

Tackling Sustainability Through an Interactive Gamified Application

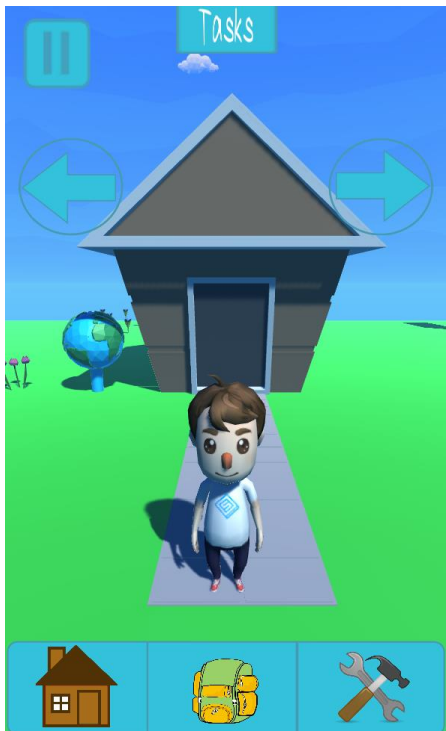


Figure 1: Example of the Main Screen from the Application.

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Abstract

This project investigates how gamification can be used to help tackle the ongoing issue of environmental sustainability. A gamified application has been created that could be used to help promote behaviour change using proven game techniques that encourage the user to act out sustainable behaviour in the real world.

Author Keywords

Sustainability; Gamification; Unity

Biography

This work has allowed me to combine two of my passions together to develop an application that could potentially have a meaningful difference. The issue of environmental sustainability is a huge passion of mine and being able to use my experience with game design

in order to help tackle the problem was the perfect combination for me. This project has allowed me to improve upon my game design skills due to using them with a different goal in mind compared to usual game development.

How to Access Project

The project can be accessed from

<https://github.com/bmoss656/CTP>

The submission branch contains all the deliverables, including builds and video. Within the builds folder, there is a simulated windows build that functions the same as the android application, or there is a .APK file that will run on any android emulator or device.

The Unity project is the folder called "AppProject" and should be opened with Unity 2018.2.2f1.

The video is also uploaded on YouTube:

<https://youtu.be/PzmFwICRic0>

Introduction

The aim of this project was to create a gamified application that could be used to help promote and encourage behaviour change relating to the issue of sustainability. Coskun, ZimmerMan & Erbug (2015)



Figure 2: Application Eco-Scale Which Acts as the Levelling System.

discuss how there is a need for different methods of promoting sustainability to different user groups, this project aims to have done this through the use of gamifying the issue which would allow much easier access to the issue to a different group of people who might usually not engage with the problem.

The issue is so prevalent in society currently and there is currently not nearly enough being done to counter climate change. The IPCC's report on climate change (2018) suggests that this is the last chance for humanity to make a difference before it's too late and the damage is already done, hence why this topic is so important and why it is even more vital to find a way for people to engage with it.

Multiple studies have proven that gamification is an effective method of improving user engagement within an issue. For example, Höchsmann (2019) looked at using a gamified application to improve intrinsic motivation and physical activity, the research was a success and proved the effectiveness of gamification when it comes to increased engagement and behaviour change.

Despite the known effectiveness of gamified applications, there is a distinct lack of sustainability applications that utilize it. Therefore, this project was done with the objective of seeing whether a gamified sustainability application could be the next method of encouraging people to get involved with the issue.

The deliverables for this project are a prototype/vertical slice of a gamified application made within Unity 2018.2.2 (Unity Technologies, 2005) in the form of an

Android .APK file as well as a simulated windows Unity build that functions as an application.

Practice

A gamified application has been successfully created within Unity, the application contains all of the features listed within the research report feature list (Appendix A) and also extra features that have been included during the development stage to improve the quality of the application.

The application created has three main parts that make up the core loop, these are the completion of tasks, leading to improving the virtual environment and gaining currency, which leads to the user purchasing items and customizing their virtual environment. The main unique part of the application is the dynamic environment which changes according to how many tasks the user has completed recently.

