Time-wARpXplorer: creating a playful experience in an urban time warp

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ABSTRACT

In this paper, we present a novel pervasive mobile game named *Time-wARpXplorer (TARX)* that comprises of a mobile client and an online authoring tool. The game was created to encourage visitors and locals to explore the city of Lancaster by travelling back in time and space to discover their immediate and distant surroundings. In particular, TARX combines exploration of past and present day by allowing players to warp back in time based on the players physical location. This time travel is linked to present day through the implementation of Foursquare's checkin platform to further raise awareness of historic sites. The paper focuses on the design considerations and implementation of the novel mobile client (*Time-wARpMachine*) and the requirement these place on the online authoring tool (*Xplorer Authoring Tool)*.

Categories and Subject Descriptors

H.5.m [Information Interfaces and Presentation]: Miscellaneous

General Terms

Design

Keywords

Pervasive, Mobile, Mixed Reality, Augmented Reality, Location Based Game, Geo Game, Player Generated Content, Playful.

1. INTRODUCTION

In 1916, Einstein expanded his special theory, to include the effect of gravitation on the shape of space and the flow of time, referring to this as the, general theory of relativity [13]:

"When a body of mass and volume moves with a velocity, then many changes take place in is physical appearance. When the body reaches the speed of light mass becomes infinite and time factor disappears. In liegeman's terms, no time passes covering millions of light years in no time as the time for movement has disappeared. It is in this phase when the body is said to be moving in a time-warp speed".

Nearly a century after Einstein expressed this 'general theory of relativity', time travel has yet to be realised. However, the emergence of the Internet and networked media has opened fissures within the neat chronological representations of time by allowing memories and stories to seep through theses fissures and come back to the present. Mixed Reality Games and Location Based Games (LBG) are game genres that would appear

particularly adept to reveal these cracks in time and space.

2. BACKGROUND

LBGs have in fact been around for decades, in our backyards and streets, such as capture the flag, tag/tig and lurky[1]. However, it is predominantly the digital counterparts to such games that are now referred to LBGs particularly over the last decade, as they have become practical realisations of, Location Based Services (LBSs). This is largely through the integration of Global Positioning Satellite (GPS) sensor on board mobile phones and more recently the advances of Assisted GPS (AGPS) systems using network and Wi-Fi based methods for improving the positioning performance. This has facilitated the expansion of LBSs [2] with the majority of these (e.g. Google's Maps and Latitude[2], Facebook Places[3]) aimed at providing users with contextualised information based on their surroundings such as what or who is around and/or turn by turn navigation. However these services offer little in terms of a playful experience for more casual social walking, exploration and discovery activities.

It was during this time (when GPS was a common commodity within mobile phones) that a new phenomenon, known as Geocaching[4] was conceived. Unlike many subsequent LBGs, Groundspeak the creators of Geocaching, saw an early rise in the games popularity with a global fan base of loyal players, of both consumers and creators.

However, it was a further five years later, when we started to see mapping services introduced; Open Street Maps and Google Maps paved the way for a plethora of mapping data services we know and use today. Since the arrival of the iPhone and Android, LBSs such as Google Maps and those alike, soon established themselves as data map providers to be used within social networks and mobile LBGs. For example LBS such as Dodgeball (the first mobile location based social network), digital LBGs have yet to capture a similar player base as seen in Geocaching. This can be attributed to the fact that digital LBGs, have often drawn inspiration console games that involve movement [19], rather than

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the exploiting players current surroundings, exploring and discovering new locations, which are motivations addressed by Geocaching, of which appeal to a wider demographic of participants from groups such as families to singular person walking activities [24].

Furthermore, traditional video games that focus more on player movement rather that the environment can be seen in early attempts of digitising the outdoor game space with physical games like laser tag (in particular lock-on[5]; a digital outdoor running and chasing game). This is in stark contrast to less digital outdoor activities, such as orienteering and Geocaching[6], which are playful activities that place a greater emphasis on contextualised exploration and discovery, rather than harnessing a competitive element, that is usually a required characteristic that would effectively place it in the category of games [1, 5, 22, 24, 27].

