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The Smart Food Waste Management System

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ABSTRACT
The Smart Food Waste Management System is a comprehensive platform designed to minimize food wastage by connecting food donors, NGOs, and delivery personnel through a web and mobile-based application. The system enables users to donate surplus food efficiently while ensuring it reaches those in need. Key features include real-time donation tracking, NGO coordination for food collection and redistribution, and seamless delivery task management. A chatbot is integrated to provide users with instant support and answers to frequently asked questions. The platform ensures a secure and user-friendly experience for all stakeholders by leveraging a robust backend, intuitive frontend interfaces, and a centralized database. The project emphasizes sustainability and social responsibility by reducing environmental impacts and promoting community well-being. Donors can input surplus food details via web or mobile interfaces, while NGOs and delivery personnel can manage pickups and deliveries effectively. The database maintains records of users, donations, and feedback, ensuring smooth operations and continuous improvements. With its scalable architecture and AI-driven chatbot, the system aims to revolutionize food waste management and contribute to global hunger reduction efforts.

1- INTRODUCTION

The Food Waste Management System is an innovative platform designed to address one of the most critical challenges of our times—food wastage. This system aims to create a bridge between food donors, NGOs, and delivery personnel, ensuring that surplus food is effectively managed and distributed to those in need. It employs a two-pronged approach: leveraging modern web and mobile technologies to facilitate easy food donations and using backend systems to coordinate food collection and redistribution. The system is designed to enhance collaboration among stakeholders while ensuring transparency, accountability, and efficiency. Food donors, including households, restaurants, and organizations, can report surplus food through an intuitive user interface. NGOs can access this information and coordinate with delivery personnel to schedule pickups and deliveries. Real-time tracking features ensure that every donation is accounted for and reaches its intended destination promptly. Additionally, the system incorporates a chatbot to assist users with queries, enhancing user experience and engagement. The backend architecture is robust, utilizing APIs to manage data exchange between the web/mobile applications and a centralized database. This database securely stores information on users, donations, feedback, and delivery records,
ensuring data integrity and privacy. By automating processes and providing real-time updates, the system reduces manual intervention and delays, making the redistribution process more efficient. The platform not only addresses logistical challenges in food donation but also promotes social responsibility and environmental sustainability. It aligns with the United Nations Sustainable Development Goals (SDGs), particularly Goal 2 (Zero Hunger) and Goal 12 (Responsible Consumption and Production). By reducing food wastage and redistributing resources effectively, the system helps combat hunger, improve resource utilization, and minimize the environmental impact of food disposal.

2- LITERATURE SURVEY

Title: IoT Based Food Waste Management System
AUTHORS: Sreeji S1 , Laya Rose Joseph 2 ,Sandhaya S 3 , Aiswarya P S 4 , Ravindra kumar5
Year: 2023
If you believe you can reduce the amount of food waste by analysing food waste for each individual and awarding Offer bonuses and prizes through reports generated by system. Wasting food is common among students today At university, hostels and at work. This creates great demand Due to future groceries, it may lead to food shortages future generations. Because food waste disposal is a long process. This paper has mainly focused on measuring food waste Offer rewards to users viewing real-time Everyone's Food Waste on Screens and Websites Reference to the future. This study is primarily focused on monitoring. Food loss for everyone. Our model proposes and creates it produce results

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in parallel, User about the amount of extra food each time. this helps Analyse and generate a list of users who fall into non-food groups Waste standards and reward their noble deeds. We can do it Automate processes manually or over the internet Things as central tools. Uses RFID sensors for monitoring personal waste. Can only be opened with RFID A map provided by the government. It basically automates how to determine the amount of local food waste

