Challenges in Preserving Augmented Reality Games: A Case Study of *Ingress* and *Pokémon GO*

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ABSTRACT

Video games, as an evolving medium, present specific challenges to preservation, and with the introduction of newer technologies, these difficulties are ever increasing. Augmented Reality Games (ARGs) present challenges unique to the technologies implemented within them, blending the physical world with the virtual world, the socializing factors embedded in play, and the increasingly network-distributed nature of their content. We examine two popular ARGs, *Ingress* and *Pokémon GO*, as case studies and illustrate the additional challenges ARGs bring to preserving video games. Boundaries in ARGs question the traditional understanding of gameplay, while preserving changes in virtual and physical space present challenges to ARG representativeness and authenticity. Metaplay illustrates behavior based on non-deterministic situations, often as a result of real world changes. We also review different approaches suggested in prior literature for preserving video games, focusing on preserving the context and history of the game by collecting relevant artifacts and documentation, and explain why implementing these approaches could be challenging for ARGs.

KEYWORDS

Augmented reality games, Video games, Ingress, Pokémon GO, Digital preservation, Preservation, ARG

1 INTRODUCTION

Video games are a complex and multifaceted medium which present many organizational and preservation challenges. The pressing need for preserving digital games was articulated in a white paper published by the Game Preservation Special Interest Group within the International Game Developers Association -- digital games are an important part of our cultural heritage and a failure to take action to preserve them now may result in a significant loss of content and the contexts in which they are presented, within but a few short decades [9]. However, preserving video games is not a simple task, as noted in prior literature. For instance, the final report from the "Preserving Virtual Worlds" project led by McDonough et al. [8] presents a number of issues pertaining to preserving games and virtual worlds, such as the obsolescence of game hardware/software, scarcity of media, third party dependencies, complex and proprietary code, difficulty in verifying object authenticity, intellectual property rights issues, problems in determining significant properties, and the importance of preserving context. Additionally, McDonough [7] and Lee, Clarke, and Perti [5] also point out limitations of existing game metadata and difficulties in collecting useful metadata due to the nature of games and their unique publication process. Multiple versions, relationships with other non-game objects, modifications and additional content, and complicated intellectual property situations are but a handful of issues important to video game preservation. Barwick, Dearnley, and Muir [3] also examine the same problem from the practitioners' perspectives by interviewing representatives from three different museums/archives (Computerspiele Museum, Strong National Museum of Play, and The National Videogame Archive) with extensive video game collections, examining the current status of digital game preservation. They also note the legal challenges in the long-term preservation of games as well as the difficulties associated with presenting games to the museum audience, and preserving the cultural significance of the game and the game's relation to its cultural context.

In addition to the multitudes of challenges of preserving digital games, McDonough et al. [8] raise an important question in preserving specific types of virtual worlds or games such as *Second Life* or Massively Multiplayer Online Role-Playing Games (MMORPGs) like *World of Warcraft*. In these environments, "the value and meaning of a virtual world is primarily derived from the actions and interactions of its players (p. 29)" and experiencing the world outside of their prime time would mean that the player's interactivity would be more akin to an archaeological study, attempting to envision how the virtual world might have looked. Winget [12] elaborates on the challenges of preserving MMORPGs, including technical dependencies, representation, and collection development. She argues that in addition to solving technical and legal issues, other challenges such as determining the nature of primary and secondary artifacts, modeling interactivity, and collecting contextual information, need to be considered as well.

In our work, we aim to expand the discussion on video game preservation by examining Augmented Reality Games (ARGs). ARGs are generally understood as games that blend the virtual world and real world via gameplay, although some scholars argue for a more precise definition. For instance, Azuma [1] specifies three characteristics that defines ARGs: "1) combines real and virtual, 2) interactive in real time, and 3) registered in 3-D" (p.2). Generally, the term ARG would include a game like *Pokémon*

GO, which may or may not meet the third criterion depending on the use of the AR feature in the game. In either case, mapping physical space virtually is an integral piece of defining the ARG experience and creates unique preservation challenges due to the demands of location-based play.

