Chasing Change: the Escape Room for World Changers

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***Abstract*— This innovative virtual escape room game is designed to educate users about the United Nations' 17 Sustainable Development Goals (SDGs). With the rise of digital engagement, this game caters to a younger generation receptive to gamified learning experiences. Using Java's four pillars - encapsulation, abstraction, inheritance, and polymorphism, the game provides an immersive platform for users to understand the SDGs via real-world challenges and problem-solving. Although the initial launch will feature a minimum of five SDGs due to time and resource constraints, the team plans to expand the game to encompass all goals. The project follows a methodical approach, including planning, design, development, testing, troubleshooting, documentation, and presentation phases. Despite various project constraints, the main focus is the game's quality and educational value, making it a powerful tool for promoting sustainability awareness and inspiring action towards global change.**

Keywords—Gamified learning, Virtual escape room, Sustainable Development Goals, Interactive education, JavaFX

I. Introduction

In an era where digital learning and engagement have transformed, especially among younger generations, this application leverages interactive and gamified experiences to promote understanding of the SDGs. It presents real-world sustainability challenges in a fun, immersive environment, sparking a sense of urgency and empowerment to address these global issues.

The primary goal of this program is to meld gaming and education, helping users comprehend the complex aspects of the SDGs and sustainability. Offering puzzles that reflect genuine sustainability problems, it fosters critical thinking and problem-solving skills. Features like timed progress, scoring, leaderboards, and achievements are planned to encourage competition and repeat participation. The aim is to create a virtual environment that doesn't just educate but also inspires users to effect change in their communities, echoing the SDGs' spirit.

However, the project has certain constraints, including time, resources, and technical limitations. Initially, the game will only cover three SDGs due to these constraints, with plans to expand in future updates. Priority is given to the game's quality and educational value over the number of SDGs included at launch. Resource limitations may impact the budget, manpower, and technical proficiency available, while technical constraints could influence the game's design and overall user experience.

A. *Main Objectives*

- To create an innovative and interactive virtual escape room game that educates players about the United Nations' Sustainable Development Goals (SDGs).
- To employ Java's four pillars - encapsulation, abstraction, inheritance, and polymorphism - to create an immersive gaming platform that encourages real-world problem-solving related to the SDGs.
- To prioritize quality and educational value, ensuring that the game serves as a compelling tool for promoting sustainability awareness and inspiring action towards global change.
- To expand the game overtime to cover all 17 SDGs, notwithstanding initial constraints that limit the launch version to cover a minimum of five SDGs.

B. *Specific Objectives*

- To design and develop a virtual escape room game using JavaFX and Scene Builder that provides an interactive learning experience about the SDGs.
- To integrate gamified features like timed progress, scoring, leaderboards, and achievements to motivate competition and repeated participation.
- To present real-world sustainability challenges in a fun and engaging manner, thus stimulating critical thinking and problem-solving skills related to the SDGs.
- To inspire users through this gamified learning experience to take action for change in their own communities, in line with the spirit of the SDGs.

II. Related Work

Escape room games have evolved into fully immersive experiences with high-quality props, challenging puzzles, and engaging storylines. Players form a team and must work together to solve the puzzles within a given time limit to "escape" from the room. The challenges vary from logic

puzzles to physical tasks, encouraging players to think unconventionally and approach problems from different perspectives. The appeal of escape rooms lies in their experiential nature, requiring diverse skills and knowledge from the players.

In education, escape rooms have found applications as powerful and interactive tools for learning. They promote critical thinking, problem-solving, and creativity among students. By designing escape rooms around educational content, teachers can create engaging and immersive learning experiences. For example, in a history-themed escape room, students can explore historical events, analyze clues, and piece together the narrative to progress through the game. Similarly, in a science-themed escape room, students might perform virtual experiments and solve scientific challenges. Escape rooms also foster teamwork and communication skills, as students must collaborate effectively to solve the puzzles. This hands-on and interactive approach to learning can enhance student motivation and retention.

Educators are increasingly recognizing the potential of escape rooms to transform traditional classroom settings. By integrating escape room games into the curriculum, teachers can cater to diverse learning styles and make learning enjoyable and memorable. Furthermore, escape rooms encourage a growth mindset, where students learn from failure and persevere in finding solutions. As educational institutions seek innovative ways to prepare students for the challenges of the future, escape room games offer a promising avenue for promoting critical skills and fostering a positive and collaborative learning environment.

