Building Digital Tools Assisting Escape Room Maintainers

Survey and Analysis Stage, COM3610

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Signed Declaration

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Simon Fish

Abstract

Escape rooms are physical, interactive experiences in which a group of participants must solve puzzles to escape a locked room, solve a mystery, or otherwise meet some goal in a particular timespan. This report uses various studies into applications of escape rooms to discuss the priorities of well-made escape games, particularly with regards to the inclusion of technology. It also marks my current progress in research into my dissertation topic as expressed in the title. It focuses on the difficulties in applying technology in escape rooms and priorities that should be held in order to mitigate these. On this basis, it serves to document universal requirements to bear in mind when developing hardware or software for escape rooms.

Contents

Introduction

The aim of this project is to build tested tools to meet the needs of escape room maintainers. Research will be focused towards exploring the needs of escape room maintainers, such that a product can be designed and built to target some subset of these needs. These needs may be related to various issues - such as making sure a timer is visible to the group, or to processes that currently take more time than necessary, such as posting photos of teams to social media (Woff 2019).

In order to guide the focus of my project, I will use this paper to identify and discuss the features of escape rooms and their implementation across existing publications. I intend to do so guided by my chosen research questions. This is expected to reveal requirements for developing tools for escape room maintainers across industries.

Research Questions

I have identified two research questions, which this stage of the project will be focused towards answering:

RQ1: What has been reported about concepts used in escape rooms applied in different environments?
RQ2: Based on this, what can we establish as the requirements for escape games, independent of their environment?

Chapter 1

Background and Motivation

Escape rooms are physical, interactive experiences in which a group of participants must solve puzzles to escape a locked room, solve a mystery, or otherwise meet some goal in a particular timespan. They are a phenomenon that has existed since around 2007 (Nicholson 2015), and are a growing industry. Escape rooms are run both by enthusiasts as solo ventures, and as franchises across the country. Nicholson (2015) documents escape rooms as the culmination of a variety of media. Nicholson identifies puzzle hunts as team-based problem-solving challenges, which, with treasure hunts, appears most similar to escape rooms. Various others have lent features to escape rooms, such as immersion in a story as the "hero", which DuPlessie (2013) reports as being something participants enjoy. This is embodied by live-action roleplaying, another inspiration for the genre (Nicholson 2015). Nicholson presents the precursors to escape rooms in further depth in his paper - Figure 2.1 summarises these.

Escape rooms have grown popular in many locations across the world as a recreational activity (Nicholson 2015; Stasiak 2016), even serving as a tourist attraction (Dilek and Kulakoglu Dilek 2018). Nicholson reports that the *Real Escape Game* by SCRAP was the earliest well-documented activity branded as such. SCRAP has gone on to develop escape rooms at a much larger scale than the typical escape room, which serves teams of an average size of 4.58 people (Nicholson 2015).

My goal in writing this literature survey is to understand not only the needs of the commercial escape room industry, but also the differing requirements for the application of escape rooms in education and corporate contexts. The major difference between these contexts is that the commercial escape room industry is most regularly founded on permanent fixtures, and educational escape rooms are often applied in a classroom environment, which can imply more limited space and the need to tear down the room after it has been completed. These different environments dictate some differences between escape room experiences. However, as I intend to show in the literature survey, inspiration can be taken from both contrasting environments and applied universally.

Figure 1.1: Nicholson (2019) presents the precursors to, and inspirations for, the escape room phenomenon in this diagram. Adapted with permission from Nicholson, Scott. 2015. "Peeking Behind the Locked Door: A Survey of Escape Room Facilities." *White paper available online at http://scottnicholson.com/pubs/erfacwhite.pdf.*

Chapter 2

Literature Survey

Escape room maintainers are able to apply technology to varying degrees. On the outside of the escape room experience, maintainers implement leaderboards, share team photos to social media, and interact with the team via a screen or handheld transceiver in the room. Inside the room, entire puzzles can be based on technology, if the owner has the necessary expertise. Some more unique applications within the room are also possible, such as using a hidden camera to take a photo of the team, apply filters, and display the photo among works of art as demonstrated in The Gallery[1], which I visited in July 2019. However, there is a general aversion to the use of technology in escape rooms, for a variety of reasons. Woff (2019) suggests that the time investment, reliability, and necessary expertise are some of the greatest contributing factors. DuPlessie (2013) approaches this from the perspective of immersion - with 70% of escape room games being purely physical activities (Nicholson 2015), DuPlessie recommends movement away from what he calls the "glowing rectangles" as our medium of choice.

