

MultipliCity, a case study in generative AI-assisted immersive illustration workflow

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Abstract— It is timely to consider the possibilities of new workflows to integrate generative AI with illustration in ways that do not displace the enjoyable visual-centered aspects of the illustrator's work. We consider this problem in the special case of immersive drawing and illustrate it in the case of MultipliCity, an installation exploring and representing the interplay between myth and reality in urban environments, specifically focusing on Venice.

Keywords—generative AI, equirectangular panoramas, illustration, virtual reality, drawing

I. INTRODUCTION

It is likely that illustrators will be compelled to integrate AI into their workflow somehow. A worst-case scenario would be replacing handmade drawing with textual prompting as a main skill. Illustration is a visual art that involves visual thinking, and we would like it to remain so. Our great concern is ensuring this integration is done in a way that enhances rather than replaces the discipline of handmade drawing and painting. Artists must cooperate with engineers to guide the tools in a desirable direction. In this paper, we explore this idea in our own specialty of illustration, which is particularly technical and carries its specific characteristics: that of immersive illustration using spherical perspectives and VR panoramas.

II. NEW HYBRID WORKFLOWS IN ILLUSTRATION

A. *The purpose of illustration*

Illustration has always walked on a tightrope – on the one hand it is a commercial artform, bounded by tight deadlines and external requirements for profitability; on the other it has always been a work of passion and creativity and one of the great expressive avenues for the human skills of drawing and painting. One can view illustration as a job aiming to create

consumption images. This is strictly correct. But we might as well take the viewpoint that illustration's main point of interest is that it is a commercial vehicle that finances one of the worthwhile endeavors of the human spirit – in this view, the main thing produced is not illustrations, but illustrators. Drawing can be seen as a mode of thinking supported by a skill set developed and transmitted by multiple generations on a chain akin to a genetic lineage. In this view, illustrators are not just commercial makers of pictures – they are the bearers of one of the torches of the human spirit, and the existence of this knowledge and this mode of thought is something that enriches us all, even those who do not partake in it directly but only infer its existence from the enjoyment of the products it creates. In this view, we take pleasure in illustrations not just because they look pretty but because it pleases us to know that other humans – like us – exert their abilities to the utmost in a way that makes us proud of being human, just as we ourselves may dignify our humanity by expressing it in some other creative way, being engineering, science, chess playing or sports. Let us put it this way: the value of the Renaissance is not that it produced Brunelleschi's dome but that it produced Brunelleschi. And our pleasure in visiting the dome is not that it has such splendid structural properties but that it reassures us of our value as humans, even if we ourselves are no Brunelleschi.

So, in the case of illustration – as in fact in many other such human activities – there is a delicate balance between the legitimate needs of the commercial activities that finance the artist and the preservation of the deeper aspects of the art form. The insertion of AI-generated imagery – like many technologies before, photography, for instance – risks breaking this delicate balance. Drawing may be

replaced by textual prompting as a main creative tool of illustration – and this may happen whether or not the AI imagery is better than the human-generated one; all it takes is that it is judged good enough by the clients and publishers so that whatever originality and creativity is lost is deemed compensated well enough by speed and convenience. This may happen by sheer market force, even if not desired explicitly by any specific client or publisher. One can easily imagine a scenario where drawing can no longer compete in terms of speed and convenience with text prompting and gets replaced with it, even if the generated imagery never reaches the same quality level as the best human illustration. The number of images created would certainly not decrease; quite the opposite; one expects imagery to multiply to the point of a market glut, but how much poorer the experience of creating them is! Prompting is mainly a verbal, not visual, activity, and what a poor verbal activity usually is! It is mostly very poor, disjointed prose, a guessing game with no intrinsic beauty, but is strictly goal-oriented. The promise of AI that it would allow for natural conversation instead of programming may be true in LLMs, but is not the usual experience of AI image generation. Textual prompts are like blind probing for the hidden knobs inside a black box. They are often filled with ugly pseudo-technical terms of doubtful effect, like so many dark incantations. Take this gem of anti-poetry by an AI prompter using Midjourney [1]:

maze, Narrow, steep staircase, Old Building, Floating buildings, Urban, City rain, art by Miyazaki and Ian McQue and Akihiko Yoshida and Katsuya Terada, colorful, trending on artstation, gorgeous, ultra-detailed, realistic, 8k, octane render, hyper-detailed, cinematic

