Empowering a Creative City: Engage Citizens in Creating Street Art through Human-AI Collaboration

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Abstract
A "creative city" can promote creativity among its citizens and provide them fulfilling lived experience. Such a concept has captivated city authorities worldwide, and motivated plenty of works to investigate how to make our cities more "creative". We argue that there is a need and an opportunity to design interactive technologies to push the creative city agenda. In this paper, we present WeMonet, a design prototype supporting citizens engaging in participatory street art creation via human-AI collaboration. Citizens' sketches are synthesized, enhanced to be more vivid through machine machine learning algorithms, and projected on a screen, forming a participatory artwork. WeMonet aims to promote citizens' engagement in creative practices and hence the city's creativity. More broadly speaking, we hope this work could inspire designers to consider the role of interaction design in the creative city agenda.

Author Keywords
Creative city; design; civic engagement; machine learning; participatory art.

CCS Concepts
•**Human-centered computing** → **Human computer interaction (HCI);** *Interaction design;*

Introduction

The Creative City is a call to "foster creativity among its citizens and to provide emotionally satisfying places and experiences for them" [31]. The creative city discourse believes that there is always a creative potential in a place. By exploiting the citizens' creativity, designers can make the city more liveable and vibrant [16, 24]. The notion of creative city investigates also how citizens think and act creatively, which can be seen as a novel strategy for urban planning [16]. Such a concept has captivated city authorities worldwide since they believe that a creative city could lead to urban renewal. Meanwhile, we can see a growing body of research discussing the importance of a city's creativity and exploring how we can step towards a creative city.

We believe there is an opportunity to explore how interaction design can contribute to a creative city. Basically, a creative city emphasizes the citizens' lived experience rather than the infrastructure or the architecture in the city [17, 28]. Coincidentally, the third wave of HCI emphasizes people's lived experiences [2]. Therefore, we believe that HCI design knowledge could help us build a creative city from a bottom-up approach [6, 25]. Introducing interaction design into the creative city could help us understand the discourse from the perspective of "creative citizens" rather than simply a technical or industrial perspective [27]. As a starting point for the creative city design, this paper aims to explore the design of interactive technologies to engage citizens in creative practices.

This article presents a design called WeMonet which supports citizens engaging in participatory street art creation. In WeMonet, citizens collaboratively add sketches to a canvas which is constantly processed by the system to make the drawing more vivid and harmony via machine learning algorithms. The idea of engaging citizens in street art creation was inspired by the street art in Melbourne. Melbourne is a big city in Australia and is know as "stencil capital of the world" [32]. In a traditional sense, street arts such as graffiti are often identified as radical, rebellious, and even revolutionary art practices [24]. However, in recent years, street art and graffiti are revalued [34]. City authorities now believe that mobilizing and deploying creativity can be an efficient approach to energize civic engagement and make the city more vital, especially when the sense of community is fading away in quickly-expanding cities [20]. Therefore, more and more city spaces are provided to writers for creating street art legally. Since art is a motivator for urban changes and transformation [20, 33], we believe that street art is closely related to the creative city discourse.

According to Varbanova's work [28], engaging citizens in interactive participatory street art creation can empower a creative city. First, street art could transform the public space where citizens meet and interact into a culturally meaningful space. Moreover, the creative street art can attract tourists and let them engage with the city's culture. For example, there are always crowds of visitors along Hosier Lane in Melbourne because of the graffiti there. Besides, WeMonet supports citizens' creative expression by engaging them in the participatory street art drawing, promoting the collective creativity among citizens and supporting them to participate in the city's cultural life. Since prior works prove the strong correlation among culture, citizenship, participation and creativity [28], we believe that WeMonet could step towards a creative city by engaging citizens in the participatory street art creation via human-AI collaboration. With this work, we hope to call for more works in HCI contributing to the creative city discourse. Moreover, we hope to inspire designers to consider supporting people's creativity via human-AI collaboration in creativce city approaches.

Related Work

We learn from previous works investigating how HCI knowledge can improve civic engagement. Civic engagement focuses on engaging citizens in addressing issues of public concerns to promote the quality of the community [8] while our work aims to engage citizens in creative lives. Recently, many HCI researchers are investigating how design can promote civic engagement to make the city a better place for us to live in [21]. For example, Harding et al. [11] discussed design considerations of civic engagement interactions from the stakeholders' perspective. Ferri et al. [10] adopted the perspective of playfulness, arguing that urban play can be designed as a tool to empower citizens and benefit public involvement. Balestrini [1] investigated the design of civic technology to foster civic engagement from the target communities' perspective whereas Howell et al. [13] took a perspective of citizens' affective experiences, investigating how smart city technologies can be designed to provide emotional support for citizens. Similarly, Schouten et al. [25] focused on the end user, calling for the design enabling "smart citizens" to tackle the challenges in city making. Inspired by these works, we take the perspective of the citizens to investigate the design of the creative city by engaging citizens in creative practices, i.e. street art creation.

