NATIONAL TEACHERS COLLEGE

Barangay Waste Collection Management System Using DSA Concepts

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Subject: Data Structures and Algorithms

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I. Introduction

1.1 Project Overview & UN SDG Target

The Barangay Waste Management System is an interactive web application created to help barangays systematically track household waste contributions. The system allows users to add new waste records, view all household contributions in a table, identify the Top 5 contributors, search for a household by name, and undo the last added record.

The main goal of this project aligns with UN Sustainable Development Goal 12: Responsible Consumption and Production. By tracking household waste accurately, the system encourages accountability, promotes proper waste segregation, and provides data-driven insights to barangay officials for better waste management practices.

1.2 Problem Statement

Many barangays face challenges in monitoring household waste contributions. Currently, the process is often manual, prone to errors, and lacks efficiency. This system addresses the following issues:

- Data Tracking: Automatically records and maintains a log of all household waste contributions.
- Top Contributors Awareness: Highlights the households contributing the most waste to raise awareness and encourage responsible behavior.
- Quick Search & Correction: Facilitates finding specific household records and undoing incorrect entries efficiently.

By implementing these features, barangay officials can manage and monitor waste contributions in a systematic and transparent way, helping communities achieve better waste reduction and recycling practices.

II. Requirements & Analysis

2.1 Functional & Non-Functional Requirements

Functional Requirements (FR):

- **FR1:** Ability to add new waste records including household name, address, waste type, weight, and date.
- **FR2:** Display all waste records in a dynamic table.
- **FR3:** Highlight the top 5 contributors based on the weight of waste.
- **FR4:** Undo the last added record to correct mistakes.
- **FR5:** Search for a specific household by name and display its details.

Non-Functional Requirements (NFR):

- **NFR1:** Must efficiently handle at least 50 records without performance lag.
- **NFR2:** User-friendly interface with clear layouts for easier interaction.
- **NFR3:** Responsive design for compatibility with different screen sizes and devices

2.2 Data Requirements

- **Input Data:** Household name, address, waste type, weight in kilograms, and date of contribution.
- **Storage:** Records are stored in an array for sequential access and a stack for undo functionality.
- **Volume:** Initially includes 50 sample household records, representing a realistic scale for demonstration and testing.

2.3 Complexity Analysis

- **Sorting (Top 5):** Uses bubble sort, complexity $O(n^2)$, acceptable for small datasets like 50 records.
- **Undo Operation (Stack):** O(1) time complexity, allowing instant removal of last record.
- **Searching Household (Linear Search):** O(n), efficient for the dataset size.
- **Display and Refresh Table:** O(n) as each record is iterated and displayed.

The chosen algorithms balance simplicity, readability, and efficiency suitable for a small-scale real-life barangay system.

III. Design Specification

3.1 Core Data Structures Used (The Five DSA Concepts)

1. **Array (Prelim DSA)**
    - **Justification:** Stores all household records in a sequential manner, enabling easy access and iteration over data.
    - **Implementation:** JavaScript array `records[]` contains all records including name, address, waste type, weight, and date.
2. **Stack (Prelim DSA)**
    - **Justification:** Implements undo functionality efficiently by keeping track of the last added record.
    - **Implementation:** JavaScript array `undoStack[]` uses `push()` when adding a record and `pop()` when undoing.
3. **Bubble Sort (Finals DSA)**
    - **Justification:** Sorts records based on weight to determine the top 5 contributors. Simple to implement and readable for demonstration.
    - **Implementation:** Nested loop compares each record's weight with the next and swaps if necessary to order descendingly.

4**. Linear Search (Midterm DSA)**

- Justification: Enables searching for a household by name quickly.
- Implementation: Iterates over `records[]` to find a matching household name (case-insensitive).

