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11A - Tamagotchi 2.024

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Advanced User Interfaces

Abstract

Tamagotchi 20.24 is an interactive virtual pet designed for individuals with Neurodevelopmental Disorders (NDDs). To foster social and cognitive skills, our application integrates AI-driven conversations and gamified interactions, enabling users to engage with their virtual pet through natural speech and play activities.

By leveraging Large Language Models (LLMs), the system provides adaptive and personalized interactions, encouraging the users to practice communicational skills while learning about emotions. Tamagotchi 2.024 includes progress tracking features that allow caregivers and therapists to monitor the user's activity throughout the different days. It effectively extends the therapeutic benefits beyond clinical sessions into the home environment.

Built in Unity, the platform ensures an engaging, accessible and user-friendly experience, with playful and intuitive interactions and smooth transitions. Tamagotchi 2.024 boosts emotional regulation, as well as learning, with an innovative approach to digital therapy for individuals with NDDs.

The Team

Members Contribution

Tasks	Member	(Responsible/Contributor)
Project Management		
Redact the report	Josefina Ferrari	Responsible
	Fernando Álvarez	Contributor
	Pilar Bocage	Contributor
Diagrams	Fernando Álvarez	Responsible
Video Pitch	Josefina Ferrari	Responsible
Presentation	Fernando Álvarez	Responsible
Presentation	Fernando Álvarez	Responsible
	Pilar Bocage	Contributor
	Josefina Ferrari	Contributor
Requirements Definition		
Requirements definition	Fernando Álvarez	Contributor
	Pilar Bocage	Contributor
	Josefina Ferrari	Contributor
Design		
Application flow	Fernando Álvarez	Contributor
	Pilar Bocage	Contributor
	Josefina Ferrari	Contributor
Backgrounds	Fernando Álvarez	Responsible
Tamagotchi	Fernando Álvarez	Responsible
Development		
AI Integration	Fernando Álvarez	Responsible
Speech AI Implementation	Fernando Álvarez	Contributor
	Josefina Ferrari	Contributor
Tamagotchi's facial animation system	Fernando Álvarez	Responsible
Tamagotchi's movement in rooms	Fernando Álvarez	Responsible
Tamagotchi's emotional system	Josefina Ferrari	Responsible
Initial Screen Design	Fernando Álvarez	Responsible
Initial Screen: Select and Deselect Emotion	Josefina Ferrari	Contributor
	Fernando Álvarez	Contributor

Initial Screen: Save Emotion	Josefina Ferrari	Responsible
Playroom: Connect with Speech AI	Josefina Ferrari Fernando Álvarez	Responsible Contributor
Playroom: Game Selection screen design	Fernando Álvarez	Responsible
Playroom: Game Selection screen functionality	Josefina Ferrari	Responsible
Playroom: Tic Tac Toe Game	Josefina Ferrari	Responsible
Playroom: Memory Game	Josefina Ferrari	Responsible
Playroom: Cups-Ball Game	Fernando Álvarez	Responsible
Bathroom Design and Implementation	Fernando Álvarez	Responsible
Bedroom: sleep system functionality and design	Josefina Ferrari	Responsible
Kitchen: Display different kinds of food	Pilar Bocage	Responsible
Kitchen: Drag food and eat	Pilar Bocage	Responsible
Kitchen: Food taste implementation	Pilar Bocage Josefina Ferrari	Contributor Contributor
Kitchen: replace eaten food	Josefina Ferrari	Responsible
Park: Ball animation and game	Josefina Ferrari	Responsible
Settings: Change font	Fernando Álvarez	Responsible
Settings: Change eyes' and body's color	Josefina Ferrari	Responsible
Reports: Calendar View	Josefina Ferrari	Responsible
Reports: Detailed date activity report (emotions, comments and games)	Josefina Ferrari	Responsible
Save System: structure of json files	Josefina Ferrari	Responsible
Save System: link with activity on the app	Josefina Ferrari	Responsible
Emotion System: structure (total sum, distribution and adjustment)	Josefina Ferrari	Responsible
Emotion System: relation to energy bar	Josefina Ferrari	Responsible
Emotion System: relation to AI	Fernando Álvarez	Responsible
Emotion System: relation to playroom, kitchen, bedroom and park	Josefina Ferrari	Responsible

Table 1: Team Members and Contributions

Contents

1 Executive Summary

1.1 Problem statement

The original Tamagotchi is playful and charming but focuses solely on basic pet care, lacking deeper engagement with social and emotional development. Our project aims to bridge this gap by supporting individuals with Neurodevelopmental Disorders (NDDs) in understanding and responding to emotions.

NDDs affect emotion recognition, self-regulation, concentration, and communication. Many individuals struggle to interpret facial expressions and emotional cues, leading to misunderstandings and anxiety in social interactions. They may also have difficulty identifying and managing their own emotions, often resulting in frustration and distress. Limited attention spans further impact learning and engagement, making social interactions challenging.

Therapists and caregivers also face difficulties in understanding and supporting individuals with NDDs. They must accurately assess emotional states and thought processes to provide effective guidance. Our project seeks to address these challenges through interactive and adaptive support.

1.2 Proposed Solution

Our solution, built in Unity, creates an interactive and gamified experience tailored for children with Neurodevelopmental Disorders (NDDs). It provides a safe and engaging environment where users interact with their virtual companion to express emotions naturally.

We integrate AI-driven speech recognition to personalize interactions, adapting responses in real-time based on speech patterns and emotional context. The Tamagotchi offers structured activities to develop emotional and social skills, including games for emotional recognition, empathetic conversations, and caregiving tasks that reinforce responsibility and connection.

To support therapists and caregivers, the system generates reports with insights into emotional and behavioral progress. By combining gamification, AI, and professional insights, our solution enhances emotional learning and engagement beyond traditional therapy.

1.3 Value Proposition

Our Tamagotchi uniquely blends gamification, emotional support, and AI-driven interaction to help children with NDDs develop social and emotional skills. Unlike traditional digital pets, it actively fosters emotional recognition, self-regulation, and communication.

