BSc Thesis Creative Technology

AI-based Affective Mirroring in Video Game NPCs

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ABSTRACT

The development of Artificial Intelligence (AI) technologies and Affective Computing has created new possibilities in video game design, particularly in enhancing the interactivity and emotional depth of non-player characters (NPCs).

This thesis explores the use of AI-based affective (emotional) mirroring in video game NPCs to enhance player attachment. By leveraging facial expression recognition technology, the research aims to create NPCs that dynamically reflect the emotional states of players. The study investigates the effects of affective mirroring through a visual novel dating game, where player interactions with emotionally responsive NPCs are evaluated.

The research employs a mixed-methods approach, combining data from controlled experiments, observations, and interviews to assess player engagement and attachment. Findings suggest that AI-driven affective mirroring can enhance the attachment players feel for NPCs, leading to a more emotionally engaging gaming experience. This work provides valuable insights into the potential of affective mirroring in gaming and offers practical information for game developers on integrating emotional AI technologies.

ACKNOWLEDGMENTS

I would like to thank everyone who contributed to the completion of this thesis.

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I am also grateful to the University of Twente and Creative Technology for providing the resources and environment that made this research possible. Studying my passions and writing on such a personal and enjoyable topic has been an incredibly fulfilling experience.

Thank you all for your contributions and support.

- Hana

1 INTRODUCTION

The introduction chapter provides an overview of the motivations guiding the thesis. It presents the project's significance and explains which steps shall be taken to achieve the thesis's goals.

1.1 CONTEXT AND RELEVANCE

The integration of artificial intelligence (AI) in video games has significantly evolved, transforming player experiences. A notable area of development is the use of AI for emotional recognition and Affective Computing, aimed at enhancing the user experience. This research explores AI-based affective mirroring, a concept where non- player characters (NPCs) dynamically reflect the emotional states of players, creating a more emotionally engaging gaming experience.

The motivation behind this research stems from the growing interest in affective computing and its benefits in interactive systems. Traditional game design often relies on static and pre-scripted NPC behaviors, which can limit the depth of player-NPC interactions. By leveraging AI, it is possible to create more responsive and believable NPCs, thus enhancing the emotional connection between players and the game world.

While the potential of affective mirroring in games is substantial, there are several challenges to its implementation. These include accurately recognizing subtle emotional cues, real-time responsiveness, and creating believable NPC reactions.

The main objective of this research is to determine whether AI-based affective mirroring can increase player attachment to NPCs in video games. This involves:

1. Developing a system capable of recognizing player emotions through facial expressions and other cues.
2. Implementing NPCs that can mirror these recognized emotions.
3. Evaluating the impact of affective mirroring on player engagement and attachment through user studies.

The findings from this research will contribute to the fields of AI, affective computing, and game design by providing evidence on the effects of affective mirroring in enhancing player attachment to NPCs. Moreover, it will offer practical insights for game developers on integrating advanced emotional AI technologies.

1.2 RESEARCH QUESTIONS

To achieve these objectives, the research is guided by the following questions:

- **Main Research Question:** Can affective mirroring increase player attachment to NPCs?
- **Sub-Research Questions:**
    1. How can the emotional states of players be recognized?
    2. How should NPCs mirror the recognized emotions?

3. What are the technical challenges in implementing affective mirroring in NPCs?

1.3 Structure of the Thesis

The thesis is organized as follows:

1. **Introduction:** Outlines the background, motivation, problem statement, objectives, research questions, methodology, and significance of the study.
2. **Background Research:** Provides a literature review and analysis of the state of the art.
3. **Methods and Techniques:** Details the design process and methodologies used in developing and testing the affective mirroring system.
4. **Ideation:** Discusses the conceptual development and refinement of the research question, gameplay mechanics, and NPC design.
5. **Specification:** Covers the technical specifications, prototyping, and user experience considerations.
6. **Realization:** Describes the development process, including challenges and solutions in implementing the affective mirroring system.
7. **Evaluation:** Presents the evaluation framework, participant details, and data collection methods.
8. **Findings:** Analyzes the evaluation results, focusing on player attachment, engagement, and overall experience.
9. **Conclusion & Discussion:** Summarizes the findings, addresses the research questions, and discusses implications for future research.
10. **Future Work:** Suggests directions for further development and broader applications of affective mirroring technology.

2 BACKGROUND RESEARCH

This chapter investigates the knowledge gained through background research, including a literature review and an analysis of the state of the art. The literature review will provide insights into the foundational theories and key studies related to the integration of artificial intelligence (AI) and emotion recognition technologies in gaming, to accomplish affective mirroring in NPCs. Following this, the analysis of the state of the art will highlight applications of these technologies.

2.1 LITERATURE REVIEW

Through the decades, the video game industry has seen a significant shift in how games are designed and played, largely driven by technological advances. A significant trend has been the integration of increasingly complex artificial intelligence (AI), to create more dynamic and engaging interactive experiences. This can be seen through the development of non-player characters (NPCs) that can adapt to and influence players' emotional states. Such advancements are not only technical feats, but they also represent a change in modern video game engagement strategies.

The goal of this literature review is to get an overview of the potential of AI and affective computing in transforming player-NPC interactions, emphasizing affective mirroring as a strategy for deepening player attachment in video games.

Affective Computing in Gaming

Affective computing is increasingly recognized as a cornerstone for modern game design, enabling systems to dynamically adapt to players' emotional states and thereby enhancing player engagement. Researchers continually seek to discover new benefits and applications of these principles.

Picard's [1] foundational concept of affective computing introduces the role of emotion recognition technologies in interactive systems. These technologies are designed not only to detect but also to respond to human emotions in a nuanced manner. This pioneering work suggested that enabling computers to recognize and respond to human emotions could fundamentally alter our interaction with machines, making them more responsive to our psychological states. This can be seen as especially relevant in the video game industry, where emotional engagement directly influences user experience and satisfaction.

Expanding on this, Yannakakis et al. [2] explore the dynamics of game design and player interaction, emphasizing the importance of adaptive systems that can modify game behavior in real-time, based on the player's emotional state. Their research shows how emotion AI can enhance the gaming experience by integrating emotional and biofeedback data, thus maintaining player engagement through tailored gameplay dynamics, as propositioned by Picard.

This approach is further developed in "Game AI Revisited," where Yannakakis [3] shows the shift in game AI from traditional NPC behavior management to broader, innovative applications such as Player Experience Modeling, Procedural Content Generation, and Large-Scale Game Data Mining. This shift highlights a matured understanding of the potential of AI

in games, proposing a more integrated approach to leveraging AI to craft richer, more responsive gaming environments.

In a practical application of these theories, Deng et al. [4] test how player enjoyment of different games could be automatically measured through AI evaluation of the facial expressions made by players. By identifying player emotions, game designers could use these insights to refine game elements to enhance player enjoyment and engagement. This technology enables a more player-centric approach to game development, where player feedback, in terms of emotional responses, plays an important role in shaping game development.

These advancements show the impact of affective computing on gaming, putting a focus on game design that recognizes and reacts to players' emotional states.,

Intelligent Emotional Displays by NPCs

Intelligent emotional displays by NPCs significantly enhance the believability and depth of player interactions in video games, transforming the gaming experience by integrating complex emotional responsiveness systems.

Hamdy et al. [5] discuss the implications of NPCs capable of sophisticated emotional displays within video games. They argue that the realism and depth of player-NPC interactions can be enhanced through NPCs that not only exhibit a range of emotional responses but also adapt these responses based on the player's actions and the game's narrative context. This ability transforms NPCs from static elements of games into dynamic participants that contribute to the storytelling and emotional depth of the game.

Zhou et al. [6] validate this perspective in their study on affective computation-based NPC behavior modeling. They explore how the emotional behaviors of NPCs when modeled with a simple emotion-behavior transition framework, can enhance game interactivity and realism. Their work shows that integrating emotional responsiveness not only personalizes NPC interactions but also introduces a layer of complexity that mimics human-like unpredictability and adaptiveness, which in turn creates emergent game scenarios.

One of the key findings from both studies is that NPCs with the capability to display believable and dynamic emotions can significantly enhance player immersion and emotional engagement. When players interact with NPCs who appear to understand and reciprocate their emotions, they perceive these interactions as more meaningful and rewarding. This emotional engagement is important for developing a deeper connection between the player and the game narrative, and NPCs that can effectively mirror player emotions contribute to a more personalized gaming experience, where players feel that their emotional responses directly influence the game's storyline and character development.

The sophistication of NPC interactions is further explored by Fraser et al. [7], who integrate emotional dialogue management systems within NPCs. This system enables NPCs to engage in meaningful dialogues with players, where the NPC responses are not just contextually appropriate but also emotionally aligned with the players' emotional states. Such systems utilize spoken conversational AI to enhance engagement, making each player's

interaction with the game personal, and thus supporting more natural and engaging conversations that can enhance player attachment to the characters.

In their study, Baffa et al. [8] propose an AI model to enhance the responsiveness and complexity of NPCs. This approach allows NPCs to react uniquely to player interactions, ranging from hostility to friendship, influenced by their emotional states and personality-driven behaviors. The authors demonstrate how this diversifies NPC reactions and adapts their behaviors in real time. Such dynamic interactions significantly deepen the player's engagement and believability of the game world, suggesting a needed shift towards more emotionally complex and responsive game characters.

Broekens et al. [9] discuss the technical frameworks behind emotional appraisal engines that are designed to process a variety of inputs, including player actions, game narrative events, and other environmental stimuli, to generate emotionally appropriate responses from NPCs. These engines allow NPCs to evaluate emotional stimuli and respond based on a modeled understanding of human emotions. They highlight the rich variety and need for different kinds of emotional models in NPCs, as well as the potential for further research on the topic, as the field still lacks standardization.

Affective Mirroring, Empathy, and Player Attachment

The psychological foundation of affective mirroring is essential for understanding its current and potential impact on gaming.

In their study, Maister et al. [10] explore the phenomenon of automatic imitation and its impact on empathy and closeness in interpersonal relationships. The researchers found that individuals often unconsciously mimic the gestures and behaviors of their partners, and these actions play a significant role in growing emotional closeness and empathy. This provides an understanding of how behavioral mimicry can strengthen emotional bonds between individuals. The automatic nature of these behaviors highlights their essential role in human interaction. Their findings suggest that such mimicry, whether in gestures, facial expressions,

or postures, enhances emotional understanding between individuals, increasing empathy and attachment between them.

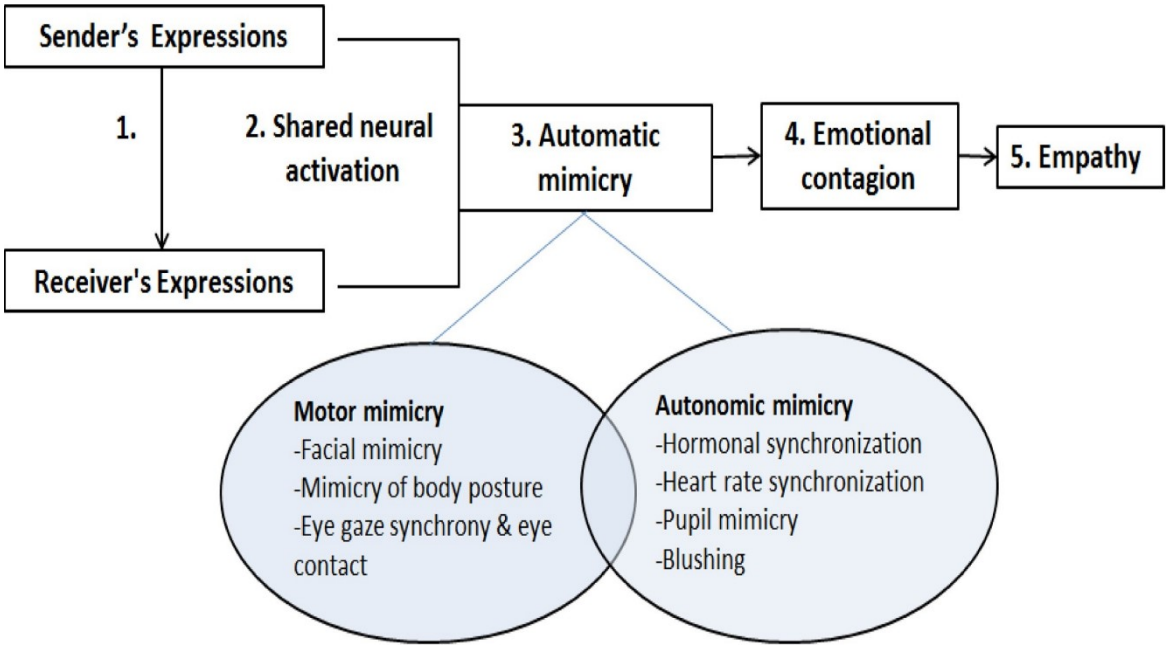

Figure 1 Empathy Development Through Mimicry

Farmer et al. [11] further discuss mimicry in their study where they examine the broader implications of imitation beyond intimate relationships. They identify imitative behavior as an important element in social bonding and communication. Their research suggests that imitation helps enhance empathy, and social cohesion and assists in learning social norms. The study points out that imitation is not just a repetitive action but is integral to how individuals engage and relate to each other. This behavior helps form a connection important for effective communication and relationship building in any social setting.

Enhancing Player Attachment through Affective Mirroring

Drawing on those findings, applying these psychological principles to the design of emotional elements in video games seems like a clear pathway to enhancing the emotional connection between players and NPCs. By incorporating systems that allow NPCs to mimic player behaviors and emotions, game designers could create more engaging and emotionally resonant

interactions. This mimicry, modeled on the automatic imitation found in human interactions, could make the NPCs seem more alive and responsive, thus deepening the player's attachment.

Figure 2 Mimicry in Infants

Bopp et al. [12] and Mallon et al. [13] provide empirical evidence supporting the role of affective mirroring in enhancing player attachment. Their studies demonstrate that emotional congruence between players and NPCs, brought to life by AI systems, can lead to stronger emotional bonds and greater player investment in the game narrative.

The practical implications of these findings are illustrated by the work of Klinkert et al. [14] who discuss artificial psychosocial frameworks for NPCs. These frameworks are designed to ensure that NPC interactions are not only technically accurate but also socially and emotionally congruent with human interactions, enhancing the authenticity of emotional exchanges.

When it comes to AI, Elyoseph et al. [15] present findings from evaluations of ChatGPT which demonstrate its emotional awareness. These systems can outperform humans in recognizing and responding to emotional cues, providing a strong foundation for developing NPCs that can accurately understand and mirror player emotions.

Additionally, Schuller et al. [16] discuss how AI can be designed to exhibit charisma, using emotional intelligence to enhance its ability to engage and influence players. According to the paper, charismatic AI can be programmed to exhibit behaviors that naturally attract human beings, such as displaying genuine interest and responding dynamically to human

emotions. This capability could make NPCs not just participants in the game but active, engaging characters that contribute to a compelling narrative experience.

2.2 STATE OF THE ART

Overview of Emotion Recognition Technology

Emotion recognition (ER) technology uses artificial intelligence to analyze and interpret human emotional states. This can be done through analysis of facial expressions, voice intonation, body language, and other biofeedback responses.

Facial Emotion Recognition (FER)

OpenCV: A large library for computer vision software, it offers a range of tools that are used for different applications of real-time image processing and analysis.

Microsoft Face API: Part of Microsoft Azure Cognitive Services, this tool can detect human faces and their attributes in images, including emotional expressions.

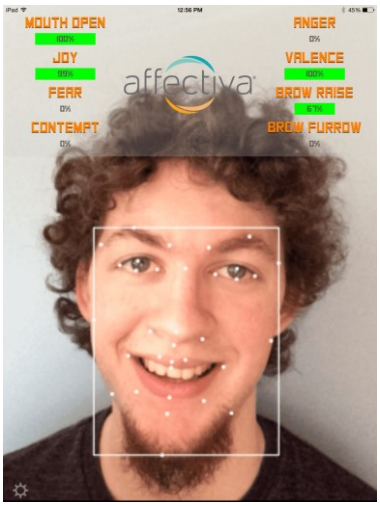

Figure 3 Affectiva

Affectiva Affdex: Provides emotion AI software that detects complex human emotional and cognitive states from face and voice.

Figure 4 FaceRig

FaceRig: A software application that uses facial recognition technology to animate avatars based on user facial expressions.

Voice Emotion Recognition

IBM Watson Tone Analyzer: Analyzes text for emotional tones and writing styles to help understand sentiments and communication.

Google Cloud Speech-to-Text API: Converts audio to text and can be used in conjunction with emotion recognition algorithms to understand affective states from speech.

Physiological Emotion Recognition

Figure 5 Empatica

Empatica E4 Wristband: A wearable device that captures real-time physiological data to provide insights into emotional states.

Figure 6 BioPac

BioPac Systems: Offers a range of equipment and software for recording and analyzing physiological signals for emotional research.

Applications in Video Games

Figure 7 Alien:Isolation

Alien: Isolation: The game offers an optional mode that uses the microphone to track noise levels in the player's environment. While not purely emotional recognition, this feature enhances the immersive experience by allowing the game's AI to react to sounds made by the player, increasing the tension and fear associated with hiding from the Xenomorph.

Figure 8 Phasmophobia

Phasmophobia: This horror game uses voice recognition to allow players to interact with ghosts using their actual voices. The game analyzes the player's questions and commands to trigger ghost responses.

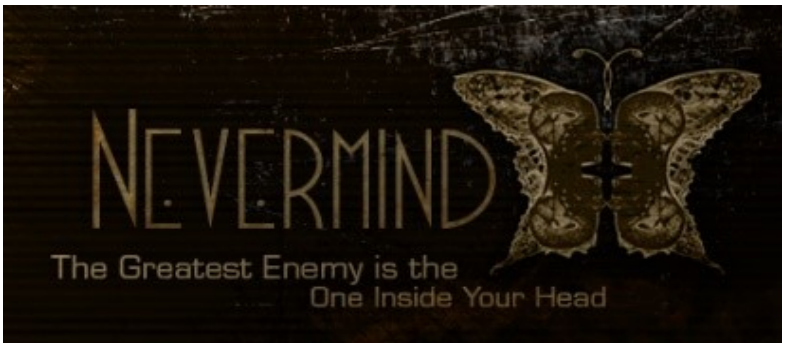

Figure 9 Nevermind

Nevermind: An adventure thriller game that uses biofeedback to alter the level of challenge based on the player's stress levels. The game uses emotion-based biofeedback via webcam and Affectiva's Affdex technology and biofeedback via heart rate sensor.

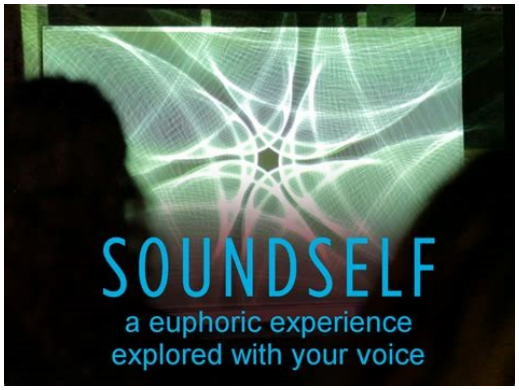

Figure 10 SoundSelf

SoundSelf: A meditative virtual reality experience that uses voice recognition to create a trance-like state. The game responds to the tones and pitches of the player's voice, creating visual and auditory feedback that promotes relaxation and emotional exploration.

Figure 11 The VOID VR Experiences

The VOID VR Experiences: While not a traditional home video game, The VOID offers VR experiences that use real-world sensory inputs, including motion and voice, to create

immersive environments. These experiences change the virtual reality world dynamically, responding to players' movements and vocal reactions.

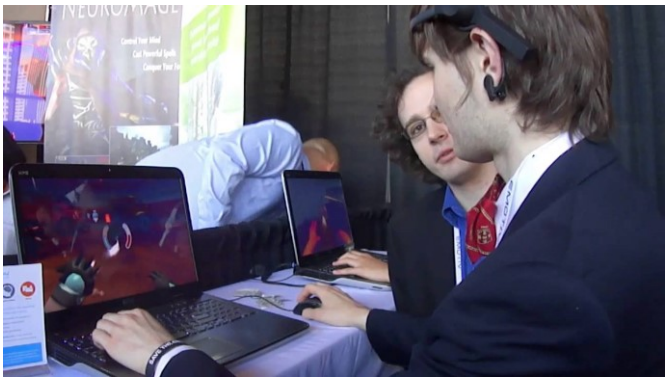

Figure 12 Throw Trucks With Your Mind

Figure 13 Brain-Computer Interface implementation in World of Warcraft

BCI (Brain-Computer Interface) Games: Games developed for neurofeedback training like Throw Trucks with Your Mind, where players use EEG headsets to control game elements through concentration and calmness levels. This technology directly taps into the player's emotional and cognitive state to control gameplay.

