

# Chasing Digital Shadows: Exploring Future Hybrid Cities through Anthropological Design Fiction

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## ABSTRACT

This paper presents an anthropological design fiction envisioning a future hybrid city where 3D virtual city models and physical reality are intertwined seamlessly. The crafted fiction addresses three broad themes. Firstly, it explores how not only digital and physical but also past and present as well as near and distant places might become entangled in such a hybrid city. Secondly, we speculate what it means if the digital traces of a person – perhaps even his/her digitalized body – continue “living” in a hybrid city after s/he has passed away. Thirdly, we raise questions regarding power: who owns the digital city, and who has the right to change it? Lastly, we ponder some sociocultural questions and design ideas opened up by the fiction.

## Author Keywords

Hybrid city; virtual reality; augmented reality; 3D city models; anthropological design fiction; science fiction.

## ACM Classification Keywords

J.4 Social and Behavioral Sciences.

## INTRODUCTION

The design fiction presented in the paper is driven by 3D city modeling and the 3D web which have taken significant advances in recent years. Modern technologies enable the creation of a detailed digital 3D representation of a city that is visualized using a computer game engine as a collaborative virtual environment where multiple users can simultaneously interact with various devices including web browsers on PCs and mobile devices. Such a persistent, immersive and collaborative 3D virtual city model can be regarded as a “mirror world” that together with the real city constitutes a “hybrid city” [8; 20]. A number of taxonomies have been proposed for such coupling of virtuality and reality. For example, Adriana de Souza e Silva [17] defines hybrid space as a result of using mobile technologies as social devices; mobile interfaces enable people to

experience the physical and digital space simultaneously. Thus, hybrid city refers to the profound hybridization of a physical and a digital city. Several authors, e.g., David Gelernter [8], have forecasted that these kinds of digital meta-worlds could become an integral part of our reality in the near future [15]. There is still a great amount of uncertainty about how they will manifest themselves in our society and what kind of implications they may have. Thus, we considered design fiction an interesting option to explore their potential implications and uncertainties.

The design fiction presented in this paper is inspired by an ongoing interdisciplinary research program on hybrid reality conducted in Oulu, Finland. Its aim is to explore the possibilities of 3D virtual city models, specifically the coupling of the virtual city with the real world into a *hybrid urban space*. Our exploration of the hybrid city is still in its early days but some small-scale prototypes were already developed before this fiction was created, such as hybrid reality games blending the physical and the virtual city [e.g. 2]. For the purpose of enabling co-presence in multiple realities we have introduced the concept of hybrid avatars that refers to avatar-based interactions between VR and AR users residing roughly in the same place both in the real world and in the virtual mirror world [11].

Overall, the research is conducted in a real-world context instead of only testing technologies and applications in laboratory settings. In Oulu the development of 3D virtual models and related applications has already been going on for several years by many parties with various interests. In 2011, we university researchers initiated the creation of an immersive street-level 3D model of the city center that is now published on the web as a collaborative 3D virtual environment using an open source game engine [1]. The model is offered as an open and extensible general purpose platform for anyone to develop new applications for web-based collaborative and immersive virtual city models. The city planning division of the City of Oulu has commissioned the 3D modeling of selected city districts that have been used to conduct participatory urban planning sessions and to explore alternative future designs, and these models have been published on the web to inform the general public. Local SMEs have employed 3D virtual environments in various domains such as (serious) games, participatory urban planning and building design, visualization of open government data, management of IoT networks, educational and emergency services, and the real estate business. Working in parallel, university researchers

and industrial programmers have developed the open source realXtend platform that is now included in the European FIWARE initiative as an enabler for creating real-time multi-user web applications with 3D user interfaces.

While the above parties may have different goals, they all share the need and vision for common, openly accessible and up-to-date 3D models of the city. The presented design fiction is intended to serve as a coherent imaginary reflection of a world where the goals of these stakeholders would be realized and 3D city models would have become an integral part of city life. The design fiction enables us to speculate and reflect on what the blending of virtual and physical cities could mean on an *experiential level*. Simply put, how would city residents experience a hybrid urban future, and what would they see and hear? How would hybridization affect everyday activities and aspects of urban life, such as work and play as well as social relationships? (See Figure 1.) The imaginary nature of the story allows us to take today's applications such as online 3D real estate brokering one step further. Two of the authors of this paper have their background in cultural anthropology. Therefore, we are especially interested in the social, cultural and ethical aspects of the potential hybridization of cities. Design fiction allows us to dive deep into these themes before the change has actually happened, and to ponder its promises, challenges and threats.

#### SHORT STORY: CHASING DIGITAL SHADOWS

"Stop it." The look on Amanda's face is tired. "Do you think I can't see what you're doing? Your eyes tremble. Just stop it."

