

# Spatiando con gli Occhi: Delivering an Interactive 3D Reconstruction of 17<sup>th</sup>-Century Rome

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## Abstract

The publisher of Giovanni Battista Falda's great map of Rome ca. 1676 invites the viewer to stroll the streets with their eyes: "spatiando con gli occhi per tutte le vie, piazze, giardini, et contrade della Città". Falda crafted a printed version of the city that could be taken abroad allowing 17<sup>th</sup>-century viewers a virtual visit to Rome. They could "walk" every street, seeing the grandeur of the modern building programs of Urban VIII, Innocent X, and Alexander VII and the impact they were having on the urban environment of Rome.

The *Envisioning Baroque Rome* project takes this virtual Rome into the modern era, allowing the viewer to virtually visit 17<sup>th</sup>-century Rome using XR technology. By combining extensive research, artistic rendering, and XR world building, we are recreating Falda's 1676 Rome one building and block at a time in 3D, using Autodesk Maya, 3DS Max, and Unity to create an interactive large-scale build. Our efforts to research every detail that Falda renders in his prints have resulted in precious insights into the priorities of the artist and his patrons, the construction programs in Rome, and relationships among artists and publishers.

## 1. Introduction to Project

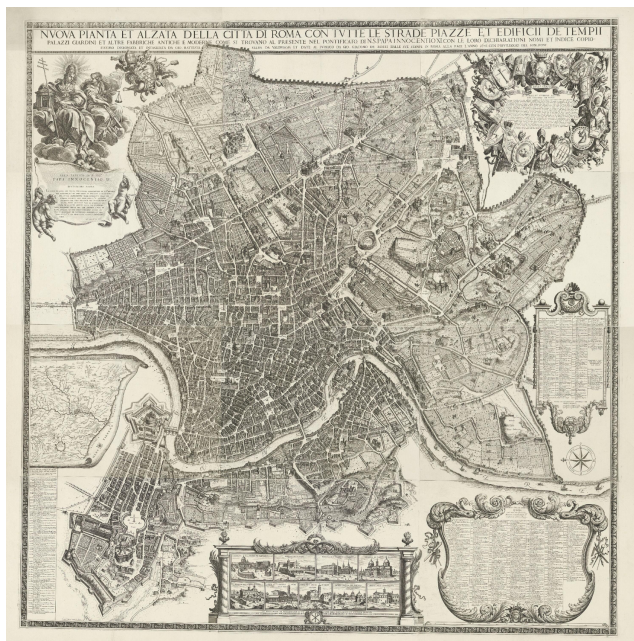
*Envisioning Baroque Rome* is a virtual heritage project based at Emory University. Professor Sarah McPhee has been leading the project since its inception in 2012. Under McPhee's guidance, the project is creating an interactive 3D reconstruction of Rome ca. 1676, centered on the etchings of Giovanni Battista Falda. Falda was an artist and printmaker in Rome, who, due to his prolific, detailed, and accurate works, remains one of the best sources on 17<sup>th</sup>-century urban Roman heritage. He crafted a printed map of Rome in 1676, under the auspices of Pope Clement X and then Pope Innocent XI. While other maps illustrated 17<sup>th</sup>-century Rome, Falda's map is commonly regarded as the finest [McP12, McP19]. Composed of 12 etchings, and measuring 154 cm x 153 cm total when put together, the map is both grand and yet able to be transported in pieces (Figure 1). The publisher of Falda's great map invites the viewer to stroll the streets with their eyes, saying they can "spatiando con gli occhi per tutte le vie, piazze, giardini, et contrade della Città" [Fal76]. The map could be taken abroad,

presenting 17<sup>th</sup>-century viewers with the opportunity to visit a simulated Rome. Long before digital options, they could virtually walk every street, seeing the grandeur of the modern building programs of popes like Urban VIII, Innocent X, and Alexander VII and the impact they were having on the urban environment.

