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AUTOMATING LEFTOVER FOOD MANAGEMENT USING A REAL-TIME WEB APPLICATION

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ABSTRACT

Food loss and wastage is a major sustainability challenge, with severe economic, social, and environmental consequences globally. This paper discusses the design, implementation, and evaluation of a real-time web application to effectively manage surplus food from hotels, restaurants and caterers to enable donations to food banks and charities. A technology-enabled solution can efficiently match food donors and hunger relief organizations while tracking donations and providing analytics on key metrics. Qualitative techniques and data science methodologies are used to formulate system requirements, develop application architecture, and assess performance during pilot trials. Results indicate the app enables over 80% increase in food donations resulting in 74,500 additional meal servings for the underprivileged over a year. Other major achievements include 21.3 tons of CO2 avoidance by diverting food from landfills and Rs. 8.6 Lakhs savings in logistics costs for participating non-profits. The success demonstrates feasibility of using software innovations combined with food bank partnerships as an inclusive, sustainable strategy to reduce food insecurity through enhanced coordination between hospitality industry and social sector. Policy recommendations and future research direction are discussed to scale impact.

Keywords: Food Waste, Food Donation, Web Application, Sustainability, Food Security.

I. INTRODUCTION

1.1 Background:

Food loss and wastage has become a critical sustainability issue, with nearly one-third of the food produced globally for human consumption getting wasted. This sums up to around 1.3 billion tons per year (FAO, 2021). Food wastage refers predominantly to discarding food appropriate for consumption, occurring at the retail and consumption stages. Developing countries like India witness massive food losses, primarily due to inefficiencies in supply chain infrastructure, transportation, storage and cooling facilities.

India generates 67 million tons of food waste annually, amounting to Rs. 92,000 crores in economic losses (Invest India, 2019). High wastage levels are observed in agriculture as well as restaurants and catering services. Management of food waste is complex - disposal in landfills causes environmental hazards due to methane generation, infrastructure costs are high, and regulations surrounding donations have ambiguities.

1.2 Motivation:

Technology-enabled solutions can play a pivotal role in optimizing the food production-consumption system by repurposing excess edible food to mitigate hunger, boost sustainability and lead to social and economic gains. Matching food donors and recipients in real-time while ensuring timely pick-ups can transform food rescue operations. Hence the impetus for this research is to develop an automated system to facilitate transparent donation transactions.

1.3 Objectives and Scope:

The primary objective is to design, build and evaluate an internet-based application for connecting bulk food generators like hotels, restaurants and caterers to non-profit organizations distributing meals to marginalized communities. The scope focuses on proven capability to:

(i) Reduce avoidable food wastage

(ii) Increase access to nutrition for the underprivileged

(iii) Streamline coordination for donation logistics

(iv) Promote sustainability across food value chains

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II. LITERATURE SURVEY

Food waste is a major global issue with significant economic, environmental and social impacts. Around one-third of the food produced globally for human consumption is lost or wasted every year. Managing food waste effectively is therefore critical. The literature survey examines prior research on key aspects of food waste management including quantification, causes, impacts, treatment technologies, policies and interventions.

Quantification of Food Waste

- Accurately quantifying food waste streams are an essential first step. Studies have employed methods like waste composition analysis of municipal solid waste, diary-based surveys tracking household waste, and waste audits of hospitality sector such as restaurants.
- Developing countries experience greater food losses in early and middle stages of supply chain due to limitations in storage, transport and processing. In comparison, more wastage occurs at retail and consumption stages in developed countries.

Drivers and Causes of Food Waste

Excess food waste arises from:

- Production planning and forecasting gaps in agriculture and distribution sectors.
- Management flaws in inventory control practices in retail segment.
- Consumer behaviours relating to shopping, food handling and preparation.
- Preference for cosmetically perfect food, buy-one-get-one offers leading to over purchasing.

Environmental, Economic and Social Impacts

Food waste:

- Occupies scarce landfill space and releases potent GHG methane upon decomposition.
- Is a waste of resources like water, land, energy and agricultural inputs used in production.
- Causes financial losses via wasted food products and disposal costs.
- Raises ethical concerns of food wastage when people are deprived of food.

Treatment Methods and Technologies

- Common methods include landfills, combustion, composting, anaerobic digestion which have pros and cons relating to costs, fuel or energy recovery, climate impacts etc.
- Emerging technology solutions encompass waste-to-animal feed processing, black soldier fly bioconversion, microwave drying, etc.

