WAYFINDING AND AUGMENTED REALITY: APP FOR OUTDOOR EXPERIMENTS IN THE PERUGIA STATION AREA

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ABSTRACT:

This research aims to improve wayfinding in the Fontivegge district of Perugia, a chaotic and disorienting area due to the numerous redevelopment projects. The goal is the development of an Augmented Reality application to improve the urban orientation experience. The app will provide users with indications on how to reach pre-selected places of interest, through the visualisation of directional arrows placed horizontally along the route and vertically at major turning points. In addition, it will provide a number of thematically categorised infopoints, which will accompany the user along the route, enriching it with information. The aim is, therefore, to create a more positive and engaging orientation experience for users and to promote a sense of belonging and social cohesion in the place.

1. INTRODUCTION

The purpose of this research is to improve the wayfinding strategies through the use of an Augmented Reality smartphone application designed for the railway station area of the city of Perugia, the urban hub of modal interchange between public transport services.

The district of Fontivegge, an historic and cardinal place of the city of Perugia, due to its degradation, has been affected by various redevelopment and rehabilitation interventions (Figure 1). The main one is represented by the "periphery plan" (Piano, 2015) that was developed from the collaboration between the Department of Civil and Environmental Engineering and the Municipality of Perugia (Bianconi et al., 2020b; Bianconi and Filippucci, 2018a). Through altering perceptions (Bianconi et al., 2021; Bianconi and Filippucci, 2019; Maffei, 2007) of the area covered by the plan, the aim is to mend the relationship between the community and its places (Appadurai, 1996; Bauman, 2000), associating public space with a community wellbeing service (Burry and Burry, 2012; Gehl and Gemzøe, 2003; Kim and Kaplan, 2004; Steg et al., 2013).

Figure 1. Current state of the Fontivegge station affected by requalification works.

The choice of the field of investigation related to the problems of the area, identified in the neighborhood can be traced to the difficulty of orientation encountered by users, proven in research previously conducted (Bianconi et al., 2020b, 2018; F. Bianconi et al., 2023; Fabio Bianconi et al., 2023; Bianconi and Filippucci, 2017); the chaotic nature of the area emerges and there appear to be numerous nodes of urban flows such as the railway, bus stop and minimetro, which are poorly connected and difficult to identify.

In this path of urban regeneration, the research of wayfinding is included, which can be likened to the process of orientation in a place, as it literally means "finding one's way"(Barnard, 1998). This term is historically attributed to Kevin Lynch, who uses it in his famous work "The image of the city" (Lynch, 1960) to indicate that then very innovative approach of mixing architecture, urbanism, semiotics and psychology, issues that are connected to the cognition of space, to the transformation of the images experienced in a scheme correlated to the urban form and ascribable to the two-dimensionality of drawing (Alexander, 1964; Bridgman, 1959; Venturi, 1967; Wolbers et al., 2008).

During a period of great transformation of western cities, such as the years after the Second World War, the reading of urban space and, in particular, the legibility of the complexity experienced as the foundation of contemporaneity (Alexander, 1964; Bridgman, 1959; Empire, 1955; Venturi, 1967), opened up a new research theme, namely the revitalisation of the increasingly structural relations between the built environment and images (Jencks and Baird, 1969). The totality of sensations and what is perceived is, in fact, re-elaborated in a design where orientation and identification are two essential aspects of the abstract processes of our mind, ascribable in any case to representative, immaterial, virtual acts (Mirzoeff, 1999; Picazo et al., 2020). At the centre is the value of images, because "it should be borne in mind that man is a predominantly visual animal. More than 50% of the neurons in his brain respond to this sensory input" (Maffei, 2007).

