

Santa Clara University

Scholar Commons

Computer Science and Engineering Master's
Theses

Engineering Master's Theses

6-2023

EMBRIDE: A Madhubani Art Creator

Jui Banik

Follow this and additional works at: https://scholarcommons.scu.edu/cseng_mstr



Part of the [Computer Engineering Commons](#)

Santa Clara University

Department of Computer Science & Engineering
Date: Mar 31, 2023

I HEREBY RECOMMEND THAT THE THESIS PREPARED UNDER MY
SUPERVISION BY

Jui Banik

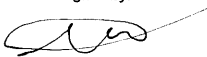
ENTITLED

EMBRIDE: A Madhubani Art Creator

BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

**MASTERS OF SCIENCE IN COMPUTER SCIENCE AND
ENGINEERING**

DocuSigned by:

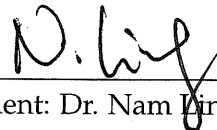


7124333375444A1...

Thesis Advisor: Dr. Margareta Ackerman



Thesis Reader: Dr. Silvia Figueira



Chairman of Department: Dr. Nam Ling

Acknowledgements

I would like to express my deepest gratitude to my supervisor Dr. Margareta Ackerman, who has provided me with extensive guidance, support, and motivation throughout the course of this research. Her insights, encouragement, and mentorship has been invaluable and has significantly contributed to the success of this project.

SANTA CLARA UNIVERSITY

Abstract

Dr. Margareta Ackerman
Department of Computer Science and Engineering

Master of Science

EMBRIDE: A Madhubani Art Creator

by Jui BANIK

Creative machines are playing an increasingly important role in the art world and society at large. This gives rise to the need to consider the ethical dimensions of artistic machine agents. Whose art are we amplifying, or more importantly, who is being left behind? Computational Creativity offers the opportunity to bring awareness and visibility to art forms that have been systemically suppressed due to a range of longstanding societal biases. In this paper, we introduce EMBRIDE, a system that creates Madhubani art, practiced by women in the villages of India and Nepal. We hope that this work will encourage further exploration into computational systems that amplify lesser-known art forms.

Contents

Acknowledgements	i
Abstract	ii
1 Introduction	1
1.1 Background	1
1.2 Representation of Art Forms	1
1.3 Madhubani Art	2
1.4 EMBRIDE	2
1.5 The Cultural Heritage of Madhubani Art	3
2 EMBRIDE: A Madhubani Art Creator	4
2.1 EMBRIDE: Introduction	4
2.2 Implementation	4
2.2.1 Sample EMBRIDE art	5
3 Societal Impact	7
3.1 Introduction	7
3.2 Future Work	7
4 Text to Image Models	9
4.1 Introduction	9
4.2 DALL-E	9
4.3 MidJourney	11
4.4 Conclusion	12
5 Discussion and Conclusion	13
5.1 Discussion	13
5.2 Conclusion	13
Bibliography	15

Chapter 1

Introduction

1.1 Background

Recent years have seen growing interest in creative machines expanding beyond academia. More than ever before, artists¹ are utilizing AI-based methodology in their creative processes, companies such as MORF AI² are bringing greater awareness to AI-based art, and products such as Playform (Playform, 2019) are making it easier to incorporate AI into art making.

1.2 Representation of Art Forms

Most work on creative machines focuses on amplifying well-known art forms. A notable exception in the narrative creation space exception is MEXICA (Pérez and Sharples, 2001), which produces original narratives about the old inhabitants of what today is Mexico City. MEXICA was embraced by researchers from the Humanities and Social Sciences as “a collaborative transnational project that interrogates the cultural and artistic questions that develop from LatinX migration.”³

Discussing the role of cross cultural impact on Computational Creativity, Prof. D. Fox Harrell, MIT, asks “Must computers always express the voice of the colonizer — could a computer instead express the voices of sovereign indigenous peoples, the oppressed, and the otherwise underrepresented?” (Fitch 2018)⁴.