The unprecedented success of *Pokémon GO* in 2016 has resulted in an increased interest in ARGs, including academic perspectives examining the benefits and drawbacks of these games, impacts on real-life player behaviors, emergent issues regarding safety and privacy, as well as interest from game developers wanting to understand how *Pokémon GO* was able to captivate such a massive and diverse audience. Preserving ARGs will undoubtedly be an important task for conveying the cultural heritage of paradigmatic play (i.e., play specific to a time and place) and how such games have impacted our current society. ARGs amplify existing challenges in preserving digital games by physically mapping context-sensitive and social events in the real world. Here, we specifically discuss two examples of ARGs as our case studies to illustrate some of these challenges. We will conclude with a discussion of the impact of ARGs on various game preservation approaches.

2 Two Example ARGs

2.1 *Ingress*

Ingress was developed by Niantic, a spinoff company from Google, and was released in 2014. In 2015, Niantic reported that they had over 7 million players[1]. The game uses Google Maps as a base for overlaying game elements onto real-world locations. In *Ingress*, there are two factions (Enlightened vs. Resistance) that players can choose from. The main goal of the game is to take control of "portals" which are mapped to various real-world locations such as landmarks, public places like parks, or local businesses. Capturing these portals is done by placing a resonator at a portal which marks it based on team affiliation: green for Enlightened and blue for Resistance. If players come across portals already controlled by the opposite team, they can remove opposition control by using in-game weapons like bursters or ultra-strikes. Players aim to take control of as many portals as possible and control an area by deploying "fields" connecting three portals into a triangle. These game control actions can happen at varying scales; connecting portals highly concentrated in a small local area is called "microfielding", while a large-scale operation which can cover multiple states or even countries is called a "megafield". The larger fielding endeavors require many participants and tight coordination, and are referred to as "field operations" ("field ops"). Field ops typically involve anywhere from a dozen to hundreds of players engaging with the game in real time. There is an elaborate out-of-game narrative that establishes relationships between player actions and story events. Niantic also hosts global community events called "anomalies" where player teams compete to take control of portals in a local area, and "shard events", where players must coordinate the capture and movement of in-game items called "shards" to certain target portals to "score" them.

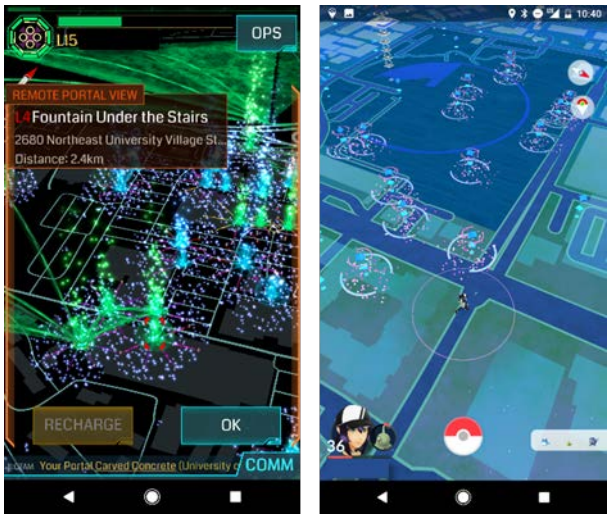

Figure 1. Screenshot of *Ingress* (left) and *Pokémon GO* (right)

2.2 *Pokémon GO*

Pokémon GO is undoubtedly the most popular and well-known ARG of all time. Niantic recently announced that the game has been downloaded over 650 million times and has made over one billion dollars in revenue[2]. In *Pokémon GO*, the players' objective is to locate and catch virtual creatures called Pokémon that appear in real-world locations. Pokémon was already an extremely popular media franchise from Japan and has multi-generational appeal to users across the world. The overarching goal of the Pokémon franchise is to "catch'em all"; collect all the Pokémon, train, and battle with them. In the game *Pokémon GO*, Pokémon randomly spawn in different real-world locations, as well as at locations called "nests" where a substantial number of a specific kind of Pokémon spawn. Players can also use incense and lures to attract Pokémon to a particular location. Incense can be used by individual players to lure Pokémon to the current location of the player. Lures are used at PokéStops to attract Pokémon to that location and benefit multiple players who are close by. PokéStops are mapped onto real-world locations just as in *Ingress*. In fact, Niantic used some of the portals in *Ingress* to populate PokéStops in *Pokémon GO*. Players can receive resources like balls (to capture Pokémon) and berries (to help improve some aspects of the catch experience, such as increasing catch rate or restricting Pokémon movement) by interacting with PokéStops. There are three different teams (i.e., Instinct, Mystic, and Valor) and players can battle with players from other teams at Gyms using their captured Pokémon in order to take control of them. Gyms, just like PokéStops, represent particular locations in the real world.

