ECAI 2024
U. Endriss et al. (Eds.)

doi:10.3233/FAIA241036

A Demonstration of AI Personalized Interactive Fiction for Young Children

Jasmine Lesner[a], Luke Murayama[a], Tony Guizar[a], Poom Phunjamaneechot[a] and Daniel Shapiro[a]

{jlesner,lmurayam,aguizaro,sphunjam,dgs}@ucsc.edu
[a]University of California, Santa Cruz

Abstract. We present a high-fidelity prototype that allows young children to create personalized, interactive stories using AI, designed to enhance their learning, creativity, and decision-making. Children select story topics using emojis to create stories with multimedia elements integrated to boost engagement. The prototype uses AI models for text-to-image, text-to-sound, and text-to-music to enrich the storytelling with visuals, sounds, and music. Parents can monitor the AI-generated content through story charts and media galleries to ensure it remains age-appropriate. While the system can scale out horizontally to accelerate content creation, challenges remain in maintaining consistent visual character portrayal and offering diverse narrative paths. We aim to provide an educational tool that entertains while supporting children's cognitive development, language skills, and imagination. Our prototype demonstrates the potential of child-centric AI storytelling tools to impact children's learning and development.

1 Introduction

Creating stories allows children to benefit from the novelty bias, where fresh narratives capture their attention, improving learning and memory retention [4, 7]. The IKEA effect and endowment effect mean that children value the stories they create, making them personally meaningful [15, 5]. Additionally, children engage more deeply with personalized stories, leading to improved learning outcomes like better vocabulary acquisition [10, 6]. These insights guided our design. **Child-Centric Story Creation**: Our prototype puts young children at the heart of the storytelling process[1]. By using emojis to choose story topics and making decisions that influence story outcomes, kids are encouraged to practice decision-making. **Multimedia Integration**: By incorporating AI models for text-to-image, text-to-sound, and text-to-music generation, our prototype offers a rich multimedia storytelling experience that resonates with young audiences. **Parental Oversight Mechanism**: Understanding the need for appropriate content, our prototype provides parental oversight features. Parents can review and regenerate AI-generated elements, ensuring stories align with their expectations and educational goals. **Accessibility and Open Source Contribution**: The prototype is freely available online[2], encouraging broad accessibility and community participation. With the source code[3] released under an open-source license, other researchers and developers can build upon our work, fostering further innovation in AI-driven educational tools.

Figure 1. Interaction flow: (1) Child chooses topics for their story. (2) AI generates the story and its media galleries. (3) Parent reviews galleries, gives AI feedback. (4) AI updates story as guided by parent. (5) Child enjoys their new custom story.

2 Interaction Flow

Figure 1 shows the five steps of our **child-centered experience**:

1. **Child chooses topics for their story.** There are hundreds of emoji topics to choose from (Figure 2 right).
2. **AI generates the story and media galleries.** The story includes illustrations, sounds, music and decisions (Figure 3). The galleries give parents an overview of these elements (Figure 4).
3. **Parent reviews galleries, gives the AI feedback.** This is to be sure that AI generated media elements are suitable for their child.
4. **AI updates story guided by parent.** AI models remake unapproved media – as many times as requested.
5. **Child enjoys their new story.** The child engages with custom multimedia elements based on their selected story topics and their story time decisions (Figure 3).

[1] Video about the prototype [14]: https://youtu.be/TaVGem3nFrk
[2] High-fidelity Prototype [12]: http://www.ufafu.com
[3] Source Code [11]: https://github.com/jlesner/aipif