It is these traits observed in many LBGs that are based on movements rather than unveiling the location and requiring a constant player attention, which has lead to the conclusion, of what context is location used within LBGs. In contrast to the term 'location' applied to many LBGs, where such games the players' location and surroundings are independent from the actual game [19, 20] as the players' actual locations are not contextualised within these games. Designing LBGs to be more than simply moving through space to actually permit players to interact with their surroundings can unlock greater depth of gameplay.

Some LBG designers employ location independence deliberately, as it allows these games to be more scalable, in the sense of being able to play it at any location. The downside of this is that it effectively removes one of the success factors seen in Geocaching, which is discovery and exploration of the specific location.

We would argue that Foursquare, arguably the most popular Location Based Service (LBS) to date, has undergone a clear shift from what could have once been considered a game, to now a very service driven approach with gamified elements. The early drivers of Foursquare participation where badge collection and mayorships [17]. Since then, Foursquare have repositioned themselves as a location based search and recommendation service which encourages participation through deals, specials and other monetary promotions. For example, by synchronising their credit cards (such as American Express) users receive certain deals if they use their credit card and check into the venue) [14]. Besides, the observed shift from 'game' to a service with game like activities [12], the creators of Foursquare have themselves categorised the application on mobile app stores as 'social networking'. Therefore for the purpose of this paper, we will refer to Foursquare as a LBS.

The most common theme that runs through both LBGs and LBSs is place data, whether it's a Point Of Interest (POI) for a venues' location or a geo-fenced areas or zones [18] of interest. In relation to LBGs, POIs are typically sourced from existing Application Programming Interfaces (APIs) such as Yelp, Google Places, Foursquare or open data. Nevertheless, in some instances the POIs are created by the community, which is known as Player Generated Content (PGC). These often require extra interfaces for players to interact with, typically a separate online authoring tool [18, 19, 24, 29] but also integrated into the mobile gameplay [20].

Early explorations of digital LBGs, such as My Town[7], Shadow Cities[8], Life is Crime[9] and Run Zombie Run[10] place greater emphasis on the players' movement, rather than the players' actual location and their surroundings thus requiring the player to focus on the screen rather than the environment. The characteristics observed in these games in particular have demonstrated why LBGs in general have yet to reach a critical mass. Due to the stark contrast with the word 'location' applied to many LBGs, the authors refer to 'location' specific games, as Geo Gaming. Therefore Geo Gaming focuses not only the player's location but also a player's exploration of immediate and distant surroundings.

Similarly to LBGs, Geo Games utilise a plethora of mapping and location technologies such as a map and place data providers. Comprising a variety of mobile sensors to assist in determining location, these are can be expressed as direct and implied solutions. Direct solutions such as GPS, AGPS, gyroscope and magnetometer (digital compass) determine the location based on higher degrees of accuracy. As apposed to an implied solution whereby users can interact with objects or systems that have a known location relative to the environment, these solutions vary from utilising the camera lens, Wi-Fi hotspots, Radio Frequency Identification (RFID) and more particularly Near Field Communication (NFC) [24].

It is these sensors that permit for a MR gaming experiences, especially in Augmented Reality (AR) games. However, crude accuracy of sensory information results in jerky augmentation, which can have significant impact on the gameplay experience particularly in urban environments [7]. Although, implied solutions using sensors often create poor performance, they can also increase interaction between user and object to a more physical presence, for instance NFC a user must be physically present in order to interact which such sensor, thus determining a precise location. Early LBGs such as PAC-LAN [24] used NFC to leverage precise positioning to improve LBGs when GPS could not be utilised and also as a method of determining a physical connection between players and objects.

It is a combination of these sensors (such as the gyroscope, magnetometer and camera lens) that provide developers the ability to augment objects over the mobile screen, which is known as AR. The term is often used to describe the merging of physical and virtual environments; the augmentation of virtual/audible data over real world environments, used to produce new and exciting ways to reveal further information, based on the users physical surroundings. Although usually described within research literature as the registration of computer generated graphical information on the users' view of the real/physical world [23]. It was, Ronald Azuma that provided the first clear definition of AR, in which he stipulated the following characteristics; the combination of real and virtual, interaction in real time and expressed in three-dimensions (3D).