The increasing application of IT in education means that computers are often part of the school environment, and can be used as a tool when building an escape room experience for educational purposes. Several studies cover the use of escape rooms as a means for education (López 2019; Rouse 2017; Peleg et al. 2019; Beguin et al. 2019). Rouse (2017) applied technology to an escape room in the classroom using a game loaded from a memory stick. This application seems understandable, as Rouse's audience was likely to have some basic level of expertise in, and enthusiasm for, handling computers as part of the digital native generation. However, in practice, it brings to mind the image of a small group of people crowding around a screen. Woff (2019) warns against situations like this, saying that visibility of the puzzle to the entire team should be a priority.

However, poor implementation does not mean technology should not be excluded from escape room environments outright. Instead, I feel technology has the potential to inspire change in escape rooms. Escape rooms and technology are inherently linked - digital escape-the-room games such as *Myst* precede and inspire physical escape rooms (Nicholson 2015). These forms of escape room evade a shortfall that is one of physical escape room maintainers' greatest anathemas - resetting these rooms is as simple as resetting the game. Whether this is done by restarting an attempt, restarting the game, or removing save files and starting over, it is often trivial compared to how long it takes to reset escape rooms. Woff (2019) suggests that resetting rooms can often take as long as 15 minutes, and that it is something escape room maintainers seek to optimise; the shorter a reset takes, the more time is available to welcome customers.

Commercial escape rooms are often permanent fixtures. This means that more immersive environments and more complex physical puzzles can be built. However, puzzles of a physical nature usually need to be reset by the room owner back to their original state, so that more than one group can attend a room in the same day. Contrary to this, escape rooms built in a classroom environment are usually of a temporary nature, and may even try to allow for multiple groups to attempt the room at once, at the cost of immersion and interactivity. A study by López (2019) organised its puzzles in a manner whereby puzzles could be completed in any order, allowing multiple groups to attend the room at once. One example puzzle given in the study was an exercise likely done on paper - exercises in this form make resets trivial, as a fresh worksheet is all that is necessary, but they also demonstrate the lack of immersion. Commercial escape rooms regularly employ more physical interaction - 78% of escape rooms employ

[1] https://escapist.nl/en/

a search for physical objects as part of the experience (Nicholson 2015). Some varieties of commercial escape room visit the other end of this spectrum, such as those developed by Tuzak, an Istanbul company developing portable escape games (Gündüz 2018). Portable or temporary escape games often trade immersion for greater logical challenge.

Application of technology in escape rooms comes with some uncertainty, and a break in the flow of the escape room experience can shatter participants' immersion and lead to negative reviews (Woff 2019). This also creates some difficulty when it comes to visibility - unless monitors are suitably placed and large enough to be viewed by a full party, the whole team may not be able to interface with a puzzle that applies technology. This is particularly an issue if a single typical workstation is set up - Nicholson (2015) warns of the danger of removing just one player from the "mental space" of the team.

Woff (2019) theorises that VR escape rooms such as EXIT VR[2] may be the next stage for the industry, which allow immersive rooms to be created while effectively eliminating the issue of resetting the room as above. This would bring the escape room cycle full circle, reincarnating the modern wave of physical escape rooms in the digital form that inspired them.

While the escape room industry cautiously explores the "glowing rectangles" DuPlessie (2013) warns against, the video games industry sometimes takes small strides to recede from them. This has resulted in concepts that escape rooms, and interactive experiences of all kinds, can learn from. *Keep Talking and Nobody Explodes*[3] focuses on asynchronous gameplay, in which one player must defuse a bomb while the others guide them using the bomb's manual[4]. Conceptually, the game shares fundamentals with escape rooms, but what is of most importance here is that the foremost task in the game is communication. Escape rooms already apply asynchronous gameplay - The Lockup Escape Rooms' *Meltdown* (Woff 2019) begins with most of the party in individual chambers, with the designated 'leader' communicating from outside - but *Keep Talking and Nobody Explodes* demonstrates that with technology, it is possible in almost any location. *1-2-Switch*[5] similarly pulls away from the screen, with the majority of its minigames relying on what is done physically with the Joy-Con controller and instructing players to face their opponent directly. It is an effective example of how to apply technology in a way that does not lock singular players into staring at a screen.

In summary, technology brings a variety of benefits, from quick resets when used as part of a puzzle to interesting and reactive ideas that may not otherwise be possible. Many ideas and inspirations have been discussed here. However, care must be taken to ensure that if the implementation separates one player from the group, it is applied in an engaging manner. Escape room maintainers value reliability, with negative reviews being the consequence for ill implementation (Woff 2019). The strength of escape rooms as an educational tool has also been demonstrated here, which is worth consideration when building for the escape room industry.

Keywords

I identified the following keywords for use in my search. The search was conducted using the Google Scholar search engine.

- escape room / puzzle hunt
- owner / host
- implementation
- software
- virtual reality
- education / classroom

This led to the following searches.