Title: IoT-Enabled Smart Waste Management Systems for Smart Cities: A Systematic Review
AUTHORS: Inna Sosunova; Jari Porras
Year: 2021
With urbanization, rising income and consumption, the production of waste increases. One of the most important directions in the field of sustainable development is the design and implementation of monitoring and management systems for waste collection and removal. Smart waste management (SWM) involves for example collection and analytics of data from sensors on smart garbage bins (SGBs), management of waste trucks and urban infrastructure; planning and optimization of waste truck routes; etc. The purpose of this paper is to provide a comprehensive overview of the existing research in the field of systems, applications, and approaches vis-à-vis the collection and processing of solid waste in SWM systems. To achieve this objective, we performed a systematic literature review. This study consists of 173 primary studies selected for analysis and data extraction from the 3,732 initially retrieved studies from 5 databases. We 1) identified the main approaches and services that are applied in the city and SGB-level SWM systems, 2) listed sensors and actuators and analyzed their application in various types of SWM systems, 3) listed the direct and indirect stakeholders of the SWM systems, 4) identified the types of data shared between the SWM systems and stakeholders, and 5) identified the main promising directions and research gaps in the field of SWM systems. Based on an analysis of the existing approaches, technologies, and services, we developed recommendations for the implementation of city-level and SGB-level SWM systems.

Title: Smart eNose Food Waste Management System
AUTHORS: Shazmina Gull, Imran Sarwar Bajwa, Waheed Anwar, Rubina Rashid
Year: 2021
The modern age is an era of fast-growing technology, all thanks to the Internet of Things. The IoT becomes a prime factor of human life. As in this running world, no one cares about the wastage of food. However, this causes environment pollution as well as loss of many lives. A lot of researchers help in this era by introducing some great and beneficial projects. Our work is introducing a new approach by utilizing some low-cost sensors. In this work, Arduino UNO is used as a microcontroller. We use the eNose system that comprises MQ4 and MQ135 to detect gas emission from different food items, i.e., meat, rice, rice and meat, and bread. We collect our data from these food items. The MQ4 sensor detects the CH_4 gas while the MQ135 sensor detects CO_2 and NH_3 in this system. We use a 5 kg strain gauge load cell sensor and HX711 A/D converter as a weight sensor to measure the weight of food being wasted. To ensure the accuracy and efficiency of our system, we first calibrate our sensors as per recommendations to run in the environment with the flow. We collect our data using cooked, uncooked, and rotten food items. To make this system a smart system, we use a machine learning algorithm to predict the food items on the basis of gas emission. The decision tree algorithm was used for training and testing purposes. We use 70 instances of each food item in the dataset. On the rule set, we implement this system working to measure the weight of food wastage and to predict the food item. The Arduino UNO board fetches the sensor data and sends it to the computer system for interpretation and analysis. Then, the machine learning algorithm works to predict the food item. At the end, we get our data of which food item is wasted in what amount in one day. We found 92.65% accuracy in our system. This system helps in reducing the amount of food wastage at home and restaurants as well by the daily report of food wastage in their computer system.

Title: IOT Based Smart Waste Management System **AUTHORS:** Gayathri N 1, Divagaran A R2 Akhilesh C D3, Aswiin V M4, Charan N5
Year: 2021
Nowadays, wasting food is common among the students in colleges, hostels, and workplaces. This results in a great demand for food products in the future, which may lead to food scarcity for future generations. As food waste management is tedious process. In this paper we have mainly focused on measuring the food waste and providing rewards for the users, where it shows the real-time food

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wastage of every individual on a screen and in a website for future reference. This research mainly focuses on monitoring the food wastage of everyone. Our model proposed over and create a parallel result to give a detailed report to the managing and the user about their amount of food excess each time. This helps to analyze and generate the list of user falls under the non-food wasting criteria and reward them for their noble act. We can do this either manually or automating the process using Internet of Things as a key tool. We use an RFID sensor to monitor the wastage of individuals. They can be opened only by using the RFID card provided by the management. Basically, we are automating the method of identifying the amount of food wastage in the areas, where we are sure that the amount of food waste can be decreased by the analysis of food wastage by every individual and awarding them with rewards and prices by the reports generated by the system.

