Human Avatars in Playful and Humorous Environments

Anton Nijholt

Abstract In future smart environments sensors and actuators know about the environment's inhabitants and visitors. This knowledge allows them to predict and suggest activities and behavior and even to take care that certain activities and behavior are enforced on inhabitants and visitors. For example, in a potential dangerous situation a car driver can be alerted, can be given a limited number of choices or the car can take over. Similar environmental behavior, not necessarily involving danger, can happen in domestic, urban and office or other professional environments. Humans have now become part of the Internet of Things. Wearables, clothes, body sensors, smart tattoos and implants allow the environment to monitor a user, but also to guide and steer a user in a way and a direction that suits the environment and those who own or maintain the environment. In this paper we investigate how a smart environment can use its smartness to create funny and humorous situations by suggesting or enforcing particular activities and behavior of its human inhabitants. In order to do so we have to look at how actor behavior and activity is modeled in storytelling research. In this research we have actors, but sometimes also directors or the environment is called upon to act as a smart director. Rather than aiming at efficiency when guiding 'actors' in these environments, we can as well guide human and virtual actors towards situations that are humorous or potentially humorous.

Keywords Smart environments · Sensors · Actuators · Smart technology · Playable cities · Human-computer interaction · Multi-modal interaction · Entertainment technology · Augmented reality · Virtual reality · Game environments

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1 Introduction

Game engines help to develop video games. They offer software tools for rendering graphics, for creating physics, for realizing animations, integrating artificial intelligence and other requirements of software that is needed for the creation of (networked) games. In games we have software sensors and actuators, for example, a collision detection sensor and a collision response actuator. Scripting takes care of confronting the gamers with problems that have to be conquered in order to reach a certain goal. Gamers can be offered different paths and a variety of hurdles, including negotiating about cooperation and having to compete with other players, to reach their goal.

In action and adventure games players can be represented as avatars, embodied, human-like and animated characters. There is not always a need to represent the body. In shooting games the visualization of the gun barrel and its direction is more important than the visualization of the shooter. Often it is ‘just’ the viewpoint of the gamer that is important and needs to be represented for the game to play. However, even if the body of the gamer is not visualized, it can be subjected to and affected by the designed virtual properties of the environment and its designed virtual physic laws. Even if our body is not visible in the virtual environment it does not mean that our actions and activities do not take into account our physical properties.

There is no way to look away from physical properties of players when we are interested in ‘real world’ or ‘urban game’ implementations of videogames. This has been done for some iconic videogames such as (Super) Mario, Pac-Man, Space Invaders, and Quake. These are interesting applications, in particular when they make use of advanced digital and software technology such as virtual, augmented and mixed reality technology. We have players moving around in the real world but their behavior and actions are controlled by decisions that are made by the game environment. In this paper we elaborate on stimulating playful activities and guiding citizens of playful cities towards playful activities.

We investigate how a smart environment can use its smartness to create playful and humorous situations by suggesting or enforcing particular activities and behavior of its human inhabitants. In Sect. 2 we survey examples of videogames that have found real-life implementations. Some observations on narratives in theme parks and city environments are included. In Sect. 3 we shortly discuss how technology enforces humans to become nodes in the Internet of Things (IoT). In the IoT they are subjected to expectations about their behavior, subjected to persuasion, and subjected to rules that apply to their routine activities (activities of daily living such as eating, bathing, dressing) and professional or recreational activities. Actor behavior and activity is also modeled in storytelling research. In this research, discussed in Sect. 4, we have actors, but sometimes also directors or the environment is called upon to act as a smart director. In particular we look at attempts to model human behavior in such a way that things go wrong, leading to humorous situations. That is, rather than aiming at efficiency when guiding, advising and persuading ‘actors’ in these environments, we can as well guide human and virtual

actors towards situations that are humorous or potentially humorous. Finally, in Sect. 5, we have some preliminary observations and conclusions how to integrate these viewpoints in future research.