- escape room owner
- escape room host
- escape room software
- escape room education

[2] https://exit-vr.de/en/
[3] https://keeptalkinggame.com/
[4] https://bombmanual.com
[5] https://www.nintendo.co.uk/Games/Nintendo-Switch/1-2-Switch-1173186.html

- escape room classroom
- virtual reality escape room
- portable escape room

Additional searches were made based on discoveries such as escapED (Clarke et al. 2016) and Breakout EDU ("Breakout Edu," n.d.) to see where they had been applied.

Chapter 3

Requirements and Analysis

The objective of the project was to build a tool for the escape room community. The exact form in which this would come was to be dictated by the nature of the problem - if the scenario called for a tool that would be active inside escape rooms themselves, it would have been more likely to be hardware. At the initial stage, this was the intent - a set of networked microcontrollers/SoCs that would unite to track the escape room experience - but this was abandoned. The idea of building an escape room, even in the form of a prototype, was out of scope. Additionally, Woff (2019) warned that digital uptake in traditional escape rooms may be middling due to the inherent risk and time involvement, as discussed in the literature survey.

I met with Liam on the 20th November to discuss the challenges he faces as an escape room owner, and his philosophy in developing the rooms he offers at The Lockup. Liam and I discussed some areas that could be targeted, which inspired a survey I sent to the Facebook group created by Nicholson (2015). This group is for escape room enthusiasts, encompassing both maintainers and participants, to which I sought and gained access as part of my work. The majority of posts during research were from enthusiasts who would report back from rooms they have attended, though I have seen posts about types of puzzles that can be implemented. I chose to survey this group, as it appeared to be a central hub for what seemed to be a sparse online community.

From the seven responses received, the following conclusions were drawn:

- The majority of the group already shares photos online, but those that do not are all interested by the prospect of it
- Memberships, in-character communications, advertisement among other escape rooms, and participant metrics are all of interest
- Memberships are agreed upon by those interested as something that should not be done without the involvement of technology

I was able to elicit a direction from these conclusions - the idea of a social network shared by escape room maintainers and enthusiasts allowed me to potentially target several of these factors at once. In particular, the purpose of this social network would be to allow escape rooms to advertise among others of their ilk and share photos. I concluded my analysis of the results by setting a goal statement.

Goal Statement

To design and build a system that:

- allows escape room owners to share photos with their community
- allows escape room owners to advertise among other escape rooms
- allows escape room enthusiasts to discover new escape rooms to tackle
- allows escape room enthusiasts to track which escape rooms they have cleared

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With these as an initial guide, I began to set requirements using the MSCW system, aiming to complete all defined as **Must**- and **Should**-Have by the end of the project. Though these were not formally defined

and did not dictate the order in which I completed tasks, I thought on what I had learned during my year in industry - while haste was of the essence, I made strides to emulate the software development process as I had seen it firsthand.

Stories were written with parts of the goal statement ('epics') in mind and estimated according to their complexity using a modified Fibonacci scale. In agile software development, complexity estimates are preferred to time estimates as the former are easier to settle upon (Karlesky and Voord 2008). Stories with estimates any greater than 13 would need to be broken down into smaller stories. This was a principle I kept in mind from my year in industry. Atlassian suggests a differing scale and limit, but the basic principle of keeping stories small and manageable is there. Velocity is of the essence, and smaller tickets assist with that.

Another factor I kept in mind when creating stories was keeping them open. Stories, as often as possible, would need to describe what the user would wish to achieve, as opposed to what the developer working on them should aim to do. Framing stories from this perspective allowed me to keep their implementation open to change and interpretation.

My approach was not reminiscent of the Scrum process used in my team last year. Instead, I elected to move towards a Kanban approach. Kanban is employed when more flexibility is desired. It prioritises throughput and encourages a "culture of 'done' " by enforcing work-in-progress limits. With this in mind, it would be difficult to set more than two development milestones. Treating each MSCW category as an epic and taking the amount of time necessary for work on this report and my other modules into account, I aimed to work on the project for a month, devoting about two weeks to each milestone.

I figured that each milestone would take a similar amount of time - while Rails' built-in generators would likely ease the burden of scaffolding the initial functionality, setting that groundwork in the right way would take slow and careful decisions. Scaffolds would dictate the flow of the rest of the project to a degree.

- **Dev commenced** Mar 12th
- **Must done** Mar 26th (actual 24th)
- **Should done** Apr 16th (actual 13th)

After setting my focus, I decided my solution would take the form of a web application. Ruby on Rails was chosen as the development platform. The QOC analysis below was the source of this decision, in which I weighed up other potential candidates such as Iron (Rust), ASP.NET MVC 5 (C#), and Next.js.