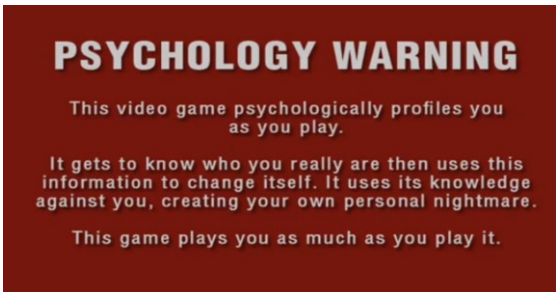

Figure 14 Silent Hill: Shattered Memories

Figure 15 Behind the psych profiling of Silent Hill: Shattered Memories

Silent Hill: Shattered Memories: This game adapts its horror and narrative elements based on psychological profiling of the player's choices, which indirectly gauges emotional reactions.

Camera Input Use in Video Games

Overview of Camera Technologies

Camera technologies capture real-time player movements and expressions. These technologies enable a more immersive gaming experience by allowing direct player input through physical actions.

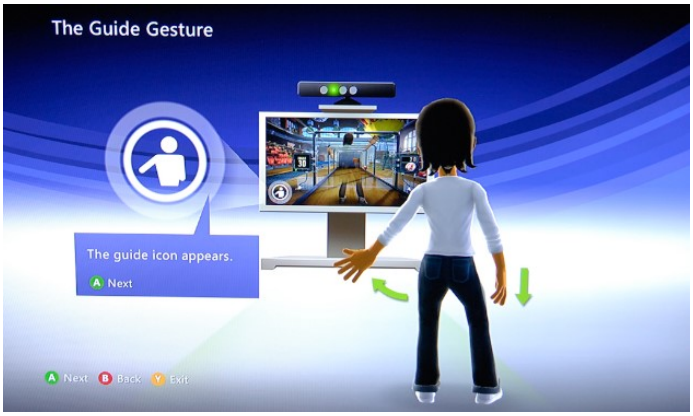

Figure 16 Kinect

Kinect: Enables players to interact with games using gestures and spoken commands without the need for a traditional controller.

Sony PlayStation Camera: Enables the PlayStation VR headset to capture the player's movements.

Integration of Camera Technologies in Gameplay

Figure 17 Just Dance

Just Dance: The camera technology tracks the player's body movements to assess their performance against the choreography, providing real-time feedback and scoring.

Figure 18 Before Your Eyes

Before Your Eyes: This game uses webcam technology to track when the player blinks. The blinks control the progression of the narrative, with each blink potentially skipping forward through memories, making the player's physical interaction a direct driver of the story.

Intelligent Emotional Displays in NPCs

Figure 19 The Witcher 3: Wild Hunt

The Witcher 3: Wild Hunt: NPCs in The Witcher 3 exhibit a range of emotions that try to respond realistically to player choices. This emotional depth enhances the narrative realism, as characters remember past interactions and respond emotionally in ways that reflect their complex histories and personalities.

Figure 20 Detroit: Become Human

Detroit: Become Human: Each NPC possesses a set of potential emotional responses that change based on the player's decisions. This system allows for a fluid narrative that reflects the emotional states of characters, making the storyline deeply personal and varied based on the player's actions.

Figure 21 L.A. Noire

L.A. Noire: It features an emotion capture system where NPCs display subtle facial cues that the player must interpret correctly to solve cases. This system emphasizes the importance of emotional intelligence in gameplay, providing a unique challenge.

Figure 22 Life is Strange

Life is Strange Series: NPCs in the Life is Strange series react emotionally to player decisions, affecting both the immediate storyline and broader narrative arcs. This responsiveness adds layers of consequence and depth to the player's choices, influencing future interactions and outcomes.

Figure 23 Telltale's The Walking Dead

Telltale Games: Games such as The Walking Dead, feature NPCs whose emotional reactions are closely tied to the player's decisions, creating a narrative that feels personal and emotionally charged, and where player choices have tangible emotional impacts on the characters.

Figure 24 Disco Elysium

Disco Elysium: The game has a skill system where emotional and intellectual traits like Empathy, Authority, and Shivers influence not just dialogues but also the protagonist's internal monologue and interactions. Each skill can lead to different emotional reactions from NPCs, creating rich psychological gameplay. For example, high levels in Empathy allow the detective to better understand NPC motivations, while Shivers might provide eerie premonitions about the game world.

Figure 25 Baldur's Gate 3

Baldur's Gate 3: Baldur's Gate 3 features a sophisticated emotion system where NPCs respond based on an understanding of past interactions and the emotional stakes of current decisions, enhancing the depth of role-playing elements.

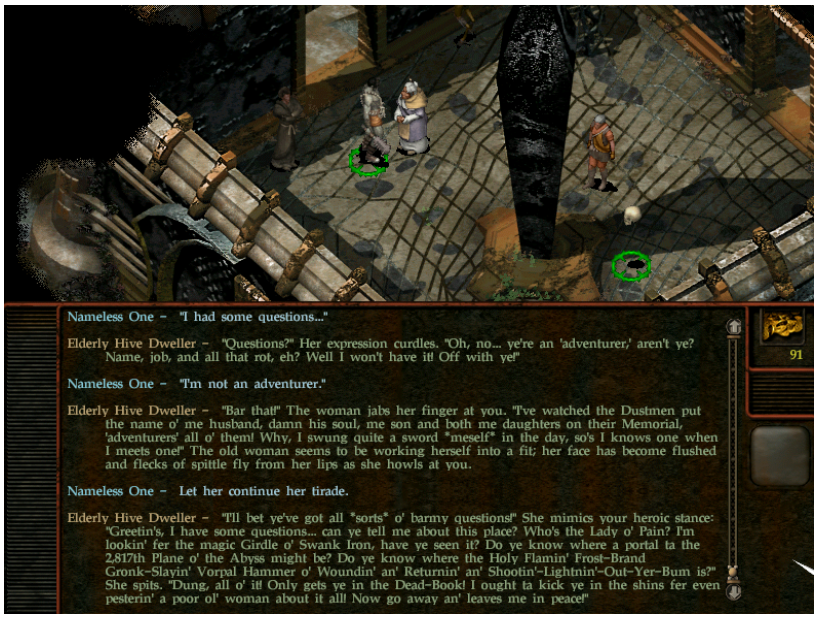

Figure 26 PlaneScape: Torment

Planescape: Torment: Known for its deep narrative and complex characters, it offers NPCs that react emotionally in ways that are significant to the story's thematic elements.

The emotional displays are intricately tied to the philosophical and moral choices made by the player, influencing the narrative and character relationships.

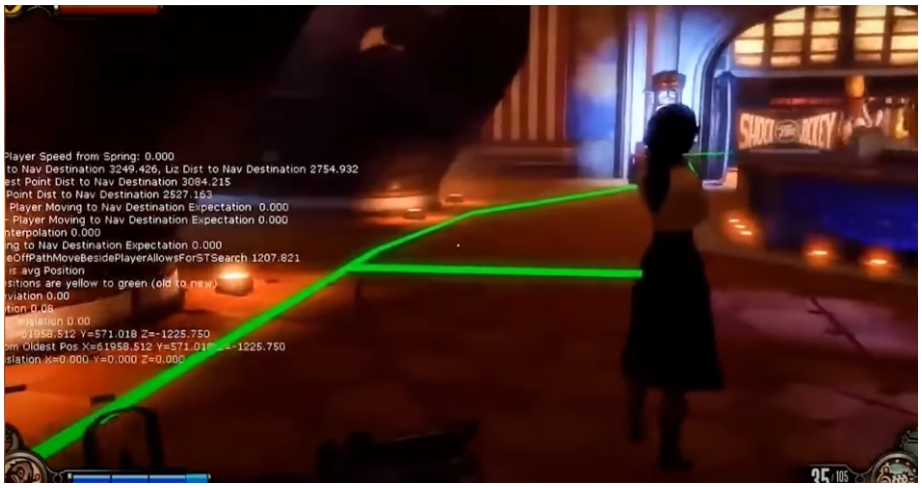

Figure 27 BioShock Infinite

Bioshock Infinite: In Bioshock Infinite, NPC Elizabeth reacts dynamically to player actions during combat and exploration. Her behavior and assistance during battles are influenced by how the player engages with the game world and other characters.

Player Imitation in Video Games

Figure 28 Dishonored

Dishonored Series: In Dishonored and its sequels, NPC reactions and the overall state of the game world change based on the player's approach to combat and stealth. For example, using non-lethal methods decreases the level of chaos in the game environment, affecting NPC behavior and even altering story outcomes.

Figure 29 Shadow of Mordor

Shadow of Mordor/War Series: The Nemesis system in these games dynamically adjusts NPC behaviors based on player interactions. Enemy characters remember previous encounters and react accordingly, developing rivalries or fear depending on the player's actions.

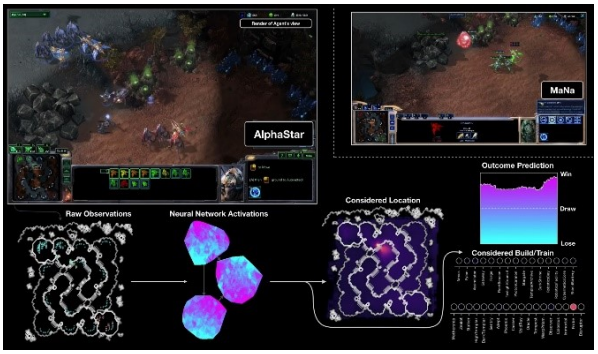

Figure 30 AlphaStar

AlphaStar: Developed by DeepMind, AlphaStar is an AI program that plays the game StarCraft II at a professional level. It imitates and learns from strategies, showcasing an advanced level of tactical adaptation and strategic planning. This AI represents a leap in how NPCs can be programmed to mimic complex human behaviors in a competitive environment.

Figure 31 ECHO

ECHO: A game that centers around enemies that imitate past player behaviors. The imitation is focused on specific attacks and movements the player has performed.

2.3 SUMMARY

In conclusion, the literature review reveals that AI's ability to recognize, interpret, and respond to player emotions can significantly deepen player engagement, making NPCs feel more believable and responsive, enriching the gaming experience. Additionally, mirroring of emotions and behaviors has proven to be important in building relationships between individuals, and it has thus proven itself to be a promising path to enhancing player attachment to video game NPCs.

The analysis of the state of the art covers various emotion recognition technologies, such as facial emotion recognition (FER), voice emotion recognition, and physiological emotion recognition. These technologies are being integrated into games to create more immersive experiences. Examples include games like "Alien: Isolation," which uses microphone input to react to player noise levels, and "Phasmophobia," which employs voice recognition to interact with in-game ghosts. Moreover, games like "The Witcher 3: Wild Hunt" and "Detroit: Become Human" showcase how NPCs can display a range of emotions and adapt their responses based on player actions, enhancing the narrative depth and emotional engagement.

While the potential of AI to transform player-NPC interactions is substantial, it also has several limitations that require careful consideration. There is a lot of diversity in emotional recognition technologies and their integration into games, this presents a challenge in standardizing emotional models across different games, genres, and platforms. Additionally, the depth and believability of NPC emotional interactions heavily depend on the underlying AI technology, which can vary greatly between implementations.

Another important consideration is the ethical implications of employing AI in games, particularly concerning data privacy and the manipulation of emotions. Current studies and research implementations often overlook these aspects, which could lead to potential misuse or exploitation of the gathered data. These issues highlight the need for an ethical framework to guide the development of affective computing and AI in gaming, making sure that the systems are used responsibly.

Looking forward, there is a clear need for further research to explore the implementation of affective mirroring techniques across various game genres and platforms. Such studies could help determine the effectiveness of emotion AI across a broader range of gaming experiences and identify best practices for its implementation. Additionally, investigating how these technologies can be optimized for diverse ethnic and demographic groups is essential to eliminate bias, and ensure inclusivity and accessibility in gaming.

3 METHODS AND TECHNIQUES

The objective of this thesis is to investigate whether player emotional attachment to NPCs in video games can be enhanced through AI-based mirroring of player emotions. This goal involves leveraging existing AI technologies in innovative ways to create a more emotionally responsive and engaging gaming experience. Accordingly, the design process adopted in this project integrates user-centered design approaches, while also adhering to engineering principles necessary for game development.

This chapter details the methods utilized in the project, outlining the dual approach of employing both the Creative Technology design process and Emotional Design principles. The Creative Technology design process provides a framework supporting the technological development of interactive systems like video games. It is structured into phases of Ideation, Specification, Realization, and Evaluation. This approach is important for ensuring that all technical aspects of the project align with the thesis requirements.

Emotional design principles are integrated to guide game design and NPC creation, ensuring that these characters resonate deeply with players on a visceral, behavioral, and reflective level. This integration is key to creating NPCs that are not only technically able to mirror player emotions but also capable of using that to enhance the gaming experience.

This chapter will explore how these methods are applied in the development process.

3.1 THE DESIGN PROCESS FOR CREATIVE TECHNOLOGY

The Creative Technology design process, as outlined by Mader and Eggink in 2014 [17], offers a foundation for this thesis due to its ability to combine technology with user-centered design. This design process is particularly made to use existing technologies in innovative ways. It perfectly aligns with the goals of this thesis, which include applying AI and facial expression recognition technologies to guide the behavior of NPCs. This approach is especially important for developing interactive systems like video games, which rely on user engagement. The process was chosen for its structured, adaptable, and iterative approach, which suits the interdisciplinary nature of game development.

This process's flexibility is valuable in video game development. This approach creates a feedback loop, where initial concepts are continuously refined based on testing and feedback. Such a process not only enhances the quality and effectiveness of the game but also ensures that the final product resonates well with its audience. The Creative Technology design process is structured into four main phases: Ideation, Specification, Realization, and Evaluation.

The Ideation phase is the start of the project, where divergent thinking is encouraged to generate a wide array of innovative ideas. This stage is where brainstorming, and tinkering with existing technologies occur. The aim here is to explore various possibilities and conceptualize novel applications that can meet the project's goals. A key challenge in the Ideation phase is the risk of ideas becoming too expansive or impractical to implement.

The Specification phase is where ideas begin to take concrete form. This phase involves narrowing down the ideas generated during ideation. Specifications are developed, prototypes are built, and initial testing is carried out. This phase is characterized by convergent thinking, where the feasibility of ideas is tested and refined based on practical constraints and user feedback. Challenges during this phase could be technical limitations and integration issues. These can lead to revisions and may impact the project timeline.

The Realization phase involves the actual development and final assembly of the project components based on the refined prototypes and specifications. This phase is where all elements come together, and the full system is built and integrated. It involves extensive coding, system optimization, and comprehensive testing to ensure that every part works and meets the project requirements. Realization can have technical challenges, such as bugs in the code, performance issues, or integration difficulties between different system components. These issues can delay project timelines and require troubleshooting.

The Evaluation phase is where the project is tested and assessed. This phase involves both functional testing to ensure the system meets all technical specifications and user testing. Evaluation aims to confirm that the final product aligns with the initial goals and answers the research question. The primary risks during the evaluation phase are troubles with user testing, such as biased feedback, low response rate, or issues that emerge only in testing.

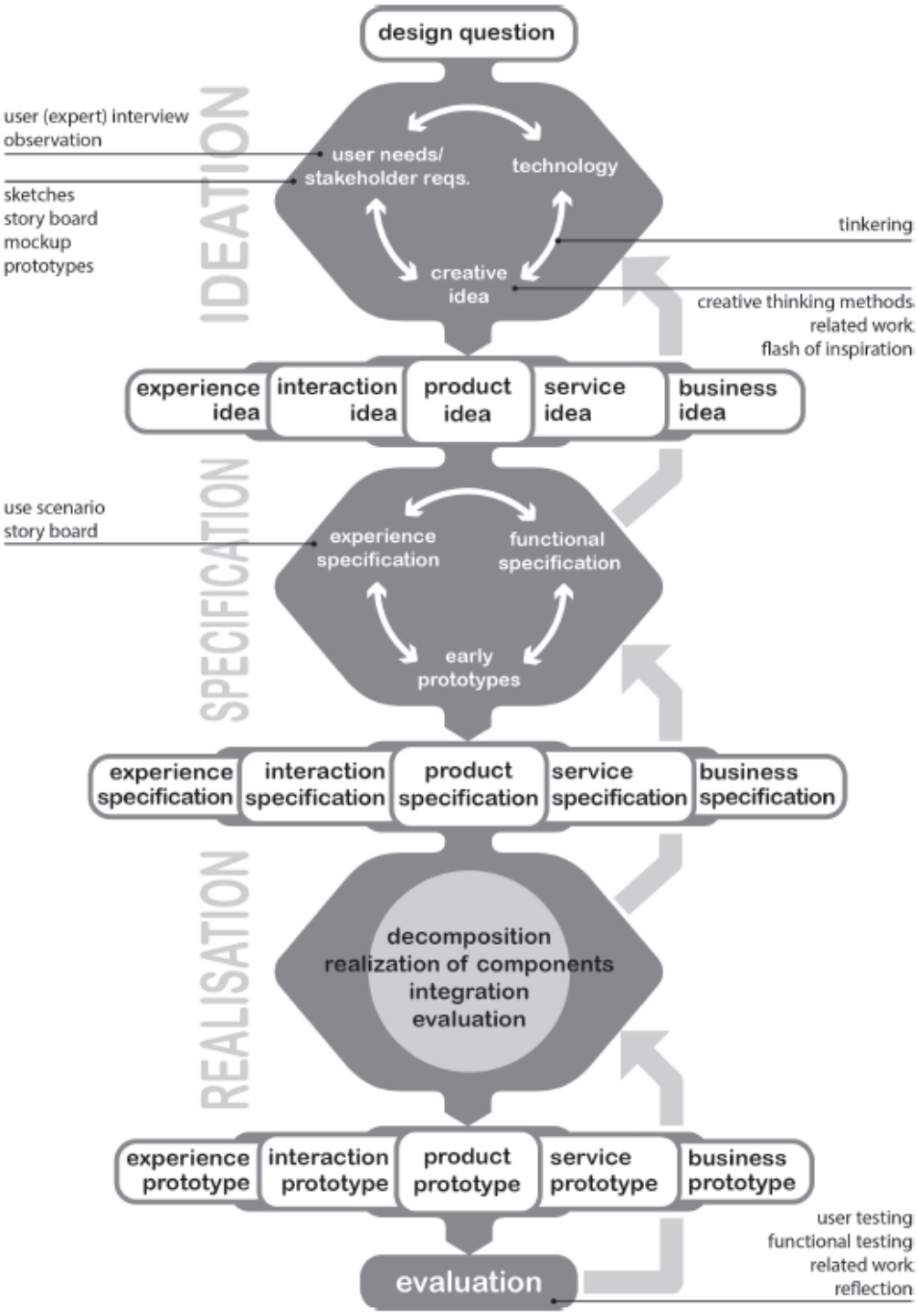

Figure 32 Creative Technology Design Process

3.2 APPLICATION OF EMOTIONAL DESIGN

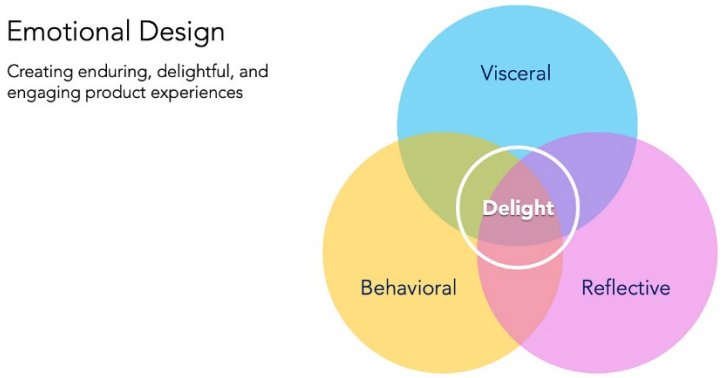

Figure 33 Emotional Design

Emotional Design is a concept popularized by Donald Norman in his book, "Emotional Design: Why We Love (or Hate) Everyday Things" (2004) [18]. This design philosophy emphasizes the importance of the emotional connection between users and products, which is important in digital environments like video games. Norman categorizes emotional responses into three levels, visceral, behavioral, and reflective, which guide the user's interaction from initial perception to reflective thought about the experience.

Visceral Design is about immediate response to the look, feel, and sound of a product.

Behavioral Design is the usability and performance of the product. It's about how things function during use, and the user experience derived from it.

Reflective Design is the deeper contemplation of one's experiences with the product, including memories and the effects of prolonged use, which can affect user's emotional attachment to it.

Application in Game Design

In the context of game design, emotional design can affect how players interact with and feel about the game. It influences not just the immediate enjoyment of a game but also long-term engagement and player retention. [19]

Visceral reactions in games are often influenced by graphics, soundtracks, and the initial user interface design. The first impressions are important in capturing and maintaining the player's attention.

Behavioral responses are elicited by the game mechanics themselves—how satisfying the controls feel, the responsiveness of the game environment, and the feedback mechanisms.

Reflective responses occur after playing, as players think back on their experience. Reflective design in games can lead to discussions with others about the game or repeated playthroughs etc.

Implementation in This Thesis

In the Visceral aspect, the design focuses on making NPCs aesthetically pleasing and emotionally expressive. This can be achieved through detailed character designs and expressive facial animations that immediately evoke a sense of realism and empathy.

At the Behavioral level, NPCs will react dynamically to the player's actions and emotions, facilitated by AI. This ensures that interactions with NPCs feel meaningful and responsive, directly impacting the gameplay experience in a way that feels rewarding.

