MyStoryKnight: A Character-drawing Driven Storytelling System Using LLM Hallucinations

Sechayk Yotam[4,a)] Penarska Gabriela A.[2,†1,b)] Randsalu Isa A.[1,†1,c)]
Arzate Cruz Christian[3] Igarashi Takeo[4]

Abstract: Storytelling is a valuable tradition that plays a crucial role in child development, fostering creativity and a sense of agency. However, many children often consume stories passively, missing out on the opportunity to participate in the creative process. To address this, we propose a storytelling system that creates adventure-type stories with multiple branches that users can explore. We generate these interactive stories using a character drawing as input, with visual features extraction using GPT-4. By leveraging LLM hallucinations, we generate interactive stories using user feedback as a prompt. Finally, we refine the quality of the generated story through a complexity analysis algorithm. We believe that the use of a drawing as input further improves the engagement in the story and characters.

1. Introduction

Creativity is increasingly recognized as a crucial aspect of the modern working environment. In the context of child development, creativity plays a pivotal role in fostering learning and growth [5], which extends to adulthood. As a result, there has been a growing interest in leveraging creative artificial intelligence (AI) and exploring the use of AI agents to stimulate children's creativity. Previous research has demonstrated the positive effects of incorporating AI agents with creative abilities in enhancing children's creative thinking. Additionally, the use of storytelling robots and virtual characters as interactive tools has gained traction in recent years [17]. In this paper, we propose *MyStoryKnight*, an interactive AI tool for generating stories.

Our proposed system is intended to promote children's creativity through storytelling, a popular activity for entertaining and bonding [17]. Both storymaking and storytelling contribute to the development of verbal and social skills [3], [14], such as broadening the vocanulary and improving narrative comprehension. Besides, creating fictional worlds and characters helps children improve their language skills, both in comprehension and usage [1]. In *MyStoryKnight*, users, together with an AI, co-create stories with multiple explorable branches.

[1] Lund University
[2] Technical University of Denmark
[3] Honda Research Institute Japan
[4] The University of Tokyo
[†1] Presently with The University of Tokyo
[a)] sechayk-yotam@g.ecc.u-tokyo.ac.jp
[b)] gabriela-penarska@g.ecc.u-tokyo.ac.jp
[c)] randsalu-isa071@g.ecc.u-tokyo.ac.jp

Despite all the benefits of practicing storytelling, many children do not have the opportunity to engage in interactive storytelling. *MyStoryKnight* addresses this problem by generating an adventure-type story through LLM hallucinations. Figure 1 shows an overview of our system. Our system uses drawings of characters as input, and generates an unfolding story that the user can navigate through based on their choices. Using a complexity analysis algorithm, we guide the LLM hallucinations to generate a coherent and consistent story. Resulting in a story that is both engaging and easy to follow.

Our contributions are:

- Storytelling system that uses the character drawing as a basis for the story.
- LLM hallucinations to generate an adventure-type story with user navigation.
- Complexity analysis of story generation for coherency and consistency.

2. Related Work

2.1 Interactive Storytelling

Interactive storytelling is a form of storytelling in which the audience is an active participant [19]. Interactive storytelling has been shown to be an effective way of building and strengthening relationships [15], also playing an important role in parent-child bonding [20]. Interactive stories stimulate thinking and imagination [4], and help children make sense of their world through shared experiences [14].

Prior work has explored physical interactivity through the use of tangible objects [14] to create stories, and physical gestures to control characters [10] or generate stories [21]. Other studies have explored the use of sketches to influence