We are in an outdoor café in the Rotuaari square, lattes in front of us, and my eyes have been wandering ever since we sat down. Every time I'm in the city I let them wander. I let them seek. Search. Recognize. I let my eyes slip under the valances of the mirror cities, see Rotuaari from different times and viewpoints. On an early summer morning. In late October at five. A century ago. From the perspective of a bicyclist, or an architect, or a public space activist. But I have yet to find a way to see through the eyes of my little sister.

Reluctantly I turn the lenses off and concentrate on the person sitting before me - my living, breathing older sister. It takes a while for my eyes to adjust, to shut out the mirror cities. Yellow afterimages dull my vision.

"Let her go", Amanda says. "Emilia's personal data is spread all around. Let it be." She is sad and angry.

"I'm sorry, I really am."

"It's unbelievable that you still have the nerve to do that in front of me. Even after what you did to my child."

A month ago or so, I was out on the Toppila frisbee golf course, throwing discs with Irene, my niece. I had been searching for Emilia from the mirror cities earlier that day

and had the lenses on. And only in Toppila I realized that I had never tried to find her there, in the imagined nature park created by environmental activists, or in the dystopian city game in which Toppila is filled with crime, drugs and violence. I turned the lenses on. Different versions of the city flashed in front of my eyes while I followed my niece from hole to hole. I cheered as she threw the disc even though I could not quite see it. My eyes were focused on a group of curlews skipping on the beach against a beautiful spring sunset; then they were seeing a midnight confrontation between two criminal gangs.

I was in spectator mode, just watching the events unfold. Through the haze of other realities I could see three teenagers running with laser pointers, which stood for guns in the mirror city. They were screaming, pointing at each other, crouching behind walls visible only in the game world. Still they avoided the golf courses, knowing well that a real, plastic disc thrown at the speed of 30 meters per second would hurt them more than the imagined bullets flashing at them in the dark city game. I was not interested in their avatars but in the other characters that were created and clothed by the AI: the bad guys, the corpses piling up, the innocent bystanders fleeing the computer generated shootout. Some parts of the characters might have been obtained from my sister's personal data: maybe a nose here, a flock of hair there, a certain sway of the hips. Or her eyes.

Irene talked a lot between her throws, and seemed to be satisfied with my one-word answers. But when it was my turn to throw, my mind was still occupied. The crime game clouded my perception, and the pink sunset from the virtual nature park blinded me. The disc hit my niece.



Figure 1. Hybrid city.  
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Even when she started screaming, I was unsure whether the sound was an echo from the mirror city or emanated from a human throat.

Irene got a purple bruise in her arm, one that she was actually quite proud of, boasting about it to everyone. But it could have been far worse: I could have broken bones.

I wanted to lie to Amanda and say that it was just bad luck and an accident. But there have been too many lies in this family, and so I told her about my stupidity. My niece was keener to accept my apology than her mother, who now sits in front of me, as angry and sad as ever.

"It's been more than a year since she was buried. We should be talking about the terms of the elderly home mama is going to move into, not about this. Again."

"A year and two months. Plus a few days", I correct her.

"Whatever. The point is that the company has handed all her data over to us, and that should be enough."

"All the data they know of", I say and realize that this is soon going to grow into a quarrel.

My sister pauses, lets the quarrel slip. "Anyway. I need your help in packing up mama's things. And in convincing her that she can't take everything with her."

I could catch the quarrel, but do not. We agree to meet in our childhood home on Sunday.

It is not an obsession. It is not. It just bothers me that fragments of her are wandering around the mirror cities. Had I not met her avatar shortly after her funeral I might not even care. It might be enough to know that most of the data is given to us, the relatives, and deleted from the databases, while the rest is so scrambled and fragmented that it cannot be traced.

But I did meet Emilia. Or a vision of her.

See, I am a real estate agent, and the publicly funded mirror city is very useful in my work. There are other mirror cities too, of course, but the public one is the most important for me, because the city administration maintains it. The public mirror city is the only one with the purpose of reflecting the real, concrete city that we live in. Others represent imagined cities, either depicting the real city as it once was or as it might be or become.

The first step of selling is surveying the estate and its surroundings. Often it is easier to observe the place from the mirror city than to drive around. I scan the city planning reports for the area and read up on the history of the district. I also walk through the district with the lenses on to see the location from the perspective of different users, and recommend also to my clients to do so. To see how a dog walker uses the area might be an important selling point for a dog-owner. For a client who is interested in local culture it may be thrilling to see past street fairs and restaurant days recorded to the mirror city. An aspiring gardener will do

better to wander around the summer version of the neighborhood rather than wading into the actual gardens in November.

Examining other mirror cities than the public one is also crucial. An area may be a regular spot for enhanced live role playing games, such as the Toppila frisbee golf course, which may be a positive factor for some and negative for others. Political mirror cities are even more important. A movement that aims to turn part of Toppila into a nature park uses a mirror city to prove the importance of the project. Feminist activists mark the spots where one is likely to be sexually harassed with big, red, flashing titles in a mirror city. And many seemingly peaceful neighborhoods are contested by public space activists who work mainly in mirror cities. Such as my sister.