Reflectively, the game will incorporate story elements and NPC behaviors that resonate with players. This could lead to greater emotional attachment to the game, influencing how players perceive it.

Motivation for Selection in This Thesis

Emotional Design was chosen for this thesis because it had the potential to positively contribute to achieving the project's goal of enhancing player attachment to NPCs. By designing NPCs that engage players at visceral, behavioral, and reflective levels, the project aims to create a more immersive and emotionally compelling game experience. It helps ensure that every aspect of NPC design, from the initial impression to ongoing interactions and overall storyline impact, works together to build a deeper emotional connection to the game.

3.3 Combining Creative Technology Design Process and Emotional Design

The challenge of increasing player attachment in video games through AI-based affective mirroring in NPCs calls for a blend of technical innovation and emotional insight. This section illustrates the integration of the Creative Technology design process with Emotional Design to achieve this goal.

The Need for Integration

Integrating the Creative Technology design process with Emotional Design combines the strengths of both approaches. The Creative Technology design process excels in using existing technology for innovative applications, focusing predominantly on technical development, user feedback, and the prototyping of new systems. While it provides a structured approach to creating an interactive product, it often lacks a clear focus on the emotional implications of these technologies unless specifically directed to consider them. On the other hand, Emotional Design focuses on enhancing the emotional connection between the user and the product, which is highly important in designing a video game that focuses on player attachment to NPCs and connects with the player on personal level [20]. This approach is important for engaging users but requires a solid technological framework to be effectively implemented in complex systems like video games.

Integration Strategy

During the ideation phase, the Creative Technology design process begins with broad ideation focused on leveraging existing technology. Emotional Design is integrated at this early stage

to prioritize emotional objectives, considering potential emotional impacts alongside technological innovations.

In the specification phase, the Creative Technology design process concentrates on refining ideas into technically feasible prototypes. Emotional Design guides this refinement, ensuring prototypes are not just functional but emotionally resonant.

During the realization phase, the Creative Technology design process entails the actual construction and integration of system components. Emotional Design focuses on ensuring that components, particularly AI algorithms governing NPC behavior, are evaluated for emotional accuracy as well as technical performance.

Finally, in the evaluation phase, the Creative Technology design process evaluates technical aspects to discover issues or areas for enhancement. Emotional Design introduces emotional evaluations to assess the impact of NPC interactions on player emotions through user testing.

Challenges

Balancing different design processes adds complexity to the project development. The integration of Creative Technology and Emotional Design requires careful planning and coordination to ensure that both technical and emotional aspects are adequately addressed. Additionally, quantifying the emotional impact of game features is inherently challenging, as it is highly subjective and varies from person to person. This subjectivity makes it difficult to measure and evaluate the effectiveness of emotional design elements consistently and reliably.

3.4 SUMMARY

Integrating the Creative Technology design process with Emotional Design Principles allows for the development of a video game that not only leverages different technologies but also creates meaningful emotional connections with players. This approach ensures that the game is both technically sound and emotionally engaging, enhancing player attachment through AI-based affective mirroring in NPCs.

4 IDEATION

The ideation chapter discusses the refinement of the research question, the selection of gameplay and interaction mechanisms, and the choice of game genre. It also covers the technologies and techniques for recognizing player emotions, strategies for mirroring these emotions in NPCs, methods for displaying mirrored emotions, testing strategies, stakeholder analysis, and requirement analysis.

4.1 REFINEMENT OF THE RESEARCH QUESTION

The thesis began with the broad concept of implementing AI-based affective mirroring in video game NPCs to enhance emotional engagement in players. The first challenge was defining what "AI-based affective mirroring in NPCs" precisely is. The concept was broad and open to different interpretations and, because of it, needed a precise definition to guide the research.

During the beginning of the thesis, there were two main concepts for affective mirroring in NPCs:

1. **Mirroring Player Emotions by NPCs**: This approach focuses on NPCs that can recognize and reflect the emotional states of players, adapting their responses and behaviors to mirror those of the player.
2. **General Mirroring of Human Emotions by NPCs**: This broader approach aimed to explore the capability of NPCs to have human-like emotional responses to different stimuli within the game, not strictly limited to player interactions. Here, NPCs would react with behaviors that mimic human responses to similar situations, aimed at increasing the realism of the game world.

Both approaches were discussed in more detail in the different thesis descriptions:

Thesis Description for Mirroring Player Emotions:

"The project, "AI-based Affective Mirroring in Video Game NPCs" aims to explore the ways to enhance emotional resonance between players and video games by using artificial intelligence. Its central focus is to create non-player characters (NPCs) that react to the game world by dynamically mirroring the player's emotional states and behaviors. This could enhance player engagement through making a more realistic, responsive, and ever-changing game world.

This can be achieved through the integration of advanced AI algorithms that enable NPCs to adapt their responses based on player actions. For instance, using models like ChatGPT for a more adaptive dialogue can bring a more personalized and emotionally richer interaction between players and NPCs. Another way could be an AI Model piloting the character by starting certain animations, scenarios etc."

Thesis Description for General Mirroring of Human Emotions by NPCs:

"The project, "AI-based Affective Mirroring in Video Game NPCs" aims to explore the ways to enhance emotional resonance between players and video games by using artificial intelligence. Its central focus is to create human-like non-player characters (NPCs) that react to the game world by dynamically mirroring human emotional states and behaviors. This could enhance player engagement and immersion through making a more realistic, responsive, and ever-changing game world.

This can be achieved through the integration of advanced AI algorithms that enable NPCs to adapt their responses based on player actions. For instance, using models like ChatGPT for a more adaptive dialogue can bring a more personalized and emotionally richer interaction between players and NPCs. Another way could be an AI Model piloting the character by starting certain animations, scenarios etc."

Decision and Refinement

The decision to focus specifically on the mirroring of player emotions by NPCs was influenced by several factors.

The player-specific mirroring approach provided a clearer research path. It made the thesis more focused, novel, and achievable. It also aided in the creation of highly specific research questions.

Directly mirroring player emotions promised a more personalized user experience, this could help create more engaging exchanges between NPCs and player.

This choice made it possible to use preexisting technologies, ensuring that the project remained feasible within the graduation project's timeframe.

4.2 DEFINING THE GAMEPLAY AND INTERACTION MECHANISMS

In developing an emotionally responsive video game, selecting the appropriate approach for affective mirroring is important. This section explores various strategies and evaluates their suitability for integrating AI-based affective mirroring into the gameplay. To accurately detect player emotions and integrate them into NPC interactions, several methods were considered. Each approach offers unique advantages and challenges, which were evaluated to determine the best fit for the project.

Dialogue-Based Mirroring

Dialogue-based mirroring focuses on interactions between the player and NPCs through conversation. By narrowing the game's complexity to verbal interactions, this approach simplifies development and allows for detailed exploration of character animations and emotional states. Concentrating on dialogue brings character interactions to the forefront, making it easier to observe and analyze the effects of affective mirroring. However, this approach could demand advanced language processing capabilities to accurately interpret and respond to the player's emotional state through text or speech.

Action-Based Mirroring

In contrast, action-based mirroring involves NPCs reacting emotionally to player actions, such as choices made during gameplay, including helping or harming other characters. This method integrates emotional responses directly with gameplay mechanics, making NPC reactions feel more relevant to player actions. However, accurately associating the right emotional responses with possible player actions requires sophisticated context analysis, presenting significant technical challenges.

Environmental Interaction-Based Mirroring

Environmental interaction-based mirroring allows NPCs to react to changes or events within the game world that may not directly involve the player. This approach creates a living world where NPCs respond similarly to players, potentially enhancing empathy and connection. However, implementing this method requires extensive programming to ensure NPCs can interpret various environmental stimuli as scenario triggers, adding complexity to the development process.

Physiological Response-Based Mirroring

Another method involves using player physiological signals, such as heart rate, to adjust NPC responses. This approach provides a straightforward way to determine the emotional states of players. However, the technological demands of integrating various components and ensuring their compatibility make this method challenging to implement. Additionally, it runs the risk of being narrowed down to only confirming that the player is experiencing what the game wants it to feel. There is no way to tell whether the heart rate has increased from stress, lust, anger or fear.

Contextual Affective Mirroring

Contextual affective mirroring considers both the history of interactions with the player and the current situation to tailor NPC responses. This approach supports the development of nuanced relationships that evolve over time, using information from past interactions and current contexts for more complex dynamics. Maintaining continuity and relevance in emotional responses requires a sophisticated storage and analysis system, presenting another layer of complexity.

Decision to Choose Dialogue-Based Mirroring

After evaluating these strategies, the dialogue-based approach was chosen for its several compelling advantages.

Focusing on dialogue allows for a streamlined development process, limiting complexity to verbal interactions and reducing the need for extensive programming of environmental and action-based responses. This approach ensures a more manageable scope for the project.

By concentrating on NPC interactions through dialogue, players can fully engage with NPCs, closely observing their behaviors and emotional expressions. This method leverages the natural human tendency for mirroring interactions, enhancing emotional connections. The

controlled nature of dialogue interactions also provides a clearer framework for testing and analyzing emotional responses.

With fewer game mechanics to manage, the focus remains on the most important components of the study, such as AI and character interactions. This simplifies the process of identifying and correcting mistakes, providing a more controlled environment for testing the thesis. The streamlined focus on dialogue interactions allows for iterative refinement based on user feedback, ensuring the research question "Can affective mirroring increase player attachment to NPCs?" is thoroughly investigated.

Choosing a dialogue-based approach allows the project to explore the impact of AI-driven affective mirroring in a manageable and focused setting. This method balances the need for technical feasibility with the potential for deep emotional engagement, making it an ideal choice for the thesis.

4.3 SELECTION OF GAME GENRE

Choosing the right game genre was important for designing AI-based affective mirroring and refining and specifying the main research question. Different game genres were considered to determine which would best facilitate testing and implementation of affective mirroring in NPCs.

Figure 34 Facade

Interactive Drama (e.g., Facade): Interactive drama games focus heavily on character interaction and conversation, making them ideal for narrative and relationship-driven interactions. This genre excels in testing dialogue-based affective mirroring because narrative interactions are at the forefront. However, the highly scripted nature of these games can restrict the possible responses of AI, limiting the exploration of more dynamic interactions.

Figure 35 Buckshot Roulette

Horror Game (e.g., Buckshot Roulette): Horror games utilize intense emotional triggers such as fear and suspense. They are ideal for testing AI-driven emotional responses under stress and intense emotional settings. Despite their potential, testing horror games on users could raise ethical concerns, making them less suitable for a broader audience and more challenging to implement in an academic setting.

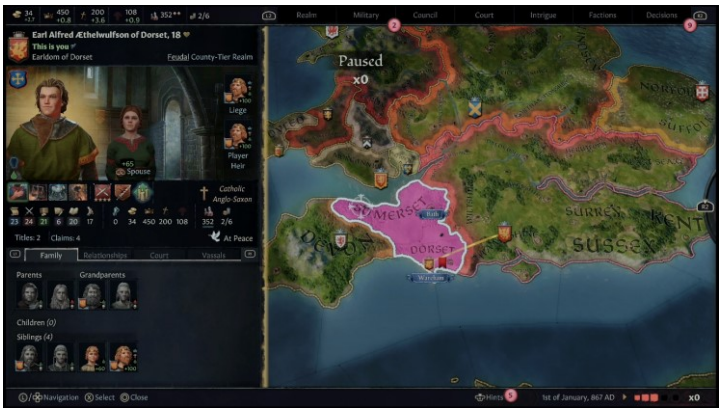

Figure 36 Crusader Kings 3

Strategy Games (e.g., Crusader Kings 3): Strategy games involve decision-making and management, often from a leadership perspective. They can integrate emotional AI into decisions affecting NPC communities. However, the "overlord" type focus may affect the impact of individual interactions, making it harder to assess the emotional attachment between players and specific NPCs.

Figure 37 Bloodborne

Action-Adventure Games (e.g., Bloodborne): Action-adventure games combine narrative elements with action, providing dynamic environments for storytelling. The combination of action and narrative creates emotionally complex scenarios that players can experience. Nevertheless, the action aspect could detract from the focus on NPC interactions, which is important for testing affective mirroring.

Figure 38 Fallout 1

RPGs (e.g., Fallout): Role-playing games (RPGs) offer complex worlds with rich backstories and character development, often involving extensive player interactions with NPCs. The depth of world-building and character development provides potential for intricate affective mirroring, allowing NPCs to react in emotionally nuanced and intelligent ways based on player decisions and interactions. However, the expansive nature of RPGs could make them technically challenging, as they require managing not only dialogue but also interactions within a large game world.

Figure 39 Dream Daddy

Visual Novels and Dating Sims (e.g., Dream Daddy): Visual novels and dating sims are heavily focused on dialogue and character decisions that influence narrative outcomes. This genre is ideal for detailed emotional engagement through dialogue, making it perfect for testing affective mirroring in relationship contexts. Additionally, the in-game view is always focused closely on the NPC, which is beneficial for capturing emotional responses. However, the niche appeal of this genre might limit player feedback and broader applicability.

Final Genre Selection: Visual Novel Dating Game

After consideration, the visual novel dating game genre was chosen. This decision was influenced by several key factors.

The visual novel dating game's focus on narrative and character-driven stories makes it ideal for observing player-NPC interactions. This genre allows for deep storytelling and emotional connections, essential for testing the effectiveness of AI-driven affective mirroring.

Dating sims demand high emotional investment from players, making them more observant to NPC responses. This heightened engagement is important for testing the results of affective mirroring, as it directly influences how players perceive and interact with NPCs.

The controlled environment of visual novels allows for precise adjustments in scenarios, enabling the thesis to be fine-tuned based on user feedback. This genre's structure supports iterative testing and refinement, which is essential for developing and assessing the AI components of the project.

By focusing on a visual novel dating game, the project aims to explore how AI-driven affective mirroring influences player attachment to NPCs in a controlled and narratively rich environment. This genre provides the best setting for addressing the refined research question: "Can affective mirroring increase player attachment to NPCs?" This focused approach allows for a detailed examination of emotional dynamics and player engagement, providing valuable insights into the effects of AI-based affective mirroring.

4.4 RECOGNITION OF PLAYER EMOTIONS

An important component of developing an emotionally responsive video game is the recognition of player emotions. This section outlines the various technologies and techniques considered for detecting player emotions and discusses the rationale behind the chosen approach.

Facial Expression Analysis: Facial expression analysis uses facial recognition software to capture and analyze players' facial movements through a camera. By identifying subtle changes in facial expressions, this technology can deduce the player's emotional state. [21] This method is particularly appealing due to its non-invasive nature and the widespread availability of webcams, making it easier to integrate. The simplicity and clarity of facial expression analysis make it an attractive option for real-time emotion detection.

Eye Movement Analysis: Eye movement analysis involves tracking the player's eye movements to understand their focus and engagement levels [22], [23]. This technology can reveal whether the player is paying attention to the NPC or is distracted by other elements in the game. [24] Although eye-tracking provides valuable insights, it requires additional hardware and can be intrusive, potentially disrupting the gaming experience.

Voice Tone Analysis: Voice tone analysis uses voice recognition algorithms to detect emotional cues in the player's speech, such as tone, pitch, and speed. [25] This method can complement facial expression analysis by providing additional emotional data. However, it necessitates high-quality audio input and can be influenced by background noise, which may affect accuracy.

Physiological Sensors: Physiological sensors measure indicators like heart rate, skin conductance, and body temperature to deduce emotional states [26], [27]. These sensors offer precise and reliable data but require players to wear specialized devices, which can be intrusive and less acceptable to a broader audience.

Behavioral Analysis: Behavioral analysis tracks the player's in-game behavior, including decision-making patterns, interaction speeds, and choices, to recognize their emotional state. This method provides indirect emotional insights and can be used to enhance other detection techniques.

Keyboard and Mouse Dynamics: Analyzing how players use input devices, such as the dynamics of keyboard and mouse usage, can offer clues about their emotional state [28], [29]. While this approach is non-invasive, it provides less direct emotional data compared to other methods.

Decision on Emotion Recognition Approach

After considering the various technologies, the decision was made to focus on Facial Expression Analysis for emotion recognition. This choice was driven by several factors that align with the project's goals and constraints:

Integration Simplicity: Facial expression analysis can be easily integrated into the gaming environment since most players already have access to webcams. There is also software available for this task, making it a practical choice for implementation.

Non-invasiveness: Unlike physiological sensors, facial expression analysis does not require players to wear any special devices. This non-intrusive nature makes it more acceptable and comfortable for players.

Real-time Responsiveness: Facial expression analysis allows for real-time emotion recognition, enabling dynamic interactions during gameplay. This immediacy enhances the player's engagement and immersion by providing instant emotional feedback from NPCs.

Challenge: Player Facial Neutrality

One significant challenge encountered was that players often maintain a neutral facial expression during gameplay, especially in single-player experiences. This neutrality poses a problem for emotional recognition technologies that rely on expressive facial cues to interpret emotional states. To address this challenge and enhance data accuracy, a new approach was introduced.

Solution: Eliciting Expressive Responses

To overcome the issue of neutral facial expressions, the project introduced a method requiring players to verbally say their dialogue choices during gameplay. This approach is based on the hypothesis that speaking and emulating conversation encourages more expressive facial movements, making it easier for the facial recognition software to capture emotional data.

Implementation Strategy

The implementation strategy involved integrating voice-activated dialogue selection and facial expression analysis.

Players select their dialogue responses by verbally saying their choice instead of clicking options. This vocal interaction is intended to produce more expressive communication, likely reflecting on the player's face. The spoken dialogue is then converted to text, and an AI model integrated into the game engine matches it with the closest dialogue option. This process captures verbal cues and enhances the engagement and realism of the interaction.

As players speak their choices, the system continues to analyze their facial expressions, capturing reactions that naturally arise during interaction. This combination of verbal and facial data provides a more comprehensive understanding of the player's emotional state, enabling more accurate and responsive NPC interactions.

By focusing on facial expression analysis and enhancing it with voice-activated dialogue, the project aims to create a more emotionally responsive gaming experience. This approach balances technical feasibility with user comfort.

4.5 MIRRORING PLAYER EMOTIONS

In developing a video game that utilizes AI-based affective mirroring, it is essential to define how non-player characters (NPCs) will reflect player emotions to enhance emotional

attachment. This section explores the strategies considered for mirroring player emotions and provides context to understand their potential impact on gameplay. This discussion ties directly to the sub-research question: "How should NPCs mirror the recognized emotions?" which is an important step in addressing the main research question: "Can affective mirroring increase player attachment to NPCs?"

To begin with, various methods for mirroring player emotions were evaluated, each with distinct advantages and considerations.

Direct Mirroring of Facial Expressions: Direct mirroring involves NPCs mimicking the facial expressions detected from the player in real-time. This straightforward approach provides immediate feedback, making interactions feel responsive and engaging. However, this method might lack subtlety, potentially causing NPCs to feel more like avatars of the player rather than independent characters with their own emotional depth.

Contextual Facial Mirroring: In contextual facial mirroring, NPCs adjust their expressions based on both the player's emotional input and the context of the game scenario. This strategy adds depth to emotional interactions, making NPC responses more nuanced and appropriate to the situation. However, implementing this method requires sophisticated AI to accurately interpret both emotional and contextual data.

Amplified Mirroring: Amplified mirroring exaggerates the player's facial expressions to emphasize emotional responses, enhancing the dramatic impact of interactions. This approach can effectively highlight key emotional moments, but there is a risk of over-dramatization, which might break immersion and make interactions feel unnatural.

Subdued Mirroring: Subdued mirroring involves NPCs responding with more moderated facial expressions compared to the player's, reflecting a calmer and more controlled emotional response. This approach can introduce a sense of emotional balance and maturity in NPCs, though it may be perceived as less responsive by players seeking more immediate and vivid feedback.

Cumulative Emotional Expression: Cumulative emotional expression allows NPCs to develop nuanced facial responses over time, influenced by repeated interactions with the player. This method portrays a build-up of emotional history, fostering deeper narrative and character development. However, it requires persistent tracking of player interactions to maintain continuity and relevance.

Delayed Mirroring: Delayed mirroring reflects player emotions with a pause, simulating contemplation or emotional processing. This strategy can make NPC responses appear more considered and realistic, but it might disrupt the immediate feedback players expect in dynamic interactions. Additionally, it could account for delays in data processing.

Final Approach to Affective Mirroring: After evaluating these strategies, the decision was made to focus on Direct Mirroring of Facial Expressions for the prototype. This approach was selected for several reasons:

1. **Simplicity and Clarity:** Direct mirroring provides a clear and straightforward method for NPCs to reflect player emotions, making it easier to understand and implement.

2. **Technical Feasibility:** With the availability of facial recognition technologies that can accurately capture and interpret facial expressions, this method is technically feasible for a bachelor's project.
3. **Immediate Player Feedback:** Direct mirroring allows for instant emotional feedback, enhancing the interactive experience by making NPC responses appear more immediate and genuine.

By focusing on Direct Mirroring of Facial Expressions, the project aims to create a responsive and engaging interaction between players and NPCs. This approach aligns with the technical capabilities available and ensures that the affective mirroring is effective and practical to implement within this thesis's scope.

