A
Project Report
on

Foodlink: Bridging the Gaps Between NGOs and Hotels

Submitted to

Sant Gadge Baba Amravati University, Amravati

Submitted in partial fulfilment of the
requirements for the Degree of
Bachelor of Engineering in
COMPUTER SCIENCE AND ENGINEERING

Submitted by

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Under the Guidance of
Dr. R. A Zamare
Asst. Prof., CSE Dept
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Department of Computer Science and Engineering
Shri Sant Gajanan Maharaj College of Engineering,
Shegaon – 444 203 (M.S.)

Session 2023-2024

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SHRI SANT GAJANAN MAHARAJ COLLEGE OF ENGINEERING,

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CERTIFICATE

This is to certify that **Ms. Chitvan Naik, Ms. Mitalee Uplenchwar, Ms. Shreya Ingale and Ms. Sneha Khatke** students of final year Bachelor of Engineering in the academic year 2023-24 of Computer Science and Engineering Department of this institute have completed the project work entitled "**Foodlink: Bridging the Gaps Between NGOs and Hotels**" and submitted a satisfactory work in this report. Hence recommended for the partial fulfillment of degree of Bachelor of Engineering in Computer Science and Engineering.

Dr. R. A Zamare
Project Guide

Dr. J. M Patil
Head of Department

Dr. S. B. Somani
Principal
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Internal Examiner

Dr. R. A. Zamare

Name and Signature

Date: 10/5/24

External Examiner

Dr. A. D. Kankale

Name and Signature

Date: 10/05/2024

Acknowledgement

It is our utmost duty and desire to express gratitude to various people who have rendered valuable guidance during our project work. We would have never succeeded in completing our task without the cooperation, encouragement and help provided to us by then. There are a number of people who deserve recognition for their unwavering support and guidance throughout this report.

We are highly indebted to our guide **Prof. R. A. Zamare** for his guidance and constant supervision as well as for providing necessary information from time to time. We would like to take this opportunity to express our sincere thanks, for his esteemed guidance and encouragement. His suggestions broaden our vision and guided us to succeed in this work.

We are sincerely thankful to **Dr. J. M. Patil** (HOD, CSE Department, SSGMCE, Shegaon), and to **Dr. S. B. Somani** (Principal, SSGMCE, Shegaon) who always has been kind to extend their support and help whenever needed.

We would like to thank all teaching and non-teaching staff of the department for their cooperation and help. Our deepest thank to our parents and friends who have consistently assisted us towards successful completion of our work.

– Projectees

Chitvan Naik

Mitalee Uplenchwar

Shreya Ingale

Sneha Khatke

ABSTRACT

Each year, one-third of the world's food production intended for human consumption is lost or wasted, exacerbating global hunger and threatening food security. In response to this pressing issue, Foodlink aims to bridge the gap between NGOs and hotels, thereby reducing food wastage and insecurity. With millions suffering from hunger and malnutrition, and the COVID-19 pandemic exacerbating food shortages globally, innovative solutions are urgently needed. FoodLink leverages technology, including the K-Nearest Neighbors (KNN) algorithm, to create a user- friendly platform. This platform efficiently matches surplus food from hotels with the most suitable NGOs, ensuring that food reaches those in need swiftly and efficiently. By considering the shelf life of donated food, FoodLink minimizes wastage and ensures food safety. The project not only addresses the immediate need for food delivery but also contributes to long-term food security. Some of the key objectives of FoodLink include developing a user-friendly platform, implementing the KNN algorithm for efficient food distribution, ensuring food safety by considering the shelf life of donated food, and ultimately reducing food wastage and insecurity.Through this initiative, FoodLink aims to make a significant impact by alleviating food insecurity in communities affected by the pandemic and beyond.

Keywords: KNN, Food Distribution, Hunger

Contents

LIST OF ABBREVIATIONS

Abbreviation	Particulars
NGO	Non-Governmental Organization
KNN	K-Nearest Neighbors
COVID	COronaVIrus Disease
AI	Artificial Intelligence
UNEP	United Nations Environment Program
GHI	Global Hunger Index
NDRC	National Development and Reform Commission
GB	GigaByte
RAM	Random Access Memory
API	Application Programming Interface
CSV	Comma Separated value
WHO	World Health Organization
GPS	Global Positioning Index

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INTRODUCTION

There is an obvious and sad paradox between the increasing amount of edible food that is lost over the supply chain or consciously discarded by the consumers and the scarcity of food supplies for a significant part of humanity who still suffers from malnutrition [4].

1.1 Overview

In a world where millions suffer from hunger and malnutrition, the issue of food wastage presents a significant contradiction. Despite efforts to enhance food production and distribution, a considerable portion of the global food supply goes to waste annually. According to the World Health Organization (WHO), the number of people affected by hunger has been steadily increasing, with 3.1 billion individuals unable to afford a nutritious diet in 2020. This trend continued in 2021, with 29.3% of the global population experiencing severe food insecurity. Projections indicate that by 2030, the number of people facing food insecurity could rise to 670 million.

India, as the world's second-largest food producer, plays a substantial role in global food production, contributing 10.04% of the total output. However, despite this contribution, the country grapples with severe hunger issues, as evidenced by its Global Hunger Index (GHI) score of 28.7 in 2023. The Ministry of Agriculture in India estimates that the economic cost of wasted food amounts to approximately 50,000 INR, highlighting the financial implications of food wastage.

The problem of food wastage is not limited to national borders. The United Nations Environment Program (UNEP) reports that Indian households alone waste a staggering 68.7 million tons of food. Additionally, global food waste is a significant issue, with reports from the National Development and Reform Commission (NDRC) revealing that 40% of food produced in the United States is discarded annually. Moreover, Asia loses a staggering 1.34 billion tonnes of food each year, further emphasizing the magnitude of the problem on a global scale.

To address this issue effectively, innovative solutions are needed to reduce food wastage and ensure that surplus food reaches those in need.

1.2 Background and Significance of the Problem

Each year one third of all the produced food for human consumption is lost or wasted. Food wastage scales up the number of hungry people throughout the world and impairs the global food security [8]. Food wastage not only decreases the availability of food, it also reduces the resources needed to produce food for future generation. The Economist Intelligence Unit mentions that Indonesia is a country with the second largest producer of food waste after Saudi Arabia, one person Indonesia annually produces 300 kg of food waste. While in Saudi Arabia, one man produces 427kg. Even though Famine numbers in Indonesia are high, according to the Global Hunger Index, Indonesia is in the serious category with a score of 20.1 and ranks 70th from 117 countries [3]. Nowadays in Jakarta, there are several communities that care about the issue of food waste and hunger in Indonesia. The community collects leftovers that are still suitable for consumption to be distributed to people in need. Such scenarios areseen all over the world. Take example of the COVID-19 pandemic, the entire world population has been left to endure drastic consequences [1]. At that time also the need of application which can be useful for the effective distribution of food was much more needed. So implementation of platforms which makes the food distribution is todays need.

1.3 Aim of Research study work

Our project aims to combat food wastage by creating an efficient platform that connects NGOs with surplus food providers through the use of the K-Nearest Neighbors (KNN) algorithm by considering the food type and shelf life, this system ensures timely and safe distribution of surplus food to communities in need.

1.4 Objective and Scope of the work

The objectives of this project include:

a) Develop a user-friendly platform that facilitates seamless communication and collaboration between NGOs and food providers, allowing surplus food to be efficiently distributed to communities in need.

b) Implement the K-Nearest Neighbors (KNN) algorithm to match surplus food with the most suitable NGOs, ensuring that food reaches those who need it the most.
c) Incorporate a feature into the platform that considers the shelf life of donated food, ensuring that it is still fresh and safe for consumption by considering expiration dates or the remaining time until the food is no longer edible.
d) Reduce food wastage by allowing surplus food from restaurants and other providers to be distributed among multiple NGOs, ensuring that no food goes to waste.

1.5 Organization of the project

This project tackles the global challenge of food waste by establishing a streamlined connection between food donors and NGOs utilizing innovative technology. Whilehunger and malnutrition persist worldwide, a significant amount of edible food goes to waste. Our solution proposes a user-friendly platform built with the MERN stack (MongoDB, Express.js, React.js, and Node.js) that leverages the K-Nearest Neighbors (KNN) algorithm for efficient food donation management.

Project Structure:

i. **Needs Assessment and Data Collection:** We will begin with a comprehensive investigation into the global food waste landscape, specifically focusing on India, a major food producer facing unique challenges. Data will be collectedon food waste patterns, NGO capabilities, and recipient community needs.

ii. **Platform Development with MERN Stack:** Our team will leverage the MERN stack to develop a user-centric platform fostering seamless communication and collaboration between food providers and NGOs. MongoDB will provide a flexible database to store information on food donations, NGO profiles, and recipient needs. Express.js will facilitate server- side interactions, while React.js will create an intuitive user interface for smooth

navigation and data visualization. Node.js will act as the runtime environment for server-side functionality.

iii. **Intelligent Matching with KNN:** The platform will integrate the KNN algorithm to facilitate efficient food donation allocation. KNN will analyze factors like food type, location, NGO capacity, and recipient needs to match surplus food with the most suitable NGOs, ensuring timely delivery to those in need.

iv. **Prioritizing Freshness and Safety:** A core feature of the platform will be its focus on food safety. The system will consider the shelf life of donated items, ensuring only fresh and consumable food reaches recipients.

v. **Rigorous Testing and Iterative Improvement:** The platform will undergo rigorous testing to ensure functionality, scalability, and user-friendliness. Feedback from stakeholders, including food donors, NGOs, and recipient communities, will be actively incorporated to optimize the platform and enhance its effectiveness over time.

vi. **Deployment and Continuous Monitoring:** Following development, the platform will be deployed and its performance continuously monitored. Data on food donations, NGO interactions, and recipient feedback will be analyzed to identify areas for improvement and ensure the platform's ongoing impact in tackling food waste and food insecurity.

LITERATURE REVIEW

Christina Varghese.,[1] The literature review for the SeVa app research paper encompasses key areas such as food waste, hunger, sustainable development goals, AI, HCI, and Smart Cities. It explores existing research on global foodwaste and hunger issues, emphasizing the necessity for innovative solutions like SeVa. Additionally, it discusses how SeVa aligns with UN Sustainable Development Goals by facilitating food donation and waste reduction. The review delves into the intersection of AI and HCI in food systems, highlighting SeVa's role in optimizing distribution and enhancing user engagement. Moreover, it touches upon the concept of Smart Cities and how apps like SeVa contribute tomore efficient and sustainable urban living. Finally, it discusses mobile app development and user experience, showcasing SeVa's user-friendly interface and engaging functionalities. Through this synthesis, the literature review underscores the significance of SeVa in addressing food waste and hunger issues through a multidisciplinary approach.

Shinta Oktaviana R.,[3] The paper presents the development of the FoodX application, designed to connect food donors, humanitarian communities, and individuals facing hunger in Jakarta. The study involved analyzing existing social communities like Food Cycle, Foodbank of Indonesia, and Garda Pangan to gain insights into their operations and requirements. Using the Prototyping model, the application was developed with active user involvement throughout the process. The system caters to four user types: application managers, community managers, donors, and volunteers, each with specific roles. Feedback from 25 volunteers and 3 communities indicated that the system effectively addressed their needs and streamlined the food donation process. Suggestions for further improvement include collaborating with food safety experts and other NGOs, as well as integrating gamification elements to encourage more donations.

