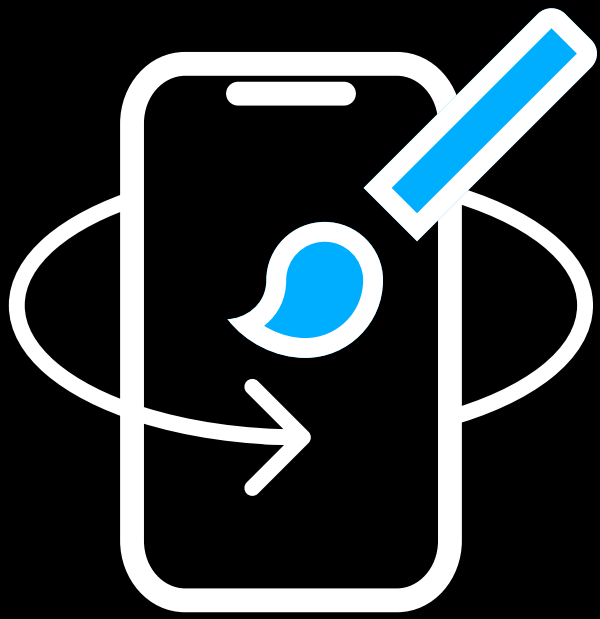
Chair of Architectural Informatics
Department of Architecture
Technical University of Munich



Draw Your City

Ruoxi Yang, Ruijie Ma, Yuan Zhang

Draw Your City

Chair of Architectural Informatics
Prof. Dr.-Ing. Frank Petzold

Tooling Urban Futures
Ivan Bratoev, Nick Förster, Frank Petzold
Ruijie Ma, Ruoxi Yang, Yuan Zhang
03759037, 03743495 03742743

Table of Contents

Semester Topic Introduction

Background

In the winter semester of 2024/25, our academic program Tooling Urban Futures aims to address the multifaceted challenges faced by urban centers through the integration of digital tools and architectural strategies.

Vacant department stores, monofunctional pedestrian zones, and climate-stricken urban streets have become symbols of the crises threatening the vitality of city centers. These issues prompt us to rethink the traditional structures, functions, and spatial concepts that have shaped urban life for decades. This program views the collapse of SIGNA Group (the parent company of retail giant “Galeria Karstadt Kaufhof”) as an opportunity to explore innovative solutions for the future of urban spaces.

Tooling Urban Futures departs from traditional building-centric approaches, instead focusing on the potential of digital tools to reshape urban environments and societal interactions. Furthermore, the program prioritizes the symbiotic relationship between urban spaces and their users. It advocates for solutions that balance social accessibility with environmental responsibility. Unlike conventional smart city narratives, which often emphasize automation and efficiency, this program embraces participatory, human-centered design principles. Through the lens of digital tools and experimental planning, this project should redefine urban crises as opportunities for innovation. The prototypes and strategies developed in this program aim to reimagine urban spaces as dynamic and inclusive environments that adapt to the needs of communities.

Process

The project is divided into three core phases: understanding inner-city crises, designing concept for strategic tools, and prototype development.

The project begins with an in-depth analysis of the planning issues caused by inner-city crises, based on case studies of department stores and their surrounding urban spaces. Through collaboration with municipalities and relevant stakeholders, we will investigate the social, economic, and environmental impacts of these crises.

In the concept development phase, we need to bridge urban strategies with the development of digital tools. Through brainstorming workshops and experimental planning games, the studio will design participation platforms, negotiation toolkits, and simulation models tailored to specific urban contexts.

Finally, the project will culminate in the prototyping phase, where our concepts will take tangible form. Intensive workshops focusing on game engines, data visualization, AI tools, and mixed reality will enable us to create prototypes of our digital interaction software. These prototypes will not only validate the concepts but also serve as sources of inspiration to foster new modes of urban engagement.

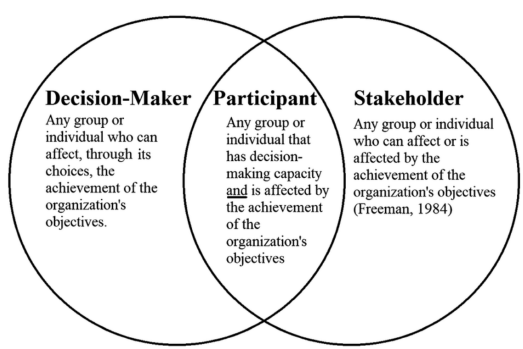
Research

In the early stages of the project, following extensive visits and research at various department stores in Munich and its surrounding areas, we identified Transforming Department Stores through Participatory and Stakeholder-driven Processes as the primary focus of our study. This theme serves as the theoretical foundation for developing subsequent design strategies and concepts. Based on this research focus, we will delve into several key discussion points.

Defining Stakeholders and Participants

The first and most critical question is: How do we define stakeholders and participants? Who are the stakeholders and participants of this project?

From a theoretical perspective, we can reference Colin Williams and Liping Fang to explain the relationship between decision-makers, participants, and stakeholders:

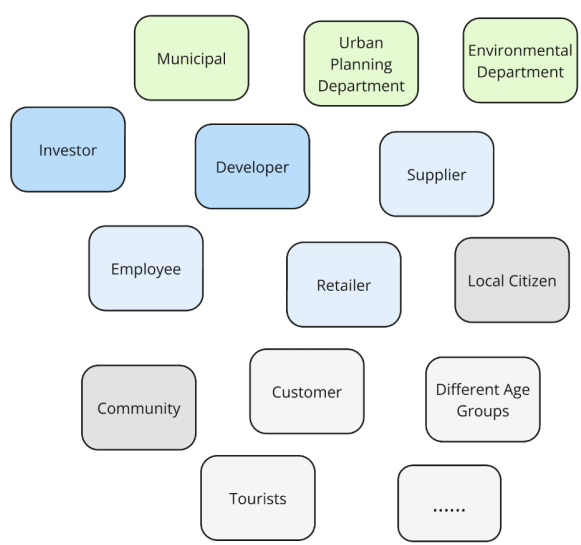


Williams, C., & Fang, L. (2019)

In the process of achieving organizational goals, the roles and interactions between “decision-makers,” “stakeholders,” and “participants” are distinct yet interrelated. These dynamics determine the levels of influence and involvement across different entities.

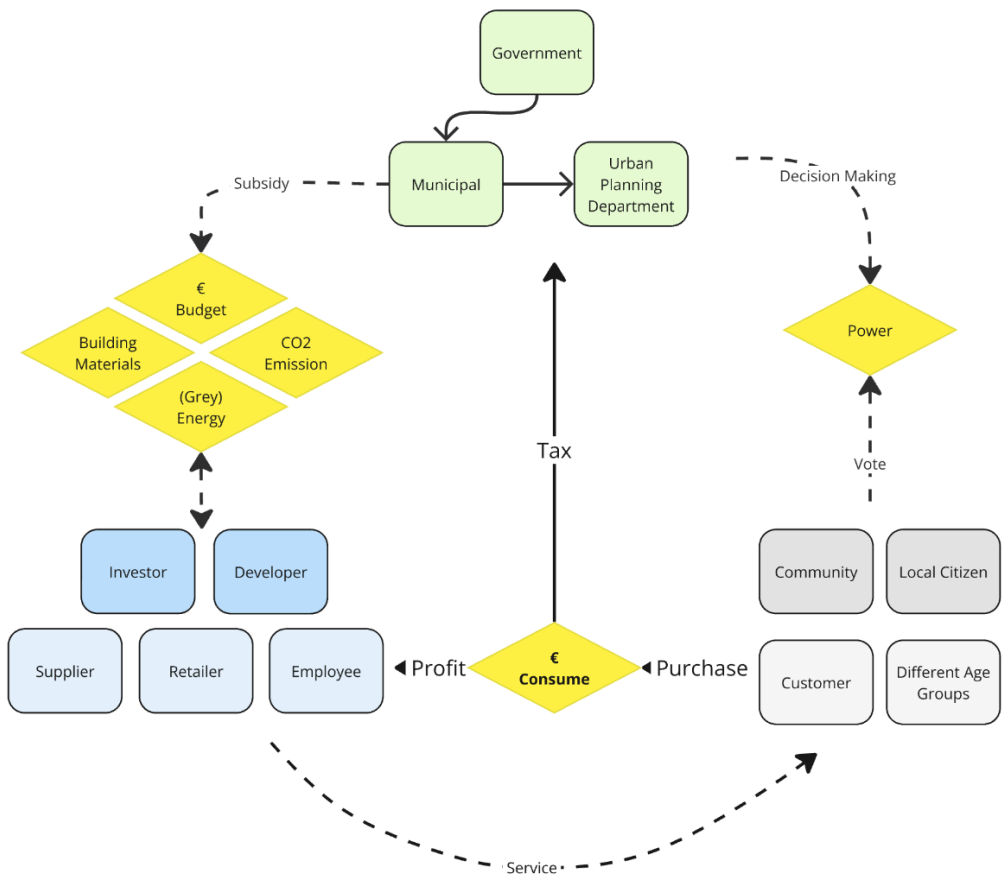
Furthermore, two critical questions have been identified for deeper consideration in the next design phase: How can the perspectives of minority groups be included? Is active participation from all stakeholders necessary to achieve project goals?