Through personalized AI interactions, children explore emotions in a judgment-free space while engaging in activities designed to improve emotional understanding. The Tamagotchi also promotes responsibility and empathy through caregiving tasks and meaningful conversations. Additionally, therapists and caregivers benefit from automated progress reports to track emotional development and refine therapy strategies.

By merging technology, psychology, and play, our Tamagotchi transforms emotional development into an engaging and accessible experience, empowering children to navigate their emotions with confidence.

This version keeps all key ideas while being more concise. Let me know if you need further reductions!

2 Requirements

The following requirements have been identified through the UNG (User Needs Goal) Model analysis. This model provides a structured approach between the identified stakeholders and their needs together with the system goals. See Annex A for the complete UNG Model Diagram.

2.1 Stakeholders

Our system serves three key stakeholders groups. In first place, our primary users, children with Neurodevelopmental Disorders (NDDs). As previously mentioned, these children often face challenges in emotional recognition, processing and response, resulting in social anxiety, miscommunication and challenges when building relationships. The support given to these primary users is crucial, that is why our secondary stakeholders are therapists and caregivers. Professionals should provide support and monitor their patients' progress Therapists and caregivers of children with NDDs are also relevant. They are not direct users, but they play a critical role in supporting and monitoring the children's progress. They need from different therapeutic tools for better understanding of the children's emotional state and development.

2.2 Needs

Our analysis has identified several needs concerning our stakeholders. In first place, children with NDDs require a structured support for therapeutic exercises to keep developing their emotional intelligence outside the therapy session. This exercise must be entertaining enough as children with NDDs need to practice concentration and focus on social interactions.
Therapists and caregivers need a deeper understanding of the children's emotional state and patterns in order to treat them effectively.

2.3 Context

The system operate between three interconnected contextual dimensions. In terms of social context, the solution provides an individual interaction, a space where the child should feel safe sharing emotions, without any external pressure. It fosters authentic emotional responses and connect with the virtual pet.
The physical context is primarily on the children's home environments. A place where children typicaaly feel secure and comfortable. Allowing the child to incorporate this solution to the daily routine, extending beyond the traditional therapeutic settings.
Regarding the temporal context, is between five to ten minutes a day. A short period of time, with different but simple interactions, that do not alter the child's attention span.

2.4 Constraints

There are three key constraints that shape our system. User-related constraint that involves the sensibility of children with NDDs to certain sounds and stimuli. They tend to get scared when with loud sounds. That said, the system should be considerate about the audio design and tone chosen.
Another constraint, technology-related, is the use of a technological device that relies on internet connection.
The system should also collaborate with the concentration aspect. The tasks should be short, engaging and repetitive so that the user always pays attention.

2.5 Goals

Our system aims to stimulate real-life interactions, communication and social skills through an engaging and simple digital experience. We assure that children with NDDs fulfill their need to practice social skills and focus on interactions.
Create an enjoyable experience that captivates the user's attention, to tackle the need to entertain and develop concentration skills of children with NDDs
With our system we also aspire to motivate the users to keep learning in their daily routines. Acting as a support to therapeutic exercises.
Finally, another goal our system has is to monitor the children progress. Act as a support for therapist and caregivers to better understand the emotional state.

3 State of the art

The intersection of virtual pets, emotional learning, and therapeutic tools for individuals with Neurodevelopmental Disorders (NDDs) has witnessed remarkable advancements in recent years. Many research studies and existing projects have enlightened the different angles of interactive avatars and personalized LLMs on emotional intelligences, communication skills and learning processes. This section examines existing solutions that have refined the development of our solution, focusing on the influence of of AI tools and the avatar designs.

3.1 The Role of AI-driven Virtual Agents in EmoEden

A key consideration in assistive technologies for individuals with NDDs is the effective application of Generative Artificial Intelligence to enhance emotional learning. *EmoEden: Applying Generative Artificial Intelligence to Emotional Learning for Children with High-Function Autism ([1])* showcases how generative AI can be used to help High-Functioning Autism (HFA) children to improve emotional recognition and expression. This study integrates LLMs and Text-to-Image models that together create conversations and interactive emotional recognition tasks, where HFA children are able to learn in a changing environment.

The results have shown how the feasibility of using generative AI as a tool to enhance emotional learning for HFA children, providing an engaging and personalized intervention tailored to the child's emotional needs. The finding suggest that generative Ai creates a safe space where children can develop their emotional skills and adapt to the user's learning pace.

In our project we aim to imitate these results. With similar leverage AI-driven techniques we guarantee that the virtual pet assists and helps improve emotional recognition, expression and regulation in individuals with NDDs. Create a dynamic learning environment, adapting to the user's progress.

3.2 LLMs and VB-MAPP on Dialogue Interventions for ASD

The Verbal Behavior Milestone Assessment and Placement Program (VB-MAPP) framework used for assessing language and social skills in children with Autism Spectrum Disorder (ASD). In the report: *ASD-Chat: An Innovative Dialogue Intervention System for Children with Autism based on LLM and VB-MAPP ([2])* the results show how LLMs can structure and constrain dialogue topics to create a controlled, engaging, and safe environment for the user. This project facilitates conversations and acts as

a guide in social interactions, providing feedback and support.

This study's application lies in its ability to guide interactions within a structured framework that enhances communication and social engagement. By integrating LLMs into our system we can provide a structured social interaction where our user experiences meaningful conversations, mainly about their feelings, in a controlled environment.

3.3 Importance of Avatar's Cuteness

In the research exposed on *Virtual pets' cuteness matters: A shared reality paradigm for promoting internet helping behavior ([3])* the aesthetic appeal of avatars is discussed. In this study the cuteness factor of a virtual pet was investigated, and the results reflect how this factor may influence the user engagement and emotional responses.

Results have shown that users are more likely to form emotional bonds with avatars that are visually appealing, with cute features. This is a significant aspect as the bond is primordial for the user to open up, learn and have better interactions.

In the context of our project, this information is crucial. Designing a cute virtual pet and cute settings is one the most important parts of our solution. We had also realized that the cuteness of the pet should also be in accordance to the rest of the application. With this great focus on whole design, we manage to create an emotional bond where participation and engagement are positively affected.

