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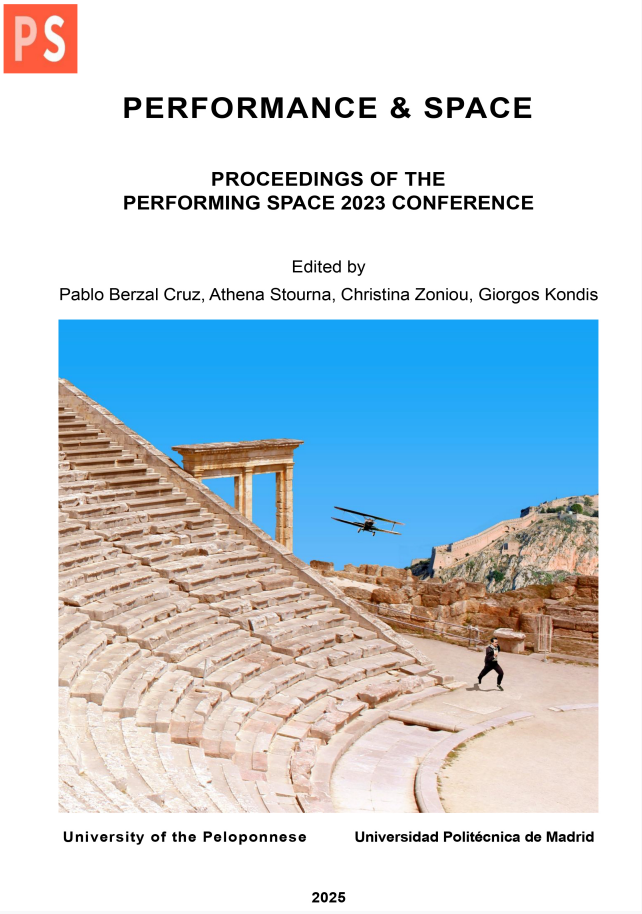

Unveiling Nottingham's Hidden History through Augmented Reality

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Abstract

The research identified and tested the use of Augmented Reality to investigate and restore the forgotten yet unique identity of Nottingham (UK). Since the building of the Nottingham Castle in 1068 by the French Normans, until the eighteen Century, two populations lived almost segregated in Nottingham: the Anglo-Saxons in the English borough, and the French-Normans in the French borough on the opposite hill. The two Boroughs were divided by the Market Wall that was acting as an administrative and legal boundary of the boroughs but also a physical division of the Saturday Market. Data collection was finalised to the mapping of all historical architectural and archaeological data into layers, and they had been investigated using locative media on a website platform. The research team included researchers from Confetti Institute of Creative Technologies, that recreated a 3D version of the Market Wall into an Augmented Reality App to be used with smartphones. The aim was to allow the citizens to visualise the Wall in its original position and size in the Old Market Square, discovering and experiencing the 'unknown' roots of the city through virtual immersive archaeology. Specifically, the aim was to realise a user-friendly digital tool to enable a broader dissemination of the research output embracing young generations. The research demonstrated the possibility to effectively share, display, and promote heritage to improve both community awareness, and the visitor economy of Nottingham. It argues that revealing the intangible heritage of Nottingham could act as a stimulus to enhance and re-vitalise social and cultural engagement.

