ADVISORY REPORT

EFTELING AI STORYTELLING

Partnership with Livewall

Eindhoven

Date	**:**	**27/11/2024**
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I. Abstract (sumaya)

This report reflects on our group’s challenges in using AI to generate images and text for a cohesive story. The generated images often did not match the intended characters, such as those inspired by the Efteling. Additionally, the text was created after the images, leading to inconsistencies and making the story hard to follow.

We advise using advanced AI tools, like OpenAI’s models, which integrate text and image generation for smoother workflows. With better tools and more time, the process can be more efficient and enjoyable. Expected outcomes include improved story coherence and alignment between visuals and narratives.

II. Objectives (sumaya)

The purpose of this report is to identify the current issues within the MijnSprookje app and provide recommendations for future improvements. We aim to enhance the app's performance, particularly the integration with AI, making it more reliable and consistent. A key area for improvement is ensuring that the AI generates both text and images correctly, presenting a clear and uninterrupted story. This means the text should not switch to English, and there should be a coherent storyline where users do not have to scroll.

Additionally, we want to expand the app with features that improve the user experience, such as allowing children to save their stories and revisit them later. It is also crucial to add a parental control feature so parents can monitor the content. If these improvements are implemented, the app, with a well-functioning AI, can become a successful product in the market.

III. Methodology (Jasmin)

For this project, we as a team used the **Double Diamond process** to design and develop a **Progressive Web App (PWA)** that allows children to create their own fairy tales with the help of AI. The team applied methods from the **CMD Methods Pack** in each phase to research, analyze, and improve the app. Below is an overview of each phase and the methods used:

a. Briefing Phase

In the first phase, the team focused on planning and setting up the project:

- **Kick-off Meeting:** The client explained their goals: creating an (web)app to make storytelling fun and interactive for children aged 4-6.
- **Stakeholder Analysis:** The team listed what the client wanted and how the app could align with Efteling's goals of promoting reading and their Fairy Tale Forest.
- **Project Planning Tools:** The team created a **Trello board** for tasks and a **Gantt chart** to schedule work.
- **Research Questions:** The main question was: *"How can we create an interactive, educational storytelling app that fits the interests of children aged 4-6?"*

b. Discover Phase

In this phase, the team focused on understanding the users (children) and the topic (AI and storytelling). Key methods included:

- **Target Group Literature Research:** The team explored studies about how young children learn and interact with digital tools.
- **Generative AI Research:** Research was done to understand how AI could assist in creating fairy tales, like suggesting characters or story ideas.
- **Interviews with Children:** The team interviewed children aged 4-6 to learn what they find fun in storytelling. For example, they liked colorful visuals, funny characters, and simple interactions.
- **Observation:** While interviewing, the team also observed how children reacted to storytelling ideas and visual elements, which helped identify what worked well.

c. Define Phase

The team organized the research findings and turned them into clear tools to guide the app design:

- **Personas:** The team created fictional profiles (e.g., "Olivia, a 5-year-old who loves animals and fairy tales") to represent the target audience.
- **Empathy Mapping:** They summarized what children think, feel, and want when creating a story. For example, children prefer playful visuals and need guidance while using the app.
- **Task Analysis:** The team broke down how children would use the app step by step, like choosing characters, creating a story, and hearing it read aloud.
- **User Stories:** Short scenarios were written, like: *"As a 5-year-old, I want to pick a princess and a dragon so I can create a fun fairy tale."*

d. Develop Phase

The team started designing and testing the app. This phase included:

- **Prototyping (PWA):** The team built various versions of the app with simple features, like choosing characters, creating a story, and listening to it.
- **User Testing:** Children tested the app prototype, and the team observed how they interacted with it. For example, they noted if the children found the buttons easy to use or if they understood how to create a story.
- **Feedback Analysis:** The team reviewed children's feedback, like wanting brighter colors or more interactive options, and used it to improve the app.

e. Deliver Phase

In the final phase, the team completed the app and presented it to the client:

- **Validation:** The team checked if the app met the research findings and the client's goals. For example, they ensured it was fun, easy to use, and educational for young children.
- **Stakeholder Presentation:** The app and results were shown to the client, explaining how it inspires creativity, promotes reading, and matches Efteling's magical theme.