3.4 Interactive Avatars Influence on Attention and Cognitive Performance

The study under the name *Interactive Avatar Boosts the Performances of Children with Attention Deficit Hyperactivity Disorder in Dynamic Measures of Intelligence ([4])* demonstrates how interactive avatar improve attention and cognitive performance. Evidence support that they can serve as an effective tool in attention, memory and cognitive skills. With interactive avatars we can create memory and problem-solving exercises.

Applying this to our virtual pet, we can design the pet to serve as a motivator for attention-based tasks. For example, the pet could encourage the user to focus on short and easy tasks, such as games or chores. Helping the emotional learning and improving the cognitive engagement and concentration is essential for users with NDDs.

3.5 Virtual Daily Life Coaching

As discussed on the report: *Virtual Avatar-Based Life Coaching for Children With Autism Spectrum Disorder ([5])* virtual agents have also been used for daily life coaching, where AI-driven systems support users in managing their daily routines, setting goals, and providing reminders.

Virtual agents can be effective improving self-managemnet skills, acring as a life coach, organizing their plans and tasks.

For our project, integrating a daily life coaching aspect could be beneficial in assisting users with NDDs to follow structured routines or practice specific skills. The Tamagotchi could say reminders or suggestions about when to take breaks, complete tasks, or how to act in certain situations. This integration could help build routine

and structure, which is essential for users with certain NDDs.

3.6 Accessibility Considerations and User Interface Design

Figure 1: In this display the Microphone is more accessible than the scenarios.

Finally, a key consideration when designing our project was evaluating the accessibility of our application. We have considered and analyzed different displays, to keep the most suiting one based on user experience.

Our main concern was how we were going to displays all the buttons to access the different scenarios. We have considered diverse options, shown and explained as follows. We evaluated what was the most important and accessible button and if it was confussing to the user or not.

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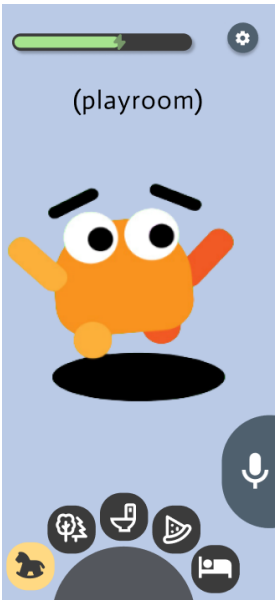

Figure 2: The Microphone is still accessible, even if using one hand, but the scenarios take too much space of the screen.

Figure 3: In these displays the Microphone and scenarios are at the same level, but the selected scenario is constantly changing and it can generate confusions. We don't want to alter the order.

Figure 4: As compared to Figure 2, this one does not take too much space, but the microphone becomes more accessible than the scenarios

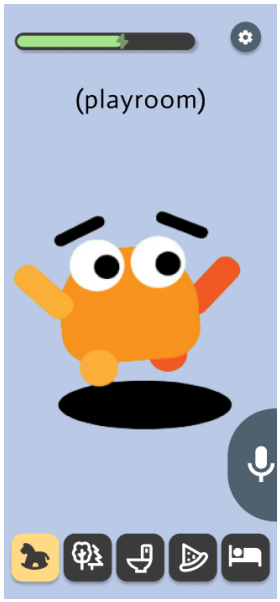

Figure 5: The Microphone is still accessible, even if using one hand, the scenarios are also easily accessible and not constantly changing places

After considering and analyzing all the possible displays, the decision made was to follow the last display, the one on figure 5. With this display changing scenarios is easy, as well as talking to the Tamagotchi. The final display also has fixed buttons positions, which is beneficial for the user as children with NDDs prefer consistency and predictability and having a predetermined order of things.

4 Solution

4.1 UX Design

4.1.1 General Approach

Tamagotchi 2.024 is a virtual companion designed to extend therapy sessions into the home environment, assisting children with NDDs in the emotional learning, concen-

tration and social skills. The core idea of our solution is that the interaction between the user and the Tamagotchi is simple and brief, seamlessly adapting into any child's daily routine, without causing any fatigue or stress. For this reason, the application was designed for mobile devices, which allow children to interact comfortably from anywhere they want to, not impeding their moment of relax.

The interaction between the user and their virtual pet is not limited to a singular mode of engagement, it is a multimodal experience, adapting to the child's emotional state. It combines text-based dialogue, as well as voice interaction. When the child feels expressive, they can speak to the Tamagotchi; but if it is a quieter day, typing their emotions might be a better outlet. The Tamagotchi will always speak and write the response. If they prefer minimal interaction, the application counts with simple buttons that perform actions like sleeping, feeding, playing and cleansing their Tamagotchi. This ensures a versatile experience that adapts to many emotional states the user might be going through.

Furthermore, the Tamagotchi's behavioral model is designed to evolve based on user engagement, encouraging sustained interaction without overwhelming the child. Our soolution features an emotional system that not only takes into account the registered emotion that the user selected, but also the interactions between both. Given a set of different emotions with their corresponding values, the Tamagotchi will visually express the predominant emotion. Emotions vary from anger, sadness, sleepiness, happiness, confusion and neutral over time. An essential aspect our solution addresses is the initial emotional state of the user upon opening the application. "Allowing the child to choose from a few predefined emotions and add a comment if desired will help the Tamagotchi correctly respond to how the child is feeling in that moment.

The value of this application goes beyond benefits to children with NDDs. It is also serves as a tool for tracking progress and providing valuable insights to caregivers and therapists. The reports created upon the child's interaction are shown in a separate section of the application, a section that is not eye-catching for the child not to explore it.

4.1.2 User Workflow

The upcoming diagrams clearly illustrate the user workflow throughout the entire application. Though, these diagrams do not include the voice and text interaction as the vary in every use, they just showcase al the possible interactions within clicks.