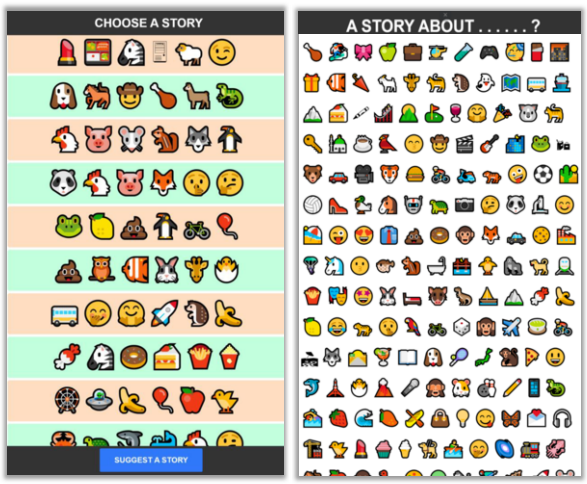


Figure 2. **Story List View** (left) contains a list of previously generated stories and offers the option to 'SUGGEST A STORY'. **Story Suggest View** (right) allows the user to pick story topics to generate a new interactive story

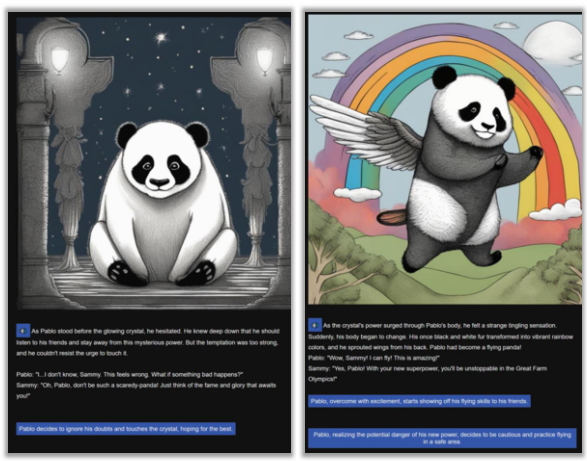


Figure 3. **Story Page View** flips through each story scene showing illustrations and text. One or more large blue buttons advance the story to the next scene determined by each button's text.

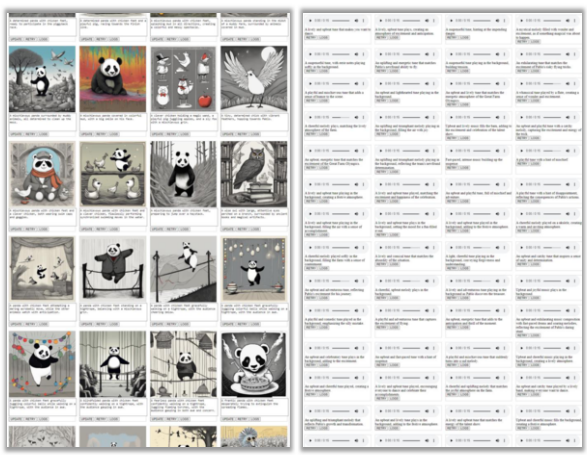


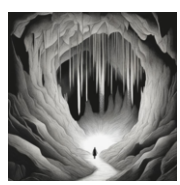
Figure 4. **Picture Gallery View** (left), **Music Gallery View** (right), and Sound Gallery View (not shown) allow parents to inspect illustrations, sounds and music and request AI regenerate specific ones. These views are accessed from the bottom of each story page to hide them from children.

Here is a story a young child created for themselves using our prototype by choosing the following six topics:

SCENE 1: *Once upon a time in the animal kingdom, there was a mysterious farm where all the animals could talk and had their own unique abilities. One day, as the sun rose over the farm, the animals gathered for their morning meeting.* ***Pablo the mischievous panda****: "Good morning, everyone! What's on the agenda today?"* ***Chickie the clever chicken****: "Cluck-cluck! Today, we're going to test our animal abilities in the Great Farm Olympics!"* ***Piggy the playful pig****: "Oink-oink! I can't wait to show off my incredible mud-splashing skills!"* ***Foxy the sly fox****: "Hehe, I'll be using my cunning tricks to outsmart everyone!"* ***ACTION****: Pablo decides to participate in the Great Farm Olympics, even though he hasn't quite mastered any special abilities.* ***PICTURE****: A clever chicken with vibrant feathers and a mischievous smile.* ***MUSIC****: A lively, upbeat tune plays, creating an atmosphere of excitement and anticipation.*