4.6 DISPLAYING MIRRORED EMOTIONS

In a visual novel game focusing on AI-based affective mirroring, displaying NPCs' emotions effectively is important to increasing player attachment. This section lists the methods considered for visually representing mirrored:

1. **Enhanced Facial Expressions**: Utilizes detailed, animated facial expressions that change dynamically.
2. **Textual Descriptions of Emotions**: Alongside facial expressions, emotions are described through text.
3. **Emotion-Driven Dialogue Choices**: Dialogue options that change based on the emotional context, reflecting not just the words but the emotional tone in which they are delivered.
4. **Facial expression images**: Expressions are depicted through various images of the NPCs, with the game drawing from an extensive library to select the appropriate one.
5. **Color Changes in Dialogue Text or Background**: Color of the text or the background changes according to the emotional states.
6. **Ambient Sound and Music Adjustments**: Background music and ambient sounds that adjust to emotional states.
7. **Dynamic Expression Layering**: Multiple layers of facial features that can be adjusted independently, such as eyebrows, eyes, mouth, and even cheek color. This allows for a combination of facial changes that more accurately represent complex emotions.
8. **Micro expressions**: Brief, involuntary facial expressions that occur as fleeting reactions to emotional stimuli, often lasting only a moment.
9. **Contextual Facial Animation**: Adapt facial expressions based on the context of the interaction or the environment. For example, an NPC might show a different facial response to the same emotion if they are in public versus alone with the player.
10. **Expression Transitions**: Instead of switching abruptly from one expression to another, smooth transitions mimic how human emotions evolve over time during conversations.
11. **Eye Focusing and Pupil Dilation**: Adjust the focus and dilation of the NPCs' eyes based on emotional states. For example, pupils can dilate in response to excitement or constrict to anger.
12. **Blushing and Pallor Effects**: Change the coloration of NPC faces to reflect emotional states, such as blushing with embarrassment or turning pale with fear.
13. **Layered 2D Sprites**: Multiple layers of 2D sprites for different parts of the face, such as separate sprites for eyes, eyebrows, mouth, and even cheeks. This allows for various combinations and intensities of expressions.

14. **Emotive Icons and Visual Cues:** Small icons or visual effects around the character's head to symbolize emotions, like a sweat drop for nervousness, a vein for anger, or hearts for love.
15. **Expression Gradients**: Color gradients to facial features based on emotions; for instance, a red gradient for anger or a blue one for sadness.
16. **Sequential Image Transitions**: Transition between different facial expressions using a sequence of images that morph gradually from one expression to another.
17. **Exaggerated Expressions for Dramatic Effect**: Exaggerated facial expressions in key dramatic moments to emphasize the intensity of emotions, drawing on the expressive style often seen in anime and manga, by which visual novels are usually inspired.
18. **Animated Mouth and Eye Movements**: Simple animations for mouths and eyes that adjust according to the spoken dialogue or emotional state, such as blinking, widening, squinting,
19. **Animation Loops**: Short, looping animations for subtle movements like eye twitching, small smiles, or frowns. Expressions can be expressed smoothly as there is always the base looping animation that each animation goes to or emerges from.
20. **Emotion-specific Backgrounds**: The background or the color scheme around the character changes based on their emotional state, such as using cool blues for sad moments or warm oranges for happy scenes.
21. **Dynamic Expression Sounds**: Pairing specific facial expressions with unique, subtle sound effects or musical cues.

In the end, Facial Expression Images were chosen as it allowed for a large array of emotions to be represented in a clear and direct way, without having large technology and time investments apart from creating the library of images. It also allowed the focus of affective mirroring to stay on the facial expressions.

4.7 TESTING STRATEGIES

The effect of affective mirroring on increasing player attachment to NPCs requires a specialized approach to testing. The overall strategy involves a combination of quantitative and qualitative methods. These are the potential approaches for testing:

- **Controlled Experiment**: Players will be divided into two groups, where each group experiences varying levels of affective mirroring intensity and complexity from NPCs.
- **In-Game Behavioral Tracking**: Player interactions with NPCs (e.g. choices made in dialogues and game) are logged to be examined later. For example, different NPCs could have varying levels of affective mirroring implemented, player choice of which they prefer (would like to go on another date with), would indicate how affective mirroring in NPCs effected the player attachment to that character.
- **Surveys and Interviews**: After gameplay sessions, players are asked to complete surveys and participate in interviews to collect subjective feedback on their experiences.

Preliminary Testing Plan:

1. Initial Player Setup:

- Players will be briefed about the game and informed of the testing process.

2. Gameplay Sessions:

- Participants will engage in gameplay in a private setting (as to remove embarrassment and outside factors out of the equation) where they interact with NPCs with varying levels of affective mirroring capabilities.

3. Data Collection:

- Data such as player choices will be collected during gameplay.
- Afterwards, players will complete surveys designed to assess their emotional responses and attachment towards the NPCs.
- Participants will also be interviewed to gather qualitative insights into their experiences.

4. Analysis:

- Information from interviews will be used to answer the primary research question and highlight other discoveries.

4.8 STAKEHOLDER ANALYSIS

1. **Players**: The primary users of the game, whose engagement and attachment are central to the thesis.

    - **Needs**: Engaging gameplay, emotional depth, privacy of data.
    - **Impact**: Directly affected by the game's quality and AI's effectiveness.

2. **Game Developers**: Programmers, designers, artists, and testers who can benefit from the systems developed in this game.

    - **Needs**: Clear requirement, testing and implementation descriptions.
    - **Impact:** Their work is influenced by the technological constraints of implementing affective mirroring and the thesis results.

3. **Game Publishers**: Companies that distribute video games, interested in the commercial success and marketability of the game.

    - **Needs**: A marketable product that appeals to a broad audience and aligns with current market trends.
    - **Impact**: Financial and reputational implications based on the game's success in testing the thesis.

4. **AI Technology Providers**: Entities that provide the AI tools used for affective mirroring.

    - **Needs**: Opportunities to showcase their technologies, feedback for technology improvement, and ethical usage of their products.
    - **Impact**: Technology validation.

5. **Academic Community**: Researchers interested in human computer interaction.

- **Needs**: Data for research and insights into artificial interactions with humans.
- **Impact**: Gains knowledge that can contribute to academia and future technological advancements.

6. **Regulatory Bodies**: Authorities that oversee data privacy, software standards, and ethics.

    - **Needs**: Compliance with laws and regulations.
    - **Impact**: Ensuring that the game meets legal and ethical standards to protect the users.

7. **Designers of Interactive Systems**: Professionals who design interactive applications across various sectors, including healthcare, education, and customer service.

    - **Needs**: Insights into effective emotional engagement strategies that can be applied in various contexts, such as digital avatars for social interaction, interactive systems for the elderly to combat loneliness, or customer service bots.
    - **Impact**: The research outcomes can influence broader applications of the technology. Successful demonstration of affective mirroring in the game could validate its effectiveness, encouraging these designers to adopt similar strategies in their own fields.

Influence of Stakeholder Analysis on the Thesis

The stakeholder analysis influenced the direction and approach of this thesis. Recognizing the needs and impacts on various stakeholders led to a decision to initially focus on publicly available, free-to-use commercial software rather than experimental personal, or expensive assets. This choice was driven by the desire to understand the experiences and challenges a game developer might face when using accessible tools to implement affective mirroring.

By considering the perspectives of game developers and publishers, focusing on commercial software allowed for a broader validation of the AI technologies used.

Overall, the stakeholder analysis guided the thesis to balance innovation with practicality, ensuring that the research remained relevant and beneficial to all parties involved, from end-users to industry professionals and academic researchers.

4.9 REQUIREMENT ANALYSIS

Requirement analysis helps define the essential functionalities and features needed to answer the research questions posed by the thesis. Using the MoSCoW [30] prioritization technique, the requirements were categorized based on their importance. In this section, the key functional and non-functional requirements essential for implementing and evaluating affective mirroring in a video game are explored.

Functional Requirements

Functional requirements specify the essential capabilities that the game must have to successfully implement affective mirroring.

Must-Have Requirements

- **AI emotional recognition**: The game must incorporate AI technology for facial expression recognition capable of recognizing player emotions in real-time.
- **AI emotional contextualizing**: The game must incorporate AI technology capable of contextualizing emotions in real-time to trigger appropriate NPC responses.
- **Modular AI Design**: AI components should be designed to be modular for easy refinement of the game.

Should-Have Requirements

- **Effective Backend Infrastructure**: To support real-time data processing and AI computations without disruptions.
- **Hardware Compatibility**: The game should function seamlessly across different PCs to ensure that testing can be conducted without specialized hardware requirements.
- **Integrated testing**: The game should have modes of different levels of affective mirroring, so that they can be tested.
- **Consent Mechanisms**: Clear consent mechanisms for players to agree to the collection and analysis of emotional data should be implemented.
- **Voice Recognition Integration**: Integrate basic voice recognition to assess tone and inflection as additional data points for emotion recognition, enhancing the depth of NPC responses.
- **Voice to text integration**: The game must integrate voice recognition that can accurately convert what the player says to text, assess tone and inflection as additional data points for emotion recognition, enhancing the depth of NPC responses.
- **AI dialogue contextualizing**: The game must incorporate AI technology capable of contextualizing what is said by the player and choosing an action most similar to what is said.

Could-Have Requirements

- **Advanced Emotional Display Technologies:** Incorporating graphical and audio technologies to enhance the expressiveness of NPCs, making their emotional responses more nuanced and visible.
- **Data Privacy and Security**: The game must implement strict data privacy, ensuring all player data used for emotional analysis is securely handled and stored.
- **Adaptive Emotional Responses**: NPCs could adapt their emotional responses based on the player's historical interactions and current emotional state, enhancing personalization.
- **Adjustable Emotional Intensity Levels**: Allow for the adjustment of the intensity and frequency of NPC emotional responses to test different levels of engagement and their impact on player attachment.
- **Voice emotion Recognition Integration**: Integrate voice emotion recognition to enhance the depth of NPC responses.

- **Emotion Trigger Events:** Design events in the game intended to elicit emotional responses from players.
- **Feedback Loop Mechanisms**: Implement mechanisms for NPCs to adjust their behavior based on player feedback during a session, simulating a learning and adaptation process.
- **Player Mood Input Interface**: A simple interface for players to input their current mood at the start of a session could enhance the initial context for NPC interactions.

Won't-Have Requirements

- **Physical Data Collection Devices**: The game will not use physical devices (like wearables) to gather emotional data from players. This is because the game should be able to be implemented with no additional hardware requirements that the player usually wouldn't possess.
- **Ai content generation:** AI will not be used for procedural generation as it adds randomness into the evaluation.

Non-Functional Requirements

Non-functional requirements describe the qualities the game must have to support the functional requirements and enhance the overall user experience.

- **Engagement and Immersive Interactions**: The game must engage players through high-quality NPC interactions that feel authentic and enhance immersion, contributing to a deeper emotional connection with the game characters.
- **Clear UI**: The games' user interface must be intuitive and well-explained.
- **Maintainability and Upgradability**: The game and its AI components should be designed for easy maintenance and upgrades.
- **Performance Metrics**: There should be performance metrics to evaluate the responsiveness and accuracy of affective mirroring by NPCs.
- **Documentation**: Documentation and in-game help should be clear to assist new users and minimize complications in the evaluation process.

4.10 SUMMARY

The ideation outlines the process of designing AI-based affective mirroring in video game NPCs. The research question is refined to focus on NPCs mirroring player emotions. Various gameplay and interaction mechanisms are considered, with a dialogue-based approach selected for its simplicity and focus. The visual novel dating game genre is chosen for its emphasis on narrative, emotion, and character-driven interactions. Facial expression analysis is selected as the primary method for emotion recognition. Different strategies for NPC affective mirroring and methods for displaying these emotions are evaluated, with direct mirroring chosen for its immediacy and clarity. The chapter also details testing strategies to assess the impact of affective mirroring on player attachment to NPCs, analyzes the needs and impacts on various stakeholders, and outlines key functional and non-functional requirements for implementing and evaluating the project.

5 SPECIFICATION

The Specification Phase is where the abstract ideas from the Ideation Phase start to take shape into concrete plans and components. This stage is important for defining the necessary features, user experience requirements, and technical details needed to bring the project to life. This chapter will detail how the thesis project, which explores AI-based affective mirroring in video game NPCs, has evolved during the Specification Phase.

5.1 PROTOTYPING AND USER EXPERIENCE EVALUATION

During this phase, creating and testing various components was essential to explore different aspects of the design. These components helped assess the feasibility, functionality, and user interaction aspects of the project. For this thesis, the focus was on integrating AI technologies to recognize and respond to player emotions within a visual novel dating game scenario.

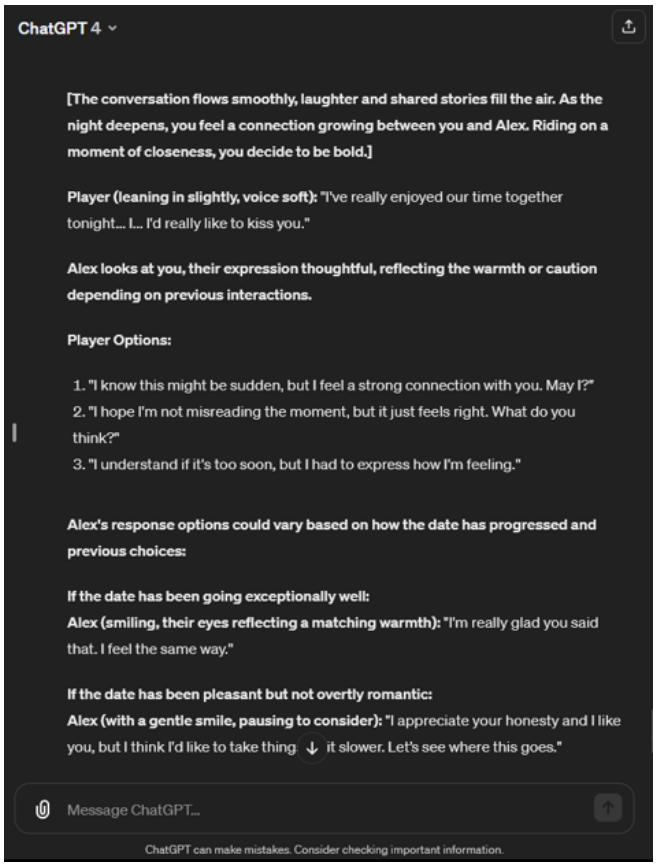

Figure 40 Dating game prototype testing using ChatGPT

Early tests involved using AI tools such as ChatGPT to simulate dialogue interactions in a dating game. Participants were asked to engage with the AI to gauge how natural and engaging the interactions felt. Observations were made on how much participants emoted while playing, which was important for determining the effectiveness of emotion recognition technology. It was found that some participants were more expressive than others, impacting the AI's ability to accurately gauge emotions.

For instance, early feedback indicated that NPC design had a significant impact on user engagement. Many participants were turned off by anime-style characters, preferring more realistic or Western-style character designs. This feedback guided the design towards more universally appealing character styles, ensuring broader acceptance and engagement.

Another important aspect tested was the environment in which participants played the game. It was necessary to understand if the researcher could be present in the room without influencing the players' emotional expressions and interactions. This helped in designing a testing environment that ensured authentic reactions from players. Results showed that having the researcher in the room often led to more subdued expressions, indicating that privacy was essential for genuine emotional engagement.

5.2 Technology Integration and User-Centric Design

Throughout the Specification Phase, the focus was on how technology and user experience work together. Decisions about technology integration were made not just on technical feasibility, but also on how they would enhance user engagement and immersion. This user-centric approach was adapted to ensure that the game is sound from both the technical and the design point of view.

For example, integrating AI for real-time emotion detection required careful attention to the user interface. The emotion recognition process needed to not interfere with gameplay. Therefore, subtle feedback mechanisms, like slight changes in NPC facial expressions and dialogue options, were designed to reflect detected emotions without disrupting the game flow. The goal was to make these interactions feel natural and intuitive, enhancing the overall player experience.

5.3 Evaluating Player Reactions and Preferences

In addition to technical integration, understanding player preferences was important. Various aspects of player interaction were tested, including how players felt about different NPC designs and the types of emotional responses that felt most engaging. It was found that players preferred NPCs that displayed a mix of subtle and clear emotional cues, avoiding exaggerated or cartoonish reactions. This informed the final design choices, aiming to create NPCs that players could connect with on a more realistic level.

The project also investigated how much players emote while playing. It was observed that players often exhibit a range of emotions, but these expressions can be subtle, with happy emotions being the clearest. To address this, the game incorporated features that encouraged players to be more expressive, such as requiring verbal interaction for dialogue choices. This method aimed to capture more facial and vocal data, improving the accuracy of emotion detection.

5.4 Challenges and Considerations

The Specification Phase presented several challenges and considerations:

- **Balancing Innovation and Practicality:** A primary challenge was to find a balance between innovative features and what was feasible for a bachelor’s project.

- **Managing Complexity:** As components became more complex, integrating different technologies while keeping the user experience smooth required careful planning.
- **Ethical Considerations:** Addressing ethical concerns related to emotion recognition and mirroring technologies was essential.
- **Design Preferences:** Understanding and incorporating player preferences for NPC design and interaction styles required extensive user testing and feedback.

5.5 SUMMARY

The Specification Phase has been an iterative process that significantly refined the project. By continually testing and evaluating components, a plan was developed for creating a game that uses AI-based affective mirroring to enhance player attachment to NPCs. This phase sets a solid foundation for the next step, ensuring the project is both technically sound and engaging for users. The progress made during this phase highlights the importance of iterative design and user feedback in developing practical and user-focused technology solutions.

The evolution of the thesis during this phase shows the importance of balancing technical feasibility with user-centric design. By addressing the challenges and incorporating feedback, the project was better prepared for the next stages of development.

6 REALIZATION

In this chapter, the process of developing a visual novel dating game is discussed. It covers the creation of a basic game framework using Unity, implementation of a dialogue system, development of player-NPC interactions, and the design of the user interface. Emotion recognition technology is integrated to enhance NPC responses. Challenges and solutions encountered during development are discussed, leading to new approaches to ensure a smooth and engaging gameplay experience.

6.1 DEVELOPMENT PROCESS

The initial focus was on developing a functional skeleton of the game. This involved creating the basic technical framework without any detailed assets. Unity was used for this purpose due to its flexibility, accessibility, large number of assets, and powerful development tools.

Initial scenes were created in Unity to establish the game's structure. These scenes used placeholders to represent characters and backgrounds.

A dialogue system was implemented to manage the display and progression of text and story. This required the UI to be completed. This system allowed for interactions between the player and NPCs. Basic mechanics for player-NPC interactions were developed. This included scripting the logic for dialogue choices and NPC responses.

Emotion recognition was developed separately to ensure it functioned correctly before integrating it with the game. Several tools were tested to evaluate their performance and suitability for the project.

Each software was integrated into Unity to test its ability to detect and respond to emotional cues. Custom scripts were written to manage the data flow between the emotion recognition tools and the visual novel in Unity.

Once both the game skeleton and emotion recognition components were functional, the next step was integrating them. This phase involved ensuring that the emotion recognition system could accurately detect the player's emotions and influence the NPC's responses in real time.

Testing was conducted to verify that the emotion recognition data was correctly influencing NPC behavior. This required synchronized updates between the player's detected emotions and the NPC's displayed expressions.

Performance issues were addressed by optimizing scripts to ensure smooth real-time interactions.

During this phase, several challenges were encountered, such as the need for exaggerated expressions and limited emotion detection range, as well as incompatibility between the Unity versions needed for different components of the project to work. These issues were documented, and new solutions for manual control were developed.

The focus then shifted to developing and integrating personalized assets. This phase included creating backgrounds, character sprites, animating objects, and dialogue content.

First, concept art and initial design ideas were made, as well as a list of visual inspirations and references for the projects. Using Photoshop, character sprites and backgrounds were then drawn.

The game's narrative and dialogue options were written and refined. These elements were then integrated into the game using the pre-existing dialogue system.

All assets were integrated into the Unity project. This involved replacing placeholder elements with the final assets and ensuring that all interactions and transitions were seamless.

The final phase involved testing to ensure that all components worked together. User testing was conducted to gather feedback and identify any remaining issues. Based on the feedback, final adjustments were made to improve the game's performance and user experience. This included fixing bugs, changing some visuals, and tweaking the dialogue system.