Figure 6: User workflow when application is opened, navigating through the initial screen, the reports screen and the settings screen

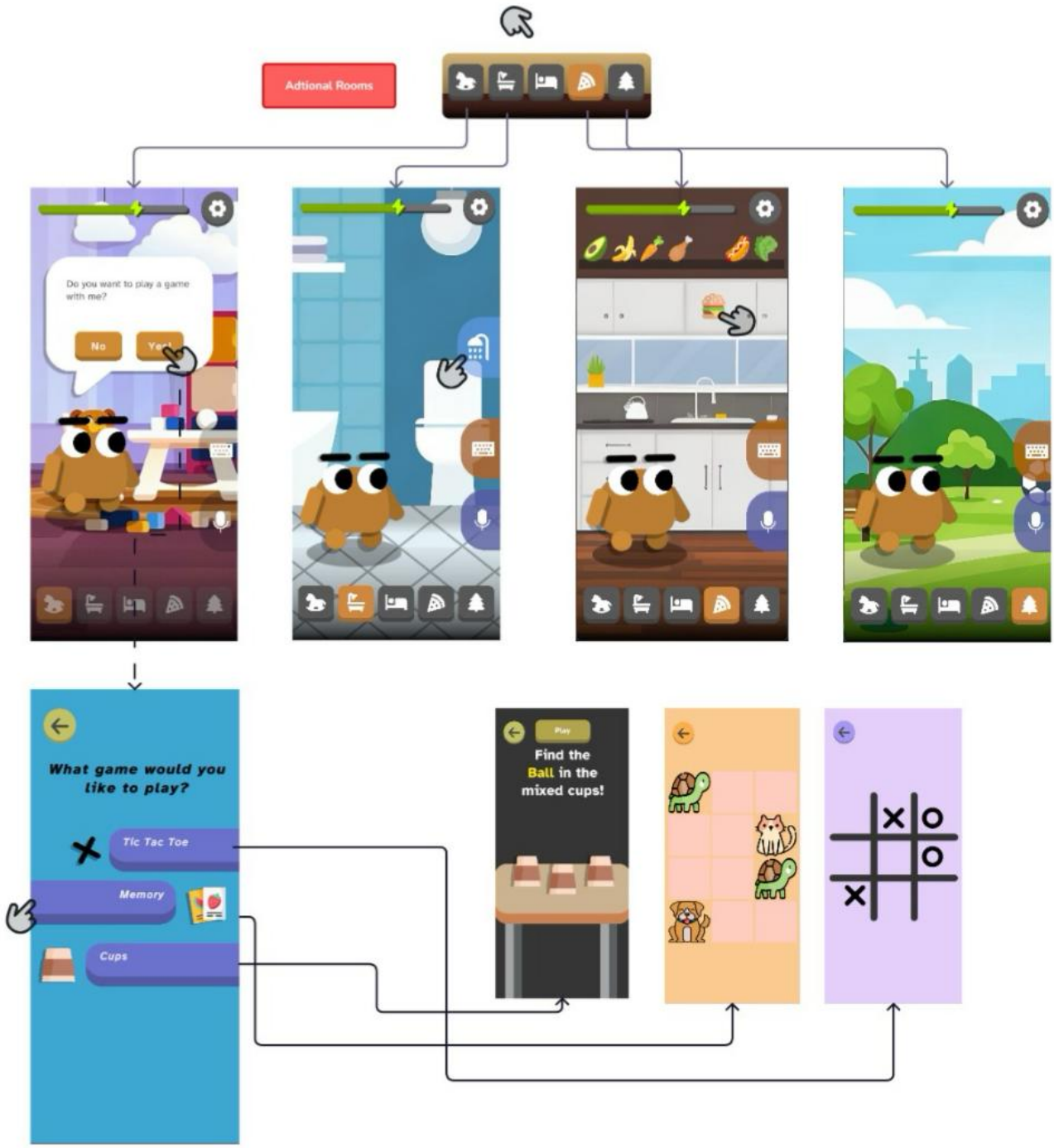

Figure 7: User workflow through all the scenarios and the playroom games screen

4.1.3 Scenarios

The following section includes all relevant scenarios that were identified in the process of designing our application. They represent the different interactions available in Tamagotchi 2.024. Users transition between them based on the Tamagotchi's state, user choices, and contextual triggers within the application.

- **Registering Emotional State**

  User Profile: The child with NDDs
  Goal: Track the child's emotional state at the beginning of each session.
  Context: The child opens the Tamagotchi 2.024 application on their device.
  Narrative: The application presents a set of 6 different emojis that relate to sad, happy, angry, excited, sleepy and normal. The user sees al the different expressions and the user clicks on the one he relates the most.A text box for optional notes is also suggested if the child wishes to add a comment to the current emotion. The system saves this data for tracking progress over time and to interact with the Tamagotchi.

- **Dialogue Interaction**

  User Profile: The child with NDDs
  Goal: Engage an express in a simple, fun way using both voice and text input to foster communication skills.

  - **Voice Interaction Context:** The child prefers speaking to the Tamagotchi and attempts verbal communication.
    Narrative: The Tamagotchi prompts the child, "Can you tell me how your day was?" The child responds verbally, and the system processes the speech. If the response is understood, the Tamagotchi reacts appropriately: "That sounds wonderful! Tell me more!" If the response is unclear, the Tamagotchi gently asks, "I didn't quite get that. Could you say it again?" encouraging further verbal engagement.
  - **Text Interaction**
    Context: The child prefers typing rather than speaking to interact with the Tamagotchi.
    Narrative: The Tamagotchi asks, "How do you feel today?" The child types a response using an on-screen keyboard. The system reads the text and reacts dynamically, such as displaying an animated expression or replying with encouraging feedback like, "I see! That sounds interesting. What else would you like to share?" This allows children who are less comfortable with speech to still engage in meaningful dialogue.

- **Customization User Profile:** The child with NDDs
  Goal: Create a personal bond with the Tamagotchi by customizing different parts of the application.

  - **Pet Customization**
    Context: The child navigates to the configuration menu and enters the pet customization section.
    Narrative: The child selects from a variety of preselected color for the body and eyes, that he feels identifies with.

- **Font Customization**
  Context: The child navigates in the configuration section.
  Narrative: The child notices the different font selection available for the application, and changes for the one that catches his attention.

