Problem Statement:

Most of the people do not know about waste segregation, animal health issues, and food insecurity.

We aim to teach about these issues to the young minds with the help of a small game. Thus, we target the following SDGs listed by UN:

Goal 06 : Clean water and sanitation

Goal 15 : Life on Land

Goal 02 : Zero Hunger

Proposed Solutions:

We propose to make a 2D platform based game to educate the young generation about these SDGs.

We propose multiple levels where each level targets a particular SDG. The player is supposed to collect various items throughout the level and utilize them wisely to proceed to the next level. For example: in one of the levels, the player has to collect different waste items hidden in the level and segregate them at the end.

These small tasks in the game target the unconscious minds of young children and teach them about waste segregation and make them responsible humans. For example: the animal based level, as well as the food collecting level makes them emotional and caring towards animals and humans.

Hopefully, this game will help in developing sustainable habits in the younger generation which will play an indirect significant role in fulfillment of SDGs.

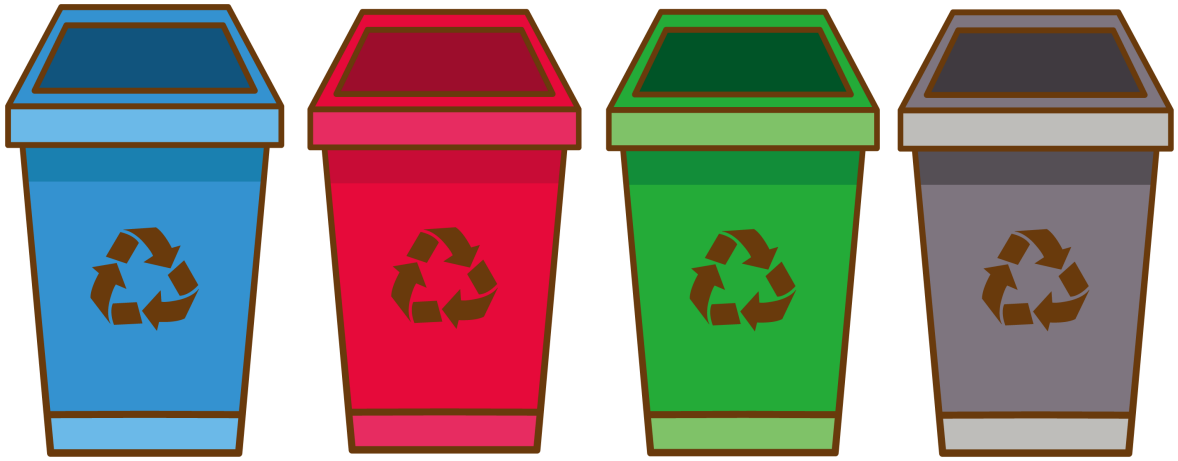
Game Play:

The protagonist of the game, Veda, a normal civilian, is unaware of different threats that the world is currently facing for example, climate change, food insufficiency, animal cruelty, lack of potable water et cetera. As she explores the city, she starts knowing about the different problems and the vigilante inside her wakes up and she starts on a mission to target the problems the current world is facing.

The first level targets SDGs Number 06 - Clean Water and sanitation where Veda has to collect different types of waste scattered throughout the map. The different categories of wastes are wet waste, dry waste, medical waste and electronic waste. The wet waste includes kitchen waste et cetera. Dry waste includes old newspapers, plastic bottles, glass bottles , cold drink cans, et cetera. Medical waste includes used bandages, syringes, gloves, masks et cetera. Electronic waste includes broken laptops, batteries, smartphones.

At the end she needs to segregate them into different colors of dustbins. Wet Waste should go in green dustbins , dry waste in the blue ones, medical waste in the red one and electronic waste should be in the black one. To complete the puzzle, she has to collect all waste from the map and place it into the correct dustbins. The waste item will disappear if it's placed in the correct dustbin. Failing to collect all the waste and trying to submit the puzzle will prompt her with a wrong answer verdict. Otherwise, she will be prompted with an All Correct verdict.

She also has to avoid the radioactive and toxic waste scattered throughout the map going through which will reduce her life.



DRY WASTE **MEDICAL WASTE** **WET WASTE** **ELECTRONIC WASTE**

The map is also loaded with various other things which will be required for the forthcoming levels - for example, food items.

The second level targets other two SDGs - 15 Life on Land and 02 Zero Hunger. In this level, as Veda explores the city, she finds injured, famished and agonized animals such as dogs and cows. She needs to find food and water hidden in the map, she collects them and feeds them to the animals.

She also finds a malnourished and poor child, whom she feeds. The map is packed with Hidden cash reserves which Veda needs to find and use them to build a Hospital catering to injured/sick animals.