Ayesha Anzer.,[7] The paper explores a range of topics including real-time luggage tracking, smart plugs, food waste reduction, greenhouse gas emissions, and antimicrobial agents for food packaging. It emphasizes the importance of reducing food waste and its environmental impacts. Additionally, the study focuses on a mobile app designed to facilitate food donations from restaurants to those in need, with features for user registration, item viewing and adding, and checkout, with potential enhancements for GPS location, meal sharing details, and multi-platform support.

Dongkuan Xu.,[9] This paper dives deep into the world of clustering algorithms, a crucial tool in data science. It explores both traditional methods, like the well- known k-means algorithm, and modern techniques designed for handling complex data. The paper doesn't just throw algorithms at you, it also explains the fundamentals – how to measure distances between data points, how to evaluate the success of a clustering approach, and how complex each algorithm is in terms of processing power. It then breaks down traditional algorithms into three categories: partitioning, hierarchical, and fuzzy clustering. You'll learn the advantages anddisadvantages of each, along with what kind of data they're best suited for. Finally, the paper explores the exciting world of modern clustering techniques. It categorizes them into 10 groups and analyzes 45 commonly used algorithms, giving you a clear picture of their strengths and weaknesses when it comes to speed, scalability, and accuracy. To quench your thirst for even more knowledge, the paper also provides references for further exploration of specialized clustering techniques and their applications in various fields.

Monika Agrawal.,[10] This paper examines the issue of food loss and waste in India. Existing data on food losses are difficult to compare due to differences in measurement methods. It is essential to identify hotspots and critical points of loss in food supply chains using a standardized approach. However, there is a lack of empirical research on food waste, especially at the household level. The social, economic, and environmental impacts of food loss and waste in India remain largely unexplored. Furthermore, gender-disaggregated research on

food loss and waste is scarce, and it is not considered in the development of technology or management solutions.

Jingwen Sun.,[11] The research paper offers a detailed review of the kNN algorithm, focusing on its application in text classification. It covers various aspects, including the algorithm's development, implementation steps, advantages, and disadvantages. The paper also discusses the historical background of the kNN algorithm, mentioning its initial proposal by TM Cover and subsequent improvements leading to the kNN algorithm.In terms of technical content, the paper explains the principles of the kNN algorithm, such as calculating distances between data points and selecting the k-nearest neighbors for classification. It also discusses methods to reduce computational complexity and improve classification accuracy. Additionally, the paper explores the application of the kNN algorithm in text classification, highlighting its effectiveness in this task.Furthermore, the paper introduces the idea of clustering the training set text before applying the kNN algorithm, which can enhance execution efficiency. It also discusses establishing a document model for text mining, including preprocessing steps and the use of feature dictionaries for word segmentation.

Hema Krishnan., [14] The literature review of the paper compares different NoSQL systems, analyzes query performance, and discusses specific features of MongoDB. It includes studies on query performance, audit log management, and dynamic query form systems for MongoDB. The paper also highlights MongoDB's document-oriented storage, replication, high availability, and auto- sharding features. It emphasizes the flexibility of data models in MongoDB to support various storage needs. The growth of NoSQL databases is attributed to scalability, distributed partitioning, and a shift from relational databases. Additionally, MongoDB's use of BSON for document transfer is praised for its compatibility with modern programming methods and support for rich queries and indexes.

3.1 SYSTEM DESIGN

3.1.1 Class Diagram:

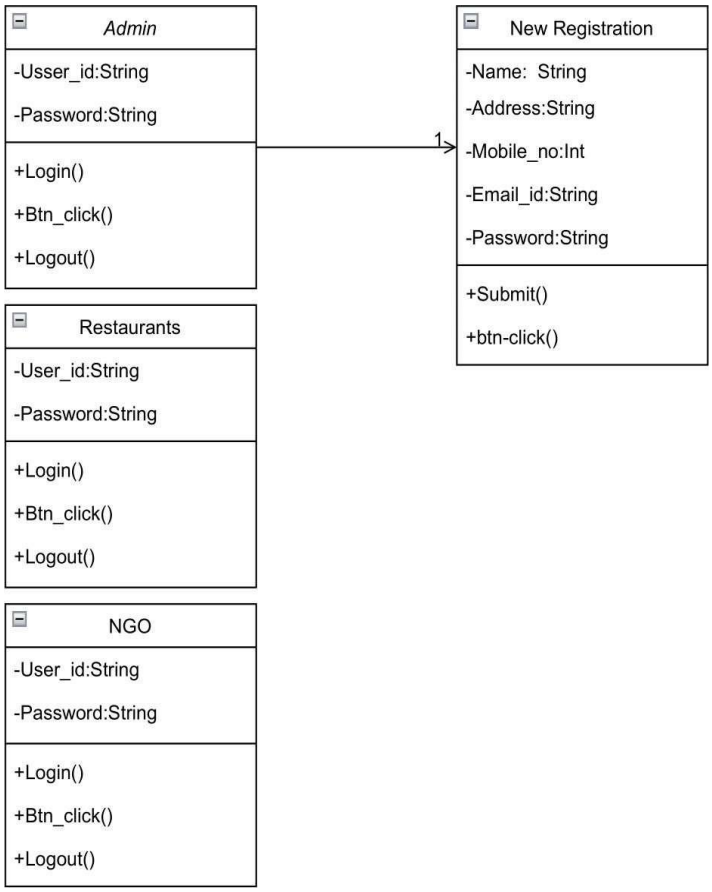

Fig 3.1.1: Class Diagram

Class diagram depicts a food donation web application with three main user classes: Admin, Donor(Restaurants), and NGO.

- **Admin:**
  - Attributes:
    - admin_id (unique identifier for the admin)
    - username (username for login)
    - password (password for login)

- Methods:

        - login() (authenticates the admin)
        - manage_users() (creates, edits, or suspends donor and NGO accounts)
        - manage_donations() (edits or cancels donation listings)

- **Donor:**
    - Attributes:
        - donor_id (unique identifier for the donor)
        - username (username for login)
        - password (password for login)
        - name (donor's name)
        - address (donor's address)
        - contact_info (phone number or email address)
    - Methods:
        - login() (authenticates the donor)
        - register() (creates a new donor account)
        - post_donation() (creates a new donation listing)
        - manage_donations() (edits or cancels donation listings)
        - track_donation_status() (views the status of their donations)

- **NGO:**
    - Attributes:
        - ngo_id (unique identifier for the NGO)
        - username (username for login)
        - password (password for login)
        - name (NGO's name)
        - address (NGO's address)
        - contact_info (phone number or email address)
    - Methods:
        - login() (authenticates the NGO)
        - register() (creates a new NGO account)
        - browse_donations() (searches for available food donations)
        - manage_requests() (accepts or declines donation requests from donors)

3.1.2 Use case Diagram:

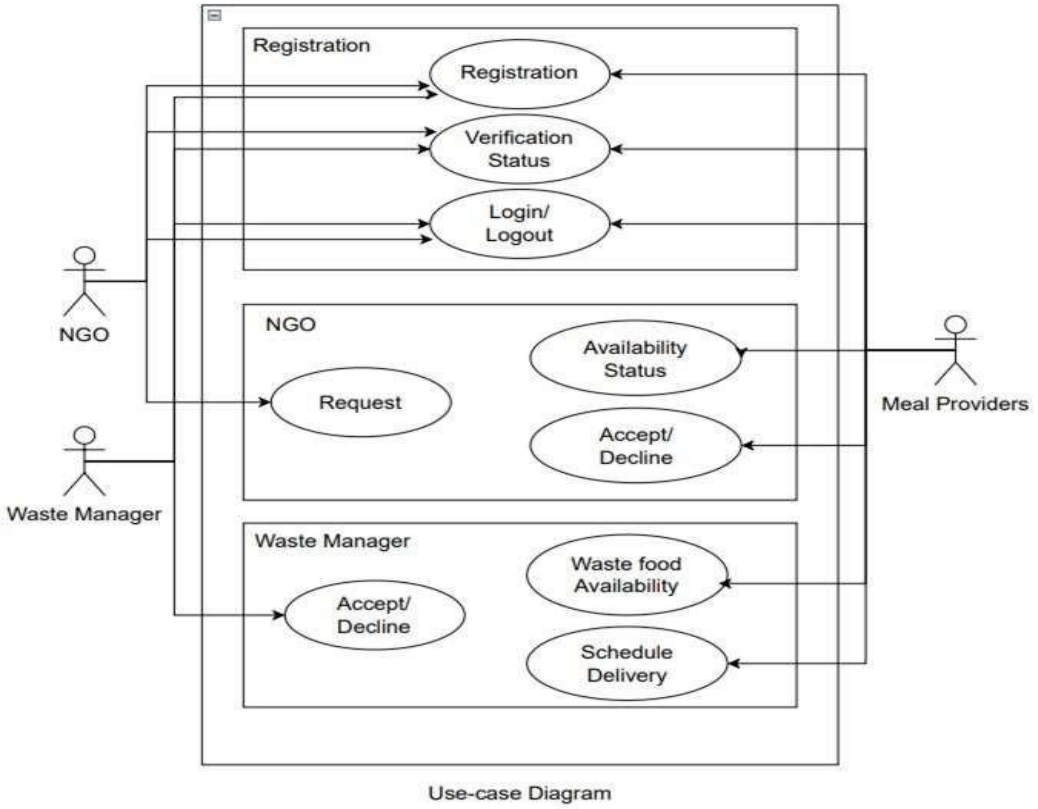

Fig 3.1.2: Use Case Diagram

Actors:

- Donor: An individual or organization willing to donate surplus food.
- Recipient (NGOs): The NGOs or organizations accepting donated food.
- Administrator (Admin) (Optional): A website manager overseeing website operations (account management, content moderation).

Use Cases:

- **Donor**
  - **Register/Login:** Create an account or log in to the website.
  - **Post Donation:** Provide details about the food being donated (type, quantity, expiry date, dietary restrictions).

- **Manage Donations:** Edit or cancel existing donation listings.
- **Track Donation Status:** View the status of their donation (pending, accepted, picked up).

- **Recipient Organization**
  - **Register/Login:** Create an account or log in to the website.
  - **Browse Donations:** Search for available food donations based on location, type, quantity, and expiry date.
  - **Manage Requests:** Accept or decline donation requests based on their needs and capacity.
- **Administrator (Optional)**
  - **Manage User Accounts:** Create, edit, or suspend user accounts (donors and recipients).
  - **Website Content Management:** Update website content, resources, and guidelines.
  - **Monitor Activity:** Track website usage and donation activity.

Relationships:

- Donors can post donations and browse recipient organizations.
- Recipient organizations can browse donations and manage requests from donors.
- The Administrator (if applicable) manages user accounts and website content and monitors overall activity.