It is hard to see an improvement in the human condition when instead of taking classes in drawing – or 3D modeling, or even programming – one takes instead classes on “prompt engineering”, which is to say, on begging the machine for favors, especially when the “techniques” involved are not stable nor translatable nor deep nor developed enough to be called either an art or a science (it is hardly clear whether some common tokens such as “50mm lens, 8k, hyper-detailed” are effective or just cargo cult superstitions).

III. IMMERSIVE ILLUSTRATION

Immersive art has a long history that we will not recap here, from the 19th-century panoramas to VR

(see, for instance, [2], [3]). We will only refer to the special case of the more recent type of immersive illustration done with the help of spherical perspective drawing. This is a drawing discipline that has hijacked the tools of spherical photography. Spherical photography stitches several photos to cover a full “360” view from a fixed spatial point. They usually store the stitching as an equirectangular projection that carries all the visual information. This image can then cover a virtual sphere to allow immersive visualization of the photographic content in VR or on a screen. Immersive illustrations work by drawing directly onto the equirectangular projection. Then, the drawing, just like a spherical photograph, can be visualized in VR. Of course, this requires the artist to know how to draw while considering the peculiar perspective deformations that the equirectangular projection causes. This has been formalized into a specific type of perspective called spherical perspective [4]. Recently, not only equirectangular [5] but also azimuthal equidistant [6] and cubical perspective [7] have been formalized and can now be learned as technical drawing methods. However, most artists just draw using fixed grids and other ad-hoc methods or just by their intuitive knowledge of the perspective’s geometry.

A. The effects of AI on Immersive Illustration

The pressure to integrate AI is felt in immersive illustration, and the authors have experienced it personally. The first author is an experienced professional illustrator working in this field for many years ([8], [9]) and the second author has been deeply involved in this formalization of spherical perspective drawing as well as in the development of immersive drawing software. Both authors are enthusiastic about the potential of AI. Still, they are concerned that their field – currently based on a foundation of handmade technical drawing – will be rendered not obsolete but less interesting by relegating the artist to the position of prompter and art director, thereby not robbing him of the job exactly (the main worry in the art field today) but making that job less satisfying by pushing it far from its visual foundations.

There are several ways in which AI can render immersive illustration less interesting, the main ones being:

1. By negating the use of drawing, relegating the artist to a cycle of textual prompting

and evaluating AI proposals, more an art director than an artist.

2. By negating the need for perspective knowledge through interfaces that do not require or profit from it.

Point 2 sounds strange to outsiders. There have been considerable efforts in software interfaces to eliminate the need for perspective knowledge [10], [11]. However, for many immersive illustrators, understanding the perspective is both interesting and leads to its form of visual expression [12], [13].

The installation described in the present work is a first exploratory step in a program – to be implemented as a Ph.D. dissertation by the first author under the second author’s supervision – on how to go a different way: how to develop artistic workflows that integrate AI techniques to enhance rather than replace the art of handmade drawing in the specific context of immersive illustration.

B. Current platforms for Immersive Illustration

The installation described ahead uses Skybox AI, a generative AI from Blockade Labs that specializes in generating equirectangular panoramas. Let us describe the tools currently available to the immersive artist in the generative AI field to explain our platform choice.

A 360° illustrated environment has a higher complexity than a normal image: rules of composition have to be concerned with object disposition around the viewer, details are usually numerous, and the resolution must be larger than a normal image because in the process of re-projecting a spherical image onto a screen, the viewer watches only a small part of the image at a time, and each such part must have enough resolution to fill the screen with adequate detail. Thus, combined with a specific spherical projection format in which those illustrations must be done to work properly (usually the equirectangular projection), this limits the number of Generative AIs up to the task.