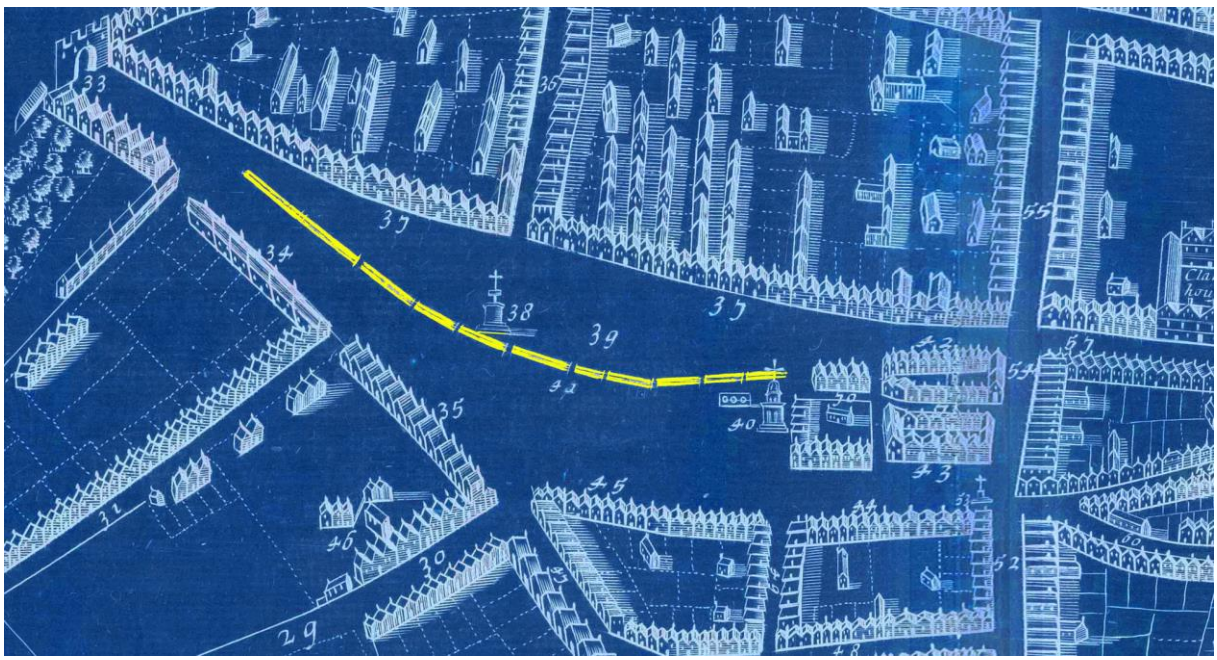
Keywords: Augmented Reality; Mixed Reality; Intangible Heritage; virtual archaeology; virtual museum.

Nottingham Secret Heritage

History, like layers of sediment, often conceals fascinating narratives beneath its surface. Nottingham, renowned for its association with Robin Hood and his Merry Men, for over seven centuries stood divided into two distinctive boroughs, each inhabited by different cultures. The Old Market Square, the pulsating heart of Nottingham, was a unique crucible where these two boroughs met and mingled, separated not by hostility but by a breast-high wall. In this paper, we embark on a journey to uncover Nottingham's hidden history and explore the creation of an Augmented Reality (AR) app designed to resurrect this obscured heritage. Beyond the realm of entertainment, AR has permeated sectors like retail, interior design, education, logistics, and healthcare. It has birthed new paradigms, making its presence felt in cultural and heritage preservation, blurring the lines between the past and the present. In the years since the 2016 phenomenon of Pokémon Go app, AR technology has evolved significantly, and its applications have deepened. Notably, it has taken a critical role in the domain of Virtual Tourism, breathing life into historical sites and enigmatic stories that time has hidden (Mads, 2017). The present paper delves into the evolution of Virtual Heritage through AR and the profound impact it has on preserving and sharing cultural legacies.

Figure 1

The Market Wall (highlighted in yellow) represented in the Thoroton's Map of Nottingham in 1677 (Source: author's elaboration of Thoroton's historical map published in 1790).



In 2021, the author led a research team to unearth the concealed history of Nottingham through research funded by Nottingham Trent University which lasted two years. Through the review of historical maps, archaeological findings, and use of digital locative

technologies, this team embarked on a quest to recreate the Market Wall, a vestige of history that had long been forgotten.

The vision was to present this historical marvel through the lens of an AR app to enable the citizens and visitors of Nottingham to journey back in time, immersing themselves in the historical tapestry of the city through the lens of virtual archaeology. The app extended its reach to encompass two other historical treasures: the Malt Cross and the Ducking Stool, each offering a unique window into Nottingham's bygone era. The research which is presented in this paper underscores the significance of bringing historical research to life using digital locative technology, emphasizing how it can fortify societal bonds and cultivate a shared sense of history, purpose, and identity. With the relentless progression of smartphones and their capabilities, AR technology opens endless possibilities, potentially transforming every corner of the city into an interactive museum of Intangible Heritage.

