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asphalt spur

ubiquitous gaming inside the real-time city

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I wake up from a loud bang. I am standing in the middle of my room. To my feet, a bottle is spilling water all over the blanket I am wrapped in. I grab the bottle, take it to the sink where I put it down and look at my face in the mirror. It takes me a moment to realise I have been sleepwalking again. — October, 2021.

For the first time, I am able to remember the dream I had, while moving through my bedroom in parallel. My blanket had turned into piles of smaller, strangely shaped blankets I was digging through. Everything further away than my hands was rather dark and blurry. I am in the same space in a new timeline. Thanks to the immaterial and material maps roughly matching up, I was able to navigate the dream space without colliding with the walls in my physical surroundings. Now something clicks and I realise why, all these years, I have been obsessed with giving objects, places and people new meaning within fictional narratives in my work. Subconsciously I felt these sensations for many nights as a child, and its mechanics of two coexisting, interlaced maps have sparked the curiosity in me to conduct the following research.

There is a difference between a space and a place. A space has a fixed geographic location, but can host different places at the same time, in different timelines, for different people, even all at once.[1] The way we experience our own mobility though these spaces is dictated by our conception of the paths and boundaries within its place. These boundaries can be fluid, moving beyond the simple distinctions between an open or closed door. I was sensing these invisible borders and forces as I was moving through the city surrounding me. I can compare this experience to realising the horizon within a video game is in fact a two-dimensional skybox[2] image depicting mountains and cities forever out of reach. The moment of reaching the boundaries of a seemingly open map destroys the immersion of the player and reveals the underlying limited grid. Game makers will try to avoid this discovery and confrontation at all costs. Well established methods of concealing the limitations of mobility on the map seem to integrate a secondary, fictional reasoning in line with the overall narrative of the game. There is a clear link between these thought processes and methods and the real-life applications made by city planners. Citizens should not feel threatened or locked in, but kept content by the constant illusion of an open map.

1. rephrased concept as in Firmino, R. and Duarte, F. (2010).

2. A skybox is a two-dimensional image layed out in a cube pattern, which can be folded into a three-dimensional cube in game engines to surround the virtual terrain with a realistic horizon and sky.

Try a little thought experiment with me: If you would build a city or a village for a new video game, using only the places you have visited and the people you have interacted with throughout the last year, would it feel sufficient? All the other districts, buildings and people would vanish off your map, leaving only the bare bones of the cornerstones and pathways you have moved through. One could argue that humans are creatures of habit, causing us to revisit the same places over and over again, without straying too far off. While this might be a valid factor, I am convinced there is more at play. From the very blueprints of the cities to the ubiquitous computing emerging from its structures. Smart devices, surveillance cameras, movement sensors and sound recorders have begun to mediate almost every interaction, slowly creating an omnipresence of computed control. This leads me to consider navigating through these emerging smart spaces quite similar to being on rails in a pre-written storyline of a game, enforced by the layout of its places and spaces. In this research I am taking some steps back into the past, to the very beginning of this century, to understand the different components at play. From handheld GPS devices to sensor networks, I am laying down the bare structure of the dream of ubiquitous computing and

mirror worlds. I am interested in unveiling the electric structures interlacing real spaces, two realities sharing one spatial grid.

In the first chapter, I am researching methods game designers are commonly using to herd user movement to desired areas and influence their actions. In the second chapter, I will draw a comparison from ubiquitous gaming to ubiquitous computing through smart city technology such as IoT devices in public space, accelerating its architectural preconceived paths and behavioural scripts. In the final chapter, I will lay out a prototype that embodies the mechanics of smart city technology in a very simplified way and explain the thought process behind building a narrative for a city game based on this structure. The goal will be to highlight the effect of ubiquitous computing on the invisible borders of our shared map, whilst staging moments where the gameplay breaks these preconceived paths and behavioural scripts.

img 1

Let's start by taking a close look at invisible borders in games, from psychological techniques to technical applications. From there, I will look into games that blur the lines of the game space or magic circle[1] by taking place in real cities and everyday media, hiding in plain sight for non-players. Digging into methods game makers are using to herd players' movement will function as a comparison for methods used by urban planners, companies and governments who implement technology to influence the self-determined paths of citizens through public space. By doing so, I aim to lay the base for the following chapters, which are focussing on applied devices of the "real-time city"[2] vision: A second digital twin platform of the city, visualising real-time and location-specific data.

