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Inpainting in Urban Design: Artificial Intelligence as a tool for thinking about sustainable cities and communities

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Inpainting no desenho urbano: Inteligência Artificial como ferramenta para pensar cidades e comunidades sustentáveis

RESUMO

Objetivo - Reconhecer os potenciais da ferramenta inpainting, de modelos de redes neurais generativas de imagens, como instrumento de comunicação no planejamento urbano.

Metodologia - pesquisa bibliográfica, para a revisão crítica e aprofundada da literatura existente, e pesquisa experimental, para a verificação empírica das hipóteses por meio de testes. Na pesquisa experimental, foram realizados sete experimentos utilizando inpainting, para explorar soluções visuais que auxiliam um planejamento urbano mais sustentável. Cada experimento foi concebido para abordar uma meta específica do Objetivo de Desenvolvimento Sustentável 11, que visa tornar as cidades e os assentamentos humanos mais sustentáveis, por meio da utilização de diferentes cenários brasileiros com problemáticas a serem superadas.

Originalidade/relevância - A democratização de ferramentas de Redes Neurais Generativas de Imagens, como o *inpainting*, ainda está em estágio inicial, e sua adoção em contextos profissionais permanece limitada. Da mesma forma, estudos que correlacionam o uso dessas redes com o planejamento urbano ainda são escassos, tanto em nível nacional quanto internacional.

Resultados - Os resultados demonstram que a utilização dessa ferramenta pode significar um estreitamento da comunicação entre os urbanistas e a população e o consequente favorecimento de um planejamento urbano mais transparente e participativo, mitigando ambiguidades e perdas de significados durante as expressões e publicações de ideias, porém, evidencia que o papel do desenho urbano especializado permanece insubstituível.

Contribuições teóricas/metodológicas - O estudo contribui para a literatura ao propor o uso do *inpainting* como ferramenta complementar de representação no campo do desenho urbano, articulando conceitos de inteligência artificial e planejamento sustentável. Metodologicamente, demonstra um modelo experimental replicável, capaz de testar cenários urbanos com base em metas específicas dos ODS, abrindo espaço para novas abordagens híbridas entre práticas projetuais tradicionais e tecnologias digitais emergentes.

Contribuições sociais e ambientais - A pesquisa evidencia o potencial do *inpainting* para ampliar a participação social nos processos de planejamento urbano, ao facilitar a compreensão das propostas e estimular o diálogo entre especialistas e comunidade. Ambientalmente, a ferramenta contribui para refletir sobre soluções urbanas mais sustentáveis, ao permitir simulações visuais rápidas e acessíveis que reforçam a importância de integrar aspectos ecológicos e sociais no desenvolvimento das cidades.

PALAVRAS-CHAVE: Inteligência Artificial. Inpainting. Planejamento urbano.

Inpainting in Urban Design: Artificial Intelligence as a tool for thinking about sustainable cities and communities

ABSTRACT

Objective – To recognize the potential of the inpainting tool, from generative neural network models for images, as a communication instrument in urban planning.

Methodology – Bibliographic research, for a critical and in-depth review of the existing literature, and experimental research, for the empirical verification of hypotheses through testing. In the experimental phase, seven experiments using inpainting were carried out to explore visual solutions that support more sustainable urban planning. Each experiment was designed to address a specific goal of Sustainable Development Goal 11, which seeks to make cities and human settlements more sustainable, through the use of different Brazilian scenarios with challenges to be overcome.

Originality/Relevance – The democratization of Generative Neural Network tools for images, such as inpainting, is still at an early stage, and their adoption in professional contexts remains limited. Likewise, studies correlating the use of these networks with urban planning are still scarce, both nationally and internationally.

Results – The findings show that the use of this tool may strengthen communication between urban planners and the population, thereby fostering more transparent and participatory urban planning, mitigating ambiguities and losses of meaning during the expression and dissemination of ideas. However, the study also highlights that the role of specialized urban design remains irreplaceable.

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Theoretical/Methodological Contributions – The study contributes to the literature by proposing the use of inpainting as a complementary representational tool in the field of urban design, articulating concepts of artificial intelligence and sustainable planning. Methodologically, it demonstrates a replicable experimental model capable of testing urban scenarios based on specific SDG goals, opening opportunities for new hybrid approaches between traditional design practices and emerging digital technologies.
Social and Environmental Contributions – The research highlights the potential of inpainting to broaden social participation in urban planning processes, by facilitating the understanding of proposals and stimulating dialogue between experts and the community. Environmentally, the tool contributes to reflections on more sustainable urban solutions, by enabling quick and accessible visual simulations that emphasize the importance of integrating ecological and social aspects into city development.

KEYWORDS: Artificial Intelligence. Inpainting. Urban planning.

