Problem Identification and User Research: ADHD in Teenagers Affecting Learning

1. Introduction

- **Project Title**: The Spark
- **Objective**: To find a way for people suffering from ADHD (diagnosed/undiagnosed) to learn, study or work in a less distracted manner.

2. Problem Identification

- **Problem**: ADHD, short for Attention-Deficit/Hyperactivity Disorder, is one of the most common mental illnesses that affect children. Symptoms of this include hyperactivity, short attention span, and impulsivity (Elmaghraby and Garayalde). Unfortunately, due to the nature and symptoms of ADHD, it can often go unnoticed in children, as most symptoms are typical of their behaviour. Additionally, it is also quite difficult to diagnose it in teenagers due to other conditions that they are affected by, such as anxiety and depression. This makes it difficult for them to focus on anything for too long, resulting in a lot of difficulty focusing on areas like education, which affects them later in life.
- **Context**: Many teenagers that I grew up with, including some family members, have faced immense difficulty while concentrating on single activities. In some of these cases, the person was also suspected of suffering from ADHD but was quickly dismissed due to the lack of "seriousness" of the problem. ADHD, like most mental illnesses, isn't treated seriously by most Indians, leading to it impacting people's lives, especially education, without any form of help ever being acquired. Now, these adults lack the knowledge foundation that most of us acquired in school and are falling behind in other parts of their lives.
- **Importance**: ADHD has many possible effects on one's life. However, in the context of my project, the lack of attention during primary education can lead to a lot of basics

being unknown to the patient. In the future, where the intensity might reduce, the lack of a foundation can be extremely detrimental to any form of future development/education that the individual may try to engage in.

- **Problem Statement:** ADHD in teenagers often goes undiagnosed or misunderstood, leading to significant challenges in focus and learning, which negatively impacts their academic performance and future development.

3. User Research

- **Research Methods**:
  - **Targeted Interviews**: The most important interviews for my research, were conducted on people suffering from diagnosed ADHD. By asking them about their experience with ADHD, and the way they adapted their life to counter their difficulties.
    - I also interviewed people who once believed that they were suffering from ADHD, but once got it tested, realised that it wasn't actually ADHD. The line of questioning here focused on the way their behaviour changed between two instances.
  - **Random Interviews**: I also interviewed people without a diagnosis at all. The interviews were conducted on random people, who display the major symptoms of ADHD but don't know if it is ADHD, or don't even consider ADHD as a possibility. Questions to these interviewees were focused on their approach to dealing/coping with their difficulties.
  - **Psychologist Interviews**: This is yet to be conducted, but it is one that I plan on conducting in the near future. Despite speaking to psychology students, I want to understand the treatment that a clinical psychologist recommends to a patient suffering from ADHD. I also want to understand the mannerisms/complaints that the patient provides, that make the doctor suspect ADHD.
- **Insights Gained**: A summary of the information that I've acquired so far:
  - People suffering from ADHD either follow the therapy recommended by their therapist (including meditation, controlled breathing, journaling, etc) or don't do

anything at all. In one interview, the following statement was noted, "I don't feel the impact that severely anymore, but I've never really seen one [psychologist] for it. I mainly just got the diagnosis, now I use it as an excuse for my bad grades."

- ○ People who were never diagnosed, use a few different types of techniques to counter their attention difficulties. The most notable ones are sensory overload, sensory deprivation, multi-tasking and working under pressure.
- ○ Those who had their beliefs of ADHD overturned, were in a miscellaneous group. In some cases, their attention improved as they got older, while others believed in a misdiagnosis, claiming that they got worse. However, most of them do nothing in particular to counteract their bad attention.
- ○ Lastly, one common factor across all the interviews, was that participants belonging to more orthodox or traditional households were considered to be lazy or incompetent whenever they made any mention of their inability to concentrate.
- ○ Existing treatment includes medications like Adderall and Ritalin, which have unfortunately been shown to lead to dependencies and addiction. Other treatments are forms of therapy, such as meditation, journalling, controlled breathing, etc. However, these are long-term solutions, as opposed to instant help. If these forms of therapy were not done regularly, the effectiveness was fairly low. Usually, the excess energy that people with ADHD have, needs to be burned out for them to stay calm. However, most tools for this, such as fidget spinners, and stress balls, were fairly distracting (to patients, as well as others), or difficult to carry everywhere. Many of these tools often fail to keep the patient engaged for too long.

4. Target User Group and Personas

- **Target User Group**: The target user group consists of teenagers aged 15-19 who are struggling with concentration issues, potentially due to ADHD, whether diagnosed or undiagnosed. This group includes students who have received an ADHD diagnosis but may not have fully engaged in treatment, those who suspect they have ADHD but haven't

been diagnosed, and individuals who experience similar symptoms but attribute them to other factors. This group was chosen due to the critical impact that ADHD can have on their educational development, especially in environments where mental health issues may be minimized or misunderstood.