Although, substantial research has been conducted for the use of AR in museums, navigation, search and augmenting historical

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artefacts [10, 11, 15]. Earlier instances of playful AR experiences, used wearable Head Mounted Displays (HMD) [4, 21] that immerse the users whole viewing experience, whereas handheld AR (typically a mobile device) provides the users with a less obtrusive experience often referred to as a '*magic lens*' [3]. Unlike HMDs, which are usually more expensive, uncomfortable, provide limited vision, handheld devices have achieved greater adoption rate amongst many AR applications (for services like Layar[11] and Wikitude[12]). Arguably, handheld AR could have been considered the only viable practical platform for leveraging AR capabilities, although Google's latest developments in Google Glass[13] may change this perception.

Despite substantial research, in the field of mobile AR over the last few years, few entertainment implementations of the system have been realised. AR can be broken down into three main implementations; sensor-based, marker-based and markerless solutions.

In the terms of gaming and playful experiences on mobile platforms sensor-based AR has yet to make its mark in the gaming industry. Nevertheless, their has been recent success adoptions of marker based AR within games on popular handheld gaming platforms such as Nintendo's 3DS[14] and Sony's PS Vita[15]. In the research this trend is almost reversed with few marker based solutions the most notable being by Chehimi et al, which used them within a laser tag style game [6]. In terms of sensor based solutions .The mobile LBG Free All Monsters [8, 19] bears most similarity to the game presented in this research

The activity presented in this project looks to be incorporated within the tourism strategy of Lancaster as a way of revealing historical information in a playful way. Therefore the most relevant pieces of research are REXplorer [28] and TimeWarp [16]. In REXplorer, players used the mobile phones as a wizardry device, to enable the player to perform gestures to reveal their location and site-specific spirits. In this game the mobile phone served two purposes; one to act as a gesture device and the other was to enable audio feedback to guide the player through the city. TimeWarp created for the city of Cologne; provides an early foundation of mobile MR games for exploring the history of a city, in a spatial and temporal dimension. TimeWarp used HMDs, which as the authors previously stated, are difficult to deploy in a wider scale, as they have limited reuse functionality.

It is the common theme that runs through these two games of navigation between space and time that the research presented in this paper, basis its foundations, for exploring the concept by creating a novel playful experience that allows users to explore their surroundings through both spatial and temporal revealing the cracks within the history of a city.

3. Time-wARpXplorer – The Game
Although, Einstein's '*general theory of relativity*' theory has yet to be realised, the advances in today's mobile devices and social platforms have opened fissures within exploring places through space and time. The aim of TARX is to provide a platform for the local community and tourists, to explore the city in space and time and in a playful manner.

Arguably, Britain's most famous Victorian photographer, 'Francis Frith' has impacted the concept of TARX, with relation to a recent BBC's documentary, 'Britain's First Photo Album'[16] that retraced the steps of Frith, in his attempt to photograph every city, town and village in Britain, by comparing photographs from years ago in the modern day environment. TARX looks to build upon the this style of retracing steps, with a modern day digital twist. Contrary to the show, TARX uses a collection of Victorian photographs provided by the local museum, but also extended to engage the community directly within the gameplay, by permitting players to upload their own personal photos. By extending the photo collection from solely professional photographers to include community participation [18, 29], permits for a wider spread collection of content.

The premise of the game is to explore and discover a modern day city, navigating through space and time, by augmenting photos of historical locations over the present day. Every player of the game has the ability to store the photos and data they collect as they navigate their way through the city in their own sticker album.