SCENE 2: *As the animals prepared for the Great Farm Olympics, a mysterious figure appeared out of nowhere. It was a sneaky snake named Sammy, known for his tricks and pranks. Sammy slithered up to Pablo and whispered, "Psst! I heard there's a secret shortcut to victory in the Olympics. Follow me if you want to win!" Curiosity got the better of Pablo, and he decided to follow Sammy, unaware of the trouble that awaited him.* ***Pablo****: "What's this secret shortcut you're talking about, Sammy?"* ***Sammy****: "Oh, Pablo, it's a shortcut that will make you the champion of the Olympics! But remember, it's a secret, so don't tell anyone!"* ***ACTION****: Pablo decides to trust Sammy and follows him, ignoring the warnings from his friends.* ***PICTURE****: A sneaky snake with a mischievous grin, slithering towards Pablo.* ***MUSIC****: A suspenseful tune, hinting at the impending danger.*

SCENE 3: *As the sneaky snake Sammy led Pablo deeper into the farm, they stumbled upon a hidden cave. Inside, they discovered a glowing crystal that seemed to radiate with power. The air crackled with anticipation as Sammy whispered, "Pablo, this crystal has the ability to grant any animal a special superpower. With it, you can become the greatest athlete in the Great Farm Olympics!" Pablo's eyes widened with excitement and he couldn't resist the temptation.* ***Pablo****: "Wow, Sammy! This crystal is incredible! I can't wait to see what superpower it grants me!"* ***Sammy****: "Yes, Pablo! Just touch the crystal and your power will be revealed!"* ***ACTION 1****: Pablo decides to touch the crystal, hoping to gain an extraordinary superpower.* ***ACTION 2****: Pablo hesitates, realizing that touching the crystal might have unknown consequences.* ***PICTURE****: A mysterious cave with a glowing crystal in the center, surrounded by shadows.* ***MUSIC****: A mystical melody filled with wonder and excitement, as if something magical was about to happen.*



Before this story ends a dozen more scenes follow. Figure 3 shows screenshots of what the child sees. **ACTION** elements appear as blue buttons that advance the story. **PICTURE**, **SOUND**, **MUSIC** elements are sent to text-to-image, text-to-sound and text-to-music AI models so that each scene has its own unique illustrations, sounds and music. The screenshots in Figure 3 are the two scenes that follow when the child selects **ACTION 1**. Figure 1 and 4 show more illustrations from this same story.

3 Technical Approach[4]

Our stories feature illustrations, sounds, and music are generated by AI, based on narratives from an LLM following a configured 'story plan' (Figure 5). The story plan serves as a template, guiding the LLM in sequencing scenes and keeping the narrative focused and structured. We represent stories and their branches in XML, which we grow using 'forward chaining' [18] with XSLT [20] into 'Time Cave' [1] structured stories. To maintain narrative continuity, we supply the LLM with 'the story so far' for each branch when generating subsequent scenes. Completed stories are then converted into Twee [8] and rendered as interactive HTML (Figure 3) using the Twine [9] engine.

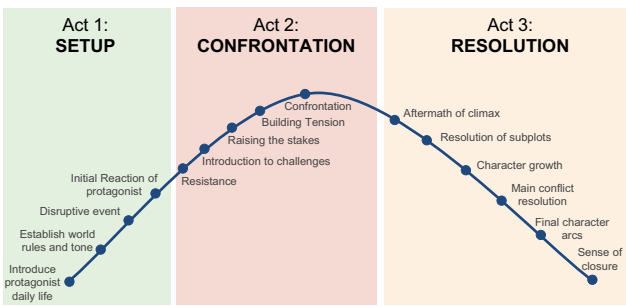


Figure 5. A three act fifteen scene story plan [3].

4 System Design

Figure 6 shows our prototype's components. Our high-fidelity prototype lets children create custom choice-based stories through an interactive interface. Children can select, suggest, and view stories using emojis, while parents have the ability to oversee and edit story content. This interface connects to a web service that processes story and media requests, updating content based on parental inputs. Stories and media are stored on AWS S3, with a pool of GPU workers processing these elements asynchronously. Parallel processing by workers can greatly reduce the time it takes to create a story. A story with 32 narrative paths and 15 scenes each, totals 528 AI model requests for all generated elements. Without fast GPUs operating simultaneously, generating such a story could take hours. By using multiple workers with NVIDIA RTX 4090 GPUs, we can cut this down to minutes.