- **Persona 1**: Sharp Patel
  - **Demographics**: 16-year-old male student in the 11th grade.
  - **Goals**: He wants to improve his maths and science grades to prepare for his engineering entrance exams.
  - **Challenges**: He gets distracted during his classes causing gaps of knowledge, which he then needs to fill in by studying the same concepts again.
  - **Motivations**: He wants to be an engineer like his father.
- **Persona 2**: Focus Sharma
  - **Demographics**: 17-year-old female high school student currently in class 12.
  - **Goals**: She wants to improve her focus during exams and study sessions so that she scores well. She wants to apply to a prestigious university and also wants to manage her time better between extracurricular activities, academics, and personal time.
  - **Challenges**: Lack of focus during study sessions, resulting in excess time spent studying the same topics, as well as difficulty concentrating during exams, leading to incomplete papers. She often procrastinates, resulting in a lot of wasted time in her schedule.
  - **Motivations**: She comes from a family of over-achievers, and does not want to fall behind them.
- **Persona 3** : Diligent Menon
  - **Demographics**: 15-year-old female student in class 10.
  - **Goals**: She wants to get decent grades to get the stream of her choice in class 11, while also being able to manage her passion for music.
  - **Challenges**: She wastes a lot of time while studying as she gets distracted, resulting in an inability to pursue her passion.
  - **Motivations**: Wants to be in a position where she can pursue her musical talents even more.

5. Conclusion

- **Summary of Findings**: The report aimed to explore ways to help individuals with ADHD, whether diagnosed or undiagnosed, to learn, study, or work with fewer distractions. The problem identified is that ADHD often goes unnoticed in children and is challenging to diagnose in teenagers, leading to significant difficulties in focusing on educational tasks. This issue is exacerbated in environments where mental health concerns are not taken seriously. The user research, which included targeted, random, and prospective psychologist interviews, revealed that people with ADHD often use varying coping strategies, from formal therapy to self-developed techniques. Many individuals, whether diagnosed or not, struggle with maintaining focus and managing time effectively, with cultural attitudes sometimes leading to the dismissal of their difficulties as laziness.

6. References

Elmaghraby, Rana, and Stephanie Garayalde. "Psychiatry.org - What is ADHD?" *American Psychiatric Association*, June 2022, https://www.psychiatry.org/patients-families/adhd/what-is-adhd#section_0. Accessed 2 September 2024.

Ideation

a) A small game as a fidget toy (Water Sorting, 2048, etc.) - Fidget toys are a commonly used tool by people suffering from ADHD. However, a huge problem with these tools, is that they are highly disruptive to others in the vicinity. As such, they cannot be used in largely quiet environments. Video games are also used as a substitute for fidget toys, however, they run the risk of being too entertaining, in which case they become the primary focus point. Conversely, if the game is not simulating enough, the user may get distracted and abandon the game altogether, defeating the purpose of the game entirely.

b) Overload senses other than the ones used in class (i.e. sight and hearing) - Keeping the non-essential senses occupied will help alleviate them from any form of distraction. Flavourless chewing gum can keep the mouth (taste) occupied, and tools such as pocket sliders to keep the hands occupied. However, practically executing this concept would be highly difficult to execute consistently. If the entire ordeal is not customised for each individual user, then the entire experience fails, and results in more distraction.

c) Divide study material into smaller segments to avoid overload - This is the ideal solution for this. By teaching content in short burst, a student suffering with ADHD can hold their attention for the duration. However, every individual topic would have to be custom created in order to make this possible to work with, which would make it impossible to use for every case.

d) Depriving senses other than the ones needed to study (i.e. sight) - Using tools such as noise-cancelling headphones to block out uncontrolled sounds (such as birds chirping), can help avoiding distractions. In addition to this, by drawing the curtains, and further reducing stimulation on the required senses, it is makes it even easier to concentrate.

Game Design for ADHD Students to Enhance Focus During Lectures

Objective:

The goal is to design a game that helps individuals with ADHD stay focused during lectures by providing just enough engagement to prevent distractions, without drawing too much attention

away from the lecture itself. The game is intended to serve as a supplementary tool to maintain attention on the lecture while allowing small bursts of activity that help manage ADHD-related challenges, such as fidgeting, restlessness, and a tendency to lose focus.

Understanding ADHD:

Attention Deficit Hyperactivity Disorder (ADHD) is characterized by difficulty in sustaining attention, impulsiveness, and hyperactivity. Individuals with ADHD often find it challenging to remain focused on tasks, especially those that require prolonged mental effort, such as listening to lectures. Common struggles include zoning out, restlessness, and becoming distracted by environmental stimuli or wandering thoughts.

Game Design Requirements:

1. **Low Cognitive Load**: The game must not require complex decision-making or deep focus, as this would detract from the primary task—listening to the lecture.
2. **Short Interactions**: To accommodate brief breaks in focus, the game should feature short, simple interactions that don't require extended gameplay.
3. **Minimal Intrusiveness**: Visual and auditory elements should be subtle, ensuring they do not overshadow the lecture.
4. **Physical Engagement**: The game could include light physical interaction (e.g., tapping or swiping), allowing students to channel their restlessness into the game rather than unrelated distractions.
5. **Reward System**: Provide mild, non-intrusive rewards (e.g., points or visual feedback) that reinforce engagement without overshadowing the importance of the lecture content.
6. **Lecture-Linked Elements**: The game could be designed to incorporate elements from the lecture, such as keywords or ideas, to subtly reinforce the lecture material.