Dall-E can be used to create an immersive image by generating six views (one for each cube face of a cube map) with six text prompts, assembling and patching utilizing a combination of inpainting techniques and exporting the portion of the image through a panoramic patching software (Pano2VR). Kevin Holer explains the process in detail [14].

nVidia GauGAN 360 [15] [16] is a highly intuitive tool to help artists create virtual worlds from scratch. It

converts scribbles into realistic spherical panoramas, allowing users to draw their segmentation maps and manipulate the scene on an equirectangular or cube map image, updated in real time. Each drawn area is labeled with material labels like sand, sky, sea or snow rendered in the generated output. However, there was no way to integrate this interface with detailed handmade drawings as a prompt, and the results were too painterly for our purposes; we wished for a more drawing-like look for both input and output.

Midjourney can generate panoramic seamless images by using a text prompt and setting the following parameters: “2:1 aspect ratio”, the same ratio of an equirectangular image, and “tile,” to get seamless images for a tiling pattern.

The generation of an equirectangular image in *Stable Diffusion* was done with Deforum on Google Colab. The only parameter that can be set for panoramas is the aspect ratio 2:1.

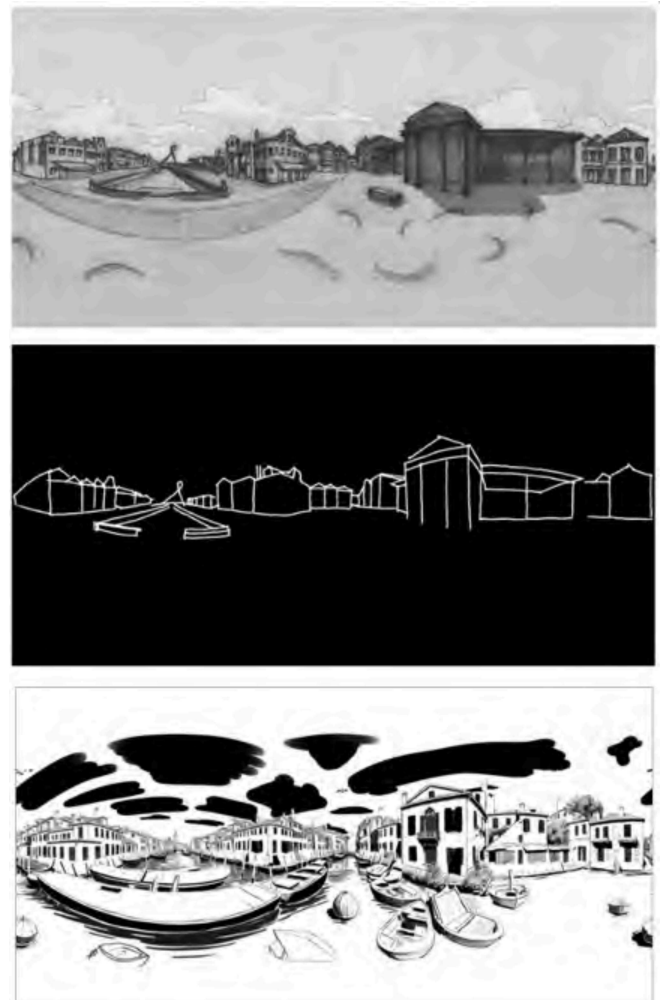


Fig. 1. Top: Equirectangular drawing of Praça do Peixe in Aveiro, Portugal. Center: Control image traced from the original drawing. Bottom: The image was generated from the control image, and a text prompt was given by the Skybox AI from Blockade Labs. All illustrations in this paper are © Chiara Masiero Sgrinzatto.

Both models fail to solve the spherical geometry: it happens that the horizon is not in the vertical center of the image, or that the distorted areas at the zenith and nadir are not rendered at all, or are rendered in another projection, or the tiling fails. The generated image is 1024px wide for Stable Diffusion and 1500px wide for Midjourney, and it needs to be processed through an upscale to be viewed as a VR panorama at a sufficient resolution on a modern screen. The control over the composition is mostly non-existent, although, in Midjourney, it is possible to highlight and change some areas of the image during the generation process.

By contrast, *Skybox* by Blockade Labs [10] is a model based on Stable Diffusion but specially trained for generating spherical images [17], capable of generating 8k equirectangular scenes from text prompts with various styles. It also creates depth maps of the generated panorama.