Dynamic Environment

The dynamic environment is a vital component of the created application, it allows users to visualize the impact they are having on the in-game environment and in turn can lead them to draw comparisons from what they are seeing in the application, to the real world. This is important because giving the user control over what is happening allows them to feel empowered enough to change their behaviour.

The tasks that the user completes rewards experience, this experience increases the 'Eco-Scale' (Figure 2) which works similar to a leveling system; however, it is displayed in a slightly different way that is more simplistic and would allow any user to understand how they are progressing in the application, since this



Figure 3: Example of Feedback from Completing a Task.

application could be used by anyone it needs to be easy to use for all. This scale of progression is what links the dynamic environment changes with the user's actions, as the scale increases the user transitions through different states that improve how the environment looks and if the user does not use the application or does not do their tasks this decreases the scale and has the opposite effect.

As well as this allowing the users to see the impact they are having, leveling systems are also an important way of keeping a user engaged. Adams (2012, p.71) discusses the importance of a progression system, as it creates a relationship between the user and the game which encourages them to keep coming back. This is important for this application as the more a user comes back, the more the sustainable behaviour change is being permanently learnt and engrained.

On top of the visual differences in the world, it became apparent during development that the user might need some additional information about what is happening to the environment and why changes were occurring, but this information needed to be displayed in an interesting manner.

This led to the inclusion of objects in the environment that the user could interact with which would display information about why the environment looks different depending on how much they engage with the application and also draws references to the real world to make sure the user is also gaining information about the real world issue. Due to the fact these objects are obvious and must be interacted with to be read, it means the user would hopefully be more likely to read the information since they are actively engaging with it.

However, one step to take this aspect further would be to perhaps read in real-time information about the world from an external application programming interface (API) instead of through the current method of customisable text files.

Tasks

The key focus of this project is finding a way to change the behaviour of people relating to sustainability and to encourage them to act out these changes in real life by consciously making decisions that have a positive outcome. During the research phase, it was decided upon that customised tasks would be used to encourage these changes and as such, the final application has this feature included. Zichermann & Cunningham (2011, p.86) discuss the importance of giving the user direction using challenges and tasks in order to keep them interested, as without this engagement users will lack any sort of interest and therefore will not sure the application.

Customisation is a key part of making the user feel connected to what they are doing, Zichermann & Cunningham (p.92) further go on to discuss the importance of customisation and how it directly links to a level of commitment between the user and the application. Therefore, varying levels of customisation are included throughout the application. Within the tasks section, on initial entry the user can fill out a short section about themselves which then allows them to choose from a customised list of tasks that then are saved and used for both the daily and weekly section of tasks. Unfortunately, the section about the user is not currently linked to the tasks they can choose from, however the functionality for this is there as all the information is saved but just not full implemented.

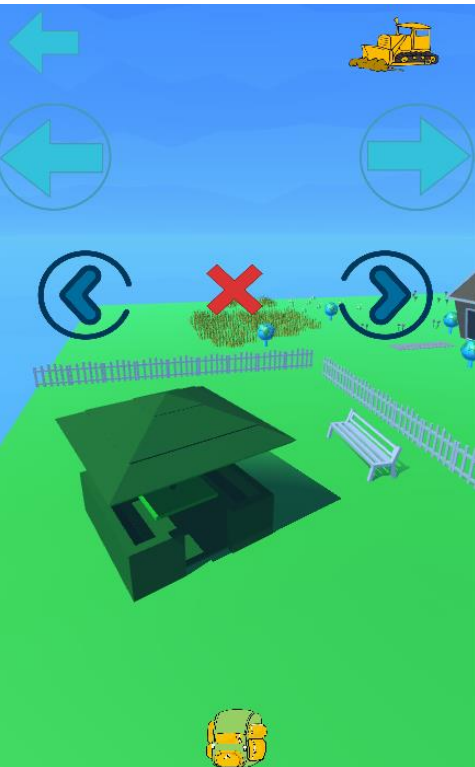


Figure 4: *Building System in Use.*

An issue that was had was saving user data within the application, as Unity has basic built in functionality for saving data in the form of PlayerPrefs (Unity Technologies; PlayerPrefs), but this functionality was far too basic for the information that needed to be saved. PlayerPrefs also does not allow for any data serialization meaning the saved data is not secure and could easily be modified which could have had detrimental effects on the application. Instead a more robust save system was made, this involved creating serialized classes for different data that needed to be saved and then using binary formatters to write this serialized data out to a file, as well as using some custom data wrappers since certain Unity functionality, such as Vectors cannot be serialized. This allows for variables within Unity to be customised for the user and easily saved and loaded back in when they use the application.