Expected Benefits:

- **Reduced Distractibility**: By providing a mild and controlled stimulus, the game helps individuals with ADHD avoid distractions from their environment or intrusive thoughts.
- **Improved Lecture Retention**: Short, low-impact interactions keep the player engaged enough to manage their ADHD symptoms without detracting from the learning process.

- **Enhanced Focus**: The simple, repetitive actions provide an outlet for excess energy or restlessness, making it easier for students to maintain their focus on the lecture.

Wireframes

Game Concept: Reactive lights that have powered off, by navigating an electrical current to them. While moving the current around, active lights will heat up. If a light overheats, it will then power out, ending the game.

User Mechanics: There is only one mechanic that the user has access to, which is the ability to move the current. By keeping the user mechanics simple, it allows the user to focus elsewhere, and not waste effort in trying to memorize the various game controls.

Game Mechanics:

- Switch Heat Up - When the current travels over a switch, the heat value of the switch increases. If the light was inactive, the light now turns on. However, if the switch was already activated, it increases the heat level of the switch by one level. If the heat level of the switch exceeds a certain value, it blows out. This is the game end criteria.
- Score Tracking - Initially, the game had a score multiplier that kept increasing as more lights were reactivated. However, that resulted in the players getting distracted by the score changes. To counteract this, the score is now displayed as the number of lights that are reactivated. By doing this, there are fewer elements to distract the user.
- Instant Restart - Currently, the game restarts immediately after a loss. Doing this avoid a thought flow gap, which makes it more likely that the player will remain concentrated on whatever they are trying to accomplish.

Design:

- The game follows a pastel colour scheme, reducing the strain on the eyes. Pleasant colours allow the user to look at the game for a longer period of time, further reducing opportunities to get distracted.
- The switches will be rounded squares. This is another decision that makes the shape more pleasing for the user to look at. This will also be applied to other UI elements (e.g. font) in the future.

Key User Interactions:

- All elements in the game are intended to avoid opportunities to get distracted. By keeping short game durations, the user doesn't treat the short length of time as too long of a commitment to play, taking away reasons to avoid playing the game.
- The game will be a downloadable game on the computer. Not being dependent on any other resource (in the case of online games it would be the dependence on the internet connection). By keeping all the elements of the game as simple as possible, it becomes relatively easy to run the game on most machines. This also makes it so that the visual quality of the game doesn't get influenced much regardless of the resolution. If the game's visual quality is good, the players will not hesitate to play it. Making it a computer game also allows users to play it in an academic environment without standing out too much.
- The game will have minimal to no animation. The lack of flair in the game will not only reduce time gaps between two playthroughs, but also reduce distractions on screen.