On November 5, 2024, during the workshop, we had the privilege of engaging in an in-depth discussion with Mr. Eric Treske from intrestik to define and explore the stakeholders and participants, as well as their interrelationships, within the context of Department Store Transformation.

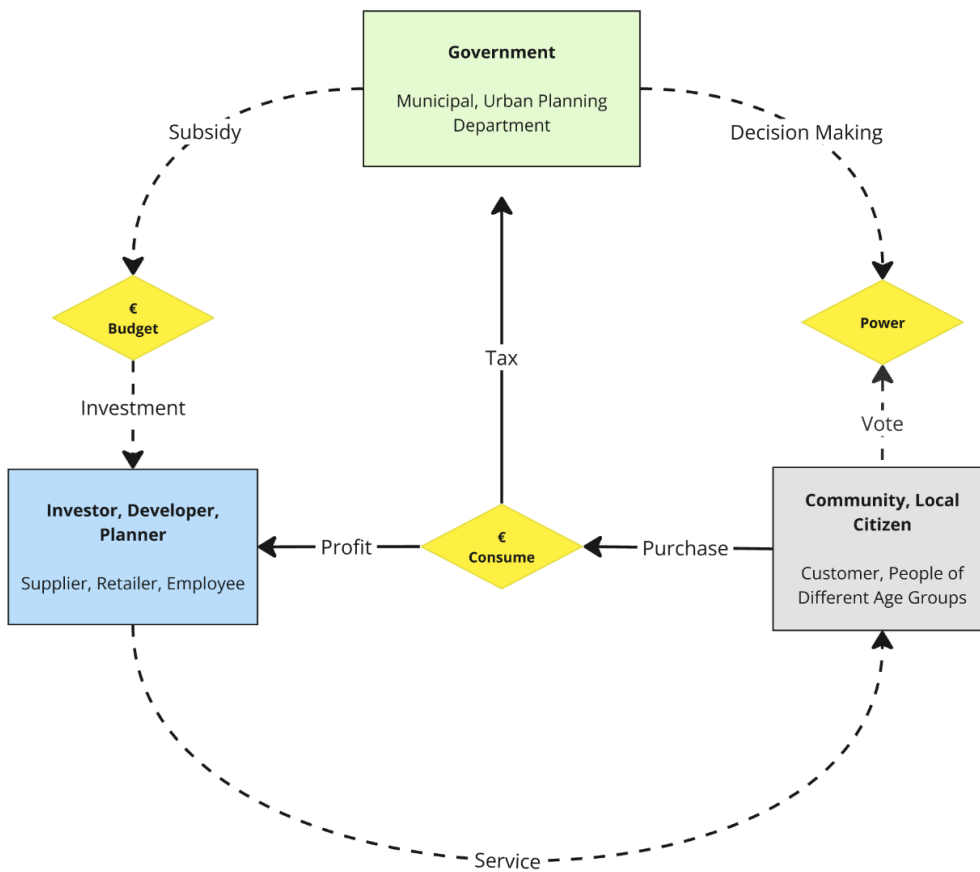


Potential Stakeholders and Participants

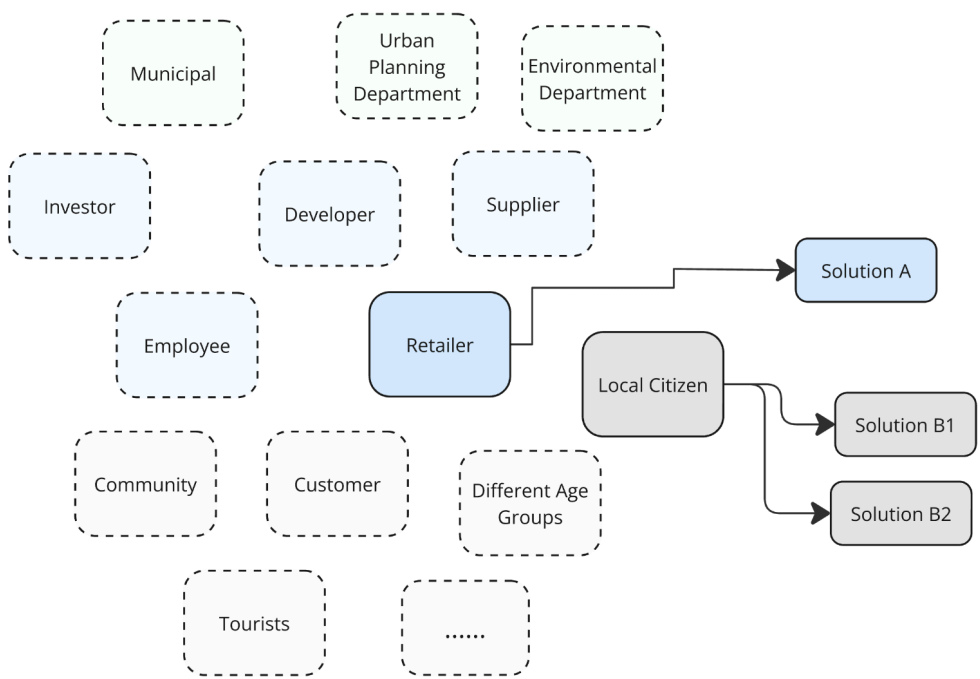
In the process of department store transformation, various stakeholders and participants form a complex network of relationships through different types of resources and mediums.



Based on different analytical perspectives, their network of relationships can often result in multiple distinct variations.



In addition, selecting different stakeholders as direct participants will significantly influence the design and implementation of project solutions. The diagram illustrates how stakeholders such as retailers and local citizens, through their respective needs and perspectives, drive the formation of different types of solutions. For example, retailers tend to propose economically-driven solutions, while the participation of local residents may lead to solutions that prioritize social inclusivity and environmental sustainability.

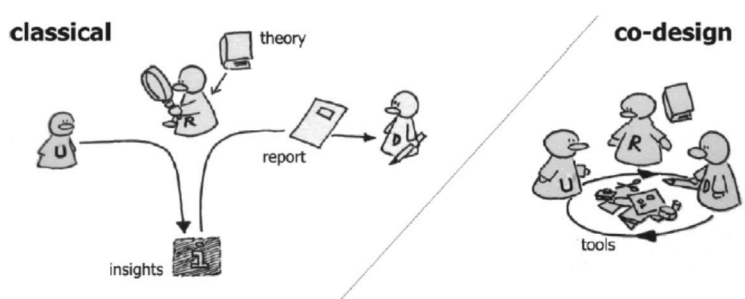


Co-Design as a Form of Participation

After conducting an in-depth analysis and defining the potential stakeholders and participants for this project, we explored forms of participation that align with our needs in urban transformation design. Among these, we found co-design particularly compelling.

Co-Design is a design approach centered on the deep involvement of stakeholders, aiming to align design objectives with real-world needs through shared discovery, planning, design, production, and evaluation. This approach transcends the traditional “theory-to-report” linear model of design, shifting toward a dynamic process that emphasizes multi-party collaboration and interaction (Sanders and Stappers, 2008).

Co-design not only addresses complex problems by integrating diverse perspectives but also employs participatory tools and iterative feedback mechanisms to make the design process more inclusive and adaptable (KA McKercher, 2023). By simultaneously meeting the needs of multiple parties, this approach provides a more feasible and practical path toward achieving design objectives.



Sanders, E. B. N., & Stappers, P. J. (2008)

The Role of Digital Technology in Participatory Design

At the conclusion of the Research phase, we discussed the characteristics and potential of digital technology in the participatory design process.