- **Play Games with the Tamagotchi**

  User Profile: The child with NDDs
  Goal: Encourage the child to focus and have a good time playing short and intuitive games.
  Context: The Tamagotchi is on the playroom scenario.
  Narrative: The Tamagotchi excitedly invites the child to play a simple game, and the child accepts. Three different games are shown for the user to choose from: Tic-Tac-Toe, Memory Game, and Cups Ball Game. These games are easy, quick, and designed to help the user practice concentration. While playing, the Tamagotchi's emotional system boosts in happiness and sleepiness. The user is allowed to play only if the energy is above 30 percent of the total, If the energy is too low, the Tamagotchi suggests resting or eating before playing, the games are not interactable.

  - **Tic-Tac-Toe**
    Context: The child selects Tic-Tac-Toe, and a 3x3 grid appears on the screen.
    Narrative: The child takes turns placing Xs while the Tamagotchi places Os. The algorithm behind the Tamagotchi is random, because the objective is for the user to win and discover what patterns works for him. Once the game is over, the result is shown and the option to restart the game or go back to the game selection screen.

  - **Memory Game**
    Context: The child selects the Memory Game, and a grid of 12 face-down cards appears.
    Narrative: The user is let to turn over 2 cards at a time and discover the pairs that were randomly distributed. This helps the child practice pattern recognition and memory skills, in order to easily find the pairs the user must pay attention.

  - **Cups Ball Game**
    Context: The child selects the Cups Ball Game, where a ball is hidden under one of three shuffled cups.
    Narrative: The cups a randomly mixed, according to a certain difficulty level the cups shuffled, and the child must pick the correct one. The result of the games is displayed, and the opportunity to play again.

- **Cleanse the Tamagotchi**

  User Profile: The child with NDDs
  Goal: Teach the child responsibility and basic hygiene habits through interactive play.
  Context: The Tamagotchi is on the bathroom scenario.
  Narrative: The Tamagotchi gets dirty when playing in the park, so when he is dirty in the bathroom, there is a

button with a scrub to help cleaning the Tamagotchi. When the virtual pet is being scrubbed, dragging it over the body, the dirt aspects slowly disappears and soap bubbles appear.

- **Put the Tamagotchi to Sleep**

  User Profile: The child with NDDs
  Goal: Help the child understand bedtime routines and relaxation techniques, teach that sleeping is good when you are feeling tired.
  Context: The Tamagotchi is on the bedroom scenario.
  Narrative: The Tamagotchi shows the tired expression and the energy bar is getting low. The user clicks on the moon button displayed, and so the lights are turned off and the Tamagotchi sleeps. The energy bar starts to fill again.

- **Feed the Tamagotchi**

  User Profile: The child with NDDs
  Goal: Encourage decision-making and awareness of nutrition by feeding the Tamagotchi, as well as the user reminding what the Tamagotchi like to eat and what not.
  Context: The energy of the virtual pet is getting low, so the user decides to feed it. There are certain dishes that the pet likes and other that he dislikes. With likes dishes, the happiness increases and sleepiness decreases, but when the dish is disliked the angry emotion increases.

- **Play Outside with the Tamagotchi**

  User Profile: The child with NDDs
  Goal: Promote physical activity, exploration, and interaction in an outdoor setting.
  Context: The Tamagotchi is on the park scenario.
  Narrative: The user wants to play with the Tamagotchi but in a casual way. If the energy of the Tamagotchi is enough a football ball we be displayed on the screen, bouncing nonstop and directing itself wherever the user click on the screen. As the user plays, the pet gets dirty and energy starts to decrease (sleepiness increases).

- **Access Reports**

  User Profile: Therapist or Caregiver of children with NDDs
  Goal: Monitor a child's progress and interactions with the Tamagotchi.
  Context: User is on the report section of the app.
  Narrative: The calendar is displayed. If the date had any activity registered, a dot beneath the date appears and the current date is shown in red. The user clicks on a date that has registered activity. 3 sections are shown, with a scroll view, to display information about the emotions the user identified with, comments made and the games played. The emotions registered are shown on a bar chart. The comments shown are the ones the user said or wrote to the Tamagotchi that are emotion related. Finally the detailed activity regarding the games in the playroom, addressing the amount of times played and the results.

4.1.4 Conversational Interaction

The conversation interaction in our Tamagotchi system is design to be engaging and intuitive, allowing users to communicate naturally with their visual companion. As seen below, the system recognizes speech input

from the user, processes it through AI-driven speech recognition, and generates personalized responses. The conversation follows a structured but adaptable flow, encouraging emotional expression and interaction.

The second picture shows the Tamagotchi's visual response while processing a user's message. It appears to be thinking, reinforcing a natural dialogue experience. This animation provides feedback to the user, making the interaction feel more lifelike and emotionally engaging.

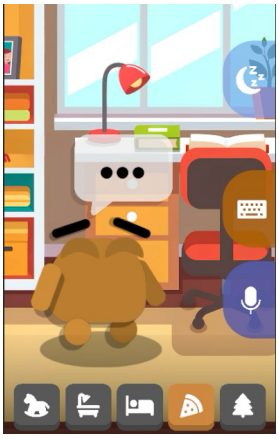

Figure 8: Design displayed while the AI generates the response.