Most of the works we mentioned above overlook the collaboration among the citizens. However, Manuel et al. [19] highlighted the role of participatory interactions in citizen engagement. Inspired by this, we believe that we can engage with participatory media technology to involve numerous citizens in the art creation and sharing in order to step towards a creative city. Therefore, this work also learns from prior works in HCI exploring the design of collaborative art production. For example, Sargeant et al. [23] designed a playful participatory installation called "The Storytelling Machine" which can transform the audiences' drawings into animated characters wandering in various video "worlds". With an increasing number of participants, the system delivers a collective story. Similarly, "Graffiti Nature" designed by teamLab [26] is a co-creative installation that engages people with interactive graffiti. Participants are provided with a paper depicting an animal's outline and can freely color the animal. The user's drawing can be transformed into an animated animal projected on the floor for participants to interact with. Moreover, Carter et al. [4] developed digital graffiti that allows people to publish digital graffiti annotations on a publicly situated digital community poster board. These works demonstrate that participatory art can support participants' self-expression and engage people with creative practices. However, these works usually restrict the objects' type or shape that people can draw and hence limit the users' creativity. Moreover, they did not consider that people who are not good at drawing might lose motivation to participate. Instead, our work supports participants to draw freely and uses AI techniques to support novice painters' drawing.

This work can also learn from works utilizing Human-AI collaboration in creative practices since WeMonet facilitates a partnership between citizens and computers in street art creation. Human-AI collaboration is often used to accomplish complex tasks [7, 9]. In recent years, researchers begin to investigate how human-AI collaboration can be applied in creative practices, i.e. co-creativity. According to Karimi et al. [15], co-creativity involves "interaction between at least one AI agent and at least one human where they take action based on the response of their partner and their own conceptualization of creativity during the co-creative task". In practice, Lucas and Martinho [18] presented a design tool to foster creativity by supporting human and computer to work together on game level design. Hoffman

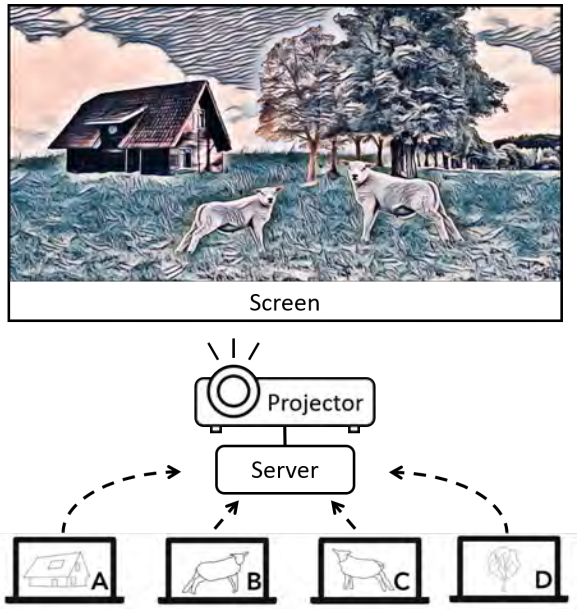

Figure 1: This shows the system of WeMonet. Participants' drawings on their own devices are synthesized via a server and are later projected on a screen.

and Weinberg [12] presented a robot which can continuously adapts its improvisation and choreography when playing with a human musician simultaneously. Clark et al. [5] investigated the user experience of two systems supporting users to write stories and slogans in cooperation with computers. These works give us insight into the design of human-AI collaboration in creative practices. In this paper, we investigate how human-AI collaboration can support multiple users creating street art.

Design

In this section, we describe WeMonet and explain its technical details.