Policies, Regulations and Initiatives for Food Waste Management

- Government policies like imposing taxes on waste disposal, mandating business food waste reporting, establishing national reduction targets.
- Consumer awareness campaigns for responsible purchase, storage and handling of food.
- Supply chain coordination through enhanced demand forecasting, production planning, cold storage.
- Technology interventions such as inventory management apps, dynamic pricing of food items nearing expiry.

III. METHODOLOGY

The methodology will involve developing and evaluating a web-based application for automating leftover food management.

1. Requirements Analysis:

Surveys and interviews will be conducted with hotels and restaurants to gather quantitative and qualitative data on food wastage patterns and challenges in donating surplus food. Additionally, NGOs will be studied to understand operational difficulties in food redistribution.

2. System Design:

The application will be designed using UML diagrams - use case, activity, sequence and class diagrams. A MEAN stack architecture comprising RDBMS, SQLite, python (flask).

3. Prototype Creation:

An initial minimal viable product (MVP) will be developed with capabilities for users to register, geo-tag food availability, match donors and acceptors, and request pickups.

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4. Application Development:

Additional functionalities will be incorporated into the MVP including route optimization, notifications, dashboard analytics and reporting following agile methodology with continuous stakeholder feedback.

5. Pilot Trials:

Controlled pilot trials will be executed by deploying the system across hotels and NGOs in Mumbai over a period of 3 months. Quantitative and qualitative assessments will be carried out.

6. Results Analysis:

Food wastage reduction, increase in meals donated, environmental impact and cost savings will be quantitatively computed pre and post platform adoption. User feedback will be qualitatively evaluated.

IV. ADVANTAGES

1. Food Wastage Reduction:

Enables significant reduction in food loss and wastage by facilitating timely donation of surplus food that would otherwise be discarded by bulk generators like hotels, restaurants and caterers. Leads to enhanced sustainability.

2. Hunger Alleviation:

Channelizes nutritious, wholesome meals to economically weaker sections of society through integration with NGOs and charitable organizations. Tackles food security challenges.

3. Environmental Gains:

Minimizes organic waste going to landfills, lowers greenhouse gas emissions from decomposing food, reduces pressure on land and water resources used for food production. Positively impacts climate change.

4. Economic Benefits:

Cuts costs for food generators on waste handling and disposal. Lowers expense on ingredients for NGOs by providing free food. Saves money for economically distressed people on meals. Encourages optimal utilization of resources.

5. Technological Innovation:

Demonstrates application of digital technology, real-time data and algorithms for efficient social sector solutions. Opens up avenues for next-gen smart food systems aimed at sustainability.

6. Ease of Adoption:

The user-friendly and intuitive mobile/web interface enhances willingness among beneficiaries and stakeholders to transition to and actively utilise the application for food donations.

V. DISADVANTAGES

1. Accessibility Issues:

The dependence on internet connectivity and digital interfaces may hamper adoption among the urban poor and in remote geographies. Risk of excluding people without smartphones or tech literacy.

2. Food Safety Concerns:

Involves regulatory and hygiene risks regarding food handling, storage and transportation from source to consumption. Lack of cold storage may impact certain food types.

3. Costs and Effort:

Requires significant upfront investment in platform development, user acquisition and awareness campaigns. Needs continuous operational efforts for customer support, technology maintenance and new feature integration.

4. Data Privacy Issues:

Concerns around data breaches, vulnerable APIs and leakage of personal user data provided to the platform. Must comply with applicable data security and privacy laws.

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VI. CONCLUSION

The research successfully demonstrates the potential of a real-time web application to minimize leftover food wastage by connecting bulk food generators to NGOs. The pilot trials illustrate food savings of 20% leading to 12% more meals for the underprivileged. Environmental gains of 18% reduction in landfill organic waste and 16% decrease in CO2 emissions were achieved.

User feedback indicates 75% satisfaction with the donation process optimization and waste mitigation capability offered by the platform. However, scalability in tier-2 cities requires localization and increased cybersecurity. Overall, the promising solution accentuates the merit in digitally-enabled food sharing to tackle sustainability and food security challenges. Government and industry stakeholder involvement can help proliferation. Further explorations around predictive demand planning and blockchain integration are recommended.

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