[1] http://www.tomsguide.com/us/endgame-proving-grounds-beta,news-20650.html

[2] http://www.polygon.com/2017/2/27/14753570/pokemon-go-downloads-650-million

3 Issues and Challenges in Preserving ARGs

In this section, several issues and challenges for preserving ARGs focusing on the aforementioned games will be presented, including 1) determining the boundaries of the game in ARGs and dealing with subsequent preservation scalability issues, 2) recording changes in physical and virtual spaces while preserving a game's representativeness and authenticity, and 3) preserving metaplay, social gameplay, and interactive contexts.

3.1 Boundaries of the Game and Scalability

One of the foremost challenges in preserving ARGs is establishing the boundary of the game object. Does the reflection of real world elements in gameplay warrant preserving real world data not represented in the virtual world? Does this mean, for games like *Ingress* or *Pokémon GO*, that we need to save the Google Maps data used to create them? One may argue that preserving the object itself, in this case, the digital game, should remain the primary goal in game preservation. However, Niantic has made it clear that real-world interactions of players in *Pokémon GO* are the foundation of their games: as Niantic CEO John Hanke says, "From the very beginning, our games were about encouraging people to go outside and see interesting places."[3] If this is indeed the case, completely disregarding the representation of real-world data in ARG preservation does not seem ideal, as it may be impossible to replicate intended or meaningful player experience, at least as it is described by the developers. However, even if we were to accept that real-world data should be part of the object we preserve, it is unclear how much and what kind of data we would be preserving. Is the current version of Google Maps data enough? What kinds of legal challenges exist in obtaining and preserving such data? Does it need to include a visual representation or description of each of the real-world locations beyond what is provided by the game itself? How will this information be obtained for all the real-world locations across the globe? Additionally, how would we go about replicating gameplay that involves real-world data and movement between locations (e.g., walking to hatch eggs in *Pokémon GO*; linking portals or creating a field in *Ingress*) in ARGs to recreate a similar experience for players in a museum setting?

As Winget [12], Newman [11], and Kaltman [4] argue, the scalability of data preservation for video games gets more difficult as more content distribution becomes network-based. ARGs are entirely network-based and their particular scale is often determined by their players. As more players are added to a game such as *Pokémon GO*, the scale of data becomes increasingly dense and as a result, difficult to meaningfully track, describe, or emulate. Based on recent estimates from Android Central and Business Insider, an average *Pokémon GO* play session uses about 20MB of data[4]. For a single user, that figure may seem rather benign, but if we scale that up to the actual *Pokémon GO* user base of roughly 20 million active daily users of the game[5], that is roughly 400 terabytes of data per day. The amount of information necessary to account for the representative game experience of just an average day for *Pokémon GO* is extraordinary, and these are the information needs for most network-distributed games, including ARGs. The result of such needs is a product that is likely impossible to preserve in its entirety at scale. Rethinking what or how to preserve becomes necessary for ARGs without a significant revolution in the quality, quantity and availability of data storage. *Pokémon GO* is but the start of what is likely to be a larger trend, where franchises attract large audiences and players create large amounts of data, making it increasingly difficult to track pertinent and meaningful information about these games.

3.2 Changes in Physical and Virtual Spaces

ARGs are played in the real world, with specific geospatial points in the real world corresponding to an analogous location in the virtual world. As mentioned in Section 2, portals in *Ingress* and PokéStops/Gyms in *Pokémon GO* correspond to real world locations such as monuments, public art, and businesses. However, changes often occur in the real world (e.g., construction removing a business) or the virtual game world (e.g., a new version or update removes PokéStops), that do not get updated accurately in its counterpart.

For instance, *Pokémon GO* or *Ingress* players looking to orient themselves to a particular place in a virtual environment may find that while the location exists in the game, the actual object associated with it has since disappeared (e.g., mural, natural object, business). On the University of Washington campus, players may look for the Washington Elm tree reflected as a portal in *Ingress* or PokéStop in *Pokémon GO*, but will not be able to find it in the real world, as the tree has been removed from campus. Similarly, a quarter mile away a chocolatier is still shown as a portal in *Ingress*, yet the business is now closed. These virtually or physically missing elements leave a legacy of sorts, marking a space's historical past. As ARGs age, elements within them intended to reflect places and objects in the real world disappear as the physical or virtual game environment change.

