Creative Technologies: Research Report

Tackling Sustainability Through an Interactive Gamified Application

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Figure 1: *State of the Global Climate.* (WMO, 2018)

Abstract
The project aims to increase awareness of environmental sustainability and change behavior regarding this issue. It will take the form of an interactive application which will use multiple gamification techniques.

Author Keywords
Gamification; Sustainability; Behaviour Change; Unity 3D

Introduction
The projects purpose is to create an effective method of changing behavior towards environmental sustainability. A gamified application will be developed in Unity 3D 2018.2.2 (Unity Technologies, 2005) as a platform to tackle sustainable behavior change. Sustainability is a pressing issue for the future of our planet and can be defined as development that "*meets the needs of the present without compromising the ability of future generations to meet their own needs*" (United Nations, 1987: 204).

Figure 2: *Home screen of Global Hero game.* (Nutrien Ltd, 2018)

The United Nations (2018) have developed 17 Sustainable Development Goals (SDGs) to be achieved by 2030 (Appendix A), in order to help tackle the issue. However it needs urgent attention because according to the IPCC (2018), this is humanity's last chance to act on climate change.

Therefore, new techniques are desperately needed in order to make a difference and address the goals. With gamification evolving to be a prominent feature of many applications, as discussed by Bohyun (2015) about the popularity of gamification, this project will draw on meaningful gamification techniques to encourage behavior change.

Research Questions

- How can information about sustainability be integrated into the application?
- What gamification techniques will be most effective for the project?
- Is Unity 3D suitable for the development of the application?

Sustainability

Sustainability is currently being tackled in many ways, for example the 5p levy on plastic bags has dramatically decreased their use (BBC, 2016). There are also company level initiatives such as Apple who now power all their operations with renewable energy (Apple, 2018). However, considering the IPCC's warnings, this is not currently enough.

Kenis & Mathijs (2012) investigate behavioral change and how an individual can feel powerless regarding sustainability issues. Therefore, this project aims to instead make the individual feel empowered to make a difference, using gamification techniques to encourage them.

Sustainability, however, is an incredibly holistic topic. Dempsey (2011) discusses how the issue incorporates not just environmental concerns but also economic and social dimensions. Therefore, tackling it in its entirety is not feasible and will not be the most productive method for the project. Instead, this project will be focusing on a specific issue within sustainability: energy consumption. This will be in context of SDG 7, affordable and clean energy, and SDG 13, climate action.

Sustainability Applications

Some applications already exist that attempt to increase awareness about sustainability. For example, the app *Eco City* (Nevosoft Inc, 2018) puts the player as a mayor of a town and encourages the player to manage a city in order to build it in an eco-friendly manner. The game does try to increase awareness about renewable electricity and other sustainable ways of living, but the general message is lost behind most of the gameplay elements. However, this project will draw on the concept of a customised environment which will change and evolve along with the user's real-world actions. This will create a sense of ownership for the user as they will be able to visualize their actions.

Considering an application with similarities to this project, *Global Hero* (Nutrien Ltd, 2018) in Figure 2, is

Figure 3: *Social Engagement Loop.* (Zichermann & Cunningham, 2011:90).

an application that teaches about the SDGs. It uses a mini-game to represent each goal and the player goes through each mini-game to attempt a high score. The game does have some information about the SDGs, but it is not worked into the mini-games and is in a different section that most users would not access. The main problem with this application is that it does not leave the user thinking about what they can do to help with the SDGs after playing it.

Therefore, for this project, the key information about SDGs 7 and 13 will be embedded into the functionality of the app through a customisable avatar that relays information to the user. This will leave the user thinking about their actions when not physically engaging with the application, therefore having a meaningful impact on their behaviour.

Behavioural Changes

Little (2016) discusses how technology is becoming one of the most effective ways of encouraging behavioural changes. This is mostly due to the accessibility of technology through smartphones. For example, Van Mierlo (2014) looked at using mobile phone software to help people quit smoking and found it to be extremely effective compared to quitting without the software.

Gamification

There is an ever-increasing amount of applications and software choosing to use gamification techniques to help engage with their consumer. For example, the apps Nike+ (Nike, 2018) and Epic Win (Supermono Studios, 2013) have been widely successful and use gamification as an integral part this.