Falda further represented Rome through *vedute* (views) of key points around the city, particularly those which benefitted from recent modern construction. Through volumes published by Giovanni Giacomo de Rossi, including multiple volumes of *Il Nuovo Teatro*, and individual volumes of *Palazzi di Roma*, *Li Giardini di Roma*, and *Le Fontane di Roma*, as well as single prints, he depicted around 300 scenes from the early modern city of Rome [McP13]. The first volume of *Il Nuovo Teatro* introduces the viewer to the city, entering at the northernmost point, the Piazza del Popolo, and roughly following the path of pilgrims and other visitors, passing down the via del Corso toward the Campidoglio [McP13]. Falda's prints also cluster along other critical routes through the city, such as those that were associated with the Papal *posse* (procession of the Pope), a key route from the Vatican, over the Campidoglio, and on to St. John Lateran, along the via Papalis, a combination of individual roads making a ceremonial route through the city [DeM21]. The ceremonial route also became a theatre for building projects among competing families and groups, shaping the urban structure of Rome [Caf10].

*Envisioning Baroque Rome* takes Falda's 17<sup>th</sup>-century visual exploration of Rome, created through his maps and prints, into the digital era, allowing the viewer to virtually visit Falda's Rome in 1676 using XR technology. By combining extensive research, artistic rendering, and XR world building, we are recreating Falda's Rome one building and block at a time. *Envisioning Baroque Rome* is building the map in 3D, using Autodesk Maya, 3DS Max, and Unity to create an interactive large-scale build; a build is a compiled executable file Unity creates that holds all the project files and code, supplied to the end user so they can interact with Rome. We have begun by focusing our building along the ceremonial routes, from the Piazza del Popolo to the Campidoglio, from the Campidoglio to the Lateran, and from the Campidoglio to the Vatican, as these routes were often the backdrops for papal building programs and other major Baroque building projects.

*Envisioning Baroque Rome* has been exploring different delivery methods for a large-scale 3D educational environment. By utilizing Unity's built-in WebGL system, we are able to share the environment with the public at no cost to them. Through feedback sessions with students and teachers, we are able to adjust our methods to better accommodate educational needs.



**Figure 1:** Falda, G. B. *Nuova pianta et alzata della città di Roma*, 1676. Rijksmuseum, Obj. no. RP-P-OB-207.658, C-PD.

## 2. Interactive Heritage

The field of virtual heritage developed as a combination of cultural heritage and developing virtual reality (VR) and other digital information technology. Virtual heritage provides methods for studying historical periods and for education and outreach to students and the public about art and history [Cha21,KFH09]. The Baroque city of Rome is no longer extant, obscured and buried over the course of centuries. Prints, rather than photographs (not invented for 150 years), are one of our best sources for this period of Rome's heritage. *Envisioning Baroque Rome* combines a 3D reconstruction with examination of 17<sup>th</sup>-century prints to observe Roman heritage. Printmaking, a key practice of representation and communication of the city, recorded building programs as well as ephemeral events to be sold in sheets or bound volumes to the public, both locally and abroad [McP13]. While we cannot perform a 3D scan of Baroque Rome, we can discover historically significant elements for cultural heritage and art history by effectively pulling these prints apart and digitally constructing 3D models of the researched buildings and spaces visible in Falda's prints. Our methodology of mindfully reconstructing spaces by researching every detail that Falda renders in his prints results in information about the priorities of the artist and his patrons, the modern construction programs being undertaken in Rome at that time, and relationships and communication networks among artists and publishers. Falda distilled "composition and line to produce a crisp, economical, almost buildable rendering of architecture and space," [McP13] and the reasons underlying each detail he chose to include in his works can reveal aspects of the development of modern urbanism geographically, architecturally, and socially.

For example, we see in Falda's depiction *Altra veduta di Piazza Colonna spianta et ampliata* a narrow strip of a palazzo in the background on which the windows appear to only be roughly shaped (Figure 2). Falda is representing the Palazzo Ludovisi, today the Palazzo Montecitorio, the seat of the Chamber of Deputies, part of the Italian Parliament. Falda represents it in an unfinished state, the state in which it stood for nearly four decades after the death of Pope Innocent X. While the Palazzo Montecitorio was later finished in a style recalling Bernini's original design, its construction was not continuous, resumed by Carlo Fontana in 1694 after a decades-long break, preserved by Falda here [BFH77].

In order to make the digital heritage of Baroque Rome interactive, after researching and modelling the spaces, we are publishing them along with research reports onto our website. The interactive environment and research materials are designed to communicate Roman art and history to students and the public.