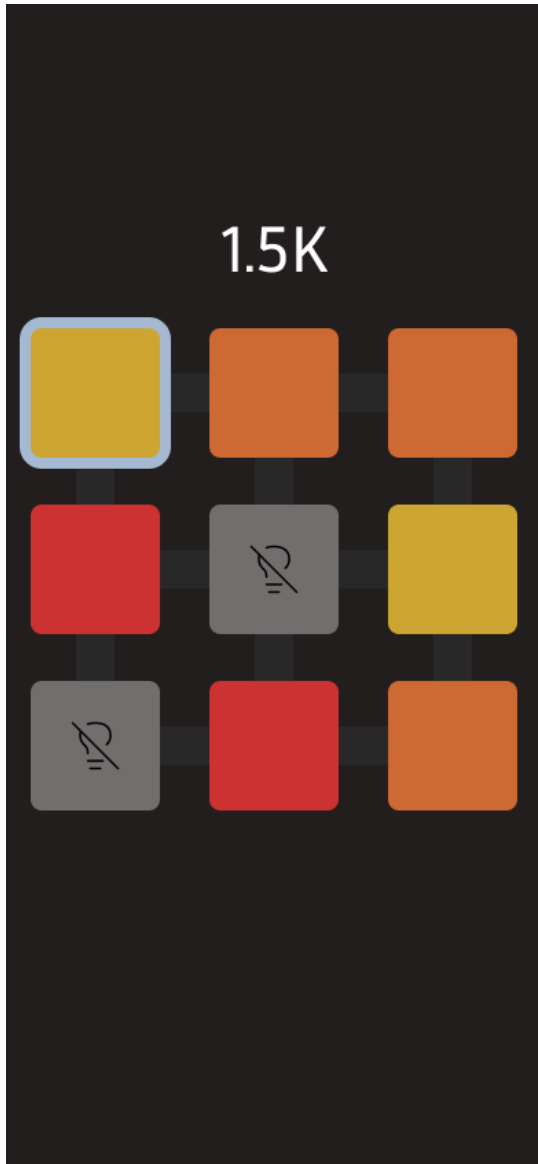**Initial Mockups**

Image 1: Initial Mockup 1
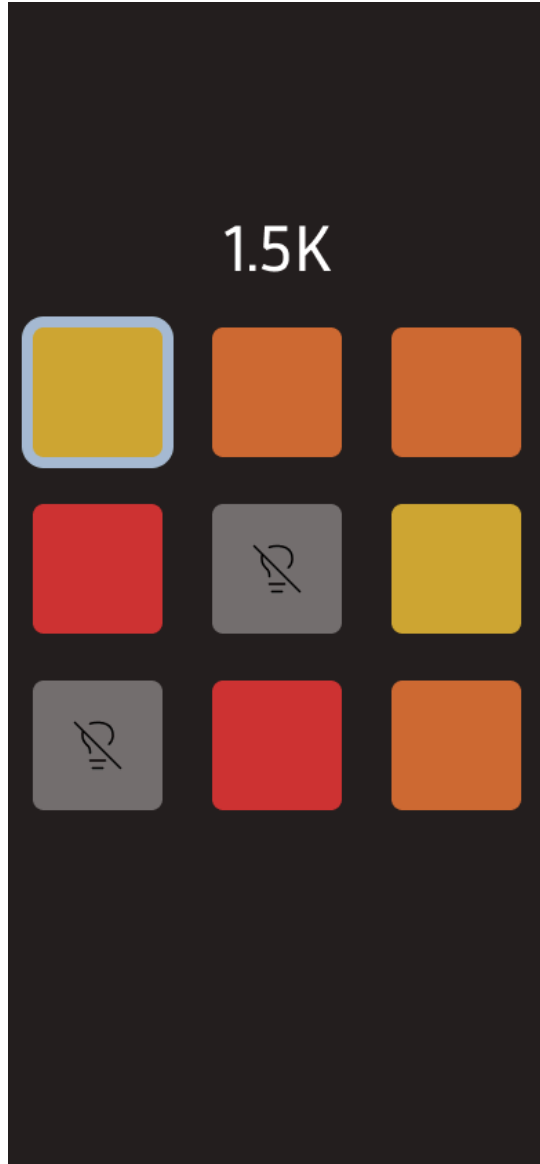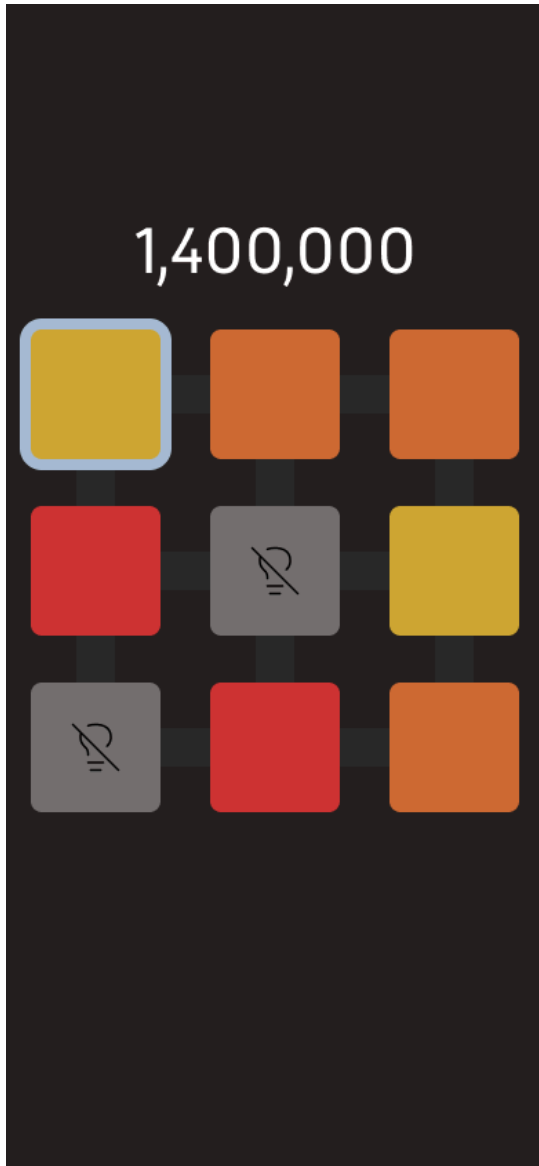
Image 2: Initial Mockup 2
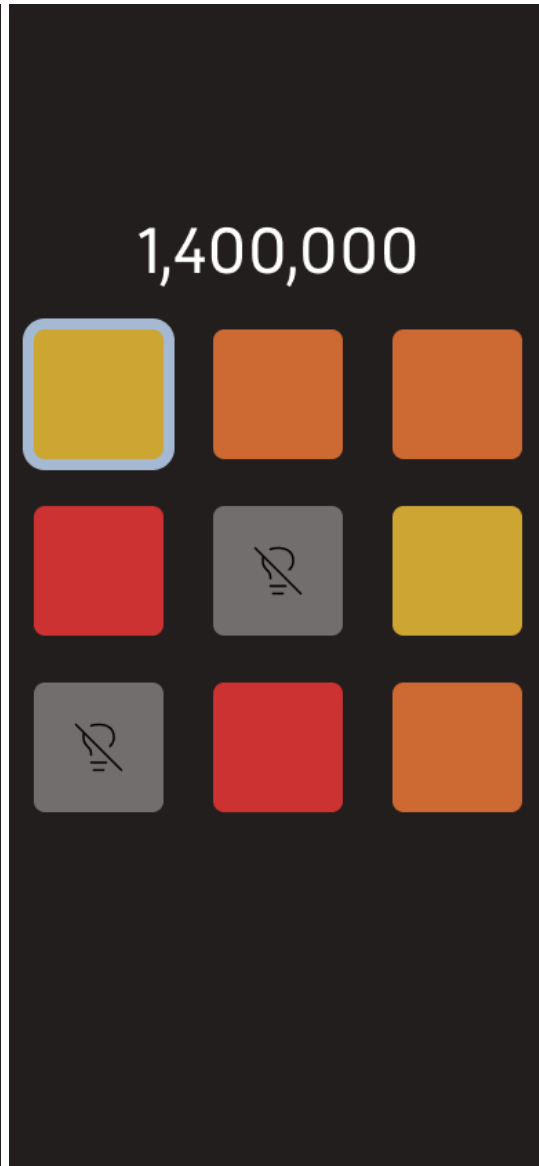
Image 3: Initial Mockup 3   Image 4: Initial Mockup 4

