

Cyber Escape Room

A Technical Report submitted to the
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at the School of Computing and Information
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Table of Contents

Abstract	3
List of Figures	5
1. Introduction	6
1.1 Problem Statement	6
1.2 Contributions	7
2. Related Work	8
3. System Design	10
3.1 System Requirements	10
3.2 Wireframes	10
3.3 Sample Code	11
3.4 Sample Tests	12
3.5 Code Coverage	13
3.6 Installation Instructions	14
4. Results	15
5. Conclusions	16
6. Future Work	17
7. References	18

Abstract

This project is designed to be a cyber escape room that provides an entertaining experience that exposes people to cybersecurity and teaches them about its significance. Existing cyber escape rooms contain numerous problems regarding teaching young adults about cybersecurity. For instance, their intended audience is either too young or too old, being marketed toward elementary schoolers or working professionals. These cyber escape rooms also face issues related to mobility, being hard to transport between locations and efficiently set up. Additionally, these cyber escape rooms are often not focused on cybersecurity education.

Through this project, we set out to solve these problems by creating a cyber escape room that teaches an audience of roughly 16-20-year-olds about the threads of cybersecurity while allowing the puzzles to remain portable. To create the five total puzzles, we researched threads within the field of cybersecurity and tried to include a wide variety to increase players' exposure. Ultimately, we decided to include content about cryptology, security awareness, and password protection as we could easily incorporate them into puzzles while maintaining educational aspects. We also researched existing escape rooms to get inspiration for puzzle options, which we then combined with our chosen threads of cybersecurity to make puzzles like the maze which includes the use of a Caesar cipher.

Narratively, we wanted to write about something that would entertain the players, however we did not want the topic to be too unrealistic. For example, we originally wanted to write a story about superheroes, but we did not want to make cybersecurity seem like a field that you need to be 'super' to be in. Rather, our goal was to make cybersecurity seem accessible to everyone. We decided on the player being a security agent who sets out to protect a pop singer from an attacker and to protect her new songs from being leaked. With this narrative, we believe

we can both entertain students and teach them about cybersecurity. One of the biggest takeaways from this project is the exposure to the iterative design process. By ideating with each other and the client, and by playtesting over the five sprints, we learned how extensive the process of adjusting and refining ideas is. Moreover, we learned the importance of being conscientious designers. One of our main goals through this project was to make it accessible to everyone and to not disparage any communities or demographics. Overall, our cyber escape room provides an entertaining and educational experience that provides young adults with information about the field of cybersecurity and teaches them how to keep their information safe.

List of Figures

Figure 1. Desktop Wireframe.....	11
Figure 2. Password Entry Wireframe.....	11
Figure 3. Security Image.....	11
Figure 4. Desktop Final Product.....	11
Figure 5. Playtesting Sheet.....	13

1. Introduction

Cybersecurity is a topic that is becoming more and more prevalent in our society. Cyber attacks are increasing in frequency, and anyone can fall victim to them. By creating a portable cyber escape room, we aim to make an accessible, engaging experience for our users that also provides valuable educational content surrounding cybersecurity.

Our target for this experience is mostly high school to college-aged individuals so we may begin educating people on the threats of cyber attacks and breaches from a young age. We considered this when mapping out and creating the puzzles required to complete or 'beat' the escape room so that we could keep players engaged while also keeping the underlying theme of cybersecurity prevalent throughout the experience.

1.1 Problem Statement

As a professor at the University of Pittsburgh, the client, Dr. Ahmed Ibrahim, teaches cybersecurity. Through this experience, he has fostered his passion for enhancing cybersecurity education through the use of hands-on content. He has worked on immersive projects that teach students how hackers hijack SSH sessions, perform DNS spoofing attacks, impersonate CAs, and intercept communication with no detection. While these are beneficial in educating students who already have some background in computer science and cyber security, they do not serve as an introduction to the field.