Ultilising the right gamification techniques is a crucial part of this project. It can be all too easy to add basic features such as badges or points, Ferrara (2013) mentions how developers of 'gamified' software often *"tack on"* useful parts of what makes a game in order in give their software a gamified aspect. But this can result in a product that is not quite fully gamified but still qualifies as gamification.

Octalysis Framework

This project will instead focus on more meaningful gamification, drawing on research such as Actionable Gamification (Chou, 2015), which takes gamification techniques further than basic elements. Therefore, a more personalised classification of gamification will be used, inspired by the Octalysis framework (Appendix B) which looks at eight core drives that make a well gamified product.

Gamification Techniques and Engagement

Research such as Pedreira et al (2015) map out key and prominent features within software related to gamification. This finds eight elements commonly used across gamification software reflecting trends of different gamified features in recent years. This is useful for deciding exactly what core elements should be within the application created.

Gamified applications often fail to keep the user engaged as a singular system is used repeatedly, causing user fatigue. Rethinking Gamification (Fuchs et al, 2014) discusses extending the endgame of gamified products by having a fresh stream of new challenges as well as larger challenges that the user can progress towards. These techniques will be utilized in this project

to keep users engaged, a key part of creating sustainable behavior change.

Adding certain gamification features to an application can be relatively simple however creating an application that has gamification elements embedded at its core and builds around them can be a harder task. Zichermann & Cunningham (2011) look at effectively embedding gamification features within mobile applications. Applications with effectively embedded gamification techniques, at their core, will often follow the social engagement loop as seen in figure 3. This loop can help ensure the product will continue to re-engage the user and will be kept in mind during this project's development.

Project Suggestions and Features

The project will use several key gamification techniques (see Appendix C for feature list). These features have been informed by the research discussed and particularly the Octalysis framework. A personalised version of this has been created which contains specific techniques that will be used for the creation of this application (figure 4).

The personalised framework created uses more specific methods to create the application, beyond basic task lists and points. The focus will be on ownership and meaning, which are important categories in encouraging users to take ownership for their actions. This is integral to creating behavioral changes regarding sustainability.

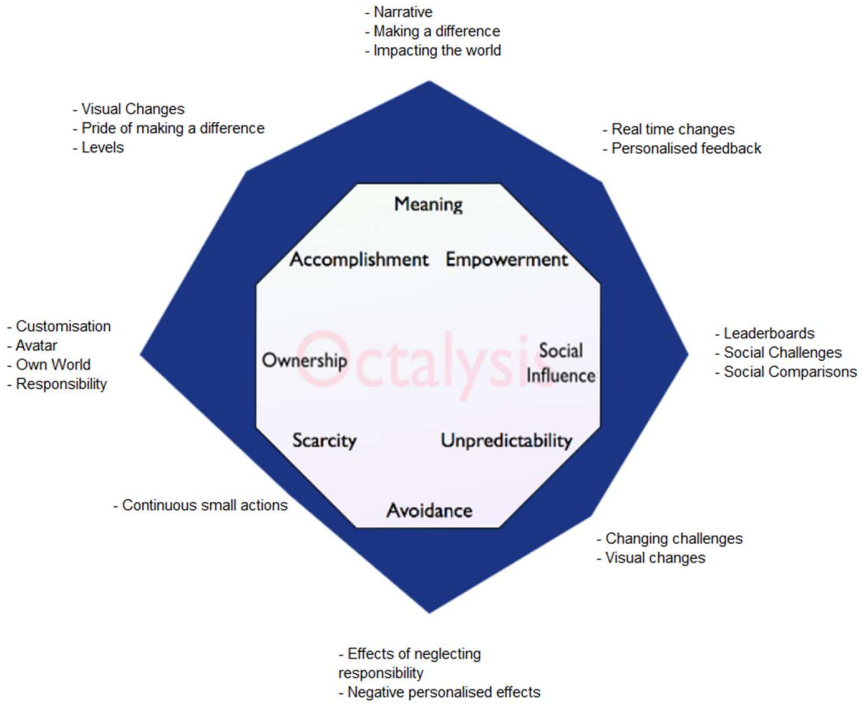

Figure 4: *Peronalised Octalysis Framework* (Chou, 2018).