The Role of Digital Locative Technology for Heritage Preservation

World Heritage sites are not merely static relics of the past but living, breathing entities that play a pivotal role in sustainable human development. They align with the 2030 Agenda put forth by the United Nations in 2015.[1] Yet, the physical facets of our heritage, wrought by time and vulnerable to the ravages of wars, natural calamities, urban expansion, and the sands of time, face a relentless onslaught. The research was then directed at exploring the vital domain of heritage preservation and the transformative influence of Augmented Reality in upholding and disseminating these cherished cultural legacies. Cultural heritage is a precious aspect of our history that reflects the customs, traditions, and values of our ancestors. Preserving and sharing this heritage is vital, as it connects us to our roots and provides a sense of identity and continuity. Nottingham, a popular city in the United Kingdom has a rich, mostly unknown history with a unique multicultural heritage that has contributed to its distinct identity. In recent years, augmented reality technology has emerged as a powerful tool for preserving and showcasing cultural heritage. Nottingham, a city synonymous with the folklore of Robin Hood, paradoxically conceals a fact as intriguing as any myth - it was a city divided for seven centuries. In 1068, the Normans' arrival started a settling process in the space left between the castle and the Old Anglo-Saxon borough which led to the creation of two distinct boroughs, one inhabited by the Normans and the other by the Anglo-Saxons. The demarcation line was the Market Wall, a physical embodiment of unity rather than division. This research scrutinizes the concept of

[1] See further definition of Intangible Cultural Heritage on: UNESCO. n.d. “World Heritage and Sustainable Development.” Accessed October 10, 2023. https://whc.unesco.org/en/sustainabledevelopment/

selective history, illuminating how critical elements can fade into obscurity and underscores the multifaceted multicultural heritage that discreetly shaped Nottingham's destiny.

Preserving Cultural heritage

Cultural heritage encompasses the material and immaterial aspects of our shared history. Material heritage consists of tangible artifacts such as historical sites, artifacts, and monuments. These elements serve as tangible connections to the past. Nottingham, like many cities, boasts a wealth of material heritage, reflecting the different periods and influences that have shaped its history. In Nottingham's case, the remnants of the Market Wall hold a significant place in the city's history. This wall that once marked the division between the Norman and Anglo-Saxon boroughs was indeed not limiting the exchange and movement of people and goods, because its purpose was to define the boroughs' administrative boundaries and different laws. While the physical structure no longer exists, its historical significance remains intact, reminding us of the city's complex past. The preservation and interpretation of this type of material heritage are essential for maintaining a sense of continuity and identity. The immaterial aspect of cultural heritage is equally crucial. It encompasses the traditions, customs, language, stories, rituals, and intangible knowledge that are passed down through generations. These elements define a community's cultural identity and are integral to understanding its history. In Nottingham, the cultural exchanges between the Norman and Anglo-Saxon populations have significantly influenced the city's intangible heritage. This multicultural heritage is what sets Nottingham apart, making it distinct from other cities. By embracing both material and immaterial heritage, Nottingham could better recognise and celebrate its multicultural identity embracing social cohesion. Preserving cultural heritage serves as a bridge between the past, present, and future, allowing us to appreciate our history and gain insights into the development of societies over time.

Augmented Reality and Heritage

Augmented Reality (AR) technology has emerged as an innovative and powerful tool for preserving cultural heritage and making it accessible to a broader audience. AR combines the physical world with digital information and interactive experiences, enabling users to explore and interact with historical sites, artifacts, and stories in new and engaging ways. This technology has gained popularity in various sectors, including education, tourism, and entertainment. The emergence of Augmented Reality in the context of heritage preservation is a testament to the evolution of virtual archaeology and virtual tourism. This digital alchemy has empowered museums, monuments, and ancient archaeological sites to extend their boundaries and create immersive virtual experiences that captivate a diverse audience, from