Inpainting en el diseño urbano: Inteligencia Artificial como herramienta para pensar ciudades y comunidades sostenibles

RESUMEN
Objetivo – Reconocer los potenciales de la herramienta inpainting, proveniente de modelos de redes neuronales generativas de imágenes, como instrumento de comunicación en la planificación urbana.
Metodología – Investigación bibliográfica, para la revisión crítica y profunda de la literatura existente, e investigación experimental, para la verificación empírica de las hipótesis mediante pruebas. En la fase experimental se realizaron siete experimentos utilizando inpainting, con el fin de explorar soluciones visuales que apoyen una planificación urbana más sostenible. Cada experimento fue concebido para abordar una meta específica del Objetivo de Desarrollo Sostenible 11, que busca hacer las ciudades y los asentamientos humanos más sostenibles, mediante el uso de diferentes escenarios brasileños con problemáticas a superar.
Originalidad/Relevancia – La democratización de herramientas de Redes Neuronales Generativas de Imágenes, como el inpainting, aún se encuentra en una etapa inicial, y su adopción en contextos profesionales sigue siendo limitada. Asimismo, los estudios que correlacionan el uso de estas redes con la planificación urbana todavía son escasos, tanto a nivel nacional como internacional.
Resultados – Los resultados demuestran que el uso de esta herramienta puede significar un acercamiento en la comunicación entre urbanistas y población, favoreciendo así una planificación urbana más transparente y participativa, mitigando ambigüedades y pérdidas de significado durante la expresión y difusión de ideas. No obstante, se evidencia que el papel del diseño urbano especializado sigue siendo insustituible.
Contribuciones Teóricas/Metodológicas – El estudio contribuye a la literatura al proponer el uso del inpainting como herramienta complementaria de representación en el campo del diseño urbano, articulando conceptos de inteligencia artificial y planificación sostenible. Metodológicamente, demuestra un modelo experimental replicable, capaz de poner a prueba escenarios urbanos basados en metas específicas de los ODS, abriendo espacio para nuevos enfoques híbridos entre prácticas proyectuales tradicionales y tecnologías digitales emergentes.
Contribuciones Sociales y Ambientales – La investigación evidencia el potencial del inpainting para ampliar la participación social en los procesos de planificación urbana, al facilitar la comprensión de las propuestas y estimular el diálogo entre especialistas y comunidad. Ambientalmente, la herramienta contribuye a reflexionar sobre soluciones urbanas más sostenibles, al permitir simulaciones visuales rápidas y accesibles que refuerzan la importancia de integrar aspectos ecológicos y sociales en el desarrollo de las ciudades.

PALABRAS CLAVE: Inteligencia Artificial. Inpainting. Planificación urbana.

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1 INTRODUCTION

The way we conceive and design our cities has been revolutionized in recent decades by the imperative to transform social groupings into more inclusive, safe, resilient, and sustainable spaces, thereby requiring a critical reassessment of how we communicate our urban intentions and strategies. In this context, the Sustainable Development Goals (SDGs) —a set of 17 goals (Figure 1) established by the United Nations (UN, 2016) to address the major challenges faced by communities worldwide —emerge as a framework for promoting more sustainable thinking across ecological, economic, social, and cultural dimensions. Among these, Sustainable Development Goal 11, "Sustainable Cities and Communities," holds particular relevance for urban planning, as it sets forth targets aimed at transforming cities and human settlements into more sustainable, inclusive, safe, and resilient environments.

Figure 1 – The 17 Sustainable Development Goals

Source: United Nations, 2016.

The emergence of this debate highlights the need to envision urban planning practices that extend beyond technical and academic discussions. While these discussions are essential for the development of urban projects, they often remain confined to specialized circles, which does not align with the growing demand for broader and more informed public participation. There is an increasing need for more accessible and engaging approaches, supported by the use of illustrative imagery. Studies by Oliveira and Silva (2015) on housing policies and urban infrastructure in planned neighborhoods show that integrated planning strategies can make cities more inclusive and sustainable, serving as a reference for the application of visual tools in urban communication.

The use of visual representations not only simplifies complex concepts but also plays a crucial role in facilitating dialogue among planners, policymakers, and the community. Images possess the ability to make projects more tangible and understandable, eliminating ambiguities and fostering a more intuitive grasp of proposed plans.

The importance of images in the communication of ideas and information is closely related to the way our brains process information. Lynell Burmark (2002), in her book Visual

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Literacy: Learn to See, See to Learn, explains that human cognition is heavily dependent on visual stimuli for the absorption and understanding of concepts, as words are managed by brain regions associated with short-term memory—making them more volatile—whereas images are processed in long-term memory, ensuring more durable retention.

The ability of images to capture attention and provoke emotional responses creates a deeper and more transparent connection between urban proposals and the public, who are the principal stakeholders in planning processes. When proposals are presented clearly and visually, stakeholders can more effectively assess implications and benefits, promoting an environment of greater openness and collaboration.

Within this context, the potential of utilizing generative Artificial Intelligence (AI)—fueled by recent technological advances in deep learning systems, and more specifically for the present study, Generative Image Neural Networks (GINNs)—emerges. In order to better understand the potential applications of this technology, it is necessary to first explore the functioning of GINNs.

2 OBJECTIVE

The objective of this study is to recognize the potential of the inpainting tool, based on Generative Image Neural Network models, as a communication instrument in urban planning.