Understanding the benefits of exposing students to cybersecurity early on, Dr. Ibrahim wanted a fun and interactive way to educate a younger audience. Dr. Ibrahim desired a solution that not only introduces an understanding of cyber threats but also makes cyber security seem

like an accessible career. This escape room is beneficial to both high school and college-aged students in how it fulfills these desires.

1.2 Contributions

We were able to contribute to the solution of the problem statement by creating a fun and interactive narrative around cybersecurity education. We made tie-ins to pop culture references in our narrative to keep college and high school-age students hooked. Most cybersecurity education activities that we found did not tie into stories that high school-age students would care for. We know Taylor Swift is a divisive icon in the entertainment industry. Using a little bit of a name tweak, we figured having a recognizable name was a quick conversation sparkler for groups that may have otherwise been hesitant to begin working together. Our playtest results support this claim, as many players said the narrative kept them hooked regardless of whether they had negative or positive views of Taylor Swift.

In addition, we created an intersection of digital and physical artifacts. With a variety of artifacts, players felt like they had a lot more to work with. Players not only felt like they were detectives or heroes but also some high-tech hacker decrypting important information. In other words, players felt immersed in the story while they were learning, a change that kept players interested and passionate.

2. Related Work

Using the escape room format to teach cybersecurity has been tried many times. Notably, the Thales Group has produced a mobile escape room that can be assembled and disassembled for each location. It combines a generic narrative scheme with transportability to allow for an experience that many people can replay. The experience is designed so that three people can solve the escape room in under ten minutes (Cyber escape room, 2024). However, Thales's mobile escape room has a few disadvantages. For instance, because the escape room needs to be assembled and disassembled at each location, it is not as efficient as an escape room in a box. While creating our cyber escape room, we prioritized the portability of all artifacts and the efficiency of setup and cleanup times. Additionally, the Thales cyber escape room restricts players to a physical space, thus limiting the number of players that can participate to three. By not limiting our players to a certain area, up to five players can participate. Moreover, because the Thales escape room lasts only 10 minutes, our 30-minute cyber escape room gives players more time to synthesize information and solve puzzles. Our cyber escape room ends with a cybersecurity learning module, providing a summary and concise teachable moment.

The Thales Group also provides a more portable version of their mobile cyber escape room, called the 'escape-room-in-a-box'. This 35-minute experience, primarily marketed towards children aged 12-14, allows two teams to compete to see who can complete their assigned tasks first. These tasks revolve around environmental protection and sustainability (Cyber escape room, 2024). While these are important issues, they do not teach children about the many fields within cybersecurity. As we were designing our project's narrative and puzzles, we placed cybersecurity at the forefront, ensuring all tasks and narrative elements revolved around elements of cybersecurity. In addition, because our client requested our cyber escape

room be designed for people aged roughly 16-20, about the age of high school and college students, the Thales cyber escape room does not fit the desired requirements. Finally, because the ‘escape-room-in-a-box’ requires the usage of a mobile phone, it does not meet our client’s requirements. Because our project will be used by different school districts, it is hard to adapt to their rules regarding mobile phones, so our client requested we design around that. Ultimately, our cyber escape room provides an entertaining, holistic approach to cyber security learning that the Thales Group’s products do not satisfy.

3. System Design

The goals of our escape room are exposure and education to cybersecurity through a medium that keeps players engaged and entertained. Another big part of our goal was targeting a younger audience to bring more awareness to the topic. Users should be able to work with both physical and digital elements to complete cybersecurity-themed puzzles and beat the escape room. We utilized the HTML and CSS coding languages to create user interfaces that served as puzzles and also guided the players through the experience. We chose these languages as they are the best tools to create polished web pages that are interactive and robust.