Such environmental mismatch could certainly become an issue as gameplay is affected by changes in an ARG's physical and virtual game environment. Furthermore, descriptive information about the game, as a result, will make less sense with the different versions of the game due to discrepancies in physical and virtual game environments. For example, if someone wants to experience an aspect of *Pokémon GO*, such as PokéStops that were particularly contentious, they need a version of the game from before these PokéStops were removed due to requests from individuals or organizations owning the associated locations. However, much of the external information about the game, such as popular media coverage, or user-generated discussion, tend to not specify which version of the game they are referring to, sometimes making it nearly impossible to track down a specific

[3] http://www.recode.net/2016/9/19/12965508/pokemon-go-john-hanke-augmented-virtual-reality-ar-recode-decode-podcast

[4] http://www.androidcentral.com/how-much-mobile-data-does-pokemon-go-use

[5] http://expandedramblings.com/index.php/pokemon-go-statistics/

version containing relevant location information. In ARGs, version control is uniquely challenging due to the necessity of keeping track of multiple environments and their relationships.

3.3 Metaplay, Social Gameplay, and Context

To fully understand the dynamics and gameplay of ARGs, it is necessary to understand how people interact with one another in both physical and virtual environments. The major ARGs that have been released share several challenges with that of preserving other virtual worlds, such as those in MMORPGs. These include preserving the players as an intrinsic part of a game's historical context, and recording the changes in MMOs and their players over time [2].

ARGs present several additional challenges to preserving gameplay and dynamics, including gameplay taking place out in the real world with players competing, cooperating, and reacting to one another in real space. As a result, there is a strong and unique social dynamic among players of the game that takes place in the real world. In MMORPGs, one might argue that it is possible to at least preserve part of the non-social gameplay, such as PvE (Player vs Environment) components that can be played by a solo player. In games like *Ingress*, the kind of game interactions one can have is severely limited if you do not account for social play (play with other players). PvP (Player vs Player) actions are integral to the gameplay. Once you take control of the portals around you, there is essentially *no game* unless players from other teams come and take them down. Even in *Pokémon GO*, where social action may be perceived as less important than *Ingress*, luring PokéStops to attract players is a common behavior.

Also, while MMORPGs require players to play together to fully experience the game, and various communities emerge and social gatherings happen, because some ARGs require players to interact with people in close proximity in the real world, a number of additional issues emerge. In the case of *Ingress*, because it is inherently a social game that forces players to interact with other people in real-life, a large amount of information is shared among players regarding who they should work with, based on their personalities, mobility, and level of commitment to the game. Players who have shown dangerous behavior (e.g., stalking, physical confrontation) are actively watched and avoided via third-party tools that allow people to track the location information of all players. High-profile players from the opposing team are identified and any of their unusual movement is reported back to the community to alert the possibility of a field operation being deployed. None of this information about the players is represented anywhere within the game itself. Furthermore, much of the gameplay regarding *Ingress* occurs outside of it. Examples include expanding and maintaining local player networks, collecting intel about players on the other team, mapping routes for a mega-field operation, and so on. These types of *metaplay* are not something recorded anywhere within the game itself, yet remain a critical component of the play. Ultimately, the problem is that interactions happening within a digital game only make up part of the overall play experience of an ARG.

It is also difficult to preserve temporal factors in the physical world that impact the game state. The nature of ARGs present unique challenges in preserving real world factors that impact and alter gameplay, particularly as it pertains to location access in the game world. For instance, in a traditional online game, access to in-game areas is dependent upon the developers changing the game code and in-game environments, or in some instances, player behavior. With augmented reality games, any number of factors in the real world can change access to physical areas, and by extension the game state, even though those real-world changes are not reflected in the game's world. For instance, winter snows make ARG play in some areas seasonal, and the timing and duration of play is dependent on the weather, not player behavior or the game. Additionally, some public spaces once available for play can become blocked by construction, road closures, new rules and regulations, or other access changes. Some players utilize such tactics to their advantage. For example, *Ingress* players will make strategic use of portals in amusement parks that close for a season, or claim portals high in the mountains just before snow storms hit. Some *Pokémon GO* players report locating and claiming gyms that are in less accessible areas in the real world so they can have access to the secure, steady supply of resources owning an inaccessible gym provides. Understanding such temporal conditions builds the foundation allowing for strategic play, and establishes a form of competitive advantage conferred by knowledge of both the game and how it is affected by temporal conditions, such as the seasons. Yet the question remains as to what the best way might be to preserve the temporal, real-world, events frequently occurring in ARGs.

