An Augmented Reality Game using Face Recognition Technology

Tom Feltwell
Northumbria University
Newcastle upon Tyne, UK
tom.feltwell@northumbria.ac.uk

Gavin Wood
Northumbria University
Newcastle upon Tyne, UK
gavin.wood@northumbria.ac.uk

Conor Linehan
University College Cork,
Cork, Ireland
conor.linehan@ucc.ie

Shaun Lawson
Northumbria University
Newcastle upon Tyne, UK
shaun.lawson@northumbria.ac.uk

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Abstract
In this paper, we explore the coupling of mobile facial recognition technology with the exploitation of non-players as a powerful mechanic in locative augmented reality games. A prototype game is presented which asks players to "capture" the likeness of members of the public. Driven by free-to-play models, *and* inspired by the phenomenal success of *Pokémon GO*, we have created an experience where players hunt for and "capture" *real* creatures in a *real* world.

Author Keywords
Game design; augmented reality; urban exploration; vagrancy; facial recognition; homelessness;

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Introduction
The huge success of the Augmented Reality (AR) game *Pokémon GO* in the summer of 2016 – which was downloaded by one in four phone and tablet users across the world [18] overtaking *Candy Crush Saga* for daily users [1] - has reignited many conversations, in academia and in industry, about the potential of mixed-reality and augmented reality locative games. Many such games have been released in various forms for the last decade or so, with varying degrees of success.

Chemically soiled, disused industrial zones

Woods and forests inhabited by banjo playing bumpkins

Rat infested 1970s brutalist urban walkways

Figure 1: Three prototypical play environments.

This has led to much speculation and discussion over what, specifically, drove the unparalleled success of *Pokémon GO* [13, 14, 19]. An argument can be made, for instance, that mobile technology is only recently capable of supporting reliable engaging AR experiences.

Our work continues the tradition of Augmented Reality and Mixed Reality games being used as ways of exploring the relentlessly expanding materiality, the design opportunities afforded, and the social and psychological significance of new mobile technology e.g. see [4, 5]. We are specifically interested in the powerful opportunities presented by mobile facial recognition tools when used as game mechanics. A recent innovation in cloud-based facial recognition as a service, Facebook's Face API, provides real-time access to Facebook's *DeepFace* facial recognition services [21]. Previously this was only available to the Facebook platform, but the Face API now allows arbitrary developers such as ourselves, access to a recognition database more powerful than that used by the FBI [7].

This paper also explores a theme that has commonly emerged in research on AR and MR games – how to creatively make use of the non-players moving around in the real world as part of the "board" on which the game is played [15, 10]. While much of the literature has been distracted by discussing ethical problems surrounding non-player involvement [16, 17], researchers have also emphasized that the involvement of non-players is the most exciting and novel aspect of AR and MR game playing. Specifically, interacting with those non-players creates unpredictable, intense experiences [5, 10, 15]. It also creates randomness in a game, because we cannot force non-players to be in locations that are convenient for our game players.

Bringing together these two exciting and relevant strands of research has led to the creation of a game that we believe is fun, challenging and novel. In the following sections, we present the design of *Homelessmon GO,* a novel mixed reality game experience that allows you to hunt down, identify, and capture real location-based creatures.

Homelessmon GO

Our game design was inspired by Pokémon GO*,* and the literature on non-player involvement in location based games. Unlike Pokémon GO, where players are asked to hunt for *imaginary* digital creatures situated between the real world and the virtual world of Pokémon, our intention was that our players could hunt for *real* creatures in the *real* world. We decided to use members of the public as our creatures and the Face API as a means to uniquely identify them.Through our initial research through design work, we realized that there are challenges when using members of the public as a collectable game resource. For example, in Pokémon GO, a creature can be spawned at a public location and it will stay there, allowing players to interact with it and collect it. However, the habit of real people to frequently move between private spaces, such as their homes and workplaces, as well as semi-public places such as brewpubs, gyms and artisan bakeries, causes problems for our design goals. These issues are compounded by the predominantly private and/or difficult to access modes of travel used by real people: namely fixie bikes, planes, trains and automobiles. As such, this leaves only small windows of opportunity when members of the public are in public places. We realized that this was a major limitation for our game, and one which we have considered heavily.

Figure 2: Play interface, showing hints at nearby populations

As Justin Keller noted in his letter to the San Francisco mayor [11], homeless people are often commonplace in cities. Moreover, they can be a blight in such urban environments as they assume a wide variety of undesirable, bothersome behaviors. However, in looking to leverage the NPCs for our game design, we struck upon the idea of using the homeless population as a resource. In our own explorations of example play environments (see Figure 1) we observed that homeless people typically remain, more or less, motionless in public spaces for much longer periods of time than normal people. Thus, using homeless people as location-based NPCs offered us the benefits of the randomness derived from using non-players, but in a more predictable and deterministic manner. We realized that the general populace also regularly "tag" homeless people (e.g. as junkies, travelling hobos, wood/forest dwellers), and this also provided us with a taxonomy that we could utilize in the game design.