3.1.3 Activity Diagrams:

3.1.3.1 Activity Diagram for Login:

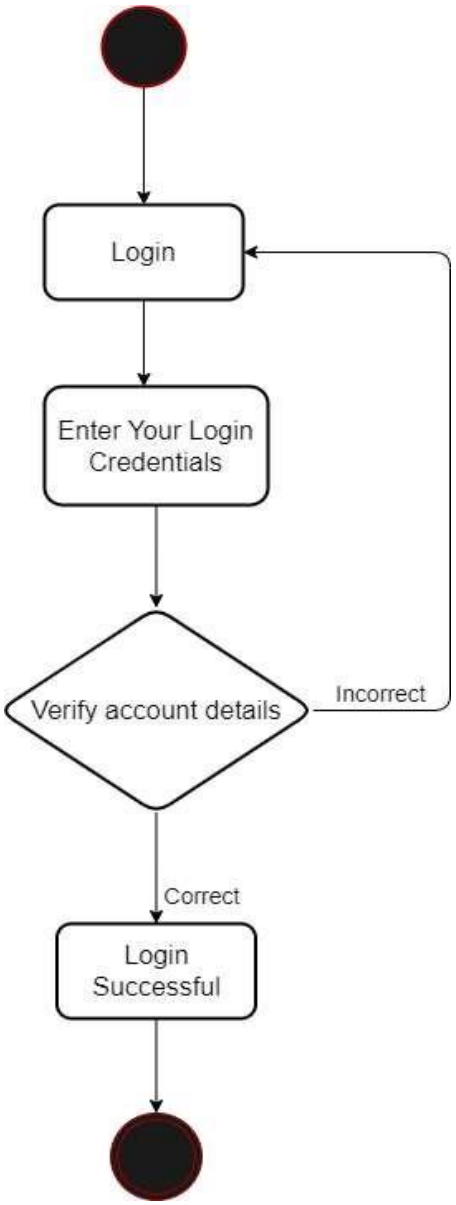

Fig 3.1.3.1: Activity Diagram for Login

3.1.3.2 Activity Diagram for Donors (Restaurants):

Fig 3.1.3.2: Activity Diagram for Donors (Restaurants)

3.1.3.3 : Activity Diagram for NGOs:

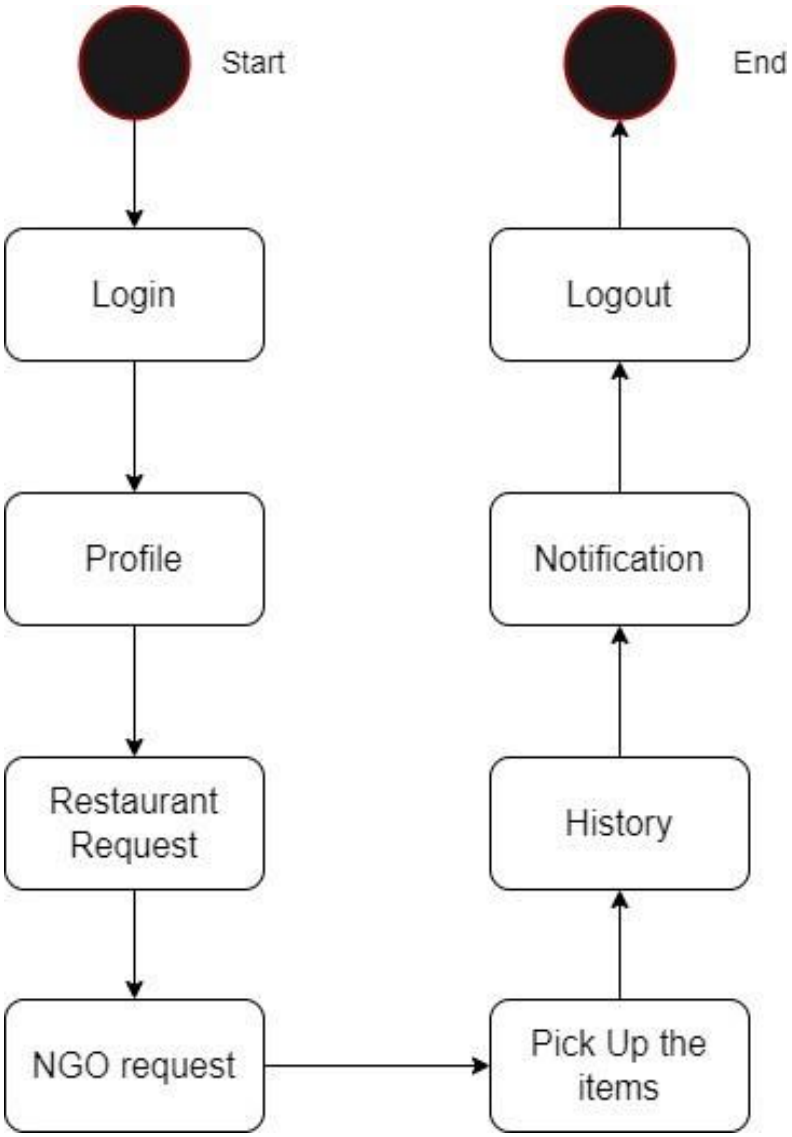

Fig 3.1.3.3: Activity Diagrams for NGOs

3.1.4. Sequence Diagrams:

3.1.4.1 : Sequence Diagram of Admin:

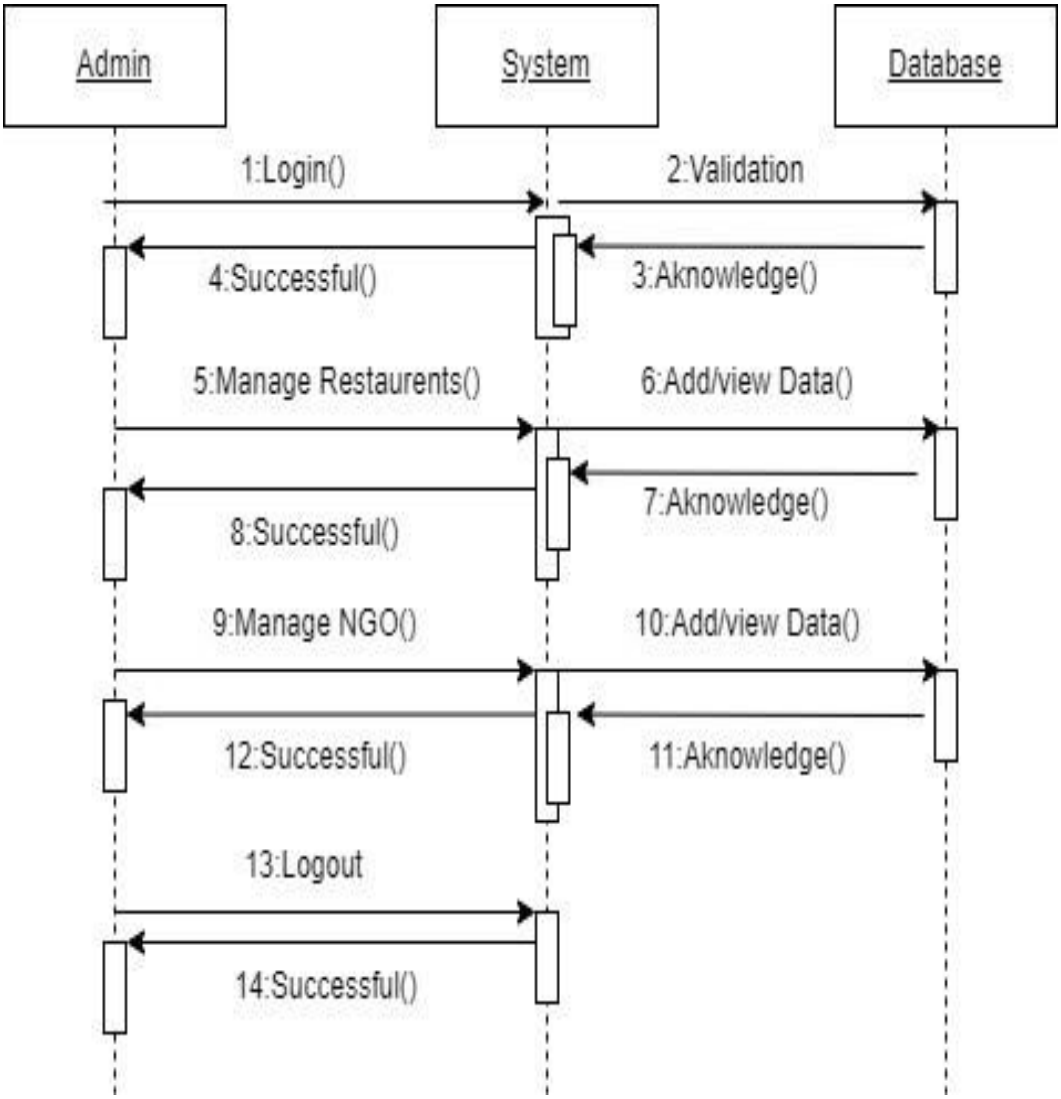

Fig.3.1.4.1:Sequence Diagram for Admin

3.1.4.2 : Sequence Diagram of Restaurants:

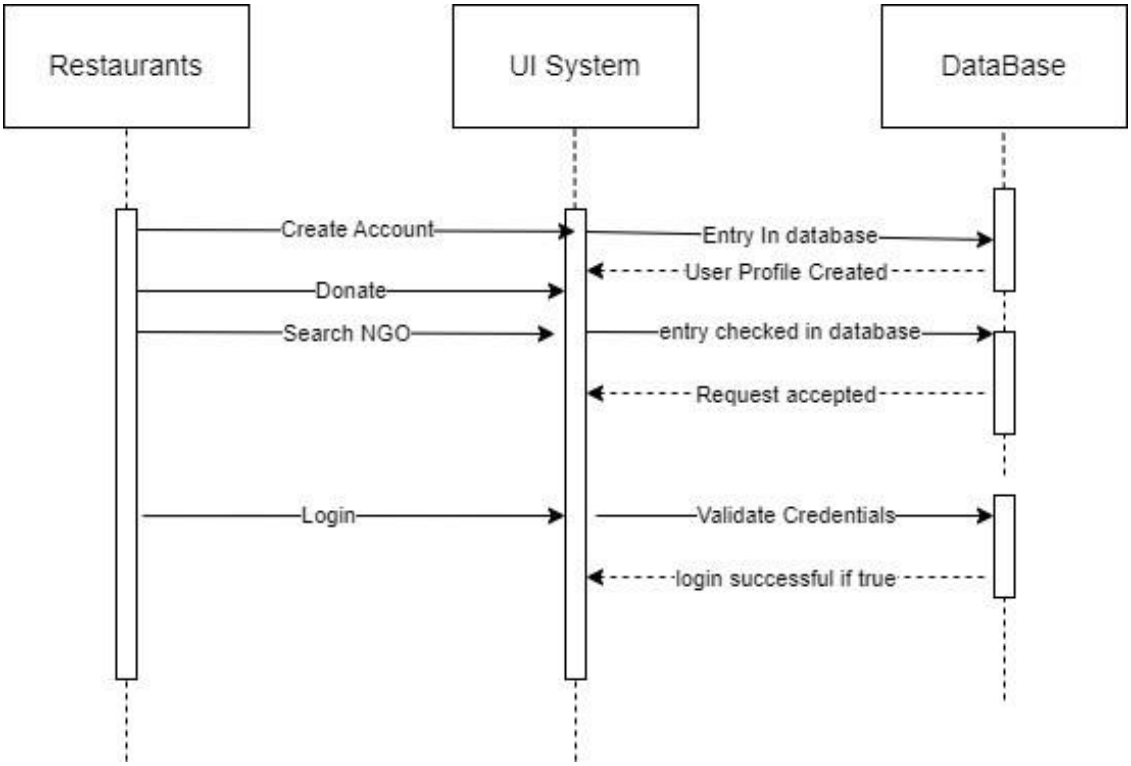

Fig.3.1.4.2: Sequence Diagram of Restaurants

3.1.4.3. Sequence Diagram of NGOs:

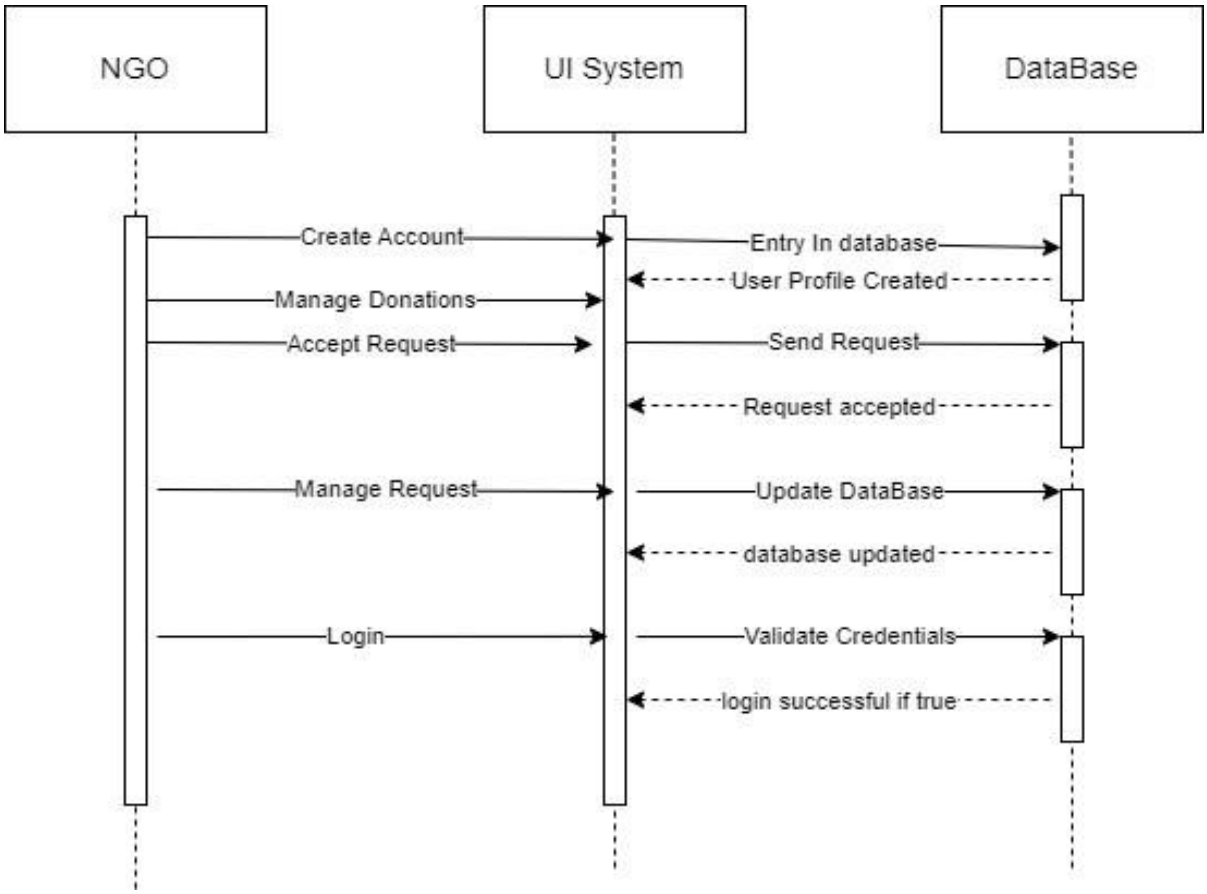

Fig.3.1.4.3: Sequence Diagram of NGOs

METHODOLOGY

4.1 Agile Software Development Model:

Agile software development methodology is an iterative and incremental approach to software development that emphasizes collaboration, flexibility, and continuous improvement. It's a stark contrast to traditional, waterfall-style development.

Agile Software Development Process:

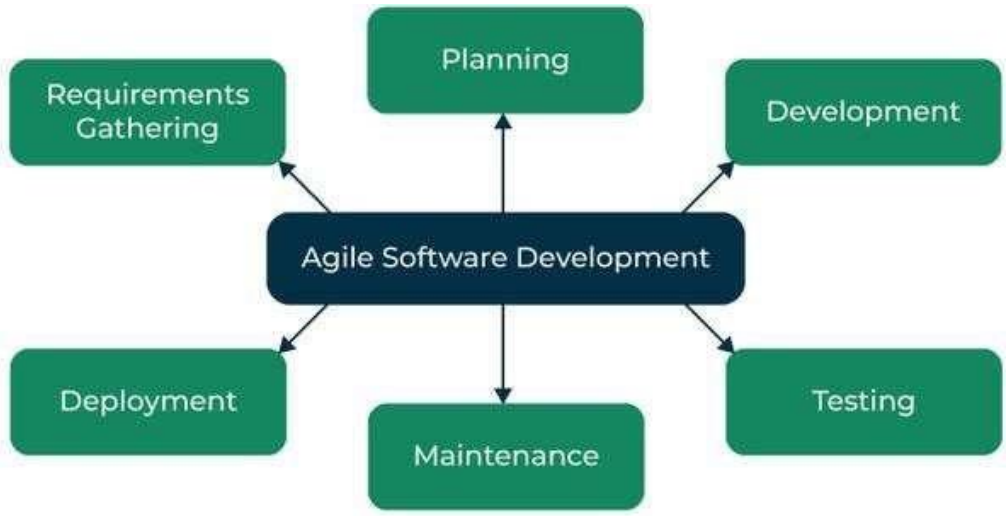

Fig 4.1: Agile Software Development

Requirements Gathering: First, we talk to the customer to find out what they want the software to do. We figure out what's most important to them.

Planning: Next, we make a plan for how we'll make the software. We decide what features to work on first and how long it will take.

Development: Then, our team starts making the software. We work on it in small chunks, making changes quickly.

Testing: After we've built something, we test it a lot to make sure it works like the customer wants. We want the software to be really good quality.

Deployment: Once everything is tested and works well, we put the software out there for people to use.

Maintenance: Finally, we keep an eye on the software to make sure it keeps working well. If the customer wants changes or finds problems, we fix them. We want to make sure they're happy with it.

4.2 Agile Software Development Life Cycle:

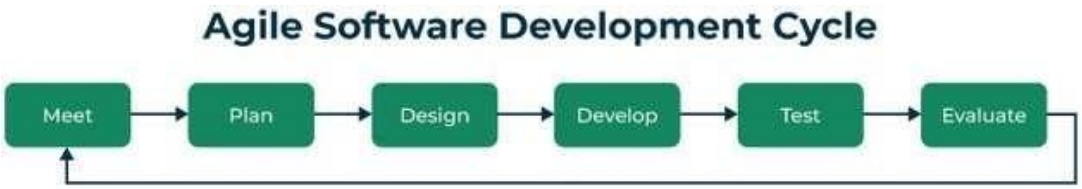

Fig 4.2: Agile Software Development Life Cycle

- Agile development is like building a Lego set. You start with a plan, then work on small sections at a time (iterations), adding more pieces as you go.
- Every day, you check in with your team to see how things are going. You keep testing and fixing any mistakes you find.
- Once a section is done, you show it to others for feedback and make improvements.
- This process continues until you've built the whole set, making adjustments along the way based on what you learn. Finally, you release the finished productand celebrate your accomplishment!

4.3 Working

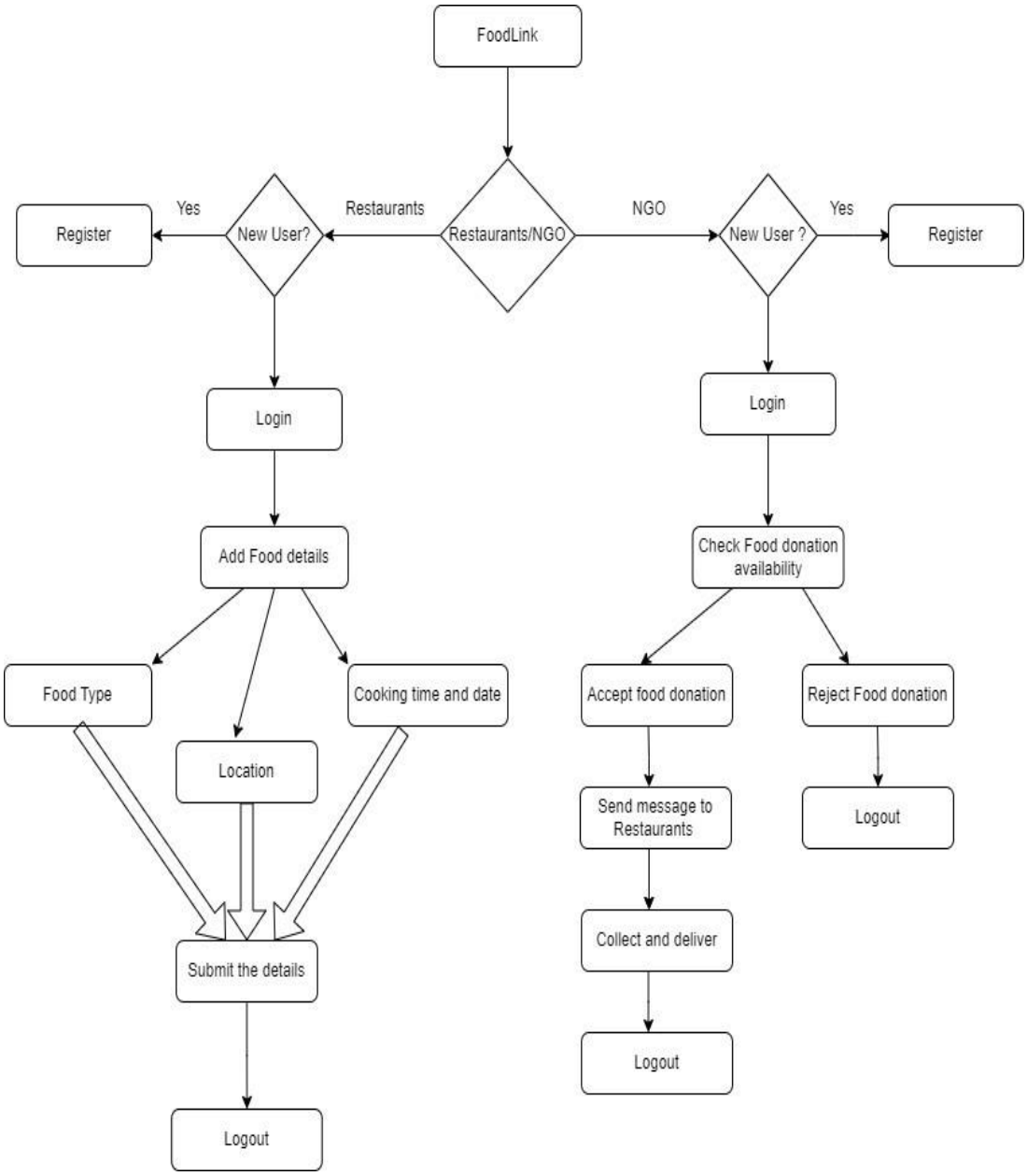

Fig 4.3: Flowchart

4.2 Project Implementation

We used Visual Studio code for Design and writing code for the project. Created and maintained all the databases in MongoDB. We used the ReactJs FrameWork for the UI design of the web Application. Used Nodejs, and Express JS as the Backend for the Functionality of Our FoodLink Web Application.