III. Proposed Application

The proposed Virtual Escape Room Experience addresses the gaps in engaging education about the Sustainable Development Goals (SDGs) by leveraging JavaFX and Scene Builder to create immersive escape rooms that focus on SDG-related challenges such as Quality Education (SDG 4) and Life on Land (SDG 15). Traditional methods of educating about the SDGs lack engagement, resulting in a knowledge gap, particularly among the younger generation. Existing solutions fail to immerse users in the complexities of achieving the SDGs or provide personalized learning experiences. Moreover, interactive and entertaining platforms to raise awareness and inspire action towards the SDGs are limited.

To address these gaps, the Virtual Escape Room Experience utilizes JavaFX and Scene Builder. JavaFX enables the creation of interactive user interfaces, incorporating engaging minigames and puzzles for each escape room. Scene Builder complements JavaFX by simplifying UI design, enhancing user-friendliness. The application offers interactive minigames and personalized character selection, enhancing engagement and understanding. Through this approach, players are immersed in challenging scenarios related to SDGs, fostering awareness, empathy, and a sense of responsibility. By integrating these SDGs into the core of the experience, the application encourages players to actively contribute to a more sustainable and equitable future. This innovative and enjoyable educational platform empowers individuals to gain valuable insights and be inspired to make a positive impact on the world, supporting the SDGs.

IV. Implementation/OOP Aspects

A. Materials

In the course of the project, the team employed a suite of software tools, languages, and platforms to facilitate design, development, and collaboration. IntelliJ Idea, a powerful integrated development environment (IDE), was primarily used for writing and debugging Java code. The use of JavaFX, a Java library for building rich internet applications, was integral for creating a sophisticated graphical user interface (GUI). SceneBuilder, another JavaFX framework, was utilized for designing the visual layout of the game, while CSS Styling was applied to improve the aesthetics and user experience of the game's interface.

The project also relied heavily on documentation. Java Documentation was essential for understanding the intricacies of the Java language and its associated libraries, ensuring the team's code was both effective and efficient. PlantUML Documentation was similarly crucial, providing guidance on creating UML diagrams to design and visualize the system's architecture and object interactions.

Collaboration and communication were equally important aspects of the project. Google Docs was used as a collaborative tool for writing and sharing documentation, tracking progress, and managing tasks. Zoom was the platform of choice for remote meetings, allowing the team to discuss issues, share ideas, and make collective decisions in real-time, ensuring a synchronized and harmonious workflow. Together, these materials and tools enabled the successful implementation of the project.

B. IPO Table

INPUT	PROCESS	OUTPUT
➔ Mouse clicks ➔ Keyboard clicks ➔ 3 SDG-themed puzzle challenges ➔ Player's time input ➔ Player's name ➔ Player's appearance ➔ Player's score data	➔ Mouse clicks and keyboard clicks detect user's interaction to navigate around the game, select options, solve puzzles, and interact with the game environment. ➔ In the SDG-themed puzzle challenges, the program accepts the input, processes the user's solutions, and checks for correctness against the game's pre-set answers. ➔ The player's time input is used to measure the time taken by the player to solve puzzles and overall game progress. ➔ The player's name and appearance is used to personalize the player's game character and game experience. ➔ The player's score data processes the score based on the speed and accuracy of solving puzzles ➔ The player's score and time are utilized to generate the leaderboard of the program	➔ Player's in-game actions, such as moving around, picking up items, manipulating objects, or solving puzzles. ➔ Feedback on whether the user's solution is correct. Every correct solution will progress the user in the next level/room of the three rooms. If wrong, hints or prompts are displayed. ➔ A personalized game character and personalized game experiences. ➔ An updated player's game progress based on its total attempts and scores, and individual times for each accomplished room. ➔ An updated leaderboard and achievements section

Fig. 1. IPO Table

"Chasing Change: The Escape Room for World Changers" is an interactive game that employs the critical facets of Input, Process, and Output in its design and execution. Player's inputs, primarily through mouse and keyboard clicks, drive the game's progression, determining character movement and puzzle-solving attempts. Personal inputs like the player's name and chosen character appearance are also included, enhancing the user experience. Other crucial inputs such as time taken to solve puzzles offer additional data points that contribute to the game's adaptive design.

