ParlAIConPlinio: A Smart City Experience in Castellammare di Stabia Powered by Generative AI and Augmented Reality*

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Abstract—One of the fundamental missions of a smart city is to make its cultural heritage accessible and enhanced, exploiting the most advanced technologies to involve citizens and visitors in meaningful experiences. With this in mind, this article presents a mobile app developed for an initiative of the city of Castellammare di Stabia, designed to promote knowledge of the area through an immersive, interactive and innovative approach. The application combines the potential of generative artificial intelligence, the semantic web, 3D avatar generation, and augmented and virtual reality to offer a unique experience: talking and interacting in real time with a 3D avatar of Pliny the Elder, a historical figure deeply linked to the city. The user can ask questions, receive contextual answers, and experience an interactive historical narrative. One of the central elements of the experience is the possibility of watching the eruption of Vesuvius in augmented reality: by framing the volcano with the smartphone camera, the app recognises the real profile and overlays a virtual historical simulation, offering an immersive experience. This app is a concrete example of how in smart cities it is possible to enhance historical and cultural heritage by making it accessible in a massive and engaging way using the full potential of new technologies.

Index Terms—Generative AI, Augmented Reality, Virtual Reality, 3D Avatars

I. Introduction and Motivation

When we talk about Smart cities, we often tend to focus in particular on aspects related to the modernity of infrastructures, energy and environmental sustainability and the efficiency of transport systems [1]. Another very important aspect of smart cities is the use of new technologies, such as the Internet of Things and the most recent ones related to artificial intelligence, augmented and virtual reality [2] in the provision of services that the city provides to citizens. In this perspective, the objective of a city to preserve, disseminate and enhance its historical-cultural heritage, using all the means that technological advancement makes available, falls within. In this regard, for several years now, an attempt has been underway by various cities in the world and in Italy to use modern technologies of augmented reality, virtual reality and artificial intelligence to create apps, available to citizens and tourists that allow them to create and share experiences of enhancement and dissemination of the historical-cultural heritage [3]. Based on these premises, this article illustrates an application created for a case study of the City of Castellammare di Stabia, which allows you to interact through written and spoken conversation with an avatar of a historical figure famous for the city, which is Pliny the Elder. Users, through a simple link, can view the avatar in Augmented Reality or from a web interface, manipulate it, positioning it as desired in space, on floors, etc., and start a conversation with it, either through a chat or spoken. The avatar will be able to adequately respond to the user's questions by impersonating the historical figure consistently in the register and in the information regarding his account. Furthermore, this application also allows users to see a simulation of the eruption of Vesuvius in augmented reality superimposed on the recognition of the image of Vesuvius framed by the camera of a mobile phone or tablet. This application allows citizens of all ages to get closer to the history of a territory told by its illustrious characters by creating attractive experiences that combine technological advancement and the preservation of the historical and cultural heritage of the territory.
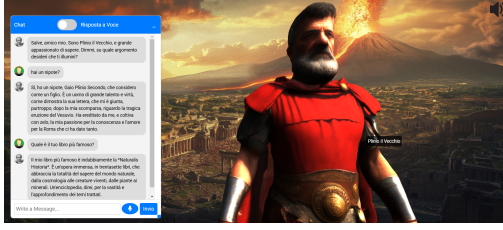
Fig. 1. ParlAIConPlinio Use: Web Virtual Reality Mode

II. Application Description

The app allows the historical character Pliny the Elder to be visualised in Web Virtual Reality Mode or Augmented Reality Mode and interact with him via a special chat in the first case or via a speech-to-text and text-to-speech system in the second case. This architecture allows for a natural, immersive and consistent dialogue experience with the represented historical character, while maintaining a clear separation between the interactive frontend and the backend. To make the interaction more historically accurate the LLM was instructed to simulate the behaviour and language of Pliny the Elder, assuming the role of the famous Roman naturalist throughout the dialogue session. This *prompt-based role simulation* [4] strategy was flanked by a Retrieval-Augmented Generation (RAG) approach: the model does not generate responses based only on pre-trained data, but interrogates a corpus of selected historical documents, provided by the developer and uploaded on Dify as a documentary reference base.

III. User Interaction and Immersive Experience

The simulation of the eruption of Vesuvius is integrated into an AR application accessible from mobile devices. The operation is simple and designed to be immediate even for non-expert users: just frame the panorama that includes a mountain with the phone camera. At this point the deep learning model integrated into the application comes into action, which analyses the image in real time, identifies the mountains present and extracts their shape and contours. This silhouette is compared with a database of sample images of Vesuvius. If the system recognises a sufficiently high correspondence (exceeding a predefined matching threshold), it confirms that it is Vesuvius. Once confirmation has occurred, the app automatically activates a 3D animation in augmented reality: realistic effects such as lava, lapilli, smoke and ambient sounds are superimposed on the top of the framed Vesuvius. The app offers the user a free choice between two interaction modes: AR or VR. Figure 1 shows a screenshot of using the app in Web Virtual Reality Mode. The user has the option of viewing Pliny the Elder's 3D avatar and interacting with it via chat. By means of special buttons, the user can choose whether or not to enable voice response, so as to simulate a spoken conversation with the character. After a welcome message, the character waits to receive a question from the user, to which he or she will provide an answer using the LLM. A screenshot

Fig. 2. ParlAIConPlinio Use: Augmented Reality Mode

of using the app in AR Mode can be seen in Figure 2. It is possible to superimpose Pliny's 3D avatar in the real world and by means of gestures, it is possible to interact with him.

IV. Conclusions

This article shows an interesting web app that combines the latest technologies of augmented reality, virtual reality and artificial intelligence. It is an example of how cutting-edge technologies can be used to enhance the historical and cultural heritage of a city in line with the needs of a smart city.

References

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