In the games current state, TARX consists of two main interfaces: the mobile client known as *Time-wARpMachine* (Figure 1) and the online authoring tool *(Xplorer Authoring Tool)*.
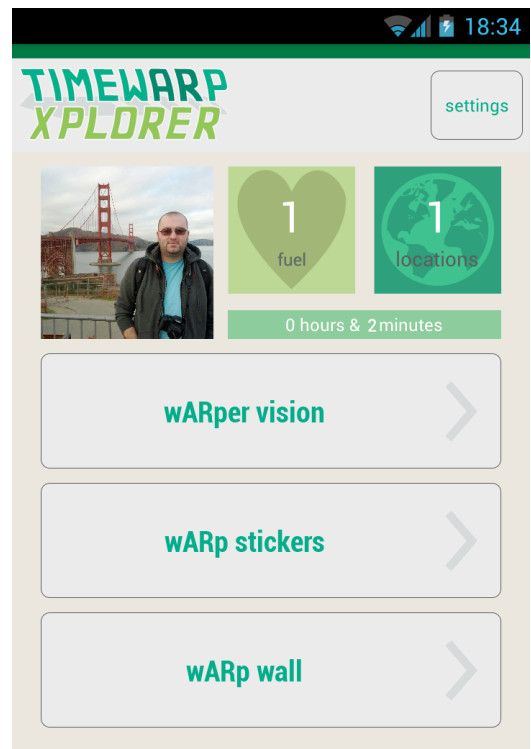

Figure 1. Screenshot taken from the TARX mobile clients Time-wARpMachine menu.

3.1 Time-wARpMachine
As the game outlined is to be played outdoors and on the move around the city. The determination of location is achieved using the mobile phones' GPS.
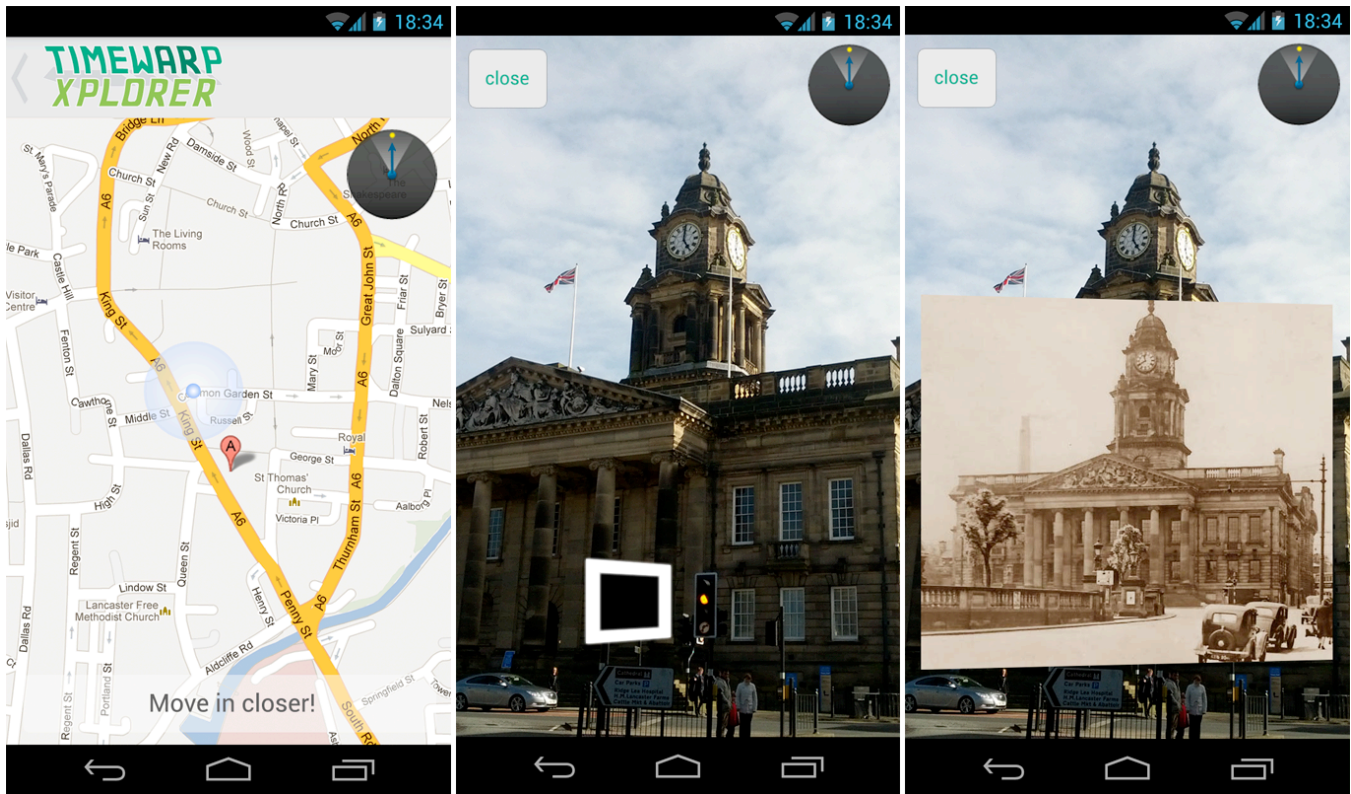