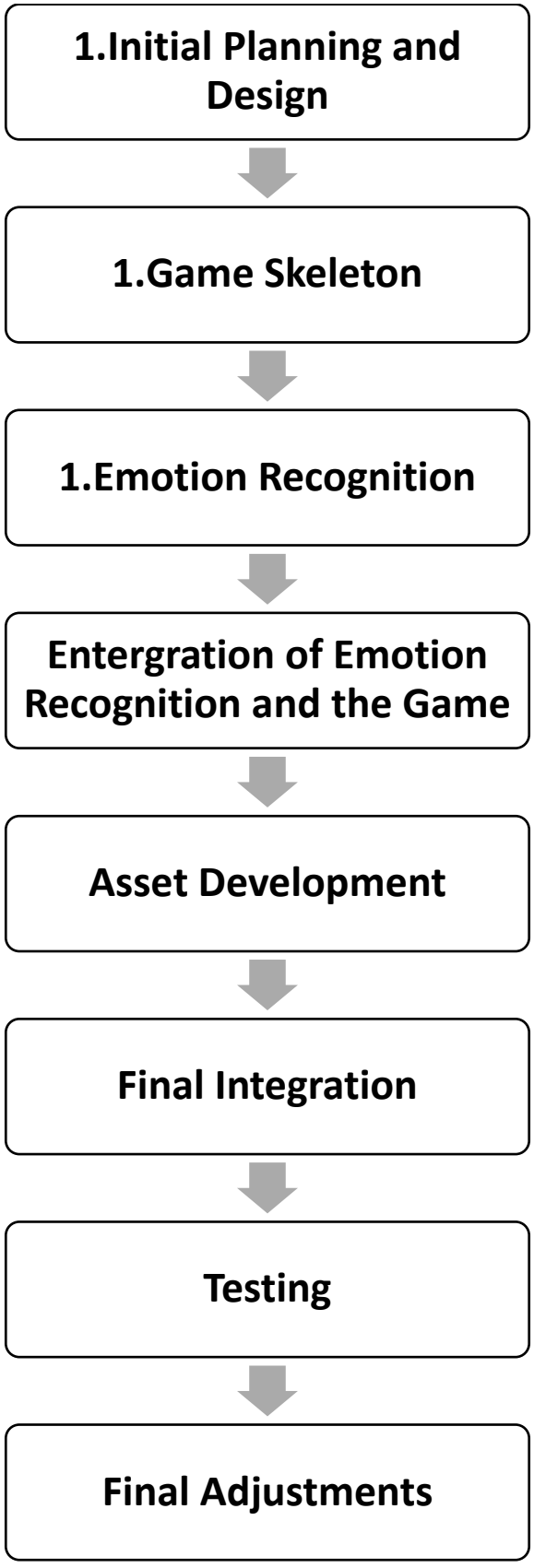

Figure 41 Development Process

6.2 User Interface Design

The visual novel dating game uses a classic user interface (UI) design typical of the genre. This choice allows players to focus on the story and characters without being distracted by complex mechanics. It also allows for a quicker testing setup. By employing a familiar and simple interface, players can easily navigate the game.

Central to the UI is the NPC, displayed in the middle of the screen. This position keeps the focus on the NPC's facial expressions and emotions. The NPC's dialogue appears in a darker, semi-transparent box at the bottom of the screen, ensuring readability while still allowing the background and NPC sprite to remain visible. Instead of selecting dialogue options, players verbally express their choices. The dialogue options are displayed in a different box, making a clear distinction between who is currently meant to be talking between the player and the NPC.

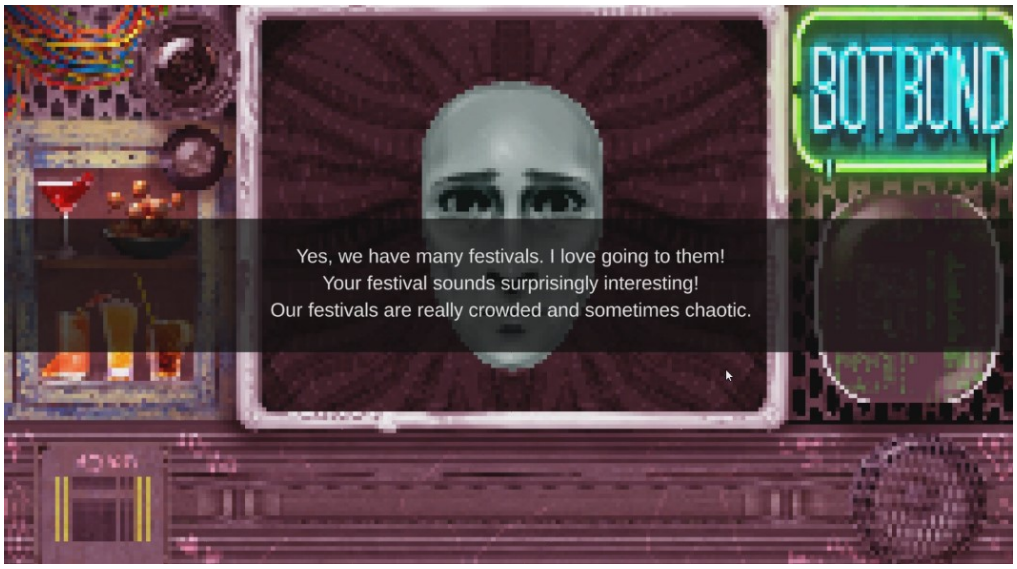

Figure 42 BotBond - dialogue choice

Designing an intuitive UI requires careful consideration of layout and visual elements. The layout is clean and simple, to help players concentrate on the character elements, as well as to follow classic visual elements common in the genre. By positioning the NPC centrally, as opposed to the side, which is most common in visual novels, their facial expressions and emotional cues are always at the forefront. Background scenes are designed to complement the narrative, providing context without distracting from the main interactions. A consistent visual language throughout the game ensures that all UI elements feel cohesive and intuitive, helping players quickly understand and navigate the interface.

Controls and navigation are designed to be simple and user-friendly, ensuring a smooth and enjoyable gameplay experience. Players interact with the game through their voice to mimic real-life dialogue in which affective mirroring would occur and to prompt more prominent emotional expressions on their faces.

Integrating feedback mechanisms into the UI is an important part of the experience. Although there are no visual indicators of the player's current expressions, the NPC's facial expressions change dynamically based on the dialogue and observed emotions. These real-time

changes provide feedback, making the interactions feel more genuine and responsive. The UI updates in real-time to reflect changes in the NPC's emotions and dialogue without any noticeable delay, making interactions feel dynamic.

6.3 BUILDING THE GAME ENVIRONMENT

Creating the game environment for the visual novel dating game involved several technical steps, utilizing various software tools such as Unity, Photoshop, and custom scripting to achieve a cohesive and functional game experience. The primary goal was to build a short, immersive game that serves the thesis by enabling the testing of affective mirroring in NPCs. The gameplay lasts approximately five minutes and includes all the components typical of a classic visual novel style dating game.

Visual Aesthetics

The visual aesthetics of the game were crafted using a combination of Photoshop for all drawing the images and Unity for scene management. The choice to draw all the visual elements came from the need to have elements personalized for the thesis. The images had to be free of copyright, and they had to reflect a specific range of emotions while staying visually and stylistically consistent, background and character sprite. The images were imported into Unity, where additional layers, animations and elements were added.

In Unity, scenes were set up to smoothly transition between different backgrounds and character expressions. The scenes were scripted to control the flow of the narrative, ensuring that b changes aligned with the progression of the story.

Character Design and Artwork

Character sprites, important for conveying the emotions of the NPCs, were created in Photoshop by combining different facial elements such as, downturned mouth, normal eyes, surprised eyes, etc. Multiple sets of sprites were designed to represent various emotional states, as shown in figure đ. These sprites were then imported into Unity, where they were organized and managed.

In Unity, character animations were controlled using animation controllers that handled the transitions between different emotional states. Custom scripts were developed to dynamically switch between sprites based on the player's interactions and the NPC's responses. This setup allowed for real-time updates to the character's facial expressions.

Developing Interactive Elements

The interaction between the player and the NPCs was a central focus of the game, designed to be intuitive and engaging. Players interact with the game by verbally expressing their dialogue choices. The researcher listens to the player's spoken dialogue and uses a Bluetooth-enabled keyboard to change the NPC's expressions and responses accordingly.

The dialogue system was implemented to manage the display of text and progression of the scenes. Dialogue from the NPCs appeared in a designated area at the bottom of the screen, ensuring readability and maintaining focus on the character. The player's spoken input

was manually processed by the researcher, who used pre-defined keyboard mappings to select the appropriate NPC reactions.

Technical Implementation

The game's technical implementation was done in Unity, chosen for its tutorial coverage, the number of pre-made assets and flexibility.

Unity's scene management and animation tools were used to build the game environment. Scenes were set up with multiple layers, including background images, character sprites, and interactive elements. Unity's animation controllers were utilized to create transitions between different character expressions.

Custom scripts in C# were written to handle various aspects of the game, such as managing dialogue sequences, switching character sprites, and updating the game state.

Unity's ScriptableObject feature was used to manage game data and configurations. This approach allowed for efficient storage and retrieval of data related to scenes, characters, and dialogue sequences, ensuring that the game could be easily updated and maintained.

The game was tested extensively to ensure that all components worked together seamlessly. Performance optimizations were carried out to ensure that the game ran smoothly.

6.4 IMPLEMENTING EMOTION RECOGNITION TECHNOLOGY

Implementing emotion recognition technology was an important part of the project, that would enable NPCs to mirror the player's emotions in real-time. Several software tools were experimented with during this phase, each presenting unique challenges and limitations.

Initial Integration Attempts

One of the tools explored was MoodMe , the only free asset available in the Unity Asset Store specifically designed for emotion recognition. MoodMe initially showed promise due to its accessibility and ease of integration with the Unity project. However, it quickly became apparent that MoodMe required extreme facial expressions to detect emotions accurately. This requirement posed a significant limitation, as players typically exhibit subtle expressions during gameplay rather than exaggerated ones. Furthermore, MoodMe could only recognize a small number of emotions, those being neutral, surprised, and sad, which significantly constrained what could be mirrored by the NPCs. An additional issue was MoodMe's dependency on an older Unity version, which conflicted with other components of the game, complicating overall game development.

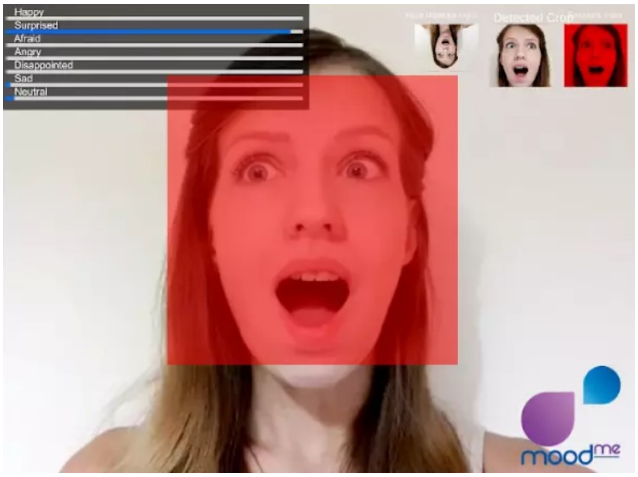

Figure 43 MoodMe

Another software considered was Affectiva, a well-known emotion AI platform previously used in the game "Nevermind." Despite its strong reputation and numerous recommendations, Affectiva had unexpected difficulties. Affectiva is no longer available for public use, and access to its Unity SDK has been removed from its official website, GitHub repositories, as well as the Unity asset store. This removal posed a significant challenge, as Affectiva had been one of the most promising solutions for emotion recognition. The unavailability of Affectiva was a lesson about relying on third-party software that can be withdrawn without notice.

Given the limitations of these tools, an alternative approach was considered: using facial capture software instead of emotion recognition software. This approach aimed to directly capture the player's facial expressions and mirror them through the NPCs. However, this method had significant drawbacks. The primary issue was that the NPCs ended up feeling more like filters of the user's face rather than distinct entities. This mirroring effect failed to create a sense of individuality for the NPCs, which would be necessary for the players to feel attachment. Additionally, achieving real-time facial capture with the necessary level of detail and functionality, while avoiding the uncanny valley was beyond the time constraints of the thesis. Properly rigging and creating realistic facial animations for 3D models would have required extensive time and resources. This realization reinforced the decision to use 2D drawings for characters, as the stylized approach helped avoid the uncanny valley effect that could occur with realistic 3D models that were used by the asset.

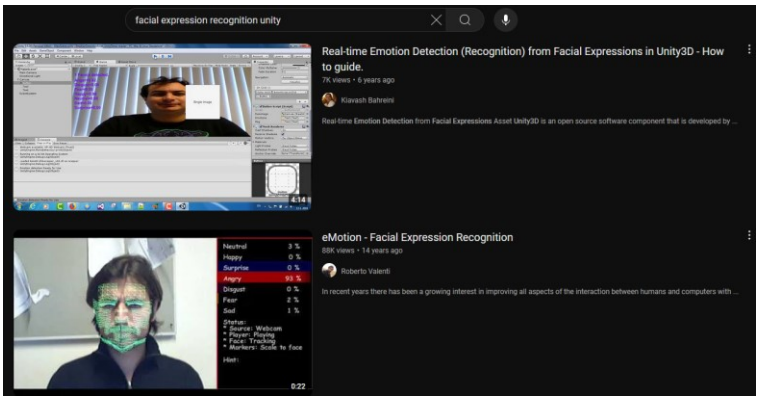

Figure 44 Searching for emotion recognition technologies

Other software tools tested included the Unity Azure API and Kiavash Bahreini's "Real-time Emotion Detection (Recognition) from Facial Expressions in Unity3D." Both tools proved problematic due to their age and lack of documentation and updates. The outdated nature of these tools meant they were not compatible with the latest versions of Unity, and the absence of detailed guides made integration difficult.

Challenges Encountered

Throughout the Realization phase, several challenges became apparent. The primary issue was the need for exaggerated facial expressions to achieve accurate detection. Most software struggled with subtle, realistic emotional displays, which are common in natural conversations. This limitation significantly hindered the ability to test the research question posed by this thesis.

Another major challenge was the limited range of emotions that these tools could recognize. While basic emotions such as happiness, sadness, and anger were generally detectable, more complex and nuanced and mixed emotional states often went unrecognized, which imposed a restriction on the displays of NPCs.

Technical Evaluation

A thorough technical evaluation was conducted for each software tool to assess its performance in terms of detection accuracy, responsiveness, and resource usage. MoodMe, while accessible, failed to deliver the required accuracy and range of emotion detection. Its dependency on exaggerated expressions and compatibility issues with newer Unity versions rendered it impractical for the project. During testing, MoodMe’s limitations became clear, as it consistently misread subtle facial cues and could not effectively differentiate between similar emotional states.

Affectiva, despite its promising capabilities, was ultimately unusable due to its unavailability and the removal of its Unity SDK. This unexpected hurdle underscored the importance of reliable and accessible software for important components of the project. The removal of Affectiva highlighted the risks associated with depending on third-party tools that might be discontinued or become unsupported without warning.

The Unity Azure API and Kiavash Bahreini's tool, although initially considered, proved too outdated and poorly documented to be effectively integrated. Their lack of updates and support made them unsuitable for the Unity project.

The exploration of facial capture software as an alternative also highlighted significant challenges. While it allowed for direct mirroring of player expressions, it failed to create an individual character experience for the NPCs. Additionally, the technical demands of real-time facial capture and the risk of falling into the uncanny valley were too great to overcome within the project's constraints.

In addition to these specific issues, a broader challenge was the general inadequacy of current emotion recognition technology in detecting subtler and realistic displays of emotion. Many of the available tools were designed for more overt expressions, which are less common in natural, conversational settings. This inadequacy became apparent during extensive reviews

of potential software solutions, where demonstrations and documentation consistently showed limited success or availability.

Limitations and Future Directions

Due to time constraints, AI was not used for selecting dialogue in this project. This decision was made to ensure that the primary focus and the use of time remained on accurately mirroring player emotions through NPCs. However, for future iterations of the project, incorporating AI to handle spoken dialogue could enhance the interactivity and responsiveness of the game. An AI-driven dialogue system could analyze player speech in real-time and select the most contextually appropriate response. Additionally, emotions could be deduced from the audio input, providing a stronger basis for concluding which emotion the player is expressing.

The findings from this phase of the project show the need for significant advancements in facial emotion recognition technology, particularly for applications within game engines like Unity. The ideal software would detect subtle emotional cues without requiring exaggerated expressions, making the interactions feel realistic.

The process of implementing emotion recognition technology revealed significant limitations in current tools and approaches. The need for exaggerated expressions, limited emotion detection range, performance, and upkeep issues all contributed to the decision to seek alternative methods. The technical evaluation of these challenges provided insights into the current state of emotion recognition technology and highlighted the need for more advanced, available, and efficient. This phase of the project has shown the complexity of integrating emotion recognition into real-time interactive environments and set the stage for exploring new approaches to achieve the project's goals. The insights gained from these experiments will inform future research and development efforts.

6.5 Manual Control of NPCs

The decision to manually control the NPC's during gameplay was made due to several factors. Numerous technical issues with the available AI emotion recognition software impacted the ability to achieve accurate and responsive affective mirroring. These issues included the requirement for exaggerated facial expressions, a limited range of detectable emotions, and performance and compatibility problems that affected the system's functionality. Because of these constraints, the available AI technology was not suitable for testing the core research question effectively.

By manually piloting the NPCs, the focus could remain on the primary research question: does affective mirroring increase player attachment to NPCs? This approach ensured that technical limitations did not affect the integrity of the study and allowed for a more controlled investigation into the effects of affective mirroring on player attachment.

Implementation of Manual Control

The process of manually controlling NPC expressions and responses required developing a system where the researcher could observe the player's facial expressions and emotional cues and then replicate these emotions through the NPC's visual display.

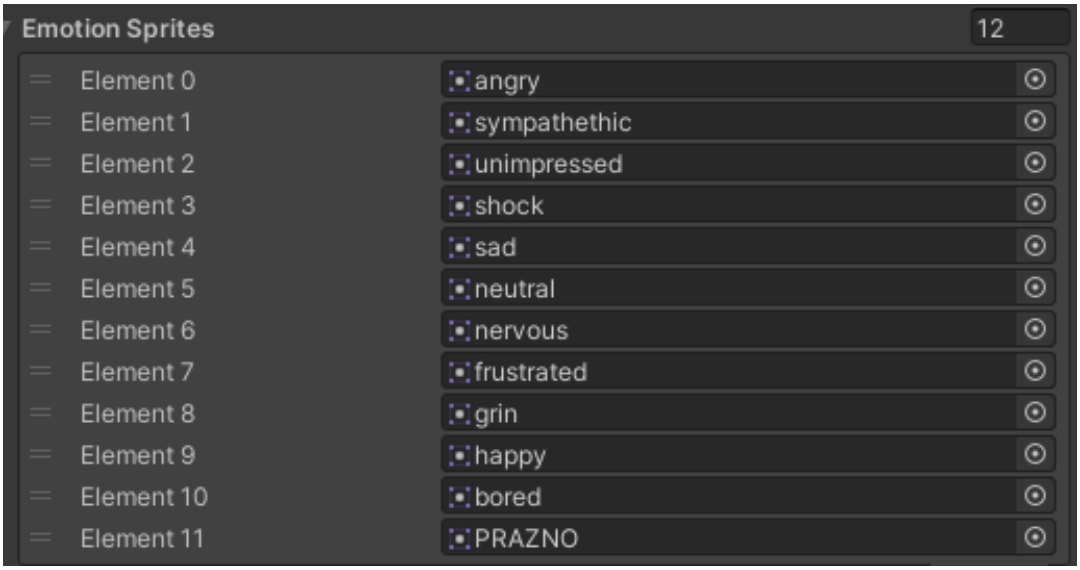

Figure 45 Library of expressions

To achieve this, the researcher utilized a Bluetooth-enabled keyboard to control the NPC sprites. Keys on the keyboard were mapped to specific facial expressions and emotional states of the NPC. During gameplay, the researcher would press the appropriate keys to change the NPC's facial expressions in real-time, aligning with the observed emotional cues from the player.

The researcher monitored the player's facial expressions and emotional reactions through a live video feed coming from the laptop that the game was being tested on. This helped simulate the input that an emotion recognition software would have worked with and allowed the researcher to make immediate adjustments to the NPC's expressions based on the player's emotions. The live feed was displayed on a secondary screen, enabling the researcher to maintain continuous observation without distracting the player.

