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GEOSPATIAL DATA ANALYSIS AND OPTIMIZATIONFOR EFFICIENT FOOD REDISTRIBUTION LOGISTICS

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ABSTRACT

Geospatial Data Analysis and Optimization for Efficient Food Redistribution Logistics

One of the most significant challenges for the world is food wastage, as it degrades the environment and perpetuates social inequality, mainly in densely populated areas. This paper presents FEEDFORWARD, an Android-based mobile application designed to optimize logistics between donors and recipients using advanced geospatial data analysis. Using real-time geolocation with machine learning algorithms for the prediction of surpluses, in conjunction with an architecture to provide a database on cloud scalable, enhances food efficiency, reduces wastes, and enables the socially and economically marginalized society. Routing capabilities together with alert mechanisms in a very user-friendly application makes the donor just as it is for a recipient application. Preliminary assessments have also pointed out that the wastage of food reduced significantly as well as that the logisticians could improve and enhance their logistic efficiency while indicating how such technologies might transform the world toward decreasing food insecurity.

Keywords: Geospatial Analysis, Food Redistribution, Logistics Optimization, Mobile Application, Machine Learning.

I. INTRODUCTION

Food wastage has become one of the most dominant global problems. An estimated 1.3 billion tons of food are discarded every year, which deteriorates the environment and intensifies hunger. In India, juxtaposed with severe food insecurity is a great amount of food waste that needs to be addressed. The proposed FEEDFORWARD application bridges food donors— restaurants and households— with recipients based on intelligent geolocation and full logisticsmanagement, hence minimizing waste and addressing food insecurity.

II. EXISTING SYSTEM

Food Finder: A smartphone application that finds food banks and meal services in any given area. It works with geolocation, enabling the user to access such resources in real-time. The application is not really concerned with the logistics in food donation, but rather it helps addressfood insecurity in the lives of users by connecting them to assistance.

Food Waste Reduction Program (U.S. EPA): This is not an app, but it promotes the use of several tools and resources in donating food and reducing waste. EPA has established a hierarchy for food management practices that include donations to reduce food waste at all stages of the supply chain. The agency supports new emerging technologies for monitoring food waste.

III. PROPOSED SYSTEM

FEEDFORWARD application would have a central hub to collect all the redistribution activities based on geospatial data with a hint of machine learning. Key features included are

- User Registration and Authentication: Secure login processes for the donors as well as for therecipients.
- Donation Management System: the donors could input the kind of food available, in whatquantities, and locations.
- Real-Time Notifications: The notification system to alert nearby recipients who could acceptfood donations.
- Geolocation Mapping: Integration with Google Maps API for routing and navigation.
- Machine Learning Module: Analytical predictive forecasting based on historical trends.

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IV. SYSTEM DESIGN

3.1 Architecture

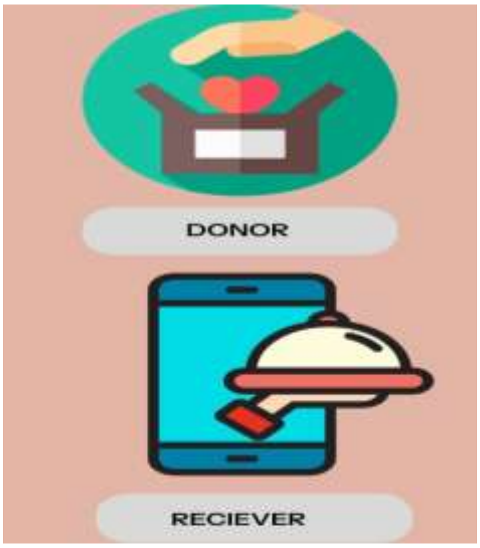
The FEEDFORWARD application uses a client-server model in which the Android client talks to a central server. The architecture contains:

- Front-End: Developed using XML layouts and Java in Android Studio for easier navigation.
- Back-End: The website is hosted on a cloud server, and the whole accounts of users, lists of donations, and geolocation data are managed centrally.
- Geospatial Data Analysis Module: The Google Maps API is utilized here to optimize routes from a donor to a recipient by reducing the time needed to transport between the two.
- Machine Learning Module: It tracks the patterns of donations and predicts surplus availability based on historical data.