1. Huizinga, J. (1955). Huizinga defines the magic circle as the space within a game where an alternate ruleset and behavioural script is applied

2. The term real-time city as in mentioned in *Digitally managed cities of the future – how close are we?* (2020) refers to urban data platforms (UDP)

After living in Rotterdam for a few years, I noticed myself moving in very strict patterns through the urban landscape. It was as if I was inhabiting a tiny village, spread around different districts. It felt almost impossible to change the paths that I travelled through. As if there was an invisible force holding me back from peeking into a side street I had never been to, or to stop and look closely at the buildings I passed by. But there wasn't, was there? I remember feeling dissociated as I realised I was not able to see the corners of the rooms I was in any more. I can only see sharply what I need to see in order to move around and do what's needed to complete the objective of the moment. In video games, you instinctively know where to go, what object to click on or pick up, whom to fight and who to befriend. It appears as if there was an infinite amount of things to explore, places to visit and people to have meaningful dialogue with. If the game makers have done their job, you won't notice that every other room in that building was empty, that only in that main hall you stumbled into, there was an overflow of storyline presented to you. This made me think back about the small village I have lined out for myself within the city of Rotterdam. I have the constant feeling that I could go anywhere, at any time, if only I chose to.

Chapter 1.1 Of Game Masters And Speedrunners

Have you ever walked in one direction for a long time in a video game, just to see if you can reach its borders? You wouldn't be the only one. Some gamers record themselves for hours and hours on end just to capture the moment they finally cannot go any further, revealing the boundaries of the map. Video game maps are often surrounded by sea, a reason for players not to consider it part of the playable area. But what happens when a player does decide, against all odds, to go for an extended swim? Well, in some games they might drown, in some a shark might attack, and in some a massive electric eel might penetrate their submarine. Understandably, since the depths of the ocean are not a safe place for humans to explore, many dangers are waiting under its reflective surface. In some war games, players might get warnings about landmines, when trying to reach a part of the map that's not intended for gameplay, undeveloped areas which are not adding to the progression of the narrative. Also understandably, since this is a war setting, some areas that are unsafe to walk over. Whenever the limitations of the map are integrated into the narrative and story world of the game, the primary reasons for the limitations

remain undisclosed. Speedrunners are players who record themselves as they play through a game as fast as possible, often making use of glitches or other mistakes by the game makers to bypass lengthy tasks. Their practice reveals cracks in the seemingly perfectly orchestrated story worlds and their mechanisms of immersion, revealing the technical approaches by the game makers to prevent areas from being reached prematurely.

The player swam too far

A shark circles player

The player dies and sinks

img 2

In September of 2021, during a media art festival in Amsterdam, my sister put on VR glasses for the first time. There was an immediate cut from her and her previous environment, a rather empty room. She started moving around in excitement, calling out the things she was seeing. All of a sudden, I saw her walking closer to the wall. She stopped right in front of it, looking down and saying: Woah!! It goes down so far! What she was seeing instead of the wall was an abyss. Instinctual fear kept her from daring to take any step further.

In mixed reality (XR) applications, geographical markers are translated into landmarks within a fictional environment to make sure players are not walking against walls or outside of the playing field. I recently visited the XR lab at Saxion in Enschede, where I met instructor Stefan Talman. He set up a computer for me with various VR and AR glasses. As I was telling him my interest in invisible borders and the idea of overlapping maps, he decided I should play the game "Richie's Plank", in which you step into an elevator in Virtual Reality (VR) and step out on a wooden plank on top floor of a skyscraper. The task is simple: dare to jump off the building. To my surprise, this was incredibly hard for me, even though I was well aware that in reality, I was standing inside a big room with carpet flooring. Similar to the sensation of falling in dreams, the emotions of fear are real, but somehow watered down, less intense as they would be in reality. It was almost impossible for me to step off of the plank, I only let myself jump after taking a careful step off and felt the solid ground of my actual environment. VR game designers have to take the physical surroundings of the players into account when designing the virtual playfield. Half-Life Alyx is a good example of a VR game that creatively deals with the limitations of movement of the player in an open-world game. The player might be in a very confined space in real life, so the VR experience needs to accommodate that. I was amazed by its realism and depth to the objects surrounding me. I started out on a tiny balcony, overlooking a city. Within close reach, there were intricate objects to pick up, read, and use all around me.

img 3

During my stay in Enschede, I also visited Robert-Jan den Haan at the University of Twente. He designs serious games for environmental solutions, and he explained his recent project 'Virtual River Game' in depth. We talked about the technical elements and workings of the game, as well as its psychological impact and communicative powers. The game board is set up on a wooden table on which modular panels of different heights are arranged to form the terrain of a river bed. A webcam films the underside of the panels to recognize the different types, for example water or a specific type of grass. A program then translates it into a live projection mapping back onto the terrain which visualises the flow of the water according to the current arrangement. Robert-Jan explained to me that this game is a very functional tool to bring different stakeholders together and involve them in the design of the river beds, especially since not everyone speaks the same language. It is intuitive and inviting, combining tactical game pieces and imageries of real landscapes.