- **Hardware Requirement:**

  Laptop or PC:

  - I3 Processor-Based Computer or Higher
  - 1GB RAM
  - 5 GB Hard Disk

- **Software Requirement:**

  - Windows 7 or Higher
  - Visual Studio code
  - React js
  - Node Js
  - MongoDB
  - Express Js
  - Git & GitHub

- **Dataset:**

  This project utilizes data sourced from two reputable platforms: NGODarpan, an official government website providing information on NGOs, and Kaggle, a well-known platform for datasets, particularly restaurant data. By leveraging NGO Darpan, comprehensive details regarding NGOs were acquired, while Kaggle furnished diverse restaurant datasets. Focusing on Pune as an example, the project compiled location-specific data for NGOs and restaurants, ensuring precise insights upon integration into the algorithm. This meticulous approach to data acquisition and utilization enhances the project's implementation, facilitating informed decision-making and yielding impactful outcomes.

Introduction to MERN Stack Technology:

MERN Stack: A Powerful JavaScript Web Development Stack

The MERN stack is a popular choice for building modern web applications. It's a collection of four powerful JavaScript technologies that work together seamlessly to create dynamic and interactive user experiences. Let's break down each component of the MERN stack:

M - MongoDB:

MongoDB serves as the database management system for our project. It stores data related to NGOs, restaurants, food donations, user accounts, and any other relevant information. MongoDB's flexibility allows for the storage of JSON-like documents, making it suitable for handling diverse data types in our application.

E - Express.js:

Express.js is used as the web application framework for Node.js. It facilitates thecreation of robust and scalable server-side applications by providing a set of features and middleware. Express.js handles routing, middleware integration, and request/response handling in your backend API.

R - React.js:

React.js is the frontend JavaScript library used to build the user interface of our application. It enables the creation of dynamic and interactive UI components, allowing for a seamless user experience. React.js components are modular and reusable, making it easier to maintain and scale your frontend codebase.

N - Node.js:

Node.js serves as the backend runtime environment for our application. It allows JavaScript to be executed on the server-side, enabling the development of full-stack applications using a single programming language. Node.js handles server-side logic, database interactions, and API endpoints in our application.

Project:

4.2.1 Landing page: The landing page serves as the entry point to our platform, offering a welcoming and intuitive interface.

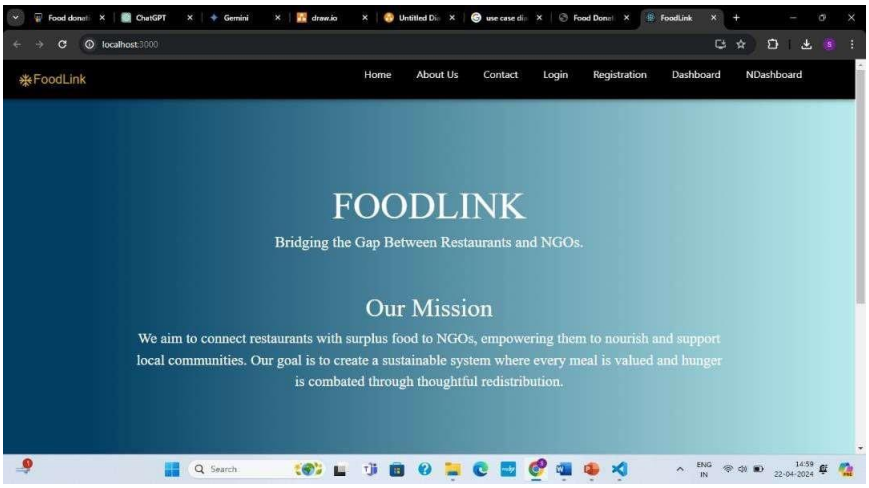

Fig 4.2.1 Dashboard

4.2.2 Registration form for the NGOs and Restaurants: Our registration forms are designed to capture essential information from NGOs and restaurants wishing to participate in our food redistribution initiative. These forms ensure a streamlined onboarding process, collecting details such as organization name, contact information, and location.

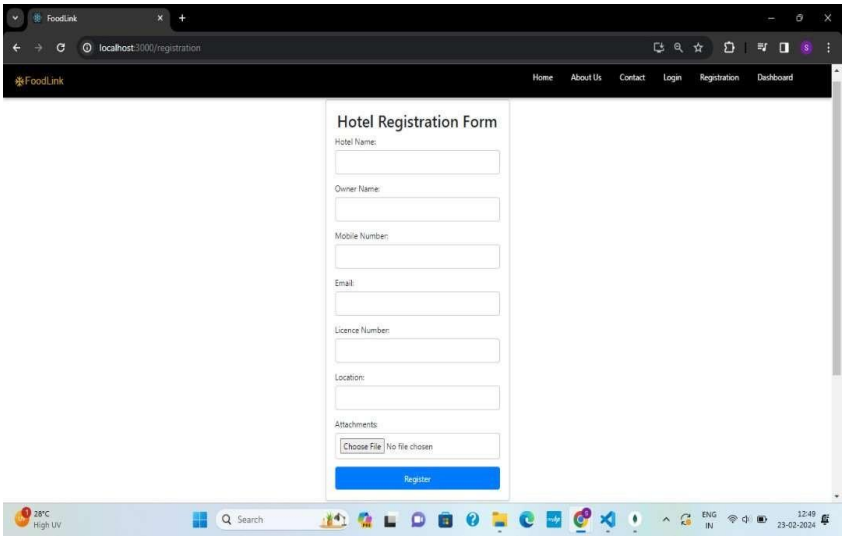

Fig 4.2.2 Hotel Registration

4.2.3 DataBase: Behind the scenes, our platform leverages MongoDB to store data in a JSON-like format. This robust database system allows for efficient data management, ensuring that information on NGOs and restaurants is securely stored and easily accessible for matching processes.

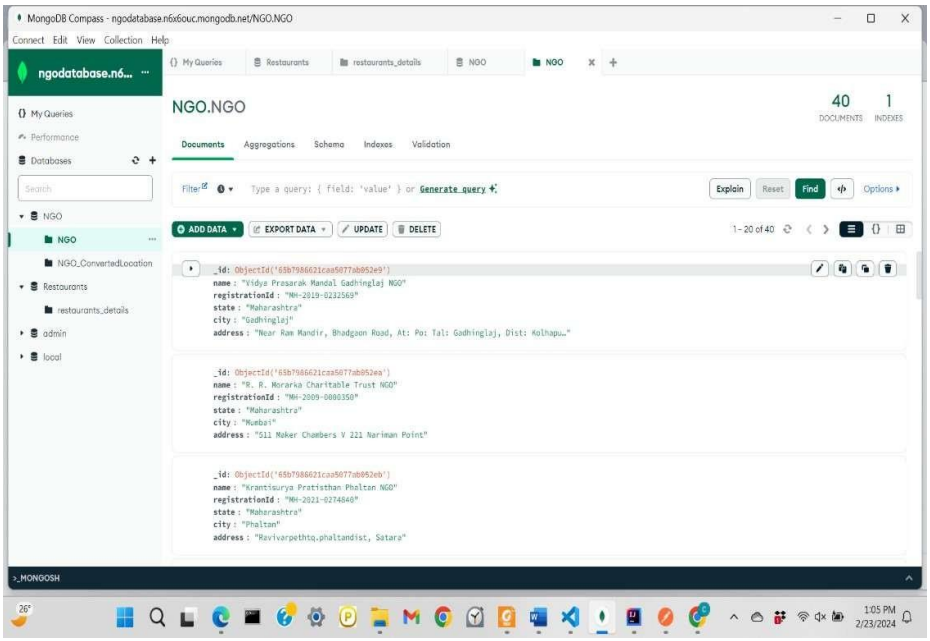

Fig 4.2.3 NGO Database

4.2.4 Hotel Dashboard: Upon logging in, hotel owners are presented with a comprehensive dashboard providing an overview of their account activities. This dashboard offers a snapshot of current donation listings, upcoming events, and recent interactions.

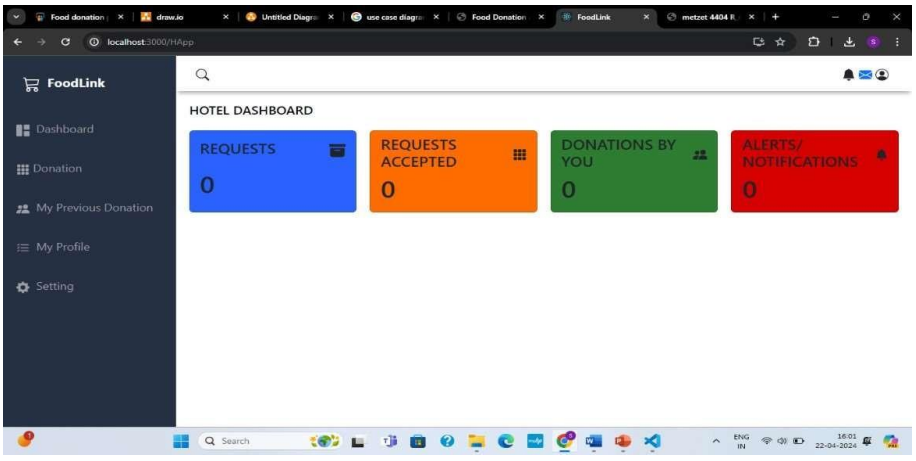

Fig 4.2.4.1 Hotel Dashboard

Within the hotel dashboard, the 'Donation' tab allows restaurants to contribute surplus food items to the platform. Here, restaurants can list available items along with details such as quantity, expiration time, and other relevant information. This streamlinedprocess simplifies food donation efforts for our partners**.**

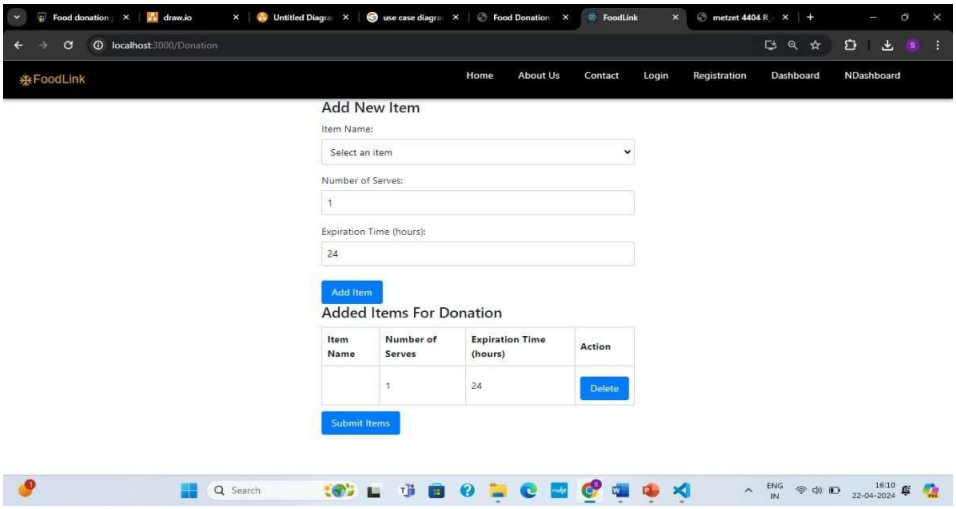

Fig 4.2.4.2 Hotel Add item

4.2.5 NGOs Dashboard: NGOs accessing our platform are greeted with a dedicated dashboard tailored to their needs. The NGOs dashboard provides a centralized hub for accessing nearby restaurants, managing donations, and coordinating logistics for food collection and distribution.