IV. Current Situation Analysis

A. Strengths (Magda)

This section highlights the strengths of the project during the implementation of the project and how it differentiates from similar and already existing concepts offering storytelling experience and customisation of the story output.

1. Key Strengths

   User-Centric Approach: The project aligns with the targeted audience of Sprookjebos, Efteling and, moreover, narrows down the target to 4-6 year-olds, ensuring engagement and curiosity. This approach and implemented principles were validated by two consecutive sessions of user testing with the targeted audience. Detailed report on the user testing could be found in the appendix of this document.

   Third-Party API integration: Usage of a third-party API services with integrated AI models for text, image and voice generation functionalities.

   PWA performance: Implemented progressive web app features for the story generation, that allow seamless experience without the need of downloading an app.

   Focus on accessibility: Incorporating Text-to-Speech and Speech-to-Text features that allows the targeted audience to use the product independently without having to rely on an adult. These features take into account children's inability to type and/or read on their own and provide a solution that benefits the product and facilitates the user flow. In addition, the story's length and content are aligned with the users' cognitive and motoric skills developed by this moment. (e.g. Attention span taken into consideration and providing a story output of maximum 2 minutes; larger area for buttons, etc.)

B. Weaknesses (Ellyshia)

Despite the strengths possessed by MijnSprookje progressive web app at its current stage of development, there are still several areas to improve in consideration of future development to ensure the product is fully prepared for distribution. The areas of improvement to focus on are:

1. ***Performance problems***

a. The currently used image and text generation AI model are still considered unstable, as the AI model does not always generate what it is programmed to in the input prompt and system prompt.
b. Instability of the AI results in the generation of stories that still lack clear connections between the sentences.
c. The story characters in the generated images are not consistent, so the character has a different appearance in every image.
d. Image generation speed is still considered slow.

2. ***Functional bugs***
    a. Timing of voice-over audio generation needs correcting in order to match with the timing of the text appearance.

3. ***Missing features***
    a. Parental control and save story features were designed in the prototype, however due to time constraints these features were not developed.

4. ***Design Flaws***
    a. Speech recognition interface requires further improvement in the visibility of system status. Currently, there is no visible change in appearance and system status text when the microphone button is pressed, therefore it is not clear enough to the users of whether the button works.

C. Opportunities (Ellyshia)

This project provides opportunities that can benefit all parties that are involved in the project. The potential opportunities to be considered are:

1. ***Market expansion***
    a. *Localization and translation:*
    The product is currently fully in Dutch, as it is the main target demographic. Providing English language support and other languages support might help reach a more global audience.

    b. *Target new demographics:*
    The current target audience is a quite small group, therefore adjusting the app to provide the fitting interface and experience

depending on the age group could help the app to reach multiple groups of audience.

2. ***Feature enhancement***
    a. *Improve personalization:*
    This point is a further expansion that is only suitable if reaching an older target audience will be implemented. Providing an open input for the users to choose their own genres and characters that they want will create an even more personalized experience for the users.

    b. *Provide educational features:*
    Providing look-up features for words in a text, and/or adding the words to a words collection list in the app to review after the story ends could help the current target audience (4 - 6 years old) to also at the same time learn reading.

    c. *Parental control feature:*
    Implement planned parental control features to appeal more to the parents of the target audience.
    d. *Save story feature:*
    Implement planned save story feature that enables users to access the previously generated stories offline.

3. ***Monetization***
    a. *Sponsorships:*
    The current product is already using the brand of Efteling, therefore a partnership with the company could be negotiated.

4. ***Technological advancements***
    a. *AI model improvement:*
    Replace the currently unstable AI models used with a more stable AI model like OpenAI.

    b. *Offline access:*
    Use self-hosting LLMs (Large Language Models) to enable users to still have the experience even without internet connection.