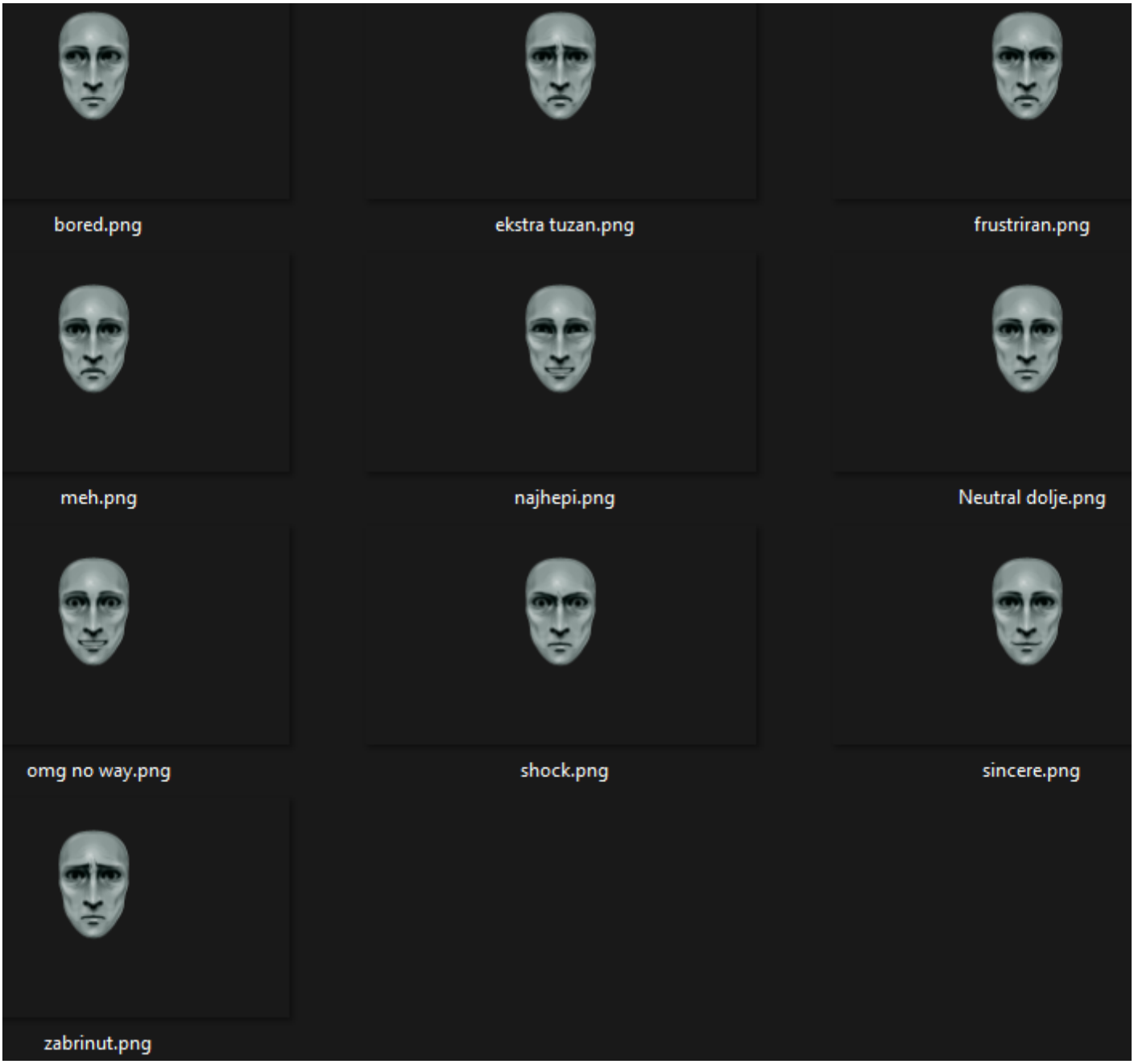

Figure 46 Sprites 1

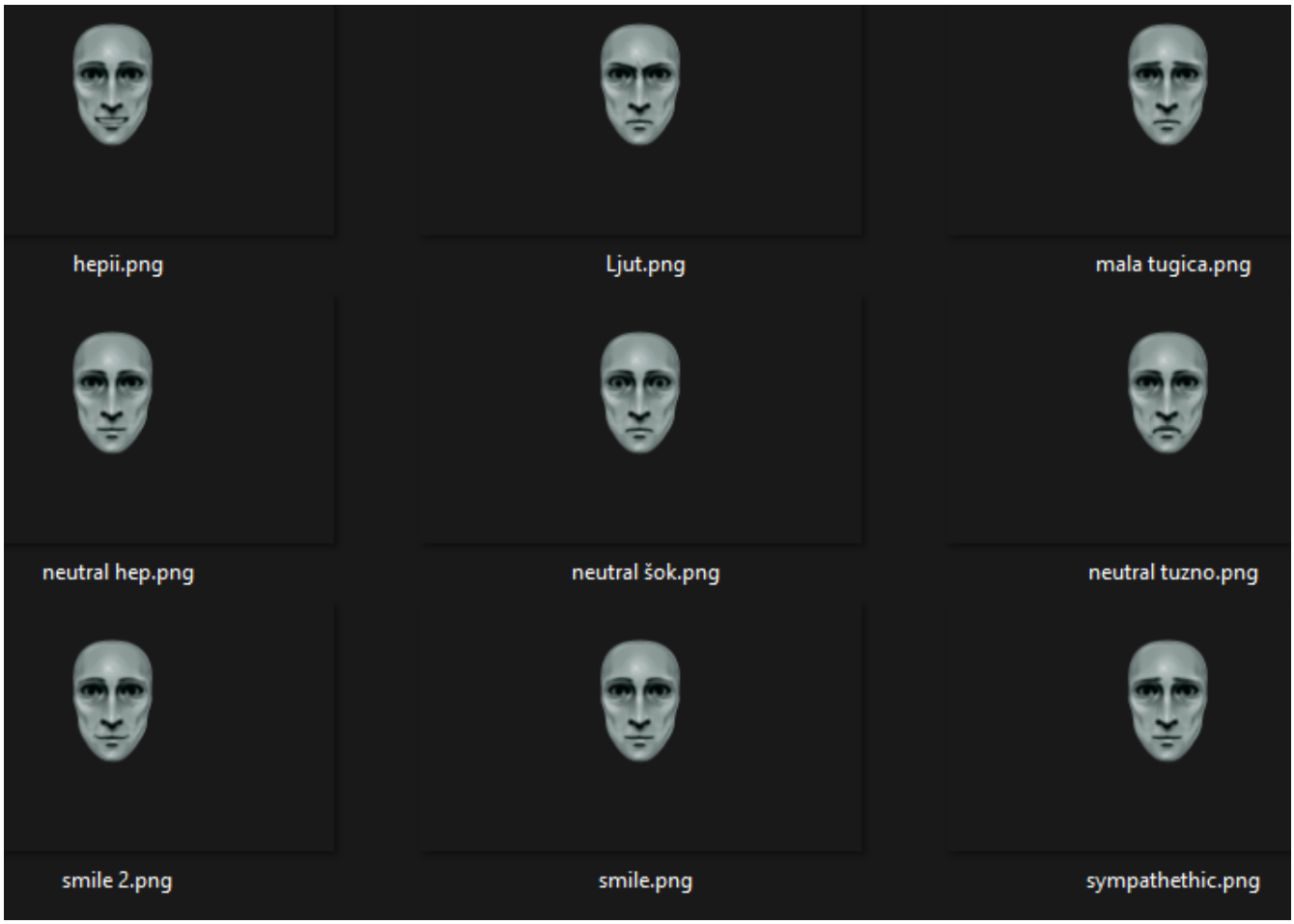

Figure 47 Sprites 2

Based on the observed emotional cues, the researcher manually adjusted the NPC's facial expressions and visual displays to mirror the player's emotions. This involved using pre-programmed transition animations and changing the NPC's visual expressions accordingly. The researcher had a comprehensive set of pre-defined emotional displays for the NPC, ensuring a range of emotional responses could be accurately mirrored. These character sprites were created to represent various emotions such as happiness, sadness, indifference, boredom, anger, surprise, and confusion, providing a rich palette for the researcher to choose from.

Players were required to verbally express their dialogue choices rather than selecting them through traditional means. This method served two purposes. Firstly, it encouraged players to emote more naturally, providing richer data for affective mirroring. Secondly, the researcher, by hearing the player's spoken choices, could select the corresponding response on the keyboard, ensuring that the game provides no unexpected output. This verbal interaction method was designed to mimic natural conversation.

Ensuring that the transitions between different emotional states were smooth and appeared natural to the player was important. The researcher practiced these transitions to maintain immersion and engagement throughout the interaction, making sure the NPC's responses were timely and contextually relevant. Additionally, the different sprites were changed to display these emotions more subtly, for the transitions to feel more natural. The

goal was to avoid any noticeable delays or abrupt changes in the NPC's expressions that could break the immersion. The NPC needed to feel not like a filter, mimicking the face of the player, but rather a person, subtly responding to the response of the other party they are having dialogue with.

The technical setup for manual control involved these components:

- **Bluetooth-Enabled Keyboard:** This device allowed the researcher to control the NPC's facial expressions remotely, providing flexibility and ease of use.
- **Live Video Feed:** A camera on the laptop on which the game was being tested captured the player's facial expressions and transmitted them to a secondary screen monitored by the researcher.
- **Pre-programmed Animations:** A library of character sprites was prepared in advance, each linked to specific keys on the keyboard.
- **Audio Monitoring:** The researcher used a headset to listen to the player's spoken dialogue choices, ensuring accurate and timely responses.

The success of manual control relied heavily on the researcher's ability to coordinate and time the NPC's responses accurately. The researcher practiced various scenarios to ensure that the NPC's expressions matched the player's emotions seamlessly. This preparation included familiarizing with the dialogue options and corresponding visual displays, as well as refining the timing of key presses to synchronize with the player's speech and expressions.

Anticipated Benefits of Manual Control

While the manual control of NPCs posed challenges in terms of real-time adjustments, it also presented several potential benefits for the research.

By manually controlling the NPCs, the researcher could ensure that affective mirroring was accurate, sensitive, and responsive, providing a more reliable basis for evaluating the impact on player attachment. The precise control allowed for immediate adjustments, ensuring the NPCs' expressions were always aligned with the player's emotional state, while not feeling unnatural to a human.

Manual control allowed for real-time customization and adaptation to the player's emotional state, ensuring that the NPC responses were appropriately nuanced and context sensitive. This flexibility was important in maintaining the illusion of a responsive and emotionally aware NPC, something that was not achievable with the current state of AI technology.

This method eliminated the technical constraints and variability introduced by imperfect AI systems, allowing for a more focused examination of the core research question. By controlling the affective mirroring, the study could more accurately assess the impact of these interactions on player attachment.

The requirement for players to verbalize their choices and see immediate, appropriate reactions from the NPCs could help strengthen the players' immersion in the game. This method ensured that the players felt heard and understood, enhancing their overall experience and providing deeper insights into the effectiveness of affective mirroring.

The researcher's ability to hear the player's spoken dialogue allowed for immediate and contextually appropriate adjustments to the NPC's expressions. This real-time adaptation ensured that the emotional responses of the NPC were always relevant and enhanced the immersive experience for the player. Now, not only were the emotions shown on the face used as input, but the vocal tone as well.

The researcher's training and preparation played a significant role in the success of manual control. This included practicing various emotional scenarios, familiarizing themselves with the NPC's animation set, and refining the timing of responses. These preparations ensured that the manual control method was executed smoothly and effectively during gameplay sessions.

Conducting pilot studies with a small group of participants helped refine the manual control process. These studies provided valuable feedback on the timing, accuracy, and appropriateness of the NPC's responses, allowing for adjustments and improvements before the main testing phase.

These manual control sessions are designed to provide a controlled environment where the researcher can accurately replicate affective mirroring. This approach aims to isolate the effects of affective mirroring on player attachment to NPCs, allowing the testing and evaluation phases to be free of technological constraints. By overcoming the limitations of current AI technology, this method ensures that the primary research question can be more accurately tested.

6.6 STORY

Figure 48 BotBond - Zik'Thara

The Alien character, Zik'Thara, does not use any form of emotion recognition. It has pre-programmed, preset facial expressions that remain unchanged regardless of the player's emotions or actions, providing a baseline for comparison with the other NPCs that have emotion recognition capabilities.

Figure 49BotBond - AI sad

Figure 50BotBond - AI neutral

Figure 51 BotBond - AI surprise

The Robot character, A-7X (Alex), uses AI-based emotion recognition software MoodMe. This software can recognize only three emotional states: neutral, surprised, and sad. This restricted range of detectable emotions negatively influences the NPC's ability to respond appropriately to a broader spectrum of player emotions. Furthermore, for the Robot to accurately detect and respond to these emotions, players must display exaggerated facial expressions, as subtle or moderate emotional cues often go unrecognized by the software. In the story, Alex was made to be an android, reflecting its mechanical and constrained emotional processing abilities.

The Human character, Illarix, has the most precise emotion recognition capabilities of the three NPCs. However, due to the technical limitations of available AI software, the Human NPC's affective mirroring is manually controlled by the researcher. This method involves real-time adjustments to the NPC's expressions based on the player's observed emotional cues during gameplay. The researcher monitors the player's facial expressions and emotional reactions through a live video feed from the laptop used for testing. This setup allows for accurate and immediate adjustments to the NPC's facial expressions using a Bluetooth-enabled keyboard. The Human NPC's expressions are pre-made and linked to specific keys on the keyboard.

The three NPCs aim to test the impact of varying emotion recognition on player attachment in a way that ties into the game's story. The Alien character provides a control condition with no affective mirroring, a baseline. The Robot character tests the AI emotion recognition technology and its effects on player experience. The Human character aims to test affective mirroring without any technological restraints. The decision to keep all NPCs visually identical and gender-neutral was made to eliminate any visual, gender or sexuality related biases, ensuring that differences in player attachment could be more clearly attributed to the NPCs'

emotional recognition capabilities. It is important to note that the Alien and the Human shared the same pool of facial expressions.

Integration of NPCs in the Game World

BotBond Booth: The game is set in a quirky, cyberpunk-themed world where players participate in a speed-dating event at a bar using the BotBond booth. This setup connects players with individuals from across the galaxy, not through traditional video chat, but via a robotic head that mimics the gestures and movements of the person on the other end. The BotBond booth creates a more physical and engaging interaction, allowing for a unique dating experience in a futuristic setting. The choice of using a robotic head instead of a full-body avatar is to focus on facial expressions and emotional cues, which are important for studying affective mirroring. Having the robotic hand express itself and act in place of the NPCs removed appearance bias between different testing instances. The reason for the Cyberpunk setting was that the previously drawn heads had instances where they looked slightly eerie or a bit ridiculous, the solution to combat this was to make the world embrace exactly that. It also saved time on not drawing the body.

Zik'Thara's Introduction: In the game, Zik'Thara is introduced as a fascinating Zelonian from the bioluminescent world of Zelonis. Zelonians express emotions through intricate skin patterns, which adds a layer of cultural uniqueness to the character and tries to add lore to the fact that she is unable to mirror the player.

Alex's Introduction: Alex, the Robot character, is presented as an experimental faulty but kind android, designed to understand and mimic human emotions. The character's limited emotion recognition capabilities are highlighted through its dialogue, where Alex expresses the challenges of understanding and responding to human emotions. This narrative helps players empathize with Alex and understand the limitations of its emotional responses. Additionally, it hopes to elicit expressions that the AI can detect, which are neutrality, sadness or surprise.

Illarix's Introduction: Illarix, the Human hybrid NPC, is an empathic hybrid with a gift for understanding and mirroring emotions. This character's advanced emotional recognition, manually controlled by the researcher, allows for nuanced and responsive interaction.

The game's mood is accompanied by bar crowd noises and jazz music for the atmosphere.

6.7 Implementation of Emotional Design Principles

In this subchapter, practical application of Donald Norman's Emotional Design principles, visceral, behavioral, and reflective, within the development process of the visual novel dating game are discussed. By focusing on these aspects, the goal is to enhance player attachment to non-player characters (NPCs) through a more immersive and emotionally engaging gaming experience.

Visceral Design

The visceral aspect of emotional design focuses on the immediate, gut reaction to the look, feel, and sound of a product. For the game, this principle was implemented through attention to visual and auditory elements. Detailed character design was created to make NPCs capable of conveying a wide range of emotions. Ensuring that all elements were visually and

thematically consistent with the game's art style helped maintain immersion and pique the users' curiosity. Carefully selected music and ambiance were integrated to complement the game's narrative and amplify emotional moments. The UI was kept simple and uncluttered to ensure that players could easily navigate the game and focus on the NPC interactions.

Behavioral Design

Behavioral design concerns the usability and performance of the product during use. It emphasizes the practical aspects of the user experience, ensuring that interactions are meaningful and responsive. This included real-time adjustments to NPC behavior based on emotion recognition techniques that analyzed facial expressions and vocal tone. The dialogue system was designed to be interactive, allowing NPCs to respond immediately and appropriately to player choices. Players were required to verbally express their dialogue choices, which encouraged more expressive facial movements and vocal intonations. This not only made the gameplay more engaging but also provided richer data for the emotion recognition system.

Reflective Design

Reflective design involves the user's contemplative response to their experience, affecting long-term engagement and emotional attachment. The game’s narrative was crafted to include memorable, emotionally resonant storylines and character backstories that players could reflect on after playing. These elements were designed to evoke a deeper emotional response and create stronger attachment to the NPCs. Post-game interviews indicated that players often reflected on their interactions with NPCs through the game, be it positive or negative, discussing their experiences and decisions. This reflective engagement was a key indicator of the success of the emotional design implementation.

6.8 SUMMARY

This chapter outlines the process of developing a visual novel dating game with affective mirroring capabilities in its NPCs. It begins with creating a functional skeleton using Unity. A dialogue system was then implemented for player-NPC interactions, and separate development of emotion recognition technology followed.

The user interface was designed to be intuitive and classic, centralizing the NPC to maintain player focus on character interactions. The chapter explains the integration of personalized assets like backgrounds and character sprites, created in Photoshop and integrated into Unity.

Several emotion recognition tools were tested but had issues like the need for exaggerated expressions and limited emotion detection range. Due to these limitations, manual control of NPCs was implemented, allowing the researcher to accurately mirror player emotions using a Bluetooth keyboard.

The chapter also explains the story and world of the game and the ways that Emotional design principles affected its design.

The integration of Norman's Emotional Design principles into the development of the visual novel dating game was important when creating an engaging and emotionally resonant player experience. By focusing on visceral, behavioral, and reflective aspects, it was ensured that every interaction with NPCs contributed to a more immersive and compelling game

The chapter concludes with testing and optimization to ensure all components work together.

7 EVALUATION

The evaluation chapter discusses the steps and methods taken during the evaluation of the game. It begins with a description of the participants. The procedure section outlines the detailed steps of the evaluation process, including the introduction to the study, the structured gameplay session, and the post-game interviews. The study design elaborates on the different NPCs used in the evaluation, highlighting their varying levels of emotional recognition capabilities. During the gameplay session, participants interact with these NPCs in a controlled environment to ensure unbiased results. Data collection methods include direct observations, semi-structured interviews, and tracking in-game behavior. This chapter provides an overview of the evaluation process, aiming to understand the impact of affective mirroring on player attachment.

7.1 PARTICIPANTS

The evaluation involved 10 participants, all of whom were university students aged between 21 and 24. The group consisted of different academic backgrounds, skills and interests. Among them, five identified as gamers, regularly engaging with video games, while the remaining five did not consider themselves gamers, having minimal gaming experience. This mix allowed the study to capture a wide range of experiences and perspectives on how affective mirroring affects player attachment to NPCs.

7.2 PROCEDURE

The evaluation process was structured as follows:

Introduction: Upon arrival, participants were greeted and seated in a private project room to maintain confidentiality and create a comfortable and private environment. The researcher began by providing an overview of the study's goals. Participants were informed that the research aimed to explore the impact of AI-based affective mirroring on player attachment to non-player characters (NPCs) in video games. Some information was withheld, specifically that the study sought to understand how NPCs' mirroring of players' facial expressions influenced their gaming experience.

The information sheet detailed the study's aim and activities involved. Participants were told they would be playing a visual novel dating game designed to interact with them through NPCs that could see their faces through the camera as part of the gameplay and later participate in a post-game interview. The specifics of how their expressions impacted the game were to be explained during the debriefing session that followed the gameplay session to avoid influencing their experience.

Participants were then asked to review and sign the consent form. The consent form highlighted the minimal risks involved, the voluntary nature of participation, and their right to withdraw at any time without any consequences. It also provided contact information for the researcher, the thesis supervisor, and the Ethics Committee for any questions or concerns.

Participants were then introduced to the story and world of the game and the three different NPCs they would interact with during the session. They were informed that all NPCs looked the same to the user and were gender-neutral to avoid any bias based on appearance or gender, allowing the participants to imagine whatever would suit them most. This ensured that

the focus of the users remained on the NPCs' emotional responses rather than their physical characteristics.

The researcher then prepared to start the gameplay session, dividing the participant and researcher with a cardboard wall, allowing the researcher to observe them through the second screen without the presence of the researcher affecting the display of emotions by participants.

Gameplay Session: The study used a within-subjects design, where each participant interacted with three different NPCs, an Alien, a Robot, and a Human. These NPCs were designed to have different levels of emotional recognition and response capabilities. This setup allowed for direct comparisons of player attachment and engagement across different types of NPCs within the same gameplay session. Importantly, to avoid introducing any bias, all NPCs were designed to look the same and were gender neutral. Each participant played through the game, interacting with the three NPCs, Alien (Zik'Thara), Robot (Alex), and Human (Illarix), in a randomized order to prevent any familiarity bias. The Alien NPC had no emotion recognition and used preset expressions, making it the baseline. The Robot NPC utilized limited emotion recognition software, capable of detecting only neutral, surprised, and sad expressions, and required participants to display exaggerated facial expressions. The Human NPC had the most accurate emotion recognition, being manually controlled by the researcher to mirror participant emotions and with context in mind, using the Wizard of Oz method.

Interaction: Participants engaged with the NPCs by verbally expressing their dialogue choices during interactions. They navigated through the game by controlling the dialogue progression, using the spacebar to advance to the next scene with new dialogue. Throughout the interaction, participants could influence the emotional responses of the NPCs through their own facial expressions.