Further, a report of the workshop in Computational Creativity and Social Justice (Gillian Smith, n.d.), which took place during The International Conference on Computational Creativity 2017, highlighted the need to bring awareness of cultural dimensions of CC research:

“Whose voices are represented in our current technologies, and how does this influence the design of CC technologies? How does the (Irani et al. 2010) notion of postcolonial computing relate to CC? How can we infuse our work with respect for the cultural roots of creativity?” (Ackerman and Pérez y Pérez, 2019)

Given the significant impact of creative machines on the art world and its consumers, it is essential to consider the ethical dimensions of this domain. In particular, we argue that we should be cognisant of the voices we amplify, but perhaps more

¹Some of the artists who use AI in their art: Pindar Van Arman(<https://aiartists.org/pindar-van-arman>), Daniel Ambrosi (<https://www.danielambrosi.com/>) and Kevin Mack(<http://www.kevinmackart.com/>)

²<https://morf.gallery/>

³<http://counterpathpress.org/crossborders-the-aesthetics-of-migration-at-counterpath-and-cou-boulder-november-9-and-10-2018>

⁴<http://blog.lareviewofbooks.org/interviews/computational-cognitive-social-talking-rafael-perez-y-perez/>

importantly, those we do not. We believe that one of the ways in which Computational Creativity can positively contribute to society is by bringing greater awareness to the little-known, underrepresented art forms.

1.3 Madhubani Art



FIGURE 1.1: A Madhubani artist creating art

One such art form is Madhubani, which originated about 2500 years ago. Madhubani, meaning “forest of honey,” was traditionally practiced by women from rural regions in India and Nepal. The paintings are characterized by vibrant colors and natural elements, as well as geometric patterns that symbolize love, valour, devotion, fertility and prosperity. Figure 1.1 shows an artist creating a piece of Madhubani art.⁵

1.4 EMBRIDE

In this paper, we introduce EMBRIDE, a creative machine that automatically creates novel Madhubani art. The name “EMDRIDE” is short for embroidery, deriving from the fact that makers of Madhubani art often embroider it on life style products, such as clothing and household items. A sample of diverse patterns generated by EMBRIDE can be seen in Figure 2. Our vision for this project involves empowering and assisting the women of villages in the creation of original Madhubani art.

Here, we bring to light the cultural heritage of Madhubani art and its history of origin. We also discuss how this art has always been a channel to uplift rural women in society and how EMBRIDE can be an agent in this mission. We then discuss the implementation of EMBRIDE and exhibit some of the unique patterns that our system created, visualized in physical artifacts. Finally, we reflect on the social impact and future prospects of EMBRIDE.

⁵Image Source: Used with permission



FIGURE 1.2: Three Madhubani-style designs created by EMBRIDE visualized on pillows and a bed sheet.

1.5 The Cultural Heritage of Madhubani Art

Madhubani art was relatively unknown to the western world until a British Colonial Officer William G. Archer came across these paintings in 1930s while assessing damages caused by a massive earthquake in the Indian state of Bihar. Since then, some of the earliest paintings of Madhubani have been showcased at Victoria and Albert Museum, London.

For generations, these paintings were drawn by women of the households on the inner walls and floor of their homes. The images they used tell stories, often representing their gods and goddesses, fertility symbols, or social commentary on the women's daily lives. (Wadley, 2014) In the 1960s, there was another natural calamity in the form of drought in the state of Bihar, India. Most families depended on agriculture as the primary source of income until this point. At that time, the Indian government encouraged women to transfer their ritual wall paintings on to paper and canvas. That is how the Madhubani art travelled from mud huts to paper. (Laasya Art, 2013) With this, the women took the primary role in generating household income and supporting livelihood. (California and (ORIAS), 2018)

Thus, an art form which was once a ritual became the channel that brought women to the forefront of art renaissance and financially empowered them. However, this art form is now gradually disappearing. There are local ventures by village women such as MITHILAsmita (Craft, 2010), trying to resurrect Madhubani and continue to encourage and empower rural women artists. Yet, they still struggle to reach to mass audiences and access global platforms.