Title: Smart Management of Food Storage and Waste Reduction
AUTHORS: Thayagarajan M, Gurunadhan B, Dileep Kumar B, Ankitha K, Bhuvaneshwar P, Divya Sree C
Year: 2022

In the era of technology advancement, everything requires monitoring and controlling. This project proposes an IoT background for facilitating food monitoring for protection of the food, so that it would not get contaminated due to surrounding conditions during storage and transportation. In present scenario, the work done is in terms of the sensed value that have been recorded and a detailed analysis has been performed but automated controlled alternatives are not present. The proposed solution analyzes temperature, moisture, light as these parameters affect nutritional values of food items such as fruits and vegetables, and makes the analysis results accessible to the user via a mobile application (SMS). A web server is used for storage of data values sensed in real time and also for analysis of results.

3- METHODOLOGY

Food Waste Management System When it comes to deployment, Food Waste Management System's process takes a guided path through the development and operation. It commences from requirement analysis to identify food wastage problem and stakeholder requirements. The system design is as follows and describes components such as User, Admin, and Delivery, along with a database design based on these components. I chosen the tech stack as HTML, CSS, JavaScript for frontend while PHP for backend and MySQL for the database and XAMPP as my local server. Each module is designed to serve different purposes: users donate food, admins control requests, and delivery are responsible for logistics. Match-making programs are run in order to match donors with local NGOs, and feedback and authenticating algorithms are running in the background for secure login and for service quality metrics. Unit testing, as well as integration and acceptance tests, ensure the functionality and performance of the application. Once the system has been tested, it deployed locally using XAMPP and connected to a MySQL database. Maintenance to do – keep systems healthy and features up to date. User feedback is constantly parsed through and processed

1. **Requirement Analysis:**
   - Problem identification: Examined the issue that many restaurants, hotels and event produce surplus food while people go hungry.
   - Stakeholder Requirements: Collected requirements from donors, NGOs and delivery drivers; designed a system that links the three in a cost-effective way. Discuss the problem of excessive wastage of food in places such as restaurants, hotels, marriage halls. Define System Goals Reduce waste Allow food to be donated effectively Track deliveries.

2. **System Design:**
   - The system includes three main modules: User, Admin, and Delivery. This helps to clearly separate functionality.
   - Database Schema: Designed tables to securely store donation details, user information, delivery tasks, and feedback.
3. **Technology Stack Selection:**
   - Tools Used: Chose HTML, CSS, JavaScript for frontend, PHP for backend, and MySQL for the database.
   - Development Environment: Used XAMPP as a local server for easy testing and integration of web and database components.

4. **Module Development:**
   - User Module: Allows donors to register, login, and submit food

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donation details like type, quantity, and location.
- Admin & Delivery Modules: Admins manage donations and assign deliveries; delivery persons view tasks and complete pickups.

5. **Algorithm Implementation:**
   - Matching Algorithm: Matches donors with the most suitable NGO based on location, quantity, and food type.
   - Feedback & Authentication: Ensures secure login for all users and analyzes ratings/comments to improve service quality.
6. **Testing:**
   - Functionality Testin: Tested forms, logins, database connections, and role-specific features for smooth operation.
   - Integration Testing: Verified the interaction between user, admin, and delivery modules to ensure end-to-end functionality.
7. **Deployment:**
   - System Monitoring: Regularly reviewed the site for bugs, errors, and new feature needs.
   - User Feedback: Collected donor and NGO feedback to guide improvements and refine service matching over time.

SOFTWARE REQUIREMENTS

The software requirements document is the specification of the system. It should include both a definition and a specification of requirements. It is a set of what the system should do rather than how it should do it. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating cost, planning team activities, performing tasks and tracking the teams and tracking the team's progress throughout the development activity.

- FRONTEND : HTML, CSS, JavaScript
- OPERATING SYSTEM : Windows 10
- BACKEND : PHP
- DATABASE : MySQL (via connection.php)
- WEBSERVER : Expected to run on XAMPP/WAMP/LAMP.