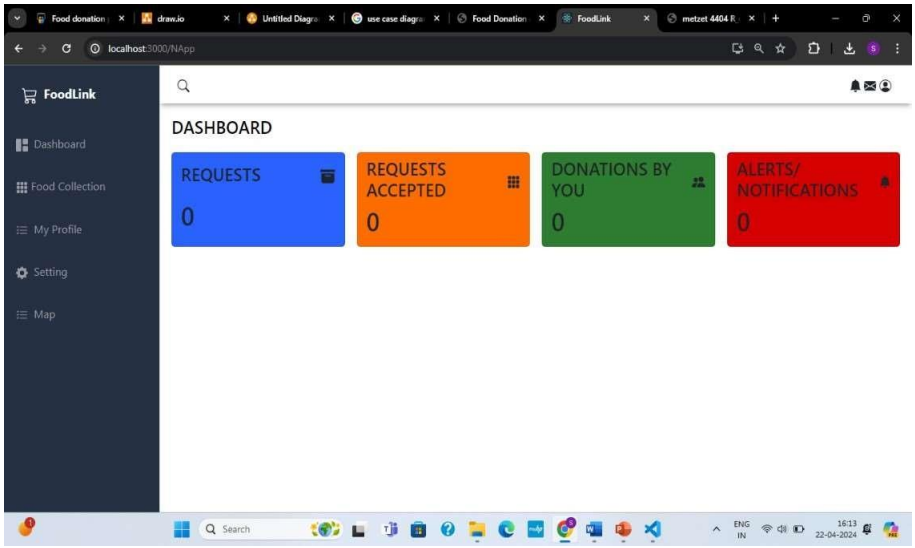

Fig 4.2.5 NGO Dashboard

4.2.6 Map: One of the standout features for NGOs is the 'Map' tab, which allowsthem to visualize nearby restaurants within their selected location. This interactive map feature enables NGOs to efficiently plan their food collection routes, ensuring timely access to donated items from local partners.

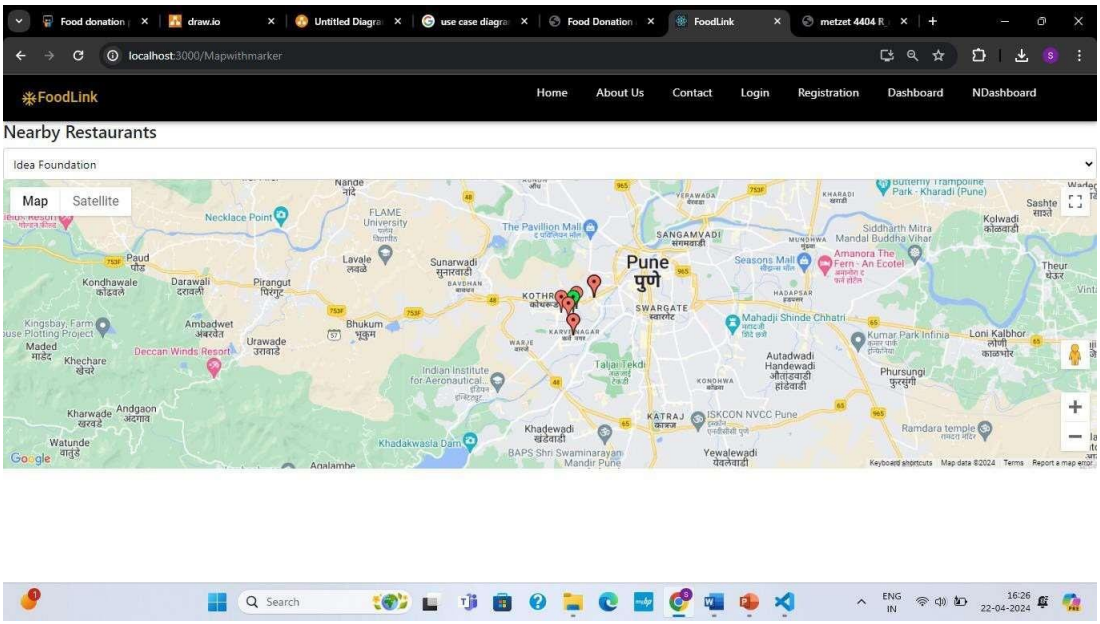

Fig 4.2.6 Map illustrating the location of NGO and restaurants

ALGORITHM

In today's world, food wastage is a significant issue, with millions of tons of edible food being discarded annually while millions of people worldwide suffer from hunger and malnutrition. In response to this pressing challenge, our project aims to bridge the gap between surplus food and those in need by developing a platform that facilitates the efficient redistribution of leftover edible food from restaurants to NGOs serving vulnerable communities.

Our project focuses on creating a platform that enables NGOs to collaborate with nearby restaurants to collect leftover edible food and distribute it to individuals in need. Central to the success of our platform is the ability to identify and connect NGOs with restaurants in close proximity to each other, thereby minimizing transportation costs and ensuring timely delivery of surplus food.

5.1 Role of KNN Algorithm

To achieve this goal, we have implemented the K-Nearest Neighbors (KNN) algorithm, a versatile machine learning technique, as a core component of our platform. The KNN algorithm plays a pivotal role in helping NGOs locate nearby restaurants with surplus edible food that can be collected for redistribution. By leveraging the KNN algorithm, our platform provides NGOs with real-time information on the nearest restaurants, streamlining the food collection process and maximizing the utilization of surplus food resources.

5.2 Significance of KNN Algorithm

The decision to utilize the KNN algorithm stems from its simplicity, effectiveness, and adaptability to our project's requirements. Unlike traditional approaches that rely on predefined geographical boundaries or manual searches, the KNN algorithm offers a data-driven solution that dynamically identifies the closest restaurants based on the NGO's location. This data-driven approach enhances the efficiency and accuracy of food redistribution efforts, ultimately contributing to the reduction of food waste and alleviation of hunger in our communities.

5.3 Working of KNN

The K-Nearest Neighbors (KNN) algorithm is a versatile machine learning technique used for both classification and regression tasks. At its core, KNN operates on the principle of proximity, where a data point's class or value is determined by the majority class or average value of its K nearest neighbors in the feature space. In the context of our project, the KNN algorithm aids in identifying nearby restaurants for food collection by NGOs based on their geographical coordinates.

The KNN algorithm involves several key parameters that influence its behavior and performance:

K (Number of Neighbors): K represents the number of nearest neighbors to consider when making predictions. Selecting an appropriate value for K is crucial, as it directly impacts the algorithm's bias-variance trade-off. A smaller value of K may result in a more flexible decision boundary but could lead to overfitting, while a larger value of K may result in a smoother decision boundary but could lead to underfitting.

Distance Metrics: KNN relies on distance metrics to measure the similarity or dissimilarity between data points. Common distance metrics include Euclidean distance, Manhattan distance, and Minkowski distance. The choice of distance metric depends on the nature of the data and the problem domain. In our project, we employthe Haversine formula, a specialized distance metric for geographical coordinates, to calculate the distance between NGOs and restaurants accurately.

Haversine Formula for Distance Calculation:

One of the fundamental aspects of our implementation of the KNN algorithm is the utilization of the Haversine formula for distance calculation. The Haversine formula is a mathematical formula used to calculate the distance between two points on the surface of a sphere, such as the Earth. Given the latitude and longitude coordinates of two locations, the Haversine formula computes the shortest distance (great-circle distance) between them, taking into account the curvature of the Earth's surface.

The decision to employ the Haversine formula aligns with our project's requirement to accurately determine the proximity of NGOs to nearby restaurants. By leveraging the Haversine formula, we can precisely calculate the geographical distance between the

coordinates of NGOs and restaurants, enabling the KNN algorithm to identify the nearest restaurants for food collection.

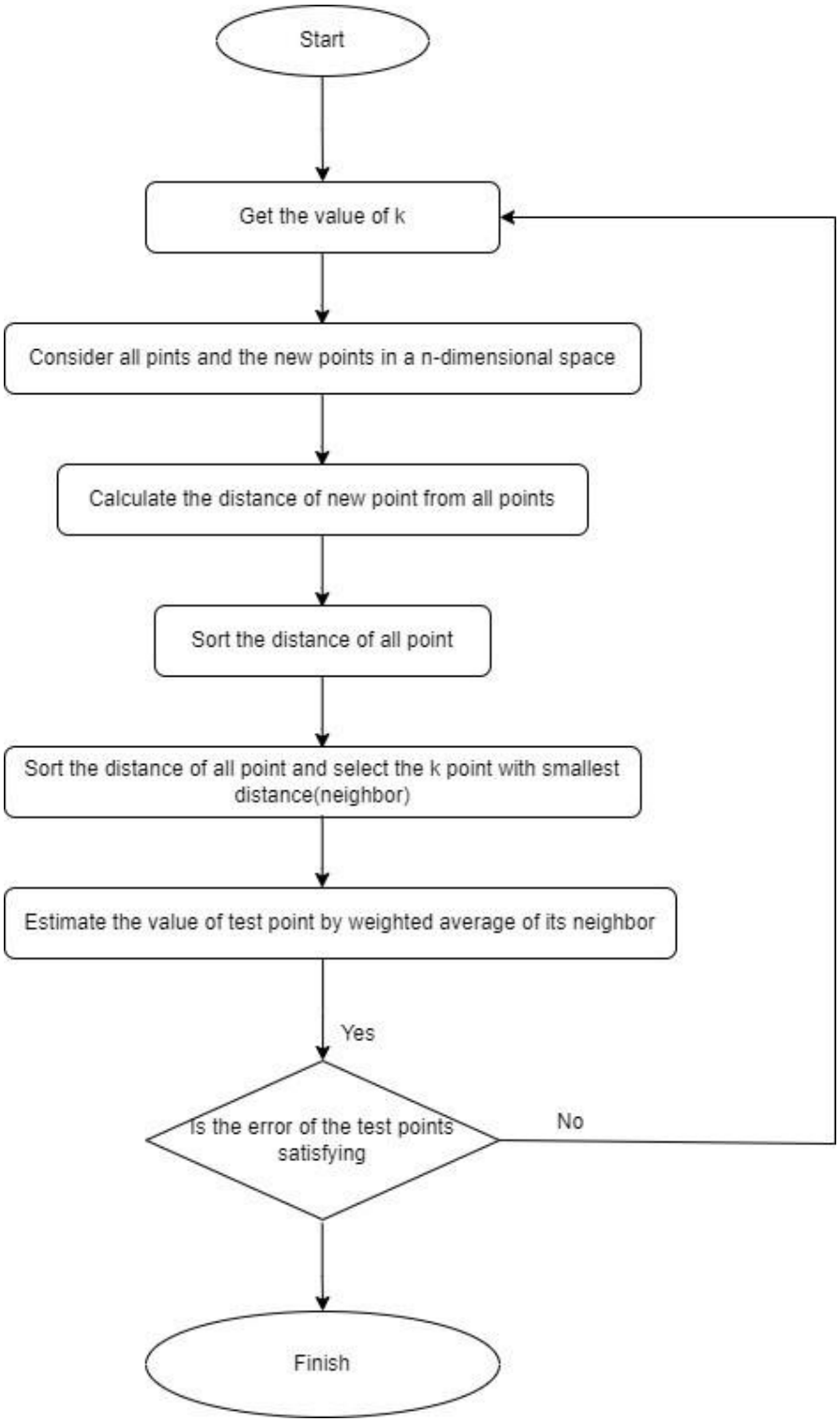

Fig 5.3 Algorithm Flowchart

5.4 Implementation

Data Preprocessing

In the data preprocessing stage, we leverage the Google Maps API key to geocode addresses and convert them into latitude and longitude coordinates. This process ensures that all relevant addresses, even those not present in the provided CSV files,can be accurately represented in the geographical space. The geocoded coordinates are then stored in our database for further processing.