Chapter 2

EMBRIDE: A Madhubani Art Creator

2.1 EMBRIDE: Introduction

EMBRIDE is a creative system that produces original designs inspired by the Madhubani paintings and folk art. This section discusses the implementation of EMBRIDE and showcases several examples of artworks created using the system.



FIGURE 2.1: A sample pattern generated by EMBRIDE visualized on a bag.

2.2 Implementation

EMBRIDE derives from an analysis of Madhubani art. The uniqueness of Madhubani art comes from the use of symmetry and nature-inspired combination of simple shapes. The following basic elements are signified using the geometric elements: Square depicts the earth, triangle with its tip downwards depicts water, triangle that has its tip towards the sky denotes fire, the inner portion of the circle depicts sky and the circumference of the circle is used to denote air.

A variety of pseudo-random subroutines were created corresponding to various positions in Madhubani designs. The creation process starts with EMBRIDE generator script that takes an input parameter representing the choice of pattern. When a pattern is chosen, each layer in the pattern consists of a repeated shape, randomly chosen from a list of options. Whenever EMBRIDE creates, it begins by selecting



FIGURE 2.2: EMBRIDE generated Madhubani-style design and the same visualized on pillow covers : Sample output 1.

from routines for the creation of the center-piece (aiming for a flower-like appearance). For example, one of the subroutines for the centerpiece involved the utilization of fractals, which with their highly repetitive symmetric nature correspond well to Madhubani designs.

The next layer is a dense region where EMBRIDE creates densely positioned geometric shapes. The outermost circumference layer concludes by selection from amongst several pseudo-random subroutines to yield a leaf-like appearance. Color is another important aspect of Madhubani art, which typically utilized bright, vibrant colors. For each sub-layer, a different vibrant color was randomly selected.

EMBRIDE is implemented in Python, using the Turtle library to draw. While at this initial stage the system relies on carefully constructed rule-guided approach, future work will explore utilizing data-driven, machine learning methods to further improve the machines' creative capabilities.

For example, consider the design depicted in Figure 2.2. The center pattern is built using several layers of randomly selected overlapping concentric designs, selecting random shapes and colors to fill in the designs.

2.2.1 Sample EMBRIDE art

We present some example art generated by EMBRIDE. We implemented these EMBRIDE's designs on layouts of home decor products to provide visualization of how artists could utilize this system. Figure 2.2 and 2.3 showcase the original patterns



FIGURE 2.3: EMBRIDE generated Madhubani-style designs visualized on pillow covers : Sample output 2.

made with EMBRIDE and then visualizes them on household items. We have used publicly available visualization tool PlaceIt¹.

¹<https://placeit.net/>

Chapter 3

Societal Impact

3.1 Introduction

It takes significant time and effort to create new patterns and designs in Madhubani style. The high investment makes it challenging to compete in the quickly-changing market of garments and household items. Using EMBRIDE, artists can experiment with original ideas at a greatly increased rate. They can further visualise the designs generated via EMBRIDE (as we have done in Figures 1.2, 2.1, 2.2 and 2.3) before investing into creating the hand-made products, thus saving time, resources and raw materials.

Startups and social enterprise such as iMithila (Nair, 2017) and pehnavacraft (Maurya, 2022) may utilize EMBRIDE in the creation of their designs. This could expedite the creation processes, potentially to the success of such enterprises.

MITHILAsmita (a recipient of a UN Women WEPs Award, 2020) works with underprivileged rural women communities of artisans, weavers and tailors to create world class handmade products, thus alleviating poverty, as well as presenting the best of Indian art and craft by traditional communities to the world (Craft, 2010).

We envision helping such social entrepreneurs and their artists with new original designs via EMBRIDE and thus help them bring traditional women's art into mainstream merchandises, such as home products, museum merchandise and lifestyle products.

3.2 Future Work

In the future, we would like to endow EMBRIDE with co-creative capabilities. This would give artists flexibility to customize their choice of design or patterns according to the story that they want to convey through the artwork. EMBRIDE could then be seen as a collaborator for artists providing them original ideas while alongside helping them curate art as per their style and theme.