The ideal digital tool should possess characteristics such as user-friendly navigation, strong accessibility, robust flexibility, information transparency, and motivational features. Intuitive and easy-to-use interfaces help users operate tools effortlessly, while support for multiple devices and platforms ensures accessibility for diverse groups. Flexible functionalities enable adaptation to various scenarios, while transparent information-sharing mechanisms build user trust. Moreover, incentive mechanisms encourage user participation, further boosting satisfaction and motivation to engage.

User-friendly Navigation

Accessibility

Flexibility

Transparency

Rewardable

References

McKercher, K. A. (2020). Beyond sticky notes. Doing co-design for Real: Mindsets, Methods, and Movements, 1st Edn. Sydney, NSW: Beyond Sticky Notes.

Sanders, E. B. N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. Co-design, 4(1), 5-18.

Williams, C., & Fang, L. (2019). A value-focused multiple participant-multiple criteria (MPMC) decision support approach for public policy formulation. Group Decision and Negotiation, 28(1), 99-126.

Concept Development

Potential of Urban Co-design

During the conceptual development phase, we focused on exploring the potential of urban co-design. One core question emerged: What defines the characteristics of urban architecture for ordinary citizens? Our answer lies in the facade.

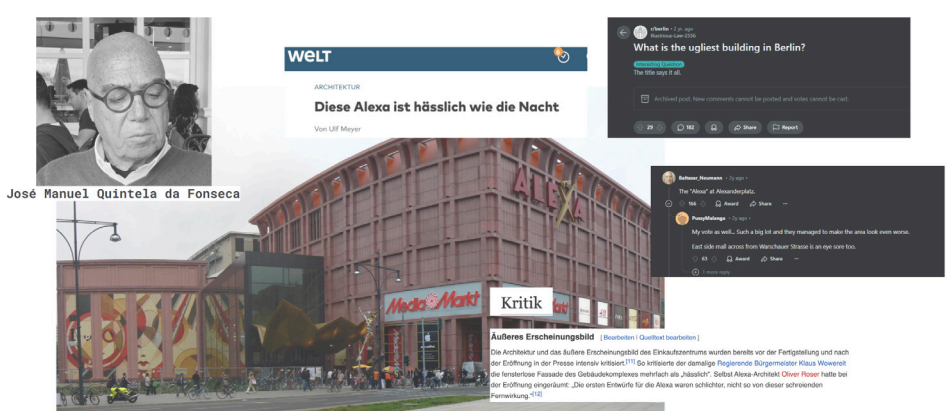
As the most visible aspect of a building, the facade not only embodies the aesthetics and functionality of architecture but also directly shapes how citizens perceive and identify with urban spaces. By viewing the facade as a crucial medium connecting architecture with the public, the potential of co-design is fully realized.

Historical Evolution of Department Store Facades

The historical evolution of department store facades illustrates the changing architectural styles across different eras and their relationship with societal needs. In 1900, the Galeria Kaufhof at Berlin's Alexanderplatz showcased a classical style, reflecting the dignity and sophistication of traditional architecture. By the 1970s, its facade design shifted towards modernism, emphasizing functionality and simplicity. Today, the design has evolved into a minimalist, utility-driven style. This progression not only mirrors the changing trends in architectural design but also demonstrates how commercial buildings adapt and respond to urban environments.

Galeria Kaufhof at Alexanderplatz in Berlin

However, certain modern buildings have faced widespread criticism for neglecting public input. For example, the Alexa Shopping Center at Alexanderplatz was labeled “ugly” due to its facade failing to harmonize with its surroundings, sparking controversy among architects and the public. Such criticism highlights the risks of excluding public voices from the design process, potentially resulting in disconnection between design solutions and community needs, which leads to frustration and a diminished sense of belonging among citizens.



First Concept

By analyzing these cases, the importance of public participation in architectural design becomes evident. Incorporating residents' opinions into the design process helps align the aesthetics and functionality of facades with community values. More importantly, it fosters a stronger sense of identification and engagement with the urban environment.

Our concept, "Draw Your City", stems from this question and aims to engage ordinary citizens in the design of facades. This concept seeks to redefine public participation in urban design by integrating augmented reality (AR) and artificial intelligence (AI). Users can simply take a photo of an existing building and sketch a basic idea, which AI will transform into diverse and professional design proposals, rendered in real time through AR technology.

This innovative design tool lowers the barrier to entry, enabling users without design experience to easily participate in interactive design anytime, anywhere. AI not only optimizes the aesthetic and functional aspects of the design proposals but also ensures a high degree of practical feasibility.

Limitations of the First Concept

After summarizing and reviewing the initial concept, we identified several areas in the design philosophy and technical implementation that require improvement.

Firstly, regarding participatory design, we realized that the initial concept lacked sufficient attention to local details and the overall street atmosphere, which makes it difficult to reflect the unique characteristics of the community. In other words, since the early implementation focused more on facade design, it overlooked the need for a holistic spatial ambiance and the user's experience of the neighborhood as a whole.

Secondly, in terms of technical implementation, we recognized that with existing technologies, it is challenging to accurately map AI-generated facade images onto building surfaces in an augmented reality environment. This highlights the need to improve the visualization and interactive mechanisms for AI-generated designs in AR.

Moreover, the initial design focused primarily on providing a one-time design experience for individual users. Once users generate their designs with AI, they often lack motivation to continue using the digital application over time. Therefore, we need to create a more immersive and engaging interactive experience, particularly one that fosters collaboration between users.

Final Concept

The final concept, “Draw Your City”, redefines the public experience of participating in urban design. Users simply take a photo of an existing building or scene, sketch a basic idea, and input relevant prompts. The AI then transforms the sketch into diverse and professional design proposals.

Building on this foundation, the new concept goes beyond the initial focus on building facades, integrating core elements such as local detail optimization, enhanced overall spatial experience, and community collaboration.

Concept Image: Co-Design

Co-Design Phase

In this phase, users can not only design small elements such as greenery, streetlights, and signage, adding vitality and character to the street, but also extend their individual designs to neighborhood-wide planning, or adjust the street atmosphere and functional layout.

Example: Detailed Design with Generative AI

Example: Holistic Design with Generative AI

Visualization and Exploration Phase

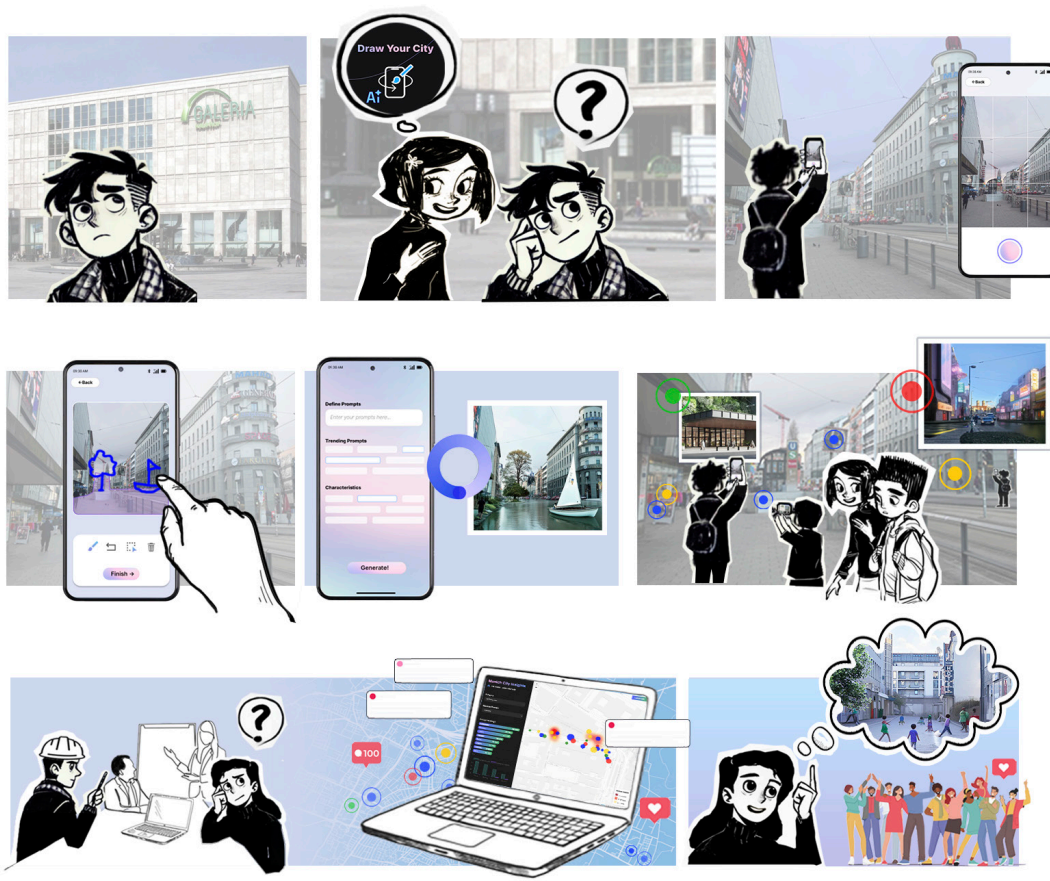
In the second phase, the integration of augmented reality (AR) introduces an “immersive urban walk” feature. This allows users to explore different user-generated designs in specific areas of the city in real time, sharing inspiration and collaborating with community members.