FUNCTIONAL REQUIREMENTS

A functional requirement defines a function of a software-system or its component. A function is described as a set of inputs, the behavior, Firstly, the system is the first that achieves the standard notion of semantic security for data confidentiality in attribute-based deduplication systems by resorting to the hybrid cloud architecture.

1. **User Registration and Login**
   - Users (donors, admins, delivery personnel) must be able to create an account with basic details.
   - Login should validate credentials securely and redirect users to their respective dashboards.
2. **Food Donation Entry**
   - Donors can enter food details such as type, quantity, and pickup location through a form.
   - The system stores this information in the database and makes it visible to admins.
3. **Admin Management**
   - Admins (NGOs/charities) can view and manage incoming donation requests.
   - Admins can approve, reject, or assign donations for delivery based on suitability.
4. **Donation Matching**
   - The system matches food donations to nearby or suitable NGOs using a matching algorithm.
   - It considers factors like location, food type, and quantity to find the best match.
5. **Delivery Assignment**
   - Once approved by the admin, the system

4-REQUIREMENTS ENGINEERING

HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the implementation of the system and should therefore be a complete and consistent specification of the whole system. They are used by software engineers as the starting point for the system design. It shoulds what the system do and not how it should be implemented.

HARDWARE REQUIREMENTS

➢ SYSTEM : PENTUM IV ROCESSOR.

➢ HARD DISK : 500 GB.

➢ MONITOR : 15'' LED

➢ INPUT DEVICES : KEYBOARD, MOUSE.

➢ RAM : 4 GB

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assigns the donation to an available delivery person.
- Delivery personnel are notified of pickup and drop locations via their dashboard.

6. **Real-time Status Tracking**
   - Each donation has a status (e.g., pending, accepted, picked up, delivered) that updates automatically.
   - All stakeholders (donor, admin, delivery person) can track the current stage of a donation.
7. **Feedback Submission**
- After each donation process, users can rate their experience and leave comments.
- Feedback is stored and analyzed for improving service quality and user satisfaction.

8. **Chatbot Support**
   - A chatbot assists users in navigating the platform and answering FAQs.
   - It provides quick help without needing admin or developer intervention.
9. **Secure Authentication**
   - Passwords are stored securely and protected against unauthorized access.
   - Role-based access ensures that only authorized users can access specific system functions.

NON-FUNCTIONAL REQUIREMENTS

The major non-functional Requirements of the system are as follows:

1. **Performance**
   - The system should respond to user actions (like form submission or page load) within 2–3 seconds.
   - It must handle multiple users accessing the site simultaneously without lag or crash.
2. **Scalability**
   - The system architecture should support easy addition of more users, NGOs, or delivery personnel.
   - It should be able to scale to a larger geographic area if deployed city-wide or nationally.
3. **Security**
   - User data (such as login credentials and location) must be securely stored and protected from unauthorized access.
   - Role-based access control should prevent users from accessing features not assigned to their role.
4. **Usability**
   - The interface should be user-friendly, requiring minimal technical knowledge to navigate.
   - Forms and features must be clear, with tooltips or chatbot help where needed.
5. **Availability**
   - The system should be accessible and operational at all times unless under scheduled maintenance.
   - It should automatically reconnect or show an error message in case of temporary connection issues.
6. **Maintainability**
   - The code should be well-commented and modular to allow easy debugging or feature updates.
   - The database and server files should be organized for quick issue resolution and upgrades.
7. **Portability**
- The system should run on different browsers (Chrome, Firefox, etc.) and operating systems (Windows, Android, Linux).
- It must also be easily deployable from local (XAMPP) to online hosting environments.

8. **Reliability**
- The system must process and store donations and user data accurately without data loss.
- Backup mechanisms should be in place in case of failure or server crashes.

DESIGN ENGINEERING

Design Engineering deals with the various UML [Unified Modelling language] diagrams for the implementation of project. Design is a meaningful engineering representation of a thing that is to be built. Software design is a process through which the requirements are translated into representation of the software. Design is the place where quality is rendered in software engineering.