To help women artisans make the most of the EMBRIDE tool we could provide training programs to guide artisans on how to use the tool. We could further add capabilities that would allow EMBRIDE to be personalized to the unique style of individual artists, incorporating machine learning methodology that would learn from their styles. Lastly, we could also implement monitoring and evaluation systems to track the tool's impact, gather feedback, and make necessary adjustments to training and support programs. These measures could help women artisans to effectively use the EMBRIDE tool, aiding with economic empowerment, preserving the traditional art, and reaching a wider audience.

We conclude this section with a brief story that captures our aims. Coming from the poor mallah (fisher folk) community working as domestic help before being an

artist, Dulari Devi shares, “While doing my routine cleaning chores I used to observe them painting these beautiful, intricate works of art and many a time used to wonder whether they would teach me as well. So one day I asked Karpuri Devi outright. To my great surprise, she readily agreed! In an instant, I was transformed from a daily wagger to an artist.”(Ahmed, 2014) By uplifting the women in villages in pursuing their dreams, we uplift society as a whole. We hope that EMBRIDE can play a small part in helping women in these communities move from poverty to financial freedom through meaningful, artist work.

Chapter 4

Text to Image Models

4.1 Introduction

The creation of Embride concluded in March 2022. After the work for this thesis was complete, the end of 2022 saw an awakening of Generative AI, with the introduction of text-to-image models such as Dall-E¹ and Midjourney².

Text-to-image models create images based on user provided 'prompts'. These prompts are natural language descriptions of the images that the user seeks to create.

In this section, we briefly explore the utility of commercially available image generators for the creation of Madhubani art.

4.2 DALL-E

In order to understand its usage, we started by giving DALL-E prompts to create Madhubani art designs on a pillow. Hence, we formulated the following prompt: "madhubani art on pillow yellow color trees". Then we explored variations on the prompt. For example, changing the color to silver and adding the term 'story' to the prompt indicating that we expect the design to represent a story. And so, the new prompt was created as: "madhubani art on pillow story silver color".

Sample outputs of Madhubani art created by using DALL-E appear in Figure 4.1. As we can see, DALL-E is able to produce interesting Madhubani designs.