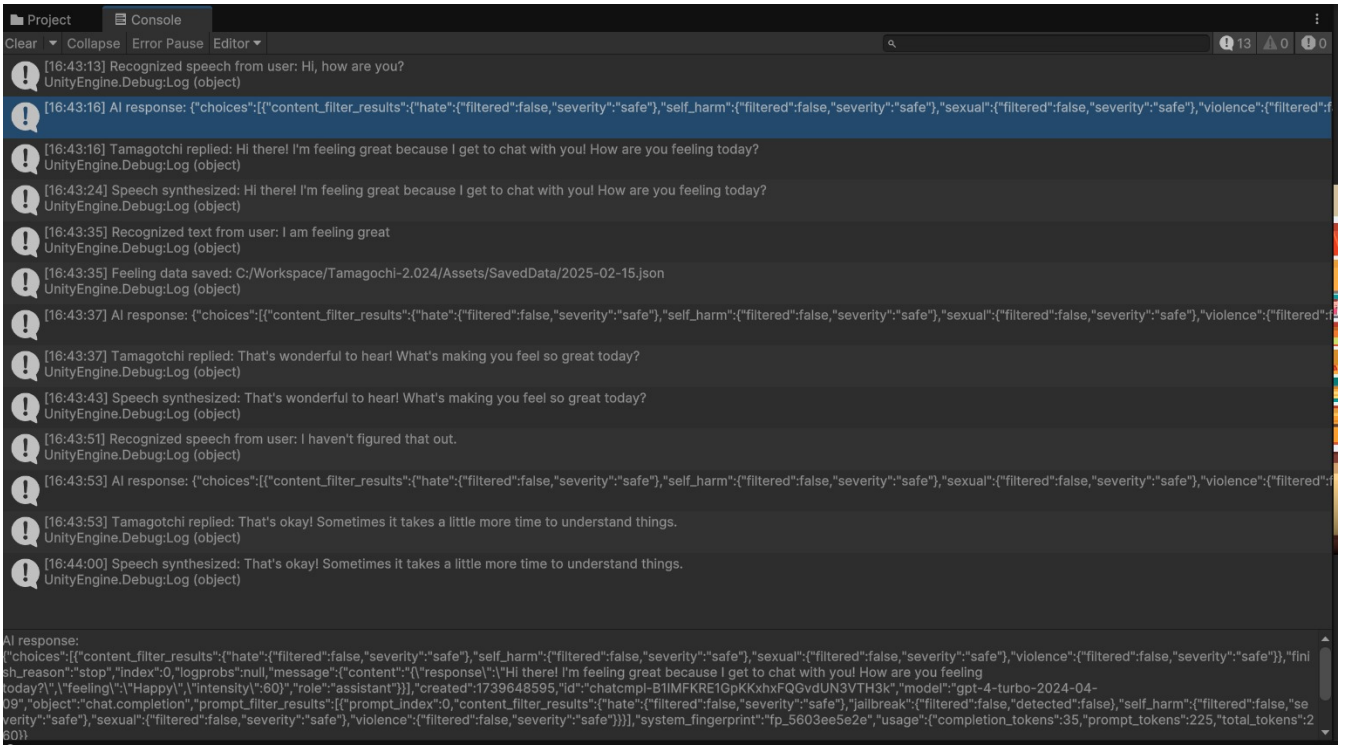

Figure 9: Debugged text example while generating the response with AI from the user input (voice or text).

4.1.5 Tamagotchi Design

Taking into account the research about the positive impact of avatar's cuteness has on user engagement and emotional bond, we carefully designed our Tamagotchi, named Elmo, with specific characteristics to maximize therapeutic benefits.

Figure 10: Animation of the Tamagotchi looking happy.

When designing our virtual pet, one of our core design principles was making everything rounded. Soft and round features make the Tamagotchi friendly and welcoming. This same feature was mirrored in every button and object displayed.

Although the motto of the application is for it to be a virtual pet, from the start we decided that it was not going to be an animal. In first place there are a lot of animal the child might want to choose from and we did not want to leave anyone out. Also, the animal's emotional system is not the same as the human. If our objective is to teach the emotional system humans have, if we illustrate it in an animal, child might be left with a huge confusion.

Another important aspect that was taken into account, was the large eyes that clearly reflect Elmo's emotional states. Narrowed the design to few and simple feature that distinct facial expressions.
Due to programming adversities the Tamagotchi has no mouth, this would have been difficult to link with the speech.

We have also incorporated the idea of customization, the user can changes the body and eyes colors. Instead of changing the accessories and clothes we decided that changing the color would suit best our idea of creating an emotional bond with the virtual pet.

4.2 Implementation

4.2.1 Unity UI

The user interface in Unity is organized inside a single Canvas. This Main Canvas contains five different GameObjects in the hierarchy that represent the initial screen, the game screen, the settings screen, the reports screen and the transitions. Each of these GameObjects plays a crucial role in structuring the application and facilitating smooth interactions.

The Initial Screen GameObject is responsible for handling the initial emotion registration process upon launching the application. It contains the title that prompts the user with a question, encouraging the user to open up about his feelings. Also, the panel with the six different emotions to select from and the text input for any comment the user might wish to add. Once the user has made their selection, a send button is available to confirm and submit the input. It also has a button that is linked to the report screen, a screen where the therapist and caregivers will access review the history.

The Screen regarding the games is divided in three major GameObjects, the scenarios, the Tamagotchi (called Elmo) and the main object.
The Scenarios GameObject is divided in five more GameObjects, according to the five distinct rooms that were thought, play-

room, bathroom, bedroom, kitchen and park. Within each scenario, various interactive objects are displayed, corresponding to the functionality and logic of that environment. The Elmo GameObject is dedicated to the Tamagotchi character itself, with all its body parts and scripts controlling its behavior. In this GameObject all the expressions, animations and movement rendering happens. The Main GameObject controls all the Buttons and Graphics that stays the same throughout every scenario. These include the energy bar, the settings button, the speech bubble, the microphone button, the text button and the buttons that create the transitions between scenarios.

The Reports Screen is the responsible of displaying the emotional data gathered in every use. It is divided in 2 main GameObjects, the Calendar and the detail Activity of each day. This GameObject is integrated with the Save System that helps gather all the persistent data.

The Settings Screen is where the user can customize the experience. That said, this GameObject contains other two, one in charge of the Font Customization and the other of the Tamagotchi's appearance.

Finally, the Transitions GameObject that manages the visual effect and animations that enhances the user experiences when switching between different screens. It ensures smooth and visually appealing movements within the application.

The implementation of Unity UI and its interactive component was developed using C#. We managed all the interactions, animations, logic and transitions.

Additionally, the development was carried out by the three members of the team collaboratively. To deal with all the different versions and integrations we used GitHub. Click [here] to access the GitHub repository with the source code to the Unity project.

4.2.2 Azure OpenAI

The integration of Azure OpenAI within the application plays a crucial role in processing and generating speech-based interactions. This functionality is primarily handled within the Speech.cs script, which facilitates real-time voice communication between the user and the Tamagotchi character, Elmo.