Emphasis is on the interpretation that wayfinding is a section of "navigation", which should be placed in parallel with "locomotion", the act of moving along a path.
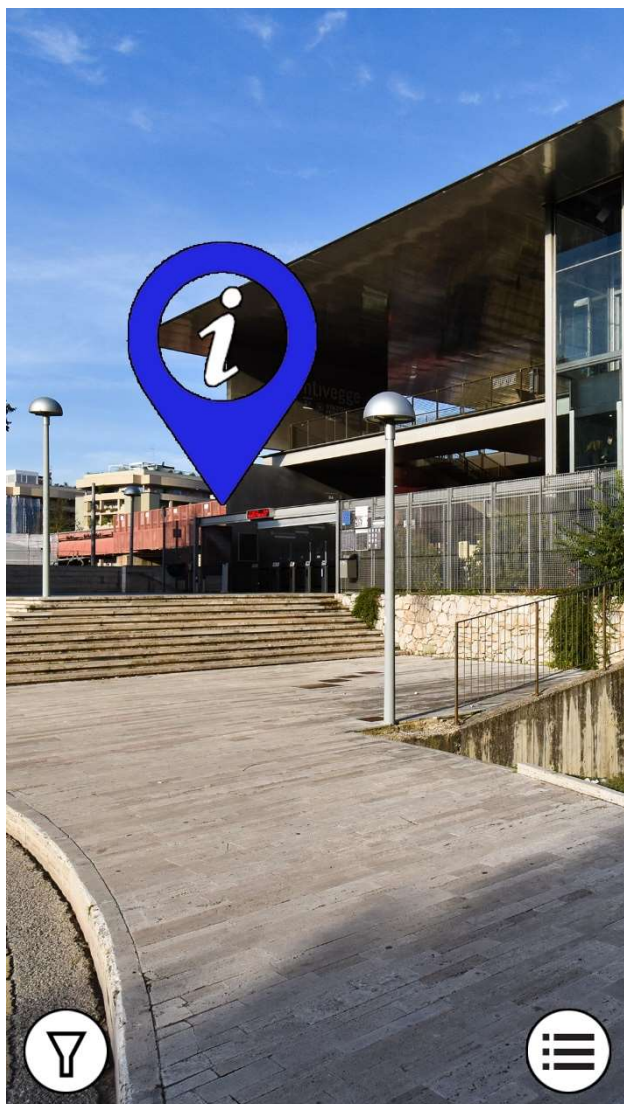
Figure 2. Infopoint located in minimetrò station.

Figure 3. Screenshot of the infopoint pop-up menu.

Wayfinding represents that process of actions implemented in order to solve the problem of identifying the route to be followed. The information anxiety of our culture (Wurman, 1989), exalted by the disruptive digitalisation, and in particular, the continuous accessibility guaranteed by smartphones, activating an addiction to their use (Matar Boumosleh and Jaalouk, 2017), poses this issue as a purely contemporary theme: spatial neophobia is a common feeling, more or less felt, that is connected to the survival instinct, to the necessary attention that comes from discovering what one does not already know. The study of the cognitive aspects of wayfinding must premise the evaluation of the impacts of an environment on the people who experience it and the mechanisms by which they move in spatiality, since loss of orientation creates anxiety and increases stress levels in users (Chías and Fernández-trapa, 2022). The sense of disorientation and bewilderment experienced by users lead to an alteration in the physiological and psychological state of the user who experiences the place, involuntarily associating it with a negative experience and leading, consequently, to the belittling of the area and its subsequent emptying (Goldhagen, 2017).
Wayfinding is based on the relationship between dots and lines, stasis and movement, focussing on spatial memory, to be understood (Siegel and White, 1975) as the set of remembrances

of images, paths and relationships, which are recognised and reconstructed in a figurative process (Bechtel and Churchman, 2002).
The idea behind the project is the development of an Augmented Reality application, capable of explicating the digital language of wayfinding, so that the user can be informed, first of all, of points of interest in the proximity and, subsequently, assisted in reaching them. Outdoor wayfinding is a little-covered topic, while there are numerous case studies of implementations on indoor locations, such as airports (Lampazz et al., 2020), schools (Cibilić et al., 2020) and hospitals (Basri and Sulaiman, 2013; Drewlow et al., 2022; Prodi and Stocchetti, 1990). To date, GPS data in augmented reality has been used for on-screen positioning of information popups that indicate to the user the direction they should follow to reach the destination, as well as the distance to be traveled, while, in this case, the approach aims to accompany the user throughout the journey by providing continuous information. A step forward from the studies conducted so far is to be performed, proposing the accompaniment of the user along the entire path and additionally providing timely and valuable information on the various critical situations of the route to be taken.

Figure 4. Screenshot of the informational route pop-up menu.

Figure 5. Screenshot of the directional arrow.

2. METODOLOGY

The goal of the research consists in reversing this paradigm, thereby creating favorable experiences that can generate positive emotional memories; these promote a sense of belonging and, secondarily, a social cohesion associated with experiencing the place. A cross-media strategy is chosen to define the wayfinding structure, which offers integration between different communicative approaches: physical, currently being designed, and digital; a transversality is sought that extends communication to the user and allows a clearer and broader reading of the place. The research aims to use the new devices in the service of wayfinding, setting a standardized methodological approach through the implementation of an augmented reality application. The smartphone and Augmented Reality become the tools for a new approach to urban exploration.