Concept Image: AR Exploration

Evaluation Phase

In the third phase, users are encouraged to provide real-time feedback on the generated designs. By combining this data with the prompts used during image generation, urban planners, architects, and other professionals can gain deeper insights into the public's vision for future urban design.

Concept Image: Evaluation

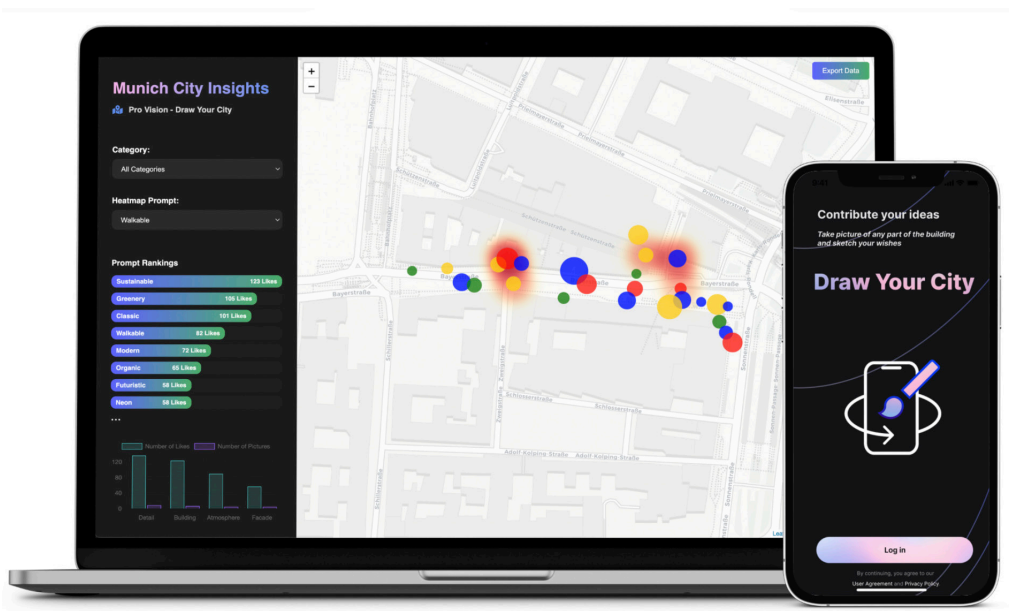


Storyboard: Usage Scenario

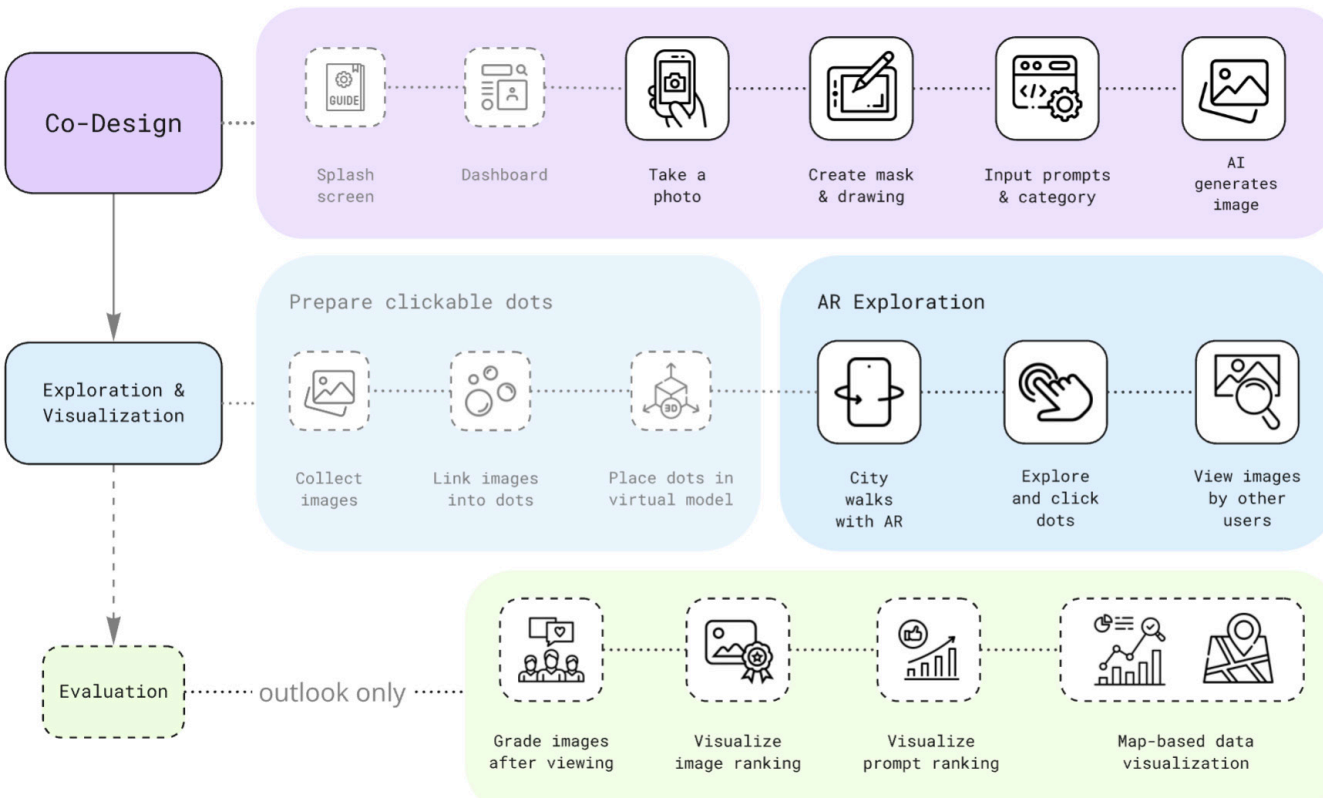
Prototype Production

During the prototyping phase, we further refined the three interaction phases proposed in the final concept and subsequently developed corresponding flowcharts and UIs.

Given the workload and technical complexity of this semester, the final prototype primarily focuses on the Co-Design and Exploration & Visualization phases.



Prototype Rendering: Mobile & PC Version



Different Phases of Interaction

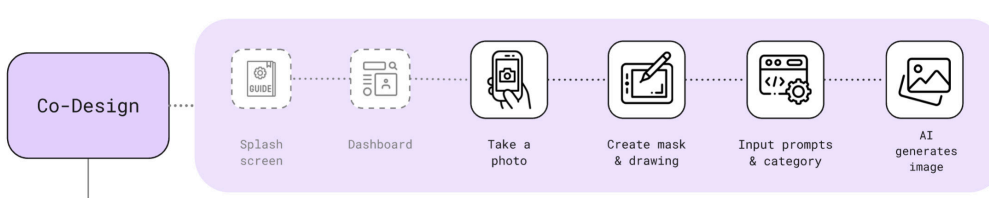
Co-Design Phase

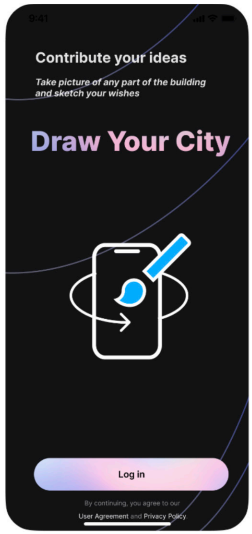
In the Co-Design Phase, users can realize personalized urban design concepts through a simple and intuitive interaction process. This approach ensures that participation is accessible even for individuals without design experience.

