Smart Bugs and Digital Banana Peels: Accidental Humor in Smart Environments?

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Abstract. In this paper we look at possibilities to introduce humorous situations in smart environments. The assumption is that in future smart environments we have the possibility to configure and even real-time reconfigure environments in a way that humorous situations can be created or that conditions for humorous situations to emerge can be implemented. However, in order to do so we need to investigate how unplanned and unintended humor can emerge when users are confronted with unknown technology or surprising behavior of new (digital) technology. We can design jokes and humorous interactions and situations in movies, on stage, in literature, or in videogames. When we introduce unfamiliar technology or even imperfect technology we can expect that its use leads to humorous situations. Although intentionally and autonomously creating humorous situations by smart sensor and actuator technology is an ultimate goal, in this paper we look at situations and the 'design' of situations that possibly lead to humor because of users interacting with the environment. Users are not necessarily aware of how the environment expects them to behave, and they are probably not aware of shortcomings of the environment. Unintended humor from the point of view of a smart environment designer can also happen when a user starts to exploring shortcomings in order to generate humorous situations. In this paper we have some preliminary observations, mainly by looking at examples and design approaches, on designing environments where such accidental humor can emerge.

Keywords: Humor · Human-computer interaction · Accidental humor · Smart environments · Sensors · Actuators · Games · Entertainment

1 Introduction

Humor is important in our daily-life interactions. It certainly would be difficult having to live with a partner who has no sense of humor. A general assumption in human-computer interaction is that in the future we will have affective interactions with tangibles, virtual agents and physical social robots that assist us and entertain us in our domestic, office, and public space environments. Especially in daily face-to-face communication with intelligent artificial virtual and physical agents our interactions become more affective, assuming that the agents know about us, empathize with us and develop a personal and affective relationship with us, just like we do with them.

Unfortunately, humor has not or has only modestly been included in models of affective human-computer interaction. Despite decades of humor research, its results have hardly transcended a primitive analysis of (verbal) jokes. In human-agent interaction, whether the agent is virtual or physical, we hardly see more than the introduction of canned jokes or the generation of a witty remark. In this latter case this at least shows that there is some awareness of the context in which the remark as part of the interaction is generated. As a consequence of the lack of theory and therefore the poor possibilities to design humor and generate from a formal model, we think it is useful to look at ways to increase the possibility that 'accidental' humor will emerge in human-computer interaction. In the literature different kinds of humor have been distinguished. Mostly they refer to emotional aspects in relation to the joker or the hearer. Hence we can talk about aggressive humor, friendly humor, self-enhancing humor, affiliative humor, self-disparaging humor and many other types of humor.

In real life, in games, or in social media these types of humor can be distinguished. But it is also possible to make a distinction between humorous situations that emerge naturally, humorous situations that are intended or invented by making certain decisions that help to realize the conditions that make a situation or interaction possibly humorous, and humorous situations that are not only non-intended, but also seen as accidental or inadvertent, and often not desirable, in particular from the point of view of a possible victim of a humorous situation who we, as audience, can laugh at. Obviously, we can also have this kind of humor where the 'victim' happily accepts this 'victimization' and laughs with the others who enjoy his misfortune. In accidental humor we look at situations where it is not the user attempting to find ways to generate humor, probably making use of digital technology such as sensors and actuators in smart environments, but where the technology acts unexpectedly because of bugs or unforeseen actions of the user. This includes situations where the user is not fully aware of how newly introduced technology needs to be handled, or where there is an interaction misunderstanding that leads to a humorous situation or interaction.

In this paper we look at various ways accidental humor can emerge in the context of digital interaction technology. In Sect. 2 we provide some general background knowledge and motivation. Then, in Sect. 3, we show examples of accidental humor and the technology that was involved in unintended creation of humorous situations or humorous expressions. In Sect. 4 we have some preliminary observations on how to increase the chance of the emergence of accidental humor in smart environments. Some conclusions are drawn in the final section.