3 METHODOLOGY / METHOD OF ANALYSIS

To achieve the aforementioned objective, this research is grounded in the work of Gil (2019), who provides a comprehensive methodological framework for the development of research projects. Among the instruments detailed by the author, the bibliographic research stands out, allowing for a critical and in-depth review of the existing literature, and experimental research, which enables the empirical verification of hypotheses through controlled tests. These methods, applied together, structure the development of the study.

As emphasized by the author, bibliographic research is an essential procedure, required in almost all scientific research. It underpins the exploratory nature of the study, providing an overview of the current state of knowledge in a particular field. The contemporary relevance of the subject discussed in this article necessitates the search for recent publication sources, ensuring that the data and theories used reflect the most current advancements. In this regard, periodicals play a key role, especially scientific journals and article repositories, which enable the sharing of information much more rapidly and accessibly than books and other traditional printed materials. This makes bibliographic research a crucial tool for understanding and contextualizing the subjects addressed, particularly in constantly evolving areas. Scientific articles establish relevant discussions on the characteristics of tools such as inpainting and foster strategies for integrating AI technologies into the daily practices of urban planners.

Experimental research, on the other hand, constitutes the core of the study. Gil (2019) asserts that, for the production of an experiment, it is necessary to identify the object of study, select the variables capable of influencing this object, as well as define the control method and the form of observation. These definitions, detailed below, are essential to ensure the

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reproducibility of the experiment by peers, a crucial step in the production of scientific knowledge.

The images, extracted from various digital sources, constitute the central object of the experiments, potentially employed as visual representations for the communication of strategies in urban planning. These images highlight urban issues from various locations across the country, simulating situations to be addressed by the government. To establish a more directed course for the experiment, the goals of Sustainable Development Goal 11, "Sustainable Cities and Communities" (UN, 2016), were used as a guide to search for images, selecting those that sufficiently exemplify the challenges to be overcome by each goal. The goals, numbered 11.1 to 11.7, are listed below:

> 11.1 By 2030, ensure access for all to adequate, safe, and affordable housing and basic services, and upgrade slums.
>
> 11.2 By 2030, provide access to safe, affordable, accessible, and sustainable transport systems for all, improving road safety through the expansion of public transport, with special attention to the needs of vulnerable populations, women, children, persons with disabilities, and older persons.
>
> 11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated, and sustainable human settlement planning and management in all countries.
>
> 11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage.
>
> 11.5 By 2030, significantly reduce the number of deaths and the number of people affected by disasters, and substantially decrease direct economic losses relative to global gross domestic product, including disasters related to water, with a focus on protecting the poor and people in vulnerable situations.
>
> 11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality, municipal and other waste management.
>
> 11.7 By 2030, provide universal access to safe, inclusive, accessible, and green public spaces, particularly for women and children, older persons, and persons with disabilities (United Nations, 2016, n.p.).

In the Results section, the images, the masked regions, and the outcomes obtained through inpainting are presented, along with the prompts used for image generation. In some simulations, it was necessary to apply masking in more than one stage to achieve better results and more precise contextual guidance. In these cases, the images illustrating the masked regions display different fill colors and are numbered to indicate the sequence of modifications applied to the original photograph. The prompts used for each generation are also listed in the text near the corresponding figures, provided in English along with their translations.

To facilitate the reproducibility of the experiment, the online platform Clipdrop (2024), developed by Stability.AI, was employed, specifically using the tool titled Generative Fill, which enables image editing through the inpainting method. Within this tool, the user simply uploads the desired image, selects the area to be masked using the mouse cursor, types in the generation prompt, and initiates the process, which takes only a few seconds. After processing, a new fill is generated for the selected region, which the user may either accept or request a reprocessing

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until a satisfactory result is obtained. Given the fast processing time, it is possible to produce multiple outputs, allowing for iterative improvements toward the intended result. Another strategy involves editing the image in separate stages, altering it part by part to facilitate the algorithm's contextual understanding, as observed in some of the experiments. It is important to emphasize that even when working in multiple stages, the overall process remains significantly faster than traditional image editing methods, requiring only a few minutes of user interaction in total.

4 RESULTS

For the present article, the results were organized into two subsections: bibliographic research and experimental research. The first subsection focused on gathering the fundamental theoretical framework concerning the use of Generative Neural Networks for Images (GNNI), with an emphasis on diffusion models, which stand out for their ability to perform visual modifications through the inpainting technique. The second subsection comprised seven practical experiments, in which the studied techniques were applied to images of real urban scenarios. These experiments were structured to test and demonstrate the possibilities and limitations of the tool in concrete urban planning situations.

4.1 Bibliographic Research

Artificial neural networks are not occasionally reminiscent of human brain function, but intentionally so. The hierarchical structure of these networks, with processing layers and evaluating nodes (also known as neurons), is inspired by the workings of the human brain. In tasks that require greater structural complexity, with an increased number of layers, deep neural networks are used — systems with more intricate nodes capable of conceiving data hierarchies in tasks such as data synthesis, information processing, and pattern recognition (Deng; Yu, 2014).

The introduction of deep learning into the machine learning literature, as elucidated by Lecun, Bengio, and Hinton (2015), represents a significant milestone in the evolution of AI techniques, introducing, more efficiently, the ability to generate new data, whether in the form of text, images, audio, or other outputs. These system architectures are known as Generative Neural Networks. Among the various types of synthetic data that such structures are capable of producing, images stand out.