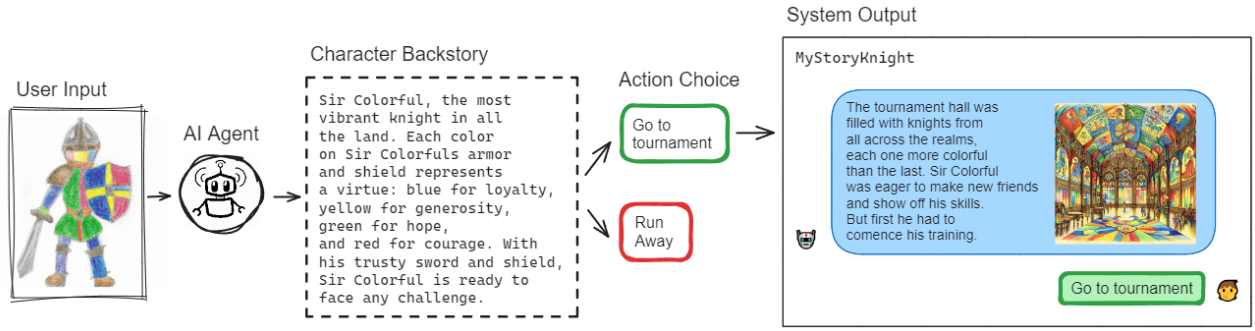

Fig. 1 MyStoryKnight system overview. Drawing is anaylzed with GPT-4. Backstory and action choices are presented to the user. Story unfolds based on user choice.

character behavior and plot development [4]. However, these studies have not explored the use of character drawings as the driving force behind the story.

2.2 AI Storytelling

AI usage has been experiencing a surge in popularity in recent years, with many applications in the creative arts. Generative AI especially has the potential to contribute to creative processes [18]. One such creative process could be storytelling. Prior work has explored how generative AI can be used to create stories [1], and even collaborate in story generation with humans [16]. Other studies explored how generative AI can be used to expand existing story worlds [2], or generate multi-modal storytelling experiences [8]. However, while consistency and coherency are essential in storytelling, they are often overlooked in AI-generated stories.

2.3 Storytelling with Children

Children oriented storytelling has been explored widely in the past. Prior work has explored the use of robots as storytelling companions [17], and the use of virtual characters to promote collaboreation [10]. Other studies have explored the use of AI agents to stimulate children's creativity [5]. Other studies have shown how AI can support parent-child bonding [20], and encourage physical interaction and play [21]. However, utilizing hallucinations to generate stories has not been explored in the context of user-agency for storytelling with children.

3. System Overview

We designed **MyStoryKnight**, an interactive storytelling that uses drawings as input and utilizes LLM hallucinations to generate a branching story. Agency is a critical factor in interactive storytelling [4], as it promotes engagement and immersion [20]. Our system supports user agency by allowing users to navigate the story through their choices. Additionally, we use a complexity analysis algorithm to guide the LLM hallucinations to generate a coherent and consistent story, fitting for children's comprehension.

3.1 System Architecture

The system consists of three main components:

(1) **Drawing Analysis**: Extracting visual features from the user's drawing. The visual features are used as a prompt for the LLM to hallucinate a character description and a background story.

(2) **Story Generator**: Story is generated based on user selection on a set of actions. LLM hallucinations are used to generate both the story and actions.

(3) **Complexity Analysis**: Natural language processing (NLP) techniques are used to analyze the story's coherency and consistency. The results are used to guide the LLM hallucinations.

To achieve our goals, we utilize GPT-4 [13] for drawing analysis and story generation. Additionally, we use spacy [9] in addition to GPT-4 for complexity analysis. The system is implemented with Django, a Python web framework [7], and React, a JavaScript library for building user interfaces [6].

4. User Interface

The user interface is shown in Figure 2. The main interaction screen consists of an action selection area (bottom), a restart button (top-right), a microphone indication toggle (bottom-left), and a story output panel (center).

Fig. 2 Mockup of the user interface.

The system uses a webcam to scan and identify user drawings which are then uploaded and analyzed. The story is

then told using speech synthesis with the OpenAI API [12], and story images are generated using DALL-E [11]. The generated images are optimized to maintain a style similar to that of the user. Actions are then presented to the user, and these could be activated by clicking, or alternatively by voice commands. The user can also choose to restart the story at any point.

5. Experiencing MyStoryKnight

In this section, we describe the interaction flow of the system.

> *Our story begind with a few colord strokes on a piece of paper.*

The user draws a character on a piece of paper, and the system scans the drawing using a webcam (Fig. 3).

Fig. 3 An example of a user drawing. A drawing of a knight, generated with OpenAI's DALL-E [11].

The drawing is then uploaded to the system and analyzed. The system then generates a character description and a background story based on the drawing. The background story is then told to the user.