The application was developed using the Unity graphics engine, preferred over the competition for its easy integration with Google services and, in particular, with the ARCore development kit.

The American computer company recently announced a new tool for developers who want to create and launch Augmented Reality (AR) experiences in real-world locations.

The tool, called Geospatial Creator, is based on ARCore and the Google Maps Platform and leverages the company's proprietary photorealistic 3D boxes to visualise and augment the 3D geometry of the world.

Geospatial Creator allows users to select a global location, obtain three-dimensional area data and anchor their own 3D content at any latitude, longitude and altitude, with sub-metre accuracy in areas covered by Google Street View.

Once the development environment was configured, through the installation of the necessary plug-ins within the graphics engine, the user experience was programmed. First of all, a number of information points were inserted inside the identified area, which, once reached by the user, allow the display of in-depth information tabs. To do this, the new anchoring functionality made available by the ARCore kit was used, associating the object to be displayed during the augmented experience with a suitably configured script with real geographical coordinates.

The infopoints were subdivided according to three themes (historical-cultural, mobility, commercial) through the insertion of a specially created script that allows the category to be associated with the object, allowing it to be displayed in the correct real position only if the category is activated in the created interface.

The same script manages the colouring of the infopoint's graphic indicator, which varies according to the selected category, and also controls the assignment of the information pop-up that can be displayed via that specific information point (Figure 2, Figure 3).

Another remarkable feature in the development of the application is the navigation to the remarkable places identified. Through a specially programmed menu, it is possible to select an item, which is linked to coordinates (Figure 4).

Arrows have been used to represent the graphical indications useful for reaching the selected place. These will be positioned on the ground along the route and vertically at notable turning points. For positioning purposes, the most convenient routes for reaching the places made available were previously created on Unity and, by means of a script, when navigation is activated, the route considered closest to the user's position at that time is displayed (Figure 5).

The methodology applied is easily replicable to other case studies and also scalable to more complex and extended situations. The aspects to focus on are the battery consumption of the devices and the quality of the GPS signal, which is not always optimal.

3. RESULTS

The results of the research are inherent in the implementation of the app for orientation within the Perugia Station area. The application, when first opened, displays what is visible through the rear camera of the smartphone in use, with the overlay of the user interface intentionally minimal in order to emphasise the augmented view.

On the screen, in fact, there are only two buttons that allow the opening of two menus for selecting the information to be shown. At the bottom right is a button that activates the visualisation of the menu of places of interest, the selection of which activates the display of directions to reach them. At the bottom left is the menu for choosing the infopoints that the user wishes to activate or deactivate according to the categories of interest. The infopoints are represented in the augmented scene through the classic 'pin' graphic element, reproduced in 2D with automatic rotation to be always perpendicular to the user's gaze.