4 How Do We Preserve ARGs?

In prior literature on video game preservation, varying solutions have been posited by scholars, responding to the numerous challenges that exist for preserving the game and gameplay experience. Lowood [6] calls for initiatives to build game performance archives containing documentation of game play and relevant artifacts of participatory culture as well as archives of artifacts and documentation representing the history of game design. Murphy [10], also noting the challenges in preserving MMORPGs, suggests several approaches for better preserving the context of games, such as ethnographic writing and video documentation of gameplay, as well as preserving crowdsourced contributions from game players. While these approaches indeed offer a better model of preserving games in general, for ARGs, we also anticipate additional challenges in implementing them.

Ethnographic documentation has specific limitations due to the amount of information volunteered. In the case of *Ingress*, certain information is withheld due to the value and impact it can have while playing the game. High-value information is often protected with the same confidence as company secrets, whereby competitive advantage is lost if certain information becomes a matter of public, distributed record. For instance, information such as strategies for successfully running a mega-field operation in *Ingress* are often intentionally not recorded and instead only

orally disseminated to players. Additionally, such high-value information would also require deep integration of an ethnographer into the game's social context in order to escape the problematic scenario of being seen as an outsider and thus not being privy to such scenarios.

Video documentation of gameplay would be able to sufficiently record the gameplay itself, but again in the case of ARGs, much of the play experience is often outside the game itself. The planning of social events and strategic contexts in relation to the game, or metaplay, often makes up a great deal of ARGs, particularly competitive games like *Ingress*. The result is that even with video documentation of the gameplay, it would not provide much context for what makes competition within the game compelling or meaningful to many of the players.

Preserving crowdsourced contributions can also be a challenging task, due to the large amounts of misinformation, disinformation, trolling, and fake news based on speculation or false information[6]. These stories often happen as a result of a game's sudden popularity, and nowhere has this been truer than perhaps in *Pokémon GO*. In *Pokémon GO*, there are reams of intentionally fabricated information online about what is possible or not possible within the game, such as whether or not certain Pokémon are in the game (e.g., Ditto), or whether it is possible to hatch region-specific Pokémon, or acquire Gen 2 Starter Pokémon. Additionally, there are numerous stories recounting different players undergoing physical harm, others making money off the game, and many varying pieces of difficult-to-verify information about the game, much of which is also related to acquiring a competitive advantage within the game.

Historical account generation is also difficult due to the fact that many ARGs take on a shared narrative, whereby the game changes based on player interaction with the game world. As a result, for a game like *Ingress*, whose narrative is constructed based on the competition ongoing within the game, an official story is being continuously generated but does not definitively exist until after certain events occur. As an example, an anomaly in *Ingress* often has the two teams in the game compete over a certain area, and the story branches based on how players perform in that event. This means even though it is known that the game developers often account for multiple different outcomes, the only official story is the one that gets told after the event. The developer often does not intend to act as a moderator of the game world and as a result it is often up to the players to self-report their own historical accounts, thus making an authoritative historical account difficult. Player bases change and shift over time, and with that fluctuating player base is an evolving story, making it particularly difficult to pin down an accounting of events.

As ARGs are still a relatively new phenomenon, many of the questions we asked here have yet to be answered. However, it is also the case that early ARGs, such as *Parallel Kingdom*, have already been shut down with information about the dynamics and culture of the game only remaining in blog posts or forum discussions, demonstrating that the loss of ARGs is already occurring. Perhaps what first needs to happen is to better understand what the "significant properties" are when it comes to ARGs. McDonough et al. [8] explains the challenge of trying to preserve games without knowing what portion of them will be considered significant by future scholars. This does seem to be the case for ARGs we examined; ultimately, what makes *Ingress*, *Ingress*? What does it mean for players to play *Pokémon GO*? Is it the discovery of real-world locations, some social aspect of play, a renewed concern for personal health, the metaplay, or something else? We have yet to understand what playing ARGs means to current users, let alone future scholars. Our future research will involve a detailed investigation of player behaviors in ARGs, in an effort to elicit user attitudes toward ARG gameplay, and to garner insight into better preservation strategies for these games.

[6] https://www.theguardian.com/technology/2016/jul/24/pokemon-go-quiz-can-you-catch-the-fake-news-story

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