Figure 2. Screenshot taken from the TARX mobile client - from left to right, (a) map, (b) AR and (c) warp view.

In terms of the gameplay players use their *wARperVision* (Figure 2) to display their location, and permit for exploration within the city through the lens of their mobile device. The *wARperVision* is the place to go for players to *warp* back in time. Each POI known as *wARpPOI* indicates that that area can be interacted with to *warp* back in time. *wARpPOIs* are depicted differently when using the map and AR view. *TARX* incorporates an automatic interface switching (Figure 2), to switch the player from an AR view (Figure 2b) to a traditional map view (Figure 2a) based on the orientation of the device. This feature was implemented to save on battery power (as constant AR operation would greatly reduce battery life), to encourage players to be more aware of their environment by not having to constantly look down or through the mobile device, to remove the need to hold the device in an upright orientation whilst walking, as it is not ideal for the player and also has greater social impact; if the device was in an upright position (similarly to taking a photo) those around may think people were being recorded.

As players navigate their way around the city, the game tracks their GPS location, which is designed to be used as an online postcard souvenir but also as a method of increasing engagement amongst players, similarly to Nike+ Fuel band[17]. As the player explores the city, glancing down on their mobile device, getting their bearings by checking their location on the map view; the player is encouraged (by alerting the player they are within a certain radius to a warp point), to hold up the phone in a vertical position to see into the real world (to gain a perspective of what surrounds the player, using the AR view), in turn this augments the POI as 'windows' (Figure 2b) to navigate towards in order to 'look through the window into the past'.

Upon arrival at the *warp* destination, the player then has the ability to *warp* back to a random time. This is achieved by clicking on the marker to reveal the *wARpCard.* The exposed *wARpCard* details the location, a brief description and information relating to the *warp*, but also has the ability to '*warp'* back to that time (Figure 3a).

A successful *warp* is determined by the return of the photo of the spot, which is augmented over the players display (this is known as the *wARpSticker*). The player can then play around with comparing what once was and what is now (Figure 2c). To enable the player to revisit the *warp,* the game adds the information for the location and the photographs into the players' personal sticker album (Figure 2c). Players can share the stickers they collect via traditional share methods such as posting to Facebook, Twitter, and Instagram etc. To create variety amongst players and encourage further participation, whereby players can unlock achievements for fulfilling certain objectives within the game.

These achievements (similar to those awarded to boy scouts[18]) are awarded to players for the amount of interaction they have with the game and specific requirements that are met by playing the game. These achievements are displayed on the *wARpWall*, where it acts similar to a hall of fame for the players playing history. Not only are the badges viewed on the players *Time-wARpMachine* but also online as a souvenir the player can take away, along with the tracked journey. Alongside utilising a badge-based system, *TARX* uses a ranking system to award explorers with a range of ranks for the type of explorer they are. The types or ranks included within the game include (starting with the lowest rank first); 'the volunteer', 'the apprentice', 'the adventurer', 'the xplorer'. 'the historian', 'the enthusiast' and 'the mentor'.

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17 Nike+ Fuel band - http://nikeplus.nike.com/plus/