> *Sir Colorful, the most vibrant knight in all the land. Each color on Sir Colorfuls armor and shield represents a virtue: blue for loyalty, yellow for generosity, green for hope, and red for courage. With his trusty sword and shield, Sir Colorful is ready to face any challenge.*

The user is then presented with a set of actions to choose from: `Go to tournament` or `Run away`. These choices are then fed into GPT-4 to generate the next part of the story, and the next set of actions. The user chooses `Go to tournament` and the story continues (Fig. 4).

> *The tournament hall was filled with knights from all across the realms, each one more colorful than the last. Sir Colorful was eager to make new friends and show off his skills. But first he had to comence his training.*

This leads to the following actions: `Jousting` and `Weight lifting`. The user makes their choice and the story continues. This process repeats until the user chooses to end the story.

Fig. 4 An example output of the system, the ́tournament hall. Generated with OpenAI's DALL-E [11].

6. Conclusion

In this paper, we presented *MyStoryKnight*, an interactive storytelling system that uses character drawings as input. We generate an adventure-type story with multiple explorable branches using LLM hallucinations. Additionally, we use a complexity analysis algorithm to guide the LLM hallucinations to generate a coherent and consistent story. We believe that the use of a drawing as input further improves the engagement in the story and characters. In the future we plan to hold a user study to evaluate the effectiveness of our system in promoting creativity and engagement.

References

[1] Burtenshaw, B.: AI Stories: An Interactive Narrative System for Children, *CoRR*, Vol. abs/2011.04242 (online), available from ⟨https://arxiv.org/abs/2011.04242⟩ (2020).
[2] Chopra, B., Verma, K., Singhal, S. and Singla, U.: Reality Tales: Facilitating User-Character Interaction with Immersive Storytelling, *CHI '21: CHI Conference on Human Factors in Computing Systems, Virtual Event / Yokohama Japan, May 8-13, 2021, Extended Abstracts* (Kitamura, Y., Quigley, A., Isbister, K. and Igarashi, T., eds.), ACM, pp. 489:1–489:7 (online), DOI: 10.1145/3411763.3451522 (2021).
[3] Currin, F. H., Diederich, K., Pantoja, L. S., Cargo, H., Franzone, N., Geiger-Lee, J. and Hourcade, J. P.: Designing Stories to Inspire Preschoolers' Creative, Collaborative Roleplay, *Proceedings of the 2023 ACM Conference on Information Technology for Social Good, GoodIT 2023, Lisbon, Portugal, September 6-8, 2023*, ACM, pp. 40–47 (online), DOI: 10.1145/3582515.3609516 (2023).
[4] de Lima, E. S., Gheno, F. J. and Viseu, A.: Sketch-Based Interaction for Planning-Based Interactive Storytelling, *19th Brazilian Symposium on Computer Games and Digital Entertainment, SBGames 2020, Recife, Brazil, November 7-10, 2020*, IEEE, pp. 154–162 (online), DOI: 10.1109/SBGAMES51465.2020.00029 (2020).
[5] Elgarf, M. and Peters, C. E.: CreativeBot: a Creative Storyteller Agent Developed by Leveraging Pre-trained Language Models, *IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS 2022, Kyoto, Japan, October 23-27, 2022*, IEEE, pp. 13438–13444 (online), DOI: 10.1109/IROS47612.2022.9981033 (2022).
[6] Facebook: React, `https://reactjs.org/` (2021).
[7] Foundation, D. S.: Django, `https://www.djangoproject.com/` (2021).

