

# Aquae Calidae - New Museum Exposition Based on Various Digitalization Methods

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**Abstract.** This paper aims to present a comprehensive overview of the new interactive exposition centre at Aquae Calidae, Burgas, Bulgaria, which was opened in 2022. Innovative technologies for digitalization and presentation of cultural heritage have been incorporated into the centre to provide visitors with a captivating journey through time and immersive experiences. The focus is on the utilization of the famous historical place into a modern tourist complex with a replica of a Roman bath with hot mineral water and an interactive museum with room featuring 3D mapping to transport visitors to different historical eras, 3D glasses for virtual reality (VR) displaying the digitalized objects and representation of the ancient baths interior, interactive floor games utilizing authentic artifacts, and a photo challenge that captures the visitors in four time periods. By exploring the implementation and impact of these technologies, this paper seeks to highlight the significance of such interactive experiences in promoting cultural appreciation, education and tourism.

**Keywords:** Digitalization, Cultural Heritage, 3D Mapping, Tourism, Virtual Reality.

## 1 Introduction

Aquae Calidae holds a significant place in the ancient history of the Bulgarian Black Sea coast due to its thermal springs with healing properties. Today, Aquae Calidae continues to captivate visitors with its historical allure and natural wonders. The site stands as a testament to the enduring legacy of human civilization and the importance of preserving and appreciating the diverse heritage of different cultures, religions and time periods. As a place of historical significance, it offers valuable insights into the past, allowing us to understand the lives, customs, and beliefs of those who came before us. The remains of the ancient baths at Aquae calidae hold immense archaeological and architectural significance due to the fact that the place was used continuously for over 20 centuries and is one of the very few that bears elements from so many cultures – Thracian, Roman, Byzantine, Bulgarian, Ottoman, *etc.* (Stewart R, 2016).

Understanding the historical context of Aquae calidae is essential for appreciating the value and significance of the newly established interactive visitor centre, which

integrate innovative technologies and immersive experiences. This historical overview sets the stage for further exploration into the design, development, and impact of the interactive elements within the centre. By combining the timeless appeal of the past with the advancements of the present, the centre aims to provide a transformative experience for visitors, fostering a deep connection with history, better understanding and attractiveness.

## **2    **Aquae Calidae: Historical Overview, Projects, Significance****

Fifteen km northwest of Burgas is home to the most popular mineral baths in Southern Thrace. Already by the middle of the 1st millennium BC, people have been using the unique combination of hot springs with healing mud of the nearby lake Atanasovsko and the salty sea water. The first bath at the sanctuary of the Three nymph near Burgas was built when the Romans conquered the Thracian lands in the middle of the 1st century AD. This is only natural; namely the Roman public baths provided the new philosophy of the Roman society on a combination of the utilitarian and cultural needs of the Roman citizens. In the baths they were not only indulged in wellness and sport games but also cultural entertainment, poetry, music and political debate (Burgas, 2018).

During the 12<sup>th</sup> century the Arab Geographer El Idrisi described it as “Megali Termi”, a small but beautiful city, rich and well-ordered. Its fate was strongly influenced by events related to the establishment of the Latin Empire in 1204 after the Crusaders’ conquest of Constantinople and the following wars with the Bulgarian King Kaloyan. After three months stay and treatment in the hot baths, they were recognized by the Latin knights for “the best in the world”, nevertheless Emperor Henry II commanded that Aquae calidae Therma is to be burned to the ground. After this devastating fire, the city could not recover and the baths led an unfortunate existence until 1562 when Sultan Suleiman the Magnificent (1520-1566) arrived. In gratitude for healed gout, he commanded establishment of a new oriental bath over the destroyed Roman pools.

During the renovation of the baths in 1910, Professor Bogdan Filov conducted the first archaeological survey. The old basin and piping of the spring were cleaned. Among the archaeological findings were more than 4000 coins, jewellery and other objects from the 5th century BC to the 17<sup>th</sup> century AD.

In 2008, in connection with the strengthening and renovation of the new piping of the mineral springs, Municipality Burgas started a large-scale archaeological research of the ancient and medieval castle, the hot mineral baths and other facilities on the territory of the ancient city Aquae calidae – Thermal. In 2020 a large scale project gave opportunity to create a modern demonstration and exposition center as a part of the municipal tourist complex Aquae Calidae (Directorate, 2021). The new building has two parts – museum and spa center that offer combined tourist product. The museum center named “Tsonya Drazheva” after one of the main researchers of Aquae calidae is a combination of traditional exposition with the most elite artefacts found in site and a variety of interactive technologies for presentation of the local cultural heritage to the

broad audience as it gives everyone the chance to learn more, discover and transfer through time and space in this place 20 centuries of existence (Stewart, 2018).