These models are designed to learn the probability distribution of the data on which they were trained and, based on this distribution, generate new samples that resemble the correlations evidenced in the original data. The training databases are generally composed of paired information, containing correlations between images and text. In systems that use natural language textual information as input, the term text-to-image is applied, while models that take other images as input are referred to as image-to-image systems. Żylińska (2020) explains the application of text-to-image systems as the transformation of descriptions — also

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called prompts — into visual representations capable of respecting indicators such as object height, background, compositions, and styles.

Image-to-image systems generate new images from a base image, capable of stylizing and modifying the image as a whole, based on a predetermined direction established either during database training or in the system's architecture. A large portion of image-generating networks is based on a combination of two strategies: diffusion models and adversarial networks.

Diffusion models are based on a process called probabilistic diffusion, which occurs in two stages. The first, forward diffusion, consists of gradually adding Gaussian noise (a type of statistical noise that follows a probability distribution known as the normal curve) until the complete destruction of the image, resulting in something resembling the static of an old television without a signal. In the reverse diffusion, the process is inverted, aiming to gradually remove the noise and recover the image (Figure 2).

The second strategy, adversarial networks, ensures the final quality and direction of the process. As the name suggests, in this system, two opposing networks work in parallel — one generating the images and the other evaluating them — thereby organizing the image refinement steps and achieving higher quality in the final product (Ho; Jain; Abbeel, 2020).

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Figure 2 – Reverse diffusion

Source: Ho, Jain e Abbeel (2020, p. 7).

After the training process is complete, the diffusion model acquires the ability to generate images directly, without relying on the prior data destruction process. Starting from an initial noise state, the model uses a numerical identifier (seed), which acts as the originating seed that will define the exact configuration of each pixel in the initial noise. This identifier guides the gradual refinement process, in which the noise is transformed, step by step, into a coherent image.

Diffusion models have gained popularity not only for their efficiency and the high quality of their results but also for their accessibility through open-source code, which is fully available for free download on a code-sharing platform called GitHub. Furthermore, its main branch, Stable Diffusion (SD), is available as an image generation engine on several digital platforms, such as Clipdrop (2024) by Stability.AI, the company responsible for SD. These platform-based systems do not require any software installation on the user's computer, operating through remote servers. They also offer daily free credit systems, enabling access without financial barriers, even from mobile devices.

Through SD, including via Clipdrop, users can access a specialized variation of the diffusion model designed for reconstructing user-masked areas, called inpainting. Masks are applied by the user over an original base image, selecting regions to be modified. The model is conditioned to understand what is missing and to generate visual content that harmonizes with the rest of the image. The neural network identifies the characteristics and patterns surrounding the masked area and generates pixels that aesthetically match the existing textures, colors, and shapes.

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This tool opens up a horizon of possibilities capable of bringing communities closer to emerging needs and planned solutions by means of reconstructions applied to images that represent the real conditions and contexts they experience. In this way, inpainting can emerge as a strategic tool in urban planning, building a visual dialogue that connects the community's expectations with the solutions developed for creating more inclusive and sustainable cities. As pointed out by Mattos and Constantino (2016), the use of urban open spaces and visual representations contributes significantly to participatory planning, fostering a more effective appropriation of environments and strengthening the integration between specialists and the community.

4.2 Experimental Research

The first goal set by the UN to achieve more sustainable cities and communities is directly related to ensuring safe housing for the entire population, with access to basic services and the urbanization of slums. This is a high-priority goal, considering the scale of the problem, which affects the majority of Brazilian municipalities. Figure 3, subdivided into three parts, illustrates in Figure 3-a a scenario of informal housing in coastal areas of Macapá, in the state of Amapá (Other Forms of Living, 2020). The image depicts a village made up of precarious stilt houses built on a polluted body of water, without proper sanitation infrastructure, and exposed to significant risks of disease transmission.

Figure 3 – Inpainting on Goal 11.1

Source: Outras Formas de Morar (2020), modified by the author using Clipdrop.

For this image, the inpainting process was executed in a single step, with a mask applied to the region of the photo that highlights the contaminated body of water and the central access between the houses (represented in blue in Figure 3-b). The mask region was associated with the prompt – access to safe, adequate housing with basic infrastructure services,