The main takeaway from this mockup are the guidelines at the back of the grid. These lines help keep the players aware of which directions they can move the current to. This, although not extremely prominent, subtly allows the players to stay informed. This was the initial mockup that I created on Figma. However, I won't be implementing the aesthetics until the underlying mechanics have been perfected and properly implemented.
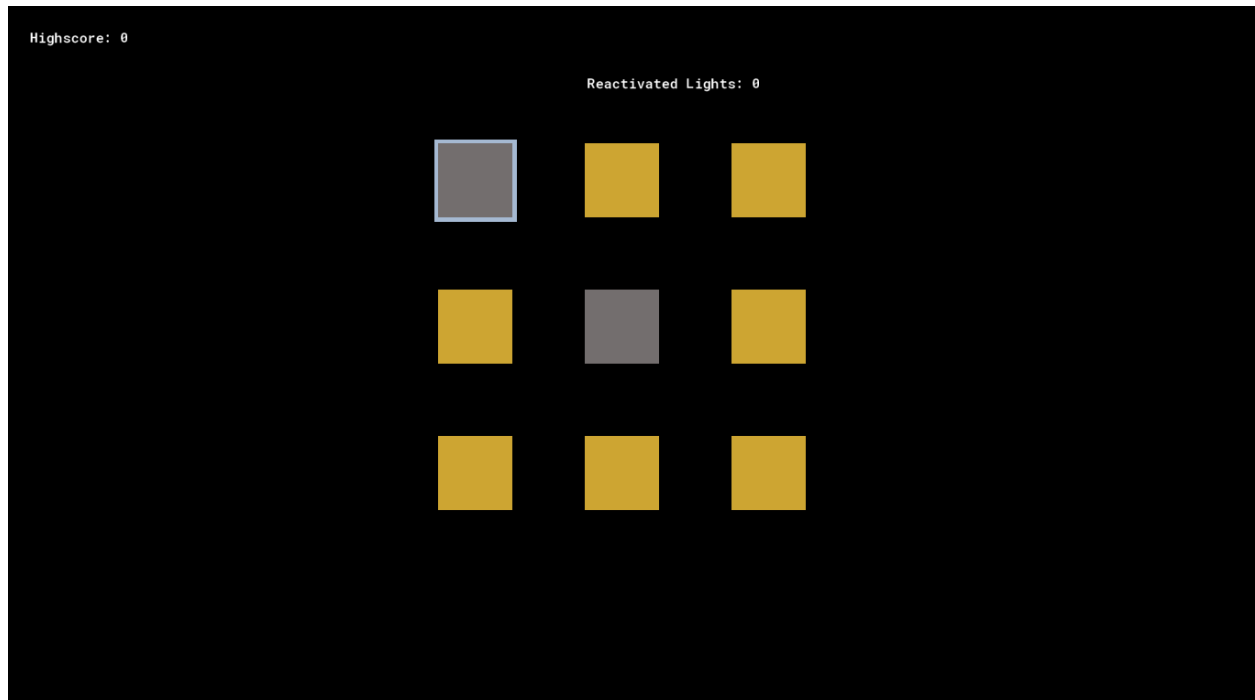
Image 5: Initial Version of the Game

The implemented model looks like this in the current state. A lot of the aesthetic design elements are not yet implemented, such as the rounded corners and guidelines, but will be implemented after the core mechanics have been properly implemented.