Whenever new technologies trickle down from government, military or industry employment and become within reach of the general public, the excitement about the new possibilities opening up fuels experimental uses and often playful applications. A genre I find particularly interesting is the Alternate Reality Game (ARG). By infiltrating the players real-life communication platforms, mixing fictive content with the real, the players are left in a constant state of wonder. Often times, they will share gathered information and puzzles to collaborate and solve them together in order to get further in the game. To facilitate this, players might self-organize themselves on online platforms, using Reddit threads for example. ARG games like Cicada 3301 attracted international attention with a very dedicated community forming as the game unfolds.

Geocaching (2000 - present)
Geocaching is a worldwide, ever-expanding treasure hunt enabling anyone to hide a cache and publish its geo-location via specific GPS coordinates. Players nearby will see it appear in the app and then go on to search for it and log their name inside of the logbook within the container once found. This mechanism is often used by locals to lead strangers to interesting sights of the area. Players are logging their whereabouts worldwide, leaving their names in physical and virtual log books whenever they discover a new location. The caches have to blend into they environment smoothly, a welcome challenge for experienced geocachers. Non-players are called muggles, and no one wants a cache to be muggled, as in found and thrown away or messed with by a passer-by. Containers take on the shape of screws on a fence, or are kept out of sight under surfaces through magnets. They are all around you in public spaces, but you would never notice them until you start searching.

img 4

img 5

Pirates! (2000)
Pirates! is a location-based game that did not stand out to me because of its narrative (nothing against pirates!), but its game mechanics of rendering virtual islands on top of the real city scape. It uses the physical world as a game board. To move their boats through the game map, the players are required to move in the physical world, a process called sailing. All islands are equipped with WLAN and short-range radio. The handheld devices the players carry play a key role: for one, they determine when a player has entered the zone of an island and measure the distance to other players to initiate sea battles.

Can You See Me Now? (2001)
A project I find particularly interesting is the location-based, hybrid catch game "Can You See Me Now?" by Blast Theory. Using GPS sensors and real-time GPS tracking in order to map the physical live location and movement of players to a simulation of the same space in a video game, a strange disconnect between on- and offline players is being highlighted. The clear objective of chasing a co-player down in public space creates friction between players and non-players, since the players are becoming disconnected from their environment through the tunnel posed by the time limit and focus the game demands.

Momentum (2007)
Momentum is a nordic pervasive Live Action Role Play (L.A.R.P) set in Stockholm. A dedicated core group of thirty players embodied deceased revolutionaries over the course of five weeks, solving puzzles and performing protests and rituals in public space. The game only presents itself as such once, at the beginning of the experience. From that moment on, every in-game language is catering to the idea that the game is in fact real. This posed various challenges to the game makers, who were surveilling the players remotely in order to keep track of their progress. The scenery ranged from nuclear reactors to other abandoned areas in public space.

EARTHRISE × Zhōuwéi Network (2021)[1]
In May of 2021 I organized a location-based game myself, leading players to seven locations around Rotterdam. Each location was marked with a cryptic symbol, which only people *in the know* could decrypt into a useable codeword to unlock a site-specific audio narrative. Together with visual artist Camilo García Aycardi, I developed a dictionary of syllables, corresponding to different visual layers within the symbols. Using chalk spray, the symbols resembled graffiti aesthetics and blended smoothly into their environment, until someone who knew how to read them would reveal their hidden story.

img 6

img 7

img 8

1. EARTHRISE was realised with artistic contributions by Liminal Vision, Gill Baldwin, Camilo García A. & Federico Poni. Directed by Louisa Teichmann and co-produced with Erik Peters & Ruta Genyte in collaboration with Mary Ponomareva, MAMA and Roodkapje as part of their "Agency & Machine" program

Ubiquitous or pervasive games are seemingly omnipresent, as they make use of various media, which are part of the player's everyday reality. By blending the storyline seamlessly along multiple channels, the player is in a constant state of wonder about what elements of their surroundings are part of the game. The projects I presented are playful applications of technoligies like GPS tracking, geofencing and psychological tools of devotion to the objective. This leads us to the following chapter, where I am drawing parallels between ubiquitous games and ubiquitous computing, not only in terms of applied technologies and structure, but also as a psychological experience of omnipresence.

