PROJECT NAME: GREENGROW
SUSTAINABLE PLANTING GAME

Team: Aries Four U

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1. Introduction

"GrowGreen" is an educational and interactive web-based game designed to promote environmental awareness and sustainable development through gamification. The core concept is simple yet meaningful: players earn "water drops" by participating in eco-themed mini-games, which they can then use to nurture virtual trees. As players care for their plants, they symbolically contribute to real-world environmental action, blending entertainment, education, and social impact.

The game experience revolves around two main mini-games — *Environmental Quiz* and *Waste Sorting Challenge* — through which players collect water drops to grow trees in five stages: *Seed*, *Sprout*, *Sapling*, *Young Tree*, and *Blossoming Tree*. Each fully grown tree symbolizes not only in-game success but also potential contributions to environmental charity.

2. Theme and Justification

The choice of theme stems from the urgent global challenge of environmental degradation and the need to raise awareness about sustainable development goals (SDGs), particularly SDG 13 (*Climate Action*) and SDG 15 (*Life on Land*).
According to the United Nations, around 12 million hectares of forest are lost every year, and global waste generation is expected to reach 3.4 billion tons by 2050 (World Bank, 2022). Moreover, research shows that over 60% of young people express concern about climate change but less than 20% actively engage in sustainability actions.

"GrowGreen" aims to close this gap by turning *environmental education into enjoyable gameplay*. By integrating environmental quizzes and recycling challenges, the project encourages players — particularly students — to *learn by playing* and *act through awareness*.

This game is not just entertainment; it is designed as an interactive learning platform that motivates sustainable habits and contributes to social good.

3. Potential Impact

"GrowGreen" seeks to create a positive impact across three dimensions:

1. Educational Impact – The Environmental Quiz game helps players gain essential knowledge about environmental issues, sustainability, and human responsibility toward the planet. The question sets align with global SDG themes to improve eco-literacy among youth.

2. Behavioral Change – By simulating recycling and resource management through gameplay, the Waste Sorting Challenge encourages real-life habits of proper waste classification and environmental mindfulness.

3. Social and Institutional Impact – The game introduces a unique *Tree Leaderboard System*, where each fully grown tree represents environmental contribution. Schools or organizations can convert virtual trees into real donations — for example, 1 tree = 10,000 VND to an environmental fund or local tree-planting campaign.
   This system connects virtual achievement with real-world action, potentially turning student engagement into green fundraising and fostering a competitive yet positive school-wide sustainability culture.

In addition, the top 100 players each month can be awarded bonus eco-points or recognition, stimulating long-term participation and community involvement.

4. Technology Stack

The game is built using modern web technologies to ensure accessibility, interactivity, and scalability:

- Frontend:
    - *HTML, CSS* for user interface
- Backend:
    - *JavaScript*
- AI and Smart Features:
    - *OpenAI API / Gemini AI* to dynamically generate quiz questions and explanations about sustainability topics, ensuring that content remains fresh and educational.

This technology stack ensures smooth gameplay, fast loading, and an engaging experience across devices.

5. Game Mechanics Overview

The **GreenGrow** project implements a unified and gamified **scoring and growth mechanism** to encourage sustainable behavior through interactive gameplay.
Players earn " Green Points" by performing environmentally positive actions within two mini-games — *Quiz Game*and *Trash Sorting Game*.
These points accumulate over time and contribute to the growth of a virtual tree, symbolizing the player's environmental progress.

5.1 Quiz Game – Knowledge-Based Sustainability Challenge 📚

Purpose

The *Quiz Game* is designed to test and improve players' knowledge of sustainability, environmental protection, and AI ethics.
Each correct answer represents a positive learning outcome and contributes to the player's environmental impact score.

Game Configuration

Parameter	Description	Value
TOTAL_QUESTIONS	Total number of quiz questions per round	10
POINTS_PER_CORRECT	Green Points awarded for each correct answer	10
TIME_LIMIT	No time limit (player can focus on learning)	Unlimited

Scoring Logic

- **Correct Answer:**
  - score++ (adds 1 to total correct answers)
  - Player immediately gains **+10 Green Points**
  - Function: GameController.addPoints(10)
- **Incorrect Answer:**
  - No points are added; the system records incorrect responses for feedback.

End-of-Game Calculation

At the end of 10 questions, the total score is calculated as:

pointsEarned=score×POINTS_PER_CORRECTpointsEarned=score×POINTS_PER_CORRECT

Examples:

Correct Answers	Formula	Final Points
7/10	7 × 10	70
10/10	10 × 10	100

Point Storage and Progression

- All Green Points are stored in localStorage, allowing cumulative progress over sessions.
- This design ensures learning motivation and continuity of reward beyond a single playthrough.

5.2 Trash Sorting Game – Action-Based Environmental Challenge

Purpose

The *Trash Sorting Game* simulates real-world recycling behavior.
Players earn or lose Green Points based on how accurately they sort falling waste items into the correct recycling bins.
This encourages players to learn proper waste categorization and take real-life eco-friendly actions.