It is possible to enhance the generation by drawing directly on the tridimensional space in the web app or by adding a *control image* when using the API service. This last aspect made it possible to integrate visual prompting suitably to our purposes.

The API version of *Skybox* Blockade Labs was used for the installation to ensure reliability in the spherical geometry, the high resolution of the generated image, and the possibility of using handmade drawings to influence the composition. Explaining the spherical drawings done during the sketching campaign through the control image feature was possible. The drawings were stylized, obtaining a white sketch on a black background fed to the model as a visual prompt and textual. Access through the API, mediated by Node.js, was another strong point, as it allowed for programmatic variations and systematic tests in prompt and control image variation.

IV. MULTIPLICITY

A. Overview

MULTIPLICITY is a phygital immersive installation in which hand-drawn 360° panoramas and generative AI are key elements in exploring and representing the enigmatic interplay between myth and reality in urban environments, specifically focusing on Venice.

Places, content, and narratives are combined to create a circular, complex relationship between these elements. Pairs of hand-drawn spherical panoramas establish identification and correspondence between

specific locations in Venice and their analogs in a series of parallel cities. The AI imagines the "invisible" third layer, where the machine's interpretation of the mythical environment is given and combined with the artist's one. The AI takes the role of a working partner in a dialogue rather than a replacement for the artist.

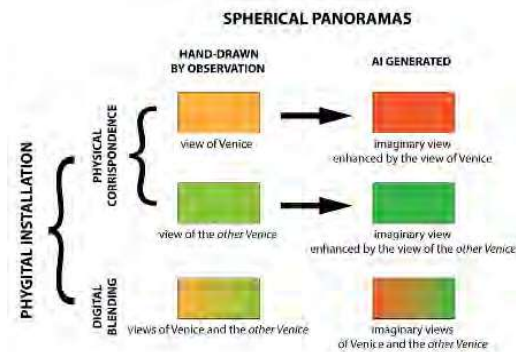


Fig. 2. Workflow diagram.

The installation includes a series of paper-printed so-called *trptychs*. The name refers to the three-pronged workflow that generates them, not to the number of pictures; in fact, each "trptych" consists of four spherical pictures displayed through mini-domes, each consisting of: 1. a view from Venice, 2. a corresponding view from another view city (recognized as another Venice), 3. two AI-generated panoramas obtained from the two hand drawn views by a cross-interaction that will be described ahead. All four panoramas have a QR code leading to the corresponding virtual world content. Visitors are invited to walk through the mini-domes, stop, and observe each of them and their cross-correspondence. They can then enter the virtual layer through their smart devices to complete the experience.

B. Concept of the exhibition: Mythical cities

Across History, a number of cities have acquired a powerful mythological allure that turned them into "eternal cities." They have become icons of the past, a pride of the present, and a simulacrum of themselves in the future. Mythical cities can bewitch the visitor and impress themselves powerfully in his eyes and heart. One of the most famous among them is Venice. When observing Venice, different mythological layers can be identified.

Venice is a myth for its physical dimension, for the water which overcomes land, its little calli, its bridges and gorgeous buildings, and its nature as a dual city – the one in the air and the one reflected in the water; and still yet for its History and that of its people, for the will of Doges that made it to resist over time as a water city, for its majestic identity, its story of harbors

and travels and far away markets, its decay and today's gentrification. And finally, it is a Myth because of the narrative it created for itself or others created about it in Literature, Music, Painting, Theatre, Video Games, Cinema, and even Science.

The power of mythic cities is so strong that the ones who visit that place start to wear an unconscious new pair of glasses. This is why they can still see Venice in Amsterdam, Aveiro, Stockholm, and hundreds of other places worldwide.

MultipliCity aims to investigate how this extraordinary inspiration takes place, how places can influence inhabitants or visitors, and how these, conversely, develop a different view, perception, and interaction in other places. In the game of perspectives this research considers, one further layer is added: the Artist dialogues with the Observer and the Machine. In an extreme contemporary provocation, the artist asks the AI to open a third eye to provide an additional glance and interpretation of Venice-the-Myth.