There is some irony in the fact that I met her avatar jogging in one of those privatized areas. The city has leased land to a construction company to build a new, expensive residential area that is advertised to be well guarded and safe. The place will be walled and sprinkled with surveillance cameras. Real estate agents, such as me, who intend to sell the houses are allowed to visit the area, but as one can guess, there is not much else to see yet than towering cranes and enormous pits growing steel beams. And hundreds of workers in yellow helmets.

Therefore, the agents rely on mirror cities to acquaint themselves with the place under construction. In the public mirror city, the area is available in two versions: as the vaguely boring pine and birch forest that covered the area before the construction work began, and as the finished residential area as imagined by the city council, architects and the construction company. During the construction the imagined residential area will serve as an advertisement, a facade for the unfinished place. When the area is ready, it will be closed and guarded, accessible by residents only, and the corresponding area in the mirror city will be scrambled for reasons of security.

Scrambling some parts of the public mirror city is customary. Naturally, the paper mill, the chemical factory and the power plants owned by the city are scrambled, as well as the military shooting range. It is replaced by forest in the mirror city, while the factories and power plants exist in modified versions. The privately owned factories have created fancy showcases of their businesses while the city-owned power plants have been replaced with a rather dull labyrinth game and some information on energy production. I have played the game, seen all the infographics and been relieved not to find anything that might belong to Emilia.

However, having a residential area walled in the real world and scrambled in the mirror city is something else than guarding military secrets or factories. I admit it: it bothered - and bothers - me, but not enough to keep me from selling properties in the area. Emilia was firmly against the new area, claiming that the city cannot simply hand out public

space to a construction company and let them close it. Public space belongs to the public: if the municipal infrastructure is funded by taxpayers, they should also have access to the area. If rich people want to build fortresses, they should be the ones to pay for the land and the infrastructure. Moreover, the city should not hype up the area and present it as something innovative and futuristic, since the project is just another step towards privatization of public space. We had discussions about the subject, or rather I was the audience for her monologues. Often I was not even listening. Now I wish I had listened more, concentrated on her while she was still with us.

As a teenager Emilia was part of a squatting community that aimed to save wooden houses from demolition and demanded free social spaces for young people, refugees, Romani beggars and homeless. Her ideology of shared and public spaces was tightly connected to the ideology of shared and public data. Everything she wrote, recorded or photographed she made available in the public domain. For Emilia, open source was not just a good practice in programming - for her it was a matter of ethics. "Things that cannot be created by anyone else but you should be shared with everyone", she said, and as I retorted: "That means that pretty much everything should be shared!" she laughed and confirmed: "Exactly!"

After the funeral I felt like being in a narrow tunnel with heavy walls and a ceiling that could collapse at any moment. I could see that mother and Amanda were in their own tunnels, separate from my own. Amanda grew overly worried about Irene, hovering around her to the brink of annoyance. Mother coiled herself in her sorrow and stopped talking for a while. When she started talking again, we realized that her memory was failing.

I concentrated on my work. I got no joy out of it. Or any other feeling either. Finding someone a new home gave me no contentment. Nor did I feel like a winner when I managed to sell an apartment that was considered unsellable after the previous resident had been lying there dead for four months. And there was no tinge of guilt or doubt when I started to sell the houses that were being built in the new privatized area my sister so objected to.

It was a routine check on the mirror city area created by the marketing company and the digital design department of the city. I sat in my office, observing the location on my 2D monitor at double speed, trying to come up with words to describe the atmosphere. The marketing material of the construction company provides neat sentences and paragraphs in their brochures, but for face-to-face communication with clients I need words that fit my mouth.

Of course the place was clean and pretty. The flowerbeds grew plants that probably would not even survive in these latitudes in the real world. The "inhabitants" created by the AI looked young, healthy and beautiful. They were dressed in clothes that did not refer to any designer label for

copyright reasons, but to an educated eye it was obvious how the texture of a pedestrian's coat imitated the best Kashmir wool and how the jogging gear of a runner was almost identical to the latest Adidas fashion.

When the runner approached, I was so focused on her fake Adidas gear that I barely looked at her face. She greeted me joyfully, welcoming me to the new area. I recognized her immediately. It was a part of Emilia's avatar from the time she still wore her hair long. It was in a ponytail, and she had well-groomed eyebrows that she let grow out later on. Or maybe the animators of the marketing company had changed them as they had changed the outfit. My sister would never have worn Adidas, real or fake.

Still, the face was the same. I knew it. It was not just a coincidence, a random accident in which an animator creates a character that resembles some real person. I turned and followed the jogger with the clicks of my mouse. The mirror city lives on, it is meant to create an illusion of a world that exists on its own, and there was no way to rewind back to the initial encounter with the jogger. I could only try to catch her and see if the character was programmed to communicate with users in some other way than the joyful greeting. I started to record and moved my viewpoint in front of her. "Hello", I typed. Had I had my headset on I could have tried to communicate with a microphone, but I did not.