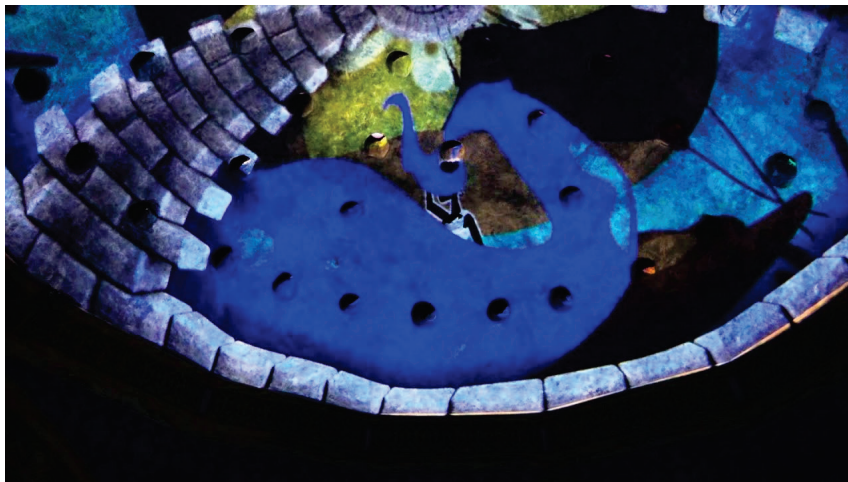
### 3 Design and Development of the Interactive Visitor Centre

The interactive visitor center is planned and designed as a part of the Tourist complex Aquae calidae with two independent set-ups in one large building - Exposition Center and Demonstration center. The Exposition center consists also of two parts – traditional and modern museum. The modern part combines four different interactive technologies – 3D experiences with VR glasses and a massage chair, interactive game floor, photo booth and a mapping room. In addition, they are connected to the Ottoman bath, which functions as a small museum with 3D mapping projection on the dome shaped sealing.

#### 3.1 Technological Integration

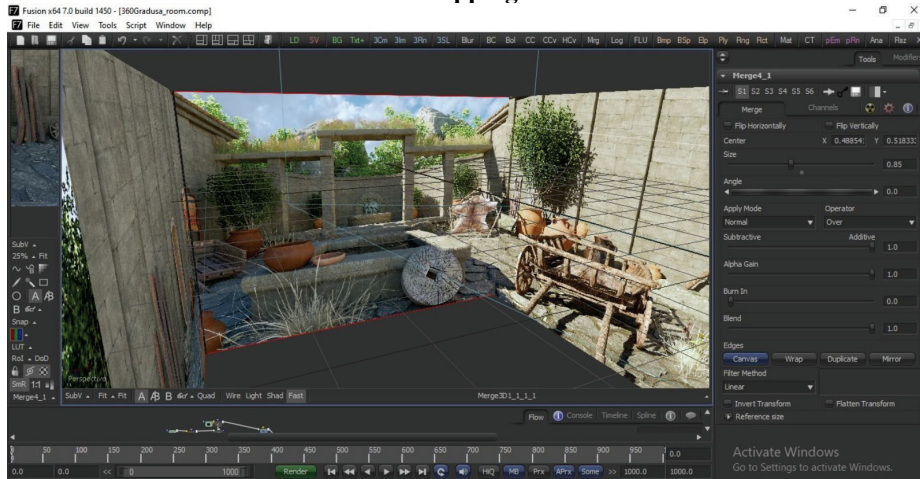
- **The Ottoman Bath: 3D Mapping and Historical Immersion**

The fully renovated bath of Suleiman the Magnificent is a functioning museum, where visitors can watch a short multilingual animation based on the 3D mapping technology over very large curved surface (Fig. 1). It leads the tourists to a virtual walk from the Thracian times and the Sacred Spring of the Three nymphs until the present day. The overlapping projectors use the curved sealing of the Ottoman bath dome with manual alignment to make the installation conform to the intended design.



**Fig. 1.** Ten minutes long animation projected over the dome of the Ottoman bath.

- **The Time Travel Room - 3D Mapping with Additional Twist**



**Fig. 2.** The design and development of custom content for the mapping room.

The 3D mapping room is designed to display a 270-degree view of a three-dimensional scenes. This is succeeded with 3 projectors that are precisely aligned, ensuring seamless continuity between the walls and creating an immersive experience within this virtual space. The software employed in the room controls the scenes by combining two-dimensional planes with images and three-dimensional models placed in a virtual environment. These elements are then animated within a timeline, all powered by the Unity game engine. An additional device is positioned within the room, featuring large buttons that enable users to change the time period. Upon pressing one of these buttons, the software reloads a new scene selecting between “Feel the mystery of the Thracians”, “See how the ancient Romans lived”, “Travel the distant Middle Ages”, “Experience the diversity of Byzantium” and “Touch the Ottoman era”. Inside the room, there are two doors: one serves as the entrance while the other serves as the exit. To ensure an uninterrupted experience for the viewers, the main entrance is automatically locked once the software and scene are initialized. This prevents individuals from accidentally or intentionally opening the door and disrupting the immersive environment. Additionally, the machine in the room is equipped with an extra button that allows users to stop the ongoing scene, simultaneously unlocking the entrance (Aqua Calidae Tourist Complex, n.d.).