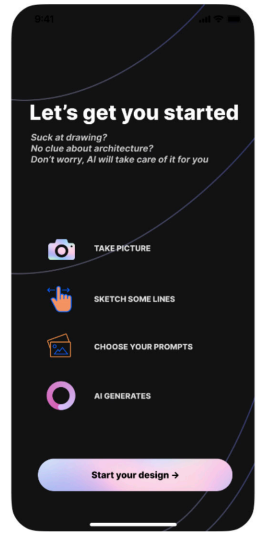
The process consists of the following steps: users begin by accessing the application through the splash screen. They then select a project from the dashboard and capture a photo of an existing scene or specific building. Next, users create a mask on the image and sketch their ideas, which helps define the modification area and initial concept. Afterward, they input prompts and select categories. The AI generates high-quality and diverse design images based on their input.

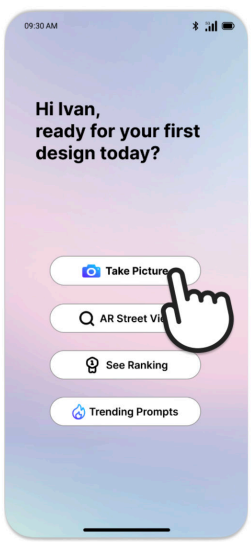
This phase is characterized by its inclusivity and does not require users to have professional design skills. The user-friendly interface and straightforward operations significantly reduce barriers for public participation in urban design. Users' sketches and prompts are transformed into rich and diverse design proposals. The AI optimizes the aesthetics and functionality of the designs while ensuring the practical feasibility of the results.

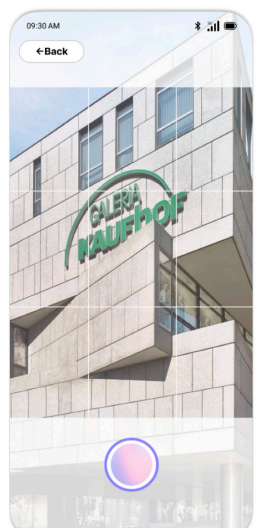
Through this design process, users can visualize multiple possibilities for future urban spaces. This approach enhances creative expression and introduces greater diversity and personalization into urban planning.

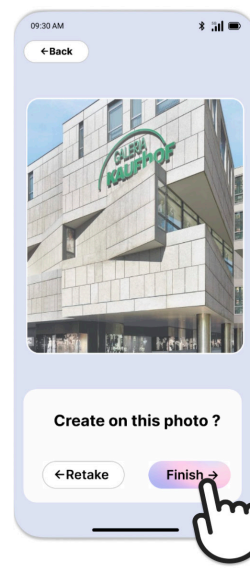




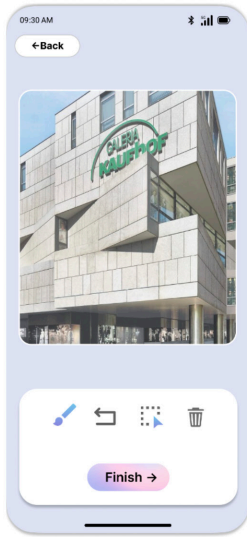


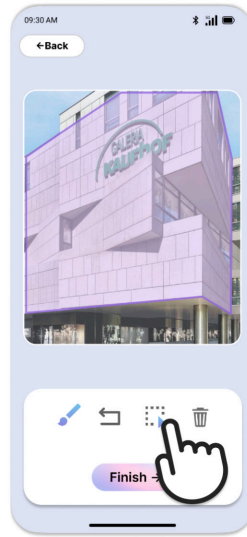


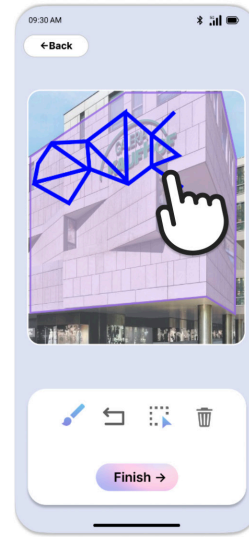


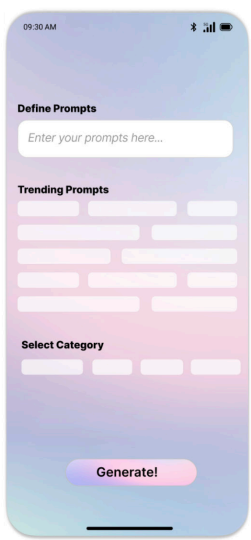


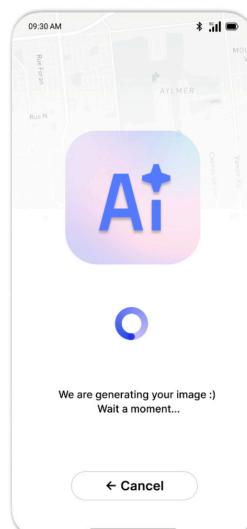
UI Design: Co-Design Phase

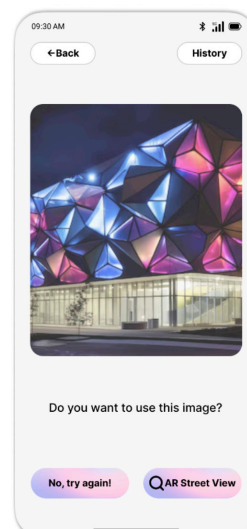












UI Design: Co-Design Phase

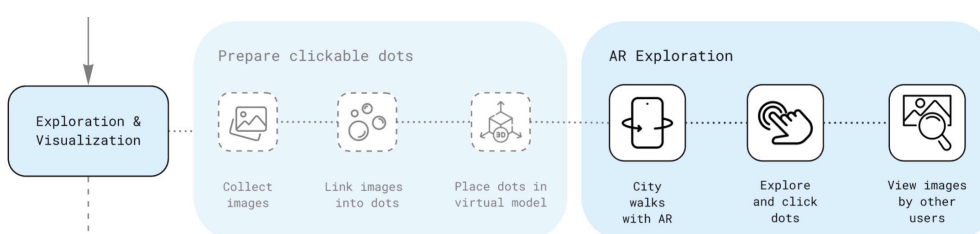
Visualization and Exploration Phase

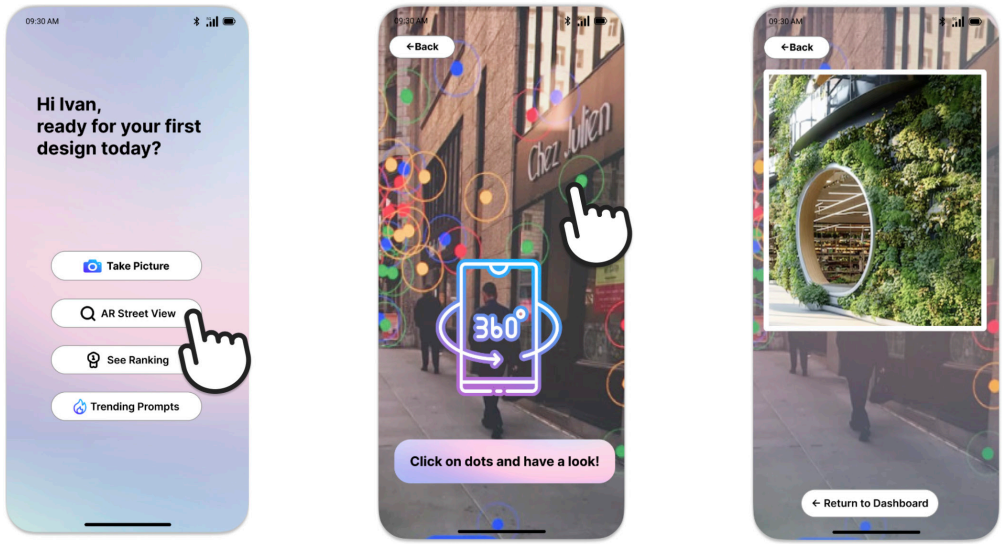
In the Visualization and Exploration Phase, our goal is to integrate participants' design outcomes with urban spaces through augmented reality (AR) technology.

In the previous phase, many participants visualized their design ideas by capturing and modifying photos of urban scenes. In this phase, users can explore and review other participants' designs by using the AR mode to click on specific "interactive points" within the city. This approach not only allows users to gain insights into others' creative ideas but also inspires new concepts, further driving design discussions and collaboration.