2   Background and Motivation

Clearly, attempting to design accidental humor is a contradiction in terms. Nevertheless, it is possible to introduce or allow ambiguities and incongruities in smart environments that surprise users, that provide them with enjoyment, and that make them smile or laugh. Accidental humor has hardly or not been discussed in humor research. In this paper we address accidental or inadvertent humor. Although designing accidental humor is a contradiction in terms, we can get inspired by it to allow digitally enhanced environments and its

users to generate changes in configurations of sensors and actuators that allow them to increase the chance of humor or to set conditions that help to increase the emergence of humorous situations.

2.1 On Accidental Digital Humor

Well-known examples of accidental humor that is caused by 'imperfect' technology are machine translation errors, errors made by speech recognition systems, chatbot errors, or suggestions made by 'auto-correct' or word completion prediction software [1]. Obviously, one can argue about this 'imperfectness'. For example, in the case of machine translation, instead of aiming at fully automatic high-quality (FAHQ) machine translation, we can also expect software for machine-aided translation only, just as we can expect that a translator consults a dictionary as a tool to find a correct translation and not assuming that the dictionary has the knowledge about the particular context that he or she has and that is necessary to obtain the perfect translation. Hence, rather than seeing a technology as imperfect, we can also look at it as a perfect or at least a helpful tool that we can use rather than having it act autonomously. In the next section we will introduce more of such distinctions with the aim to identify different kinds of accidental humor.

Our aim to increase the chance of accidental digital humor will not be achieved by simply decreasing the quality of the digital application. Frustration rather than amusement will be the result. In order to increase the chance of accidental humor we need to know about conditions that are necessary for humor to appear. Everything that helps to create these conditions or strengthen conditions helps in increasing the chance of accidental humor. We need to be able to identify humor conditions in general and in a particular application we also need to be able to introduce and implement them using design and interaction principles.

2.2 On Humor Theories

Machine translation, speech recognition and all other examples mainly address linguistic engineering applications, hence, it is mainly about verbal humor. This is a research area that can draw from decades-long research on computational linguistics and artificial intelligence. Computational approaches to humor are therefore mainly about verbal or linguistic humor. We need to investigate why sometimes errors made by these applications are funny and why often they are not. Humor theories should help us. Humor theories are usually about conditions that are necessary. These theories are not yet able to determine when a set of conditions is not only necessary, but also sufficient to have humor emerge. This is the holy grail of humor research, being able to predict with certainty that there will be humor when this particular set of conditions has been satisfied.

Usually a distinction is made between relief theory, superiority theory and incongruity (resolution) theories of humor. They can be considered to complement each other, looking at humor from an emotional, functional or cognitive viewpoint. In particular the cognitive viewpoint is interesting for us. Why do we perceive certain activities, interactions and products as humorous? There are various variants of incongruity theory [2, 3]. We usually

have a sequence of events that start with what we think or are made to think is a stereotypical situation. Something unexpected is happening and it turns out that we have to re-interpret the starting situation. Usually it is assumed that the two situations need to be opposing, that is, they should be really different, not just slight variations of a same situation. A final condition which we want to mention in order to have a situation perceived as humorous is that it should also be the case that the situation is safe for the perceiver. In the literature this situation is also characterized as the user being in a playful or appropriate emotional state, or by characterizing the situation as having an appropriate emotional climate.

3 Digital Technology and Accidental Humor

3.1 On Introducing Accidental Humor

Sensors and actuators allow us to introduce incongruities in smart environments. We can introduce absurd and surprising behavior of the environment, its objects, its devices and its virtual and robotic inhabitants. It is possible to make changes to lightening, climate, temperature and appearance; walls can be moved, illusions can be introduced. This technology allows us to introduce surprising events for inhabitants of these smart environments. Introducing such events can be the initiative of the environment or it can be an authorized user or inhabitant who has access to these sensors and actuators. Obviously, we can have a situation where everyone who is using that smart environment can access its sensors and actuators or where only hackers can do this and have fun in creating situations they will perceive as humorous.