D. Threats (Claudia)

The implementation of AI storytelling for Efteling's Sprookjesbos presents several external threats that should be carefully considered:

1. Rapid AI advancements: The field of AI is evolving quickly, which would render the current technology obsolete soon after implementation. This rapid pace of change may require frequent updates and adaptations to keep the storytelling experience relevant and engaging.
2. Competitor adoption: Other theme parks or entertainment venues might implement similar AI-driven storytelling experiences, potentially diminishing Efteling's competitive advantage. This could lead to a "race" in AI-powered attractions, putting pressure on continuous innovation.
3. Public perception of AI: There's growing concern about AI's impact on privacy, job displacement, and societal changes. Negative public sentiment towards AI could affect the reception of the storytelling experience, particularly among parents who may be wary of exposing their children to AI-generated content.
4. Data privacy concerns: As the system collects and processes user data to personalize stories, it may face scrutiny regarding data protection, especially considering the young target audience. This could lead to regulatory challenges or public backlash.
5. AI-generated content quality: The quality and appropriateness of AI-generated stories may be inconsistent or unpredictable. This could potentially harm Efteling's brand if the content doesn't meet the expected standards of creativity and wholesomeness associated with the park.
6. Technological dependencies: Reliance on specific AI platforms or technologies could create vulnerabilities if those services face disruptions or significant changes in their offerings.
7. Ethical concerns: The use of AI in creating content for children might raise ethical questions about the role of technology in childhood development and imagination. This could lead to resistance from educators or child development experts.

V. Advice and Recommendations

A. Overview (Niki)

The proposed advice focuses on refining and enhancing the MijnSprookje progressive web app to align more closely with its project objectives of delivering an innovative, user-centric storytelling experience for children aged 4–6 years. This includes addressing current weaknesses, leveraging opportunities for expansion and feature enhancement, and mitigating threats to ensure the app is robust, engaging, and future-proof.

The key recommendations center on:

a. **Improving performance** by integrating more stable AI models and optimizing system processes.
b. **Implementing missing and planned features** to enhance user experience and parental appeal.
c. **Expanding the market reach** through localization and targeting broader demographics.
d. **Fostering educational value** to provide additional benefits to users.
e. **Ensuring long-term viability** by incorporating offline capabilities and strengthening data security to address privacy concerns.

By addressing these areas, the app will better meet the needs of its audience while staying ahead in the competitive and fast-evolving AI-driven entertainment market.

B. Specific Recommendations (Magda)

Technology Stack:

1. black-forest-labs/flux-schnell - Image generation model used
2. meta/meta-llama-3-8b-instruct - text generation model used
3. lucataco/xtts-v2 - text-to-speech generation model used

- Modifying the system prompt that would set defined guideline the model to use (especially image generation)
- Create a centralized JSON file for all characters to standardize and store attributes like names, gender and descriptions. This reduces inconsistency across model prompts.

- **Security: (**explained in the following section “Legal and Ethical Considerations” **)**
- **Performance**:

- Optimizing the loading time and fetching of the product by improving the code performance by breaking down each functionality as a simple code snipped.
- Waiting time could also be manipulated by implementing UI practices such as adjusting the text-image sequences that would ensure display of each text/image pair instead of waiting on the generation on all of them before appearance.

● **User Experience**:

- Indication by highlighting text as it is being read out loud to provide real-time visual feedback, improving accessibility and engagement.
- Explicit visual distinction between the already existing elements and the following after the user's input to improve user comprehension.

● **Development Practices**:

- Consideration of hosting services supporting full-stack applications

● **Team and Resources**:

- **AI Specialist** for improving the model and prompt engineering.
- **Front-End Developer** for UI/UX improvements and user feedback integration.
- **Security Analyst** to oversee GDPR compliance and sensitive data handling.

Legal and Ethical Considerations

Mijn Sprookje complies with WCAG 2.1 (Web Content Accessibility Guidelines) in order to ensure accessibility for all users, including those with disabilities. Below are listed all implemented criterions and these that should be further considered:

● **Key WCAG Success criterias implemented:**

1. **Perceivable**
    - 1.2.3 Audio Description or Media Alternative (Prerecorded):
        - Includes audio descriptions for all content allowing children with disabilities/not yet able to read to listen to a generated voice-over of the story and follow the narrative
    - 1.4.3 Contrast (Minimum):
        - Using high-contrast colours to ensure visibility. Color contrast between text color and background color has been checked using Adobe Color Checker Analyzer with **WCAG 2.1 Level AAA** and has passed with a contrast **ratio of 9.55:1** for all text sizes and graphic components.
2. **Operable**
    - 2.5.3 Label in Name:

        - Interactive elements (like “Praat”/”Speak” for STT features) have clear labels rather than just showing an icon.