	Priority	4	5	4	2	4	3	3	5
	Criteria	Familiarity	Documentation	Stability	Linux support	Available Docker resources	Developer tools (generators)	Community	Development cycle
145	Rails (ERB)	5	5	5	5	5	5	5	4
108	Next.js	3	4	3	5	5	1	2	5
109	ASP.NET MVC 5	2	5	5	1	5	5	3	2
66	Iron	1	2	1	5	3	1	1	4
130	Rails (React)	4	4	5	5	5	3	5	4

Originally, I weighed ERB and React against one another as view engines. This estimation was taken on the assumption that I would use React even where interactivity and state management were not required. In hindsight, this approach would have slowed development. Instead, my final approach of applying React only where functional improved the quality of the application without hampering development time.

Chapter 4

Design

Chapter 5

Implementation and Testing

My commitment to emulating industry best practices carried through to implementation. I felt it vital to use and work with such things as continuous integration servers, containerisation, and linting tools to maintain code quality and readability. Of course, none of these decisions were taken lightly.

While there is still some discourse over whether containerisation in development environments is entirely appropriate, I chose to use it to maintain some degree of parity between running locally and running in CI. Another reason why I made this choice was that popular production platforms such as Amazon Web Services are backed by containers - running the app using containers sets a good precedent to running it on a platform like Kubernetes with the right expertise.

Continuous integration tests code at each commit. I was able to configure CircleCI to build the Docker image used locally, and lint and test the code - this combined well with my use of the GitHub Flow[1], in which I would aim to get both tests and linting passing before merging. Towards the end of my development cycle, when I had deployed to Heroku, I would also run through a set of checkout testing steps I devised as a manual end-to-end regression test.

Time constraints

If time were not an issue, I would have employed the following development practices:

Test coverage

SimpleCov was the standard at UKCloud with regards to coverage testing. I would have employed this and aimed for at least 80% test coverage. In the end, my testing strategy was to cover only novel backend functionality that sat somewhere outside the standard Rails CRUD mold. This included:

- additional routes created beyond a standard Rails scaffold, such as those that make the current user a maintainer/enthusiast or those that remove image associations from a `Clear` or `EscapeGame` object
- secured routes - tests were created that challenged whether some attacking user could change a user ID in a form to steal ownership of a record
- some validations, such as those relating to limits on the number of image uploads for `EscapeGame`s and `Clear`s.
- some queries, particularly those relating to user privacy and escape room hiding.

Frontend testing

I omitted frontend testing that strayed too far beyond scaffolded tests due to time constraints. However, my use of React components for major features like the Explore page means that swathes of the app are

[1] https://guides.github.com/introduction/flow/

untested. `react-rails` documents component testing here[2]. If I wanted to test that controllers render views containing React components with the desired props, I would use this.

Some are dependent on asynchronous functionality - the Explore view makes a request to the app's `/explore.json` endpoint on first render, and again afterwards. In these situations, directly employing Facebook's Jest[3] would be preferable.

Automated regression and checkout testing against production

During my year in industry, this was in high demand. Deployment of the company's primary products would take some quite time due to the number of manual steps involved - checkout testing played no small part in this. I have documented checkout testing steps in Blacklight's README, with clear indication that if the project were to continue, checkout testing would be automated. If possible, I would also follow up deployment with automated checkout testing at every instance.

[2] https://github.com/reactjs/react-rails/blob/d5da11129459cd75fd003c75319b1f7440c37322/README.md#test-component

[3] https://jestjs.io

Chapter 6

Results and Discussion

The product of my development process is a web application written in Ruby on Rails, with React.js used to generate and drive some areas of the frontend. Blacklight allows users to log in through the Auth0 authentication service only, though this allows for plenty of expansion in and of itself. Users are prompted to define themselves as an escape game maintainer, enthusiast, or both. This only affects the user's experience, not their level of access.

Escape game maintainers have options revealed to them to create and manage escape games. These escape games have an array of associated data that can be added, including the expected time to complete them, their location (by way of Google Maps integration), images, and a Markdown-compatible extended description. Listings can also be hidden from view and access via a checkbox on the editing form.

Enthusiasts can browse these escape games and mark them as cleared by selecting the lock icon on any listing. This is consistent across the site. Doing so adds the escape game to the 'My Cleared Games' section of the site for that user. There, users can upload photos to associate with each escape room, which also appear to the left of the list in a singular photo gallery.

Users have profiles where they can write a bio, set their location, and link to their own website. Here, those interested can see all escape games by a single maintainer, and all escape games cleared by a user. Which of these is shown depends on whether they have self-assigned as a maintainer, enthusiast, or both.

Forgoing the later milestones, and many ideas that might even give Blacklight commercial viability with them, was a difficult decision to make. However, I am happy with the base functionality and usability that came to be.

Chapter 7

Conclusion

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