Mangaluru, India[2]
mail2vinay.17@gmail.com and saumya2087@gmail.com

Abstract: *This paper introduces an online application designed to help bridge the gap that exists between donors and individuals in need, like orphans and NGO's. The three primary parts of the application are food management for events, subscription choices for supporters, and surplus food control for contributors. This paper mainly focuses on the efficiency of food contributions by evaluating food quality and predicting spoilage using the Random Forest algorithm in machine learning. This algorithm has gained 97% accuracy while comparing with other algorithms such as KNN and SVM. Within a predetermined radius, donors and recipients are seamlessly connected, with recipients communicating via the app. A large database records past contributions and notifies people to upcoming events. Ratings and feedback systems ensure that donors have a good experience, which promotes philanthropy and a sense of community that benefits society.*

Keywords: Random Forest Algorithm, Food remain, Donors, Web Application, Food Quality Management

I. INTRODUCTION

In an era marked by technology advancement and a growing sense of social responsibility, the need to connect donors with those in need has never been greater. This paper introduces a dynamic web application meticulously developed to bridge this important gap, catering to a wide spectrum of recipients, including orphans and people in need of immediate aid. The application is deliberately organized into three main parts, each aimed at improving the donation process and instilling a sense of community involvement. Initially the platform empowers donors by providing them with tools for efficient excess food control, allowing them to successfully offer surplus resources. Second, supporters are offered subscription alternatives, which provide them with unique ways to sustain their philanthropic efforts over time. Finally, the application allows for seamless food management across functions, ensuring efficient coordination and distribution of donated resources. At the heart of this new platform is the use of the Random Forest algorithm, a powerful tool in the field of Machine Learning. Using this technology, the proposed work not only evaluates food quality but also forecasts possible deterioration, increasing the effectiveness and impact of food.

II. LITERATURE SURVEY

Food waste is a critical global issue with significant environmental and economic consequences. Efficient food waste management not only benefits the environment, but also has the potential to alleviate poverty. This research aims to address these issues by developing a web application for the efficient gathering and distribution of donated food items. The program simplifies registration for both donors and recipients by allowing them to define food availability or criteria. This platform is unique in that it accepts both cooked and raw food donations and allows donors to promote their gifts through submitted images. The app's goal is to drastically reduce food waste by developing a donation culture and encouraging active involvement, so positively contributing to environmental sustainability and societal well-being[5].

The Random Forest Methodology is commonly used in machine learning to predict academic progress. It entails creating several decision trees to make accurate forecasts. This algorithm produces these trees by voting on the best classification for test datasets and randomly sampling data to identify the ideal answer. The random forest method uses a nonlinear approach to reveal complicated correlations between characteristics, making it a powerful tool for

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classification and regression modelling. Unlike other tree-based algorithms, it does not prune trees but rather separates data into random subsets at each tree node, increasing forest diversity and overall performance. The random forest technique's adaptability is demonstrated by its applicability in a variety of fields, making it a highly competitive and in-demand methodology[10]. A hypothetical algorithm of integrated learning or a composite classifier of machine learning algorithms is commonly referred to as a random forest (RF). The bagging algorithm has received positive reviews from both academia and industry for its ability to combine several decision trees and produce outcomes through voting. In an effort to lay the foundation for further optimization studies on the method, this study examines the artificial intelligence random forest algorithm[11].

The Food quality management suggests a novel technique to increase food redistribution efficiency. The system uses technology, such as computer vision and quality control methods, to evaluate and maintain food quality throughout the redistribution process. By evaluating food photos, the technology ensures quick and objective evaluations, outperforming existing approaches. Robust quality inspections and tracking methods are in place to detect and minimize concerns like spoilage or contamination. To precisely evaluate quality, the system uses data-driven decision-making and accesses food ingredient databases. Overall, this technique maximizes food redistribution by reducing waste, increasing resource use, and guaranteeing that safe, high-quality food reaches people in need[9].

Food waste is a major concern around the world. Community organizations seek to address this issue by collecting extra food from donors and distributing it to individuals experiencing food insecurity. However, the manual nature of this technique reduces its efficacy. To solve these issues, this study introduces the FoodX system, which aims to connect communities with possible food donors. Food Wastage Management, using a prototype technique, meets the needs of varied food communities while streamlining the donation process and increasing efficiency. Food Wastage Management intends to drastically minimize food waste by promoting seamless communication and coordination between donors and recipients, as well as guaranteeing that excess food is delivered to those in need quickly and effectively[1].