These inputs are processed through intricate algorithms to effectuate the player's in-game actions, evaluate puzzle solutions, adjust the game's difficulty, and personalize the gaming experience. A player's performance, gauged by their problem-solving speed and accuracy, is processed to update the leaderboard, thereby fostering a competitive environment. The output manifests in the game through a range of responses, including real-time player movements, puzzle feedback, level progression, and regular updates of the user's overall progress. Personalized aspects of the game, such as the character's appearance, are also part of the output, enhancing the player's immersion in the gaming world. Additionally, comprehensive performance metrics are provided, giving each player a detailed account of their overall game performance.

C. Flowchart

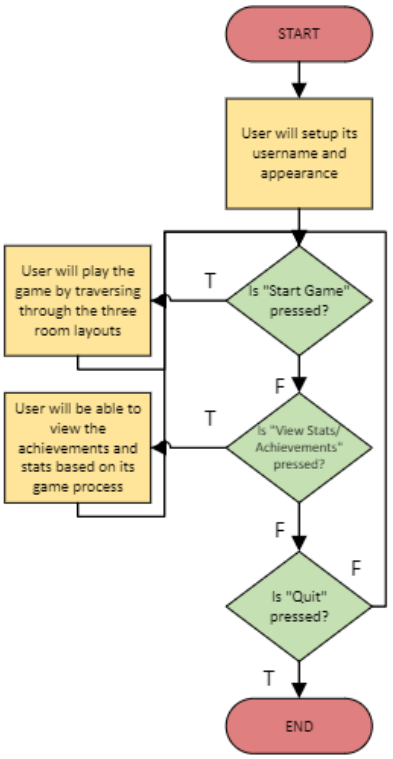

Fig. 2. Simple flowchart of the program

This figure depicts the main flow of the program. At the start of the program, the user will first need to set up its username and appearance. Then, the following elements correspond to the functionality of the Main Menu section wherein the user could play the game, view its stats and achievements, or quit the program. By playing the game, it will go through another complex process wherein the user will need to accomplish three room layouts or games in order to record the time completed and go back to the Main Menu. Aside from that, the view stats and achievements button would lead the user to the section in which the user could view its stats and achievements recorded from the user's game progress.

D. UML Diagram/OOP Aspects

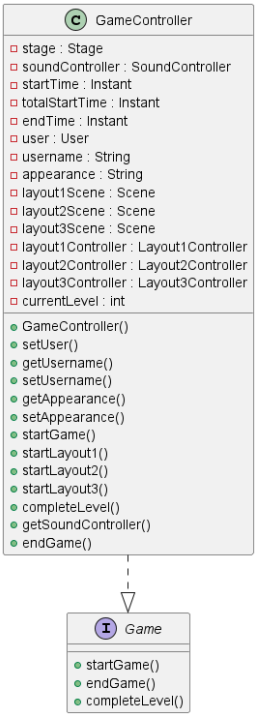

Fig. 3. Abstraction

This figure represents a UML class diagram that showcases abstraction in an object-oriented context. In this design, GameController class implements the Game interface, as indicated by the "dashed arrow" line (GameController ..|> Game). The Game interface is an abstraction of a game, defining a contract that consists of methods startGame(), endGame(), and completeLevel(). This means that any class that implements the Game interface must provide implementations for these three methods. The GameController class, in addition to other attributes and methods specific to it, implements these methods, thereby conforming to the contract set by the Game interface. This is a classic example of abstraction, where system-wide behaviors are defined in a general way (in an interface), and specific classes define or "fill in" these behaviors in a manner appropriate to their context. This approach promotes modularity, flexibility, and a clear contract of expected behavior.

Fig. 4. Encapsulation

This figure represents a UML class diagram that implements encapsulation, a fundamental principle in object-oriented programming. Here, encapsulation is demonstrated in the User and UserSession classes where data fields are marked as private (denoted by the - symbol) and are not directly accessible from outside these classes. Instead, access to these private fields is controlled through public getter and setter methods. This hides the internal state of the objects, shielding the internal complexities and details from outside classes. For example, the User class encapsulates data like achievement and time statistics, providing controlled access and potential validation through methods like setBestTime(), getBestTime(), etc. Similarly, UserSession contains private data about the user's session, again with controlled access provided through its methods. This encapsulation increases security, maintainability, and flexibility, as internal data can only be manipulated in ways allowed by the controlling class, and implementation details can be changed without affecting external classes.