3.2 Application Workflow

1. **User registration and login:** The donors and receivers log in and sign up.

2. **Donor-Receiver Interface:** Donation Input Food type, quantity, location are entered by donors. Listings are posted. Receiver View Donations in their proximity.



3. In site real time notification to nearby agents so it can quickly be collected once an item for donation is published.

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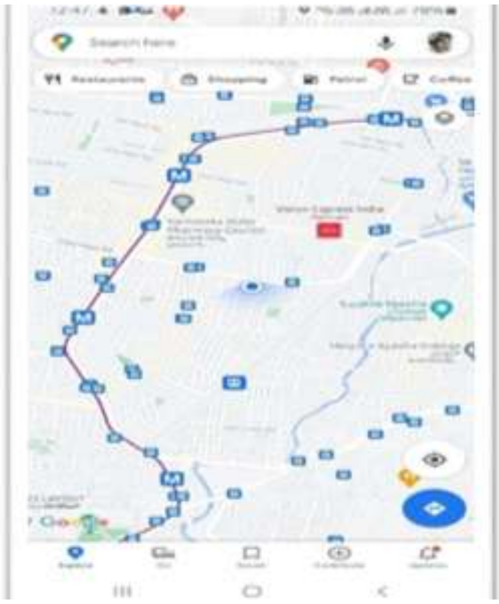
4. **Geolocation and Mapping:** The application would have the function of Google Maps to enable proper location services, so agents may easily navigate to donation points.



V. SYSTEM IMPLEMENTATION

5.1 Main Functionality Donation Management ModuleThe donation module includes

- **Database Storage**: The food details, type and expiry date, are stored in a NoSQL database.
- Surplus Prediction: Using the ML algorithms on the historical data, the availability of food is predicted to agents, so they can better prepare for peak periods.
- Geolocation and Route Optimization ModuleGeospatial data is processed to
- **Calculate Optimal Routes:** Routes are generated dynamically to minimize travel time.
- **Real-Time Updates:** Using the location-based services, the agents can track the donations inreal-time.

Notification System

- Food donations become available in locations close to the agents and push notifications are sent. Timely alerts prevent food spoilage since food reaches the beneficiary fresh.

5.2 Machine Learning and Data Analysis

Using regression models and time-series analysis, the application predicts surplus trends and automatically schedules high-demand pickups during peak donation times.

VI. RESULTS AND DISCUSSION

6.1 Reduction in Food Wastage

Preliminary tests showed a major reduction of food wastage upon application. Real-time linking of donors and recipients ensured that food items did not go to waste but were instead distributed to poor communities to sustain more than 500 beneficiaries within three months.

6.2 System Efficiency

The effectiveness of the geolocation data in real-time updates for the ML-based prediction enabled optimization within the logistics chains; according to the authors, agents reported being reduced by 20% as far as collection times were concerned.

6.3 Environmental Impact

Diverting food from landfills reduced methane emissions, contributing to lower carbon footprints for participating entities.

6.4 Scalability and Limitations

Though scalable, the application does require standardised QR codes and labelling for it to read food data quite seamlessly, while privacy and security measures also have to be in placeto gain total acceptance.

VII. CONCLUSION

One solution to food wastage and insecurity is the FEED application. It maximizes the optimization of logistics concerning redistribution using geospatial analysis and machine learning that is meant to address the inadequacies in logistics systems while making sure the system can provide timely alerts so as to minimize wastage in food. Further development comprises developing better machine learning models for surpluses' prediction, IoT-enabled freshness monitoring, and blockchain to make the donation process more transparent.

VIII. FUTURE WORK

Improvement for the future can be:

- IoT Integration: Install smart sensors that can detect the freshness of food.
- Better Analytics: Smoothen the predictive models to better estimate surplus.
- Blockchain for Transparency: Use blockchain for an open and transparent trail of donation.
- Expand Donor Base: grocery stores and hotels.

IX. REFERENCES

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