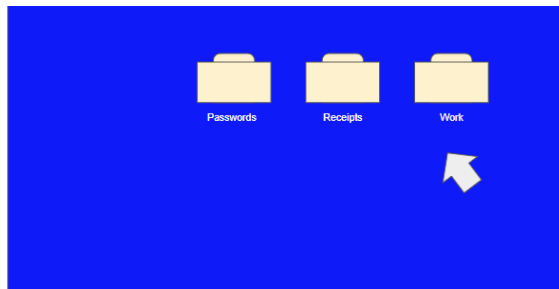
3.1 System Requirements

All users need is a laptop with a connection to the internet to access everything digital. For anything physical, players will need the briefcase, silver box, and two manilla folders. Teachers or facilitators require the setup and solutions binder. All of these are minimum requirements. The only optional requirements are scrap paper and any potential artifacts users wish to duplicate. All files for duplication can be found in the Google Drive.

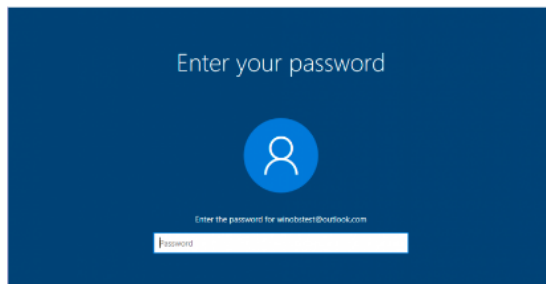
3.2 Wireframes

In the first sprint, we developed early wireframes for the digital parts of the escape room. As the narrative was solidified, we discussed the need for a password entry prompt for the players. In addition, we constructed an HTML file to mirror the structure of a computer desktop. Using this desktop, the player would be able to search through the attacker's files for clues. We also constructed a wireframe to refine our goals for the security footage puzzle.

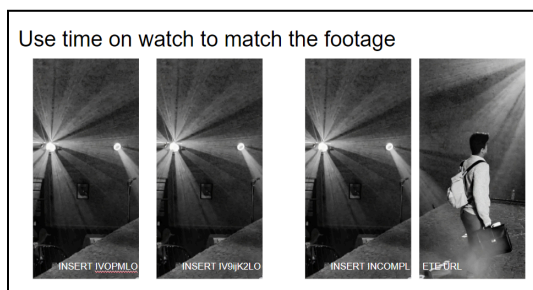
Desktop Wireframe:



Password Entry Wireframe:



Security Wireframe:



3.3 Sample Code

The following code snippet is from the first part of the desktop.html file. This file simulates a laptop desktop. The players can navigate through the attacker's files by clicking on the folders.

Final Product:



Code:

```
<style>

    body {

        background-color: #003cff;

        background-image: url('windows.jpg');

        background-size: 100%;

    }

</style>

</head>

<body>

    </div>

    <a href="songs.html" target="">

        </div>

    </a>

    <p style="margin-left: 100px; margin-right: 100px; margin-top: 40px; font-size: 18px;
line-height: 1.5;"></p>

    </div>
```

3.4 Sample Tests

This product went through rigorous testing phases. The primary concern was to test players that met the target audience, high school students. Using tests, we were able to conclude that the original first puzzle was too vague and frustrating even with hints. In response, we

completely removed the first puzzle. We also learned to refine our hints into easy-to-understand statements rather than question-like riddles.

Some testing results were unexpected. We found that smaller groups were often able to cruise through the puzzles faster than groups of four or five. A pair of high school seniors set the shortest time to solve overall. In addition, high school and college students, on average, used far fewer hints than adult testers. Despite not being our primary audience, results from adults were helpful as adult testers were more open to giving constructive criticism.

To maximize our note-taking and documentation of test results, we constructed a file to fill in timings, bugs, questions, comments, and concerns. Here is an example of a copy of this document completely filled out:

Cyber Security Escape Room Playtesting			
Team Members <u>Sarah, Bella, Dura</u>			
Average Age <u>18</u>		Playtest Date <u>3/11/21</u>	
Puzzles	Hints Used	Time (min:sec)	Bugs
N/A Puzzle 1	N/A	N/A	N/A
1 Puzzle 2	1	10:00	Bus card "7"
4 Puzzle 3	1	1:00	—
2 Puzzle 4	1, 2	~15:00	No idea how to use decoder
3 Puzzle 5	1	6:00	—
5 Puzzle 6	1	3:00	Tab Placeholder
Total	6	45:00	BASD placed with it