2 Moving Avatars from Videogames into the Real World

We mention some early examples of games that have moved outside the monitor and into the real world, whether it is an indoor location or an outdoor urban environment. Augmented Reality Quake was introduced in 2000 [1]. It is a first-person shooter game using GPS and various sensors and a laptop carried in a backpack. It is claimed to be the first augmented reality game for outdoor use. ARQuake has only one player. A more elaborate real-life version of a videogame requiring multiple players is Human Pac-man [2]. It has teams of interacting players (Ghosts and Pacmen), equipped with head mounted displays, wearable computers, GPS and inertia sensors, and they are wirelessly connected with remote helpers. Physical cookies with embedded Bluetooth devices can be collected by the players, similar to what can be done in the videogame. Players can swap from the augmented reality view to a linked and continuously updated full virtuality view of the Pac-world. We mention these examples because they make clear that in smart environments, that is, digitally enhanced physical environments, patterns of activity, stereotypical behavior and suggestions provided by others who have access to sensors and can control actuators, can guide and persuade inhabitants of smart environments to desired behavior or activity in situations that are created for that purpose. Our interest, also becoming clear from the next sections, is in investigating how facilities of smart environments can help in creating situations that are humorous.

In videogames we have the possibility to introduce game elements that cannot be realized in real life versions of these games or that are not meant to be realized in real life. Obviously, people can get inspired by games to perform actions in real life that are not appreciated by others. In movie versions of games, for example Lara Croft: Tomb Raider featuring Angelina Jolie and released in 2001, we can get closer to the videogame versions on which they are based. But generally we have to make concessions when moving a game from a monitor to a real-life environment or an augmented reality environment. These concessions concern not being allowed to walk around in an urban environment and shoot at whoever is a threat to your goals or not being allowed to steal cars. They also concern the impossibility to transfer certain science fiction visions and technology to the real world. In real life we don't navigate a spaceship, drive a F1 car, let alone that we have more than one life, can recover from deadly injuries, or are able to fight with ghosts or zombies. And we don't have the possibility to use Portal-like guns to shoot holes in places so that we can 'teleport' ourselves from one place to the other.

In more recent years we see other attempts to realize videogame behavior, situations and effects in real life. Usually they are limited to one particular scene or activity, or have physical implementations of virtual weapons. Some examples are

the illusion of setting opponents ablaze in a real life version of Street Fighter II, games that inflict real pain by electrical shocks, and real escape rooms. But often they realize just one or a few aspects of a videogame and do not implement a game's narrative.

Some videogame elements cannot be copied in real life, but gamers are sometimes happy to produce video clips in which they fake they can use Portal guns to create portals that allow them to pass through one portal and then emerge from another. Such activities cannot be implemented in a straightforward way in real life. However, using sensors and actuators (real, augmented and virtual reality display and interaction facilities), it is not impossible to create ambiguities and illusions in smart environments that come close to the real-life impossibilities that are accepted by gamers and that are believable in a videogame context. Not only in theme parks we can have narratives in which illusions and other special effects can be embedded, but also cities tell stories and allow narratives in which we can embed incongruities and illusions [3, 4].

3 Humans as Avatar Nodes in a Playful Internet of Things

Nowadays we see sensors and actuators exploited everywhere. It is not yet the case that we have a fully implemented Internet of Things, where we not only have 'things' that are part of the network, but also human beings that have sensors and actuators embedded in their skin and body, on their body, weaved in their clothes, in their pockets or part of other wearables. Sensors may monitor, predict and anticipate our activities. They provide actuators, whether they are on our body, in our wearables or embedded in the environment, with information that allows them to provide relevant feedback. This feedback may be explicit (consisting of an answer to a question or the execution of a command with immediate response to a user), or implicit (make changes to the environment or updating a user's preferences).

Humans become nodes in the Internet of Things. They are tracked and monitored in all their activities by their wearable and bodily position, motion and physiological sensors. Moreover, because of knowledge about the context, knowledge about activities of daily living, common-sense knowledge about human behavior, an individual's history, preferences and characteristics that have been learned from previously monitored behavior, activities and behavior of these mobile human nodes can be predicted and anticipated. It is also the case that, as we surveyed earlier [5], there are situations that only require 'thin slices of behavior' monitoring in order to make decisions about the personality of a user and use this information in interpreting and predicting his or her behavior.

In smart environments or in the Internet of Things we can assign different roles to human inhabitants, controllers and owners of such environments. In this paper we are interested in the role they can play to make such environments more playful and whether they can manipulate sensors and actuators in such a way that they help to increase playfulness and playability and maybe even help to create humorous

situations. In this context we look at the various ways humans can be involved in creating playability and humority, and experiencing playful and humorous situations. Clearly, the question is, who is in control of sensors and actuators. We distinguish three relevant views.