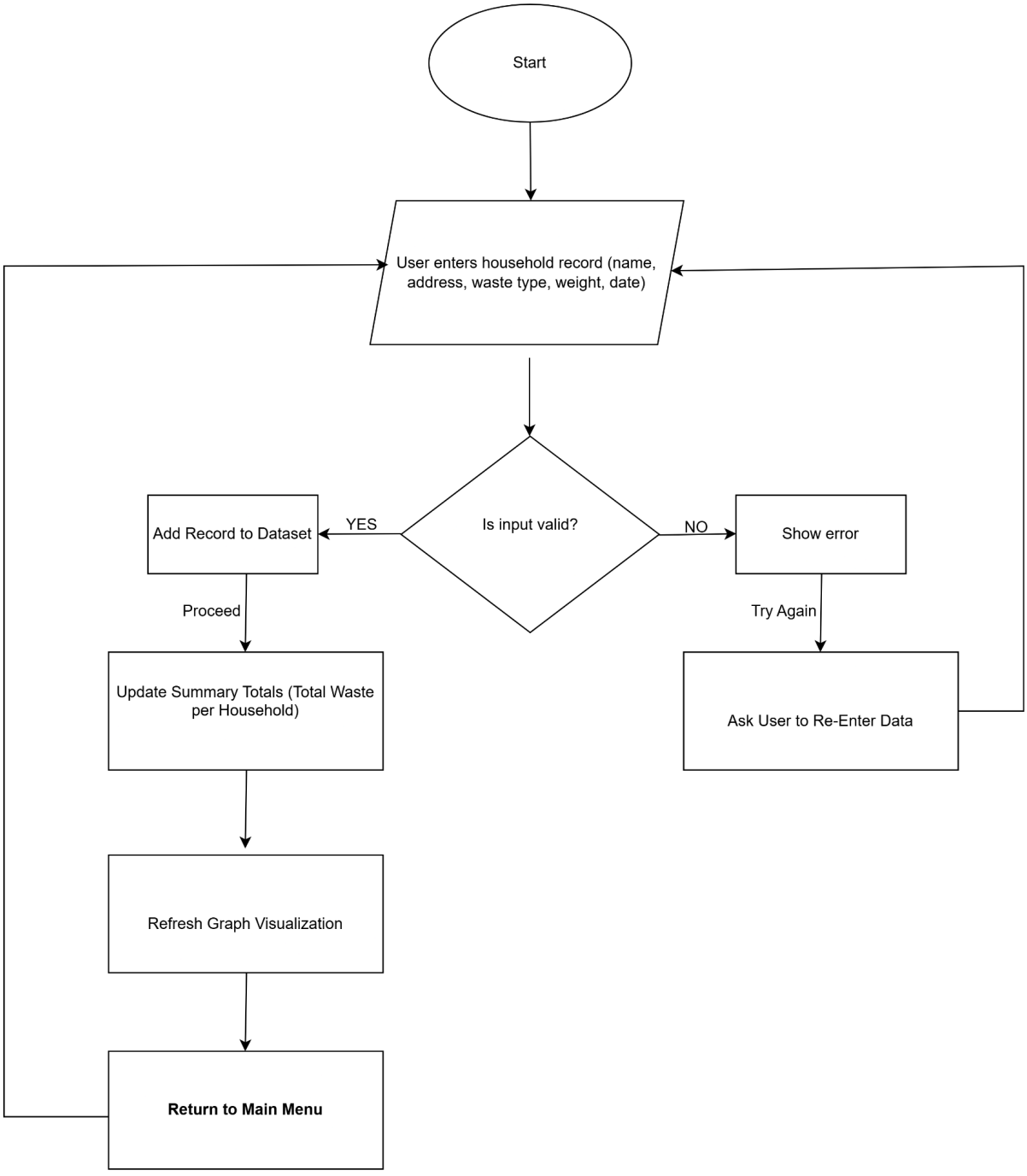
5**. Dynamic HTML Update (Finals Concept)**

- Justification: Keeps the web page responsive to changes in the underlying data. Updates the table and Top 5 list automatically whenever records are added, undone, or modified.
- Implementation: Uses DOM manipulation functions like `insertRow()`, `appendChild()`, and `innerHTML` to reflect changes in real time.