Restaurants, NGOs, and other groups can simply register and publish their surplus food products on the web-based site, which functions as a centralized hub. Donors can expedite the donation procedure by providing parameters like expiration date, quantity, and kind of food using user-friendly interfaces. The platform's exclusive focus on food donations guarantees a committed and effective conduit for dispersing surplus food to those in need, reducing administrative difficulties and optimizing impact. This also includes features like aspects and acknowledgment for top contributors to further encourage and reward donation efforts. The platform promotes sustainable measures to counter food waste and develops a sense of social responsibility by cultivating a giving culture in the hotel sector and beyond[15].

III. METHODOLOGY

To embark on the methodology of the proposed work, it is critical to establish an extensive strategy that includes the integration of many technologies and frameworks, with PHP and Django serving as the backend development. PHP is the language that has been used here as the main programming language for the backend of the work. The proposed approach makes use of the Django framework with python as language. To begin with this work, one has to have Xampp server or MYSQL in their workstation. Fig.1 shows the proposed methodology.

Following the setup, the proposed approach continues with the collecting of the food dataset. Food dataset is the primary data of the training model. There will be descriptions of various foods. Then the data will go through some preliminary steps before being used by the model. This will include cleaning the data, removing irrelevant data, and formatting the data in a way that the model can understand. Training data sets, After pre-processing, some of the data is allocated to train the model. Moreover, the training data is fed into the machine learning model, which learns features and patterns in the data. This allows the model to make predictions about new products. Another part of the original data is reserved to test the performance of the model as this is a test file. The important thing is that the model does not see the test data during training to ensure unbiased evaluation. some amount of the dataset is taken to train the model and the remaining is for testing purpose which makes the model efficient.

Classification involves Evaluating the model using test data. The model makes predictions for items in the test data and compares the predictions to the actual text of the items. This process helps determine the accuracy of the model. Based

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on the test results, the model is considered as consumable or not consumable. If the model performs satisfactorily on test data, it can be used for practical purposes. Otherwise, the model may need to be further improved or trained with different data. . The model's performance is evaluated using evaluation measures, such as accuracy such as temperature, humidity, preparation time, food type etc., using the testing dataset. After a successful review, the model is put into use and may be included into an application or web service to provide predictions in real time.

The interface involves two segments-the donor and the receiver initially both the segments have access to Register and login. In the first segment, we have Donor, subscriber and the Pre-order. Which includes unique security protocols, community participation, event planning and the incorporation of the Random Forest algorithm to evaluate Food quality and forecast spoilage, all of which improve the effectiveness of food donations. Here the donor adds the food details according to the availability of food such as food type, location, cooking date and time and ingredients etc. and submit the details accordingly. The second segment Receiver can check the availability of food to the nearest location within the radius to maintain the Quality of food. The receiver can either accept the food donation or reject the food donation. If receiver accepts the food, then they should select the pickup date and time accordingly. Using random forest, a web application is designed to bridge the gap between two critical entities: donors and individuals in need, including orphans and those requiring assistance. We create a deep learning model that can anticipate food spoiling by collecting variables from donors. Random Forest is a well-liked ensemble learning method for applications including both regression and classification.

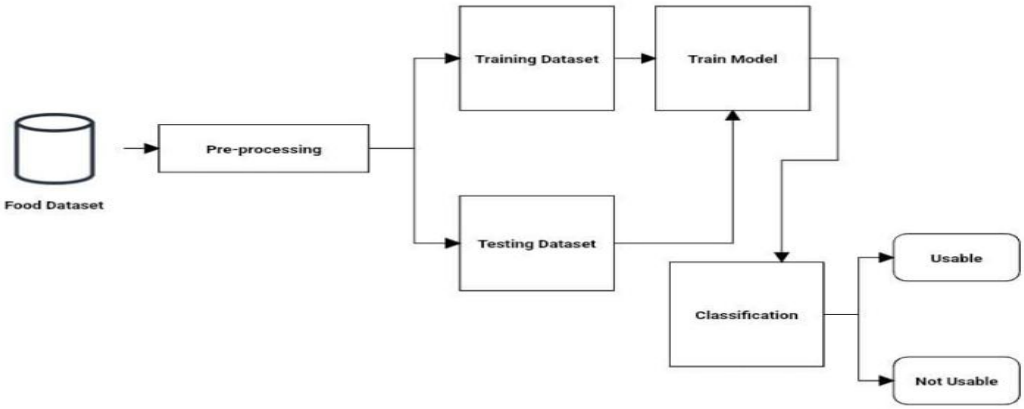

Fig. 1. Methodology of the Proposed System

IV. THE SYSTEM ARCHITECTURE

The system architecture of the website consists of seven parts. The following modules are in responsible of the application's efficient operation:

A. Login /Register

The It enables users to create an account by providing their personal information and credentials, such as email and password, and subsequently login to the application to access their personalized information and features, followed by verifying the user's email address, The login process verifies the user's credentials and generate the OTP through email against the database and grants access to the application's features and data.

B. Donor

Here the donor adds the food details according to the availability of food such as food type, location, cooking date and time and ingredients etc. and submit the details accordingly. Fig. 2 shows the process from the Donors perspective.

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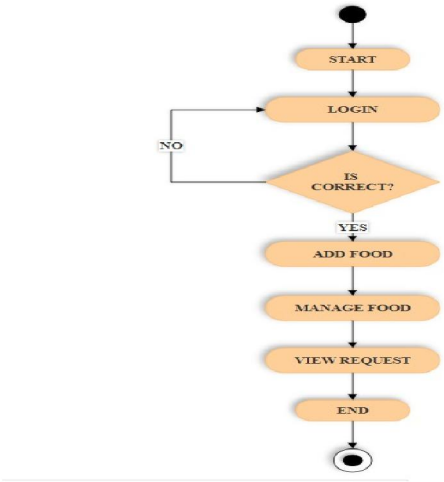

Fig. 2. Donor Diagram

C. User

The user can check the food available and also can test the food, also the availability of food to the nearest location within the radius to maintain the Quality of food. The receiver can either accept the food donation or reject the food. Fig. 3 shows the process from the Users perspective.

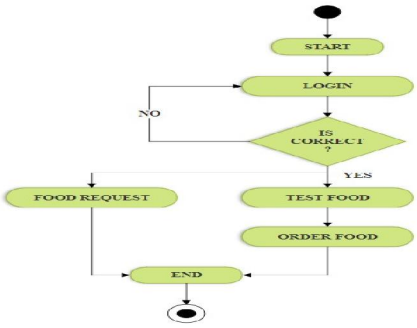

Fig. 4. User Diagram

D. Digital Menu

It contains list of eight items that are been uploaded by the donor in the most user friendly format with Quantity available, Deliverable or not, Description of the food and preparation time to serve facility all the information is present into the database which is been displayed to the user.

E. Place Order

The user can add the required Quantity of food as per their requirements but if the required are more than the quantity available then out of stock pop up message will be displayed. Further address and description shall be added, then place the order.

F. Test Food

The user can test the food whether it is spoilt or not spoilt by using Random forest algorithm.

G. Pre-order

It enables the user to request the food for the special occasions such as birthday, wedding etc at particular date and time.

H. Subscription

The people who cannot donate the food or want to donate some money, they will have the option to donate money ,this money will be provided to NGO'S and Orphanages or those individuals who are in need of food.

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V. RESULTS AND DISCUSSIONS

An experiment carried out as part of the work "Redistribution of consumable foods using machine learning" yielded convincing insights into the predictive capabilities of various machine learning algorithms regarding food spoilage. Three prominent algorithms, Support Vector Classifier (SVC), Random Forest Algorithm (RFA) and k-Nearest Neighbours (KNN), were carefully compared using a dataset carefully curated for this purpose. The initial partitioning of the data set into training and test sets enabled a comprehensive evaluation of the generalization capabilities of the algorithms. Through the use of confusion matrices, performance metrics were carefully analyzed, including accuracy, true positives, true negatives, false positives, and false negatives. Fig. 4 shows the distribution of the attributes.