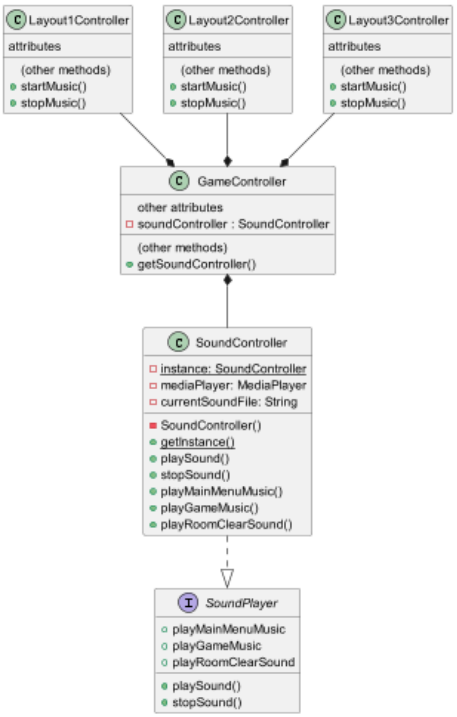

Fig. 5. Polymorphism

This figure illustrates a UML class diagram that demonstrates polymorphism in an object-oriented context. The SoundPlayer interface declares a set of methods related to sound control. The SoundController class implements this interface, as indicated by the "dashed arrow" (SoundController ..|> SoundPlayer), meaning it provides specific implementations for these methods. GameController, Layout1Controller, Layout2Controller, and Layout3Controller all have methods (startMusic(), stopMusic()) which may use the SoundController instance to manipulate sounds. Depending on the context or the runtime type of the object, these methods could have different behaviors. This is polymorphism in action, where the exact behavior of a method for an object is determined by the object's runtime type. Here, polymorphism enables flexible code where objects of the SoundPlayer type can manifest different sound behavior depending on the specifics of the SoundController class. This results in more reusable and easier-to-manage code.

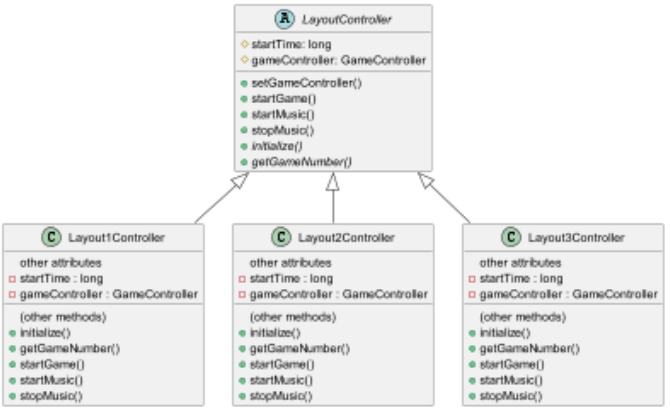

Fig. 6. Inheritance

This figure represents a UML class diagram that showcases inheritance in an object-oriented context. Here, LayoutController is an abstract class that defines common attributes (startTime, gameController) and methods (setGameController, startGame, startMusic, stopMusic) shared among its subclasses. The methods initialize() and getGameNumber() are declared as abstract, meaning they must be implemented by any concrete class that inherits from LayoutController. The three concrete classes (Layout1Controller, Layout2Controller, and Layout3Controller) inherit from LayoutController, as indicated by the "arrow" lines (LayoutController <|-- LayoutXController). This implies they all possess the common features defined in LayoutController, while they might provide their own implementations for the abstract methods. Hence, this diagram depicts inheritance by facilitating code reuse and promoting a clear, hierarchical organization among the classes.

V. Walkthrough/Data/Results

A. Walkthrough

Upon compilation, the application opens a window containing a text box that asks the users for their name. Also, the option to pick between three characters is given to choose from. After placing the user's name, the application will transition to a window that will flash the main menu screen. The user then has the choice to start the game, view the Leaderboard, and exit the program.

When the user clicks on the start button, the window will transition immediately to the first escape room containing the challenge of proper waste management by placing falling trash in their corresponding trash bin. If you successfully place 15 trash in the correct bins, you will be then redirected to the second room. The second room emphasizes an engaging learning environment by allowing users to answer certain questions that will give hints to help in identifying the password for the next room. If then accomplished, the user will automatically be placed in the third room containing cards. The user will be then tasked to match three pairs of card matching to their corresponding SDG pair. Once finished, a

pop up message will be shown, showing the total time spent in escaping the rooms. Lastly, an updated statistics will be available in the leaderboards for the user to keep track of.