Implementing Features

Unity has been chosen for the delivery of the application due to the versatility of the engine. It will allow for rapid development changes due to the combination of C# scripting customisations as well as drag and drop features within the Unity editor. This is important for this project as much of the implementation will be design based so being able to make changes easily to the application is vital.

Messaoudi et al (2017), considers the performance of 3D software on mobile devices, specifically Unity 3D software. The research shows that efficient rendering on a mobile device using Unity is very achievable. For this project a small 3D environment will be simulated for the user, which will change dependent on their actions. The research here shows that Unity is a well-suited choice for the application due to its efficient 3D rendering capabilities on mobile devices.

A large portion of application development will come from design iterations, specifically how information is relayed to the user through the User-Interface (UI). Leaderboards, levels and an interactive avatar providing the user with information will be the primary source of the UI. Unity is ideal for this development as it has a highly customisable UI section, allowing events to be triggered through C# scripts as well as information to be easily stored and maintained throughout the application's life cycle.

Conclusion

The research here has made it clear that engagement is a vital part of a successful gamified product and without adequate engagement, the user will have no reason to want to use the application. Providing a user ownership and customization is an important part of this and the main reason why the personalised Octalysis framework focusses on it. Therefore, the main part of the gamified application is going to focus on giving the user a customized experience that they can connect with, this will be done using a unique avatar and personalised digital 'world' that is affected by a user's actions in real life. Meaningful gamification techniques as listed in the personalised framework and in the feature list will be used alongside this to ensure a lasting and impactful environmental difference through the application.

References

[1] **Albertazzi, D., Ferreira, M, G, G. & Forcellini, F.** (2018) *A Wide View on Gamification.* Technology, Knowledge, and Learning.

[2] **Apple** (2018) Environmental Responsibility Report. Available from: https://www.apple.com/euro/environment/pdf/q/generic/Apple_Environmental_Responsibility_Report_2018.pdf [Accessed on 8 December 2018]

[3] **BBC** (2016) *The 5p plastic bag charge: All you need to know* [Online]. 30 July. Available from: https://www.bbc.co.uk/news/uk-34346309 [Accessed on 30 November 2018].

[4] **Bohyun, K.** (2015) Understanding Gamification. *Library Technology Reports.* 51 (2).

[5] **Chou, Y, K.** (2015) *Actionable Gamification. Beyond points badges and leaderboards.* CreateSpace Independent Publishing Platform.

[6] **Chou, Y, K** (2018) *Octalysis building tool online.* Accessed from: http://www.yukaichou.com/octalysis-tool/ [Accessed 4 December 2018]

[7] **Dempsey, N., Bramley, G., Power, S. and Brown, C.** (2011) *The social dimension of sustainable development: Defining urban social sustainability.* Sustainable Development. 19 (5), pp.289-300.

[8] **Ferrara, J.** (2013) Games for Persuasion: Argumentation, Procedurality, and the Lie of Gamification. *Games and Culture.* 8(4). pp 289-304.

[9] **Fuchs, M., Fizek, S., Ruffino, P. & Schrape, N.** (2014) *Rethinking Gamification.* 1st ed. Luneburg, Germany: Meson Press.

[10] **Intergovernmental Panel on Climate Change (IPCC)** (2018) SR15 Summary for Policymakers. IPCC.

[11] **Kenis, A. & Mathijs, E.** (2012) Beyond individual behavior change: the role of power, knowledge and strategy in tackling climate change. *Environmental Education Research.* 18:1. pp.45-65

[12] **Little, L.** (2016) *Behaviour change research and theory: psychological and technological perspectives.* 1st ed. London: Academic Press.

[13] **Messaoudi, F., Ksentini, A., Simon, G & Bertin, P.** (2017) Performance Analysis of Game Engines on Mobile and Fixed Devices. *ACM Transactions on Multimedia Computing, Communications, and Applications.* 13 (4). Article 57.

[14] **Nevosoft Inc** (2018) *Eco City.* Available from: https://play.google.com/store/apps/details?id=com.nevosoft.ecofarm [Accessed 29 November 2018].

[15] **Nike** (2018) *Nike+ Running app for iPhone and Android.* Available from: https://www.nike.com/gb/en_gb/c/nike-plus/running-app-gps [Accessed 10 October 2018].