The results revealed different performances between the algorithms, with the Random Forest Algorithm emerging as the best with an impressive 97% accuracy. Fig. 5, Fig.6 and Fig.7 shows the Confusion Matrix for SVM, Random Forest, and KNN algorithms. This superiority over KNN 94% and SVC 83% underlines the effectiveness of Random Forest in predicting the probability of food spoilage. Further research delved into factors influencing spoilage, including product type, temperature, shelf life, distance and food category. Using these parameters, the Random Forest Algorithm showed unmatched predictive power, allowing for an accurate assessment of the probability of food degradation. This nuanced understanding lays a robust foundation for implementing proactive measures to mitigate spoilage risks and increase the efficiency of food distribution. Moreover, the implications of these findings go beyond just predictive accuracy. By leveraging machine learning techniques, particularly the Random Forest Algorithm, food distribution systems can move to a data-driven approach, optimizing resource allocation and minimizing waste. This transformative shift not only strengthens sustainability efforts, but also addresses pressing global food security challenges. As research progresses, the integration of machine learning into food logistics holds enormous promise for revolutionizing distribution practices and fostering a more resilient and equitable food ecosystem.

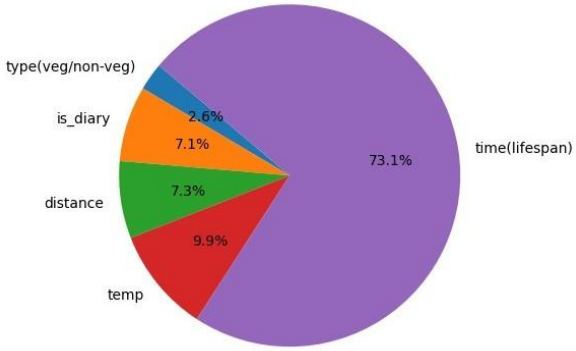

Fig. 6. Attributes Importance

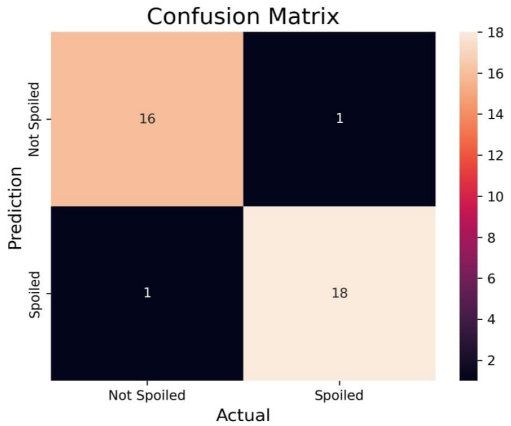

Fig. 7. Support Vector Classifier Algorithm

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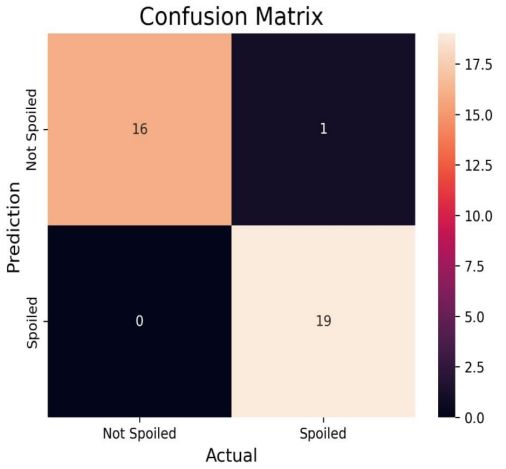

Fig. 8. Random Forest Algorithm

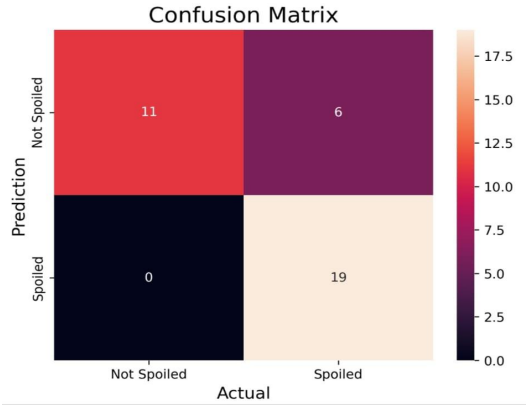

Fig. 9. K-Nearest Neighbours Algorithm

VI. CONCLUSION AND FUTURE ENHANCEMENT

Every day, one-third of the world's food is wasted, exacerbating widespread hunger and starvation. Rather than squandering these resources, they could be distributed to those in need. In India alone, 795 million people lack sufficient food for a healthy life. This website facilitates connections between food donors and those in need, offering potential for future enhancements to expand its reach to a larger radius and include small-scale donors. Currently, donations are limited to eight food items, but this could be expanded to encompass a greater variety of foodstuffs. In the future, this system could be further improved by employing a variety of machine learning algorithms.

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