Overall, the application is able to present virtual learning in a fun way. Considering the colorful design, students will be able to enjoy an aesthetically pleasing application experience that will make them aware of the concerning issues that should give attention to.

B. Data/Results

Upon completion of the application, the team proceeded to obtain data and feedback from users in order to assess its effectiveness. In accomplishing this, a convenience type of sampling was done by the team through their relatives and friends.

The application's approach to addressing the SDG Quality Education objective by utilizing an engaging, interactive Escape Room concept is both innovative and relevant. Each game employed within the application serves a specific purpose geared towards increasing awareness and knowledge on various aspects of Sustainable Development Goals (SDGs), subsequently enhancing the quality of education for the users.

The Trash Dragging Game, ranked first in the evaluation, was found to be highly effective in promoting responsible consumption and production, a key aspect of the SDGs. It uses an intuitive and interactive mechanism to teach users about proper waste segregation, providing a practical understanding of real-life application and encouraging more sustainable behaviors.

The Memory Card Match Game, ranked second, leverages the power of visual learning and memory enhancement to educate users about the different SDGs. Each pair of cards corresponds to a specific SDG, allowing users to familiarize themselves with these critical global objectives in a fun and engaging way. This game was found to significantly reinforce users' memory retention of the SDGs.

The Quiz Trivia and Password Guesser, despite ranking third, still plays a pivotal role in addressing the issue of quality education. Through its question and answer format, it facilitates cognitive learning and promotes deeper understanding of the SDGs. However, its effectiveness is somewhat limited due to a lack of question variety, which may result in repeated attempts ultimately leading to rote learning. In future iterations of the application, enhancing the question bank diversity can potentially elevate this game's impact.

VI. Conclusion And Future Work

The "Chasing Change: The Escape Room for World Changers" project represents a unique fusion of entertainment, education, and social responsibility. It transforms the traditional escape room experience into an immersive, interactive journey focused on the United Nations' Sustainable Development Goals (SDGs). The application targets a pressing need for public education and awareness about these critical goals, using a gamified environment to engage users and encourage a deep understanding of global sustainability issues.

By incorporating puzzles tied to real-world challenges, this application stimulates critical thinking and empathy, fostering a sense of urgency and motivation to contribute towards a more sustainable future. It utilizes the power of interactive technology to move beyond mere awareness, inspiring action and lasting change in users' real-world communities. Thus, the project is not just a game, but a potent tool for education and change, making complex global issues more accessible and tangible for everyone.

Through its thoughtful design, well-implemented Java principles, and commitment to the SDGs, this project contributes significantly to the broader conversation on sustainable development and the role of technology in driving societal progress. It is a testament to the group's dedication and the transformative potential of combining technology with learning and social responsibility

Looking towards the future, the possibilities for expansion and influence appear boundless. It is envisioned that the app's experience will be enriched through consistent game updates and developments, including the incorporation of new rooms that present novel themes to delve into. An amplified Character Setup with increased customization options is also anticipated.

The ultimate objective is to use this innovative approach to education to bridge the gap between understanding and action, transforming passive knowledge of the SDGs into active engagement in sustainability initiatives. By intertwining entertainment and education, the project aspires to inspire individuals to become advocates for sustainable change, further advancing the pursuit of the United Nations' Sustainable Development Goals.

VII. Contributions

Individual Contributions		
Sean Morales	*Ray Co*	*Inigo Salgado*
Program: Coded Layout1Controller.java, Coded most of the functionalities in the application (interaction, data recording and	Program: Coded Layout2Controller.java, Made the foundation of the application (Initial Look) Documentation:	Program: Coded Layout3Controller.java Documentation: Related work, Proposed Application,

display, assets, etc.), Implemented the OOP Pillars Documentation: Data/Results, Flowchart, IPO Table, All UML Diagrams (OOP Pillars/Application),Explanation of the OOP Aspects (Pillars), Materials Presentation: Added content in slides (References and Screenshots) and Poster (Screenshots)	Formatted the document, added the abstract, introduction, main objectives, specific objectives, Presentation: Added content in slides (Problem Statement, RRL, Phases, and Documentation) and poster (Introduction)	Walkthrough, and Conclusion and Future work Presentation: Mainly created the slides, Improved the design of the poster according to the theme of the application, and content for Conclusion in poster

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