The creation of a digital heritage project can itself be a part of



**Figure 2:** Comparison of Falda's print with the 3D reconstruction.

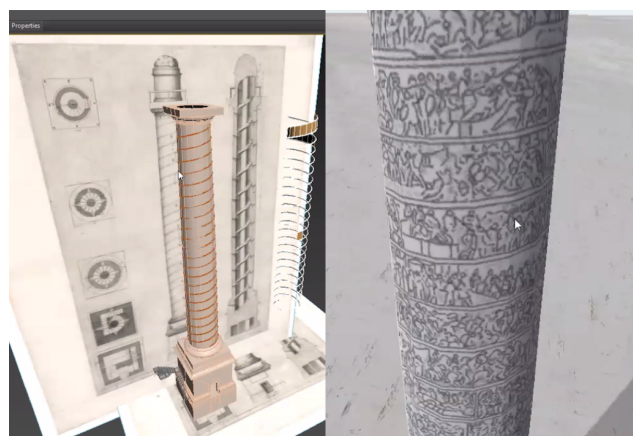
the educational process through student involvement. *Envisioning Baroque Rome* has taken the opportunity to educate students through the project on the process of digital scholarship. Professor McPhee has taught three classes teaching students the research and creation process of the project. *Envisioning Baroque Rome* also has student volunteers, who learn and participate. The website lists all participants (<https://www.baroquerome.org/about/#team>).

## 3. Construction of the City and Deployment on the Web

While procedural modeling has been a method suggested for digital projects to fill large historical spaces to answer certain research questions [DFM\*10] and agent-based modeling can be used productively to simulate future or hypothetical urban spaces [BSF24], the methodology of *Envisioning Baroque Rome* begins with researching each detail manually through artworks and archival documents before creating historically informed models. We approach the material from this perspective to reconstruct the spaces that formed backdrops for historical events and interactions, through which we can further examine the Baroque actors in these spaces. The historical models are placed in an interactive environment, allowing users to virtually interact with the lost spaces of 17<sup>th</sup>-century Rome. The project has been working on deployment strategies to improve access to the 3D interactive environment and connect it to a broader audience for education.

### 3.1 Creating the Models

Artists Ian Burr and Nicole Costello Matthews utilize both Autodesk 3DS Max and Maya to create the 3D models for the *Envisioning Baroque Rome* project. Both 3DS Max and Maya provide the precision and flexibility necessary for accurately replicating the elaborate facades of Baroque buildings and the surrounding cityscape. Drawing on a variety of historical sources, Falda's etchings serve as the primary references for reconstructing the architecture, street layouts, and landmarks of Baroque Rome. To ensure spatial accuracy, the 3D models are overlaid onto ichnographic (flat, non-perspectival) sources such as maps and building plans within the software, allowing the team to precisely position architectural elements, buildings and streets (Figure 3).



**Figure 3:** Trajan's Column model under development. Model by Ian Burr; textures by Nicole Costello Matthews.

After the 3D models are built, Adobe Photoshop is used to create textures and further illustrate the models. The textures reflect the materials and style depicted in Falda's works, ensuring the digital city is visually rich and historically faithful. While the creation of the models' geometry is precise according to historical

evidence, the textures represent a more creative process of interpreting the surfaces in Falda's works. Falda's prints cannot be directly applied to the models, due to their depictions of scale, perspective, and shading. By mimicking Falda's style and utilizing sources for detail, the artist can texture the models artistically without pure invention. The project maintains a library or "kit" of image textures such as brickwork, stonework, and patterns of tiles adapted directly from Falda's prints, as well as custom Photoshop brushes imitating his linework. The process maintains a fidelity to the style of the source material, while ensuring that the details are, broadly speaking, historically accurate. We document cases where there is insufficient evidence or Falda deviates from other sources.

### 3.2 Assembling the City

*Envisioning Baroque Rome* utilizes the Unity Engine, a real-time 3D software that allows users to create interactive 3D environments and deploy them to most desktop, mobile, console, augmented reality, and virtual reality platforms. Unity stores the assets, including 3D models, textures, materials, shaders, and programming scripts, in a project, in which they are placed into interactive 3D scenes that can be edited in real time.