An application or environment that is able to increase the chance of humor appearing while interacting with a user can not only introduce or enhance conditions expecting that they are not only necessary but also expecting that they are sufficient and therefore guarantee humor. However, in humor theory we have not yet identified these necessary conditions. But we can include the 'user in the loop', that is having the conditions ready that together with a particular input of the user make it possible for the application to give unexpected humorous feedback or create an unexpected and not intended humorous event. Clearly, in the latter case we assume that we are able to make a transition from knowledge of conditions that are necessary to have humor in a linguistic context to conditions required for generating humor in a context that is controlled and monitored by smart technology. When introducing accidental humor we should also make a distinction between the perceiver and the person who is the butt of this humor, although in the latter case it is not impossible that this person experiences the situation as humorous too.

We have digital tools that support us and our environment by monitoring our activities, whether it is about word processing or walking from our home to a restaurant or driving to our work. While monitoring, predicting, anticipating, and acting, errors can be made by the digital tools. They become clear while interacting with the technology and accidental humor can follow from these errors. We will look at this kind of accidental humor in Subsect. 3.2. In addition we can have accidental humor when we have people together, interacting with each other. Unplanned events and interactions can occur. They can also occur in smart environments, where smart environments range from

videogame and social virtual reality environments to digitally enhanced physical home and office environments, vehicles and public spaces. This will be discussed in but there the smart technology can also play a role in having such unplanned events and interactions emerge. This will be discussed in Subsect. 3.3.

3.2 Accidental Humorous Interactions with Digital Technology

The list presented below is certainly biased by information and communication technology applications that deal with language, speech and verbal interactions in general. Nonverbal aspects of interaction or physical activities require more than linguistic approaches to humor. Nevertheless, we think we can learn from the distinctions mentioned below and then can investigate how to use them in situations where rather than playing with words and phrases, we need to play with configurations and behaviors of sensors and actuators to increase the possibility to have humorous situations emerge. We distinguish the following situations:

- **Imperfect Technology.** Technology itself is usually not perfect or needs maintenance in order to stay perfect. Hence, we can have an assembly line or a mechanical device (the feeding machine in Charlie Chaplin's Modern Times) that increases or decreases its speed without human intervention or a revolving door that suddenly changes its speed. Smart sensors and smart actuators are not perfect either, they may malfunction, leading to unexpected and humorous situations. An operating system may break down or when a new operating system is introduced other applications may behave in an unexpected and humorous way. Games contain bugs. There are many games where collision detection goes wrong often leading to hilarious situations where an avatar leaves the game world or loses control of his limbs. Gamers find it a challenge to search for and record such accidental hilarious game situations [4]. Freely available 'Machinima' recording tools are used for this.
- **Unfamiliar Technology.** It is not unusual that when a user is confronted for the first time with new technology, whether it is 'mechanical' or digital, he simply does not know how to handle it, he makes 'stupid' errors or starts a 'naïve' exploration of it, probably leading to surprising events. It may also be the case that it is not recognized that the technology does not function at all. There are many movies exploring humor that is caused by the introduction of new mechanical or digital technology, whether it is about home, office, or factory automation, and often including robotic devices. This lack of knowledge about the technology makes users vulnerable and victims of ridicule by onlookers who know better or just enjoy seeing things going wrong.
- **Lack of Robustness.** We can have a situation where the digital technology does not exactly malfunction and it is neither the case that a user uses the technology for the first time, but it provides us with an answer to our input from which it becomes clear that it didn't yet understand us. There is lack of robustness, but we know it and accept it, there is a joint responsibility. You cannot yet expect that your car is able to prevent or correct any error you can make on the road. Your input to a digital system can be ambiguous for the system. If a system is able to recognize four gestures and we make a gesture that is close to two of them, then the system can provide us with unexpected

and maybe humorous feedback in the context where we are using the system. In a different context this wrong choice might not be humorous at all. A brain-computer interface may ask us to repeat our brain input several times before it concludes with sufficient certainty which action to undertake and this can still be the wrong action.

- **Diverging Viewpoints.** We can have a situation where the digital technology provides us with continuous or turn-taking feedback that after a shorter or longer period makes us realize that there is a mismatch between who we are or what we want and the system's view of who we are and what we want. This may lead to a hilarious situation. It may even lead to a situation where we start exploring how to make the situation more hilarious. Chatbots and embodied conversational agents that invite users to ask questions about products or services often fall victim to this user behavior.