3.2 Algorithm Flowchart

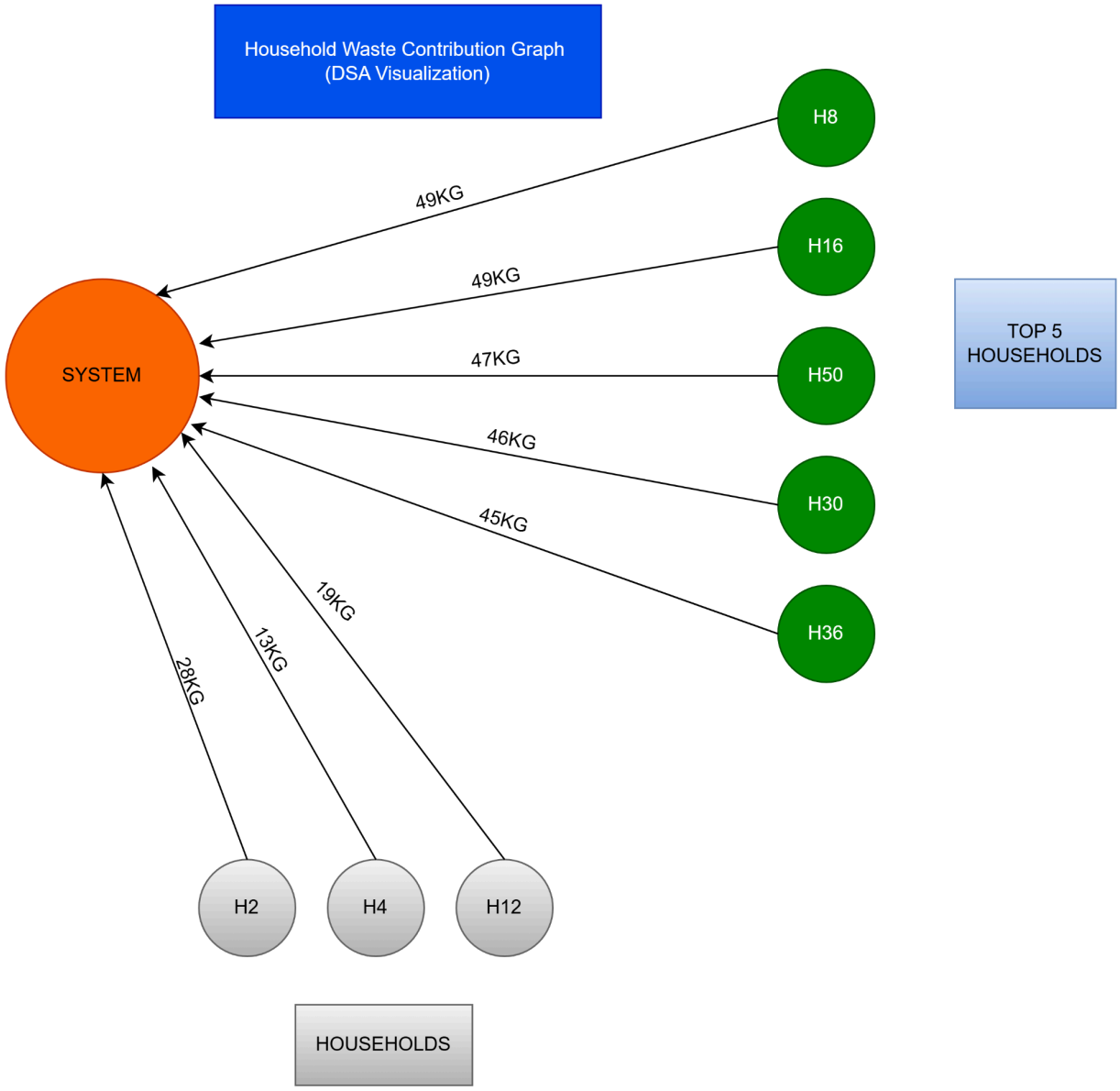
The flowchart for the system's core function (adding a new record and updating the display) follows this sequence:

1. User submits a new waste record via the form.
2. Record is added to the `records[]` array and `undoStack[]`.
3. Records are sorted by weight using bubble sort.
4. The Top 5 contributors are highlighted in the table.
5. Table and Top 5 list are updated dynamically in the HTML.


Start
User enters household record (name, address, waste type, weight, date)
Is input valid?
YES
NO
Add Record to Dataset
Show error
Proceed
Try Again
Update Summary Totals (Total Waste per Household)
Ask User to Re-Enter Data
Refresh Graph Visualization
Return to Main Menu

DSA Graph Visualization

A simplified graph was created to represent the waste contributions of households. Each node represents a household, and arrows point toward the collection center indicating the direction of waste flow. The weight of each arrow corresponds to the amount of waste (in kg). The top 5 contributors are highlighted in a distinct color for easy identification. This visual aids in quickly identifying major contributors and understanding system flow.


Household Waste Contribution Graph
(DSA Visualization)
H8
H16
H50
H30
H36
49KG
49KG
47KG
46KG
45KG
SYSTEM
TOP 5
HOUSEHOLDS
28KG
13KG
19KG
H2
H4
H12
HOUSEHOLDS

DSA Graph Explanation:

- Each circle (node) represents a household, showing their individual waste contribution.
- Arrows (edges) point from households to the collection center, indicating the flow of waste.
- The numbers on the arrows indicate the weight of waste contributed by each household.
- Top 5 households are highlighted using a different color to show the largest contributors.
- This visual representation allows quick identification of major contributors, which helps in prioritizing waste management actions.
- Simplified version with 8 nodes used for presentation purposes, while still reflecting the Top 5 data from the website.

IV. Testing and Results

4.1 Test Cases

Input	Expected Output	Actual Output
Add Household 51, 10kg	Appears in table correctly	Appears in table correctly
Undo last record	Last record removed	Last record removed successfully
Search Household 14	Displays correct info	Displays correct info

4.2 Performance Test

- Tested with 50 records, simulating real-life barangay data.
- Sorting, adding, undoing, and searching operations were all executed without noticeable lag.
- Top 5 list updated instantly with changes in records.

V. Conclusion and Contributions

The system provides an interactive and practical solution for barangay waste tracking, making data collection and monitoring easier and more efficient.

It demonstrates real-life application of five key DSA concepts: array for storing records, stack for undo functionality, bubble sort for ranking waste contributors, linear search for quick lookup, and dynamic updates for real-time table and Top 5 list management.

This approach can be implemented in actual barangays to improve waste monitoring, streamline collection processes, and enhance accountability among residents.

The system highlights top contributors to raise awareness and encourage responsible waste disposal behavior, fostering community participation and promoting environmental consciousness.

Additionally, the platform can be extended for larger datasets, integrated with IoT-based waste tracking sensors, or linked to mobile apps for better accessibility and long-term sustainability.