Algorithm Implementation

The core of our food redistribution platform lies in the implementation of the K-Nearest Neighbors (KNN) algorithm. Below is a pseudo-code representation of the key steps involved:

```
# Pseudo-code for KNN Algorithm Implementation

# Define a function to find nearest restaurants for a given NGO
def find_nearest_restaurants(address, k, location):
    # Convert the NGO location to a numpy array with shape (1, 2)
    ngo_location_np = np.array(address).reshape(1, -1)

    # Initialize and fit the NearestNeighbors model
    knn = NearestNeighbors(n_neighbors=k)
    knn.fit(location)

    # Find the k nearest neighbors
    distances, indices = knn.kneighbors(ngo_location_np)

    # Return the indices of the k nearest restaurants
    return indices[0]
```

This pseudo-code outlines the process of finding the k nearest restaurants based on the geographical coordinates of NGOs and restaurants.

Integration with the Project

To integrate the KNN algorithm with our web-based platform, we utilize React.js for frontend development. The Mapwithmarker component serves as the interface forusers to interact with the platform, allowing them to select an NGO from a dropdown menu and visualize nearby restaurants on a Google Map. Asynchronously fetching data from the backend server enables real-time updates and seamless user experience.

The Google Maps JavaScript API facilitates map rendering, while HTTP requests to the backend server fetch data, including NGO locations and nearby restaurants. Any user address not present in the provided CSV files can be dynamically geocoded using the Google Maps API key, ensuring comprehensive coverage and accurate representationof geographical data.

K-Nearest Neighbors (KNN) algorithm is used to address the crucial task of identifying the nearest restaurants to NGOs for efficient food collection and distribution. The KNN algorithm, known for its simplicity and effectiveness in spatial proximity tasks, was a fitting choice for our objective of optimizing the logistics of food redistribution.

Through the utilization of latitude and longitude coordinates, we harnessed the powerof the Haversine formula to calculate distances on a curved surface, ensuring accurate proximity measurements in real-world geographic spaces. The algorithm iteratively determined the k-nearest restaurants to each NGO, providing a practical solution for NGOs to efficiently locate and collect leftover edible food.

RESULT AND DISCUSSION

Recommendations:

Table: 6.1

Restaurant Name	Location	Latitude	Longitude
Desi Aroma	Aditi Mall, Baner, West Pune	18.5583427	73.7926375
The Asian Box Resto Bar	Siddh Icon Building, Baner, West Pune	18.5575038	73.7921847
Kerala Cafe	Parvatibai Dhondiba Dhankude Complex, Baner, West Pune	18.5608205	73.7860485
The Quick Wok	Regent Plaza, Baner, West Pune	18.5523154	73.7930752
TTF - The Tenth Floor	Deron Heights, Baner, West Pune	18.5545317	73.7983221

Precision@5: 0.6

The precision metric of 0.6 indicates that 60% of the recommendations were relevant to the user's location.

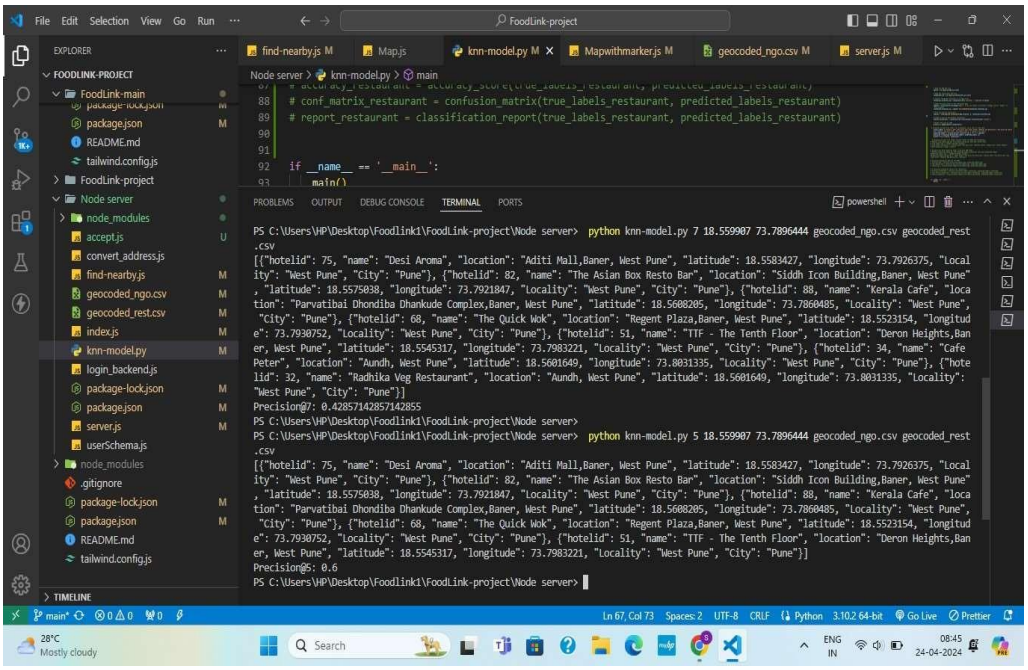

Fig 6.2 Precision

Calculating Precision@5

Precision@K is calculated as the number of relevant items recommended in the top K suggestions divided by K. For your scenario, the formula is:

$$\textbf{Percision@5} = \frac{\textbf{Number of relevant restaurants in top 5}}{\textbf{5}}$$

Given a Precision @5 of 0.6, this means:

Number of relevant restaurants=0.6×5=3Number of relevant restaurants=0.6×5=3

This suggests that 3 out of the 5 restaurants recommended by your KNN model are considered relevant to the user's needs or preferences.

CONCLUSION AND SCOPE FOR FUTURE WORK

7.1 CONCLUSION

Our food redistribution platform represents a pivotal stride in combating food wastage while aiding vulnerable communities. Harnessing state-of-the-art technologies and the K-Nearest Neighbors (KNN) algorithm, our interface empowers NGOs with real-time insights into surplus food availability across local restaurants. This strategic use of data allows NGOs to optimize their collection routes, minimizing waste and maximizing impact.

The seamless user interface ensures NGOs can effortlessly navigate the platform, making informed decisions on food collection with precision. The KNN algorithm, with its ability to calculate distances and locate the nearest resources, forms the backbone of our system's accuracy and efficiency. This fusion of technology and social responsibility lies at the core of our project.

In closing, the FoodLink project epitomizes the synergy between technology and social change. It's a testament to the power of digital innovation in addressing societal challenges, creating a more sustainable and equitable future for all.

7.2 SCOPE FOR FUTURE WORK

Waste Management Integration:

Enhancing the platform with waste management features to track and manage food wastage effectively. This could include analytics and reporting tools to identify areas for improvement in reducing food waste.

Multi-Language Support:

Implementing multi-language support to cater to a diverse user base. This enhancement will make the platform accessible to users from different linguistic backgrounds, fostering inclusivity.

Mobile Application Development

Developing a mobile application to complement the web platform, providing users with on-the-go access. A mobile app can offer additional features such as push notifications, GPS-based location services, and a more personalized user experience.

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Foodlink: Bridging Gaps Between NGOs and Hotels

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Abstract -- *An important goal in our world today is to eliminate food waste by reutilizing available food sources within the local communities: leftover food items in restaurants, stores, and food distribution centers that may be approaching expiration; and any perishable items not used in entirety within their desired period. Managing food presents significant challenges, impacting the environment, worsening hunger, and wasting valuable resources. According to the United Nations Sustainable Development Goals (UNSDGs), issues like hunger, illness, and early death have been increasing significantly. Some reasons for food waste at the local level include leftover food items in restaurants, stores, and food distribution centers that may be approaching expiration, and any perishable items not used in their entirety within their desired period [1]. It's not always about not having enough food; it's about making sure everyone can get the food that's there [2]. This paper presents "Foodlink", a collaborative approach between NGOs and hotels to effectively utilize surplus restaurant food by redistributing it to those in need, thereby contributing to food management efforts. The Foodlink facilitates registration for NGOs and hotels, enabling them to list available food and connect with verified partners. Additionally, the incorporation of KNN technology enhances the platform by identifying nearby hotels and restaurants, further streamlining the process.*

Keywords: Food management, Hunger alleviation, Web Application, Donors, NGOs, KNN

Introduction:

In a world where millions suffer from hunger and malnutrition, the issue of food wastage stands as a stark contradiction. Despite efforts to increase food production and distribution, a significant portion of the global food supply goes to waste each year. According to data from the World Health Organization (WHO), the proportion of people affected by hunger has been on the rise, with 3.1 billion individuals unable to afford a healthy diet in 2020. This trend continued into 2021, with 29.3% of the global population experiencing severe food insecurity. Projections suggest that by 2030, the number of people facing food insecurity may surge to 670 million.

India, as the world's second-largest food producer, contributes substantially to global food production, accounting for 10.04% of the total output. However, despite this contribution, the country grapples with a severe hunger problem, underscored by its Global Hunger Index (GHI) score of 28.7 in 2023. The Ministry of Agriculture in India estimates that the total cost of wasted food amounts to approximately 50,000 INR, highlighting the economic implications of food wastage.

The issue extends beyond national borders, with the United Nations Environment Programme (UNEP) revealing that Indian households alone waste a staggering 68.7 million tonnes of food. Moreover, reports from the National Development and Reform Commission (NDRC) shed light on the global scale of food waste, revealing that 40% of food produced in the United States is discarded annually, while Asia loses a staggering 1.34 billion tonnes of food each year.

Amidst this backdrop of escalating food insecurity and wastage, there emerges a pressing need for proactive solutions to address the root causes of food wastage while simultaneously meeting the nutritional needs of vulnerable populations. It is within this context that the proposed project seeks to intervene by establishing a systematic approach to collect and redistribute surplus food from restaurants to those in need.