¹<https://openai.com/product/dall-e-2>

²<https://www.midjourney.com/home>

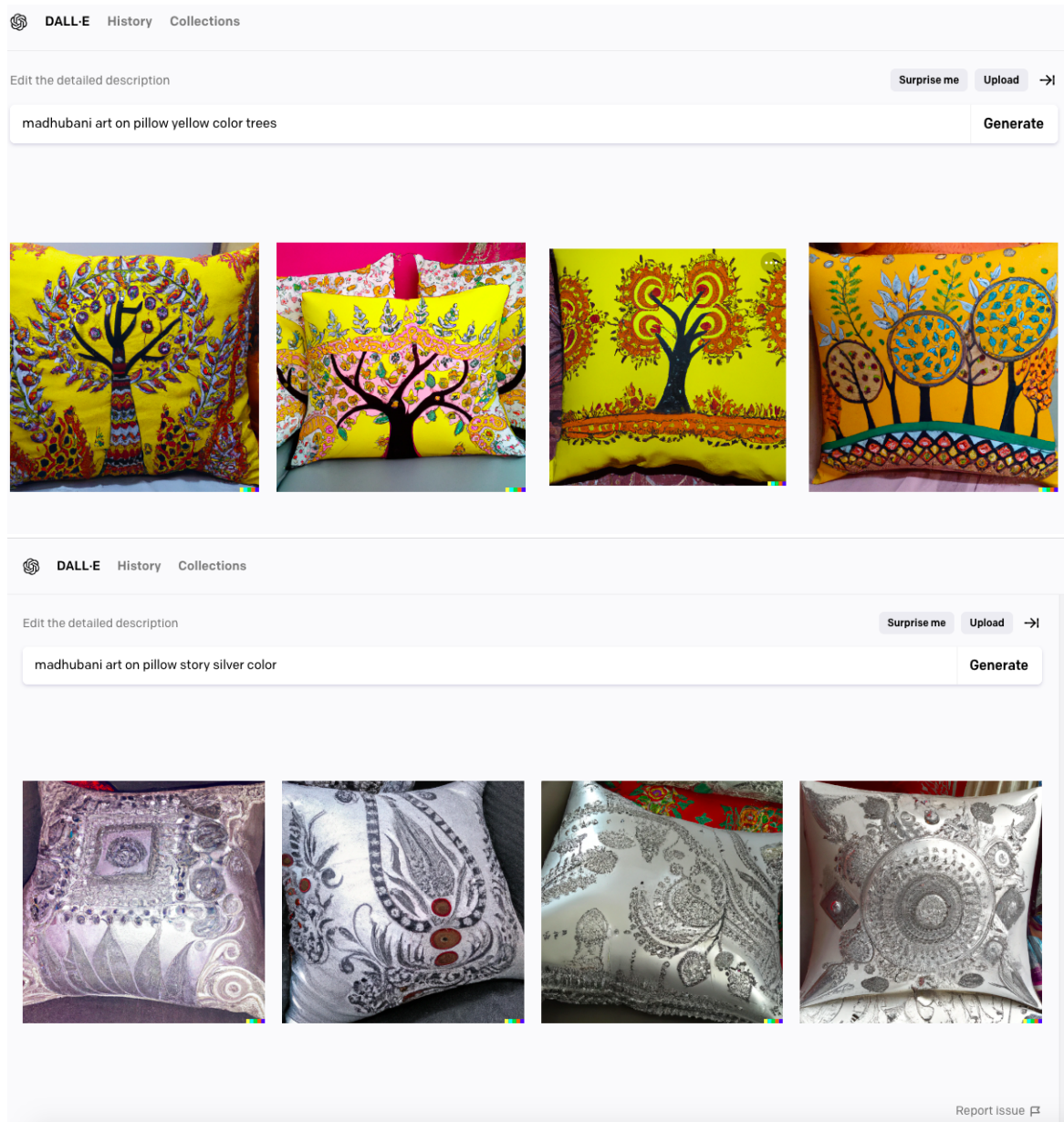


FIGURE 4.1: Madhubani designs created via DALL-E

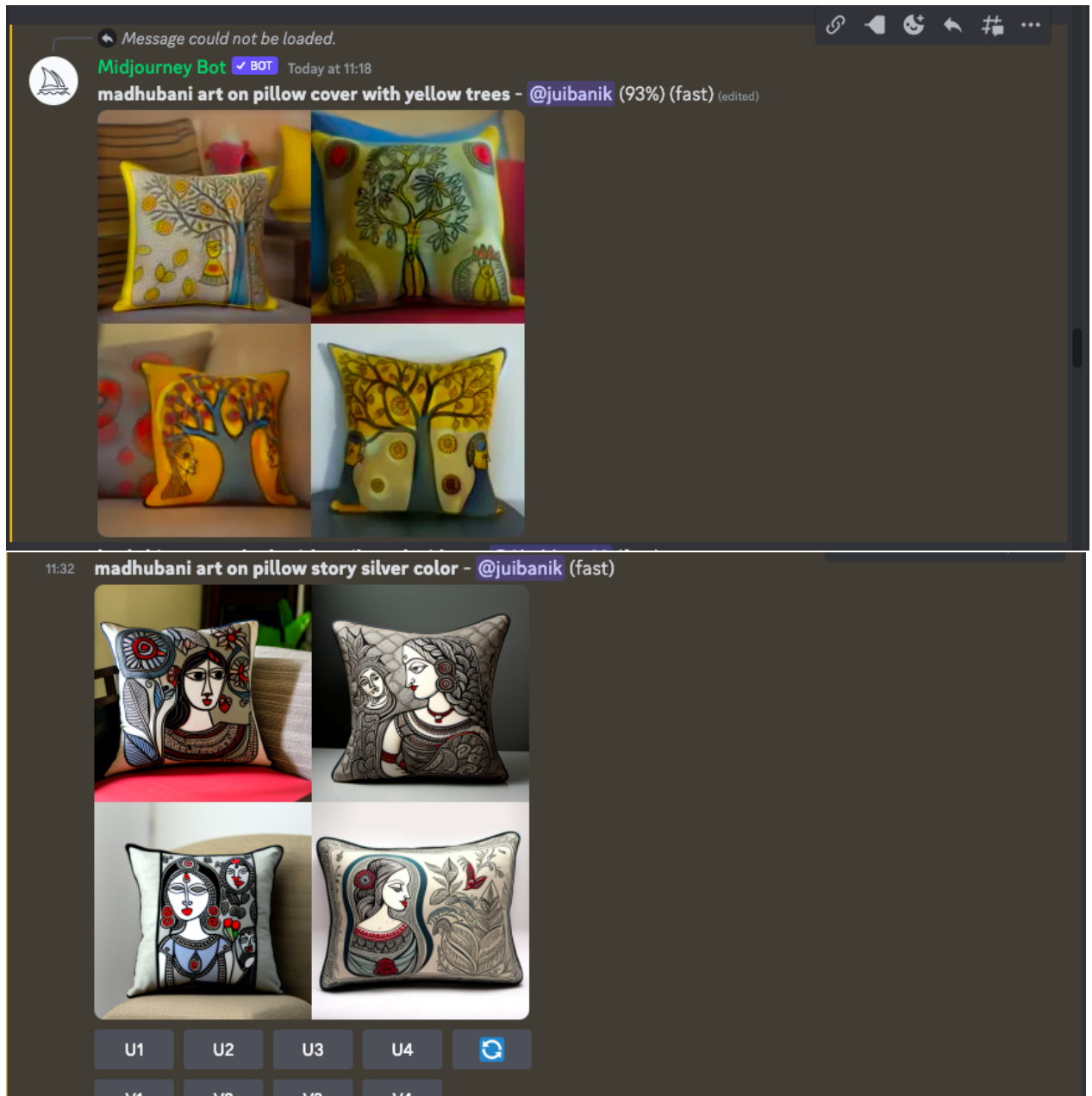


FIGURE 4.2: Madhubani designs created via Midjourney

4.3 Midjourney

We also explored the use of the system Midjourney towards the creation of Madhubani art. Midjourney is an AI program that uses Discord bot to provide an interface to generate unique images via short text description. To create prompts in Midjourney, we use the '/imagine' command followed by a text description in the prompt field.

We reused the prompts built earlier for testing DALL-E, giving these prompts to Midjourney. Figure 4.2 shows the resulting art. The results of both systems we tested are comparable in quality.

4.4 Conclusion

The aforementioned observations provide validation for the potential utilization of generative AI models as a means of promoting creativity. These models have the capacity to assist artists in the exploration of imaginative concepts for their subject matter.

An additional perspective to consider is that the outputs generated by these models possess aesthetic value, rendering them as pieces of art in their own right. This leads to a larger debate regarding the potential impact of artwork created by generative AI models on the creative pursuits and livelihoods of traditional artists.

Chapter 5

Discussion and Conclusion

5.1 Discussion

In this paper, we introduce EMBRIDE, a tool that creates art inspired by Madhubani artwork from India and Nepal, traditionally made by women of the region. EMBRIDE is a creative system designed both to preserve this ancient art form as well as extend global reach to the women from the villages of India and Nepal.

As creative machines become more integrated into society at large, we have an opportunity to make the art world more inclusive. There is also an opportunity to utilize Computational Creativity to create a positive impact on society by uplifting struggling artists. This can be achieved by intentionally using these agents to amplify the voices and styles of lesser known art forms, as well as actively helping members of the corresponding communities through the use of creative machines.

5.2 Conclusion

Art has the power to inspire, challenge, and shape our understanding of the world. It is an essential form of expression that has been present throughout human history. Yet, not all artists receive the same level of recognition or support. With the introduction of computational creative systems like EMBRIDE and MEXICA, we extend a call to the research community to leverage creative machines as a means to support the voices of lesser known communities, provide inclusion to non-western regions, and uplift the local cultural heritages in the fields of music, visual arts and other creative domains.