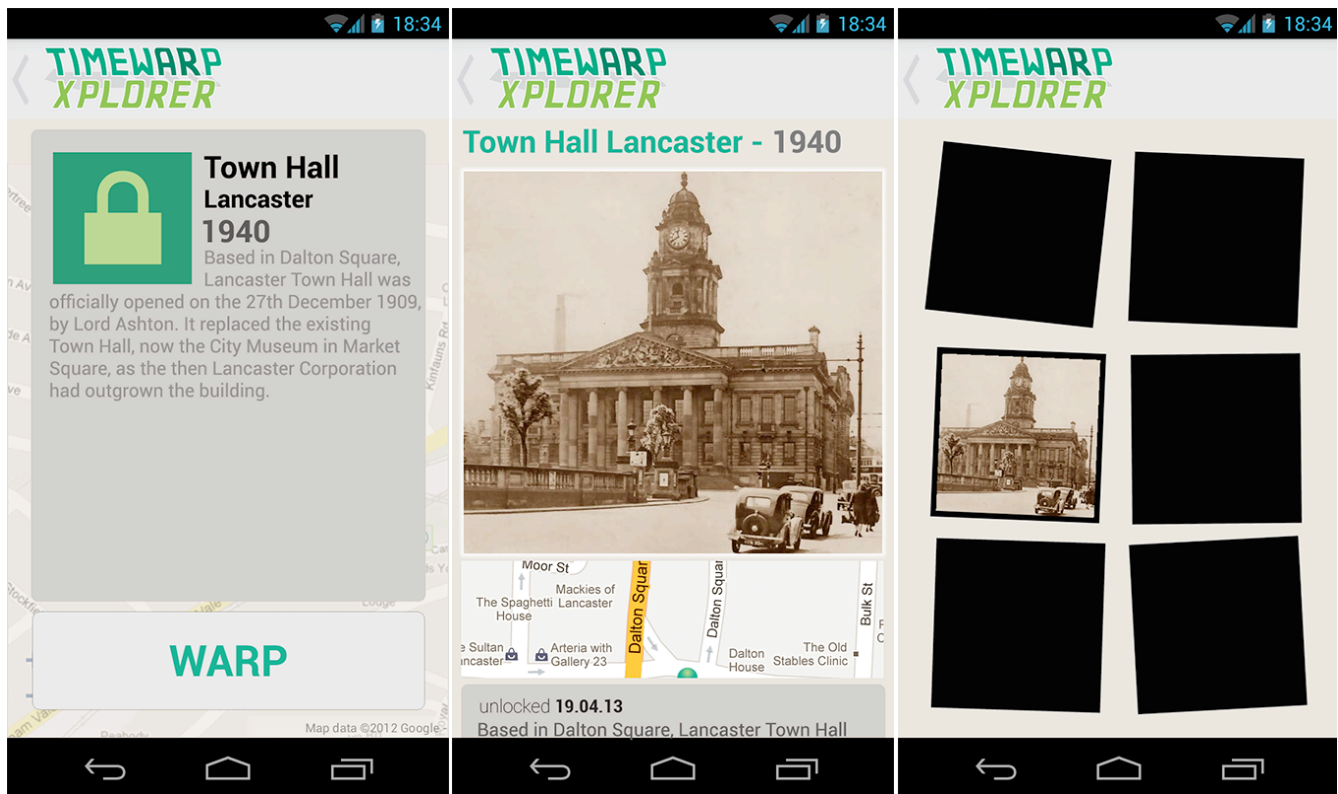18 Boy scout badges - http://scouts.org.uk/what-we-do/badges-and-awards/

Figure 3. Screenshot taken from the TARX mobile client - from left to right, (a) warp interface, (b) warp card and (c) sticker album.

As an important aspect of the project was to provide a playful way to engage with physical surroundings of the city, a pilot the game was restricted to the city of Lancaster, whereby if a player went outside the geo-fenced area, the game would ask the player to return back to the game arena. This was to keep players (who could be of young age) within a safe area of the city to avoid players wondering off into area where no POIs where present.

3.2 Xplorer Authoring Tool (XAT)

In order to provide a platform whereby the community can participate within the game creation a management-authoring tool was developed. This permits for a variety of interpretations of the community of Lancaster to contribute personal photographs that could have been a family run business or what the school looked like when they were children.