Technologies:

1. Unity Game Engine
2. Visual Studio IDE
3. Unity 2D toolkit
4. C#
5. Git and github
6. Adobe photoshop

Contributions:

CS20B012 Harmit Singh Bains:

1. Implemented a custom **Inventory System**.A brief description of the components is as follows :
    - **Interface Design** - This refers to the inventory panel (as we see in UI).The UI design involves a panel and a grid of placeholders anchored symmetrically , along with a close button.
    - **Interface Logic** - This refers to the mechanism which happens in the background (response to the events) .In the game specific events were created which were invoked to populate the placeholders.
    - **Shared Inventory** - During Scene transitions , all the game objects and data stored in that particular level are destroyed . In order to preserve the inventory items, a custom recovery mechanism was implemented.A script was written to implement it and it was then converted to a custom object for reusability.

    For Level 2 Inventory mechanism a custom logic was written to support the locking and unlocking of icons.

2. Implemented a custom **Drag and Drop system.**A brief description of the components is as follows :
    - **Implementation of drag and drop mechanism -** Implemented the interfaces for e.g. IDragHandler ,IDropHandler to support drag and drop
    - **Logic** - Similar to the inventory system the system worked in response to the callbacks during execution of an event.
3. Implemented a basic **Scoring system**.
4. Worked on the **User Interface** for the game

5. Contributed in **scripting** of logic and assets and maintained a production folder structure to support **extensibility**.
6. Worked on **Game Design**.
7. **Built** and **deployed** the game online.

CS20B018 Ishaan Kulkarni:

- Contributed to the Game Design
- Implemented the UI of the game
- Handled the interactive game objects and event callbacks
- Designed the event loop and the life-cycles of the objects
- Handled minor deployment issues
- Contributed to the documentation of the work
- Contributed to the slides for presentation

CS20B034 Sachin Kumar Sahu:

- Contributed to the Game Design
- Played a pivotal role in asset collection and management
- Implemented the UI of the game
- Handled the interactive game objects and event callbacks
- Designed the event loop and the life-cycles of the characters
- Handled minor deployment issues
- Contributed to the documentation of the work

CS20B054 Anush Mangal:

- Contributed to the **level design and map design** of the game
- Placement of the objects and callback triggers on the map
- Photoshop of the sprites - Enhanced and fine tuned the individual sprite pieces
- Contributed to game logic
- Implemented game objects, activating and deactivating scripting
- Contributed to puzzle design of waste segregation - Selection of dustbins and types of waste
- Contributed to the documentation and slides of the game

CS20B046 Soham Nandy:

- Contributed majorly in **Life Cycle of character and object** implementation
- Worked on Game Design - Distribution of the levels, the flow of the game and the event loops scheduled
- Contributed to Level 2 Design - The descriptive analysis of the characters and the objects procured in the level
- Contributed to the UI Panel scripting

- Debugged the components of the game before the final production

Audience Targeted :

- Our game is intended for the young generation.
- The small tasks in the game target the unconscious minds of young children and teach them about waste segregation and make them responsible humans. For example: the animal based level, as well as the food collecting level makes them emotional and caring towards animals and humans.
- Hopefully, this game will help in developing sustainable habits in the young generation which will play an indirect significant role in the fulfillment of SDGs.

Existing solutions and Novelty :

- No score based competitive educational games were to be found.

Software engineering principles used:

Since it was only a short-term project, we used the **Classic Waterfall Model** to build our application.

The first step was to decide the problem statement, which would fulfill the Sustainable development goals. Then we came up with the idea of a game called **G4SDG aka Game for Sustainable Development Goals**.

Requirements:

The first step was to decide the requirements specifications and we spent a considerable amount of time finalizing the requirements. It was done to ensure that the least amount of errors propagate to the next layers of the **Classical Waterfall Model**. Our requirements include deciding the game logic, analyzing the SDGs and connecting it to SDGs, This requirement specifications stage took **3-4 days**.

Design:

The next step was to **finalize a design** and the basic gameplay of the game. We all team members sat together and discussed different possibilities for the user interface. We sat with pen and paper and brainstormed over different storylines and ideas of the game and finally the design evolved to the current version of UI. Our gameplay is **simplistic and engaging**. We thought of designing three levels each targeting a specific sustainable development goal. Our initial decision was to make all the three levels

independent of each other. We narrowed down to **Unity Game Engine** and the **Unity 2D** Game toolkit. This design part took **1-2 days** to complete. This design was the **Prescriptive Architecture** of our game.

Later on into implementation, we changed our initial design of three independent to two dependent levels with a storyline.

Our design decision was such that our game **compatible with all web browsers** thus following the **portability quality**. Thus, we **finally** decided to use **Unity Game Engine** and the **Unity 2D Game toolkit** for our app development project.