Game Configuration

Parameter	Description	Value
TOTAL_ITEMS	Number of falling trash items per session	10
POINTS_CORRECT	Points earned for correct sorting	+10
POINTS_WRONG	Points deducted for incorrect sorting	−5
PASS_SCORE	Minimum score to pass the level	50
GAME_DURATION	Time limit for each session	60 seconds
ITEM_SPAWN_INTERVAL	Time interval between item drops	2000 ms

Scoring Logic

- **Correct Sorting:**
  - score += 10
  - Function: GameController.addPoints(10)
- **Incorrect Sorting:**
  - score -= 5
  - Function: GameController.subtractPoints(5)
- **Missed Item:**
  - No score impact (neutral event)

Conversion Rule

Unlike the Quiz Game, Green Points are **added or deducted immediately** in real-time as the player interacts.
There is **no separate conversion or summary phase** at the end.

Example Calculations:

Correct	Incorrect	Formula	Final Points
8	2	(8×10) − (2×5)	70
5	5	(5×10) − (5×5)	25

Pass/Fail Condition

To successfully complete the game:

Pass if score≥50 Pass if score≥50

Otherwise, the player fails and must replay the game to achieve a higher score.

Feedback and Learning

After the game, the system displays an educational message showing which waste items were misclassified and the correct recycling categories, reinforcing sustainable learning outcomes.

5.3 Tree Growth System – Visual Progress Mechanism

Purpose

The *Tree Growth System* acts as a long-term reward tracker that visualizes players' cumulative environmental impact.
Each level of tree growth reflects the player's total accumulated Green Points from all games combined.

Tree Stages

Stage	Name	Required Points	Visual Representation
1	Seed	0–20	A small planted seed
2	Sprout	21–50	A young sprout emerging from soil
3	Sapling	51–100	A small, green tree with few leaves
4	Young Tree	101–150	A taller, stronger tree
5	Blossoming Tree	151+	A fully grown tree with blossoms

Growth Algorithm

1. Green Points are **cumulative** and stored persistently in localStorage.
2. Upon reaching a stage threshold, the system automatically updates the visual state of the tree.
3. This persistent design creates a continuous sense of achievement and ecological awareness.

Example Flow:

- Player earns 70 from Quiz Game → Tree becomes *Sapling*
- Player earns 40 from Trash Sorting → Total 110 → Tree evolves to *Young Tree*

5.4 Comparative Overview Between the Two Games

Criteria	Quiz Game	Trash Sorting Game
Focus	Knowledge (Sustainability & AI Ethics)	Action (Recycling Practice)
Total Units	10 questions	10 falling items
Time Limit	None	60 seconds
Scoring	+10 per correct answer	+10 correct / −5 incorrect
Point Deduction	No	Yes
Maximum Score	100	100
Minimum Score	0	−50 (theoretical)
Pass Condition	None	≥ 50
Point Update	At end of game	Instant during gameplay
Learning Focus	Theoretical knowledge	Practical behavior

5.5 Summary of Scoring Workflow

For Quiz Game:

1. Player answers 10 questions.
2. Each correct answer → +10 instantly.
3. Final score = score × 10
4. Points saved to localStorage.

For Trash Sorting Game:

1. Items fall every 2 seconds for 60 seconds
2. Correct sorting → +10 ; Wrong sorting → −5 .
3. Final score = current accumulated score.
4. Pass if score ≥ 50 .

5.6 Unified System Objective

The shared objective across both games is to **collect and accumulate Green Points** to nurture a virtual tree from **Stage 1 (Seed)** to **Stage 5 (Blossoming Tree)**.
This integrated system motivates consistent engagement, visualizes progress, and promotes **sustainable learning through gamification and AI-powered feedback**.

By connecting environmental actions (sorting, learning) with digital rewards (tree growth), the GreenGrow project transforms small eco-friendly habits into tangible progress, reinforcing the message that **“Every drop counts.”**

Game 1: Environmental Quiz

- Players answer 10 randomly selected multiple-choice questions related to environment, human impact, and SDGs.

- Each correct answer grants 10 points (equivalent to 1 water drop).

- A full quiz (10/10 correct) rewards 10 water drops.

Game 2: Waste Sorting Challenge

- The player controls one of four types of bins (organic, recyclable, hazardous, or general waste).

- Various waste items fall randomly, and the player must move the bin to catch items that match its category.

- Players can make up to 3 mistakes before the game ends.

- Sorting 10 correct items earns 200 points, equivalent to 20 water drops.

Plant Growth System:

- Players use collected water drops to grow their trees through five growth stages:

    1. *Seed* (0–20 drops)
    2. *Sprout* (21–50 drops)
    3. *Sapling* (51–100 drops)
    4. *Young Tree* (101–149 drops)
    5. *Blossoming Tree* (150 drops)

Each time a tree reaches full bloom, the player's Tree Count +1, and the used water is deducted.
The total number of trees determines the player's position on the global leaderboard.

6. Reflection

Through the "GrowGreen" project, our team learned how technology and creativity can combine to address environmental issues. The project not only challenged us technically — from integrating AI APIs to designing user interaction — but also inspired us to think deeply about how games can shape awareness and drive positive change.

By gamifying sustainability, we bridge the gap between *knowledge and action*, turning learning into motivation and competition into community impact. The most rewarding

part of the project is its potential to extend beyond virtual boundaries — to classrooms, environmental clubs, and real-world tree-planting initiatives.

In the future, we plan to expand “GrowGreen” with:

- Real-time global challenges (e.g., “Plant 1000 trees in a week”)
- Multiplayer cooperation modes
- Integration with actual NGOs for donation tracking

Ultimately, “GrowGreen” represents a vision where playing a game can help grow a greener planet — one tree, one drop of water, one player at a time.