"Hello!" she said, still jogging. "Nice weather, isn't it?"

I was relieved to realize that even if the character had Emilia's face, her voice was different. "It's a good weather for running."

"The running path is really good", she said. Her smile was so familiar. She had that cunning look on her face, as if she meant something else than what she actually said. As if the path was some kind of a joke.

"Where does it start?" I asked.

She pointed south. "Just a kilometer and a half away. In the winter it will be turned into a skiing path."

"Thank you", I typed. I could hardly breathe; I felt like fainting.

"You're welcome. And don't hesitate to ask, if you have any other questions about the opportunities for outdoor activities in the area."

I rubbed my face and touched my eyes, but they were dry. The jogger ran away. Probably it was one of those characters that had been programmed to guide visitors in the mirror city, running in an eternal loop. If I would not move the mouse, she would reappear after some interval of time, possibly five or ten minutes. I logged off from the mirror city but could not get up and leave the office.

I triple-checked the recording I had made and compared it with Emilia's avatar. It was very clear: the marketing

company had used her face, as it had used many other faces and voices. There is nothing wrong with that. My sister had made most of her personal data public, and her avatar scan was probably contained in some of those file packages. The marketing company had done nothing illegal. Still they followed my wish and changed the face of the sports guide. Just to offer condolences for my sister's tragic fate.

I grew uneasy after the encounter. Every time I explored some mirror city I was both afraid of and hopeful for her reappearance. I looked closely at every face I saw. Only after deciding that I would purposefully search for her traces could I concentrate on what I was actually doing in the mirror cities. And then I started to see her everywhere.

Emilia worked as a programmer for one of the subcontractors of the public mirror city project. The mirror city uses open source software, and anyone with a certain set of skills can create a mirror city for any purpose. After the public one passed the beta testing, other mirror cities started to emerge. Of course the public mirror city is the most encompassing of all, and some of the other ones focus only on a specific area: for example, the student union of the university provides an extremely detailed version of the university campus in their mirror city. There are countless mirror cities that are intermingled. Especially the city center is a patchwork of mirror cities, evolving from day to day depending on the users.

When the project started, citizens were encouraged to share their data. The public mirror city contains a special version of itself in which one can see the evolution of the city through different eras, and where people can add their own photos, sound bites, memories and other interesting things for others to see.

Emilia released most of her digital data for the project to use. She also had herself scanned. Most of the interactive characters in the public mirror city are based on scans of real people, because the characters created by CGI animation still reside in the uncanny valley, while the characters based on scans have crept out of it. The first scans were those of the employees that worked for the mirror city project and the scans have been used a lot. Of course they have been modified for different purposes, but still: if I see a woman with my sister's face in a mirror city, I can be quite certain that it really once was my sister's face.

She even digitized some of her analogue data to share. In a mirror city version of Kuusisaari I found a traveling carnival that was based on a VHS video film that Emilia recorded when she was eleven. I remember blaming her for wasting tape on such a boring film: she had just kept the camera running while she sat on a Ferris wheel. She had not zoomed, filmed any of her friends or anything. The scenery just went round and round.

And more than twenty years later I stepped into a Ferris wheel and saw the carnival as the camera had recorded it on a chilly summer day when we were children. I could not

feel the wind or the nervous beating of my heart as the wheel went up, but I could recognize the colorful tents and carousels that had comforted us after we had descended from the heights.

I shared some of my own data too. Somehow it flattered me to know that the past version of the neighborhood in which we grew up was partially created out of my pictures and films. I know that the texture of the yellow wooden fence in front of our old school was taken from my failed snapshot; I had focused the camera on the fence instead of my friend standing in front of it. But I could never have scanned myself into the public domain. It gives me shivers even to think about having a scan of my body running around the mirror city steered by an AI, like the copies of my sister's scan do.

I am not trying to erase her legacy. Most of her data is untraceable, altered, evolved beyond recognition. I admit it, I seek those little pieces of her too, just to see her work flourishing even after her body is already decomposed. I just do not want her scan or avatar wandering around, being utilized and manipulated by anyone, least of all promoting a product that she would detest.

I meet Amanda in our childhood home in Vällivainio. The fate of the house is still uncertain, but we cannot leave it permanently vacant. The house is too big for me to live in, and Amanda and her family do not want to move in. If we ended up renting it, the house would have to be emptied. And if we emptied it, we might just as well sell it. Going through all of mother's things will be hard. Most of Emilia's stuff is also here, hastily packed in cardboard boxes in the garage.

"Grandma keeps calling me Emilia", Irene tells me. She is hurt and annoyed. Before Emilia's death mother spent a lot of time with Irene, but since mother's memory started deteriorating Amanda has not let Irene stay with her without supervision. In the past, grandma used to be the most important person to Irene, someone who taught her all the names of the flowers in the garden. Now grandma is someone who calls Irene by the name of her dead aunt.

