From Smart IoT Ecosystems to 'Living' IoT Ecosystems

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Abstract

While IoT and smart products have exploded onto the market in the past few years, these are typically designed from a data-driven, resource management approaches and as automation enablers. We propose a new approach to IoT ecosystems by using animistic narratives that visualise homes and cities as living entities, with IoT products as a means for them to both interact with inhabitants and to express themselves. Using design fiction, we explore the potentialities for this approach, through fictional scenarios involving a private local space such as a home.

Keywords

IoT ecosystems, Design fiction, Animism, Smart Home, Scenario-based-design

1. Introduction

The Internet of Things (IoT) has been a technological buzzword for nearly a decade and a half now [1] [2]. With a projected market growth of nearly USD 1.46 trillion by 2027 across nearly every business domain [3], it is almost impossible not to run into the promise of the IoT revolution in any domain. More and more devices are being fitted with an increasing array of sensors and actuators and are becoming capable of being connected to the Internet, where they can be remotely monitored, controlled and automated to take action in response to various events. This wealth of 'actionable' data is one of the biggest promises of IoT systems.

However, as with any technology, IoT is also designed from very functional perspectives. The promise of existing things becoming capable of doing more actions that make life easier, is the hook presented to potential consumers and users of such systems and services. While obtaining more data could allow for more actionable insights, IoT systems and their creators assume that average users are interested in trawling through so much data. Strangers et al, critique this utopian data-drive, technology-savvy user persona (dubbed 'Resource Man') that such systems are continuously being designed for, stating that it tends to overlook the dynamics and routines of daily life [3].

We propose a shift in the way IoT systems are envisioned and designed, from one being designed for human end users, to one that is designed for buildings, vehicles and other entities in and where the IoT systems are being used. From a technical standpoint, we advocate for an

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additional layer between the IoT data and the end user. This layer would embodies the animistic narrative that are ascribed to the product or system being designed. Interactions between the user and the IoT system would be moderated by this layer. It is our belief that designing for and including such a layer would lead to the creation of novel experiences using IoT systems.

2. Animism and the animistic narrative for IoT ecosystems

Animism, the attribution of life-like characteristics to non-living entities, follows one of the original definitions and intentions of the idea of IoT, as described by Ashton, one of the first people to coin the term [1]. The act of imbuing computers with the sensing and expressive capabilities that living organisms have, in order to help improve their decision making skills is very much an animistic endeavour. We do not intend to propose new groundbreaking paradigms, but rather that the paradigm for IoT revert back to this original one. Instead of imbuing sensors and actuators to an entity purely for data gathering, monitoring and control, the imbuing is rather for awareness and expression of itself. This narrative shift for IoT as one dominated by data and automation to a more organic and relatable one, greatly opens up the design space for IoT products and services. Features for IoT systems need no longer be limited to functional ones. This also enables the creation of products that can be truly unique, for no two entities can experience the same things in their life-cycle. The level of awareness can vary from localised (limited to single products) to more holistic awareness such as rooms, buildings, spaces and even, entire cities.

We envision IoT ecosystems as entities of limited intelligence and awareness, but as having experiential qualities allowing it to experience events, learn from them, and express itself (albeit in limited fashion). We intentionally propose to limit intelligence of such entities as otherwise it runs the dual risk of designers' tendencies to anthropomorphise such entities and the public fear of intelligent systems [4].

The animistic narrative for a home could be that it is a living entity with limited intelligence that is gaining new abilities and senses through the various new 'smart' devices that are being placed within it. Thus, IoT could be a set of technologies that enable non-living entities such as buildings, vehicles, parks, and even entities such as a space or a city to have experiential qualities. Buildings and spaces become new actors and users, that designers can now focus on. This enables new interactions and features to be designed from the perspective of the entity itself, rather than the end-user. Frameworks such as the Thing-centred framework exemplify this approach [5].

Designing in such spaces allows for the addition of ludic (playful) values to designing IoT systems and services, since the narrative is no longer focused on the user. The entity that has an IoT system embedded in it can use the system to express itself in playful ways. Kasilingam and Krishna demonstrate that users are more willing to pay and use IoT services and systems that have an experiential and even playful value, and that it is something design and marketing of such services should focus on [6].

Through shared experiences between users and the animistic entities, it is entirely possible that emotional bonds could be formed, leading to mutual symbiosis. We believe that such a shift in IoT development can open up a critical space that allows designers and researchers

to investigate new modalities of interaction with IoT products and serve as a ground for new research into HCI, in which the IoT ecosystems are also actors.

We use design fiction to re-envision a scenarios involving the 'living home' , where IoT ecosystems were used to give awareness and expression to the home and implement the narrative that home is 'alive' i.e having experiential and life-like qualities [7] [8].