Additional Notes:

- Started with security ~~information~~ footage.
- Dura takes control figures "7" for Bus card!
- Rectangle = 19 First thing found
- Remove red herrings from notebook
- Not sure how to use Caesar cipher
- Need how to document for Caesar cipher
- Remind players outside → in
- Maze cipher taking too long

3.5 Code Coverage

Unlike most projects, the code used to develop our system is limited to using HTML and CSS files. That being said, no additional packages needed to be installed to program and run our system. Everything was constructed in two folders with many branching HTML files and a CSS stylesheet for each.

3.6 Installation Instructions

For our project, there is no need to deploy the code and system. However, if users do wish to redeploy the Introduction and Desktop files, they can download them from the following repositories:

<https://github.com/CyberSecurityEscapeRoom/CyberEscape>

<https://github.com/CyberSecurityEscapeRoom/HackerDesktop>

They will need to create their own repository and paste all files from the Cyber Escape folder into one repository and the Hacker Desktop files into a separate folder repository. It is important that each file goes into the correct folder that it was found in. **DO NOT MERGE THE FOLDERS INTO ONE REPOSITORY.** For each repository, navigate to the settings tab in Github, then click the “Pages” button on the left sidebar. Scroll down to the branch section and select “main” and then press “save”. In a few minutes, Github will provide a link to a published site. Both sites will start at their designated index.html files if done correctly.

During the solving of the puzzle, both sites will need password entries at some point. The password for the AttackerDesktop is “RED1989”. The password for CyberEscape is “Geoffrey Lewis”. These passwords can be found in the puzzle manual and are not to be shared with players.

4. Results

One of the main goals of this project was to develop an escape room, containing both physical and digital artifacts, targeted towards high school and college-aged students. By focusing on difficulty level and experience, we were able to develop an escape room that educates this age group on the importance of cybersecurity. The project effectively places the players in the realm of cybersecurity, exposing them to its threats and making a cybersecurity career seem obtainable.

The other main goal of this project was to make a portable escape room. The final project fits into a small briefcase and lockbox, making it easily transportable between classrooms. Customers use the system by hosting playthroughs of the escape room, in which they assemble the artifacts and access the related websites as described in the puzzle playbook.

Our playtesting showed that we were able to create an engaging experience lasting 30-45 minutes that was both entertaining and educational for up to five players at a time. After completing the five puzzles and training modules, players indicated that they enjoyed the narrative while learning about the importance of cybersecurity and how to keep themselves safe.

5. Conclusions

Based on our team's observations, we believe that our cyber escape room effectively educates young adults about cybersecurity while simultaneously fostering their creative thinking. Through engaging puzzles and scenarios, it encourages young minds to understand and apply cybersecurity principles in a hands-on and immersive environment. The development process highlights the variety of ways individuals absorb information, underscoring the need for diverse teaching methods to cater to different learning styles.

One of the broader implications of the cyber escape room is it enhances learning methods. Cyber escape rooms introduce an interactive, gamified approach to learning, which can be more effective for certain topics and demographics. The collaborative nature of escape rooms enhances participants' ability to work in teams and communicate effectively, preparing them for collaborative work environments.

6. Future Work

Due to our entire team completing the capstone course and graduating soon, there is little future work to be done. However, given more time, we were planning on making multiple endings, an element that would give players an incentive to replay the puzzle after already completing it once. We also planned on having the silver box fit inside the briefcase to transport the entire escape room more efficiently. These are things that could be improved in future iterations but would require a different team.

7. References

Cyber escape room. Thales Group. (2024). <https://www.thalesgroup.com/en/cyber-escape-room>

Ibrahim, A. (n.d.). *Projects*. Ahmed Ibrahim, Ph.D. <https://www.ahmed.ai/projects>