3. **Understandable**
    - 3.1.1 Language of Page:
        - Language of the page is defined in the metadata of the HTML code as well as in the system input prompt of the AI voice generating mode to ensure correct pronunciation.

The current criterias results in WCAG 2.1, A

- **Key WCAG Success criterias TO BE implemented:**

    - 1.4.1 Use of Color
        - Visually highlights the exact word that is being read out aiding to build a literacy skill for children who are beginning to associate spoken words with their written form.

    - 1.4.2 Audio Control:
        - Interactive element available to stop the voiceover if it is being played automatically for more than 3 seconds.

    - 2.1.1 Keyboard Accessible:
        - To ensure the product can be used and fully navigated by only using keyboard or equivalent inputs. This feature is important for children with mobility impairments who might use adaptive input devices.

    - 3.1.5 Reading Level[1]
        - Content should be presented at a reading level suitable for the intended audience.

    - 4.1.2 Name, Role, Value:
        - Reviewing all interactive elements and ensuring these are labeled properly and coded using semantic HTML or ARIA attributes for assisting technologies such as screen readers.

- **GDPR alignment and recommendations**

[1] Reading levels for children should also take into consideration the Dutch AVI reading levels defined for literature

Considering the targeted audience and the features that it offers there are specific guidelines that should be implemented in order for the product to align with the General Data Protection Regulations and more specifically GDPR-K subset for children below 13. These regulations are valid for all European Union countries.

- Parental consent: Mandatory consent for processing data such as speech recognition and voice recording. Explicit explanation on how this feature is handled and how the voice recording is handled. **Mijn Sprookje does not store any voice recordings** since the application uses Speech-to-text API based on JavaScript. This ensures the voice data is processed in real time and not retained. However, data residue might temporarily retain within the browser or backend service.
- Avoiding unnecessary data collection: Mijn Sprookje does not collect sensitive data such as names or age. Moreover, MIjn Sprookje does not retain user input data even though Replicate service stores predictions created via the API, input parameters, output values and files for an hour. After an hour has passed the data is permanently deleted.

C. Implementation Plan (Niki)

Step 1: Stabilize AI Model and Improve Content Generation (1–3 months)

- **Tasks**:
  - Replace current AI models with stable alternatives like OpenAI models.
  - Improve story content coherence and consistency in character representation.
  - Optimize image generation speed to improve user experience.
- **Resources**: Developer team, AI model subscription/licenses, testing environment.
- **Milestones**:
  - AI content passes QA tests for coherence and speed improvements.
  - Deployment of the updated AI model in a controlled release.

Step 2: Introduce Missing Features (3–6 months)

- **Tasks**:
  - Develop and integrate parental controls.

    - Implement a save story feature for offline access to generated stories.
- **Resources**: UX/UI designers, developers, focus groups for usability testing.
- **Milestones**:
    - Successful integration of features validated by beta testing with target users.

Step 3: Enhance Design and Accessibility (6–9 months)

- **Tasks**:
    - Improve the speech recognition interface with clearer system status indicators.
    - Refine button sizes and layout to better accommodate the target age group.
- **Resources**: UX researchers, designers, user testing sessions.
- **Milestones**:
    - Positive user feedback on revised interface and improved accessibility metrics.

Step 4: Expand Market Reach (9–12 months)

- **Tasks**:
    - Localize app content to additional languages starting with English.
    - Modify interface and features to cater to broader age demographics.
- **Resources**: Translation services, market researchers, developers.
- **Milestones**:
    - Release of multilingual app version with extended target group customization.

Step 5: Integrate Educational Features (12–15 months)

- **Tasks**:
    - Add word lookup and vocabulary-building tools for reading support.
    - Test educational feature usability with parents and educators.
- **Resources**: Educational consultants, developers, UX designers.
- **Milestones**:
    - Educational features are fully integrated and functional.