Note - While taking the screenshots for this version, I experienced an issue with the game engine that I was using to make this project, which is why a lot of the newer code that I was writing did not get implemented.
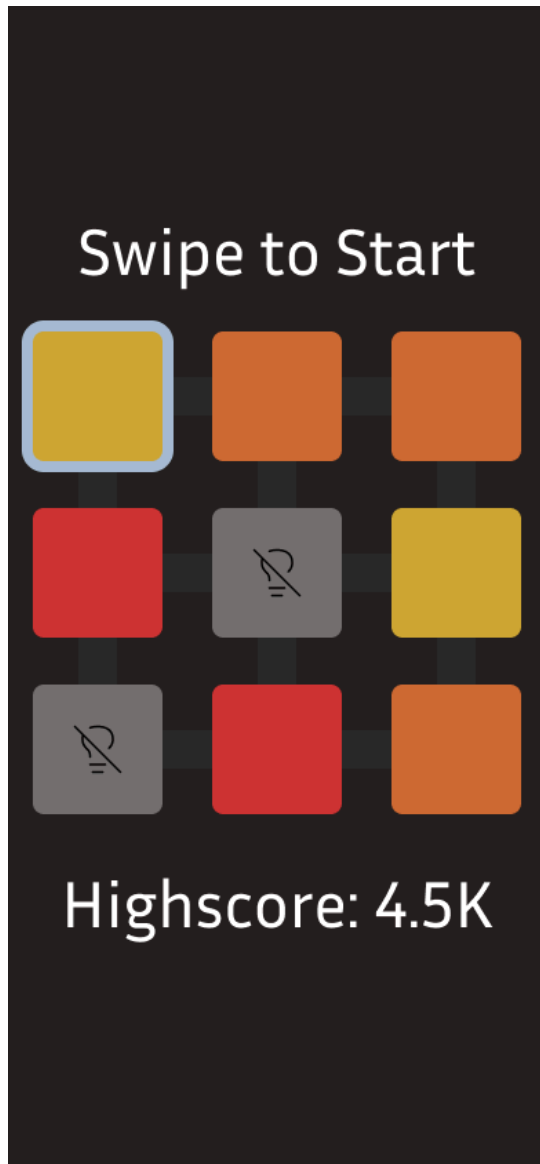
Image 6: Figma Mockup

The game screen was initially planned to look like the image above, but changes will be made as newer feedback comes in.
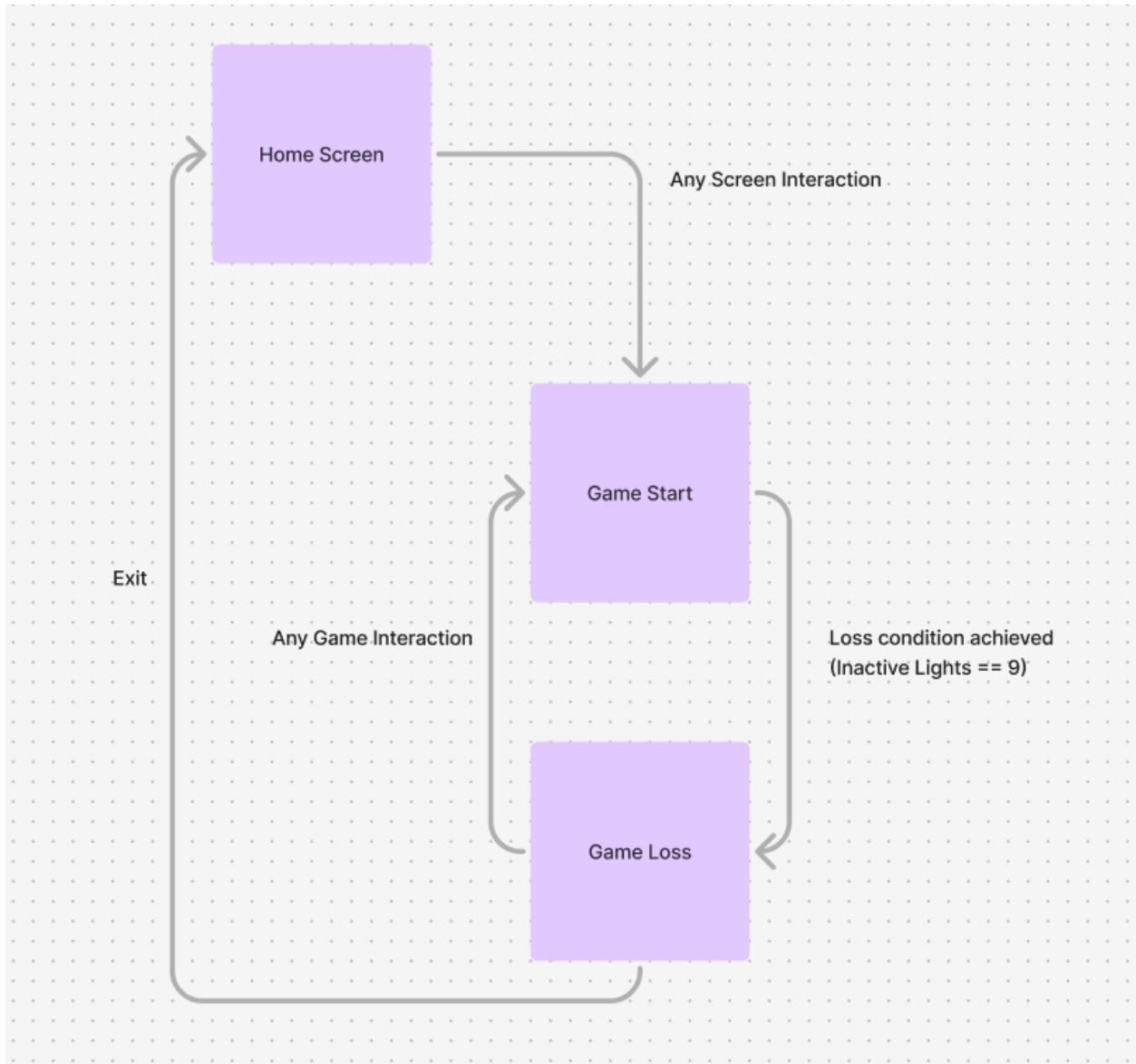
User Flow:

Image 7: Primary Game Loop

The above diagram (Image 7) is explained through the following:

1. Home Screen:
    - The user starts on the Home Screen.
    - Any interaction with the screen triggers the transition to the Game Start state.
2. Game Start:
    - After interacting with the Home Screen, the game begins, and the player enters the Game Start state.