The Speech script is responsible for capturing and processing the user's voice input. When the microphone button is activated, the script records the user's speech and transmits the audio data to Azure OpenAI's Speech-to-Text (STT) service. This service translates the spoken words into text, which allows the application to interpret the user's input, to later generate a response. On some days, the user may prefer typing instead of speaking, so our system includes an text input asset that allows the user to type in anything that he wants. This action might not be the quickest but it adapts to the user's character. This text is send the same way the transcribed text by SST is sent.

Once the Speech-to-Text (STT) service has successfully transcribes the user's speech, a reply is generated. The system generates a reply based on OpenAI. The transcribed text is sent to the AI model along with a structured prompt that provides essential context for generating a relevant and empathetic response.
In the prompt, multiple aspects of the context are highlight. We carefully included just enough information about the user's state and the Tamagotchi's role, for it not to take a long time and not be overwhelming. Together with some constraints that keep the response concise and avoid off-

topics discussions.

The use of AI, when generating the response can slow down the process. To address this problem, we implemented two key optimizations: asynchronous processing and AI-independent responses.
The use of "async" and "await" has provided a smooth user experience thank to the non-blocking execution of the HTTP request to Azure OpenAI, allowing the application to remain responsive while waiting for the AI's response.
Generating responses that do not rely on AI, but do rely on the saved information about the user's emotional status. Given that every time the user opens the application, an emotion is registered, anytime the user is speaking or writing to the virtual pet, there is going to be an emotional state that was updated moments ago. If the system has access to the persistent data, we can get the last emotion registered and generate a predefined response according to that feeling.
These optimizations guarantee a fully fucntional system at all times, with responses of the Tamagotchi in less than 3 seconds.

Furthermore, AI-generated responses also take into account past interactions to create a more contextualized conversation. With every interaction (voice or text) the previous interaction is refreshed by the system and provide he AI the last recorded interaction. This allows continuity in the dialogue without overwhelming the AI.

The system then forwards this text response from the Tamagotchi to Azure OpenAI's Text-to-Speech (TTS) service, which synthesizes the response into a natural-sounding voice. This ensures that Elmo can dynamically interact with the user through spoken dialogue, creating a more immersive and engaging experience.

As the primary users ages are relatively young, we managed to raised the pitch and rate values of the Tamagotchi's voice. With this modification, we get a friendly, young and engaging voice as compared to the preset one.

An important aspect to consider is that if speech recognition fails or input is unclear, the system will react and ask for the user to repeat it.

By leveraging Azure OpenAI, the application enables a seamless conversational experience where users can verbally engage with Elmo in a natural and intuitive way. The integration of STT and TTS technologies significantly enhances accessibility and usability, particularly for users with Neurodevelopmental disorders, making the interaction more intuitive and less reliant on text-based inputs.

4.2.3 Emotional System

The emotional system was designed to build emotions progressively; an abrupt system would alter the child. With our approach, each emotion gradually accumulate based on the user's interactions. This system is directly related to the Tamagotchi's emotions and expression, so in consequence of the energy bar too.

All emotions together will always sum up to 100 percent, the emotion with the greatest percentage is the determined one, the one that is going to be animated. After each interaction, at least one emotion is being altered in a certain amount, while all the other emotions decreased to keep the balance within all emotions. This prevents sudden emotional shifts and allows the Tamagotchi to express emotions in a more realistic and understandable way.

To ensure a natural starting point once the applications is running, the system ini-

tializes all the emotions in a balanced way that might vary from time to time. Most times, the initialization is equal to all emotions, leaving the predominant emotion to Neutral. This is not always the case, sometimes the system gets the last registered emotion by the user and it is assigned as the predominant one. The emotion that was previously registered has now a greater percentage than the rest of the emotions. With this approach we want to achieve that the Tamagotchi not always react the same way as the user. We have noticed that there might be times were the user always enters the angry emotion, and our objective is that the Tamagotchi acts as a guide and the positive emotions should always be favored.

Additionally, although the Sleepy emotion may have the highest percentage, its corresponding expression will not be shown unless the energy bar is below 30 percent. This ensures that tiredness is only visually represented when it is actually relevant, preventing unnecessary disruptions in the Tamagotchi's expressions.

Energy Bar Relation

The Tamagotchi's emotional system is directly connected to the energy bar. To calculate the energy based on the emotions we have considered the "positive" emotions as the neutral, happy and excite/surprised as the ones that maintain the energy high, while Sleepy emotion keeps the energy low. The energy level is calculated by the following equation.

$$\text{EnergyLevel} = 1 - \frac{\text{SleepyValue}}{\text{PositiveEmotionsValue}} \quad (1)$$

With this equation we ensure that as the Sleepy value increases, the positive value decreases and so does the energy level value; and vice versa.

4.2.4 Feeding System

One of the scenarios is the kitchen that was thought to feed the Tamagotchi, as a different way to recharge energy. The thought process behind includes different types of foods that the Tamagotchi likes or dislikes. Whenever the Tamagotchi is fed with something that he dislikes, the angry emotion increases (all the others decrease), whilst if the Tamagotchi enjoys the food, the happy emotion increases (all the others decrease).

4.2.5 Sleeping System

Another scenario in our solution is the bedroom. This should be a place where the child rests, a peaceful space. Whenever the Tamagotchi is feeling low energy, the child should take him to the room and put it to sleep. With this action the Sleepy emotion starts to decrease, and energy restores.

4.2.6 Playing System

The playroom and park scenarios are interactive places to cover the entertainment are as well and concentration skills. They include simple and short activities that engage the user and help develop the attention span. With all of the activities, the virtual pets starts to decreased the energy and slowly increases happiness. While playing the Tamagotchi will show the current emotional state.

4.2.7 Saving System

The saving system is responsible for maintaining significant data for the therapists and caregivers. It plays a crucial role, since the response from the Tamagotchi depends

on it too. We ensure a consistent and evolving behavior all along and not a random reset every time the application is launched.

We have divided the structure into three main categories, emotions, comments and game data.Whenever an emotion is registered, an emotion-related comment is made or a game is played, the corresponding file is updated. Files are created by day, each day with any activity has a corresponding json file. Although it is not shown, everything saved at these files has also the time and hour, acting as a log, for any future use.