- **Wrong Presentation.** Imperfectness does not only addresses malfunction, providing wrong or right answers or suggestions to a user, or continuing an activity in a undesired way. There can be unplanned humor in the way correct content information is presented. Imperfect prosody can make a serious message hilarious. Non-verbal behavior of an embodied agent may contrast the affective content of a message, leading to a humorous feedback or continuation of an interaction. Obviously, we can also categorize this as 'imperfect technology' or 'accepted lack of robustness'. But from a HCI point of view the right choice of display modalities is an important issue. A wrong choice or a choice that involves imperfect technology can lead to confusion or a humorous effect.

- **Wrong Suggestions.** It should also be mentioned that we can create digital technology that is more 'modest', is aware of its shortcomings and assumes more cooperation with a human partner in order to make decisions. Such technology does not provide a user with absolute answers or feedback activity, rather it provides suggestions and alternatives where the user can choose from. Some suggested choices can be hilarious as well. Although they don't suit the aims of the user, they can lead to amusement or even the user exploring such an alternative for his or her further amusement. Wrong suggestions can range from spelling correction suggestions, suggestions made by recommender systems advising about music choice, rule-based systems that diagnose human diseases, or decision support systems that help in deciding about the abortion or continuation of a space flight.

These distinctions are not fully independent from each other and maybe we can introduce other categories and subcategories in future research. In the above presented list we gave examples of digital technology that is imperfect, not necessarily aware of the context in which to interpret interactions with the system or simply not being able to include this context in interpreting our input to the system since it algorithms and knowledge representation formalisms don't know about it. It might also be clear that the distinctions on the list above are very much biased towards current day human-computer interaction research topics. We know that Chatbots can go wrong, we know that speech recognition and speech synthesis is not perfect, and we know that embodied agents have problems to find prosody, gestures and facial expressions that match the content of the message they want to convey.

3.3   Misunderstandings, Accidents, and Spontaneity in Smart Environments

While the previous subsection mainly addressed direct interactions between user and digital technology, we should also look at unplanned events and interactions in digitally supported environments where inhabitants have social interactions or where they engage in competition and collaboration. This is a rather unexplored area of traditional humor research. It is not about jokes or conversational humor. For example, in the latter case there can be a humorous misunderstanding between you and your conversational partner. This partner can also be an embodied agent that makes wrong decisions in the interpretation of your utterances. When two or more people interact, there are lots of possibilities to misunderstand each other. The amount of possibilities is reduced because of common sense knowledge, context knowledge and knowledge we already have about our partners, for example obtained during previous interaction or joint activity. Nevertheless, there can always be misunderstandings.

Similarly, we cannot expect that virtual agents, social robots, and smart technology in general, will always be able to interpret our activities, preferences and demands in the way we intended. In particular when our research aims at making this technology more human-like by including emotions and human-like social behavior. Hence, there will be misunderstandings between us and the smart environments we live in, just as there are misunderstandings between smart people. We can categorize such misunderstandings as being caused by 'imperfect technology' or as accepted 'lack of robustness', categories we mentioned in the previous subsection. Humans suffer from lack of robustness. However, we would rather like to include them in a category of human-like misunderstandings, probably leading to accidental humor, rather than put them in a category of technology failures.

● **Social Misunderstandings.** When interacting with a smart environment, its devices, and its tangibles, there are situations and applications where we expect human smartness and affective behavior. This is especially true when we interact with social robots or virtual agents. We can have human-like, and therefore believable misunderstandings that lead to humorous situations, maybe not or hardly distinguishable from misunderstandings in human-human interaction.

Purposefully looking for possibilities to introduce misunderstandings is one way of introducing humorous interactions. There are hardly situations where the input of a user has to be taken literally, that is, not taking into account the context. A smart environment needs to make decisions based on incomplete information. It will lead to accidental humor. If we look at the most probably correct and reliable answer or action, it is also possible to look at less probably correct answers and actions, and by using them to increase the chance of accidental humor.