The information that decides the different tasks that can be chosen is read in from text files which allowed for quick changes to be made in development when testing different types of tasks. It simply requires modifying the text files and adding new lines of tasks, which also leaves the application open to further changes such as linking the tasks to other external data which could be easily read in using the existing system.

Having tasks are important but making sure the user feels rewarded on completion is a key part of the success of these systems, McGonigal (2011, p.148) talks about the importance of meaningful rewards and how better feedback leads to more effort put in. Throughout development feedback for the user improved and changed in several ways. Initially on completion of a task it would simply disappear, this

evolved into a system that provides multiple types of user feedback. In the final prototype of the application, when a user clicks on a task the sprite changes to a different colour and has a green tick, a particle system was implemented that plays when the task is marked as done and finally sound effect is played on task completion. These different types of feedback give the user a much greater sense of accomplishment and help the user feel much more rewarded for making the effort.

Customisation/Building System

A problem that was encountered during development was keeping the balance of a game within a system that was trying to entice behaviour change towards a serious issue and as discussed in the research report, Ferrara (2013) looks at how many gamified products simply "tack on" useful parts of what defines a game, which is something this project wanted to avoid.

To counter the application simply involving interaction with tasks and not much else, one of the features added to help this was the feature that allows users to 'build' within their in-game house and in an area in the outside environment. This helped solve the issue mentioned above in a couple of different ways and included other positives on the overall design of the application.

The reason this helped the problem was that it gives the user something tangible to do and interact with, the system allows a user to purchase items from within a shop section of the application. Currency for this shop is gained through task completion, this means that players are encouraged to keep coming back to the application in order to earn more currency so they can

purchase the more expensive items in the shop. Fullerton (2014) discusses how resources can keep a user coming back to a system, so the research proved this type of system was a good addition to the project.

The user can place purchased items into set areas within the application environment and customise these areas however they wish. Not only does this added feature solve the problem, but it also improves user motivation, because as discussed by Dichev et al (2014) game dynamics such as customisation can be used to help user motivation due to the added level of interactivity.

This feature was built using a combination of ray casts and touch functionality. The building state is separate to normal game state and brings up different UI once selected. The user is able to select an object, which is done by sending a ray cast out from the touch position and manipulate the object from there, it will follow the position of the touch on screen and the material changes depending on whether the object is in a suitable location, this can be visualized in figure 4.

Discussion of Outcomes

Final Project and Significance

The main goal of this project was to see whether a gamified application could be an effective method of educating and changing behaviour related to sustainability. The finished project is at a point where to fully gain an answer to this question, user testing could be conducted. The finished application contains many proven gamification techniques that are shown from the research to be effective methods of engaging a user with a topic.

On top of these proven techniques, the dynamic environment adds a new technique that allows the user to see how their actions are affecting their digital world in real time, which allows them to draw similarities to the real world. This should ideally increase user engagement as the would be able to feel a stronger connection with something they are more easily able to relate to. This new method of combining direct real-time visual differences with exactly what a user is doing in the real world could lead to much more effective ways of making someone understand climate change and sustainability. Combining this with the proven techniques leaves a project that could have a real impact should it be taken further.

This project is significant in a wider professional context for a few reasons. It is taking proven gamification techniques and improving upon them by combining them with new techniques in order to create an application that from research is unlike any other available. With mobile gaming and gamification continuing to rise, as discussed by Bohyun (2015), this type of project could be one of the best ways to tackle the issue of sustainability and should be further investigated.