5 Limitations and Future Work

We currently use GPT-3.5 [2], which, while generally sufficient for children, can be improved by upgrading to GPT-4 [16] and incorporating newer multimedia models and AI-generated characters [17].

[4] For details on our technical approach, system design, system limitations, and future directions, consult our preprint [13].

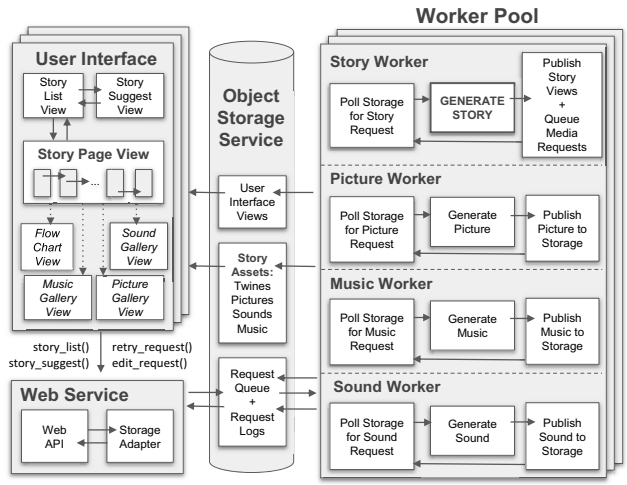


Figure 6. How the components of our prototype work together

Our story branches sometimes converge on common tropes, which we plan to address by having LLM prompts consider plot developments in parallel branches. Additionally, the vocabulary of GPT-3.5 sometimes proves too complex for children, making our system an ideal platform for testing lexical simplification techniques [19].

Challenges in sound generation and music looping also need addressing. Our prototype lacks user control over story style and aesthetics, which are preset globally, and character depiction through text-to-image models lacks consistency. Moreover, the absence of load balancing for story generation limits new story creation to scheduled demonstrations. Each point highlights an area for future development to enhance and expand our prototype's capabilities.

Our prototype shows potential but rigorous user evaluation is essential to understand the its impact on children's attention spans, creativity and language development. We plan to enhance stories with quiz questions with the aim to measure learning and gather data on which story elements and story types are more effective.

6 Conclusion

This study presents a high-fidelity prototype for AI personalized interactive fiction designed for young children, allowing them to create stories with text, images, sounds, and music. The system encourages creativity and critical thinking by letting kids influence story topics and story outcomes. Key contributions include a child-focused design, multimedia integration, parental oversight features, and open-source accessibility.

Our key insights include the importance of balancing story coherence with interactivity and the challenges of multimedia integration. Future work will focus on enhancing story quality, better multimedia handling and conducting comprehensive user studies to validate effectiveness of our design and to guide further improvements. We aim to create a tool that can support the cognitive and creative development of young children.

Author Contributions

J. L. developed the prototype's LLM story features and web app. L. M., T. G., and P. P. evaluated and integrated AI models for illustrations, sounds, and music. J. L. conducted the literature review and wrote the manuscript. All authors reviewed and edited the work. D. S. supervised the project.

References

[1] S. K. Ashwell. Standard Patterns in Choice-Based Games. Online, Jan 2015. URL https://heterogenoustasks.wordpress.com/2015/01/26/standard-patterns-in-choice-based-games.

[2] T. B. Brown, B. Mann, N. Ryder, M. Subbiah, J. Kaplan, P. Dhariwal, A. Neelakantan, P. Shyam, G. Sastry, A. Askell, S. Agarwal, A. Herbert-Voss, G. Krueger, T. Henighan, R. Child, A. Ramesh, D. M. Ziegler, J. Wu, C. Winter, C. Hesse, M. Chen, E. Sigler, M. Litwin, S. Gray, B. Chess, J. Clark, C. Berner, S. McCandlish, A. Radford, I. Sutskever, and D. Amodei. Language models are few-shot learners, 2020.