"Grandma just made a mistake. Everyone makes mistakes", I console her.

"It's not that. She didn't just say it once. She calls me that all the time."

I give mother a hug. She hugs me back but starts to talk in a worried tone: "Amanda said that I have to move. Why? Where should I go from my own home? Why didn't you tell me about this before?"

I hold her hand and say: "We have talked about it before. You cannot live here anymore. This is a big house, you cannot keep it clean by yourself. Or shovel the snow either. The yard is very slippery in winter."

"You can help me."

Mother had a fall earlier this year and spent three days in the hospital due to a concussion. If she did not have the dementia we could hire helpers, but if she cannot remember them coming, she will try to do everything by herself and end up in an accident. And what is worse, she sometimes tries to light the fireplace with paper, since we do not let her have firewood. The big house is dangerous to her.

"The new home will be very nice", I tell her. "It was built just a few years ago. There will be a cleaner and a nurse and everything."

"Just turn the computer on", Amanda cuts in. She pulls down the silver screen and releases a cloud of dust that shimmers in the ray of light passing the closed curtains. Dad loved movies, but the silver screen has not been used for the last ten years, after he died.

We have an appointment next week in the elderly home, but we agreed to show mother the place in the mirror city first, just to familiarize her with the idea. Only on a 2D screen, as a full-blown 3D virtual reality experience would only confuse her.

"Just relax", I say to her. "Let's see how nice the place is."

The old video projector starts projecting the mirror city on the silver screen. I have walked quickly through the place before, when we chose this particular elderly home. The mirror city version of the elderly home is exceptionally well made. It is meant exactly for this, to give elderly people a somewhat truthful impression of the place that they are going to move in. And maybe also a tinge of excitement.

The common living room is homely, with rocking chairs, house plants and a performing stage. I control the mouse and Amanda describes the place in a low voice. "The meal room is really nice", she says. "And look, there you can see a dog! The care dogs visit the house every Thursday. And the staff is really friendly, they will help you in every way you need."

A nurse with an approachable demeanor walks in and reacts to the clicks of my mouse. She walks toward us and smiles. "Welcome to the Tervaleijona elderly home!"

Amanda falls silent. My hands lose their power. I cannot control the mouse any more. The camera angle stays put, on the face of the nurse. If I could move the cursor, the nurse would probably walk away from my view, but I cannot.

"In Tervaleijona, we can ensure an active old age for you. Depending on your physical condition we will customize the best living options possible to your needs. And you can be sure that you will find new friends in Tervaleijona! We will actively create possibilities for you to get to know your co-inhabitants."

"But isn't that Emilia?" mother says in a weak voice.

I see Irene roll her eyes in the dark.

"I thought Emilia was lost", mother continues. "I didn't know she works as a nurse."

I and Amanda do not speak a word. Later on, I know, she will scold me. She will ask how the hell I can spend a year trying to find Emilia's data and copies of her avatar only to miss just this one. And I will go home, throw up and fear her ghost every time I log into a mirror city.

"I would like to move there", mother says. Suddenly her voice is light and happy. "There are dogs and plants and a restaurant. And Emilia. It is a good place. This old house is gloomy and there is too much dust."

I turn the program off. Amanda opens the curtains and we squint our eyes in the bright summer sunlight.

### **ANTHROPOLOGICAL DESIGN FICTION**

Design fiction is a relatively new concept. It was first used in 2005 by Bruce Sterling<sup>1</sup> in his book *Shaping Things* [18]. According to him, it can be defined as science fiction which is concerned with the realities of design. A short time later, Julian Blecker elaborated the term in a presentation given at the Engage Design conference in 2008. His talk was soon published as a digital essay [4] in which he cited another seminal paper written by Paul Dourish and Genevieve Bell [7]. In their article, entitled *Resistance is Futile: Reading Science Fiction Alongside Ubiquitous Computing*, the authors are mirroring technological accomplishments and the agenda of ubiquitous computing into visions offered by science fiction. Dourish and Bell note that instead of merely offering forecasts for tomorrow, science fiction has the ability to affect the collective imagination and, through this effect, it actually shapes our (technological) futures. We find this insight especially central for our work.

Further, it is important to note that science fiction does not only depict imaginary technological gadgets but it also offers views into the complete environments where the future devices are used. In other words, it allows one to discuss and explore future technologies in a context; it allows us to envision how technologies not yet here could be used in everyday life, how they could be discussed and what kinds of meanings, feelings and values people could attach to them. Wakkary et al. [22] note that "*This embedding of design and technology in people and practices brings to the fore the cultural questions of these futures and the roles of technologies.*" This inherent feature of science fiction resonates deeply with the central aim of cultural anthropology, which is to understand people and phenomena within their context. Thus, we argue that fiction can actually provide a great tool for social scientists seeking to understand the world of tomorrow and especially for anthropologists engaged in design [10].