Project Objectives

The project had clear goals set out from the research phase, with a full feature list being created and a unique Octalysis framework was created (Appendix D) that the application should follow. The application meets all the desired features from the feature list (Appendix A) except for online leaderboard support. The networking section of the application was dropped during development for several reasons, the main reason being that with all the other features included,

the addition of networking would not have added anything new to it. Users can already compare their score on the application between each other and are encouraging to do so within the task section of the application.

Every feature within the application has a purpose and a need, so adding the networking feature that might not be needed may start to bloat the application and overcomplicate the prototype. However, if product testing was done on this application and it was found that it needed more social interaction, then perhaps a step to take this application further would be to look more deeply into the social aspect of gamification.

Gamification and sustainability have been combined before, one example is the bottle bank arcade (Bohyun, 2015) which encourages people to recycle plastic and glass bottles using an arcade game mechanic. However, gamification and sustainability have not been combined in this way before, there are some applications available that try to educate about sustainability through a game format but research has not shown any sort of application that actively encourages people to make behaviour changes in the real world. This means this application could potentially be used to trial how effective a gamified sustainability application is at educating a completely different target audience than usual due to the different market this sort of application has.

Project Next Stage

The application is polished and bug free, with all the features needed for it to function effectively being implemented. This means that it would be ready to undergo user testing to see whether the techniques

chosen are effective at the goal of changing behaviour towards sustainability.

If user testing were to be completed, due to the nature of the application it would need to be done over a period of time, most likely users would be given the application for a week and at the end of this time period they would fill out a questionnaire, an example questionnaire has been created and can be seen in appendix B. This information from the questionnaire would be vital in deciphering whether the gamification techniques used in the application are an effective method of sustainable behaviour change or not.

On top of the questionnaire, backend data collection would also be important. It would be important to know exactly what parts of the application users were interacting with, because for example the interactive globes in the environment that relay information about the game's current state need to be actively interacted with and it would be useful to see whether users are reading this information. It would also be useful to see average time spent on the application per day as well as how many tasks were being completed.

Combining the questionnaire data and the backend data would help form a complete picture about the effectiveness of the application and this would be the ideal next step in deciding whether the new technique using a dynamic changing environment is effective or not.

Conclusion and Recommendations

The project has been a success, the application created meets the brief set out in the research report and contains multiple proven meaningful gamified

techniques that are shown to help users make meaningful differences against important issues. The application follows techniques from research into gamification as well as new techniques created that stem from that research as well as general game design knowledge. The application tries to get the combination of game feel (Swink, 2008), which looks at different ways a game feels to the user, and relaying the important information just right in order to keep the user engaged enough to want to use the application whilst making sure the behaviour change is occurring.

Whilst the application created does meet the design brief and initial idea that was planned out, there is huge amounts of scope for this project to be taken further. There are numerous features that could have been included but due to time restraints were not and because of the modular approach to development the application underwent, it would be easy to add in new features without affecting the current state of the application. On top of this, much of the functionality for the application to be taken further is already there in the scripts, as everything was written with reusability in mind, meaning that most of the codebase would be easy to re-use or expand upon for future features.

One part of the application that could be expanded upon further is the state/levelling system used. It is currently linked to how often tasks are completed which works well as a system on its own, but there is scope for different parts of the application to also affect this. An idea that was discussed during development was combining the items brought from the in-game shop to the state of the game. For example, the user can purchase plants in the in-game shop and the idea was to link these plants that are placed around the

environment to how fast the states change. The user could have the option to water their plants or even specific real-life tasks that relate to plants and this could accelerate the levelling process if they were maintaining their environment well. This would add another level of user interaction which would help with keeping the user engaged and coming back.

Another main recommendation for a way to expand the application would be the inclusion of networking aspects. These were discussed in the project proposal and the research report but were left out of the final prototype due to design decisions during development. Adding social elements to the application would have multiple positive effects, the main one being that social engagement would increase awareness of the issue due to having an increased number of people discussing the problem. As well as this, social elements are proven (Negruşa, 2015) to help encourage people partly due to the added layer of competition which would mean more people competing to complete tasks.