The following extract is an example of a json file.

```
{
    "gameDataList": [
        {
            "game": "Tic Tac Toe",
            "result": "You lost :(",
            "date": "2025-02-13",
            "time": "17:45:10"
        }
    ],
    "emotionDataList": [
        {
            "emotion": "Normal",
            "date": "2025-02-13",
            "time": "16:20:33"
        },
        {
            "emotion": "Sleepy",
            "date": "2025-02-13",
            "time": "18:48:15"
        }
    ],
    "feelingsList": [
        {
            "feeling": "I'm feeling \\ super happy.",
            "date": "2025-02-13",
            "time": "14:15:05"
        },
        {
            "feeling": "I have a birthday party and that makes me happy.",
            "date": "2025-02-13",
            "time": "16:21:05"
        }
    ]
}
```

5 Value proposition / Online Statement

Our Tamagotchi is the fist AI/powered virtual companion specifically designed to support children with Neurodevelopmental Disorders, in developing emotional recognition, self-regulation, and social interaction skills. Unlike traditional digital pets, our solution is not just an entertainment tool, it is an interactive and therapeutic experience that fosters emotional learning in a safe, judgment-free environment.

What sets our solution apart is its AI-driven adaptability, allowing real-time, personalized interactions based on the child's patterns and emotional state. Through conversations, games and caregiving activities, children can explore emotions naturally while reinforcing responsibility and empathy. Additionally, therapists and caregivers receive valuable insights through automatically generated reports, including emotional trends and behavioral progress, making it a powerful tool for monitoring development beyond traditional therapy sessions.

While there are existing therapeutic apps and emotion-learning platforms, most lack the engagement and personalization that our Tamagotchi provides. Unlike generic educational programs, our solution leverages gamification and real-time interaction to sustain attention, encourage communication, and create meaningful learning experiences. By integrating technology, psychology, and play, we bridge the gap between traditional therapy and digital engagement, offering an innovative and effective way to support children with NDDs in their emotional and social development.

6 Discussion and Future Work

Developing out Tamagotchi for children with Neurodevelopmental Disorders (NDDs) has been both an exciting and challenging journey. One of the key difficulties encountered was ensuring that interactions felt natural and engaging while remaining accessible to children with diverse cognitive and sensory sensitivities. Achieving the right balance between simplicity and depth in AI-driven conversations required refining speech recognition and response generation to avoid overwhelming or frustrating the user. Furthermore, designing an interface that maintains engagement without causing cognitive overload was another critical aspect, as many children with NDD have limited attention spans.

From a technological perspective, while Unity provided a powerful platform for gamification and interactive design, integrating AI-driven real-time speech recognition required additional optimizations. Further refinements in natural language processing and sentiment analysis could improve the Tamagotchi's ability to understand and adapt to a child's emotional state with even greater accuracy.

In the short to medium term, our focus is on enhancing the AI's personalization by refining speech recognition and emotional response models based on user interactions. We plan to expand the variety of activities by introducing new minigames and emotional exercises tailored to different stages of cognitive and developmental development, ensuring a more engaging experience. Additionally, we aim to improve the therapist reporting system by integrating advanced analytics, such as trend detection in emotional patterns, to improve deeper insights into a child's progress. To make the plat-

form more inclusive, we also intend to optimize accessibility by incorporating alternative communication methods, such as visual cues and simplified interactions, for children with speech impairments.

Looking ahead, our long-term vision includes extending the target audience beyond children with NDDs to support people with anxiety disorders or social communication challenges. We also plan to integrate multiplatform support, allowing the Tamagotchi to function across various devices, including tablets, smartphones, and even VR environments, to enhance immersion. Further, we seek to develop adaptive learning models that evolve over time, enabling AI to dynamically tailor interactions based on a child's progress and preferences. Lastly, our goal is to explore potential collaborations with therapists, schools, and institutions to validate the effectiveness of the solution and integrate it into structured intervention programs, ensuring a broader and lasting impact.

By continually refining our approach and expanding the system's capabilities, we envision our Tamagotchi evolving into a powerful emotional support tool, bridging the gap between therapy and digital engagement while empowering children to navigate their emotions with confidence.

7 Business Perspectives

Pur Tamagotchi represents a unique opportunity in the growing market of digital therapeutic tools. The increasing demand for accesible, technology-driven solutions for children with Neurodevelopmental Disorders (NDDs) positions our product as botch an innovative and necessary intervention.

Beyond direct revenue, our project has strong potential for grants, research collaborations, and corporate sponsorships within fields of digital health and assistive technology. Expanding into international markets and integrating multi-language support could further broaden our impact, ensuring accessibility to a diverse audience.

By positioning our Tamagotchi as both an assistive and educational tool, we can create a sustainable business model that balances profitability with meaningful social impact.

8 Bibliography

References

[1] Y. Tang, L. Chen, Z. Chen, W. Chen, Y. Cai, Y. Du, F. Yang, and L. Sun, "Emoeden: Applying generative artificial intelligence to emotional learning for children with high-function autism," in *Proceedings of the CHI Conference on Human Factors in Computing Systems (CHI '24)*. ACM, 2024.

[2] C. Deng, S. Lai, C. Zhou, M. Bao, J. Yan, H. Li, L. Yao, and Y. Wang, "Asd-chat: An innovative dialogue intervention system for children with autism based on llm and vb-mapp," *[Nombre de la conferencia o revista]*, 2024.

[3] F. Zhou, Y. Lin, and J. Mou, "Virtual pets' cuteness matters: A shared reality paradigm for promoting internet helping behaviour," *Technological Forecasting & Social Change*, vol. 202, p. 123308, 2024.

[4] R. A. Fabio, T. Capri, G. Iannizzotto, and A. Nucita, "Interactive avatar boosts the performances of children with attention deficit hyperactivity disorder in dynamic measures of intelligence," *Cyberpsychology, Behavior, and Social Networking*, August 2019.

[5] W. Zhao, X. Liu, T. Qiu, and X. Luo, "Virtual avatar-based life coaching for children with autism spectrum disorder," *IEEE Computer*, 2020.

Annexes

Annex A