Encased in concrete and metal armour, lie the keys to the pulsating veins of a mirror world. Whatever makes it inside its bloodstream, will travel fast and eternally through the nexus of time and space it occupies in that instant.

How are we being manipulated and persuaded by companies as well as our government to move in predetermined patterns in public space? Where is this ideal of an omnipresence of computed crowd control and data extraction coming from? In this chapter, I will take a look into the different elements and dynamics of smart city technology, especially the various smart objects equipped with sensors situated in public spaces. How do they function? How are they connected, communicating and regulating the environment around them? Going beyond the architectural layout of the inner city, highlighting the often-times unnoticed smart devices attached to it, I will take a critical look into the potentials and limitations that these structures pose for the next level of surveillance capitalism and the recursive hierarchies of the ethereal machine.

I am moving
I am floating
I am not inside my body

When talking about a feeling of constantly being watched and tracked, it is tempting to go down the route of discussing the privacy invasion of big tech companies and governments, which give users of mainstream media a constant feeling of paranoia to be caught misbehaving. I will avoid going into depth on this well discussed topic, allowing me to focus on the vision of ambient spaces and mirror worlds through the ages and concluding with a closer look at the current status. The realm of the mirror world[1] is augmenting the perception of real spaces. Not in the typical application of augmented reality (AR), through glasses or phones revealing a fictive visible layer on top of real spaces. I am talking about worlds within worlds, recursive hierarchies unravelling narratives which rest on shared geographical markers. In order to stalk down this phenomenon and pin it down, I will start by tracing the very bricks which hold the city together. I will then chase down the power lines woven amidst, all the way to its whirring epicentre. I aim to grasp the organism in its complexity and understand at which point of its evolution we find ourselves today. By laying the bones bare, and identifying the various body parts, I will discuss how these pathways lend themselves to be used and abused for ludification.

1. Gelernter, D. (1992).

Lured by light, I wandered the streets in endless loops, chasing open doors and sounds until impulses charged me and I fall asleep once more.

Making sure that people stay on designated areas and behave in pre-scripted ways is applied to the very blueprints of the city. The social encounters emerge from architectural set ups, which are put in place to achieve a desired behaviour by citizens. Public space can be seen as a stage which has been set by the city council and its urban planners. Just as in games, the intentions are not always obvious but function in subtle ways to influence people's actions in the space. Architecture provides an unspoken behavioural script to its inhabitants. Are citizens supposed to walk quickly from A to B or are they supposed to sit and gather? Angela Rijnhart (Ethics Committee Secretary and Strategic Advisor municipality Enschede) answered some of my questions on techniques of herding citizens to designated areas, through architecture as well as technology. The city is constantly adapting to the flow of citizens. If a street should be more lively, shops and cafés are added. I will go more in-depth into the applied devices later on.

In the recent past, surveillance and tracking have been able to spill into every corner of the urban landscape, from parking lots to lamp posts, justified in the name of safety, tolerated only in fear of escalation. Whenever a big, scary event happens, the boundaries of the privacy of individuals are being pushed. 911 completely changed airport customs to be an invasive process in which everyone is seen as a potential criminal, scanning passengers for guns and knives. With the Covid-19 pandemic, citizens got used to openly show their medical history to virtually anyone working in a restaurant. Allowing these boundaries to be pushed further and further is being tolerated at the moment of crisis. Still, certain mechanics of tracking individuals lend itself to being abused by governments later on, even when the crisis is long gone. Through these events, governments are able to get a tighter grip on the citizens through mass surveillance. Let me zoom back in a bit into a process of behaviour prediction. Video surveillance was first implemented in Manchester during football games in the 80s, since the hooligans were hard to control. Police were trained to read behaviour always expecting escalation, making it risky for people to not act according to the before mentioned location- and time-based scripts. In "Loving Big Brother" by John E. McGrath (2004), the author uses this example to discuss how the police are being trained to read certain behaviours as potentially dangerous and will stop the behaviour early on before it escalates into violence and crime. This approach is problematic, in the sense that harmless behaviour can be misread as the start of something harmful, even if it isn't. This eventually escalated during a game with many people dying, after the police misread the behaviour of hooligans who had been stuck in a too small space in the stadium and their acts of panicking were seen as dangerous and threatening, leaving the police to not open up doors to relieve the situation.