3. The Living Home

The house beeped excitedly as soon as it sensed that its inhabitant had returned after a long time. It had been feeling quite lonely and was happy to have its inhabitant back. Over the past few days, it had downloaded an update for its lighting interface and had been waiting patiently to show its inhabitant, the new tricks and features it had learned and acquired. As soon as it sensed its inhabitant's smartphone at the main door, it softly lit up the keycard interface, awaiting the RFID key fob. Within a few seconds, it sensed the key fob near the interface and understood that it was indeed its inhabitant who was at the door. It unlocked the door and lit the foyer lights.

Alessandro walked into his home, having been away for a week's vacation in Trentino. It felt good to be back home and he knew that his home would be excited to see him. He was happy to see that foyer lights were already lit, as if the home knew he would spend some time undoing his shoes before coming in. He wondered if it had learnt any new features. It had pleasantly surprised him last time, when the home had suggested a quick recipe, based on the food in the fridge that was starting to get old. He wasted much less food these days. Those smart boxes for the fridge had been a worthwhile investment. Such a simple plug and play solution; his home had learnt how to use the boxes, for him and was already using its advanced features. He did not consider himself as 'technology-savvy' in any way, so having his home learn things on his behalf was very appealing to him.

But it had not always been easy, sometimes his home had done completely random things such as turning on lights in the kitchen when he crossed the foyer hallway to get to the cupboard, or making random sounds when he was busy working. But it had learnt from its mistakes and his feedback and had gotten much better at anticipating his needs. He had often felt like he was training a dog. In fact, it was almost exactly like owning a pet, he thought. Each learnt from the other and tried to live in mutual symbiosis. He thought about how he himself had changed. He had always wanted to meditate daily, but other things always got in the way and he would often feel guilty for not having done a meditation session that day. So it had surprised him one day, when one of the smaller lamps in the corner was softly pulsing of its own accord, almost as if it was breathing. He had called out to his home, but it did not respond like it usually did. It had stopped by itself after a while too. When it happened again and again, over the following days, he tried to figure out what the house was doing. One day, when it happened again, he went over and sat near the lamp. His home made a slight noise, as if to acknowledge his presence. He waited and watched, until his breathing synchronised with the pulsing of the lamp. Towards the end of the session, the home made a strange beeping noise, almost as if it was happy that he had come there and sat down. He repeated this the next day and the day after, with the same results. He came to the strange conclusion that the home itself was meditating! It was oddly unsettling but at the same time, he noted that it served as a very helpful reminder to himself, to take little time for

mindfulness.

As Alessandro stepped into his room, he asked his home to play some music while he showered. This was the cue the home had been waiting for. As it played one of its inhabitants' favourite playlists, it also began to adjust the lighting in the bedroom according to the music. Another nifty trick his home had picked up! Alessandro laughed. He couldn't wait to show this one off to his friends.

4. Discussion

Using the above fictitious story, we wish to emphasise the fact that we do not envision a far-fetched vision of the future, but rather one that is achievable. The IoT technologies used in the stories already exist in some form or the other, in the present.

In the story of the living home, we intentionally created situations where the home had not behaved the way its end user had wanted. Such moments of friction are not mistakes or errors, but rather opportunities for mutual learning and reflection. Having an animistic narrative for smart homes can perhaps reduce moments user friction during errors. The pet analogy is one from which we draw a lot of inspiration for the living home. Pet owners can get frequently frustrated by the behaviour of their pets. But over time, they both learn from each other to achieve mutual symbiosis. Such moments also lend itself naturally to the training and model validation stages of machine learning.

The animistic narrative provides a umbrella under which different IoT systems and technologies, ranging from lighting and sensing to Artificial Intelligence (AI) and Machine Learning (ML) can come together to form an entity that is highly relatable to the end user. This unification of seemingly disjoint technologies can provide some greatly needed inspiration to the designers of such systems.

We do not purport to create new interfaces to interact and communicate with these IoT ecosystems either, but instead use existing interfaces under a different paradigm. The concept of communicating with a living entity pre-empts a different psyche in the end user as opposed to communicating with an arcane system. Issues relating to privacy, transparency, control and even fear are obvious challenges in the creation of such an ecosystem but one that we believe, is worth tackling in this form of an IoT ecosystem.

5. Conclusion

In this paper, we use design fiction and animism to re-envision a commonly used application for IoT ecosystems - the smart home, as a 'living entity' rather than a 'smart system'. Through this narrative, we show how end users of such a system can relate more naturally to the IoT ecosystem and that such narratives can provide inspiration to IoT system designers.

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