[8] Han, A. and Cai, Z.: Design implications of generative AI systems for visual storytelling for young learners, *Proceedings of the 22nd Annual ACM Interaction Design and Children Conference, IDC 2023, Chicago, IL, USA, June 19-23, 2023*, ACM, pp. 470–474 (online), DOI: 10.1145/3585088.3593867 (2023).
[9] Honnibal, M. and Montani, I.: spaCy 3.0: Industrial-Strength Natural Language Processing, `https://spacy.io/` (2020).
[10] Liu, C., Liu, K., Wang, P., Chen, G. and Su, M.: Applying tangible story avatars to enhance children's collaborative storytelling, *Br. J. Educ. Technol.*, Vol. 43, No. 1, pp. 39–51 (online), DOI: 10.1111/J.1467-8535.2010.01146.X (2012).
[11] OpenAI: DALL-E, `https://openai.com/blog/dall-e/` (2021).
[12] OpenAI: OpenAI API, `https://openai.com/blog/openai-api/` (2021).
[13] OpenAI: GPT-4 Technical Report, *CoRR*, Vol. abs/2303.08774 (online), DOI: 10.48550/ARXIV.2303.08774 (2023).
[14] Ryokai, K. and Cassell, J.: StoryMat: a play space for collaborative storytelling, *CHI '99 Extended Abstracts on Human Factors in Computing Systems, CHI Extended Abstracts '99, Pittsburgh, Pennsylvania, USA, May 15-20, 1999* (Atwood, M. E., ed.), ACM, pp. 272–273 (online), DOI: 10.1145/632716.632883 (1999).
[15] Schlauch, M., Sylla, C. and Gil, M.: Investigating Social Emotional Learning at Primary School through Guided Interactive Storytelling, *Extended Abstracts of the Annual Symposium on Computer-Human Interaction in Play, CHI PLAY 2022, Bremen, Germany, November 2-5, 2022* (Gerling, K., Iacovides, J., Malaka, R., Bonsignore, B. and Frommel, J., eds.), ACM, pp. 240–245 (online), DOI: 10.1145/3505270.3558313 (2022).
[16] Shakeri, H., Neustaedter, C. and DiPaola, S.: SAGA: Collaborative Storytelling with GPT-3, *Companion Publication of the 2021 ACM Conference on Computer Supported Cooperative Work and Social Computing, CSCW 2021, Virtual Event, USA, October 23-27, 2021* (Birnholtz, J. P., Ciolfi, L., Ding, S., Fussell, S. R., Monroy-Hernández, A., Munson, S., Shklovski, I. and Naaman, M., eds.), ACM, pp. 163–166 (online), DOI: 10.1145/3462204.3481771 (2021).
[17] Sun, M., Leite, I., Lehman, J. F. and Li, B.: Collaborative Storytelling between Robot and Child: A Feasibility Study, *Proceedings of the 2017 Conference on Interaction Design and Children, Stanford, CA, USA, June 27-30, 2017* (Blikstein, P. and Abrahamson, D., eds.), ACM, pp. 205–214 (online), DOI: 10.1145/3078072.3079714 (2017).
[18] Tholander, J. and Jonsson, M.: Design Ideation with AI - Sketching, Thinking and Talking with Generative Machine Learning Models, *Proceedings of the 2023 ACM Designing Interactive Systems Conference, DIS 2023, Pittsburgh, PA, USA, July 10-14, 2023* (Byrne, D., Martelaro, N., Boucher, A., Chatting, D. J., Alaoui, S. F., Fox, S. E., Nicenboim, I. and MacArthur, C., eds.), ACM, pp. 1930–1940 (online), DOI: 10.1145/3563657.3596014 (2023).
[19] Wang, Z., Romat, H., Chevalier, F., Riche, N. H., Murray-Rust, D. and Bach, B.: Interactive Data Comics, *IEEE Trans. Vis. Comput. Graph.*, Vol. 28, No. 1, pp. 944–954 (online), DOI: 10.1109/TVCG.2021.3114849 (2022).
[20] Zhang, Z., Xu, Y., Wang, Y., Yao, B., Ritchie, D., Wu, T., Yu, M., Wang, D. and Li, T. J.: StoryBuddy: A Human-AI Collaborative Chatbot for Parent-Child Interactive Storytelling with Flexible Parental Involvement, *CHI '22: CHI Conference on Human Factors in Computing Systems, New Orleans, LA, USA, 29 April 2022 - 5 May 2022* (Barbosa, S. D. J., Lampe, C., Appert, C., Shamma, D. A., Drucker, S. M., Williamson, J. R. and Yatani, K., eds.), ACM, pp. 218:1–218:21 (online), DOI: 10.1145/3491102.3517479 (2022).
[21] Zhao, Y. and Bao, X.: Narratron: Collaborative Writing and Shadow-playing of Children Stories with Large Language Models, *Adjunct Proceedings of the 36th Annual ACM Symposium on User Interface Software and Technology, UIST 2023, San Francisco, CA, USA, 29 October 2023- 1 November 2023* (Follmer, S., Han, J., Steimle, J. and Riche, N. H., eds.), ACM, pp. 119:1–119:6 (online), DOI: 10.1145/3586182.3625120 (2023).