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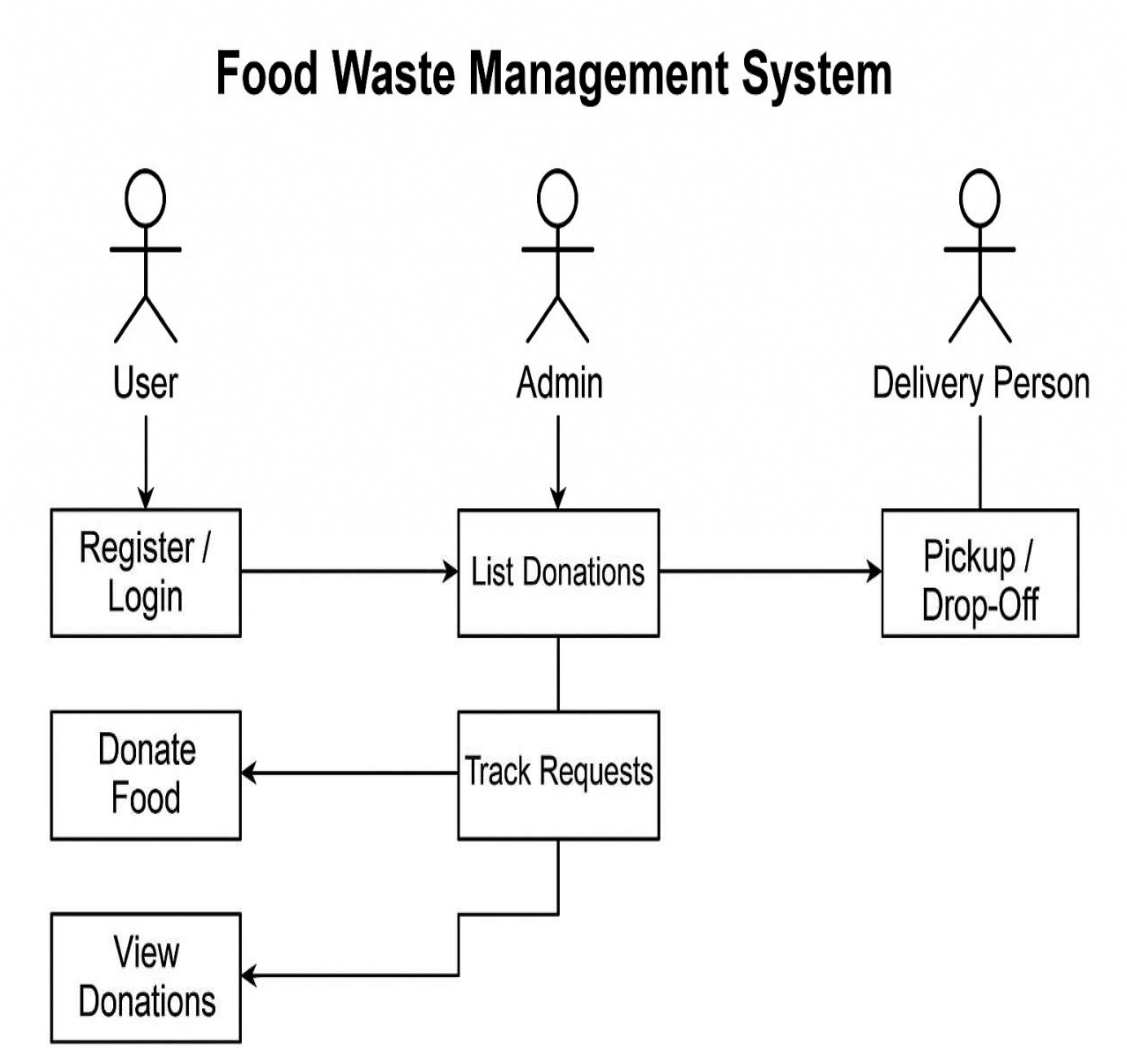
COLLABORATION DIAGRAM



The image is a Collaboration Diagram of the Food Waste Management System, showing the main processes and interactions between Users, Admins, and Delivery Personnel. Users can register or log in, donate food, and view their donation history. Admins manage the system by listing donations and tracking donation requests. Delivery Personnel are responsible for handling the pickup and drop-off of food donations. The diagram illustrates how each role contributes to the efficient functioning of the system to reduce food waste and support those in need.