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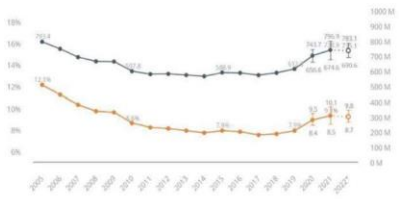

Fig1 : Graph representing Hunger faced by people[16]

By leveraging partnerships with restaurants, NGOs, and community organizations, the project aims to address the dual challenges of food wastage and hunger. Through timely collection and redistribution of surplus food, the project endeavors to prevent quality food from ending up in landfills and instead ensure it reaches the stomachs of those who need it most.

Furthermore, the project aligns with global efforts to achieve Sustainable Development Goal 2: Zero Hunger, by maximizing the efficiency of food distribution channels and promoting food security at the local, national, and global levels. By raising awareness, fostering partnerships, and implementing sustainable practices, the project aims to create a replicable model that can be adapted and scaled to address food wastage and hunger in diverse contexts worldwide. **Web development: Design and Implementation** ***A. Stakeholder:***

The Foodlink app bridges the gap between two crucial players in the fight against food waste: restaurants and NGOs. Restaurants can easily share their surplus edible food, specifying the number of available portions. NGOs, on the other hand, can browse these offerings and quickly confirm their interest in collecting the food for distribution to those in need. This simple yet powerful connection between food donors and food recipients lies at the heart of our mission to ensure that good food nourishes people. ***B. Location and Distance:***

Our web application is designed to help NGOs locate nearby restaurants efficiently, saving them valuable time. Additionally, by enabling quick access to restaurants, the food collected can be utilized before it expires, ensuring its freshness and edibility.
Diagram 3.1 maps out the interactions between different entities in the Food Link project. This project aims to bridge the gap between restaurants and NGOs, facilitating the efficient redistribution of surplus food and minimizing waste. It envisions a collaborative network where NGOs, food businesses, and **waste management specialists** work together to find sustainable solutions for food waste. This futureoriented approach could involve exploring options like composting services or anaerobic digestion facilities, creating a more comprehensive waste reduction system.

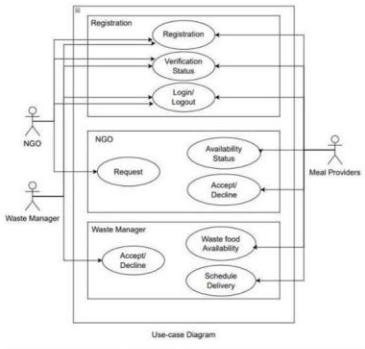

Fig 2: Use-case diagram

1. Landing Page of Foodlink

The Foodlink homepage greets user with an inviting, interface, featuring vibrant imagery and intuitive navigation options. It serves as the gateway to a platform designed to bridge the gap between NGOs and restaurants. Its purpose is to facilitate the repurposing of surplus food and reduce waste. Clear calls to action encourage user to explore the site's functionalities and engage in the mission to combat food waste effectively.

Fig 2.1: Landing page

2. Dashboard

The Foodlink dashboard offers users a comprehensive overview of ongoing activities and engagements within the platform. It includes information on donation requests, real-time alerts, and timely actions. Through dedicated sections like "Requests Accepted" and "Donated By You," users can track their contributions and monitor the impact of their donations. This transparency and accountability feature empowers users

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to stay informed about the outcomes of their efforts in combating food waste and supporting communities in need. Integrated alerts and notifications ensure that users receive timely updates, reminders, and opportunities for further engagement, creating a

dynamic and responsive ecosystem focused on sustainable food redistribution and social impact.

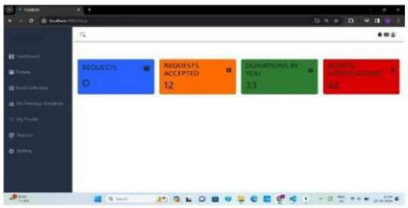

Fig 2.2: Dashboard

3. *Hotel Registration*

Hospitality establishments keen on joining the initiative can do so seamlessly through Foodink's hotel registration form. Designed for user convenience, this form captures essential details such as hotel name, location, and contact information. By simplifying the onboarding process, Foodink encourages hotels to actively contribute to food waste reduction efforts.

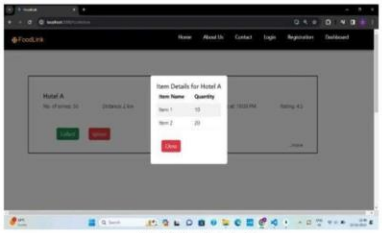

Fig 2.3: Hotel data

4. *NGO Database*

Within the Foodlink platform lies a comprehensive repository—the NGO database. Here, participating non-governmental organizations committed to food waste reduction initiatives find their place. Detailed profiles of each NGO reveal their mission statements, areas of operation, and contact information. Users can easily browse through this database, identifying potential partners or beneficiaries for surplus food distribution. This fosters collaboration and synergy among stakeholders in the fight against hunger and waste.

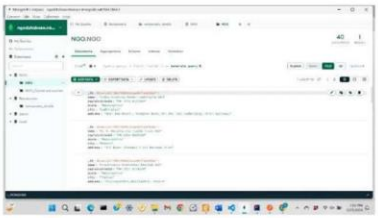

Fig 2.3: Database

Algorithm:

The uses of KNN:

The integration of the K-Nearest Neighbors (KNN) algorithm within our platform represents a significant stride towards enhancing the streamlined distribution of surplus food from dining establishments to NGOs serving vulnerable communities. KNN, esteemed for its simplicity and efficacy, presents a robust solution to address the spatial proximity challenge intrinsic to our project's objectives. By harnessing the geographical coordinates of both NGOs and culinary venues, KNN facilitates the identification of the nearest establishments with excess food stocks, thereby optimizing the logistics of food collection and redistribution. At the core of the KNN algorithm lies a fundamental yet potent principle: the classification or estimation of an unseen instance is determined by the majority o averaging of its nearest neighbors in the feature space. Applied within our context, this entails computing the distances between the coordinates of NGOs and dining establishments within a specified radius. Through the selection of the K closest venues, where K denotes a user-defined parameter reflecting the desired level of proximity, KNN generates a prioritized roster of potential food donors for NGOs to engage with.

What renders KNN particularly apt for our platform is its adaptability to accommodate a plethora of factors influencing the decision-making process. Beyond mere spatial proximity, KNN can seamlessly integrate additional considerations such as the quantity and quality of surplus food, the capacity of the dining establishment, and historical donation trends. This versatility empowers our platform not only to pinpoint nearby donors but also to make judicious choices regarding the optimal allocation of resources for maximal impact.

Moreover, the iterative nature of the KNN algorithm lends itself favorably to continual enhancement and

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refinement over time. As our platform amasses data on donation patterns, recipient needs, and donor preferences, KNN dynamically adjusts its recommendations to mirror evolving circumstances. This adaptive capability ensures that our platform remains attuned to the fluid landscape of food donation and distribution, thereby optimizing efficiency and efficacy in its operations.

Working of the web application:

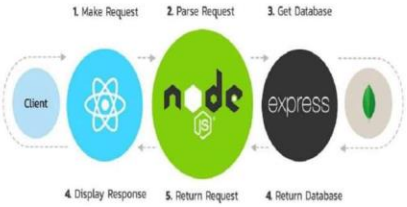

Fig 3.1[13]

K-Nearest Neighbour: Bridging the Gap Between NGOs and Restaurants

The K-Nearest Neighbors (KNN) algorithm is a versatile tool in machine learning, applicable to both classification (assigning categories) and regression (predicting continuous values) tasks. Its popularity stems from its simplicity and effectiveness, particularly for problems where the underlying data structure isn't readily apparent [12]. This makes KNN well-suited for real-world scenarios involving heterogeneous datasets, where data points come in various formats.

KNN leverages the intuitive principle of similarity: data points close together in feature space (think of it as a map of the data's characteristics) are likely to share similar characteristics. By capitalizing on this principle, KNN can predict the class or value of a new data point based on the labels of its closest neighbors in the training data [16].

A core concept in KNN is the parameter 'k,' which dictates the number of neighbours considered during prediction. Choosing an optimal k value is crucial for accurate results. When dealing with noisy data or outliers (extreme values), a higher k value is often preferred to reduce their influence. It's also generally recommended to use odd values for k to avoid classification ties (equal votes for categories).

Techniques like cross-validation can be employed to fine-tune k for a specific dataset.

Applying KNN to Connect NGOs and Restaurants:

Imagine a scenario where KNN is used to bridge the gap between Non-Governmental Organizations (NGOs) and restaurants. The algorithm would first analyze a dataset containing information about restaurants, such as their locations (latitude and longitude). When presented with the location of an unclassified NGO (new data point), KNN would identify its k closest neighbors within the existing dataset of restaurants (training data). This process relies on the assumption that NGOs positioned near known restaurants are likely to benefit from similar partnerships.

The distance metric employed by KNN, often Euclidean distance, calculates the proximity between the unclassified NGO location and all the restaurants in the training data. Subsequently, KNN selects the k closest restaurants based on these distances. Finally, the most common class label (restaurant type) among the k neighbors is assigned to the NGO, effectively recommending suitable partner restaurants for collaboration. Alternatively, for regression problems (predicting a value), the average value of a specific attribute (e.g., average meal price) can be computed among the k neighbors for prediction.

Integration and Impact:

Integrating KNN with a dedicated website can offer significant advantages for NGOs. By incorporating KNN functionality, the website can dynamically display a list of recommended restaurants closest to each listed NGO. Additionally, relevant details such as addresses and contact information for these restaurants can be readily provided, streamlining food pickup and delivery operations for the NGOs. This KNN-powered website can significantly enhance operational efficiency, allowing NGOs to better serve their communities.

KNN for Multi-Classification Problems:

KNN is particularly adept at handling multiclassification tasks, where data points can belong to multiple categories simultaneously. In such scenarios, KNN can outperform algorithms like Support Vector Machines (SVM) due to its superior ability to manage multi-modal datasets [15]. When dealing with objects possessing complex and diverse label assignments (belonging to multiple categories), KNN often demonstrates superior classification accuracy compared to SVM.

Addressing Potential Issues:

While KNN offers numerous advantages, it's essential to acknowledge potential limitations. The algorithm's performance can be impacted by the quality and dimensionality (number of features) of the data. Additionally, computational costs can increase significantly with large datasets due to the inherent need for distance calculations between all data points.

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By understanding these strengths and limitations, KNN can be effectively implemented in various applications, like the one presented here, fostering collaboration between NGOs and restaurants.

Conclusion

In conclusion, this paper has outlined the design, implementation, and evaluation of the FOODLINK website, aimed at facilitating efficient food donation by bridging the gap between NGOs and restaurants. Through its user-friendly interface and location-based system, FOODLINK contributes significantly to reducing food waste while aiding those in need. The incorporation of crucial details such as serving quantities and food expiration times enhances the effectiveness of the platform in facilitating meaningful food donations. Looking ahead, one potential avenue for future expansion could involve the integration of waste management professionals into the donation process. By involving waste managers, the platform could not only facilitate the donation of surplus edible food but also offer solutions for managing food waste that cannot be donated. This holistic approach would further contribute to sustainability efforts and maximize the impact of the platform.

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