Implementation and coding:

The next step was implementation and coding. We implemented our ideas and the prescriptive architecture gradually changed to the current **Descriptive Architecture**. Both of them are slightly different as suggested by the software engineering principles. Implementation of our game also took a considerable amount of effort as we all had to learn **C#** and **Unity Game Engine** for game development.

We implemented a **shared inventory system** for storing all the collected items. The inventory system aims at **linking the two levels** through storage of the items. The shared inventory works through the **memory recovery mechanism**, which was **custom** implemented.

Testing and Evaluation:

We installed the game on Multiple laptops, measured performance, and made observations. The outcome is that requirements for the game are 4GB Graphics Card, 8GB Ram and a good cooling system for optimal performance and 2GB Graphics Card , 4GB Ram as minimum requirements(Manual Execution).

Online game requires WebGl2 Support which almost all of the current browsers provide.

Note - Unity Installation and Project management was done on only one machine.

Reasons :

- One machine had no integrated graphics card , so it was not a good idea to install Unity there (it was one of the prerequisites of Unity Software to have a graphics card support).
- Two machines were MAC OS systems and Unity Game Development is not preferred in MAC OS machines.
- One machine ran out of storage as Unity Installation consumes a lot of space and creates copies in Local Drive C.So installation was unsuccessful there due to insufficient memory space.

As a result we did all the development related to this project in a single machine and the github repository was maintained through a single account.

Anticipation For the Change:

The game, targeted specially for the aforementioned three SDGs can be updated to include more SDGs.The assets and images used in the game can also be updated to better and more targeted assets. A database system can be implemented which can maintain a realtime scoreboard

Portability:

Since the game is hosted online, it is browser and OS independent. To run it as a standalone application, the executable of the game is available for all major Operating Systems - windows, linux, MacOs

Possible Extensions for the App:

1. More and more levels can be procedurally added.
2. Can be made into a multiplayer real time game.
3. Real time leaderboard system can be added.
4. A Mini Map can be added to the system.
5. Randomized Map generation.

UserManual

Common Instructions:

- Veda moves with **A** and **D** keys, left and right respectively
- She jumps with the spacebar
- She crouches using the **S** key
- The inventory is toggled by **I** key
- The puzzle for waste segregation is opened by reaching to the **info post**
- The user can check his/her score through the real time **score panel**

Main Menu:

- The Main Menu comprises the **Start**, **Option** and **exit** buttons each directing to what its name suggests.

Level 1:

- Items are collected by moving to the vicinity of the items and are stored in the inventory
- The map also contains **toxic & radioactive waste** distributed throughout the map, coming in vicinity to which will decrease the life of Veda by **1 heart point**.
- The game also has a acid pond, drowning in which will take Veda back to the starting location with her health depreciated by one
- In order to solve the puzzle, she has to **drag and drop** the correct waste into the respective dustbins -
    - **Wet waste** has to be dropped in **Green dustbin**
    - **Dry waste** has to be dropped in **Blue dustbin**
    - **Electronic waste** has to be in **Black dustbin**
    - **Medical waste** has to be dropped in **Red dustbin**
- If the item is dropped in the correct dustbin - the user gains **100** coins, otherwise a penalty of **20** coins is imposed
- If the user manages to classify all the waste items present in the map of level 1, a bonus of **10000** coins is added to the existing score
- The gate leading to the next level is hidden in the map which Veda needs to find.
- She can move to the next level even without completing the previous level . But she might lose some of the items which might be required in the next levels.

Level 2:

- Similar to level 1, items are collected by moving to the vicinity of the items and are stored in the inventory
- After the items has been collected, the user needs to choose an appropriate item which would be required to solve the current problem - for example, One needs to

deposit a stack of notes to a donation box, which will build a hospital in the vicinity
- If the chosen item is correct, the user gains **500** coins otherwise a penalty of **50** coins will be levied
- The map also contains **toxic & radioactive waste** distributed throughout the map, coming in vicinity to which will decrease the life of Veda by **1 heart point**.
- The game also has a acid pond, drowning in which will take Veda back to the starting location with her health depreciated by one
- To complete the game, the user has to find the hidden door in the map - which will lead him to the scoreboard

Option Panel:

- The user can access the Option Panel by pressing the **ESC** key
- The user has the option to adjust various settings such as Music and Sound volume, can view the controls, restart the level etc.

Link to online game:
https://harmitsb.itch.io/g4sdg?secret=cPZfjpUc2kQfdUelSDhUS3lQ9A

Password: **T4GAME**

Executable:
https://drive.google.com/file/d/1CsqQkbMVGSm0Cdl8R9QcCmDDbbVXkFMd/view?usp=sharing

User Manual : UserManual - G4SDG

Note: For online mode, to gain the best of experience, users are recommended to switch to **Full Screen mode**.