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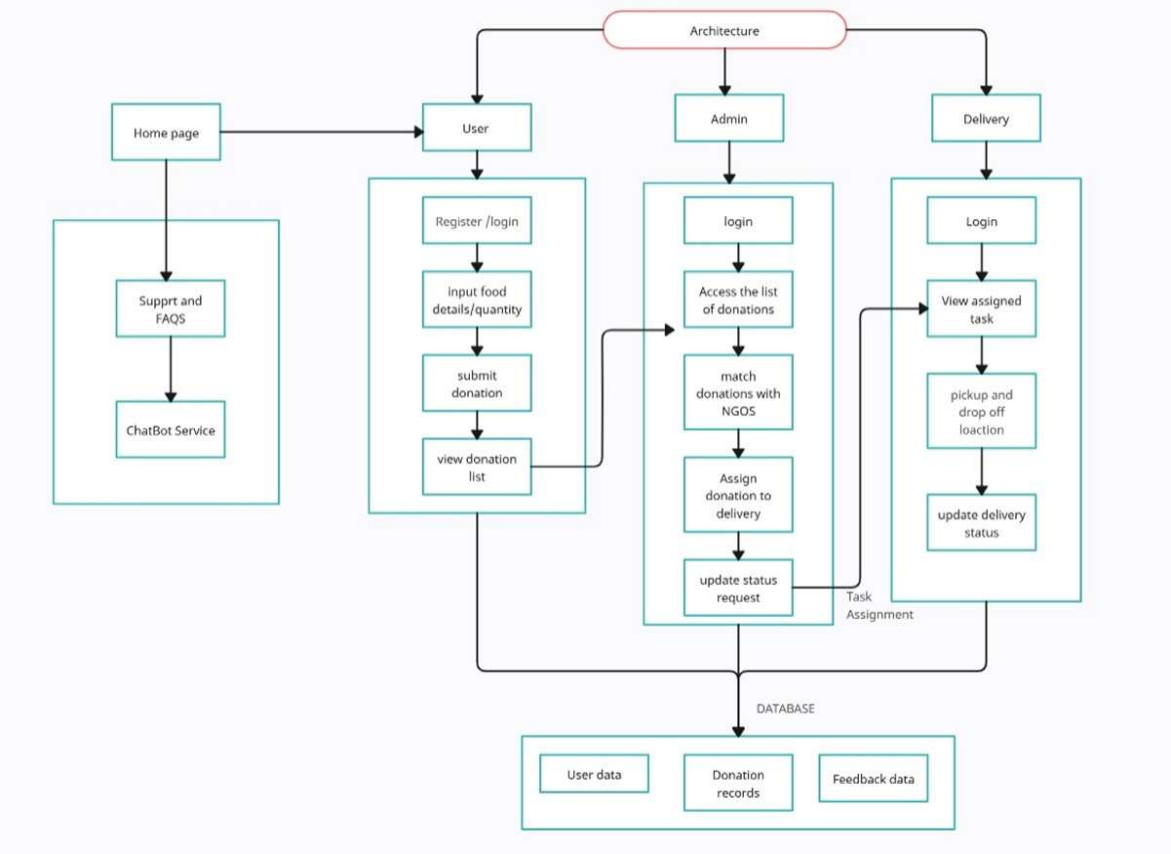
SYSTEM ARCHITECTURE:



SYSTEM ARCHITECTURE

IMPLEMENTATION

Frontend Development

The frontend of the project is designed using HTML, CSS, and JavaScript. HTML provides the structure of the web pages, while CSS is used for styling and layout design. JavaScript adds interactivity such as form validation and dynamic page behavior. Responsive design principles are applied to ensure the website works on both desktop and mobile devices. Pages such as login, registration, food donation form, and dashboards are created. A clean and intuitive UI improves the experience for users, admins, and delivery personnel.