Xplorer Authoring Tool compliments the main game; it is the name provided to the crowdsource-authoring tool used for the games content creation, it is the portal where players can generate their own POIs by uploading historical photos and metadata to be included in the game. These POIs within the game consist of a minimum requirement of supplying a photography, the name of location, a brief description of what is on the photography, a date associated to when the photography was taken (a year required, but full date can be supplied), latitude and longitude. Further data can be provided, if attained such as the direction from where the photo was taken, the incline of the photograph. The intention for opening up to the community was to provide a sense of ownership with the game amongst the local community and to increase the perspective of varying photographs, seeking to engage audiences

by supplying a piece of history within the game. Clearly those wishing to contribute towards TARX are subject to verification and filtration, as the game is about revealing stories within history to encourage exploration and discovery in a safe playful activity.

4. FURTHER IMPORVEMENTS

As the game is only its early development and deployment stage, there are numerous enhancements that have been discussed with the authors and the local museum. Amongst these are connecting the game with existing social networks that incorporate location and provide a platform to share where you are. Social networks such as; Foursquare, Facebook and Google Places, all provide a mechanism for checking in to venues [9]. It is these venue data providers that are of most interest into the extension of the game; as players could travel back in time visiting an area as it once was, simultaneously check into the current venue at the same location but separated through time.

Currently users can only upload new wARpPOIs using the online authoring tool; one issue with this interface is the accuracy in determining the exact location (by solely using a interactive map) where the historical photographs were taken. There are plans to enhance the mobile client, to incorporate the authoring tool within the application and as part of the game. The mobile client would support players in real time to align a transparent version of the historical photograph overlaid onto of the viewfinder. Such tooling would permit for finer positioning of new wARpPOIs, allowing for a higher degree of accuracy would result in a more realistic WARP experience.

In addition to fine tuning gameplay accuracies, extending the game to utilise additional locating approaches such as NFC, would permit a physical connection between two points, if a physical connection were required to determine an exact location for example physically visiting a specific location, whether it be a particular sign post, street name etc., the game would seek to integrate RFID stickers around the city whereby players could physically tag. These tags offer direction interaction (those previously seen in LBGs that utilise implied location solutions [26]) and relatively low costs. To integrate within the games ethos, the tags scattered around the city can be used to further the stories of the city, be it myths, tales or facts.

Furthermore, by extension of the games accuracies and locating method, the authors have planned to extend the games content from simply using still images for a basis of revealing a story, to time-lapse videos, similar to those currently being uploaded on Vine[19]. Understandingly these videos would be used to tell current stories, as historical videos like this would be difficult to obtain. These videos could be used to document a construction of a building or when a tragedy occurred (for example when a hurricane tears through a city landscape). Keeping inline with the enhancements within the gameplays media, moving from still imagery, time-lapse videos to utilising audio, maybe recorded from a time of a bustling market scene or steel factory workers etc., the game has been designed to utilise a range of medias.

5. CONCLUSIONS

This paper presents the concept of a multi-faceted location based game, which attempts to capitalise on the successful attributes seen in many outdoor activities. The concept of TARX was to provide users with a toolkit to create their own stories and experiences for where they live.

Although the current design has been developed through the lessons learnt from developing previous mobile games, in particular LBGs, an extensive evaluation of the gameplay and interactions will be performed by analysing its longitudinal performance during studies based on trials held with cooperation with the local museum.

Based on experiences learnt from developing LBGs for wide scale deployment [20], the authors took a slightly difference approach for dealing with event driven gamers (typically, where devices are loaned out to player) and independent participation (where the game will be launched onto the mobile's App Store ecosystem, for players to download and create their own experiences). In the instance of event driven games, where devices are shared the game automatically records the date and International Mobile Station Equipment Identity (IMEI) number from the device, players can personalise their *Time-wARpMachine* by linking their IMEI number to a chosen gamer tag and setting an avatar. Where players chose to use their own devices, the scalable method is applied to the games setup, where the player can chose to sync the game with their Google account details, thus bypassing the IMEI synchronisation.

From long-term results, we expect to be able to establish player traits, to define what makes a successful Geo Game, in terms of how players explore and discover environments and how players interact with the location and surroundings. Therefore, to understand if mobile location games can have similar success to those seen in other less technical outdoor activities, these games need to be designed with scalability in mind. However, this can

only be achieved once greater player and location data is collected.

The authors would argue that AR is a useful approach for extending user interactions within a mixed reality space, nevertheless it is important for designers of AR applications to consider practical uses within environments rather than novelty explorations.

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