Once reached, the application exits AR mode and displays an information popup across the screen, with a graphic composition containing data of interest to the user and appropriately decorated
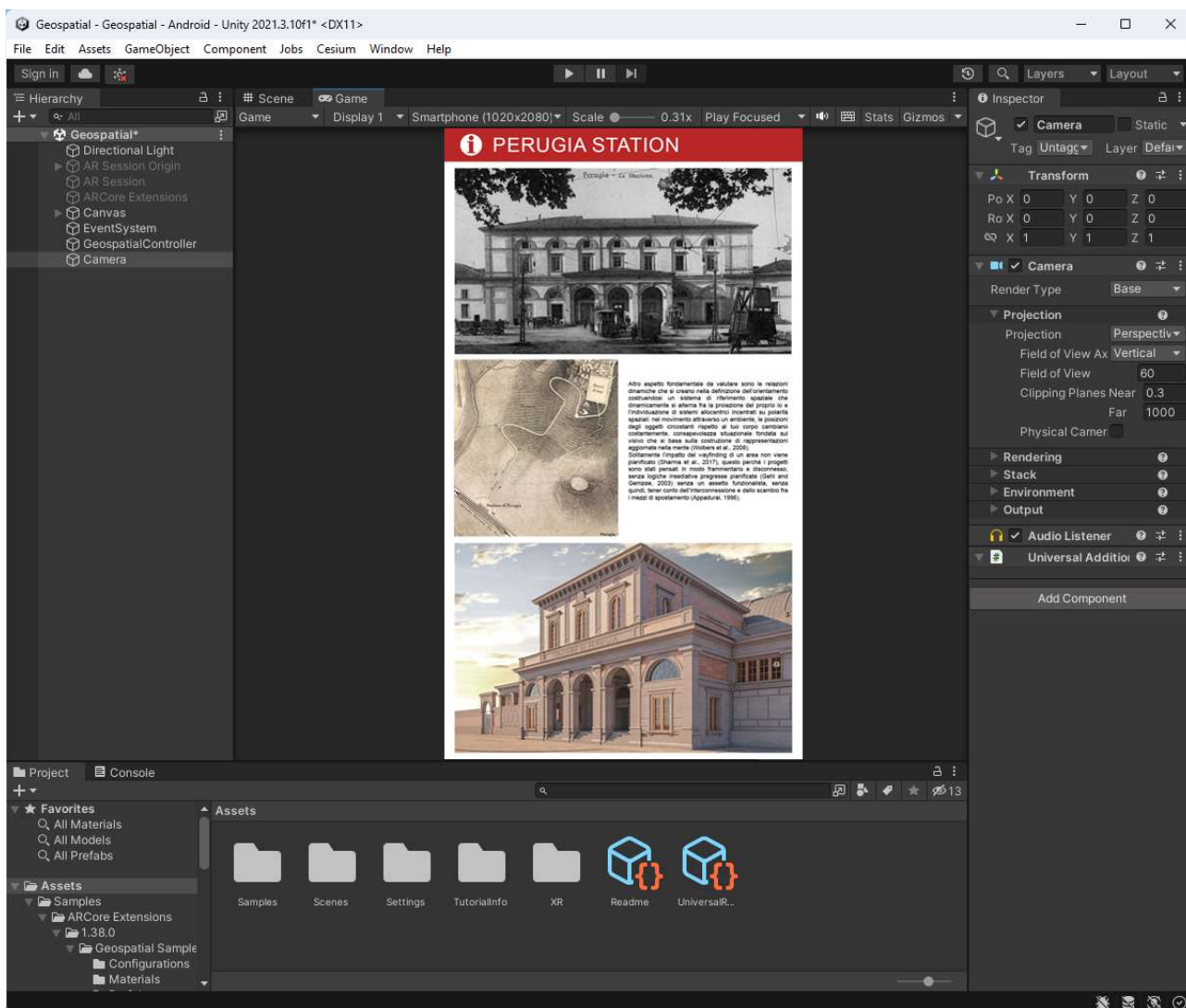

Figure 6. Development of the historical-cultural pop-up inside Unity platform.

with chromatic elements coordinated with the category of the infopoint. For the historical-cultural category red was associated as the representative colour of the city of Perugia (Figure 6), for mobility blue was chosen because the graphics of the city's main transport companies use these shades (Figure 7). For the last category, that is commercial activities, purple was chosen, simply to have as much contrast as possible with the others, excluding green from the possible choices, which is not very visible in urban contexts with natural elements. The deactivation of the augmented mode was a design choice aimed at avoiding distractions when reading the information texts provided and can be resumed by closing the panel using the X-shaped button at the top right of the graphic. As for the 2D elements indicating the path to the user, a graphic composed of a double arrow coloured with two different colours, dark red and orange, was selected to guarantee the visibility of these elements in overlapping with every possible scenario.