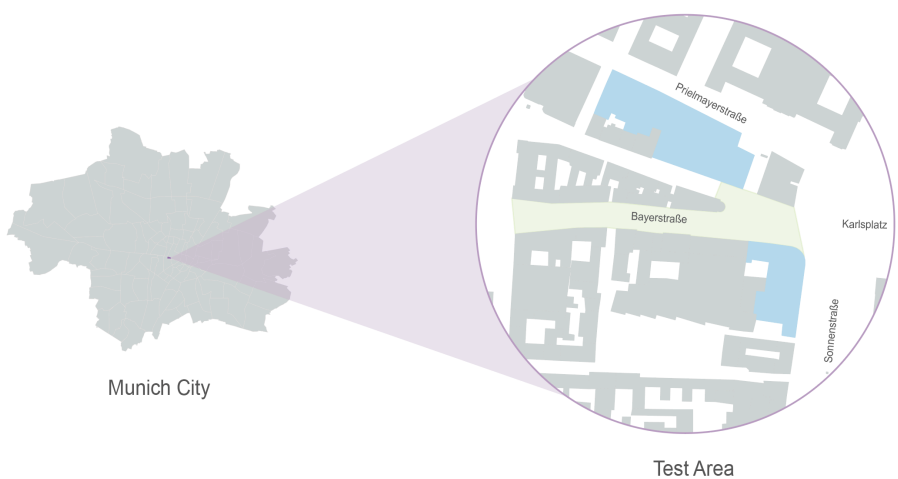
The mechanism supporting this feature links all design images to corresponding "interactive points," which are placed in their respective locations within the city. Since this is the prototyping phase, and given the technical challenges we are currently facing, this aspect of the interactive design is manually implemented rather than automated through programming.

The innovation of this phase lies in bringing participants' design outcomes into real-world environments, which enables users to explore others' ideas immersively within the city. Furthermore, this phase helps sustain and enhance participants' interest and engagement. Users are encouraged to spend more time with the digital tool instead of uninstalling it after completing the first phase. This not only deepens the user experience but also ensures long-term use of the tool and sustained community involvement.





UI Design: Visualization and Exploration Phase



Defining the Test Area

For the prototype implementation of the Visualization and Exploration phase, we selected Bayerstrasse in downtown Munich, Germany, as the test area. The advantage of this location lies in its proximity to the original sites of two former department store buildings (marked in blue on the map). This provides a rich contextual background for exploring interactive street design.

After completing the Co-Design phase, we utilized AI image generation to create approximately 30 AI-designed images within the designated test area (marked in green on the map). These images simulate the diverse visual transformations that different participants might envision for the streetscape. At the same time, we recorded the geographic coordinates of each generated image and marked them as individual points on the map.

Defining the Test Points

The next step involved linking the generated images to these points based on GPS coordinates and placing them within a virtual space created in Unity. This setup allows participants to explore different user-generated designs by tapping on these points displayed on their mobile screens while navigating the test area.

To enhance user engagement and facilitate better organization, we assigned different colors to the interactive points, categorizing them based on the type of design intervention:

Blue (Detail): Represents small objects, such as trash bins, trees, or benches.

Green (Facade): Represents modifications to building facades.

Yellow (Building): Represents changes to entire buildings.

Red (Atmosphere): Represents transformations in the overall environment, such as alterations to the neighborhood ambiance.

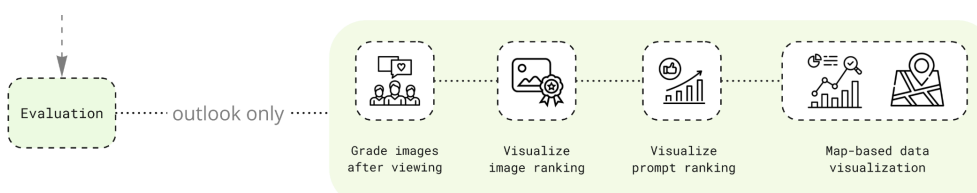
When participants input prompts in the Co-Design phase, they can directly select the corresponding category. This selection helps the system accurately record and manage different design objectives. With this approach, participants can easily understand the meaning of each color-coded point, which makes the exploration process more intuitive. Additionally, this categorization provides valuable data support for the Evaluation phase. It helps structure the analysis of user-generated design proposals in a more organized way.

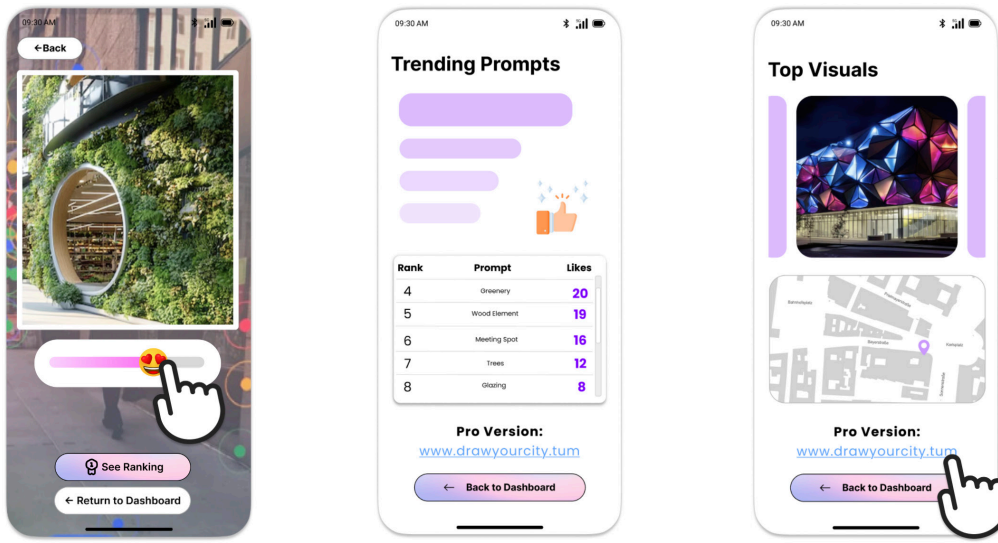
Evaluation Phase

In the Evaluation Phase, our main goal is to create a structured approach that connects participants' creative contributions with the professional requirements of urban planning and design.

For general participants, this phase introduces image rating and ranking features. On the platform, users can rate designs after viewing them. The system then generates leaderboards for the most popular images and prompts. This feature highlights trending design directions and creative ideas. It enhances user engagement and encourages community discussions on urban design. At this stage, these functions are only presented as conceptual features. Due to the workload of this project, full programming implementation was not completed within this semester.

This phase plays a key role in collecting and analyzing user preferences. It creates a connection between public creativity and professional design expertise. By incorporating community-driven ideas, this process strengthens the co-design approach and makes urban planning more inclusive.

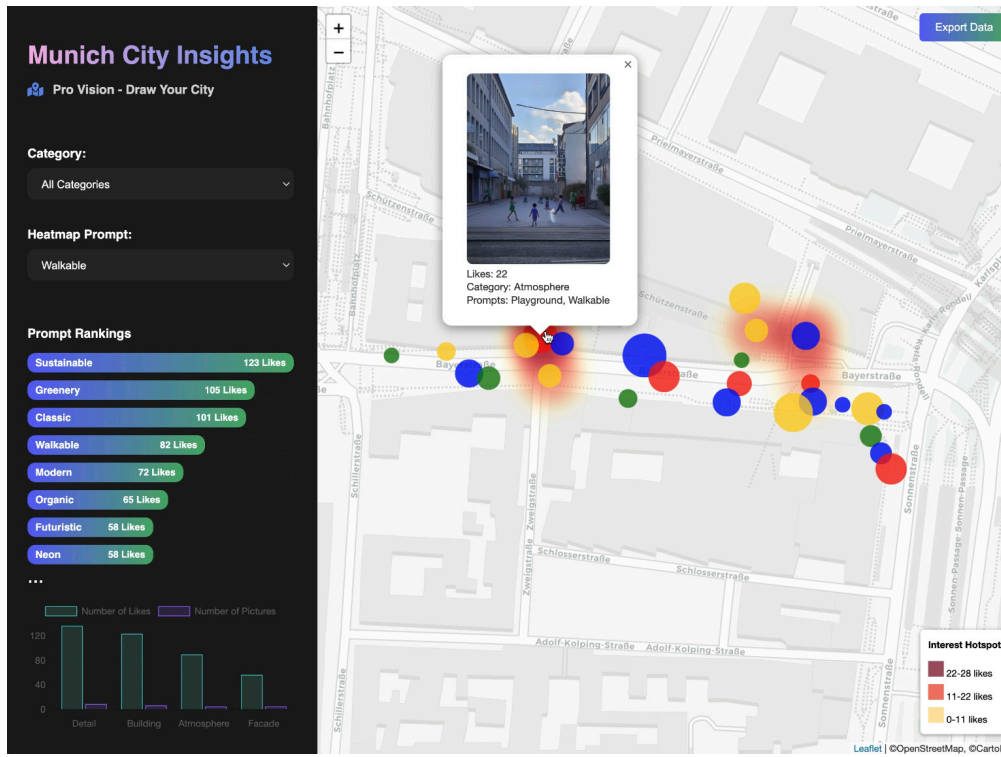




UI Design: Evaluation Phase for Ordinary Participant

We also developed a Pro Version for urban planners and architects. This version includes a map-based data visualization tool that helps professionals analyze and interpret user feedback more efficiently. Through heatmaps and distribution data, designers and planners can quickly identify key areas of user interest. The tool highlights elements such as details, building facades, entire structures, and overall ambiance.