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<sup>1</sup> Sterling is primarily known as a science fiction author. He edited the seminal anthology *Mirrorshades* (1986) that has had a profound effect on the cyberpunk genre.

Following this line of thought, there also exists a specific genre of anthropological or social science fiction [19]. It focuses on experimenting with cultural and social issues by asking, for example, what are humans and how does culture work. It can describe situations where cultural practices have developed into new directions due to encounters with alien species, or it might discuss the resilience of human culture when transferred into a strange environment. Ursula Le Guin's seminal *Hainish Cycle* novels (1969-2000) as well as Octavia Butler's *Xenogenesis* trilogy (1987-1989) are classic examples of anthropological science fiction. Our aim is to combine the ideals of anthropological science fiction with design fiction, and therefore our story ponders especially the social and cultural consequences of the hybrid city. However, we explore technologies within a rather familiar context in order to help readers to relate with the characters and their experiences.

When it comes to virtual reality, fictional influences have always been important for its development. The most famous example is probably William Gibson's novel *Neuromancer* (1984), which according to Stuart Reeves [14] and Bleecker [4] has occasionally directly influenced technology development and even acted as a certain kind of "technical manual for VR pioneers". VR has inspired many other fiction authors and filmmakers as well, giving birth to an extensive amount of films, such as *Tron* (1982), *The Lawnmower Man* (1992), *Virtuosity* (1995), *The Matrix* (1999) and its sequels, and novels such as *Chronic City* (2002). Today, science fiction continues to inspire 'new wave VR': on February 16, 2016, The New York Times published an article about the close relationship between VR and science fiction, stating that "*At Oculus, a leading virtual reality company, a copy of the popular sci-fi novel 'Ready Player One' is handed out to new hires. Magic Leap, a secretive augmented reality start-up, has hired science fiction and fantasy writers.*"

In addition, several non-fictional envisionings and forecasts contemplating the emergence of digital, photorealistic and large-scale representations of the real world have emerged during the past decades. One of the best-known is probably David Gelernter's book *Mirror Worlds: or the Day Software Puts the Universe in a Shoebox...* [8] where the author forecasts how digital representations of the real world, "Mirror Worlds", will profoundly change our lives. Another fascinating example is *Metaverse Roadmap: Pathways to the 3D Web* by Smart et al. [16].

However, as Reeves [14] contends, the differences between fiction, envisioning and forecast are not at all clear. Although the latter ones intend to offer more "serious" views of the future, they are often mixed with fictional aspects. He suggests that actually we should treat envisionings explicitly as fiction: "*Fiction guards against the teleological tendencies of forecasting, against explaining away 'bad' predictions and lauding 'accurate' ones. As a creative endeavor, fiction opens up possibilities*

*that forecast tend to shut down.*" On the other hand, fictional representations of the future can also be used in deterministic and teleological ways. Instead of following any representation without criticism and letting it become a framework that orients our work, we should employ a critical, flexible mindset and acknowledge the partial nature of our perspectives. Thus, the possible remedy is to use projections of the future more *consciously* and *analytically*, and to craft *alternative* representations of the future.

## WRITING PROCESS

We wanted the storyline of the fiction to be both plausible and capturing [21]. Therefore, we asked a professional science fiction and fantasy writer, Dr. Kangasvuo, to author the fiction instead of us researchers. She and Dr. Ylipulli know each other from the time they studied cultural anthropology at the same department. Their joint history and common ground in gender and media studies made collaboration easy. Dr. Kangasvuo was given a thorough presentation of the aims and results of our hybrid city research. She was provided with the literature cited in this paper as well as other relevant papers with which she familiarized herself. She visited our research laboratory to get hands on experience in viewing virtual environments with a head-mounted display, a 2D screen and a keyboard, and in a CAVE; this also allowed her to compare the different interfaces. She saw different versions of the 3D model of the city of Oulu, as well as other virtual models created by the researchers with various partners, including the UNESCO World Heritage site Kizhi Island.

Although Dr. Kangasvuo was in charge of writing the fiction, the story was discussed, modified and polished according to the design needs and recent developments in the technologies under scrutiny. The writing process was enhanced with meetings that we held twice a month for the period of four months. In the meetings we reflected on our personal experiences of using the technologies as well as inspirations gathered from popular culture and the media. We also commented on each other's texts during the writing process. Dr. Kangasvuo also provided ideas for using the scenario, as well as contributed to the chapter on anthropological design fiction.

The creation of the fiction started with contemplating the social and ethical challenges in using VR, AR and other hybrid city technologies. As central concepts we identified *identity*, *memory*, *power* and *embodiment*. One of the authors has experienced problems in erasing the digital presence of a deceased family member, and the starting point of the story is partly based on these personal experiences. The protagonist's fixation on the digital traces of a deceased relative is used as a way to introduce the possible uses of hybrid city technologies, and to create an identifiable character and an emotional storyline. The story imagines how future mirror cities would exist and be used as commonplace and everyday technologies rather than as futuristic innovations available only to few. Early on, it was

decided that the fiction should focus on the characters and their experiences rather than on a minute description of the technology. Technology's potential effect on people's feelings and their social relationships is more interesting than the technology itself. It was also agreed that it would be important to ponder how the technology would affect the everyday lives of its users rather than to create an extravagant and far-out scenario.