Thus, the goal of the app is not only to take the user to their destination but also to engage and allow them to explore and investigate the potential of the place they are in. During the journey, the user will be accompanied by the app through the display of specific remarkable points to allow the user to deepen their knowledge of the place.
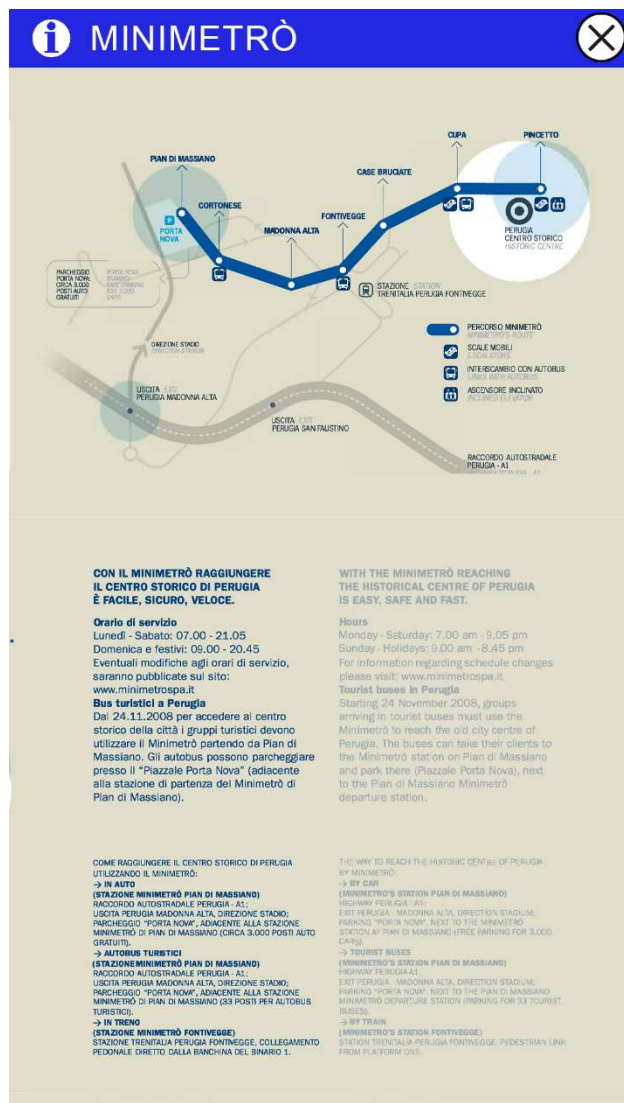

Figure 7. Screenshot of the pop-up about minimetrò.

4. CONCLUSION

The research conducted focuses on the representational issues inherent in the interaction between urban users and places. It is a proposal that supports seeing, intended not only as a functional process but as a cultural act, in the aim of requalifying the place by identifying the reasons for the development of the area (Bianconi et al., 2022) and searching for a juxtaposition of signs to improve identification and orientation (Filippucci, 2012), thus legibility (Lynch, 1960; Sancar, 1986; Schultz, 1987; Smardon, 1988) and consequently the accessibility of places (Calori, Chris et al., 2015; Devlin, 2014; Passini, 1981; Symonds, 2017). The great challenge to be addressed goes beyond the boundaries of transport objectives inherent in orientation research, but proposes processes of re-appropriation of places through the rediscovery of the qualities of place, which is the subject of an important process of territorial regeneration (Carr, 1992; Castells, 2008; Gehl, 2007; Molinari, 2021; Purini, 2021).

This is the context for the studies and experiments carried out over the last five years, aimed at creating added value through the rediscovery of places. The process of reconstructing historical evolution through the realisation of immersive models of spaces erased from collective memory becomes the key to understanding the current urban form (Bianconi et al., 2022; F. Bianconi et al., 2023), transforming the immaterial into the material (Bianconi et al., 2020a; Bianconi and Filippucci, 2018b). In the hypothesis of enhancing the image culture of our era, this path was supported by digital representation, as the history of the original architecture planned for the station was rediscovered and subsequently reconstructed three-dimensionally to ensure its exploration through Virtual Reality (Bianconi et al., 2022). The same Virtual Reality has been made usable through smartphones, with which greater interactivity is guaranteed through a 360-degree view. This path highlights the desire to create wayfinding in a process that operatively wants to place the relationship between places and those who live them at the centre, exploiting the logic of serious games as tools for creating empathy relationships. (F. Bianconi et al., 2023; Dominici et al., n.d.; Ioannides et al., 2016; Kuliga et al., 2015; Larson, 2020; Meng and Zhang, 2012; Mortara et al., 2014; Theodoropoulos and Antoniou, 2022; Wilson and Soranzo, 2015).

The studies described allow us to constestualise the value of this research in the cultural proposal system, setting as a goal the development of an application that detects the gps position in real time and, through augmented reality, projects orientation information and additional data on the architecture present, thus improving the wayfinding of the study area. In fact, the app not only wants to take the user to their destination but also to engage and allow them to explore and investigate the potential of the place they are in. The usability of the app suggested some potential future implementations, such as exploiting user profiling to suggest routes to follow in relation to physical abilities, personal tastes or needs of the moment, thus improving urban navigation, and thus wayfinding.

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