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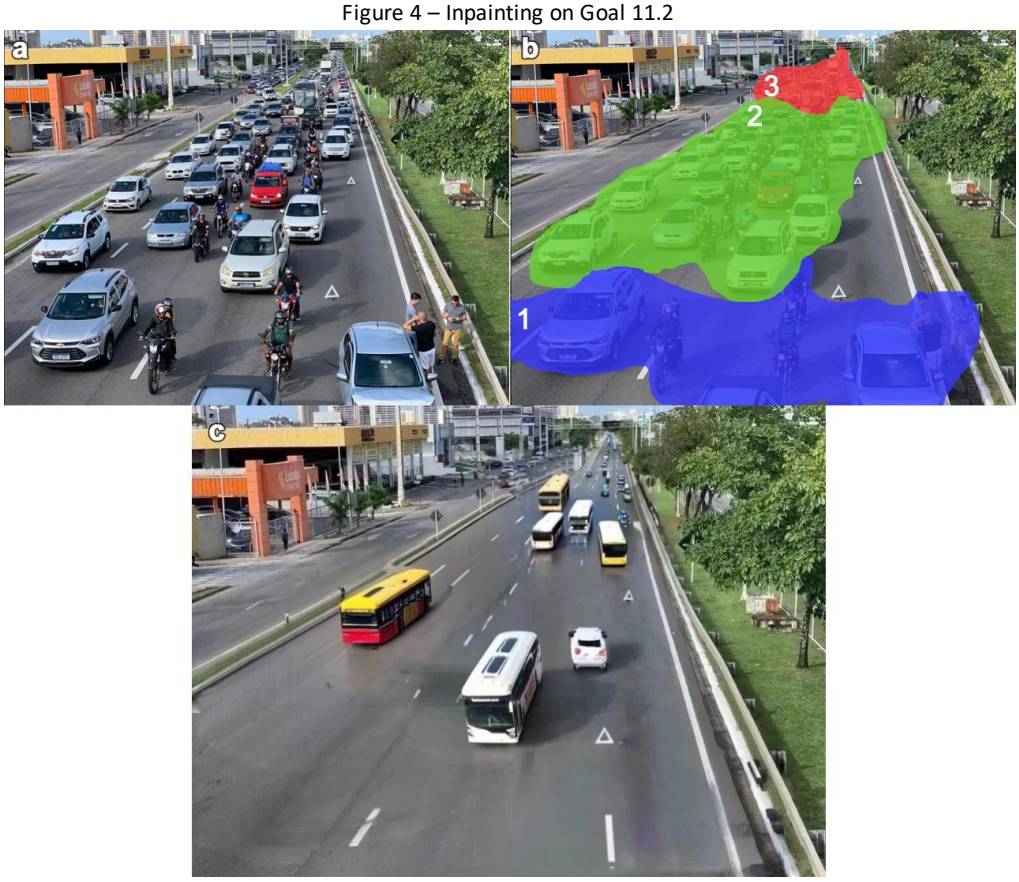
referring to the first goal. After several RNGI processes, the result obtained (Figure 3-c) shows the same scenario without exposure to the contaminated water resource, with a path having regular flooring, flanked by secondary accesses and shrub beds.

The second goal of the same objective relates to necessary improvements in public transport, with the aim of providing safer, more sustainable, and accessible means. The second experiment is based on a photograph of a traffic jam that occurred in Natal-RN (G1, 2023). Figure 4-a shows the original image, next to it (Figure 4-b) is the image with the mask markings for each step, and at the bottom (Figure 4-c) is the final result. For this experiment, three steps were needed with more direct textual inputs: for the first step, in blue, the prompt used was: asphalt pavement, street, avenue; the second step, in green, used the prompt: public transportation; and the third step, using the same prompt as the previous one. Each step also required repeated processing, but the final process lasted no more than a few minutes, resulting in an image with a traffic-free avenue, predominantly occupied by public transportation vehicles, along with some private cars.

Figure 4 – Inpainting on Goal 11.2



Source: G1 (2023), modified by the author using Clipdrop.

The third experiment focuses on more inclusive and sustainable urbanization, guided by the third goal. An aerial photograph of a social housing complex built by Norte Energia in Altamira-PA (Figure 5-a) to relocate families affected by the construction of a hydroelectric power plant (Amazônia Real, 2019). The inpainting process shown in Figure 5-b aims to reimagine this layout in a less rhythmic and standardized manner. To achieve this, a mask was