[3] S. Field. *Summary of Screenplay*. Dell Publishing Company, 1994.

[4] N. C. Foley, D. C. Jangraw, C. Peck, and J. Gottlieb. Novelty enhances visual salience independently of reward in the parietal lobe. *Journal of Neuroscience*, 34(23):7947–7957, 2014.

[5] S. A. Gelman, E. M. Manczak, and N. S. Noles. The nonobvious basis of ownership: Preschool children trace the history and value of owned objects. *Child Development*, 83(5):1732–1747, 2012.

[6] J. Horst, K. Parsons, and N. Bryan. Get the story straight: Contextual repetition promotes word learning from storybooks. *Frontiers in Psychology*, 2:17, 02 2011. doi: 10.3389/fpsyg.2011.00017.

[7] J. S. Horst, L. K. Samuelson, S. C. Kucker, and B. McMurray. What's new? Children prefer novelty in referent selection. *Cognition*, 118(2): 234–244, 2011. ISSN 0010-0277. doi: j.cognition.2010.10.015.

[8] Interactive Fiction Technology Foundation. Twee 3 specification. Online, 2021. URL https://github.com/iftechfoundation/twine-specs/blob/master/twee-3-specification.md.

[9] Interactive Fiction Technology Foundation. Twine: An open-source tool for telling interactive, nonlinear stories. Online, 2021. URL https://twinery.org.

[10] N. Kucirkova, D. Messer, and D. Whitelock. Parents reading with their toddlers: The role of personalization in book engagement. *Journal of Early Childhood Literacy*, 13, 12 2012. doi: 10.1177/1468798412438068.

[11] J. Lesner, L. Murayama, T. Guizar, P. Phunjamaneechot, and D. Shapiro. Source Code for AI Personalized Interactive Fiction for Young Children. Online, 2023. URL https://github.com/jlesner/aipif. AGPL-3.0 License.

[12] J. Lesner, L. Murayama, T. Guizar, P. Phunjamaneechot, and D. Shapiro. Prototype of AI Personalized Interactive Fiction for Young Children. Online, 2023. URL http://www.ufafu.com.

[13] J. Lesner, L. Murayama, T. Guizar, P. Phunjamaneechot, and D. Shapiro. AI Personalized Interactive Fiction for Young Children. Online, 2024. URL https://github.com/jlesner/aipif/blob/main/doc/aipif_preprint_2024.pdf. Preprint.

[14] J. Lesner, L. Murayama, T. Guizar, P. Phunjamaneechot, and D. Shapiro. Demonstration of AI Personalized Interactive Fiction for Young Children. Online, 2024. URL https://youtu.be/TaVGem3nFrk. Video.

[15] L. E. Marsh, P. Kanngiesser, and B. Hood. When and how does labour lead to love? The ontogeny and mechanisms of the IKEA effect. *Cognition*, 170:245–253, 2018. ISSN 0010-0277. doi: 10.1016/j.cognition.2017.10.012.

[16] OpenAI, J. Achiam, S. Adler, et al. GPT-4 Technical Report, 2024.

[17] P. Pataranutaporn, V. Danry, J. Leong, P. Punpongsanon, D. Novy, P. Maes, and M. Sra. AI-generated characters for supporting personalized learning and well-being. *Nature Machine Intelligence*, 3(12): 1013–1022, 2021. doi: 10.1038/s42256-021-00417-9.

[18] S. J. Russell and P. Norvig. *Artificial Intelligence: A Modern Approach*. Prentice Hall, Upper Saddle River, NJ, USA, 3 edition, 2009. ISBN 0136042597. Includes discussion on forward chaining in the context of AI.

[19] M. Valentini, J. Weber, J. Salcido, T. Wright, E. Colunga, and K. von der Wense. On the automatic generation and simplification of children's stories. In *Proceedings of the 2023 Conference on Empirical Methods in Natural Language Processing*, pages 3588–3598. Association for Computational Linguistics, 2023.

[20] World Wide Web Consortium. Extensible Stylesheet Language Transformations (XSLT) Version 3.0. Online, 2017. URL https://www.w3.org/TR/xslt-30/.