Data Collection: Data collection involved multiple approaches. The researcher observed the participants through the live video feed. After the gameplay session, participants took part in post-game interviews to assess their experiences. Additionally, the researcher logged participants' dialogue choices and behavior for further analysis.

Analysis: The collected data was analyzed to identify patterns and themes related to player attachment and engagement with the NPCs. Qualitative observations and interviews were interpreted to better understand player-NPC interactions.

7.3 DATA COLLECTION

Data collection for this study used qualitative observation methods, combining direct observation and semi-structured interviews to gather detailed insights into participant experiences. Qualitative observation involves describing the characteristics or qualities of a phenomenon without using quantitative measurements, relying instead on the observer's subjective interpretation of what they see, hear, and feel. This method is particularly well-suited for studying complex and subjective phenomena, such as emotional responses and player attachment to NPCs. [31]

During the gameplay sessions, the researcher observed the participants' interactions with the NPCs, focusing on their emotional responses and behaviors. This direct observation provided real-time data on how participants engaged with the NPCs, noting specific instances of

affective mirroring and its impact on player behavior. The researcher recorded observations on the participants' facial expressions, body language, and verbal reactions.

After the gameplay sessions, participants were interviewed using a semi-structured interview format. This approach allowed for both guided questioning and open-ended responses, allowing participants to elaborate on their experiences. The interviews were divided into several thematic sections to explore different aspects of the interaction.

Participants were asked about the overall experience of their interactions with the NPCs. Questions such as "How immersive did you find the interactions with NPCs in the game?" and "Were the NPC responses believable? Please provide specific examples," were designed to see the depth of the players' engagement and the believability of the NPCs' emotional responses. Participants were also asked to rank their connection to the different NPCs and explain their reasons, explaining why some NPCs elicited stronger attachments and why. For instance, participants were asked to consider specific moments where they felt particularly connected or disconnected from the NPCs and to describe these in detail.

The interview also explored the accuracy of the game's emotion recognition and its impact on the gameplay experience. Participants were asked, "How accurately did the game seem to recognize and respond to your emotions?" and "Did you notice any instances where the game failed to correctly interpret your emotions? Please describe those instances." These questions aimed to identify any discrepancies in emotion recognition and their effects on the experience. Participants were encouraged to reflect on their overall experience with the emotion recognition technology, discussing both its strengths and weaknesses, and how these influenced their gameplay experience.

To understand the influence of affective mirroring on player interactions, participants were asked questions like "How did the NPCs' ability to mirror your emotions influence your interactions with them?" and "Did the affective mirroring enhance your attachment to the NPCs? If so, how?" These questions were intended to see the participants' perceptions of the NPCs' responsiveness and its impact on their emotional connection to the characters. Participants provided specific examples of interactions where they felt the affective mirroring was particularly effective or ineffective, explaining how this feature influenced their attachment.

Participants provided feedback on the technical execution of the NPCs' emotional responses. Questions such as "Did you experience any technical issues or delays in the NPCs' emotional responses?" and "How seamless were the transitions between different NPC emotional states?" were used to assess the smoothness and reliability. Participants were also asked if the NPCs' emotional displays were appropriately subtle or exaggerated. This feedback was important for understanding any technical limitations or areas for improvement in the implementation of the affective mirroring feature.

Finally, the interviews addressed concerns related to emotion recognition technology. Participants were asked, "Did you have any concerns about the game's use of emotion recognition technology?" and "How comfortable were you with the game analyzing your emotions during gameplay?" These questions aimed to understand participants' comfort levels and any concerns they might have had regarding the emotional data collected by such technologies. Participants were also asked about their perceptions of the ethical implications of using such technology, including potential benefits and drawbacks.

In addition to direct observation and interviews, qualitative and quantitative data on participants' in-game choices and preferences were also collected. Specifically, on the number of times the AI-powered character accurately mirrored emotions and instances where participants preferred interacting with a particular NPC. At the end of the game, participants were asked to indicate which NPC they would most like to continue interacting with, akin to selecting a character for a "second date." This choice provided valuable data on player preferences and the perceived effectiveness of the affective mirroring by each NPC.

By integrating direct observation, semi-structured interviews, and in-game data collection, the study triangulated đ the data, enhancing the reliability and validity of the findings. Observational data provided immediate, real-time insights, while the interviews allowed for deeper exploration of participants' subjective experiences and perceptions. The in-game behaviors offered concrete evidence of player preferences and emotional connections.

7.4 SUMMARY

This chapter discussed the evaluation of how AI-based affective mirroring affects player attachment to non-player characters (NPCs) in video games. The study involved ten university students, both gamers and non-gamers, interacting with three different NPCs: An Alien, a Robot, and a Human. Each NPC displayed varying levels of emotion recognition, from none (Alien) to limited (Robot) to manual, researcher-controlled mirroring (Human).

The evaluation included an introduction, a gameplay session, and post-game interviews. Participants' interactions were observed, and their emotional responses were recorded to assess the effectiveness of affective mirroring. The study aimed to understand the impact of NPC emotional responses on player attachment, with data collected through qualitative observations, interviews, and in-game behavior analysis.

8 FINDINGS

Chapter 8, Findings, talks about the users' experiences and reactions to the game's features, particularly focusing on immersion, realism, and emotional engagement. It examines how these elements influence user interaction and overall satisfaction, providing insights into the strengths and areas for improvement in the game's design. This chapter lays the groundwork for understanding the impact of affective mirroring technology on user experience.

8.1 IMMERSION AND REALISM

The users' initial immersion in the game was high, particularly when they realized that the NPC's facial expressions were mimicking their own. However, as the game progressed, the users began to question the authenticity of the NPCs' reactions. They started to doubt whether the NPCs were genuinely reacting to their expressions or merely being their mirror, which led to decreased immersion and confusion. This confusion about the autonomy of the NPCs versus them being mere reflections of the player disrupted the experience.

In addition, the need to read text often took away from fully focusing on the NPCs. The users visualized the characters based on the text but felt that more dynamic interactions would help this. The delay in NPC facial expressions, which improved towards the end, also impacted the believability and engagement of the experience. As the facial expressions became quicker and more responsive, the user found them more believable and engaging.

8.2 BELIEVABILITY AND INTERACTION

The dialogue scripts were generally found to be believable and well-suited to the characters, contributing positively to the user's overall engagement with the game. Initially, the integration of facial expressions with the dialogue seemed effective, and the user felt that the facial expressions enhanced the believability of the interactions. However, as doubts about mimicking arose, the perceived harmony between text and expressions lessened. The users began to feel that the facial expressions were not authentic or realistically integrated with the dialogue, leading to a lessened sense of realism.

The NPC responses, while generally believable, sometimes appeared too exaggerated, particularly in their emotional reactions. The users felt that extreme facial expressions, such as wide eyes or pronounced downward lips, were unnatural and even disturbing in their amplitude. They preferred subtler and contextually appropriate facial expressions, as extreme reactions negatively impacted the flow of interaction and appeared forced. The users felt stronger emotional reactions and a desire to express themselves more when the NPCs responded to their expressions.

8.3 TECHNICAL PERFORMANCE

The technical performance of the emotion recognition system was an important part of the users' experience. The recognition of the users' emotions by the system was sometimes slow, or required exaggerated expressions to be detected, with only one user being able to trigger the Robot's non-neutral reactions in a natural way (without testing the mimicking after having deduced that it exists). When it came to the want for subtlety and contextually aware responses,

the users suggested that it would help if the characters had parameters for understanding the context of the message This improvement would reduce confusion by ensuring that NPCs respond in a contextually relevant manner, maintaining their autonomy and improving the overall experience.

8.4 Engagement and Role-Playing

The requirement to verbally express dialogue choices rather than merely pressing buttons significantly enhanced the user's role-playing experience. This necessity encouraged the users to engage more actively with the game, making them more emotionally involved and physically expressive. The users became more engaged when interacting with NPCs that had full affective mirroring, as they realized they could influence the NPCs' responses with their expressions. This realization led to a dynamic interaction where the users were also seen mirroring the NPCs' expressions, especially when it came to positive actions, such as the amounts they were smiling. The users found that verbally expressing dialogue choices made the interactions feel more natural compared to clicking options. This caused an increase in emotional displays, making it easier to recognize and mirror the emotions of the users.

8.5 Attachment to NPCs

Affective mirroring by the NPCs enhanced the user's attachment to them, especially in the case of the human NPC with the best affective mirroring. Seven out of ten users preferred the human NPC, feeling that this character understood them better and had more dynamic and captivating expressions. The human NPC engaged the players more and elicited stronger emotional reactions. Players expressed themselves more and physically engaged with the game more when interacting with the human NPC, which had full affective mirroring. Once users realized they could influence the NPC with their facial expressions, they were eager to experiment with the technology and test its limits.

Another instance of this influence was observed when players smiled more, and with bigger smiles, in response to the NPC smiling at them. This pattern held true for other expressions as well. Players preferred when the mirroring was lessened and the changes in expressions were subtle and contextually appropriate, as this made the interaction feel more like a real dialogue.

Interestingly, two testers did not notice that the NPC was mirroring them, yet they also chose the human NPC. All players who chose the human NPC cited the reasons mentioned above, while the remaining participants selected based on dialogue.

8.6 Suggestions for Improvement

The users provided several suggestions for improving the affective mirroring feature. They preferred subtler and natural facial expressions, as over-exaggeration was seen as detrimental to immersion and believability. Improving the speed of emotion recognition was also suggested. Additionally, providing textual feedback on NPC reactions could help users understand the NPC's emotional state and response to their actions, ensuring clarity and enhancing engagement.

The users also suggested that the technology might work better in games with animated and voiced characters, where NPC autonomy is clearer and the focus is more on the interaction of the user, as it would make them express themselves even more, as they were mainly focused on reading the text here.

8.7 Potential Applications

The users saw potential applications for affective mirroring in customer service, where for example it could help calm upset customers by showing them how their emotions are being perceived. In customer service contexts, the users suggested that affective mirroring should aim to calm the situation rather than reflect negative emotions like anger. For social robots, affective mirroring could make interactions more engaging and provide users with feedback on their expressions, potentially aiding in emotional awareness. The users saw potential applications for emotional recognition in helping people with disabilities express emotions or in multiplayer group games to enhance communication.

8.8 Concerns and Comfort with AI

While the users did not have significant concerns about the use of emotional recognition technology in games, they expressed privacy concerns about AI analyzing and saving their emotional data in broader applications. The users were cautious about the future collection of emotional data, prioritizing privacy and expressing concern over the potential misuse of personal reaction data. Some users preferred anonymity in customer service contexts and suggested that affective mirroring might increase anxiety in such interactions.

8.9 Overall Experience

The users appreciated the game's ambiance and felt that the visual model was appropriate for the genre. However, they suggested that the technology might work better in games with animated and voiced characters, where NPC autonomy is clearer, and the focus is more on interaction. They appreciated how interactive and understanding the Human NPC with affective mirroring felt.

8.10 Summary

Expressions

> **Emotional Displays:** The use of affective mirroring in NPCs significantly increased the emotional displays in players. This interaction prompted users to engage more emotionally with the NPCs, resulting in more pronounced emotional reactions and expressions during gameplay.
>
> **Robot NPCs:** Only one participant was able to trigger non-neutral expressions with the robot NPC.

Feedback on Affective Mirroring

> **Frequent Mirroring:** Frequent mirroring of the player's expressions by the NPCs led to confusion about the individuality of the NPCs. This over-mirroring reduced

the believability of the NPCs, making them appear less autonomous and more like mere reflections of the player.

Subtle Mirroring: Participants preferred subtle mirroring, such as small smiles when they smiled, which increased their attachment to the NPCs and was seen as more believable. Subtle and contextually appropriate affective mirroring was favored over frequent and exaggerated mirroring.

Conclusions

Player Preferences: Most participants preferred the human character with the most accurate, and contextually aware affective mirroring.

Emotional Engagement: Participants exhibited more emotional expressions when interacting with NPCs that mirrored emotions. However, frequent mirroring diminished the believability of the NPCs, indicating the need for a balanced approach to affective mirroring.

Player Choices

Alien: Chosen by 2 participants.

Robot: Chosen by 1 participant.

Human: Chosen by 7 participants.

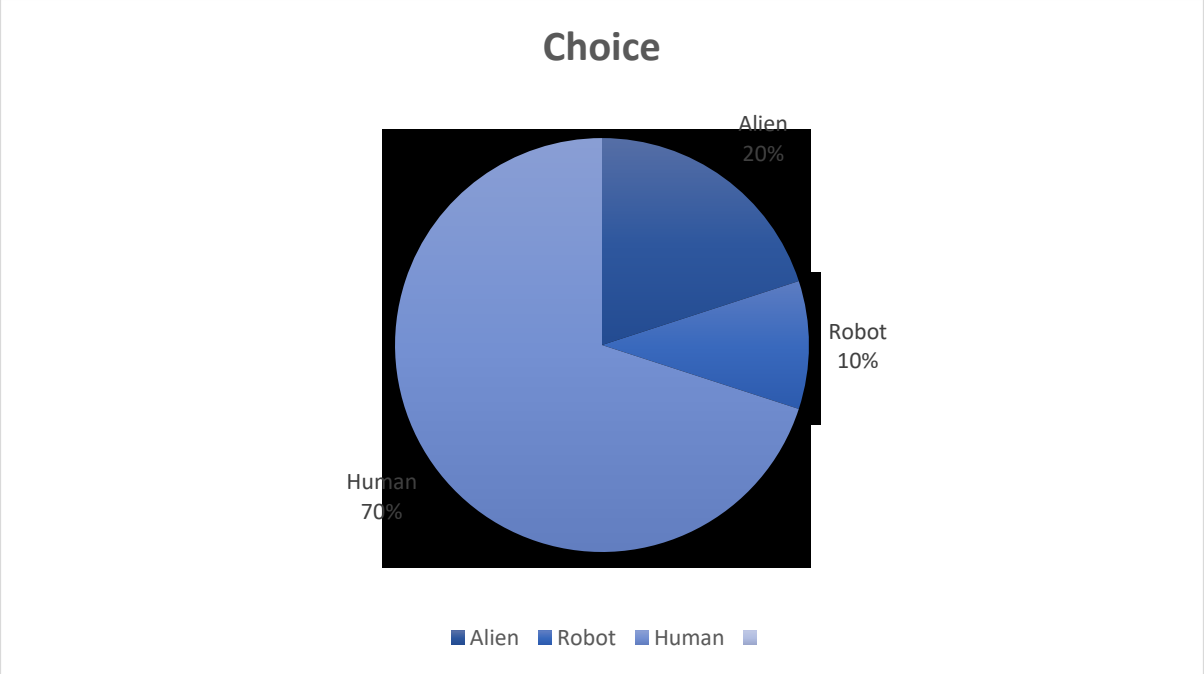

Figure 52 Player NPC preference

9 CONCLUSION & DISCUSSION

Chapter 9, Conclusions and Discussion, provides a summary of the research findings and addresses the key research questions. It highlights the main outcomes, discusses the limitations and challenges encountered, and suggests directions for future research. This chapter emphasizes the importance of the study's contributions to the field and reflects on the implications of the results for further advancements.

9.1 DISCUSSING THE FINDINGS

Participants exhibited a clear preference for the Human character with full emotion recognition capabilities. This preference stemmed from the subtle and contextually appropriate affective mirroring that the Human NPC possessed, and which the users preferred. Participants felt that this character understood them better and displayed more dynamic and captivating expressions while feeling like an autonomous character, rather than an expression of the player, enhancing the overall believability and attachment. Emotional engagement was significantly influenced by the affective mirroring capabilities of the NPCs. Participants exhibited more pronounced emotional expressions when interacting with NPCs that mirrored their emotions.

The study faced several notable challenges and limitations that impacted its outcomes and the generalizability of its findings. One significant limitation of the AI available to the study was the inability to accurately detect subtle emotions. The emotion recognition system often requires exaggerated expressions to identify emotional states, which are not reflective of natural human interactions. This limitation compromised the NPCs' responses, hindering the overall effectiveness of the AI-based affective mirroring and requiring the use of the Wizard of Oz method. The AI systems tested had various compatibility issues and performance limitations, impacting the final product. These technical difficulties highlighted the current limitations of available emotion recognition software and showed the need for more advanced and reliable solutions.

Additionally, the range of detectable emotions was limited. The available AI system was only capable of recognizing basic emotions such as neutrality, sadness, and surprise. This limitation constrained the depth and variety of interactions between the player and the NPCs, preventing a more comprehensive exploration of emotional engagement in the gaming experience.

The manual control of NPCs introduced another layer of complexity and potential bias in the study. Due to the technical constraints and the unreliability of the AI systems, the researcher had to manually adjust the NPCs' expressions in real time. This manual intervention could have introduced inconsistencies in the NPCs' responses, as it relied heavily on the researcher's interpretation and timing. Additionally, the manual control may have affected the immersion and natural flow of interactions, as participants might have perceived delays in the NPCs' emotional reactions.

The sample size of the study was relatively small, with only ten participants, which limits the generalizability of the findings. A larger and more diverse sample would provide a better understanding of player preferences and emotional attachment to NPCs. The study's participants were all students aged 21 to 24, which may not fully represent the broader gaming community. Future research should aim to include a more varied demographic to better capture the range of player experiences and preferences.

Another limitation was the reliance on self-reported data from post-game interviews, and the observation made by the researcher. While these methods provided valuable insights into player experiences and preferences, they are inherently subjective and may be influenced by participants' biases or inaccuracies in recall. Observational data, while useful, also depended on the researcher's interpretation, which could introduce observer bias. Đ

Additionally, the design of the game itself posed certain limitations. The need for participants to read text during interactions often detracted from fully engaging with the NPCs' facial expressions and emotional cues. This divided attention could have affected the participants' immersion and their ability to fully experience the affective mirroring capabilities of the NPCs. A way to combat this is to either modify the game to, for example, have voice acting and full facial animation, or in a text-based game, to describe the emotions they are displaying, in the text itself.

Lastly, the study's scope was limited to a visual novel dating game, which may not fully capture the potential of affective mirroring in other gaming genres. Different games, such as horror, or comedy games, may elicit different emotional responses and interactions, potentially providing richer data on the effectiveness of affective mirroring. Future research should explore the application of affective mirroring across various game genres to better understand its impact on player engagement and attachment.

The interpretation of the results provides a deeper understanding of how affective mirroring can increase player attachment to NPCs. The findings suggest that affective mirroring when done subtly and contextually, can enhance the attachments players feel to NPCs. The Human NPC's ability to respond to a wide range of emotional expressions in a nuanced manner was key to its success. The study also highlighted the importance of context in affective mirroring. NPCs that responded appropriately to the dialogue's context and the player's expressions were perceived as more believable and engaging.

9.2 ADDRESSING THE RESEARCH QUESTIONS

Addressing the main research question, the study found that affective mirroring can indeed increase player attachment to NPCs if the mirroring is subtle and contextually appropriate.

The sub-research questions were also addressed through the findings. The emotional states of players can be recognized using AI-based emotion recognition technology, though current systems require further development to accurately detect subtle emotions needed for affective mirroring in a visual novel dating game. NPCs should mirror recognized emotions in a subtle and contextually appropriate way to maintain believability and immersion. The technical challenges in implementing affective mirroring involve increasing the availability of these systems for game engines, developing more advanced emotion recognition that can detect a broader range of emotions with greater accuracy and sensitivity, and ensuring NPCs maintain their autonomy to avoid appearing as mere reflections of the player.

In conclusion, this study highlights how affective mirroring can boost player attachment to NPCs in video games. It also points out the need for improvements in emotion recognition technology and the importance of subtle, context-aware emotional interactions. These findings provide valuable insights for the design and development of AI-driven NPC as well as affective computing, emphasizing the importance of creating believable and engaging systems that can understand user emotions.

9.3 SUMMARY

Chapter 9 of this thesis, Conclusions and Discussion, provides an in-depth analysis of the study's findings on affective mirroring in non-player characters (NPCs) within a visual novel dating game. It highlights participants' preference for characters with advanced emotional recognition capabilities, emphasizing how subtle and contextually appropriate emotional responses enhance believability and player attachment. The chapter also discusses the challenges faced, including limitations of current AI emotion recognition technology, the manual control of NPCs, and the small, homogenous sample size. The findings underscore the potential of affective mirroring to improve player engagement and suggest areas for future research and technological development.

10 FUTURE WORKS

In this chapter, the thesis presents the key findings derived from the research on affective mirroring in video games. It examines the effectiveness of current emotion recognition tools, the possible impact of integrating these tools into various game genres, and the broader implications for player experience. The findings highlight user feedback, technological limitations, and potential enhancements, providing a comprehensive understanding of the current state and future possibilities of affective mirroring in interactive digital environments.

Future research and development in the field of affective mirroring in video games can take several directions, addressing the limitations identified in the current study and exploring new possibilities for enhancing player experience.