C. Technologies, Techniques, and Workflow

In *MultipliCity*, the artist combines 360° hand-drawn immersive panoramas with generative AI algorithms to explore and depict the interaction between myth and reality, merging and creating a dynamic relationship between places and their stories.

The correspondence of specific places in Venice and a series of parallel cities is represented in pairs of hand-made equirectangular drawings. The artist represents real locations through on-site drawing, a panoramic post-production process, and little adjustments in the composition when urban elements of daily life disturb the view.

The AI generation process is enhanced with hand-made sketches with data about Venice and the other Venices worldwide. The prompt considers the description of the hand-made panorama representing Venice and the corresponding one concerning the other locations.

The exhibition comprises triptychs (as mentioned above, sets of 4 paired pictures). The elementary operation at the basis of the triptych creation is an interaction between the human artist and a generative AI, in this case, the Skybox AI by Blockade Labs. The process is as follows (refer to Figure 1):

1) *The artist begins by making a handmade equirectangular drawing on location (Figure 1 - top).*

2) *The artist traces the original drawing to make a schematic "control image" (Figure 1 - center), that is, a white-on-black linear interpretation of the panoramic*



Fig. 3. An alternative control image for the drawing of Figure 1. *drawing that keeps only the main structural lines, as judged by the intentions and purposes of the artist.*

3) *The control image is fed into Skybox AI via its API and a text prompt, generating a new image (Figure 1 - bottom).*

This process results in a pair of related images – a handmade drawing and an AI-generated image – in a way that is deeply mediated by drawing (Figure 2). The original drawing, of course, preserves the main features of traditional illustration – it is entirely under the control of the artist, who not only draws but *chooses*, for choice is the main conventional illustration activity; the illustrator doesn't draw what is merely seen, but must choose what to emphasize, what delete, what to stress, resulting in a plethora of major and minor adjustments in the composition, elimination of extraneous elements, and so on, for compositional and general artistic effect.

This process of choice is again present in the second step when the control image is "traced." The control image is a black and white picture (white lines on a black background), sized at 2048x1024 pixels, to be fed along with the text prompt into the API of the Blockade Labs Skybox AI as a control image – a visual prompt. Here, too, there is an ample avenue of choice for the artist. One does not simply trace the main lines of a drawing, and one *decides* which lines are the main lines. There are many choices of "main lines" that one could make as well as the level of detail with which they are drawn, from the simple lines of Figure 1 (center) to the sketchy lines of the alternative control image of Figure 2. One can change details at will, remove or emphasize elements; one could even simply invert the brightness of the original sketch and supply the whole original picture as a control image. The possibilities here are a whole territory in themselves.

Having established this main process, the workflow for the creation of the images in each triptych is a variation as follows:

1. The artist scouts one of the Venices, chooses a location, performs a handmade drawing of an equirectangular image from on-site observation, and races the stylized control image of the panoramic drawing. Further, the artist writes a textual prompt describing the location of the first drawing.
2. The artist finds a corresponding location in the (original) City of Venice and once more draws a panorama on location, draws its sketch map, and describes the location as a text prompt.
- 3A. The control image of the Venice location and the text prompt of the other location are fed into the AI to generate a new panorama that mixes the two.
- 3B. The control image of the other Venice location and the text prompt of the Venice location is fed into the AI to generate a new panorama that mixes the two.

In this way, a triptych of interactions is established between the pictures of the two locations crossmatched with their prompts, between the cities themselves, and between the artist and the AI. In this interaction, the practice of drawing is essential for communication. For this reason, the textual prompt has been kept deliberately simple. For instance, in the drawing of