curious children to inquisitive elders. Augmented Reality bridges the chasm between the tangible and the digital, transmuting traditional museums into a new dimension where the past is not just observed but inhabited (Scianna et al, 2019). The research was in fact aimed at probing the two primary approaches to heritage preservation: recreating existing heritage sites and reconstructing lost history as it would have been. AR applications typically function through smartphones, tablets, or wearable devices, using their built-in cameras and sensors to overlay digital content on the real-world environment. This content can range from 3D models and animations to audio and textual information. In the context of cultural heritage, AR offers several significant advantages. Accessibility, with AR apps can be easily downloaded and used on common mobile devices, making cultural heritage accessible to a wide range of people, including those with physical disabilities. This accessibility is a crucial factor in promoting inclusivity. Interactivity, because AR enables users to actively engage with historical sites and artifacts. They can explore 3D reconstructions of ancient structures, interact with virtual objects, and even participate in guided tours or educational games. Education, because AR can enhance educational experiences by providing historical context and in-depth information about cultural heritage. It's a valuable tool for schools and museums to engage students and visitors in an interactive learning experience. Preservation, where AR can contribute to the preservation of cultural heritage by creating digital records of historical sites and artifacts. This is particularly valuable when physical preservation is challenging or when sites have been lost over time. Storytelling, with AR allowing the creation of immersive narratives that bring history to life. Users can follow historical characters, experience events, and gain a deeper understanding of the past. Tourism, due to the fact that AR can provide visitors with engaging and informative experiences at historical sites. This can lead to increased tourism and revenue for heritage locations.

The Nottingham as Melting-Pot

Nottingham's rich history has been carved by many different civilizations that brought there their language, food, commerce, laws. The establishment of Nottingham Castle in 1068 marked not only the creation of the castle but also the foundation of a French borough in Nottingham. Positioned between the Anglo-Saxon borough on Lace Market Hill and the imposing Castle Rock, this French borough, despite its initial military intent, would go on to shape Nottingham's destiny significantly. Three churches, namely St. Nicholas, St. Mary, and St. Peter, were founded within this dynamic “double town.” By 1086, all recorded land holdings in the Domesday Book were located within the bounds of the French borough, underscoring the growth and significance of this new borough. The space that bridged the two boroughs, fondly known as “The Sands”, would emerge as the Saturday Market, the second-largest

market square in all of Britain (Holland Walker, 1931). For over seven centuries, the Market Wall bisected this vibrant square, but not as a rigid barrier. Instead, it served as a facilitator of trade and cultural exchange, nurturing the rich blend of Norman and Anglo-Saxon heritage (Mastoris, 1981; Lomax, 2013). The unique essence of the Market Wall is the fact that was not a physical barrier of segregation, differentiating it from infamous dividing walls like the Berlin Wall, for it was a symbol of unity rather than division.

The proximity of the French Normans spurred the importation and adaptation of various aspects of French culture into the fabric of British life. For instance, it was in Nottingham that malt liquor gained its distinction, turning the city into a household name in the malting industry. Public proclamations, the Civil War declaration, and even the meting out of punishments all found a common stage at the “Malt Cross” in the Market Square, where malt was not just a commodity but a symbol of shared history (Roffe, 2015). It was possible to dig deep into the lingering influence of Norman culture on Nottingham's identity, exploring the subtle ways in which history leaves an indelible mark on a city's soul.

The research encountered several challenges during the collection of historical data. Nottingham's historical archives have presented numerous obstacles due to the fragmented nature of the available records. Most of the old documents were preserved in the archives of the old Corporation, consisting of local court records, royal charters, and original grants from various individuals. All relevant documentation of the city’s life and administration was collected in the “Red Book”, a comprehensive volume where the Corporation of Nottingham meticulously recorded essential matters, orders, customs of the town, and community decisions. However, this invaluable resource was tragically lost in a fire that engulfed the Town Clerk's office in 1724, resulting in the destruction of all crucial information regarding the Market Wall's origin and development. In the absence of the “Red Book,” researchers have had to rely on surviving detached documents found within the Corporation of Nottingham's archives (Anon, 1882). These documents were meticulously compiled in the late nineteenth century into nine volumes entitled “Records of the Borough of Nottingham” (Anon, 1882), presented in Latin with English translations. The span of these extracts covers a wide range, starting from 1155 and reaching up to 1900. The earliest references to the “Saturday Market” (in Latin: Foro Sabbati) and the Week-day or Daily Market (in Latin: Foro Cotidiano) are found in the Charter of King Henry II (1155-1165). Interestingly, “Foro Sabbati” eventually evolved into the “Seterday market” as documented in a source dating back to 1353. Specifically, the sixth volume, covering the period between 1702 and 1760, provides valuable insights into the Market Wall. The first mention of the Market Wall is recorded in 1529 as the “Markyt walle”, with subsequent entries regarding repair works in 1627, 1673, 1696, 1705, and 1709. In 1714, the Corporation of Nottingham made the significant decision to “pull down the Markett Wall” to facilitate the paving of the Market Place. However, it appears that the complete demolition of