All the characters in the fiction are female, which was a conscious choice. In Finland, the ICT field is very male-dominated and gender-segregated, and the experiences of women are seldom used in software production processes even if a significant proportion of the end users would be women [6; 12]<sup>2</sup>. The fiction portrays female characters as both creators and users of the hybrid city as a reminder of the importance of their experiences in software production projects, and envisions a future in which gender is not a significant factor in using and creating new technologies.

The story was inspired by the classical cyberpunk genre, of which the tabletop role-playing game *Cyberpunk 2020* (1990) is an example worth mentioning. Also, the science fiction film *Strange Days* (1995) was discussed, as it offers a bleak vision of how people could experience other people's recorded experiences. However, in contrast to the hard-boiled characters of the cyberpunk genre we wanted to create a relatable protagonist. The atmosphere of the story is inspired by Robert Holdstock's *Mythago Wood* novels in which people's feelings and subconscious needs make mythical beings come alive. As the mythago woods, our mirror cities are places where memories, feelings and thoughts can become real if so wanted and linger on.

### USE OF THE SCENARIO

The story hints at several use cases for the hybrid city, some of which already exist. For example, city planning and the real estate business are obvious applications for a municipally maintained mirror city. However, if the mirror city is responsibly created and maintained, "ordinary" citizens can also become content creators, which opens up new possibilities for crowdsourcing, urban planning, cultural heritage and citizen activism. These aspects are also depicted in the story. Also, the importance of taking gender into account when planning large-scale hybrid city projects is subtly implied.

Joshua Tanenbaum [21] defines three different roles for design fiction. Below we analyze our fiction in the light of these three roles, scrutinize the insights it gave to us and explain our plans to utilize it.

1) "*Design fiction can be a method for envisioning new futures and technologies*"

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<sup>2</sup> Also, the usability of 3D environments may be divergent for men and women because of gender-related differences in depth perception [5].

This is probably the most explicit role of design fiction in general, and this was our initial aim as well. We aimed to imagine how certain VR/AR technologies and the conceptual idea of a hybrid city would appear when placed in a context. The second broad aim was to explore what kinds of effects the use of VR/AR technologies in the context of a hybrid city would have on an individual level on their users.

The key questions that we wanted to discuss through the fiction were a) How do digital and physical, past and present, and near and distant places become entangled in a hybrid city? What kind of situations and emotions can this produce? b) What kind of digital traces will an individual leave behind after passing away? How should these traces be treated, and what kind of consequences can they have? c) Could there be, or must there be, different versions of the digital city – some that are more controlled by the authorities and others that are freely modifiable by citizens for different purposes?

As to the first question, our fiction especially highlights how virtual cities can change people's perception of certain physical places. For example, the possibility to add information about street violence to a mirror city can significantly affect city residents' views of a particular city district and have further consequences, such as lowering apartment prices. In a sense, digital information "leaks" into the real world and the city truly becomes a hybrid place. Furthermore, the story underlines that all places cannot be accessed in the mirror city for diverse reasons; these forbidden places include, for example, industrial and military areas. However, some abstract information about these can be shared in the mirror world.

The second question is connected to digital traces – a theme already apparent in current discussions about the social media in which content is highly personal [13]. If the mirror city also mirrors real people in the form of avatars, we should have clear rules for dealing with these "ghosts" after a person has passed away. On the other hand, these digital shadows can also be comforting, as our story hints. Do we want to delete all the digital traces of our loved ones or preserve and cherish them as memories? Could these kinds of digital ghosts actually change the way we perceive death and representations of the deceased? Anthropologists have documented the enormous cultural variation in how people perceive death, how they grieve and how relations between the living and the dead are understood. It has also been pointed out that digitalization has already affected these practices and meanings [9].

Regarding the third theme, the story envisions a future with a municipally maintained mirror city and a number of other mirror cities created for different purposes by city residents. This has led to a vast array of alternative mirror cities. In addition, the storyline also ponders what kind of municipal infrastructures and bureaucratic solutions would be needed to ensure that hybrid cities would be useful for everybody;



clearly, permanent structures such as the “digital design department” mentioned in the story would be crucial. Another topic that arises from the text is the ownership and access rights to the data. This is an enormous issue with city models which becomes especially problematic with providing open access to official municipal systems and data. For example, the City of Oulu has opened part of its data for public use but, clearly, not everything can be opened. In Oulu, the system providing a basic map and building information as open data to anyone also contains information on every individual living in the city. With their professional tools, the municipal officials can, e.g., select a building and see the average age of the residents. Obviously, this kind of data should not be made public.