To create an interactive virtual version of Falda's 1676 Rome, we had to bring the 3D models into the Unity project and place them accurately into the map of the city. While Falda depicts every street and block of Rome, these elements are shown in birds-eye-view, which makes it difficult to use his map for measured distances. Giambattista Nolli's 1748 map of Rome, the *Nuova pianta topografica della città di Roma*, provided a solution. Nolli created a detailed, accurate, 2D representation of Rome, working alongside other artists of that period, Giuseppe Vasi and Giovanni Battista Piranesi, who focused on *vedute* (views) of the city [Cee10]. Nolli's map represents an excellent topographic source for *Envisioning Baroque Rome*. It provides street level detail that is centuries closer to the urban plan of Falda's Rome, only roughly three-quarters of a century earlier. Nolli trained and worked as a surveyor in Milan in his youth and brought this skill to Rome to create his *Pianta Grande*, which combines printmaking with cartography to create an ichnographic representation reoriented to the north [Cie13]. It depicts a variety of spaces in Rome that were removed or changed in the 19<sup>th</sup> and early 20<sup>th</sup> centuries.

We placed the 3D models of buildings directly on the *Pianta Grande* on the footprint of each block within the Unity project. This allowed us to create Falda's Rome to a measured scale. We made exceptions in particular localities where Rome's streets or blocks had changed between 1676 and 1748, and for these we used detailed archival sources to include the 17<sup>th</sup>-century streetscape. For example, in the Montecitorio area, now Piazza di Monte Citorio, Falda depicts the 'Fontana Monte Citorio,' a fountain by Francesco da Volterra that is now lost. We utilized archival plans drawn up by Carlo Fontana to place this fountain (Figure 4). This archival plan supplements Nolli's map, which depicts the Piazza di Monte Citorio already constructed as it was in the early 18<sup>th</sup> century, after the demolition of the fountain and associated blocks.

In addition to geographic placement, we used topographical sources to place models as accurately as possible for altitude. Elevation reveals information on viewsheds and the relationships of spaces, as patrons constructed palazzi and other structures intending for them to be visible from certain positions and for them to have specific events in view, such as the *possessione* [Caf10]. We used topographical data from multiple published sources, modern studies, archaeological excavation records, and the *Forma Urbis Romae* map of Rodolfo Lanciani from 1901, and combined that data with the WorldCreator software to create as accurate a topographical landscape of Rome as we could.

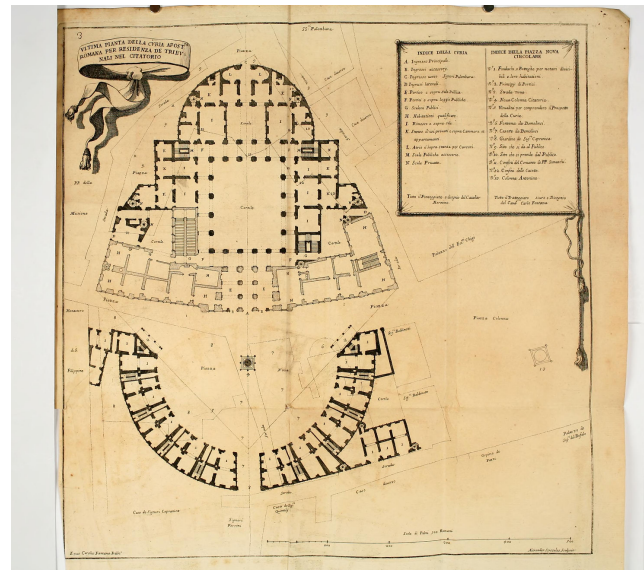


Figure 4: Fontana. Ultima Pianta della Curia Apostolica Romana per Residenza de Tribunali nel Citatorio, 1694 [Fon94].