the Market Wall did not occur until at least 1727, with repair works carried out in 1714, describing the Wall as “the Stone Wall” (Deering, 1751). One critical aspect for the reconstruction of the Market Wall is the identification of its material. The available archival evidence points to the Market Wall being constructed of stone. This fact was pivotal for the development of a 3D model for the AR app, as no visual representations of the Wall in drawings or paintings are available. However, a significant discovery was made in 2007 during the repaving of the Old Market Square when a portion of the Wall was unearthed. Archaeologist Gavin Kinsley's Watching Brief reported that this section of the Wall was made of bricks, not stone, dating back to the seventeenth century (Kinsley, 2006). The apparent contradiction in materials used can be explained by historical context. Bricks were not available in Nottingham until the late 1500s. Prior to this, houses and structures were primarily constructed using materials less substantial than brick or stone. It was only during Nottingham's “urban renaissance” between 1688 and 1750 that brick became more readily available, signifying a shift in the town's development. Before this urban flourishing, Nottingham's town centre primarily featured medieval timber-framed structures, including Elizabethan and Stuart period houses, owing to the limited availability of building materials, such as stone (Beckett, 2000). The conclusion can be drawn that the portion of the Wall discovered in 2007, made of bricks, likely represents a repaired section of the Market “stone” Wall, reflecting the evolving architectural landscape of Nottingham. Apart from these archival findings, two other notable sources provide valuable information about Nottingham's history and further confirm aspects of the Market Place and its Wall. Robert Thoroton's “The Antiquities of Nottinghamshire” (1677) and Deering's “Nottinghamia Vetus et Nova” (1751) offer comprehensive accounts of the region. Unfortunately, no illustrations depicting the Market Square before the demolition of the Market Wall had been found during the research, leaving a visual gap in the historical record.

A *Digital Window* to the Past

The research team was composed by staff from Nottingham Trent University and Confetti Institute of Creative Technologies. They used a combination of historical maps, archaeological data, and 3D modelling to identify the size and shape of the Market Wall, including its accurate positioning in the current Old Market Square, and to reconstruct the physical aspect of the wall and its neighbouring structures. This process involved meticulous research, data collection, and collaboration with experts in history, archaeology, and digital technologies. The AR application called “The Market Wall App” was tested during the Covid-19 pandemic and finally presented to the public in June 2022, which sparked the interest of the local and national UK media (BBC News, 2022; Moneta, 2022; Notts TV, 2022). A launch event was in fact planned

to present the research with the aim to invite people to download and use the app, and to step back in time and experience Nottingham's rich history.

Figure 2

The Market Wall Research Team during the AR app Launch event. Left to right: Gin Rai (Confetti), Andrea Moneta (NTU) and Yven Powell (Confetti). (Source: personal archive)

By simply pointing their smartphones or tablets at specific locations of the Old Market square, users can now visualise the Market Wall, the Malt Cross, and the Ducking Stool as they once existed as a three-dimensional, interactive experience. This immersive experience provides insights into the daily life, culture, and architecture of medieval Nottingham using a simple tool that is now available to anyone who possesses a smartphone. The importance of this project extends beyond the novelty of AR technology: It's a celebration of Nottingham's multicultural heritage, showcasing the blending of Norman and Anglo-Saxon influences that contributed to the town's unique identity. Through the AR app, citizens and tourists can now appreciate the interactions and exchanges that occurred in the very heart of Nottingham, where different cultures coexisted and shaped the town's character. These important facts are mostly unknown by Nottingham citizens. The AR app unfolded a rich tapestry of history, enabling users to interact with virtual archaeology. Users can step back in time to witness the Market Wall in its full glory. As they explore the Market Square, moving around and along it, they can experience and better understand the significance of this unique landmark. The app also extends its reach to the Malt Cross, where users learn about its important role for public announcements, a sort of *broadcasting centre* of the local authority of the time; but also its role

of public display of punishments, beyond the malt's brewing traditions that still shape Nottingham's identity.

