# Serious Mixed Reality Games

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## Abstract
We argue for serious mixed reality games as an approach to study and design for challenging real-word scenarios, such as disaster response, for which empirical data is difficult to obtain and efficacy of purely computational simulations is questionable. We outline our approach and give an example of a serious mixed reality game, which allows the study and analysis of human-agent interaction in a disaster response scenario on the ground.

## Author Keywords
pervasive games, mixed reality games, agents

## ACM Classification Keywords
H.5.m. Information interfaces and presentation: HCI.

## General Terms
Design, Human Factors

## Introduction
We suggest serious mixed reality games as a platform to explore scenarios in the real world that are typically hard to study in realistic settings, such as disaster response. Such scenarios typically include groups of human, computational and embodied agents (such as UAVs) coordinating a response to a disaster such as an earthquake, a flooding, a terrorist attack or an epidemic outbreak. Responders may have to coordinate and perform their operations potentially under critical

temporal and spatial constraints, with limited resources and personnel, where failure may costs human lives.

The ORCHID project investigates the potential of human-agent collectives in a disaster response scenario [4]. In particular, the project focuses on how autonomy can be flexibly negotiated between agents, how agile teaming can assist arrangement of human-agent response teams, how incentives to respond might be provided and sustained, and how the provenance and trustworthiness of the information gathered by large numbers of humans, sensors, and agents may be visualized and evaluated.

In this position paper, we argue that serious mixed reality games provide currently underexplored opportunities for the pervasive/mixed reality gaming community to contribute to research in complex real-world scenarios, such as natural disasters. By situating both agents and participants in real world environments, and presenting them with compelling game scenarios analogous to disasters, it is possible to study co-ordination, interaction and patterns of communication amongst actors while also having greater confidence in the efficacy of behavioural observations. In so doing, we hope to fertilize cross-disciplinary research in Human-Computer Interaction, Machine Learning, Multi-Agent Systems and Robotics. After reviewing some related work and motivating our approach, we outline iZombie!, an exemplary mixed reality game (MRG), and show how the research aims stated above may be tackled from various disciplines.

## Related work and approach

Disaster and emergency situations epitomize the non-linearity of human events. Not only are computational simulations of such scenarios extremely difficult to construct, but the veracity of their results is almost impossible to verify [10]. Particularly, these do not allow us to study human-agent interaction in a realistic disaster setting. The impact of emotional response likely in a disaster situation, such as stress, fear, or panic remains understudied or misconceived [11] in approaches relying on simulation.

However, inspiration can be drawn from robotics and adjacent fields that focus on computational intelligence, which have pushed the state-of-the-art forward by relying on competitions set out to solve problems in the real world. Notable examples include how the team that won the DARPA Red Balloon Challenge drew on a crowd-sourcing approach [9], and how the RoboCup Rescue initiative evaluates its contributions in real world test settings that integrate intelligent agents into disaster management situations [6]. Furthermore, the growing popularity in crowd-sourcing information in crisis situations and sharing ‘hard’ data (from sensors) and ‘soft’ data (from humans) on portals such as Ushahidi or Pachube open up ways to fuse and analyze that data in novel ways, for example to infer intent [5].

We propose that in addition to such real-world problem solving competitions and crowd-sourcing initiatives, mixed reality gaming provides an approach to study the outlined research aims including emotional issues of human-agent interaction in disaster settings. In particular, MRGs (or pervasive games) provide a setting under which people have been shown to suspend disbelief [8], and share some further key characteristics with disaster response scenarios, of which we highlight three by drawing on related work.

First, MRGs and disaster response scenarios bridge the physical and the digital [1]. Over the past decade we have created a series of MRGs that provide such hybrid spaces to enable playful and artistic performances and publicly accessible experiences. For example, Can You See Me Now? [3, 1] pitched online players in a virtual city against runners in the streets of a real city in a fast-paced chase game.

Secondly, both MRG and disaster response are highly orchestrated activities. For example, the online components of our mixed reality games are somewhat comparable to the control room, with the games striving to provide online players with a rich, accurate and real-time view of the physical world through the mixed reality city in order to support meaningful game play [2]. All of these games also require considerable behind the scenes support, characterized by activities such as monitoring for failures, or managing access to physical resources via dedicated interfaces.

Thirdly, in both MRGs and in disaster response people on the ground work with people online to solve a common problem [3]. For example, Uncle Roy All Around You [1] involved online and physical players collaborating in order to achieve a common goal – finding the mysterious Uncle Roy in the back streets of London – but also questioning when and how much to trust the often contrary instructions given by anonymous players on the Internet, or fictitious instructions from the narrative voice of the game.

Our approach carries the prefix 'serious' despite that the popularity of so-called 'serious games' has perhaps waned. However, we believe that a MRG that is not inherently or specifically 'serious' could provide sufficient analogues with a truly serious real-world scenario as to provide a useful test bed for understanding situational awareness, trust and interaction with embodied agents, and mixed reality collaboration in an adrenaline fueled situation.

## iZombie! – A serious mixed reality game

iZombie! gamifies a potential viral epidemic outbreak by means of a MRG based on the Zombie theme. Players in the 'game' have to survive an outbreak of a Zombie 'virus', while volunteers act as infected Zombies whose motivation is to attack and kill non-infected players. The Zombie 'virus' is spread through sustained exposure to an airborne strain present in a locality and through direct physical contact with a Zombie where the player manages to 'fend off' a Zombie attack but sustains an 'infection'. Whilst the scenario of a Zombie epidemic is clearly fictional, we believe that it forms the basis for a compelling game to play whilst maintaining an analogue to real world scenarios such as a virus outbreak.

Crucially, players in the 'game' have to collaborate in 'agile teams' to achieve situational awareness to reach their objectives, by instructing agents and by being instructed by agents. To escape the Zombies and reach safety players must coordinate with each other and teams orchestrating rescue attempts (remote players who themselves are not in danger of infection but whose goal is to rescue the players 'on the ground', as the Army and other emergency rescue teams would in a real-life situation). We also propose the introduction of embodied agents such as UAVs or ground based robots that would be able to coordinate rescue attempts through such tasks as aerial mappings or leading players away from danger zones to safety.

iZombie! seeks to leverage the viral popularity of other big urban games, including 2.8 Hours Later, and scavenger hunts such as Encounter which attract hundreds [7] of public players, in order to create a mixed reality game that both engages the public but that also provides a meaningful research environment.

## Conclusions and outlook

MRGs let us explore important interactional issues of human agent-collectives under stress-inducing realistic scenarios. How do humans interact with agents in a way that flexible autonomy can be achieved, monitored and amended in a context sensitive manner? Secondly, how can humans and agents be supported in their need for agile teaming as and when needed to achieve a particular task? Thirdly, how can they be motivated to complete their missions in spite of conflicting interest and self-interest and so on? Finally, how is trustworthiness of the information of various agents (computational and human) evaluated by players in the real-world, how can effective sharing of it be supported and how can it be presented in an understandable way?

In the future, we aim to draw on our extensive experience in mixed reality game and experience development and draw on existing relationships with artists and designers to refine our game design and work towards a public performance of our first serious mixed reality game by mid 2012. Collaborations and workshops within the Orchid project will further shape the design in terms of the research questions and development challenges to investigate future human-agent collectives for disaster response scenarios.

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