Step 6: Establish Monetization Strategies (12–15 months)

- **Tasks**:
    - Negotiate sponsorship agreements with brands like Efteling.
    - Explore potential in-app purchases or subscription models for premium features.
- **Resources**: Marketing and partnership team.
- **Milestones**:
    - Launch of monetization features and tracking of revenue streams.

Step 7: Address Long-Term Sustainability (Ongoing)

- **Tasks**:
    - Regular updates to AI models and features to keep pace with technological advancements.
    - Strengthen data security protocols and maintain transparency on data usage.
- **Resources**: IT and security specialists, ongoing R&D investment.
- **Milestones**:
    - Annual reports on system upgrades and compliance with data regulations.

Overall this task may take over a year to accomplish but if production and testing is done by a team as expedient as AURORA Studios prides itself to be, then the timeline might shrink considerably.

D. Risks and Mitigation Strategies (Claudia)

Features	Risks	Mitigation Strategies
AI story generation, integration with Efteling characters	AI-generated content may lack emotional depth or cultural nuance	Implement a human review process for AI-generated stories. Regularly fine-tune the AI model with curated, high-quality data that aligns with Efteling's storytelling tradition
Voice input for story creation, user interface	Children may become overly reliant on AI for	Design the experience to encourage user input

for children	storytelling, potentially hampering their own creativity	and imagination. Include features that prompt children to contribute their own ideas to the story
Offline functionality, story saving and sharing	Technical failures or system downtime could disrupt the user experience	Develop a robust offline mode and implement redundancy in the system architecture. Establish a quick-response technical support team
User authentication, story saving and sharing	Data breaches or misuse of children's personal information	Implement strict data protection measures, minimize data collection, and ensure compliance with GDPR and other relevant regulations. Regularly conduct security audits
AI story generation, multi-language support	The AI system may produce inappropriate or biased content	Implement strong content filters and bias detection algorithms. Regularly audit and update the AI model to remove biases. Establish a clear protocol for handling and correcting inappropriate content
AI story generation, integration with Efteling characters	Users may find the AI-generated stories repetitive or predictable over time	Continuously expand and diversify the AI's knowledge base. Implement a system that tracks user interactions to ensure variety in storytelling
AI story generation, text-to-speech narration	The technology may become quickly outdated due to rapid advancements in AI	Design the system with modularity in mind, allowing for easy updates and integration

		of new AI technologies. Allocate resources for ongoing research and development
User interface for children, integration with Efteling characters	Negative public perception of AI use in children's entertainment	Develop a transparent communication strategy that educates parents and the public about the benefits and safeguards of the AI storytelling system. Engage with child development experts to validate the approach
AI story generation, text-to-speech narration	Overreliance on a single AI provider or technology	Diversify technology partnerships and maintain the capability to switch between different AI platforms if necessary. Develop some proprietary AI components to reduce dependency on external providers
User interface for children, text-to-speech narration, multi-language support	The AI system may not effectively cater to children with different abilities or learning needs	Incorporate accessibility features and adaptive learning capabilities into the system. Consult with special education experts to ensure inclusivity

VI. Conclusion (Jasmin)

This report explains the main challenges with the current version of the *MijnSprookje* app and offers clear solutions to improve it. Some of the most important issues include unstable AI performance, slow image generation, and characters that do not look the

same in every image. Additionally, the app is missing key features like parental controls and the ability to save stories, which would make it more useful and enjoyable for families.

To solve these problems, the report suggests using better AI technology, improving the design, and adding new features that make the app easier and more fun to use. For example, making the app's voice-over match the text timing and improving the microphone interface will help children enjoy the storytelling experience without confusion. Including features like parental controls, educational tools, and the ability to save stories will also make the app more appealing to parents.

By following these recommendations, the app can become more reliable and creative, meeting the needs of children and their families. It will also better represent Efteling's magical and educational goals, ensuring that children not only have fun but also learn something from their storytelling experience. These changes are important to create an app that is loved by users and stands out in the market.

(Not done yet ;)

VII. Appendices (no)

Include any additional materials that support the report, such as detailed analysis, data tables, or reference documents.