Figure 3

The Malt Cross as visualised with the AR App in the Old Market Square, Nottingham (Source: personal archive).

The Ducking Stool, used for specific punishments, completes the triad of historical experiences as shown in Figure 4. It was reserved for women accused of scolding or backbiting and was shaped so that a person could be bonded to a chair fixed on a pole and then immersed in the Market animals' pond. The AR app was made available to users from the research website which includes all the historical maps (Badder & Peat, 1744; Bankes, 1609; Overton, 1714; Speed, 1610; Thoroton, 1790), which graphically depicted the shape and position of the Market Wall in the 17th and 18th Century, before it was finally demolished.

Beyond its role as an exploratory tool, the AR app could also serve as an invaluable educational resource. It enables schools and colleges to incorporate immersive history lessons into their curricula. Students can delve into Nottingham's past, understand the intricacies of medieval life, and appreciate how historical sites intertwine with contemporary Nottingham. Moreover, this app offers an exciting opportunity for public education and engagement. Workshops, guided tours, and educational programs could spring up around the AR app, driving home the importance of Nottingham's heritage enhancing cultural awareness, historical understanding, and fostering a sense of local pride. The Market Wall AR application has then been made available to the public following easy step-by-step instructions:

1. Download and Installation: Users can download the Market Wall AR app from the project's website (www.themarketwall.com). It's available for Android devices only at the moment, with possible development also for iOS devices.

2. Launching the App: After installation, users can launch the app on their smartphones or tablets. The app's interface is user-friendly and intuitive.

3. Point and Scan: To activate the AR experience, users need to point their device's camera at the Old Market square in Nottingham. The app uses GPS and image recognition technology to determine the user's location and orientation.

4. Immersive AR Experience: Once the app recognizes the Old Market square, it superimposes 3D reconstructions of the Market Wall, onto the live camera view. Users can explore these structures from different angles and distances.

5. Historical Insights: While exploring the AR-rendered environment, users can access historical information through interactive hotspots. Tapping on these hotspots provides detailed descriptions, historical context, and stories related to the structures and the people who once lived in Nottingham.

6. Educational Features: The app offers educational features such as voice over description and the link to the research GeoBlog website with all info about the research. These features make it an excellent tool for schools and educators, enhancing the learning experience by making history engaging and interactive. The use of AR in education is a growing trend, and the Market Wall AR project highlights its potential impact in this area.

Figure 4

The Ducking Stool as visualised with the AR App in the Old Market Square, Nottingham (Source: personal archive).

The screenshots in Figure 6 were captured using the Market Wall AR app exemplify how AR can contribute to the tourism economy, cultural awareness and history education, making heritage and history accessible, engaging, and informative for learners of all ages.

Figure 5

The AR App user interface showing its main page and the map with locations of the three experiences (Source: personal archive).