For unplanned events and interactions in smart environments we first have to look at events and interactions that can be introduced and detected in physical environments and then we need to explore how digital smartness embedded in such an environment can cause or help to introduce events and interactions that can lead to accidental humor. Here we should also mention 'spontaneous' humor. Humor can be planned. This is what is done in verbal jokes, in cut scenes of games, in practical jokes, on stage and in movies.

Clearly, the accidental humor we discussed in the previous subsection can and has to be distinguished from it. This accidental humor emerges when interacting with unfamiliar and imperfect technology. It can lead to situations that contradict the aims, needs and preferences of its actor(s) and it can be enjoyed by perceivers from a 'superiority humor' point of view. Spontaneous humor, on the other hand, is not planned either, but it requires the recognition of the elements in the environment (whether the environment is a language, social media or a physical environment) that can be composed or reconfigured in such a way that a humorous remark or a humorous event can be produced or made possible. But it requires the impulse decision to do so. Spontaneous humor is not planned, it makes use of a concurrency of circumstances, but it is not accidental. Spontaneous humor is not accidental humor. However, in order to have it occur some unplanned things have to happen leading to an accidental, not foreseen situation, that can be transformed to a spontaneous humor situation. The transformation can be done by human smartness and human sense of humor or by digital smartness and sense of humor.

4   Designing Smart Bugs and Throwing Digital Banana Peels

How to increase the chance of an emergence of accidental humor in smart environments? We are not able yet to define conditions and to provide guidelines for designing smart environments and devices in such a way that this chance will increase. Usually design aims at reducing to zero the number of unforeseen events. As mentioned in a previous section, designing accidental humor is a contradiction in terms. Hence, we don't want to design accidental humor, but rather consider the conditions that help to increase the emergence of accidental humor.

4.1   Interactions with Smart Technology

We can look at the distinctions we made in the previous section. Imperfect technology, unfamiliar technology, lack of robustness, diverging viewpoints, wrong presentation, wrong suggestions, misunderstandings. They all can lead to accidental humor in smart environments technology too. However, simply increasing imperfectness, unfamiliarity, lack of robustness, et cetera does not really seem the right answer. On the other hand, purposefully fooling the user does not seem to be the right answer either, since then we are designing humor, rather than increasing the chance of accidental humor. We have no clear answer to that. Can we design a smart bug that has a sense of humor? In a chatbot interaction it is certainly possible, even if the chatbot not really understands what it is doing, to let it ask a question or let it give an answer that may lead to (humorous) diverging viewpoints. Can we do the same for interactions occurring in smart environments and configure the conditions that guide a user into a situation where accidental humor has a chance to appear?

4.2   Introducing Incongruities in Smart Environments

We can have a closer look at the conditions under which humor can appear in physical environments. Categories of incongruities in physical environments have been introduced. Incongruities from these categories can appear in (multi-player) game

environments, social virtual environments and digitally enhanced (smart) environments as well. Hence, we can look at the various categories of physical humor or humor in physical environments and see how these humor forms can appear in fully virtual reality, in augmented reality, and in digitally enhanced reality or smart environments. Bergson [5] had many useful observations on incongruities in the real world in order to explain what makes us laugh, especially what makes us laugh about French comedy on stage. Berger [6] and Morreall [7] tried to give comprehensive surveys of examples and categories that suit these examples of possible physical humor and humor in physical environments. Neither Bergson, Berger or Morreall made references to digital technology, let alone smart environments, but clearly, in a simulated real world environment including real humans and simulated human characters we will have the same possibilities to introduce humorous situations or set conditions for humorous situations to appear as suggested in their categories. Many of the examples in the categories mention conditions that help to have humor emerge. Necessary conditions are not necessarily sufficient conditions. Increasing the number of necessary conditions increases the chance of accidental humor.