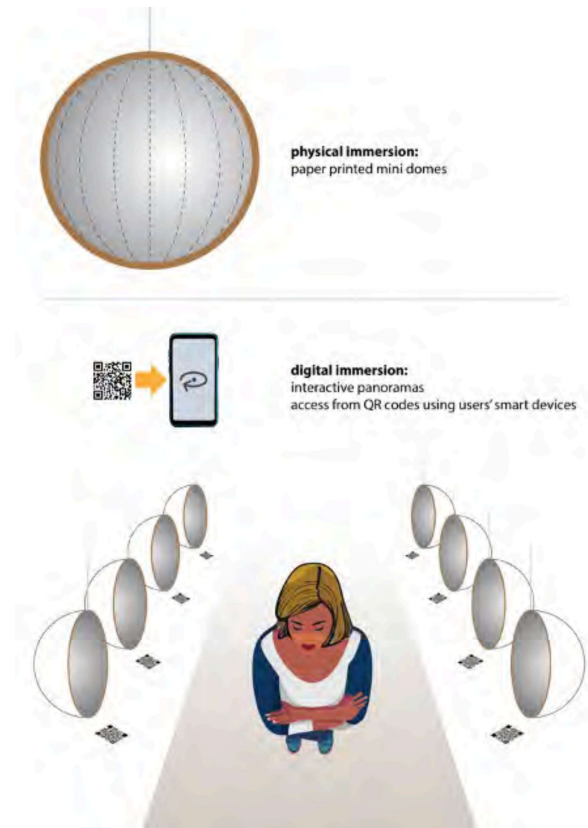


Fig. 4. Top: Images are displayed in hemispheres. QR codes link to the VR view. Bottom: Arrangement of the hemispheres.

Praça do Peixe in Aveiro (Figure 1), the corresponding prompt is simply “a view of Aveiro,” which was cross-matched with a picture of Venice whose prompt was simply “a view of Venice.” Much more than the prompt, the interaction was dominated by the drawing process and the choices it entails.

Once the triptych images are created following the above process, they are not presented directly as an exhibition of equirectangular drawings or VR panoramas. Instead, they are presented as a physical/digital hybrid arrangement of anamorphic mini-domes with QR codes linking to the VR views (Figure 4). Each picture is made into a hemispherical anamorphosis. That is, it is made to cover the inside of the physical hemisphere like the VR pictures cover the inside of virtual spheres. An ideal observer in the center of such a sphere would have the illusion of seeing the real environment. Since the hemispheres are small and the user is not located at the center, there will be some perception of visual deformation. However, the observer still has the sensation of seeing a very natural wide-angle view of the location.

The artist builds the hemispheres as mini-domes using embroidery tambourine instruments and the paper origami technique. The equirectangular images are converted into an interrupted sinusoidal projection

[18], printed, laser-cut to ensure a perfect shape, and assembled into mini-domes to achieve an anamorphic illusion of a wide semi-panoramic view (Figure 5 - top).

The mini-domes are then assembled on both sides of a corridor. Visitors are invited to walk through the hanging domes, finding the possible points of connection between the corresponding pairs of immersive environments. (Figure 4, Figure 5).

The QR codes provide the installation's virtual dimension. All panoramas are available for fully immersive view in virtual form, reachable through the QR codes on each hemisphere, and can be explored by visitors with their smartphones or tablets. Virtual environments enable the visitor to see the full panorama that is only partially visible in the physical hemispheres.

D. Exhibition Venue and Contents

MultipliCity was publicly displayed in the collective exhibition *Circuitos* in the context of the XI Doctoral Retreat in Digital Media Art of the Doctorate in Digital Media Art, a joint degree of Aberta University and Algarve University, in Portugal. The exhibition occurred from 16 to 19 July 2024 at a temporary gallery space at Aberta University in Lisbon (Figure 5).

The installation was placed at the intersection of two spaces - the auditorium foyer and the bar, where the space narrows slightly to form a hallway that facilitates the experience.

Four pairs of spherical drawings were exhibited, corresponding to the following pairs of locations:

- 1) *Venezia. Via Garibaldi – Aveiro. Praça do Peixe.*
- 2) *Venezia. Piazzetta San Marco – New York City. Madison Square Gardens.*
- 3) *Venezia. Calle Larga San Giacomo dell'Orio – Amsterdam. Oudezijds Voorburgwal.*
- 4) *Venezia. Giudecca, Molino Stucky – Stockholm. Södermalm, Münchenbryggeriet.*

The exhibition concept can be implemented in many ways and with varying numbers and locations. The choice above was influenced by the exhibition venue's spatial characteristics and the aircraft transportation portability constraints.