### 3.3 Animating the Models with Unity

After bringing together the 3D models into the Unity project, we can animate the space, allowing for interactions between users and elements of the city. This elevates the models from renderings and transforms them into a virtual city. Our Visual Information Specialist, John Halbert, utilizes features of Unity, Unity plugins, and scripted code to animate the virtual environment. Realistic sunlight animates the world through the "SunLight" Unity plugin by Hessberg. The plugin ties the sun's accurate path to a provided latitude and longitude to show the sun's precise location for any hour and day of the year. Further, water, colored to match Falda's prints, flows under the Ponte Sant'Angelo and out of city fountains. Atmospheric sounds relevant to the period also reflect the environment around the user. The fountains splash, cows low, and people murmur in the piazze. We are adding researched contemporary Baroque music around the city, such as *Gli equivoci nel sembianze* by Alessandro Scarlatti, performed in Rome in 1679 at a palazzo off the via del Corso. All of this allows users to immerse themselves into the environment and feel as if they have actually travelled to Baroque Rome.

The models are created in full 3D, and interactivity through Unity allows users to walk around the spaces and see the buildings from every angle. The User Experience (UX), including control schemes and menus, incorporates feedback from student and faculty testing. Exploration is controlled by either keyboard or gamepad, allowing users to see how the buildings existed and how they related to the spaces around them (Figure 5). Menus allow one to move around the world, adjust light, sound, and other settings.

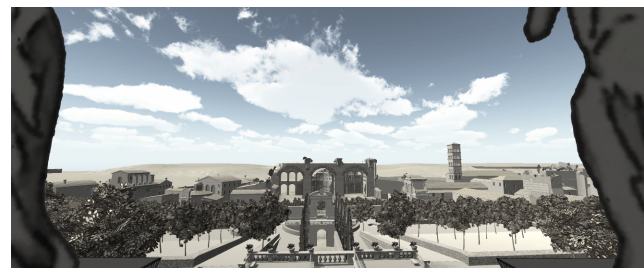


Figure 5: View from the Palatine gardens to the Basilica of Maxentius and Constantine showing their visual relationship.

### 3.4 Deployment Explorations

*Envisioning Baroque Rome* has been exploring the best ways to deploy our 3D environment for use by classes and the public. The compressed version of the build now comes to about 1 GB, a heavy load for standard laptops and Wi-Fi. We are testing different compression methods to see what loads best on various computer and internet options. While we already have sections of the city available on the web site, we are working to make the entire 3D environment available through [baroquerome.org](http://baroquerome.org), so that schools can utilize the virtual heritage tool without having to have installation permission for the computers they use. The project is currently built using Unity's WebGL system, so that it can be hosted on a standard server and presented through a website.

After regions of the city are completed, the research on each area, piazza by piazza and monument by monument, is being published to the *Envisioning Baroque Rome* website (<https://www.baroquerome.org/research/>).

### 4. Serious Games and Gamification Elements

In addition to publishing online the educational reports and the 3D interactive builds, we are working to implement interactive didactic methods to engage students and help them learn about the heritage of Baroque Rome within the virtual world. To accomplish this in-world education, we are adding gamification elements to form a serious game. Serious games are defined as games that have purposes other than entertainment only, while gamification is the "use of game design elements in non-game contexts [Bec21]."

Education through virtual heritage, learning in a serious game environment, can increase engagement with the subject material and user motivation by increasing the enjoyment of the learner and involving them in a competitive activity [YSX22]. Within our 3D environment, students will be able to learn about the process of printmaking as well as the cultural and architectural history of the spaces they explore. We are setting in game goals to motivate students to explore and game design elements to guide students so that they can more independently learn and discover 17<sup>th</sup> century urban Rome.

This version will task students with a quest to find the prints of Giovanni Battista Falda and build their own virtual volume of prints. Through their search they will interact with Baroque figures and learn about historical buildings, spaces, and events. As a part of our development process, we partnered in spring 2025 with Dr. Joy Li of Kennesaw State University, to have video game design students work on ideas for our serious game in their "Educational and Serious Game Design" course. This partnership has provided valuable ideas, while adding to the education of more students.

### 5. Conclusions

The application of virtual heritage in *Envisioning Baroque Rome* provides an opportunity for users to explore, engage with, and learn about the cultural events and art historical settings of the Baroque city. By researching Falda's prints to create this world, we have learned and are publishing about the relationships among printmakers and the priorities of the patrons in Rome. *Envisioning Baroque Rome* communicates the heritage of Rome found through archival documents in a digital and interactive manner.

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