Real-world humor can be simulated in a virtual or smart world. However, it is also interesting to see whether the virtuality and/or smartness can be used to increase the chance of humor. For that reason it is interesting to look at categories of humor introduced by Carroll [8] for movies, and Buijzen and Valkenburg [9] for TV commercials. Again, not with the purpose to guarantee humor but with the purpose to set conditions that lead to unexpected events in a smart environment inhabited and perceived by humanoids and human beings. Unfortunately, also in their categories visualization plays a more important role than mainly text-based categories, digital smartness does not play a role. Obviously, in many movies examples of (coincidental) accidental humor can be found with two clear examples in Jacques Tati's Mon Oncle (1958), the kitchen scene in which Tati is struggling with unfamiliar modern kitchen technology and the automatic garage door where a dog passes an outdoor sensor which closes the door with a husband and wife trapped inside the garage.

Observations on humor in smart environments and playable cities can be found in [10, 11]. As mentioned in these papers, it is sometimes possible to transform approaches to generate verbal humor to the generation of humor in physical and smart environments. We add another example here. We already mentioned humor that can appear because of wrong auto-correction and auto-completion in text processing and retrieval software [1]. Smart environments monitor our behavior and try to predict and anticipate our next activities. They can also suggest continuations of activities or autonomously complete activities, where suggestions or completions are not necessarily the most probable ones in an attempt to create or at least make the user aware of possible humorous continuations. Sensors and actuators are programmed or learn to expect patterns of activities and human behavior. So they can suggest possible continuations when an activity has not finished yet or suggest an alternative when an unknown sequence of actions is detected rather than accepting it as it is. All these cases may lead to accidental humor. The environment, that is, the sensors and actuators, are not necessarily aware that their suggestions are humorous. There is no guarantee that a suggestion or one of a number of suggestions will be considered humorous by users involved in activities that are being monitored by the environment.

We conclude this subsection by mentioning one more view on accidental humor in smart environments. This is the 'continuous partial attention' view advocated by Silber [12]. The assumption is that the increasing and continuous push of multimedia information will also increase our multitasking and scanning behavior, which in turn will often confront us with unintentionally muddled information, unintended mismatches and unintended incongruity humor.

4.3   Appropriation, Serendipity, Hackability, Art

There are a few approaches in product, system and art design that are useful to consider when discussing accidental humor. One of the approaches is designing for appropriation [13]. Appropriation is the process where a user adapts a technology and uses it in a way that was not intended by its designers. Dix [13] mentions the use of a screwdriver to open a paint tin. How can we design for unexpected use? As mentioned by Dix, this seems like an oxymoron, but it can also be observed that some sorts of design make appropriation difficult or impossible. Some design guidelines to allow appropriation are given. For example, by exposing the designer's intentions it may become easier to subvert the rules of a system, making the functioning of a system more visible can have the same effect and rather designing a system to do the task design it so that the task can be done. Appropriation allows for unexpected use and in the case of smart environments unexpected use, behavior and events. Appropriation leaves open how the user will use the environment.

Appropriation is also a well-known humor technique where we exaggerate, transform or contradict an existing product (for example by introducing sensory incongruities) or situations to create a comic effect [14]. In [15] appropriation is discussed in the context of unexpected but rewarding social experiences. Other design approaches that allow users to appropriate systems and tools are 'design for hackability' [16] and end-user programming approaches, for example for a domestic [17] or an urban environment [18]. Design for serendipity [19] is yet another example of an approach that focuses on unexpected events.

Finally we want to mention art that makes use of errors or glitches. In art it is not unusual to see distortions of perspectives and visual traps that include incongruities. 'Errors' and glitches can have a role in artistic expression and can be appreciated or even become a new media art form (Glitch Art) [20–22].

5   Conclusions

The aim of this paper was to survey the issues that play a role when looking at accidental humor in the context of digital technology. We investigated the various ways accidental humor can emerge when people interact with digital technology. It is not always humorous from the point of view of the interactant. Usually it is more humorous from the point of view of a perceiver or an audience. Incongruities are not necessarily humorous. However, introducing incongruities increases the chance that humorous situations will appear or that the possibility for producing spontaneous humor increases. Some categories of incongruities have appeared in the literature. In particular those incongruities that can appear in physical environments are of interest for smart

environments. There are some developments in designing software (appropriation, end-user programming, maker culture) that are interesting from the point of view that users will be able to design and reconfigure their own smart environments. Creative use of errors is an issue that is also addressed by artists.

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