○ The game continues as long as there is Any Game Interaction from the player.

3. Game Loss:

○ If the specific loss condition is met, i.e., the number of inactive lights becomes equal to 9 (Inactive Lights == 9), the player enters the Game Loss state.

4. Exit:

○ From the Game Loss state, the player can exit the game, returning to the Home Screen or quitting the game entirely.
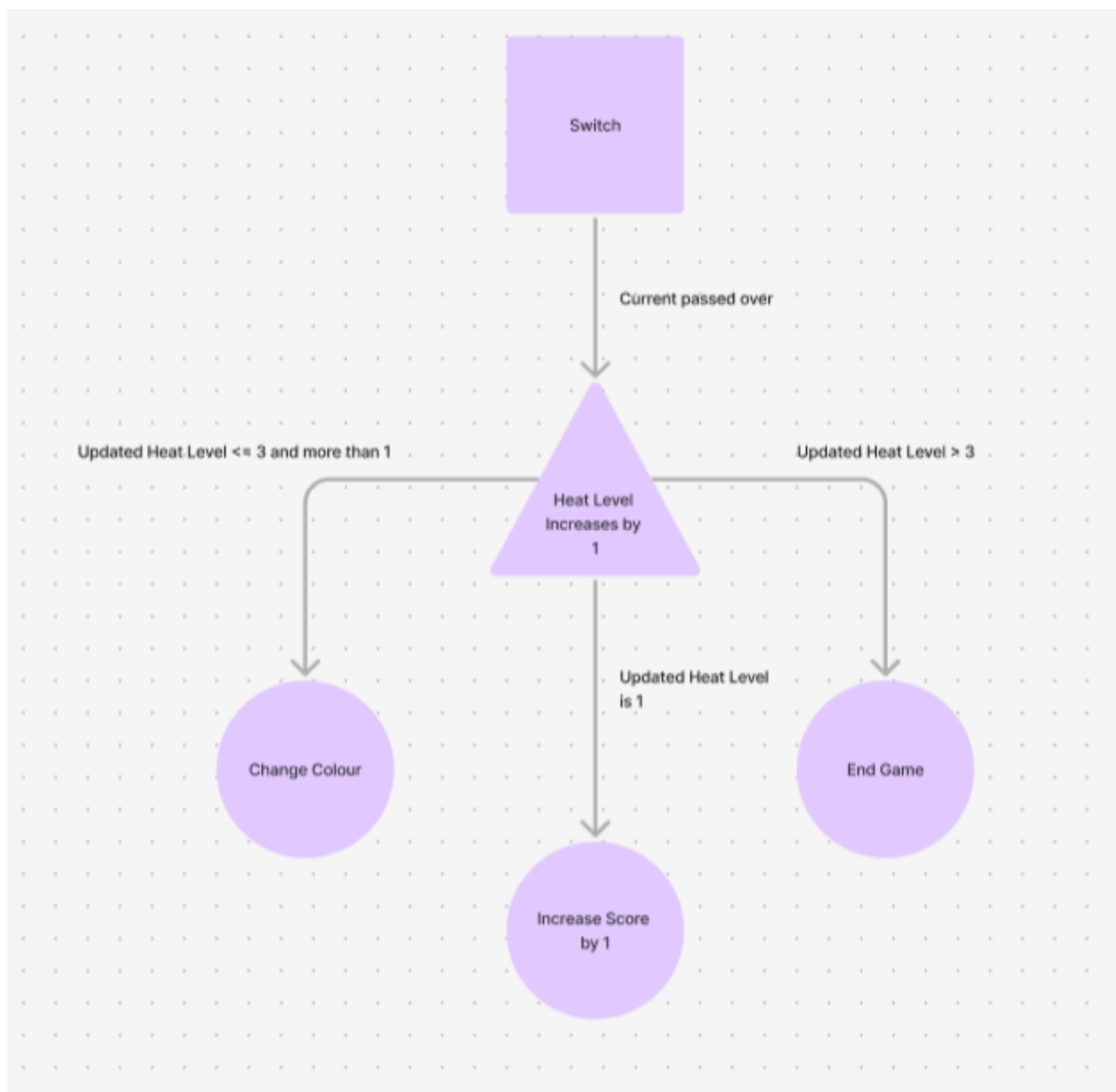
Image 8: Score Updating Sequence

The above diagram (Image 8) explains how the score updating works in the game after every individual time that the current is moved. This sequence is run every time the player interacts with the game. The following is a step by step explanation of how this sequence works:

1. **Switch**:
   - The flow begins with a **Switch** element, which represents an interactive component in the game.
2. **Current Passed Over**:
   - When a current passes over this switch, it triggers the next step in the flow.
3. **Heat Level Increases by 1**:
   - Each time the current interacts with the switch, the **Heat Level** of the switch increases by 1.
4. **Decision Points Based on Heat Level**:
   - The flow splits into three paths based on the updated Heat Level:
     - **Change Color**:
       - If the **Heat Level** is greater than 1 but less than or equal to 3, the switch changes color. This does not trigger any game event.
     - **Increase Score by 1**:
       - If the **Heat Level** is exactly **1**, the game increases the player's score by 1.
     - **End Game**:
       - If the **Heat Level** exceeds **3**, it triggers an **End Game** condition, which is a penalty for overheating.

Based on the feedback received from users, in order to make the game more pleasant to view for a long duration, the visuals were reworked. The changes that were discussed earlier in the report (See Design under Wireframes) were now implemented. As reported by the users, this made the game much easier to pay attention to in comparison to the initial version (See Image 5).

A grid was added behind the switches, making it easier for players to understand the game flow without needing to be taught the rules. This approach is common in video game design, where subtle elements are placed within the game to hint at the use of a particular mechanic. In this case, the mechanic was the movement of the current, which becomes apparent as soon as any of the default movement keys are pressed (WASD or Arrow Keys). The grid also signals the movement restrictions—specifically, that the current cannot move diagonally—and shows the limited spaces to which the current can move.

The following image depicts what the game looks like in its current state.

Image 9: Updated Game Visuals

Testing Protocol

The development of the project is currently in an iterative process of testing the game and then making changes to it based on the feedback and observations made during the testing process.

There are 2 forms of tests that are currently being conducted for this project.

1. Testing in a Controlled Environment
   ○ For this form of testing, the user is placed in an isolated environment, where they are given access to the game, as well as a notebook and pen in order to take notes.
   ○ Here, they are made to listen to 2 separate lectures, and then given a quiz on each lecture individually.
   ○ The results of the quiz are then tallied in order to understand the effectiveness of the game based on the type of topic being studied.
2. Testing in an Uncontrolled Environment
   ○ This is a setting where the user is not being monitored, and therefore, the data from this section is highly unreliable.
   ○ The user is given access to the game, and is given the freedom to use it in an academic setting.
   ○ However, since the user is not being monitored, it is unknown whether they are actually using the game or not.
   ○ This form of testing is mainly done in order to ask for general feedback regarding the experience of the game, rather than get any measurable data points.

This is the second round of testers that are being used for this project. In an earlier cycle, the testers were given the same lecture, where some testers were also given access to the game. After the lecture was completed, the testers were then given a quiz to take. Through this, the effectiveness of the game was verified, after which testing moved on to identifying the type of topics that the user would be able to effectively study using the game.

Testing Results

After the first round of testing, the total test scores were tallied. Due to the smaller number of participants for this round of testing, the scores showed a drastic increase. However, even with the fewer participants the main hypothesis was proved. The main objective of this round was to ensure that using the game is making an improvement in the academic performance. The key takeaways from this are listed below.

- Increase in average test scores - In the quiz taken after the lecture, average scores increased from 3.6 out of 10, to 7.0 out of 10.
- Fewer distractions - Distractions were measured through visual recording. The average distractions per minute dropped from an average of 2.9 times per minute to 1.8 times per minute.

These helped establish the functionality of the game. After this, the target changed to identifying what type of content is ideal to be learned using this game. To do this, every participant was given a theoretical/qualitative lecture, as well as a quantitative subject lecture, after which, their post lecture quiz scores were tallied for both lectures. The observations are as follows:

- Average scores for Quantitative subjects was 5.10 out of 10. It was harder for participants to pay attention to the content when there wasn't any reference image for them to look at and interpret what the lecturer was saying.
- Average scores for Qualitative subjects was 7.94 out of 10. Since these subjects utilized references that are easy to understand and visualize, the subject was much easier to understand when the participants were listening to the lecture, thus resulting in higher scores.

Future Prospects

Future developments could focus on the following areas:

1. **Enhanced Personalization**: By integrating machine learning, the game could adapt to individual users' unique attention patterns and preferences. This could allow for personalized adjustments to the game's difficulty, pace, and sensory stimuli based on the user's response, helping maintain an optimal engagement level.
2. **Broader Target Audience**: While the primary focus is on teenagers with ADHD, the game's design principles could be extended to support other groups who experience focus-related challenges, such as individuals with anxiety or autism spectrum disorder. This would broaden the tool's applicability, making it a more universal support resource for cognitive engagement.
3. **Data Collection for Continuous Improvement**: Introducing options to anonymously collect user feedback and usage data would enable continuous improvements. Analyzing

data on game interactions, engagement levels, and academic performance could inform iterative adjustments to the game's design and mechanics to enhance its effectiveness over time.

These prospects would support the project's goal of improving focus and learning outcomes for students with ADHD, ultimately creating a tool that is both effective in the classroom and adaptable to various learning needs and environments.