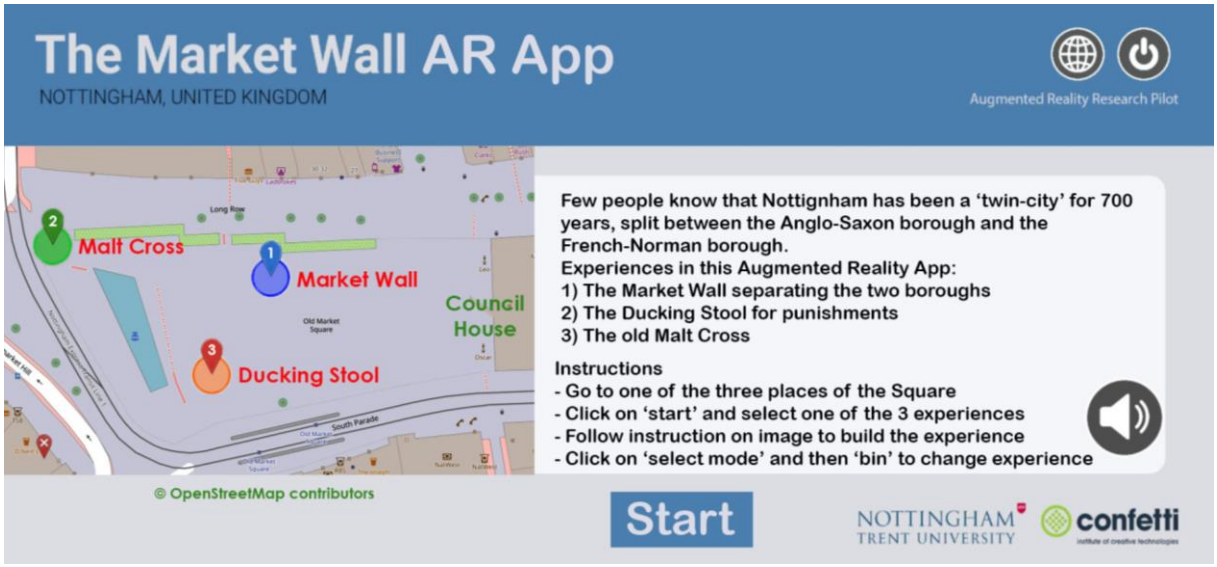


Figure 6a

AR App screenshot showing the Market Wall as it appears in Old Market Square (Source: personal archive).

Reshaping Cultural Preservation

The story of Nottingham's AR app extends far beyond a single city's heritage and can act as a pilot to be developed other cities' heritage in UK and abroad; it is emblematic of the broader transformation occurring in the realm of cultural preservation. As technology evolves and AR becomes more ubiquitous, the potential to resurrect and preserve heritage expands exponentially. The ability to recreate and interact with history becomes increasingly sophisticated and accessible. Nottingham in fact, is not an isolated example of augmented heritage. Globally, a resurgence of interest in history and heritage is brewing, bolstered by AR technology. From the Roman Forum in Italy to the ancient city of Petra in Jordan, heritage sites are leveraging AR to offer immersive experiences to visitors. Augmented heritage transcends geographical boundaries, making it possible for people worldwide to explore the cultural tapestries of distant lands demonstrating how it has potential far beyond tourism and leisure. History, at times, conceals aspects that challenge the established narratives. AR technology can serve as a key to uncover these obscured facets, offering new perspectives and insights into the past. It can shed light on marginalized histories, forgotten heroes, and hidden injustices. AR technology acts as a tool for historical revelation, discussing how it can contribute to a more inclusive and comprehensive understanding of the past.

Conclusions

The journey through Nottingham's hidden history and the creation of an AR app to resurrect it presents a fascinating case study of how technology and cultural preservation intertwine. Nottingham's hidden heritage, with its dual boroughs and the diving Market Wall, revealed the complex interplay of culture, history, and heritage. The AR app developed to bring this history back to life embodies the potential of Augmented Reality in shaping the future of cultural preservation. In a world where time seeks to obscure the past, technology offers an instrument not just for exploration; it's a means to foster a deeper sense of connection and understanding with our heritage. As the technology continues to advance, heritage preservation and education will be profoundly transformed, extending its reach and impact. Nottingham's AR app is but one chapter in this ongoing story, hinting at the incredible possibilities that await in the world of augmented heritage. Nottingham's Market Wall AR project demonstrated how a low-budget, augmented reality app can unlock hidden aspects of a city's cultural heritage, combining technology and history to create a unique and immersive experience. Through the use of AR, cultural heritage is made more accessible, engaging, and educational. Furthermore the project highlighted the transformative potential of AR in areas such as education, tourism, and entertainment. As AR technology continues to advance, it holds even greater promise for the future of cultural heritage.

Nottingham's multicultural heritage, encapsulated in the Market Wall AR project, is a testament to the city's rich history and its ability to embrace and celebrate the influences that have shaped it over the centuries. In the ever-evolving landscape of technology, Nottingham can preserve its past while stepping confidently into the future.

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