The environment can be offered as is, defining activities and interactivities that are allowed and supported. It can persuade or enforce the user to do things in a way the environment prefers or requires in order to be able to support the user or to satisfy those who maintain, control and own the environment. It does not mean that the user cannot blunder or be led into a situation that is playful or humorous. The environment and its control of the user's artificial and natural sensors can be responsible for that. In entertainment and recreational situations it is quite acceptable to confront the visitor with confusing and contradicting information, wrong directions, perceptual illusions, or incongruities. It should be mentioned that in such an environment users usually have control over their own wearables, can use them to interact with each other, have them display information about themselves or use them to cheat or persuade others, for example for playing a prank on someone.

The environment allows the user some control over its sensors and actuators. In a limited way, you can physically and virtually reconfigure your home automation devices (light control, thermostats, smoke alarms, heating, audiovisual equipment, energy monitoring, et cetera). Such possibilities can also be offered, maybe for special events, in office or public spaces. Communities can be allowed to reconfigure or redesign networks or they can decide themselves, fitting in the DIY, Hacking, and Maker Movement to design their own networks, including networks that allow real-time changes in sensor and actuator configurations. Especially in the latter case there is the possibility to play with sensors and actuators embedded in the urban environment in interaction with the wearables users own and control themselves.

The third view builds on Constant Nieuwenhuys' *New Babylon* vision [6]. In the 'Ludic Society' envisioned by Constant humans are freed by automation from productive work and can follow their need for playing and constantly transforming their environments according to these needs. Constant assumes movable assembly systems, technical devices for controlling climatic conditions (light, temperature, ventilation) that are accessible to everybody, and similarly the use of audiovisual media:

The audiovisual media will be used in the same spirit. The fluctuating world of the sectors [the basic construction element] calls on facilities (a transmitting and receiving network) that are both decentralized and public. Given the participation of a large number of people in the transmission and reception of images and sounds, perfected telecommunications become an important factor in ludic social behavior.

And, this is what Constant says about the members of this Ludic Society:

They wander through the sectors of New Babylon seeking new experiences, as yet unknown ambiances. Without the passivity of tourists, but fully aware of the power they have to act upon the world, to transform it, recreate it. They dispose of a whole arsenal of technical implements for doing this, thanks to which they can make the desired changes without delay.

Being able to play with the elements that make up the environment is the important message, where the environmental elements refer to architectural elements, elements defining the quality of space and psychological elements (effects on behavior and communication). One can discern visual, sonorous, tactile, olfactory and gustatory aspects of elements.

In Constant's view transforming the environmental elements is decided upon and performed by the human members of the society. Nowadays we can add the possibility to have the environment itself to decide upon changes based on preferences and needs of the stakeholders of smart environments. Apart from, let's say, traditional digitally controlled sensors and actuators embedded in our environments, its buildings and (street) furniture [7], its tangibles and robotic devices, we can now look at employing smart materials that change appearance and other properties due to changes in their environment and we can especially look at research on robotic or animate architecture, including DIY architecture, that addresses the architectural elements mentioned by Constant. But clearly, in a way that goes many steps further than envisioned by him. This human, hardware and software controlled robotic architecture will allow users to make changes to their or others physical living and playing environment, increasing the playability of these environments. Moreover, smartness embedded in robotic architecture makes autonomous decision making about architectural reconfigurations of living environments possible [8].

In the previous section we looked at attempts to move videogames into the real world. In these attempts we see that game situations and game narratives are transformed to real world situations and narratives. Players in the real world have to follow the videogame rules. These rules maybe slightly different because in the real world, although it can be augmented with virtual reality displays, Bluetooth devices, laptops, GPS and other sensors, we cannot realize the same audiovisual effects that are possible in fully controlled videogames. In [9] we discussed how mischief behavior in videogames can be expected to emerge in game-like smart environments. Here, in the current section we looked at opportunities to play with and play in digitally enhanced physical environments (home, office, public spaces, urban environments) by giving users control over sensors and actuators.

4 Learning from Controlling Embodied Actors

In this section we will return to playful artificial environments, but with the aim to see how we can control the behavior and activities of embodied characters by providing characters and environments with artificial intelligence. Ultimately the aim is to see whether we can translate knowledge of control possibilities to knowledge that helps us to design smart environments in which sensors and actuators help us to guide inhabitants (guests, visitors) into situations that can be considered playful and humorous. Clearly, there is some kind of contradiction here. On the one hand we want to make characters more autonomous (more human-like), on the other hand we aim to understand how we can introduce conditions that

increase the chance that their behavior leads to—usually unintended—humorous situations.