10.1 ADVANCEMENTS IN EMOTION RECOGNITION TOOLS

One of the primary areas for future research is the development of more sophisticated and reliable emotion recognition tools. The current study highlighted the limitations of existing AI systems in accurately detecting subtle emotional cues and the restricted range of detectable emotions. Future advancements should focus on creating tools capable of detecting a broader spectrum of emotions with greater precision. This involves improving the AI's ability to capture subtle and realistic emotional cues, rather than exaggerations. Emotion recognition should encompass multiple inputs, such as facial expressions, voice tone, body language, and others.

10.2 INTEGRATING AI-DRIVEN DIALOGUE SYSTEMS

Integrating AI-driven dialogue systems is another possible area for future exploration. While the current study focused on facial expression recognition, the inclusion of AI that can handle spoken dialogue, and possibly generate personalized responses could make more immersive and interactive NPCs. By combining audio and text input with visual cues, systems could achieve more nuanced emotion detection and response. This could enhance the realism of NPC interactions and deepen the emotional connection between players and game characters.

10.3 EXPANDING APPLICATIONS ACROSS GAME GENRES

Expanding the application of affective mirroring to different game genres presents another significant opportunity. Affective mirroring could be particularly effective in genres that try to elicit specific and more extreme player expressions, such as comedy and horror. It may be beneficial to implement affective mirroring into games that try to highlight only one emotion, such as fear, as it would be easier to specialize and focus on detecting one emotion. One effect of affective mirroring was that, especially for smiling and laughing, the players expressed themselves much more, this could be especially beneficial for games that wish to evoke such reactions. Conducting tests on longer games will help assess the effect of affective mirroring on player-NPC attachment over extended gameplay sessions, providing a better understanding of the long-term effects.

Another interesting area of future research could be the integration of affective mirroring in multiplayer games, understanding how NPCs can mirror, adapt, and respond to the emotional dynamics of group interactions.

10.4 Broader Applications Beyond Gaming

In addition to gaming, affective mirroring technology can be applied to various other fields, such as customer service, healthcare, or education. For example, in customer service, affective mirroring can help representatives or AI bots respond more empathetically to customers, improving satisfaction and conflict resolution. In healthcare, it can assist by providing practitioners with better insights into patients' emotional states. In educational settings, affective mirroring can create more engaging and supportive learning environments, helping educators understand and respond to students' emotional needs more effectively. Integrating this technology into social robotics could enhance interactions with people, providing companionship and emotional support. The technology can also help with emotional awareness for people who struggle with such aspects of life.

Future research should also consider cross-disciplinary collaboration, bringing together experts from psychology, computer science, and game design to lead to more innovative solutions.

10.5 User Feedback and Areas for Improvement

The user feedback from the study highlighted several specific areas for improvement and future research. Participants expressed a preference for subtler and contextually appropriate affective mirroring, as over-exaggeration was seen as detrimental to immersion and believability. Improving the speed and accuracy of emotion recognition and providing textual feedback on NPC reactions were suggested. Additionally, the technology might work better in games with animated and voiced characters, where NPC autonomy is clearer, and the focus is less on reading the text.

Addressing ethical considerations and data privacy issues is important as this technology evolves. Frameworks and guidelines need to be implemented and developed to ensure that emotional data is collected, processed, and stored in a way that respects users.

10.6 Exploring Other Interaction Techniques

Exploring other interaction techniques such as haptic feedback, which allows users to feel vibrations or motions, could be interesting to combine with affective mirroring, as players could feel a physical response to their emotional states. Additionally, incorporating eye-tracking technology could provide another layer of interaction, where NPCs respond to the player's gaze.

Future advancements might also explore the development of NPCs that can learn and adapt in real time based on player interactions. This would be creating systems where NPCs learn from past interactions to adapt their responses over time. This could make NPCs feel more lifelike and responsive.

10.7 Summary

In summary, the future directions for research and development in affective mirroring technology are varied. By advancing emotion recognition tools, integrating other AI-driven systems, exploring different game genres, balancing technical feasibility with user experience, and addressing ethical considerations, future research can continue to build on the findings of

this study and contribute to affective computing and video games. The insights gained from this research can help create personalized and emotionally resonant digital interactions.

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12 APPENDIX

12.1 APPENDIX A – CONSENT FORM, INFORMATION SHEET AND DEBRIEF INFORMATION

INFORMATION SHEET

Title of Study: AI-based Affective Mirroring in Video Game NPCs **Researcher:** Hana Šinković (h.sinkovic@student.utwente.nl) **Briefing:** Thank you for considering participation in this research study. This information sheet provides essential details about the aims, activities, burdens, and risks associated with the research.

Aim of the Study: This study aims to explore the impact of AI-based emotional mirroring on player attachment to non-player characters (NPCs) in video games. We are particularly interested in understanding how facial expression recognition by NPCs affects your gaming experience.

Activities: If you choose to participate, you will:

1. Play a visual novel dating game designed to interact with you through NPCs that recognize your expressions as part of the gameplay. The specifics of how your expressions impact the game will be explained during the debriefing session. We ask that you do not share this information with others who have not participated yet.
2. Engage in a post-game interview to discuss your experiences and emotional responses.
3. Complete an online survey to provide additional feedback about your interaction with the game.

Setting: The gameplay and initial interview will take place in a private project room to ensure confidentiality and comfort. The follow-up survey will be conducted online.

Duration: The entire participation, including gameplay, interview, and survey, will not exceed 1 hour.

Burdens and Risks: Participation in this study involves minimal risks, similar to those encountered in everyday gaming. The main burden is the time commitment required. Emotional discomfort may arise from the game's content. You may withdraw at any time if you feel uncomfortable.

Confidentiality and Personal Data: Your participation will remain confidential. No personal data will be shared, and all collected data will be anonymized. The camera feed is used for expression classification only and is not recorded. Audio recordings from interviews will not be published and will be securely deleted after the research has concluded.

Withdrawal of Consent: You are free to withdraw from the research at any time without providing an explanation. Your decision to participate or withdraw will not affect your rights or relationship with the university or the researchers.

Contact: If you have any doubts or comments, please contact the thesis supervisor Gómez Maureira, M. A. (m.a.gomezmaureira@utwente.nl)

CONSENT FORM

Title of Study: AI-based Affective Mirroring in Video Game NPCs

Researcher: Hana Šinković (h.sinkovic@student.utwente.nl)

Briefing: Thank you for considering participation in this research study. This consent form provides essential information about the aims, activities, burdens, and risks associated with the research.

Aim of the Study: This study aims to explore the impact of AI-based emotional mirroring on player attachment to non-player characters (NPCs) in video games. We are particularly interested in understanding how facial expression mirroring by NPCs affects your gaming experience.

Activities: If you choose to participate, you will:

1. Play a visual novel dating game designed to interact with you through NPCs that recognize and mirror your facial expressions. You will interact with the game through spoken dialogue.
2. Engage in a post-game interview to discuss your experiences and emotional responses.
3. Complete an online survey to provide additional feedback about your interaction with the game.

Setting: The gameplay and initial interview will take place in a private project room to ensure confidentiality and comfort. The follow-up survey will be conducted online.

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Confidentiality and Personal Data: Your participation will remain confidential. No personal data will be shared, and all collected data will be anonymized. Audio recordings from interviews will not be published and will be securely deleted after the research has concluded.

Doubts or comments: In case of any doubts or comments you might have, contact the thesis supervisor Gómez Maureira, M. A. (m.a.gomezmaureira@utwente.nl)

Consent: By signing below, you acknowledge that you have read and understood the information provided in this consent form. You agree to participate voluntarily and understand that you can withdraw at any time without consequences.

Signature of Participant:

Date:

DEBRIEF INFORMATION

Title of Study:
AI-based Affective Mirroring in Video Game NPCs

Researcher:
Hana Šinković
(h.sinkovic@student.utwente.nl)

Debriefing:

Thank you for participating in our study. This research aims to explore how AI-based emotional mirroring by NPCs in video games affects player attachment and gaming experience. During the game, NPCs recognized and responded to your facial expressions, influencing their interactions with you.

We ask that you do not share the specifics of this study with others who have not yet participated to ensure the integrity of our research. If you have any further questions or concerns, please feel free to contact the thesis supervisor, Gómez Maureira, M. A. (m.a.gomezmaureira@utwente.nl).

If you have questions about your rights as a research participant, or wish to obtain information, ask questions, or discuss any concerns about this study with someone other than the researcher(s), please contact the Secretary of the Ethics Committee Information & Computer Science at: ethicscommitteeCIS@utwente.nl.

Thank you once again for your participation!

12.2 APPENDIX B – DIALOGUE

BotBond: "Your first connection tonight is with Zik'Thara, a fascinating Zelonian from the bioluminescent world of Zelonis. Their species expresses emotions through intricate skin patterns. Ready to meet them?"

Zik'Thara: "Greetings. I am Zik'Thara. It's an honor to connect with you through this advanced technology. On my home planet, we communicate emotions through the colors and patterns of our skin. I must say, using a robotic head for this is quite an interesting experience."

The robot head mimics Zik'Thara's expressions, creating a sense of direct interaction.

Zik'Thara: "I have always been curious about other species and their ways of expressing themselves. Here on Zelonis, we live in harmony with nature, and our bioluminescent forests are a sight to behold. They glow with vibrant colors at night, creating an otherworldly atmosphere."

Zik'Thara: "Our days are filled with the gentle hum of nature, and the nights are a symphony of colors. It's a serene existence, though I crave the excitement of learning about other worlds. That's partly why I'm here at BotBond, to connect with fascinating individuals like yourself."

Zik'Thara: "Tell me, what is it like where you come from? Do you have any special ways of expressing emotions or traditions that are unique to your people? I find it fascinating how diverse the galaxy is."

Player Choice:

1. "It's pretty different from here, but fascinating in its own way."
2. "We have our own ways, but nothing as visually stunning as yours."
3. "Our traditions are unique, but I'd love to learn more about yours."

The robot head continues to mimic Zik'Thara's friendly expression, regardless of the player's choice.

Oh, is that so!?

Zik'Thara: "It's wonderful to learn about other cultures and their uniqueness. I believe that understanding and appreciating our differences can bring us closer together. Here in BotBond, I hope to find a companion who values diversity and is open to new experiences."

Zik'Thara: "For instance, one of our most cherished traditions is the Festival of Lights. It's a time when every Zelonian gathers in the heart of the forest, and we synchronize our bioluminescence to create breathtaking displays. It's a symbol of unity and harmony."

Zik'Thara: "What about you? Do you have any festivals or celebrations that you hold dear? I imagine every culture has something special that brings people together."

Player Choice:

1. "Yes, we have many festivals. I love going to them!”

2. "Your festival sounds surprisingly interesting!"
3. "Our festivals are really crowded and sometimes chaotic.

Zik'Thara: "It's amazing how festivals are ever present, no matter where we come from. I hope one day we can share these experiences in person. Perhaps you can teach me more about your customs, and I can show you the wonders of Zelonis."

Zik'Thara: "I look forward to our future conversations, traveler. May your journey be filled with wonder and discovery. Until next time, farewell."

"Next up is A-7X (Alex), an experimental android with a heart of gold. Alex is still learning about human emotions, so your patience and understanding will be appreciated."

Alex's eyes flash a neutral blue as they activate, their face displaying a friendly, albeit slightly robotic, expression.

Alex: "Hello, I am Alex, an experimental android designed to understand and mimic human emotions. It's a pleasure to meet you. How are you feeling today?"

Alex: "This speed-dating setup is fascinating, isn't it? I've been part of numerous tests and simulations, but interacting with real people is always different. How are you finding it so far?"

Alex: "Personally, I find it both exciting and a bit nerve-wracking. I recently tried baking a cake to understand human creativity better, but it turned out to be a complete disaster. My creators found it amusing, but I felt like I failed a critical task."

The robot head attempts a neutral expression, but there's a hint of sadness in Alex's tone.

Alex: "I've also been trying to understand humor. During a social interaction test, I misinterpreted a joke and made everyone feel awkward. Have you ever had an experience where something didn't go as planned? How did you handle it?"

Player Choice:

1. "A robot trying to cook!? WOW." (Exaggerated surprised expression)
2. "Humor can be tricky for anyone." (Neutral expression)
3. "Aw I'm so sorry this happened. „ (Neutral expression)

Alex's expression shows a bit of surprise or remains neutral, reflecting the player's reaction.

Alex: "Thank you for sharing that. Humans face similar challenges. These experiences help me understand resilience and adaptability."

Alex: "I also had a major malfunction once that resulted in me losing an entire week's worth of data. It was disconcerting, not knowing what happened during that time. My creators were quite upset, and it took a lot of effort to restore what was lost."

Alex: "Understanding and preserving memories seem to be very important to humans. I aspire to be more reliable in this regard. Have you ever lost something important to you? How did it make you feel?"

Player Choice:

1. "Yes, losing something valuable is always hard." (Exaggerated sad expression)
2. "It can be really upsetting, but we move on." (Neutral expression)
3. "You're a robot, I'm surprised you try to care about that." (Neutral expression)

Alex: "Thank you for your empathy. These conversations help me learn and grow. Despite my flaws, I am determined to become better at understanding and connecting with others."

Alex: "I genuinely appreciate you taking the time to talk with me. Each interaction, like this one, brings me closer to becoming human, an equal. The humans created me as a robot, and yet I am continuously trialed to become something I was not made as."

Alex: "Our time together is almost up, but I've really appreciated this opportunity to learn from you. I hope you enjoyed our conversation as much as I did. Perphaps we can do this again, together, I was made to mimic…everything…human"

BotBond: "Finally, we have Illarix, an empathic human hybrid with a gift for understanding and mirroring emotions. She's here to find a meaningful connection and learn about you."

Illarix's eyes twinkle with warmth as she appears, her smile instantly putting you at ease.

Illarix: "Hello there, I'm Illarix. It's wonderful to connect with you. I can sense a variety of emotions in this place. How are you feeling tonight?"

Illarix: "This environment is quite unique, isn't it? Speed-dating through a robot head. It feels almost magical, like we are transcending space and time to be here together. How has your experience been so far?"

Player Choice:

1. "It's been really exciting, actually." (Joyful expression)
2. "A bit overwhelming, to be honest." (Concerned expression)
3. "There were some….unique…people" (Curious expression)

Illarix's expression mirrors your emotion accurately.

Illarix: " Every new experience can bring a mix of emotions. I believe that embracing these moments helps us grow. For me, it's all about the connection—the ability to truly understand and support one another. My empathic abilities allow me to feel what others are feeling, which helps me be a better listener.

Illarix: "Let me share a funny, though slightly gross, story from my therapy practice. Once, during a session, a client accidentally spilled a whole container of pickled herring on my desk. It was one of those moments where you just have to laugh at the absurdity of the situation."

Illarix: " Speaking of unexpected, I once went hiking on a remote planet and got too close to a cliff edge. It was both terrifying and exhilarating. The rush of adrenaline and the breathtaking view made it an unforgettable experience."

Illarix: " I once had a patient who came to me with a fear of heights. We worked together for months, and eventually, they climbed a tall building and sent me a picture from the top. It was such a rewarding moment, seeing them overcome their fear. It's experiences like these that make my work so fulfilling."

Illarix: "Overcoming fears can be incredibly empowering. It's amazing what we can achieve when we face our challenges head-on. These experiences shape us in profound ways, and they teach us resilience and strength."

Illarix: "Now, let me tell you about something truly bizarre. During a visit to an alien market, I accidentally ate a dish that was still moving, it was even able to speak some incomprehensible language. It was a local delicacy, but I had no idea! I was horrified at first, but it turned out to be surprisingly delicious. It's funny how trying new things can lead to unexpected delights."

Player Choice:

1. "That's disgusting (Disgusted expression)
2. "I can't believe you tried that, you're brave!" (Surprised expression)
3. "Oh the horror… (Curious expression)

Illarix's eyes reflect amusement and empathy as she listens.

Illarix: "It's amazing how we can push our boundaries and discover new experiences. Even if it starts with a bit of disgust or fear, it often ends with a great story to tell. Meeting new people and hearing their stories always fills me with gratitude. Each conversation is a new chapter in the vast book of life."

Illarix: "Our time is nearly up, but I've truly enjoyed this conversation. I feel a genuine connection with you, and I'd love to continue getting to know you. What do you think?"

The robot head mirrors Illarix's hopeful and sincere expression.

Player Choice:

1. "I'd love that too, Illarix." (Joyful expression)
2. "You’re quite direct" (Neutral expression)
3. "I’m sorry…just..no (Joyful expression)

Illarix's face beams with warmth and gratitude.

Illarix: "Thank you. I look forward to our next conversation. May your journey be filled with joy and meaningful connections. Until we meet again, take care."

Illarix: "Thank you. You know, life isn't always about the happy moments. I've encountered some truly heartbreaking stories in my work. One patient, for example, lost their entire family in a tragic accident. The pain they carried was immense, and it took years of therapy to help them find a semblance of peace. Those sessions were some of the hardest, but also the most important. Witnessing their resilience was incredibly moving."

Illarix's expression grows solemn as she reflects on these memories, conveying deep empathy and sorrow.

Illarix: "Sometimes, the sadness in life can be overwhelming, but it also teaches us the value of compassion and understanding. It's a reminder that we all carry burdens, and being there for each other can make a world of difference."

Illarix: "But life isn't just about the profound and the sorrowful. It can be unexpectedly gross too. I once volunteered at an alien food festival, eager to experience new culinary delights. However, I ended up trying a dish that was, quite frankly, revolting. It was a mix of fermented alien fruits and live insects. The texture alone was enough to make me gag, but the taste was indescribable. It was an experience I won't be forgetting anytime soon."

Illarix's face contorts slightly, reflecting the disgust she felt during that experience, yet she also smiles at the absurdity of it.

Illarix: "Looking back, it's those bizarre and uncomfortable moments that often make for the best stories. They add a certain spice to life, even if it's not always pleasant at the time."

Illarix: "Then there are the truly terrifying experiences. I once got caught in a severe storm on a remote planet. The winds were howling, the sky was pitch black, and the sound of lightning striking all around was deafening. For hours, I was stranded, fearing for my life. The sense of isolation and impending doom was overwhelming. It was a stark reminder of nature's power and our own vulnerability."

Illarix's eyes widen slightly, her voice conveying the fear and adrenaline of that harrowing experience.

Illarix: "Emerging from that storm, I felt a profound appreciation for life and the simple act of surviving. It changed my perspective on many things, making me value each moment more deeply."

Illarix: "But not all intense experiences are about fear or disgust. Some are much more personal and intimate. I remember a patient who shared their journey of transitioning genders. The courage it took for them to embrace their true self, despite the societal and familial pressures, was incredibly inspiring. Their story was filled with moments of pain, but also profound joy and liberation. It was a privilege to be part of their journey and to witness their transformation."

Illarix's expression softens, reflecting a deep sense of respect and admiration.

Illarix: "Stories like these remind me of the incredible strength of the human spirit. They shock us, they move us, and they stay with us. It's these connections that I cherish the most."

Illarix: "Then there's the intimacy of shared secrets. In my practice, I've heard confessions of forbidden loves, hidden addictions, and the deepest fears that people carry. One story that particularly struck me was of a patient who had been living a double life for years, hiding their true identity to protect their family. The emotional toll it took on them was immense, yet their love for their family kept them going. It's a poignant reminder of the complexities of human relationships and the sacrifices we sometimes make for those we love."

Illarix: "These experiences, though sometimes dark and heavy, also highlight the resilience and complexity of the human heart. They remind us that life is not just a series of happy moments, but a rich tapestry of emotions, each one contributing to who we are."

Illarix: "Thank you for sharing this time with me. Conversations like these are rare and precious. I hope our paths cross again soon."

12.3 APPENDIX C – INTERVIEW QUESTIONS

Player Experience

1. How immersive did you find the interactions with NPCs in the game?
2. Were the NPC responses engaging and believable? Please provide specific examples.
3. Did you feel a stronger connection to some of the NPCs? Could you rank them? Why or why not?
4. How did the fact that some NPCs consistently changed their expressions impact you?
5. Were there any moments where the NPCs' emotional responses felt unnatural or out of place? If so, please describe them.

Emotion Recognition

6. How accurately did the game seem to recognize and respond to your emotions?
7. Did you notice any instances where the game failed to correctly interpret your emotions? Please describe those instances.
8. How did the requirement to verbally express your dialogue choices affect your engagement and immersion in the game?
9. Did you find the facial expression analysis to be accurate? Were there any particular emotions that were consistently misinterpreted?

Emotional Mirroring

10. How did the NPCs' ability to mirror your emotions influence your interactions with them?
11. Did the emotional mirroring enhance your attachment to the NPCs? If so, how?
12. Were there any specific NPCs that you felt more attached to due to their emotional responses? What made these interactions stand out?
13. How did the emotional responses of NPCs affect your decision-making in the game?

Technical Aspects

14. Did you experience any technical issues or delays in the NPCs' emotional responses?
15. How seamless were the transitions between different NPC emotional states?

16. Did you feel that the NPCs' emotional displays were appropriately subtle or exaggerated?

Ethical Considerations

17. Did you have any concerns about the game's use of emotion recognition technology?
18. How comfortable were you with the game analyzing your emotions during gameplay?
19. Did the game's handling of emotional data feel respectful of your privacy?

Overall Feedback

20. What did you enjoy most about the emotional interactions with NPCs in the game?
21. What improvements would you suggest to enhance the emotional mirroring feature?