WeMonet

WeMonet (see Fig 1) is a playful installation supporting participatory street art creation via human-AI collaboration. To engage with WeMonet, the citizens access a canvas by opening a web-page through their own terminals, e.g., tablets or mobile phones, and draw on the canvas at their own pace. The canvas' background is randomly chosen by the system, e.g., a grassland or a street view. The citizen then chooses from a list of 80 objects including vehicles, buildings, animals and plants, and draw the object in user-preferred colors and shapes. Once the citizen finishes drawing and clicks a sending button, the system synthesizes all available drawings from the citizens and improvises on the details, i.e. fills in the details randomly, which makes the object look more vivid and unique. Moreover, if a user adds a new object which overlaps with prior objects and background on the canvas, the system automatically harmonizes the drawing. For example, if a user draws a duck on a river, the system might not only adds the duck, but also adds the duck's reflections in the water. Moreover, an art style, e.g., Impressionism, is selected according to the ambient urban data such as weather or traffic conditions, and applied to the canvas, increasing the citizens' awareness on city issues. At last, WeMonet projects the canvas to a screen and the updated street art are shown on each user's terminal.

Technical Details

WeMonet consists of a server, a projector and several user terminals (see Fig 1). The server receives drawings from user terminals, synthesizes the final street art design using machine learning algorithms, and sends it to the projector

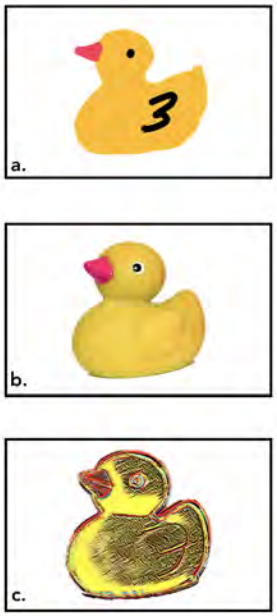

Figure 2: This picture illustrates how WeMonet processes a participant's sketch. (a) shows a duck painted by a citizen. (b) is a very realistic-looking duck generated via machine learning algorithms based on (a). (c) is the final duck projected on the screen, obtained by applying an artistic style.

and thus the screen. To be specific, the Generative Adversarial Nets (GANs) algorithms are applied to process the drawings and generates the final street art design (illustrated in Figure 2). This process consists of three steps: first, the drawings from citizens are synthesized, based on which vivid detailed are generated (see Figure 2(b)) [22, 29]; second, the selected art style is applied to the canvas (see Figure 2(c)) [14]; last, the resolution of the canvas is enhanced to reduce blurriness when projected on the screen [30]. Note that we let citizens draw on a low-resolution canvas (256×512 pixels, height $\times$ width) and only enhance the canvas resolution to 2048×4096 pixels at projection. This is because we do not expect the citizens to provide a very detailed drawing that requires a high resolution canvas. Moreover, drawing on the low resolution canvas reduces computational costs and lowers the requirements on user terminals and internet speed, so that our platform can be used in more general scenarios.

Limitations and Future Work

At this stage, WeMonet is still a work in progress. We have achieved the function that generates corresponding objects based on the users' sketches. Now we are developing to access the canvas via the web-page. We acknowledge that as design work, WeMonet has limitations. First, although this project is inspired by street art, we acknowledge that WeMonet could not let participants experience the art creation in the same way as street artists. For example, graffiti artists often express their attitudes which rebel against authority, which is hardly to be supported by WeMonet. However, we believe WeMonet can engage a wider range of citizens in creative practices, hence stepping towards a future creative city. Second, we acknowledge that WeMonet as a single design might not lead to the total answer of how to design a creative city. However, we see WeMonet as a call for more interaction designers to contribute to the creative city discourse.

For the next step, we will first engage with stakeholders including designers, artists, AI researchers and urban planners to iterate our design. For example, we will discuss with urban planners which urban data is important for citizens to be aware of. We will use such data to influence the art style applied to the canvas. We will also organize a focus group with designers, artists and citizens to discuss the relationship between certain urban data and art styles. After finishing the design prototype, we will do a study at our lab. We will iterate the design of WeMonet based on the feedback and exhibit the installation in public spaces, letting people interact with the system. We will observe the users' behavior and do semi-structured interviews. Thematic analysis [3] will be used to analyze the interview data to help us understand the design for a creative city. In the future, we also hope to collaborate with the government and install WeMonet in the wild, helping us understand citizens' experience with WeMonet in a real-world context.

Conclusion

The concept "creative city" aims to promote the city's creativity in order to provide its citizens with satisfying urban experiences. In this paper, we respond to the call and present a design called WeMonet, a system supporting citizens engaging in participatory street art drawing via human-AI collaboration. We believe our work has mainly three contributions. First, this work may inspire designers to implement human-AI collaboration for experiential purposes such as artistic expressions. Second, we contribute to practice by giving an example of how to design the creative city from the collaborative art-creation perspective. Last, by presenting WeMonet, we call for more works in HCI investigating the design for the creative city, which ultimately benefits citizens' lived experience and makes the city a better place to

live in.

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