4.1 Virtual Actors in Storytelling, Games and Smart Environments

In storytelling environments we have interacting virtual characters that usually have certain knowledge of the environment, have goals and a limited form of reasoning (choose plans) to achieve these goals. In addition to this intelligence characters can have a personality and an emotion model that both can have effect on actions to be chosen and the way these actions are performed. Interaction with other characters, including a human actor that plays a role in the story, and ‘external’ events may lead to the development of a believable storyline. Emerging stories can be visualized in an interactive virtual world that allows interactions with one or more human actors, where a human actor is either visualized as a fully embodied character in the virtual world, or represented by a camera-like view on the environment, its characters and events. Obviously, this is not really different from what we see in MMORPG’s or in FPS games, except that in these games we usually have a single-minded role-playing character and opponents (non-playing characters) that have ‘canned’ behavior, or the emphasis is on human actors represented in opposing teams that can use human intelligence and emotions to decide about actions in the virtual (videogame) environment.

In training environments there has been research on how to plan activities of a virtual agent in order to get certain virtual tasks done. This research involves the movements of a virtual character that are needed to get a certain task done and to show how to perform this task (see [10] for an early example), modelling the verbal and nonverbal communication between characters in a visualized environment [11], the planning and execution of a sequence of activities (including walking, opening doors, picking up objects, et cetera) [12]. This research is useful in making serious gaming (training) environments more realistic. In entertainment game research there are also attempts to provide the virtual non-playing characters with intelligence, emotions, communicative capabilities and autonomy. That is, making it possible for them to assess situations and act in human-like ways. Research on intelligent agents, emotional agents and embodied conversational agents is becoming part of game research. In (serious) game and storytelling research we see also attempts to give a ‘director’ role to a mediator who is able to assign roles to participants, who can guide their actions and who can introduce new events in the environment and make changes in the narrative.

In smart public spaces we will also meet these agents. They assist us on our mobile and other wearable devices and they will appear on public displays, in tangibles, as holograms or as physical social robots. Humorous interactions and humorous cooperation will be possible with devices that have human-like

characteristics (appearance, intelligence, emotions, sense of humor). Also here we can consider the possibility of introducing a ‘director’ who mediates between the human and artificial agents in the smart environment, assigning them roles and guiding them into particular situations and activities. Such a ‘director’ role can also be given or taken by someone who has access to the sensors and actuators, whether embedded in the environment, its devices, its human-like artificial characters or in wearables owned by the humans present in the environment.

4.2 *Providing Actors with Plans and Reasoning*

We shortly survey some research in game and storytelling environments that addresses the modelling of action planning and reasoning for agents in smart environments, where planning and reasoning aim at creating humorous situations. And, moreover, as is discussed in this literature, it should be possible to give a human player or someone monitoring the game some responsibility for guiding others into some preferred behavior and involvement in activities. As mentioned in [13] when we want interesting behavior we need planning mechanisms and models that not necessarily aim at rational and optimal problem solving behavior. A smart environment can try to understand and affect human behavior using such models, for example with the aim of creating humorous situations. Similarly, a smart environment can use such models to affect or direct the behavior of ‘autonomous’ agents, tangibles, and other devices that inhabit the smart environment, whether they are human or artificial. And, of course, tools based on such models and mechanisms can be used by smart city dwellers, including pranksters and mischief makers, to control and personalize their part of the smart world. And this may include cheating and hacking.

In [14] Cavazza and co-authors introduce planning mechanisms that allow agents to continue following their aims despite that certain preconditions are not fulfilled. In their research an attempt is made to visualize the failure of the continuation of regular behavior or adhering to the narrative in the hope that a corresponding animation of the situation will be comic. Hence, failing plans need to be considered as a dramatic mechanism. When translating these ideas to playable cities, as human city dwellers we can participate, initiate and ‘just’ be observers of humor creation caused by activities that fail. In [15] heuristic search planning (HSP) techniques are used to ‘control’ the characters in a ‘Pink Panther’ script. Script writing, narrative control and role authoring are issues that need to be considered when embedding action failure and its dramatic visualization in a game narrative or in a smart environment narrative in which we want to include humor. From a humor research point of view a comic act of (action) failing usually can be explained using viewpoints from superiority and incongruities theories of humor [16].

Carvallo et al. [17] also look at modelling the behavior of agents that act in a storytelling context, but in addition to action failures they look at incongruities that emerge with expected (pre-determined) behavior and personality of an agent.