- **Visualizing the Ancient Baths: 3D Glasses and Virtual Reality**

Another room is equipped with 3D glasses, ensuring a heightened sense of realism as users explore 3D representation of the Roman baths. To ensure user safety, a sturdy railing surrounds the user within the room. The rooms and spaces within the baths can be accessed by moving and entering through doorways, further enhancing the feeling of exploration.

Within these scenes, various objects are strategically placed, providing users with information about the ancient rituals and traditions associated with the Roman baths.

Users can point at these objects to trigger informative pop-ups or audio descriptions, offering details about the herbs, oils, and other items that were commonly enjoyed or seen inside the baths. This interactive feature not only engages users but also allows them to acquire knowledge in a fun and exciting way.

Initially, the 3D glasses were intended to be used in conjunction with massage chairs, aiming to provide a relaxing experience while exploring the virtual scenes. However, it was determined that using the chairs hindered users' ability to interact effectively with the virtual environment using their hands. Therefore, the decision was made to separate them and allow users to freely engage using their natural movements.



**Fig. 3.** 3D environment allowing the user to virtually walk through the ancient bath of Aquae Calidae, while sitting in a massage chair.

- **Interactive Floor Games with Digital Artefacts**

Floor games are introduced to provide interactive entertainment for the visitors utilizing floor projectors, also known as interactive floor displays. These devices project interactive content onto the floor through a combination of projectors, sensors, and software to create dynamic visuals on the floor surface. The general concept involves custom animations onto the floor, which can respond to movement or interactions from people walking or interacting with the projected content.



**Fig. 4.** Interactive floor set-up.

Sensors integrated into the system can detect movement or input, allowing the projected visuals to react accordingly. Whenever a visitor steps on a projected image of water, the system creates a ripple effect in response to the interaction (Fig. 4). Custom games developed for this unit contain digitalized artefacts found in *Aquae calidae*, which encourages visitors to return to the real artefacts in the traditional museum and learn more information about them. These actions foster extended visitor engagement as well as transfer knowledge via entertainment.

- **Photo Booth that Transports Visitors Back in Time**

The ancient photo booth uses sensors to detect the subject and instantly replaces the background, succeeded by using green screen technology. The person in the range distance of the booth is standing in front of the green screen and the system is able to quickly superimpose a virtual image of an ancient scene behind the subject. The system allows the person to have 5 seconds to position before taking a photo. The user is offered various important time periods from the historical development of *Aquae calidae* – the Thracian sanctuary, Roman bath, the Byzantine fortress (Fig. 5), the destruction of the crusaders and the Ottoman time. The user can save the digital image by scanning the QR code generated specifically for the display file on the server. Most of the visitors share on the social media the generated images, which promote the location and give it additional visibility.



Fig. 5. Photo booth design and visualization.

### 3.2 Collaboration and Expertise

The digital installations in the new exposition center of Aquae calidae were designed and developed by Ekaterina Hugasyan and the team of Momentum Digital Studio EOOD together with Kontrax AD. The activities were financed and implemented under the project "Power of Water", financed by the Operational Program "Regions in Growth" 2014-2020, Procedure "Development of Tourist Attractions".

## 4 Conclusions

The new interactive exposition center at Aquae calidae showcases the integration of innovative digitalization methods to create an immersive and educational experience for visitors and to offer a captivating journey through time by promoting cultural appreciation. However, there are potential challenges that need to be addressed, such as ensuring the long-term sustainability of the digital infrastructure and environment. Additionally, future development could focus on expanding the range of interactive experiences, incorporating augmented reality (AR), and fostering collaborations with researchers and cultural institutions to enhance the historical accuracy and depth of the

center's content. Overall, Aquae calidae's new museum exposition sets a promising example for the digitalization and presentation of cultural heritage in Bulgaria, while also pointing towards exciting possibilities for further advancements in the field.

### **Acknowledgements.**

This work was supported by the European Regional Development Fund through the Operational Programme "Science and Education for Smart Growth" under contract UNITE No BG05M2OP001-1.001-0004 (2018-2023).

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Received: March 29, 2023

Reviewed: April 20, 2023

Finally Accepted: May 24, 2023