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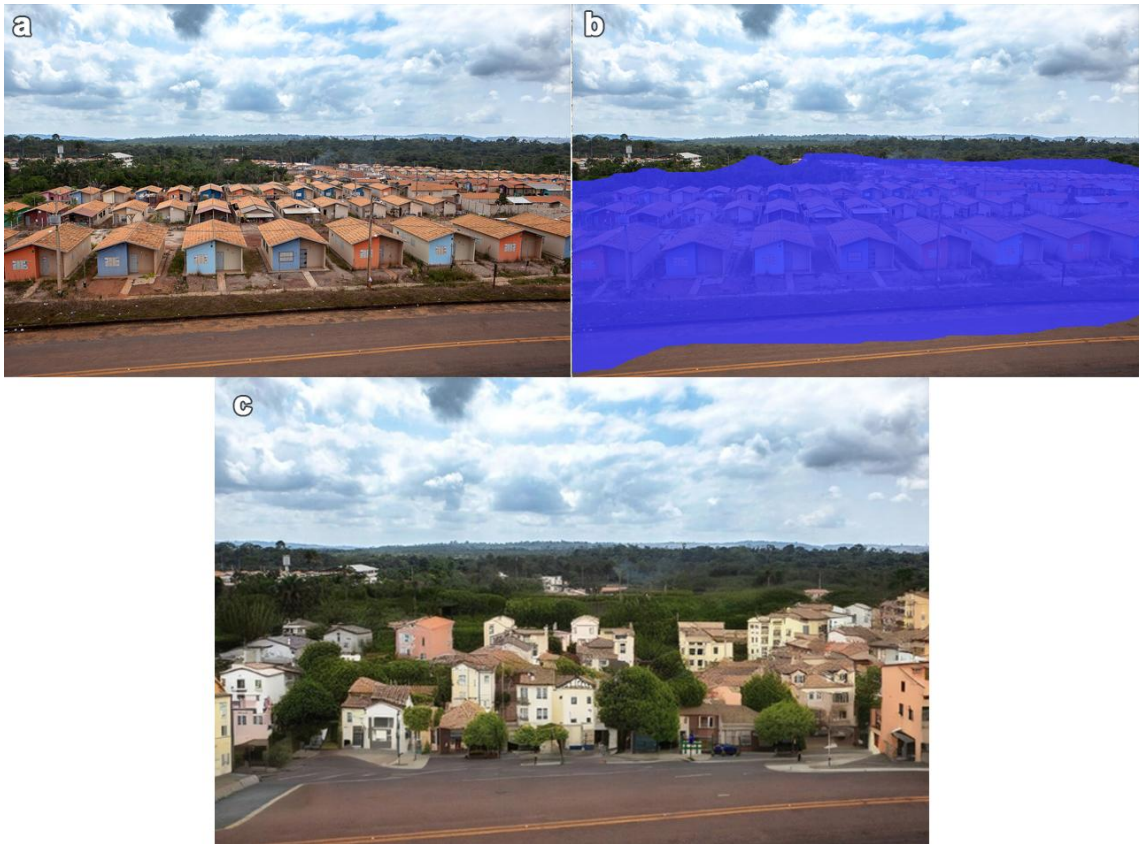
created for the entire settlement, marked in blue, associating it with the prompt: inclusive and sustainable urbanization. The final result (Figure 5-c) depicts a more diverse typological locality, with more individualized volume arrangements.

Figure 5 – Inpainting on Goal 11.3



Source: Amazônia Real (2019), modified by the author using Clipdrop.

The next goal, the focus of the fourth experiment (Figure 6), highlights the importance of protecting the cultural and natural heritage of the world. The image selected for this experiment depicts an architectural heritage site located in São Luís, Maranhão. The photo (O Imparcial, 2016) highlights the marks of degradation on the heritage: walls with graffiti and affected by rising damp (Figure 6-a).

The inpainting process, carried out in three stages, was used to digitally restore these degraded areas. In Figure 6-b, the first stage is marked in blue; the second stage, in green; and the third, in red. In all stages, the prompt – wall showed the best performance in processing the image. It was not necessary to mark specific architectural features, as the context of the original image was sufficient for the filling to respect the original structure's characteristics (Figure 6-c).

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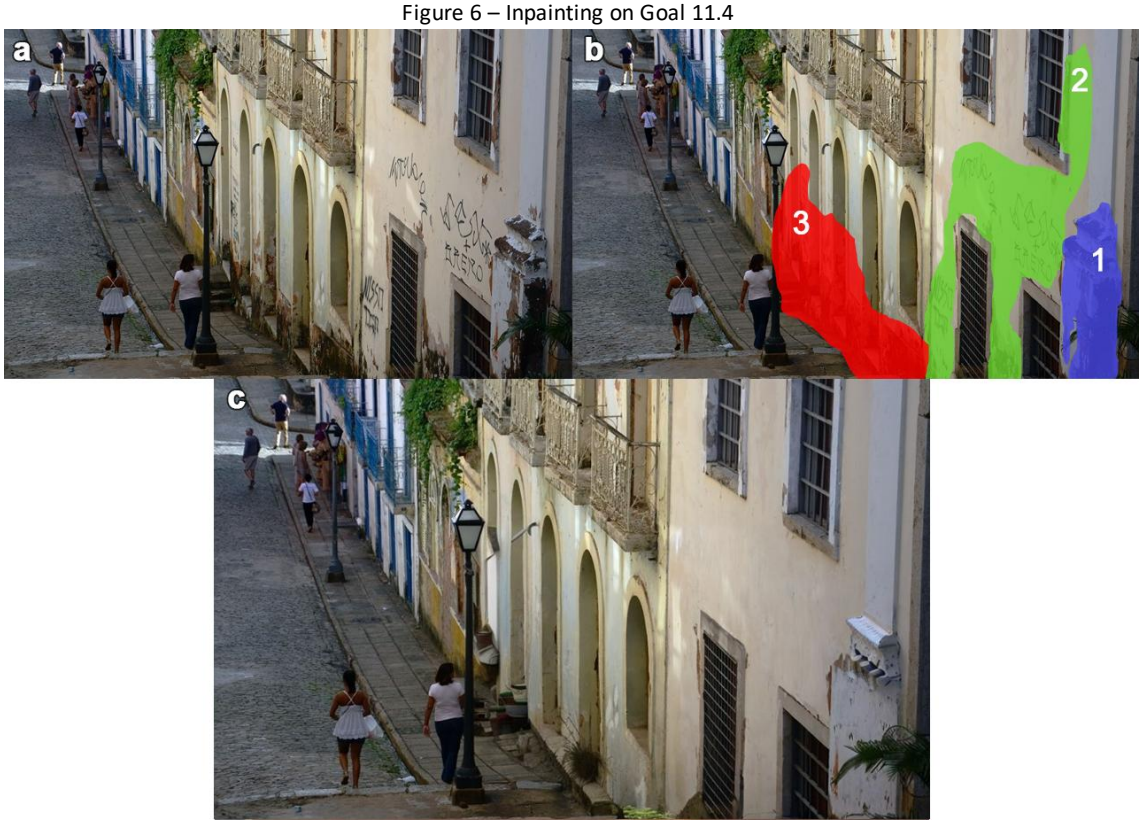
Figure 6 – Inpainting on Goal 11.4



Source: O imparcial (2016), modified by the author using Clipdrop.