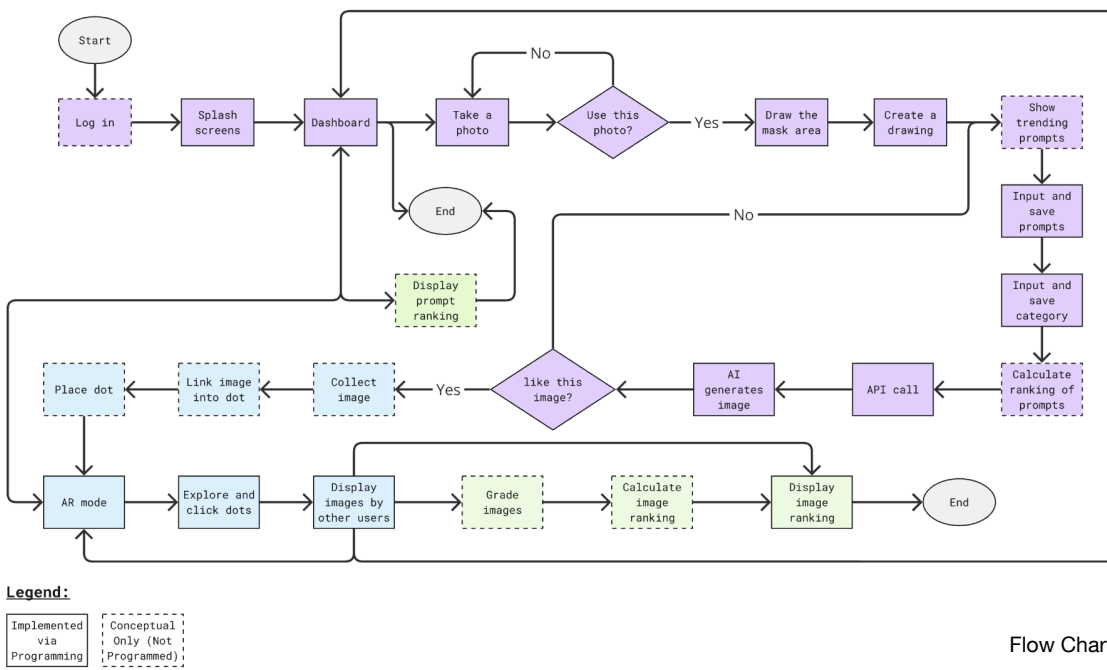
The rankings of popular images and prompts provide further insights. By identifying high-frequency elements in public contributions, this data reveals the design directions and trends that attract the most interest. It offers valuable references and inspiration for professionals in the early stages of urban planning and design.



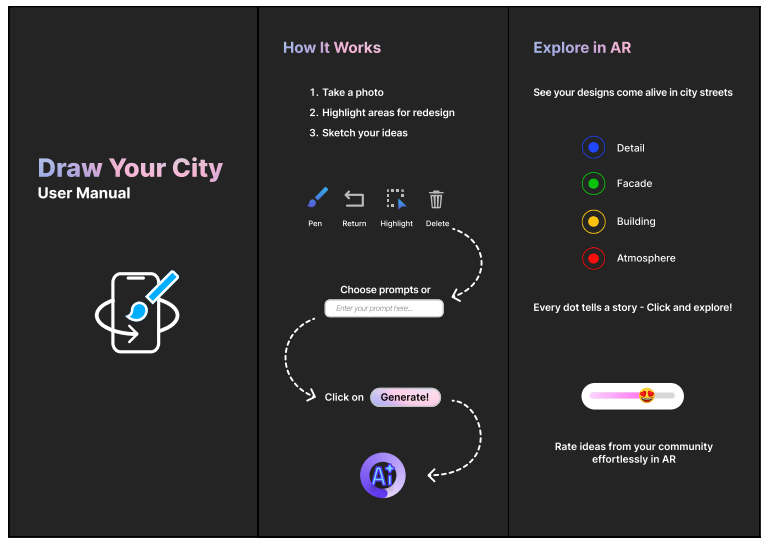
UI Design: Pro Version as a Future Outlook

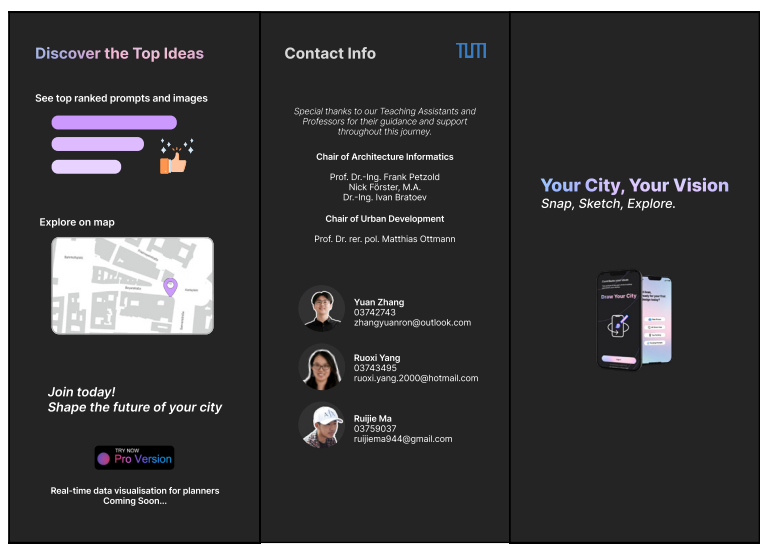
The project initially focused on individual department stores. Over time, it expanded into a broader participatory design strategy for entire neighborhoods. This transformation shows how public creativity, supported by technology, can shape larger urban planning visions. The prompt ranking and image leaderboard system inspires participants and helps designers focus on the concerns that matter most to the public. It ensures that the future design of urban districts aligns more closely with community expectations and needs.

Essential Technical and Process Illustrations



Flow Chart


Draw Your City
User Manual
How It Works
1. Take a photo
2. Highlight areas for redesign
3. Sketch your ideas
Pen
Return
Highlight
Delete
Choose prompts or
Enter your prompt here...
Click on
Generate!
Explore in AR
See your designs come alive in city streets
Detail
Facade
Building
Atmosphere
Every dot tells a story - Click and explore!
Rate ideas from your community effortlessly in AR


Discover the Top Ideas
See top ranked prompts and images
Explore on map
Join today!
Shape the future of your city
TRY NOW
Pro Version
Real-time data visualisation for planners
Coming Soon...
Contact Info
Special thanks to our Teaching Assistants and Professors for their guidance and support throughout this journey.
Chair of Architecture Informatics
Prof. Dr.-Ing. Frank Petzold
Nick Förster, M.A.
Dr.-Ing. Ivan Bratoev
Chair of Urban Development
Prof. Dr. rer. pol. Matthias Ottmann
Yuan Zhang
03742743
zhangyuanron@outlook.com
Ruoxi Yang
03743495
ruoxi.yang.2000@hotmail.com
Ruijie Ma
03759037
ruijiema944@gmail.com
Your City, Your Vision
Snap, Sketch, Explore.