[16] **Nutrien Ltd** (2018) *Global Hero.* Available from: https://play.google.com/store/apps/details?id=com.agrium.sdgawareness [Accessed 29 November 2018]

[17] **Pedreira, O., Garcia, F., Brisaboa, N. & Piattini, M.** (2015) Gamification in software engineering – A systematic mapping. *Information and Software Technology.* 57. pp 157-168.

[18] **Supermono Studios** (2013) *Epic Win*. Mobile Application. London, UK.

[19] **United Nations**. (1987) Our Common Future - Brundtland Report. Oxford University Press.

[20] **United Nations.** (2018) *Sustainable Development Goals.* https://sustainabledevelopment.un.org/sdgs [Accessed 20 November 2018].

[21] **Unity Technologies** (2005) *Unity 2018.2.2 (2018)* [Computer Program] Available from: https://unity3d.com/ [Accessed 7 December 2018]

[22] **Van Mierlo, T**., **Fournier, R., Jean-Charles, A., Hovington, J., Ethier, I. & Selby, P.** (2014) I'll Txt U if I Have a Problem: How the Société Canadienne du Cancer in Quebec Applied Behaviour Change Theory, Data Mining and Agile Software Development to Help Young Adults Quit Smoking. *PLoS One.* 9(3). pp. 91832.

[23] **World Meteorological Organization (WMO)** (2018) *Climate change signals and impacts continue in 2018.* Available from: https://public.wmo.int/en/media/press-release/climate-change-signals-and-impacts-continue-2018 [Accessed 1 December 2018]

[24] **Zichermann, G. & Cunningham, C.** (2011) *Gamification by Design.* 1st ed. Sebastopol: O'Reilly.

Appendices

Appendix A:

Figure 5: *Sustainable Development Goals* (United Nations, 2018).

Appendix B:

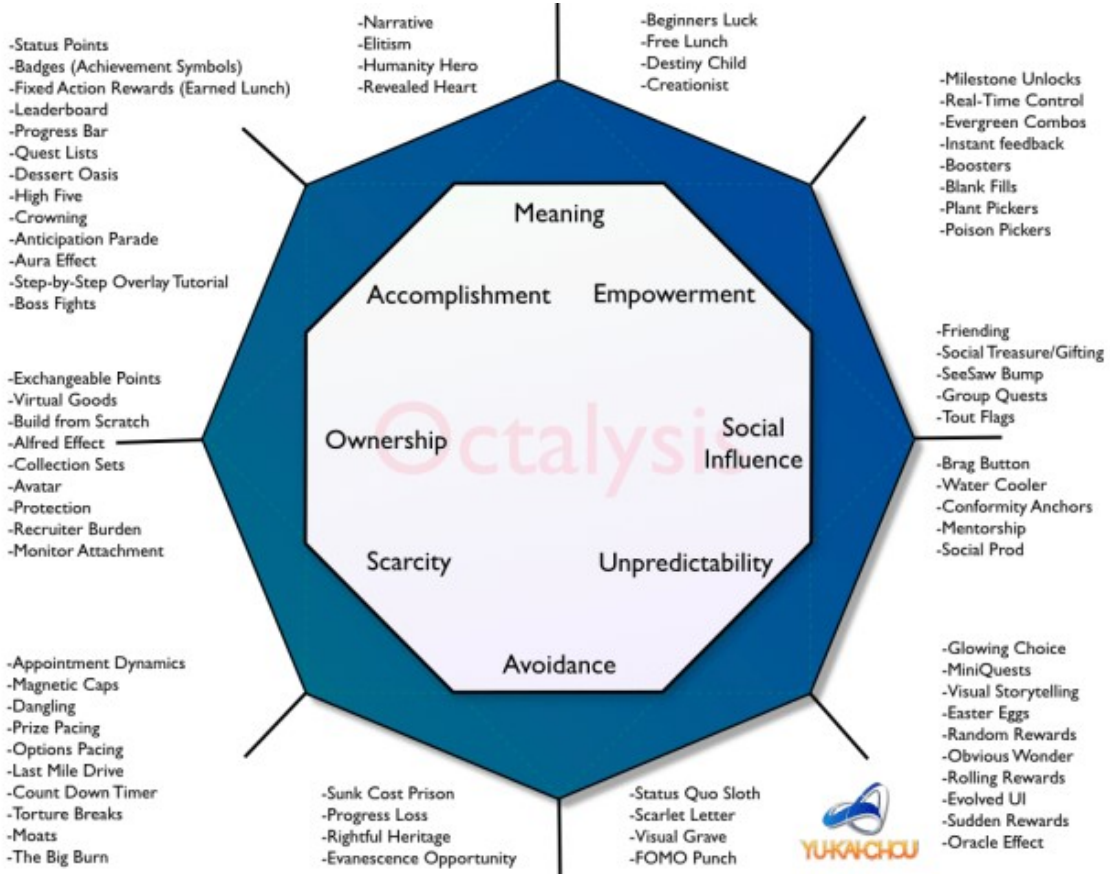

Figure 6: *Octalysis Framework.* (Chou, 2015).

Appendix C:

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 friends

Log sheet:

16017501 Brad Moss	Tackling Sustainability Through an Interactive Gamified Application		
Date of the week:	Tasks set for the week:	Summary of Tasks completed:	Questions/tasks to be taken forward:
24/09/2018	-Start official proposal document, building from summer draft.	-Started basic gamification research -Listed out multiple ideas for product being created.	-Meet with Supervisor to discuss project and what should be in the proposal -Continue working on proposal
1/10/2018	-Meet with CTP supervisor to discuss project proposal. -Work on project proposal	-Met with supervisor and discussed what is needed for the proposal (01/10). -After meeting, started research for proposal and wrote up most of the proposal.	-From meeting: contact Uni sustainability expert to discuss ideas/focus. -Create question list to discuss in above meeting.
8/10/2018	-Meet with sustainability expert. -Finish proposal for submission on 11/10.	-Met with Ian Brooks (09/10) to discuss ideas. -From meeting: Discussed electricity usage and SDGs as points for project to focus on. -Decided upon electricity focus for project, implemented this into proposal -Finished and submitted project proposal 11/10.	-Continue thinking upon ideas about final product and continue research into SDGs/electricity consumption.
15/10/2018	-Start working on creating an application within Unity 2018.2.2.	- Installed the required Android SDKs into Unity for app development. - Created a basic app that could transition between scenes which worked on an android phone.	-Supervisor meeting organised for next week. -Start to think about research ideas for research report: Come up with questions for meeting.
22/10/2018	-Meet with CTP supervisor to discuss research report/progress.	-From meeting: discussed what should be included within the research report. -From meeting: discussed potential ideas for the app, idea of basing app around an interactive avatar came up.	-Investigate other gamified apps as research. -Flesh out idea for the finished product, needs to start being more solid.
29/10/2018	-Work on some basic user functionality within Unity app. -Start research into gamification and sustainability for report.	-Work within Unity wasn't able to happen due to other assignment work taking priority this week. -Some research into gamification was started but other assignment work again meant not as much got done as planned.	-Carry this week's tasks over into next week. This is not an issue as this work is being started very early anyway.
05/11/2018	-Focus on gamification research for the report	-400 words written (as of 09/11) about gamification techniques that can be used for this project. Octalysis framework was a large part of this.	-Basic Unity functionality delayed as is not a priority. -Research into sustainability for report

12/11/2018	-Focus on getting sustainability research done for report. -Basic Unity app functionality implemented.	-Research into sustainability mostly done, sources found, and key points written out. Just needs the proper write up. -600 Words written (as of 17/11). -Unity app navigation implemented, swipe functionality working.	-Supervisor meeting organised for next week, list of questions already made about research/app.
19/11/2018	-Meet with CTP supervisor to discuss research progress	-From meeting (20/11): key sections of research identified that are needed in report. Most of work on these already done. -After meeting, summarised list of things needed to be included in the report for it to be finished.	-Continue work on research report. -Continuous work on adding features to Unity app project.
26/11/2018	-Write up sustainability research in report. -Find some basic research about behaviour change for report.	-Sustainability section of report completed (as of 28/11). -Behaviour change sources/research found and incorporated this into report (as of 02/12).	-Finish off gamification section of report, conclude findings to finish report.
03/12/2018	-Gamification section of report completion. -Conclusion needs to be written. -Proof read report.	-Gamification section of report finished (as of 03/12). -Conclusion and final part of report finished, 1500 words (as of 05/12). -Report proof read and improved, report finished and ready for submission (as of 09/12).	-Research report due next week on 13/12. Report is finished so will be printed and submitted on 12/12.