Personality aspects in their architecture follow the well-known OCC model [18]. This allows them to introduce characters in a narrative that behave differently from regular characters. Again, as in the Cavazza et al. paper [15], this research provides us with handles to create humorous situations in smart environments. We can model the behavior of artificial agents (representing smart environments, intelligent displays, tangibles, social robots, virtual agents, et cetera) in attempts to generate humor or potentially humorous situations, but with the help of these models we can also embed real-time human behavior in these models—where the humans are agents in the smart environment—and where the models help to predict and anticipate human behavior and embed it in the smart environment. And, as is the aim of this paper, the models also help to introduce humor or potentially humorous situations in smart environments.

A third example we want to mention here is research reported in Olsen and Mateas [19]. In this research we have a game environment that resembles a Wile E Coyote and Road Runner cartoon. So we have characters (the Coyote and the Road Runner) with particular goals and a game engine that is fed by a planning mechanism in order to make decisions about the characters' actions. Usually Coyote needs objects to reach his goal (to catch Road Runner). 'Gag plans' can interfere with Coyote's plans. The player or gamer in this game environment can direct the story by the manipulation of objects in this world. For example, he or she can decide to make certain objects with variable attributes available to Coyote. Entering a 'gag' plan with, for example a rocket that will explode, will result in a failure of the original plan (to catch Road Runner). Planning to generate Mr. Bean-like sketches is discussed in [20].

We think that these research examples nicely illustrate how future smart environments can model and guide the behavior of artificial agents and their human partners. The smart environment can offer opportunities that seem attractive and are expected to suit the goals of a human participant, but will nevertheless cause failure of his or her plans. This may lead to a humorous event. It can also be the case that someone (player, gamer, hacker, mischief maker) has control of the environment and can make changes to it in order to create humorous events in which human and artificial agents are involved, because we can model their behavior, predict and anticipate their behavior, and, probably most of all, can provide them with plans and reasoning that leads them into humorous situations.

5 Discussion and Conclusions

In this paper we discussed various developments in research on human and agents representing humans in virtual, videogame, digital storytelling and smart environments in general. The aim was to see how the different approaches and results can

possibly converge into research that attempts to find ways to create humorous situations in smart environments such as, for example, playable cities.

First we looked at some early attempts to transform videogames into real life games using real life sensors and actuators. Rather than being an urban game that can be played by getting messages on the screen of a smartphone, these games were designed in such a way that the players became immersed in a visual augmented reality view of the physical play environments.

In our second viewpoint we considered possibilities for inhabitants of smart environments to control, configure and design networks of sensors and actuators. Sensors and actuators are embedded in wearables. In this way we can also assume the control of human activity in smart environments, not only by wearables, but also by the environment and its devices itself. This allows us to look at smart environments as game environments with behavior of role playing and non-playing characters. It also provides us with ways to configure an environment and to lead inhabitants or visitors of such an environment into playful or humorous situations and activities. In addition, robotic architecture allows for changes in form and dimensions of smart environments. Human behavior in these environments can be predicted and anticipated and we have the possibility to let unexpected and incongruous events happen. Rather than having game engine tools to design videogames we can introduce general or domain specific game engine tools to design a narrative and voluntary or involuntary ‘player’ involvement in smart domestic and public spaces.

With our third viewpoint we looked at research on virtual storytelling that aims at creating humorous situations in storytelling environments. The behavior of the virtual actors in these environments is dependent on their knowledge and their goals and preferences. There can be conflicts with other actors and there can be events beyond their control that require them to re-plan how to reach their goal and to make new sub-plans in order to deal with an unexpected hurdle. Hence, there is goal-directed autonomous behavior, but at the same time the environment, someone having control of the environment, or other actors with their own goals can disrupt this goal-directed behavior. To let an actor become the butt of a visual joke can be a goal of an environment, a human mediator or some other actors that participate in the story.

We conclude that the introduction of digital technology in physical environments makes it possible to view and control human behavior in a similar way as we can view and control human and avatar behavior in videogame and storytelling environments. This can be done by controlling sensors and actuators, reconfigure, design and redesign networks, use them to lead the human nodes, voluntarily or involuntarily (that is, not being aware of) towards situations and activity that are unusual, unexpected and humorous. Controlling these human nodes in the network can be done by letting them operate in a context of plans and reasoning where they are not necessarily aware of.

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