The archive of material that the exhibition produced is collected in a virtual tour, accessible online via computer, tablet, smartphone, and HMDs [12].

V. TOWARDS A HYBRID WORKFLOW FOR IMMERSIVE ILLUSTRATION

MultipliCity represents a first step towards investigating hybrid human-AI workflows in immersive illustration through artistic practice. It was created in the context of a Ph.D. thesis plan in Digital Media Arts to be developed by the first author under the supervision of the second. In future work, we intend to investigate the possibility of a fruitful interaction with AI. What would that entail?

In terms of technology, we would desire to use open-source tools. This is not only for cost reasons – after all, digital illustrators have used commercial tools at great cost, even for marginal performance



Fig. 5. MultipliCity installation at the *Circuitos* exhibition, held at Aberta University, Lisbon, 16 to 19 July 2024.

benefits – but also because of a special need to control both configurations and the user’s data. This poses problems as the current best model, although it can be accessed through a convenient API is not open source and cannot be subject to the desired changes or customizations. Also, the requirements for training such a model from scratch are beyond the abilities of

the individual artist, at least as done in this case. However, it would be interesting to see how far one can go with relatively low-budget options such as DreamBooth [19] Low-Rank Adaptation (LoRA) or the more recent Weight-Decomposed Low-Rank Adaptation (DoRA)[20], which brings the promise of bridging the gap to full fine-tuning at greater efficiency. As we write this paper, a new open-source generative AI is available – 360Panolmage (See [21], [22]) based on Stable Diffusion, and might be a worthy alternative or a starting point to be refined further.

More than technology, we are concerned with objectives. It is easy to be led by the nose and forget what one’s purpose is, instead adapting to whatever is available. We must remember that our purpose is to preserve drawing, rather than textual prompting, as the main activity of the illustrator.

This may require *more* (but different) text prompting. A big limitation of Skybox and all the other panorama generators is that the “discussion” with the AI does not resemble the conversation with an assistant artist. One simply feeds prompts and gets results. It does not have the nuance found with LLMs such as ChatGPT, the sense of easy back and forth. One might look forward to a general-purpose LLM that can draw – interacting through elaborate conversation rather than the more propitiatory, one-sided prompts that are the usual interaction with diffusion models. The latest version of ChatGPT already does that upon request, but the output is Dall-E panoramas, which, for now, are lacking in quality.

In general terms, one would wish that AI would take up the drudgery and leave us more time for the creative aspects, while the direction has been the exact opposite lately. It will do us no good to have surplus production of images if our new job is in the lithium mines or, less dramatically, if it is a drudgery of bad prose.

The most significant negatives of AI for our field are, on the one hand, the removal of drawing from center stage and, on the other, the removal of the discipline of perspective itself.

It is desirable that the interface is both heavily drawing-based and understands the language of spherical perspective with its characteristic constructions, special notions such as antipodal vanishing points, and its symmetry groups. Then, communication could motivate and use the illustrator’s

perspective knowledge and ability to communicate visually.

AI could help with the undesirable aspects of panorama drawing, such as handling extreme deformations near the zenith and nadir or covering surfaces with textures, which must suffer deformations that are very difficult to attain by hand. Here, annotations such as in GauGAN 360 might be the direction to follow.

AI could be the most help outside the confines of image generation itself. A big hindrance to equirectangular drawing is the hassle of scanning and preparing the drawing to be seen in VR – a trivial but time-consuming task. Image recognition and computer vision are already used to simplify that process (see [23], [24]), but more general AI might make it much more seamless.

AI will inevitably have a strong impact on the lives of illustrators, and panoramic illustrators in particular. Blind market forces alone will not be concerned with whether the coming changes are beneficial or not to illustration as a human activity, but only with production efficiencies. It is up to illustrators and aligned technologists to ensure that whatever workflows arise treat them like more than machine operators. We hope the work we are starting will contribute in some small measure to a desirable outcome.

VI. FURTHER DEVELOPMENTS

Future developments, materials, and media will be deposited on the personal websites of the authors ([25], [26]).

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