Subtle methods of behaviour prediction and herding peoples' movement also happens in the digital realm. From an outsider perspective, this prediction of behaviour used to intervene in the path ahead of an individual has been applied not only through surveillance cameras but also many other devices ever since. Not only for crime prevention, but for many other desired outcomes, such as persuading people to make a purchase. As Soshana Zuboff lays out in "The Age of Surveillance Capitalism" (2019), this form of capitalism is a new phenomenon grown on the fertile grounds of individ-

ualization, emerging in a second wave of modernity. It monetizes content produced by users: The needs and desires which come along with self-determination of digital content streams result in an unprecedented, unhinged wave of a new mutation of capitalism. Targeting advertisement, detailed profiles used by algorithms to predict what they could be persuaded to buy:

"Now the same digital architecture used for monitoring becomes the means of behaviour modification with programmed triggers, subliminal cues, rewards, punishments, social comparison dynamics — all of it aimed at tuning and herding human behaviour in the direction that aligns with the commercial goals of business customers." [1]

1. Zuboff, S. (2019).

Surveillance capitalism is supported by widespread digital infrastructures; a connected web of personal computers, phones and also increasingly the Internet of Things (IoT); governing and mediating virtually any human interaction. Surveillance capitalism is spilling into the city streets, leading you to where the algorithm expects you to go. Zuboff is rightfully speaking up against manipulative software, even though it can be harmful to give so much credit to the companies, reproducing their narrative that their service is successful to customers. Take Pokestops as an example. It would be wild to think every player will walk into a McDonalds close to a location in Pokemon Go spending money. A small percentage will, and that percentage is enough for the scheme to be successful. It is important to remember that real life and real people are more messy and nuanced in their characters and choices and will not blindly follow instructions given by an application. In conversation with Mettina Veenstra (lector Smart Cities Saxion), who is very active in designing playful interventions for groups which help reimagine public space, including approachable data visualisations. She is involving citizens in their public spaces' design process, encouraging them to imagine a city that suits their needs. We discussed the difference between manipulation and persuasion when it comes to playful applications and secondary objectives. If an app openly discloses that it is meant for the player to become more healthy, and will do so in a fun way that does not directly relate to health topics, this would be persuasion. But if there would be an app that makes people move through the city and do tasks under the veil of play, with a secret secondary motive, for example getting people to bring life to empty areas of town or spending extended times in shopping streets, this would be considered manipulation.

"The memory represents space in this world, and the processor time."[1]

1. Gelernter, D. (1992).

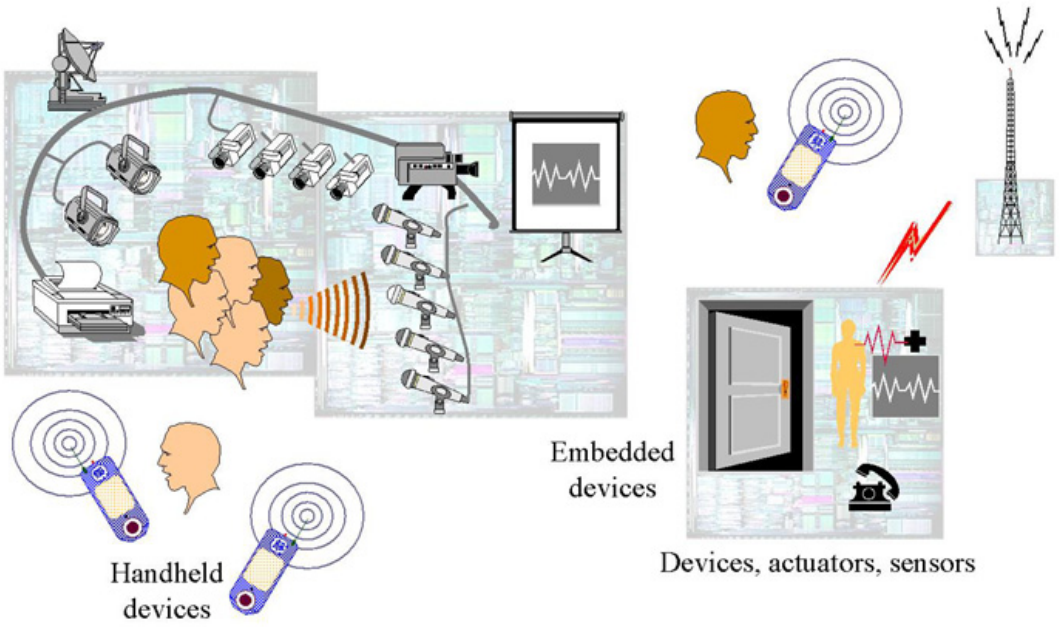
Let's have a look at the technology in place. What structures are covering the city streets, how do they sense changes in the environment, where does the information go and how is it fed back to the reality of the city?