The fifth experiment focuses on the goal of reducing the number of people affected by disasters and substantially decreasing the material and human losses caused by these events. The reference image (Figure 7-a) used illustrates a landslide scenario in União da Vitória, Paraná, where a road was blocked (Canal Rural, 2024). The inpainting process was carried out in two distinct stages (Figure 7-b). In the first stage, marked in blue, the prompt – road was used to digitally reconstruct the road, while in the second stage, marked in green, the prompt – concrete containment barrier was applied to insert a protective structure along the road (Figure 7-c).

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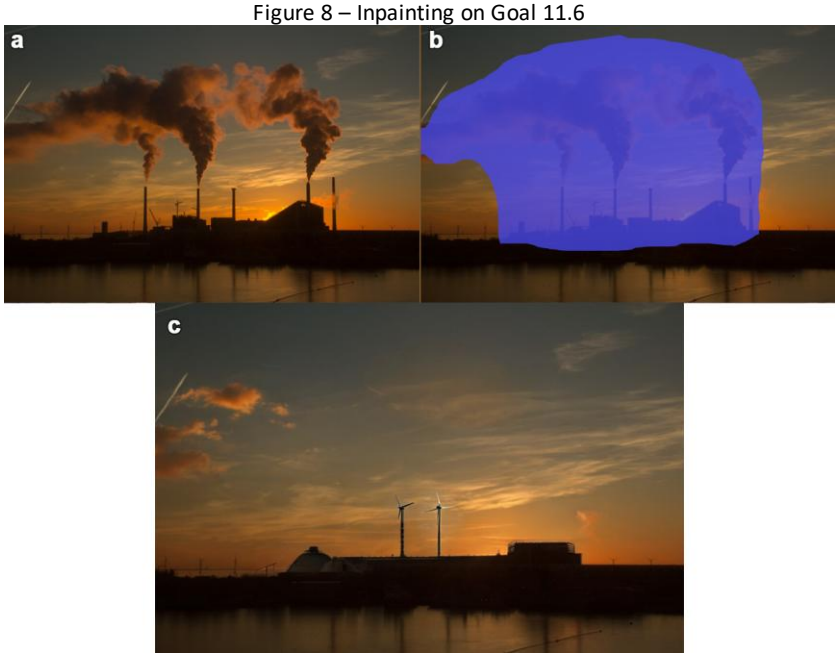
Figure 7 – Inpainting on Goal 11.5

Source: Canal Rural (2024), modified by the author using Clipdrop.

The penultimate experiment focuses on the goal of reducing the negative environmental impact of cities, with special attention to improving air quality, managing municipal waste, and other factors. The reference image (Figure 8-a) is from an industrial hub in Cubatão, São Paulo (Santa Portal, 2022), and depicts a scenario with industrial chimneys emitting gases into the atmosphere.

Figure 8 – Inpainting on Goal 11.6



Source: Santa Portal (2022), modified by the author using Clipdrop.