There are countless other ways that this project could be taken further, with features such as different environments to explore, more customisations of avatar and the environment, if the application was linked to a specific company such as the UN (United Nations, 2019) there would be lots of potential for linking the information in the application to an API which directly reads in real time information about the issue.

For this project however, the application is at a suitable point where user testing could be conducted, and it shows the potential power of gamification in helping tackle the issue of sustainability using new techniques

that help connect the user with their own real-world actions.

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Appendices

Appendix A:

Application Feature List:

- Customisable interactive avatar
 - Gives reminders about electricity consumption.
 - Communicates tasks to the user.
- Personalised 3D environment
 - The user's avatar 'lives' here, communicates to player about their behavior.
 - Visual changes depending on the user's actions.
- Challenges personalised to each user
 - Daily challenges that are easily achievable for most users.
 - Harder individual challenges to keep interest.

- Larger social/monthly challenges.
- Unlockable customisations: Activated through user's real-world actions
 - Users are rewarded for being more aware of their actions, essentially working as levels.
 - Levels will act as a green scale; user will move up this scale the eco-friendlier they act.
- User's will be ranked and can compare, through leaderboard support, with their friend

Appendix B:

Testing Questionnaire Example:

How often did you use the application?

How did you find the task system?

Do you understand why the environment was changing?

How did you find the building system?

Do you feel like you've made a difference whilst using the application?

Have you learnt anything new from using the application?

Was anything hard to understand/use?

Appendix C:

Assets used:

3D Models:

Earth:

<https://assetstore.unity.com/packages/3d/environments/landscapes/stylized-earth-94673>

Shop Items:

<https://assetstore.unity.com/packages/3d/environments/low-poly-megapack-lite-136629>

<https://assetstore.unity.com/packages/3d/props/furniture/big-furniture-pack-7717>

Skybox:

<https://assetstore.unity.com/packages/vfx/shaders/free-skybox-cubemap-extended-107400>

House + Environment:

<https://assetstore.unity.com/packages/3d/low-poly-country-house-66203>

Avatar:

<https://assetstore.unity.com/packages/3d/characters/humanoids/character-pack-free-sample-79870>

Sound:

<https://soundcloud.com/xaxattax/anima-isle>

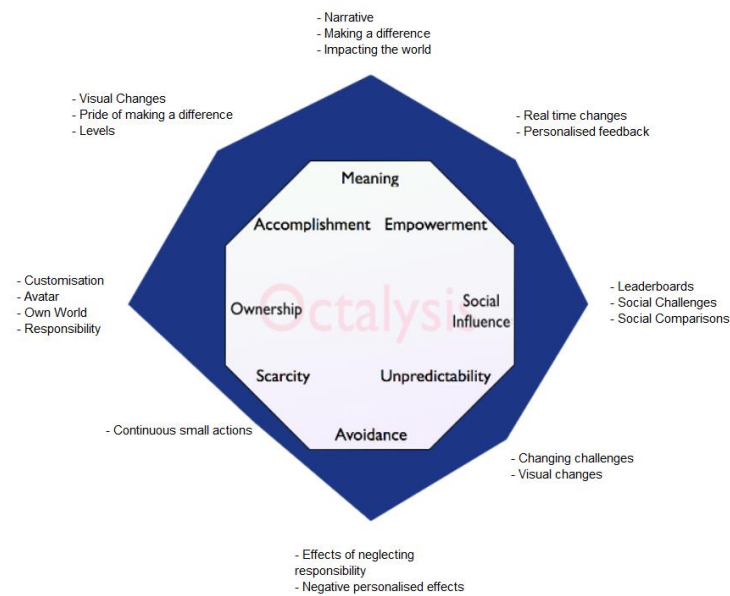
<https://freesound.org/people/rhodesmas/sounds/320653/>

UI elements made using:

<https://vectr.com/>

Appendix D:

Customised Octalysis framework (Chou, 2018)



Appendix E:

A project board on github was used to manage the tasks for the project and shows features that would be added allowing more time.

<https://github.com/bmoss656/CTP/projects/1>