2) *“Design fiction can be a tool for communicating innovations to other researchers and to the general public”*

The fiction will serve as a discussion piece within our research group as well as with the stakeholders of our hybrid city research program. Our group comprises researchers from highly different academic fields. A capturing narrative documenting our common research theme from one plausible perspective gives insights, sparks conversations and helps us to cross disciplinary borders. Further, the design fiction will be used within participatory design workshops that we will arrange for various stakeholders in different phases of our research. It provides one potential scenario for a hybrid city and, thus, makes our endeavors more concrete, for example, to “ordinary” city people. Our fiction is not especially utopian or dystopian. The aim was to ponder both the positive and negative sides of the hybrid city concept and the technologies enabling it.

3) *“Design fiction can provide inspiration and motivation for design by exploring possible design requirements within a fictional scenario before attempting physical prototyping”*

While the story is based on an ongoing 3D city modeling project, it also provides new ideas for developing and using technology. From a technology perspective, an interesting theme in the story is the protagonist’s ability to look at different versions of the city. And even more interestingly, she can adopt the perspectives of other users. We discuss these aspects along with timelines and alternative perspectives.

Timelines are a key feature of city models, although sometimes a neglected one. 3D city models that include the temporal dimension are sometimes called 4D models, which are well established in some domains. For example, the Cesium WebGL planet renderer features a timeline due to its origins in astronomy; Google Earth has been used to represent the historical growth of London; and in Oulu, FCG CityInfo features a simple annual timeline to communicate temporal data. However, the municipal information systems used for managing building models and other city infrastructure do not typically contain the temporal dimension but are often limited to current

information only. Also, the interfaces for retrieving open data from municipal databases do not typically support the temporal dimension. The CityInfo system piloted in Oulu uses the global WMS (Web Map System) and WFS (Web Feature System) standards. Inspired by the fiction, we are investigating existing support for historical and future data in these systems and standards. Our initial findings suggest that while typical WFS usage indeed does not cover time, it has been extended to include it in WFS 1.1.0 that requires GML 3.1.1, which adds time and other additional dimensions. Further, the WCS (Web Coverage Service) standard is suitable for time-series data [3].

Alternative perspectives can manifest themselves in different forms in the context of the virtual city. For example, the City of Oulu has commissioned 3D models of candidate designs for areas to be redeveloped in the future. Sometimes the city has procured competing designs from multiple candidate developers, similar to a single city appearing as multiple mirror cities in the story. These 3D models have proven very useful in informing municipal city planners and decision-makers of the pros and cons of different designs with respect to the status quo. Regrettably, these designs have not always been opened up for public viewing and debate. Providing alternative perspectives for citizens would enhance design transparency. Due to the ongoing transition from specialized software to web-based tools, sharing of professional perspectives can actually become very simple technologically. We will consider testing this possibility in our projects. Further, adopting the perspectives of other city residents could help to mitigate the sometimes conflicting views, for example, of bicyclists and motorists. It could also provide in-depth understanding on how gender, age, ethnic background or disability affect one’s experience of the city. Recording 3D views is already possible; thus, this idea would be relatively easy to realize.

## **DISCUSSION**

The fiction answered some of our initial questions but also gave birth to multiple new ones, regarding not only the technology itself but also its sociocultural implications. In that sense, the fiction enabled us to highlight issues that are rarely discussed by any of the stakeholders actively developing 3D city technologies in our city. Although we were able to address only a few of these aspects in this paper, they can offer valuable new research perspectives in the future. Thus, design fiction can be seen as way to reflect the design work that has already been started by taking its implications one step further. Design fiction clearly provides a means to contemplate the ethical and social challenges related to technologies by showing in a concrete and compelling way how they could potentially affect our relationships and everyday life practices.

To ensure the fiction gets all the attention it deserves, we are planning to translate it into Finnish to make it more approachable to local stakeholders, including “ordinary” citizens. We are also creating a dissemination plan for the

story which includes feedback discussions and sessions with our fellow researchers, representatives of the City of Oulu, companies and citizens. We believe the narrative gives plenty of food for thought, inspires designs – and perhaps even decision-making – and raises new questions. Nevertheless, we do not consider the presented story as the “final truth”. Our aim is to continue speculating in a more participatory manner in workshops.

As Reeves [14] suggests, fictional envisioning often seems to turn into frameworks that steer computer science on both practical and conceptual levels. If (science) fiction already has such a strong role in technology development and future making, it should definitely be employed as *an explicit tool* and not just something that we let inspire us and affect our work without criticism – sometimes even unconsciously. Ultimately, design fiction means using fiction for specific purposes; it is conscious future-making. It should inspire design, and also reveal potential dead ends. From a more abstract perspective, it also reveals the deeply uncertain and contingent nature of the future. Decisions made today can alter tomorrow significantly. Thus, we must carefully inspect the potential horizons.

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