User Manual

Reflection and Outlook

Reflection

In this project, we aimed to explore the potential of collaborative design in shaping future urban spaces. Through the development and testing of the “Draw Your City” prototype, we sought to empower ordinary users with the ability to influence urban design. Throughout the testing and usage process, participant feedback was highly encouraging. Users expressed that the simple process of taking photos, sketching ideas, and generating AI-based designs gave them a sense of enjoyment and achievement in engaging with urban design. Some participants noted that the AI-generated designs not only visually represented their ideas but also sparked additional creativity. Regarding the Exploration and Visualization phase, users particularly appreciated the intuitiveness and immersive experience of viewing others’creations through AR mode.

However, the testing phase also revealed several challenges and limitations. For example, from the perspective of urban planners, they acknowledged that while the platform provided an inspirational resource for early design stages, it still had room for improvement in terms of the depth and granularity of data visualization. These insights have provided valuable references for evaluating the project‘s achievements and areas for improvement.

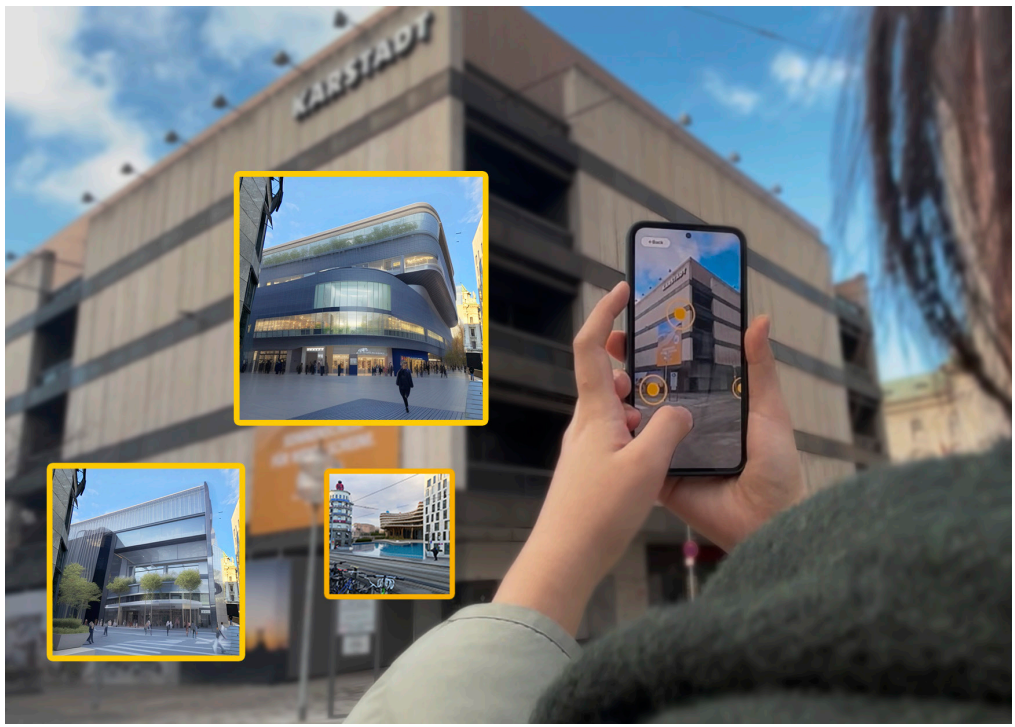


Photo: On-Site Testing with the Prototype

Outlook

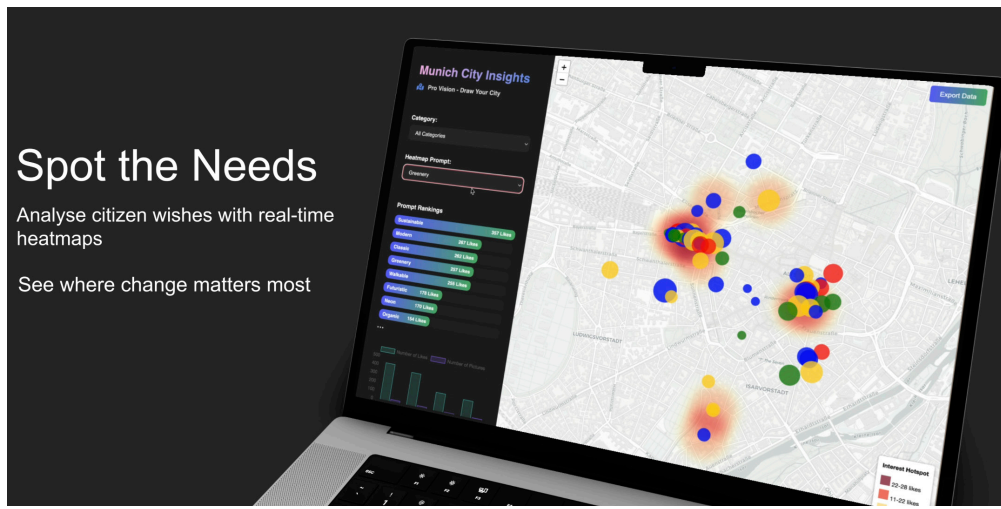
Looking ahead, we plan to enhance “Draw Your City” by addressing the remaining challenges in the current prototype. We also aim to establish technical and research directions for its future development.

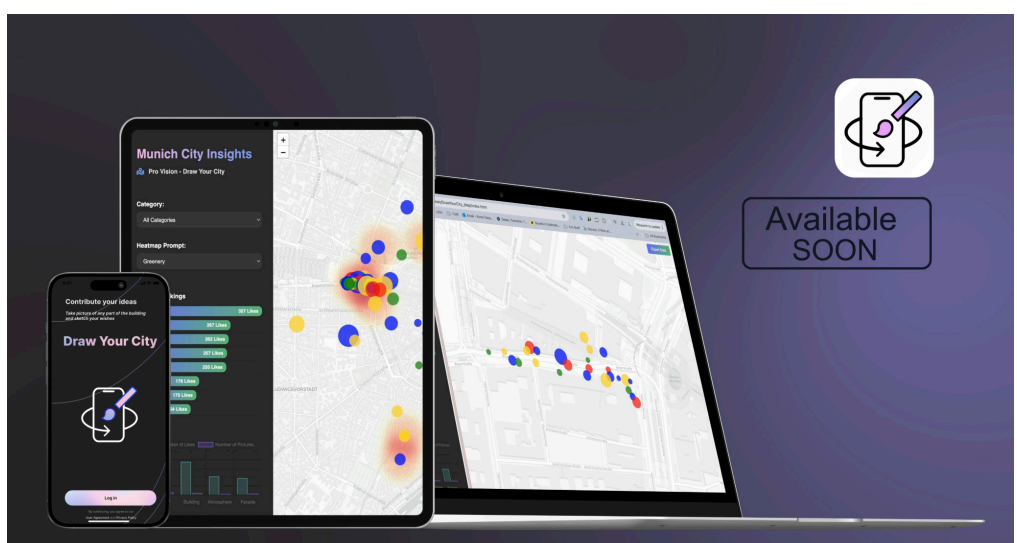
One of the key challenges is the automatic matching of generated points to corresponding objects or areas. In the existing prototype, this process requires manual operation. In the future, we will explore AI-based visual solutions to automate this matching process. This improvement will simplify user interactions and create a more seamless exploration experience.

During the Co-Design Phase, Professor Frank Petzold pointed out that differences in language affect how prompts influence AI-generated results. This issue presents an important research direction. Studying this aspect will add depth to the Evaluation Phase and help adapt the prototype for multilingual and international applications.

In the Evaluation Phase, we also plan to implement the Pro Version’s data visualization features. The current prototype includes a map-based heatmap that allows urban planners to analyze user preferences. Future improvements will refine this functionality and ensure more precise visual insights.

This project provides an initial exploration of collaborative design and public participation in urban spaces. It also clarifies key areas for future improvement. Through technical advancements and expanded functionality, “Draw Your City” will offer better support for both general users and professionals in urban design. Expanding its multilingual and multicultural capabilities will further strengthen its potential for shaping global urban development in innovative ways.


Spot the Needs
Analyse citizen wishes with real-time heatmaps
See where change matters most
Munich City Insights
Pro Vision - Draw Your City
Export Data


Munich City Insights
Pro Vision - Draw Your City
Contribute your ideas
Draw Your City
Available SOON

Contact

Ruoxi Yang
03743495
8. Sem. Bachelor
ruoxi.yang.2000@hotmail.com
+49 1525 6573092

Ruijie Ma
03759037
7. Sem. Bachelor
ruijiema944@gmail.com
+49 1525 9376351

Yuan Zhang
03742743
1. Sem. Master
zhangyuanron@outlook.com
+49 1523 6520281