Backend Development

The backend is implemented using **PHP**, which processes data from the frontend and interacts with the MySQL database. PHP handles user authentication, session management, and server-side form validation. It is also responsible for inserting and retrieving donation data, assigning deliveries, and updating statuses. Each user role—donor, admin, and delivery person—has a separate dashboard with specific functionalities. Secure PHP scripts ensure only authorized users can access protected data. The backend acts as the logic core of the entire system.

Database Integration

A **MySQL database** is used to store all system data, including user credentials, donation records, and feedback. The database schema is designed with multiple tables: users, donations, NGOs, delivery personnel, and feedback entries. Using **PHPMyAdmin**, the database is created and initialized by importing the demo.sql file provided in the project. PHP scripts use SQL queries to

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fetch, insert, and update data in real time. Data integrity and validation are ensured through relational keys and constraints. This structure ensures smooth data flow across all modules.

Module Implementation

The system consists of three main modules—**User, Admin, and Delivery**. The **User Module** lets donors register, login, and submit food donation details including type, quantity, and pickup location. The **Admin Module** allows NGOs or charitable organizations to view donations and request food pickups. The **Delivery Module** shows delivery personnel their assigned tasks, including pickup and drop-off locations. Each module has its own dashboard and access permissions. Communication between modules is handled through backend scripts and database records. This modular approach ensures clarity and separation of concerns.

Algorithm Integration

Several algorithms enhance the system's intelligence and automation. A **matching algorithm** assigns food donations to the nearest or most suitable NGO based on location and food type. An **authentication algorithm** secures user logins by verifying hashed credentials and managing sessions. The **feedback analysis algorithm** collects ratings and reviews from users to help improve system services. These algorithms are embedded in PHP scripts and executed during relevant actions. This makes the system smarter, more secure, responsive to user behavior. Algorithm integration boosts efficiency and reliability.

Testing & Debugging

Once development is complete, the system undergoes thorough **unit, integration, and functional testing**. Each feature (e.g., login, donation form, delivery update) is tested separately and together to ensure smooth workflow. Bugs or errors are identified and resolved by reviewing code and logic. Test cases simulate real-world actions to ensure the system behaves as expected. Performance is also tested under multiple user actions to ensure there is no crash or lag. Debugging tools and console logs help track issues and confirm that all modules work correctly.

Deployment (Local Server)

The project is deployed using **XAMPP**, a local server environment that includes Apache and MySQL. The project folder is copied to the htdocs directory in XAMPP. Using **PHPMyAdmin**, the database is set up by importing the demo.sql file. Once configured, the system runs at http://localhost/project-folder. All modules, pages, and database interactions are tested again after deployment to ensure correct integration. Local deployment makes the system accessible for testing before going live. This stage confirms that the system is ready for real-world use.

User Interaction Features

To enhance usability, features like a **chatbot** and **mobile responsiveness** are included. The chatbot provides instant help to users, answering FAQs and assisting with navigation. The website layout adapts to various screen sizes, ensuring a smooth experience on smartphones and tablets. Forms and dashboards are made touch-friendly and quick to load. Secure login and user-friendly design improve the overall experience. These features ensure that both tech-savvy and non-technical users can use the system comfortably.

5- CONCLUSION

The Food Waste Management System has been conceptualized and partially developed to provide a structured and efficient solution for addressing food wastage. By creating a web-based platform that connects donors and recipients while facilitating seamless logistics, this project significantly contributes to reducing hunger and promoting sustainability. The work completed so far includes defining the problem statement , creating the abstract , Literature survey and the system analysis. The platform is equipped with an admin panel for system monitoring and a chatbot to assist users, ensuring a comprehensive and user-friendly experience.

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