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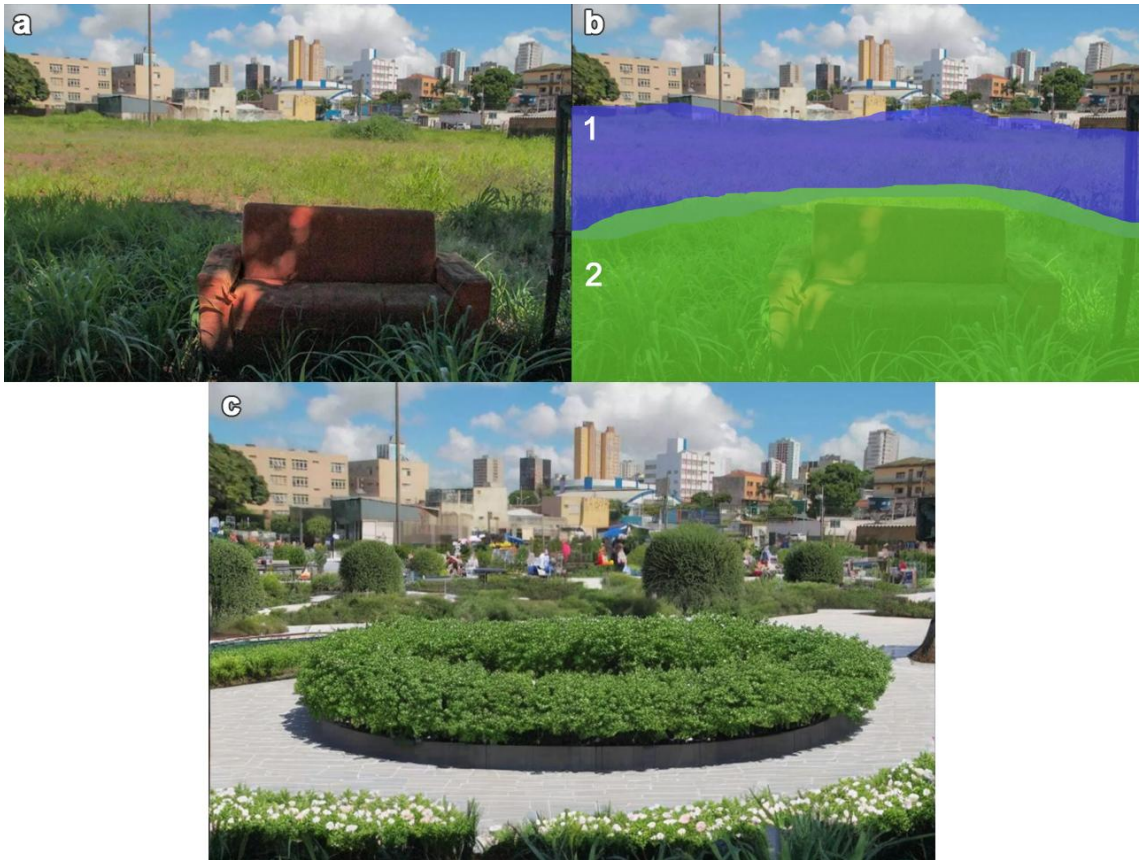
The inpainting process was carried out in a single step on the mask marked in blue (Figure 8-b), using the prompt – sustainable industry. The RNGI, for the final product (Figure 8-c), modified the industrial structures and the surrounding environment to introduce a more optimized structure with prominent wind turbines.

The last experiment of this article addresses the goal of providing universal access to safe, inclusive, accessible, and green public spaces. The reference image (Campo Grande News, 2021) depicts an empty lot in Campo Grande, Mato Grosso do Sul, with an abandoned sofa in the foreground, symbolizing the degradation and improper use of the space (Figure 9-a).

To ensure the final image maintained the correct scale and proportion, the inpainting process was conducted in two steps (Figure 9-b). The first step, marked in blue, focused on the farthest part of the lot, while the second step, marked in green, focused on the closer part where the sofa was located. The prompt used in both steps was – accessible, inclusive, sustainable, and tree-lined square.

Figure 9 – Inpainting on Goal 11.7



Source: Campo Grande *News* (2021), modified by the author using Clipdrop.

Figure 9-c shows the final product obtained after the modification made in Clipdrop. In the foreground, there is a circular garden bed with a central shrub, surrounded by cement tile paving and bordered by flower beds. In the background, medium and large trees appear, with flower beds dividing the space into various ambiances, creating a diverse and inviting environment. The space is occupied by people who are actively using the area, promoting

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community engagement and the inclusive use of a revitalized green space, in line with the goal of creating accessible and sustainable public spaces.

5 CONCLUSION

This study conducted seven experiments using inpainting, a technique of RNGI, with the aim of exploring visual solutions that assist in thinking about more sustainable urban planning. Each experiment was designed to address a specific target of Sustainable Development Goal 11, which seeks to make cities and human settlements more inclusive, safe, resilient, and sustainable.

Throughout the experiments, images of various Brazilian urban scenarios with vulnerabilities to be overcome were subjected to inpainting, using prompts determined by the researchers to generate a digital reconstruction of these spaces, suggesting improvements that could be the focus of specific proposals for urban planning in cities. The seven targets guided the selection of images and the establishment of proposals for these regions.

Each experiment required different strategies for production to achieve the final result. It was highlighted that, for image production, subdividing into multiple steps might be necessary. The experiment also showed that, for larger masks, more detailed prompts generated better results, while for more localized masks, more generic textual inputs were more effective. In all cases, the tool demonstrated practicality and speed in production, highlighting its potential for visual communication.

Thus, the use of this tool can signify a closer connection between urban planners and the population, mitigating ambiguities and loss of meaning during the expression and publication of ideas.

It is worth noting that, although the tool shows great potential, it still presents significant limitations, and the role of specialized urban design remains irreplaceable. The process of creating urban spaces requires a critical eye and a multidisciplinary approach, which only qualified professionals can offer. In this sense, the tool acts as a complement to specialized work, serving to enhance communication and facilitate the visualization of ideas, but it does not replace the technical knowledge and experience accumulated in the field of urban planning.

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DECLARAÇÃO DE CONFLITOS DE INTERESSE

Nós, **Gabriel Barcelos e Silva** e **Sergio Rafael Cortes de Oliveira**, declaramos que o manuscrito intitulado **"Inpainting no desenho urbano: Inteligência Artificial como ferramenta para pensar cidades e comunidades sustentáveis"**:

1. **Vínculos Financeiros**: Não possui vínculos financeiros que possam influenciar os resultados ou interpretação do trabalho.
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