We suggest that our game, *Homelessmon GO,* is a major breakthrough for locative game design. Games will be more fun when designed this way, as they engage people directly with the diversity in the real world [12]. This also presents the "tapping" of a previously untapped resource, in our case one that is often maligned as not contributing to society and being bothersome. This innovation will allow those members of society to contribute to the general urban good, providing fun and enjoyment to many people. We also envisage that encouraging users to search for and explore their surroundings, in the natural process of playing the game, will help raise awareness of the conditions and environments in which homeless populations live, fostering increased civic engagement and community integration.

Design

The primary interface for the game is a topographical map, as seen in Figure 2. Users will also be able to see hints within a certain radius of their position which are indicated by Hobo Signs [3] on a map. Players can toggle the AR capture mode of the game, which also toggles the camera of the smartphone. Players are continually nudged and hinted to move around and explore different areas (examples in Figure 1).

As noted previously, in western culture we already have pre-assigned "classes" of people within the homeless population, and we have utilized these in the central feature of the game, the *Hobodex*. This is a list of 40 different types of homeless people, based on existing classifications, which can be captured, and validated through facial recognition, which will provide new opportunities for memorable "face-to-face" play. For example, pan-handlers are fairly common, and thus these will be easy for players to find. However, homeless people who live in the forest, or otherwise purposely away from habitation, will obviously be more difficult to encounter, and thus worth more points. Capturing all the different types of homeless people will bestow increased prestige on the player, allowing them to appear on a global leaderboard, replete with the faces of those they have captured. In line with industry standard game designs, we will add a range of power-ups and resources that players can purchase with real currency (linked to the Play Store/Apple Store), which will keep players sustained in their quest, for example, allowing the player to dress their avatars in the finest cloth. In game purchases will also help to channel money away from direct donations to the homeless, in turn reducing their ability to unwisely purchase steak bakes, alcohol and drugs. We foresee there will be

emergent play behaviors developed post-launch. For example, players may begin to coordinate with charities to find out when and where soup-kitchens will be set up. Similarly, players may place lures, as in Pokémon GO, but of real money or food or alcohol, in order to entice homeless people to their favored location. Savvy players will benefit from learning the secret design tricks of city councils who install *defensive architecture* (e.g. spikes in doorways, slanted rail station seats) [1] to displace the homeless population, with players adapting their searching strategies accordingly as the civic landscape evolves over time.

Technology

Facebook's Face API is currently available by application only, and access is granted based on the proposed usage; we do not envisage any difficulty with our application. The facial recognition API is invoked when the user switches into the AR capture mode, with all faces within the video data from the smartphone being processed by the Face API, and stored by us as additional, collateral, data points. Alongside the facial recognition, we have generated a data set of approximate locations of homeless populations. This was mashed together from various third party datasets (civic, user generated, field studies) for each city included at launch. When users capture the likeness of a homeless person, their interactions add further data points, feeding our data model and allowing us to refine future guesses and improve play experience. We envisage leveraging this data for business purposes, making it available to interested civic and commercial parties for fixed tier pricing.

Conclusion

Pokémon GO was acclaimed for encouraging smartphone-owners to go outside and explore the richness of their own local community through interactions with imaginary Pokémon creatures. With *Homelessmon GO* we present a game design which expands upon this and encourages interaction with non-imaginary homeless people. Bringing players and the homeless into close, direct contact will foster improved relations between the two groups, with society as a whole profiting from this union. Looking to the future: the Hobo, drifter or beatnik is a stalwart of folk culture (particularly in US), and one which is often viewed romantically and imbued with the values of freedom and individualism [3]. This backdrop provides a rich seam of cultural references, which we will be able to further exploit for enhancements to our game design, invoking useful aesthetic connections with many players e.g. utilizing the real hobo signs as an authentic aesthetic in the interface and artwork.

We are aware, of course, of the cultural sensitivities around homeless people being paid danger money (e.g. *BumFights*) and we will continue to design the game only to capture homeless people's likeness in exchange for in-game points. We also acknowledge that grabbing images of homeless people is already an existing technological activity in some cities [8], and that Pokémon GO has inspired use cases in war zones [20]. As interaction designers we should be aware of the need to innovate beyond simplistic exploitation of new technology itself and, instead, strive to leverage previously untapped and underutilized resources, such as homeless populations, domestic pets, livestock and children. Then these previously dormant resources can be once again put to good use.

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