One way in which such creative systems or generative AI tools can support these artists is by providing a platform to showcase their work. By building a CC system on the artist's style, it can generate new pieces that capture the essence of the artist's vision.

Another way in which such CC systems can be employed is by serving as a tool to facilitate collaboration between artists. Collaborative projects can be challenging, particularly when the artists involved have distinct styles and visions. In future work, we can build CC systems that are capable of generating new pieces that combine their unique styles. This can serve as a starting point for further collaboration and exploration.

Such creative systems may also be regarded as a valuable tool that facilitates the creative process by circumventing the well-known affliction of "artist's block." This is akin to the practice of artists and photographers visiting natural settings, populated areas, or galleries to gain inspiration and insight from the real world or the works of other artists.

It is worth noting that the use of generative AI tools should not be seen as a replacement for traditional artistic methods or as a means of automating the creative process. Rather, it should be viewed as a tool that supports and enhances the artist's vision, providing new avenues for exploration and creativity.

As of late, the world is seeing a proliferation of widely accessible creative systems, particularly text-to-image models such as DALL-E and MidJourney. As we have shown in the previous section, such systems are able to create high quality Madhubani art. However, specialized systems for specific art forms remain valuable. Specialized systems can allow for greater degree to human-machine collaboration than is enabled through large text-to-image models, allow meaningful collaboration between multiple-people, and even have the potential for higher quality. (Maithra Raghu (Samaya AI), 2023)

It is important to ensure that the use of creative systems does not perpetuate existing power imbalances in the art world. It is crucial to consider the potential impact of these tools on artists from marginalized communities and ensure that they are not further excluded or marginalized as a result of these technologies.

In conclusion, the use of generative AI tools can have a significant impact on supporting lesser-known community artists. By providing a platform for exposure, facilitating collaboration, and aiding the creative process, generative AI models can contribute to a more diverse and vibrant art world. However, it is important to approach this technology with caution and ensure that it is used in a responsible and equitable manner.

Bibliography

- Ackerman, Margareta and Rafael Pérez y Pérez (2019). "Field Work in Computational Creativity". In: *The International Conference on Computational Creativity*.
- Ahmed, Tahir (2014). *How Madhubani Art Is Undergoing A Transformation – By Women Artists In Bihar!*
- California Berkeley, Office of Resources for International University of and Area Studies (ORIAS) (2018). *Mithila Painting: Folk Art of India*. (Visited on 04/02/2022).
- Craft, MITHILAsmita Art (2010). *MITHILAsmita*. (Visited on 04/14/2022).
- Gillian Smith Dan Brown, Anne Sullivan (n.d.). *Computational Creativity and Social Justice: Workshop Report*.
- Laasya Art, San Francisco Bay Area (2013). *FROM MUD HUTS TO PAPER: THE STORY OF MADHUBANI PAINTING*. (Visited on 04/02/2022).
- Maithra Raghu (Samaya AI) Matei Zaharia (Databricks), Eric Schmidt (Schmidt Futures) (2023). *Does One Large Model Rule Them All?* (Visited on 04/04/2023).
- Maurya, PehnawaCraft Studio: Adarsh Maurya Pratima (2022). *About Us: pehnawacraft.com*. (Visited on 04/17/2011).
- Nair, Sharika (2017). *This mother-in-law – daughter-in-law duo is helping Madhubani artists earn well through iMithila*. (Visited on 04/17/2011).
- Playform (2019). *Playform : Create Art with AI*. (Visited on 04/16/2022).
- Pérez, Rafael Pérez y and Mike Sharples (Apr. 2001). "MEXICA: A computer model of a cognitive account of creative writing". In: *J. Exp. Theor. Artif. Intell.* 13, pp. 119–139. DOI: 10.1080/09528130010029820.
- Wadley, S.S. (2014). *South Asia in the World: An Introduction: An Introduction (1st ed.)* London and New York: Routledge.