I would like to start with the concept of a Mirror World, as published in 1992 by Gelernter. In their imaginary, the future will provide enough processing power to run a virtual copy of a city, which citizens could navigate with a joystick. Users would be able to nagivate through different spaces of the virtual city in order to find location-specific information. One could even choose to go back in time, as everything would be archived in this vast network. Their vision goes into the direction of a realistic 3D render of the city, with TVs in rooms that show relevant information. They describe software as somewhat limitless, in comparison to hardware. Software is a temporary machine that exists and works the moment it's running, but can be endlessly reconfigured. This is why there would be no limit to the complexity of software as long as the processing power allows it to run. I was able to follow and imagine their ideal, until they mentioned how every citizen would be able to access it. Building such a system of real-time information and control doesn't strike me as a system that would be made for the entertainment or education of citizens. These structures lend themselves to be abused by governments and companies for data extraction of individuals, being able to trace back their every step. I can not imagine a city going all this way to install sensors and cameras to source real-time data and then putting in the money to make that accessible to all citizens as the primary goal. Am I being pessimistic? Is Gelernter being naive? Has something dramatically changed in our relation to software since the early nineties? Potentially all of the above.

Let's fast forward a few years, peeking over the shoulder of a research group at MIT around 2002, working on "Project Oxygen". During my research into augmented urban spaces, I started reading about ambient intelligence in relation to ubiquitous computing. I found out about "Project Oxygen", which lays out the concept of an omnipresent, invisible technological system:

"Oxygen enables pervasive, human-centered computing through a combination of specific user and system technologies. Oxygen's user technologies directly address human needs. Speech and vision technologies enable us to communicate with Oxygen as if we're interacting with another person, saving much time and effort."[2]

2. MIT Project Oxygen (2002).



img 9

Seven main points are being defined:

pervasive: it must be everywhere, with every portal reaching into the same information base;
embedded: it must live in our world, sensing and affecting it;
nomadic: it must allow users and computations to move around freely, according to their needs;
adaptable: it must provide flexibility and spontaneity, in response to changes in user requirements and operating conditions;
powerful, yet efficient: it must free itself from constraints imposed by bounded hardware resources, addressing instead system constraints imposed by user demands and available power or communication bandwidth;
intentional: it must enable people to name services and software objects by intent, for example, "the nearest printer," as opposed to by address;
eternal: it must never shut down or reboot; components may come and go in response to demand, errors, and upgrades, but Oxygen as a whole must be available all the time.[1]

1. MIT Project Oxygen (2002).

Project Oxygen brings all of the scattered mechanics I have come across throughout this research together, like IoT, sensor networks, and predictive intelligences, with the ultimate goal to make computing as easy as breathing, hence the title. In the project plan, they also define the different devices needed. A difference is being made between handheld devices and embedded devices, such as sensors. The goal here is not to recreate a virtual copy of the city, but to integrate a self-adjusting and intelligent system ranging from citizens homes to the city streets, which will act as an attentive, invisible partner.

Although I would love to stay in the early 2000s a bit longer with you, let's make our way back to the present for now. Mirror worlds are now called "Urban Data Platforms (UDP)"[1], or data twins, and applied in various cities across Europe. Some of them strive for a more visually engaging website to be accessible by citizens, some don't. Rotterdam is well on it's way to have it's own UDP. One of the big challenges defined by a research group of the RSM is gaining the trust of the citizens. The main goals are being defined as the following:

1. Dr van Oosterhout, M., Dr Sheombar, H., Holst, J.A., Dr Brandt, T, Prof. van Heck., E. (2020).

People, Planet, Profit.

:)

So, let's look at the devices in place which facilitate the dream of the *real-time city*. For one, we have the company skylab providing gateways to The Things Network, which is a large international network of IoT devices. The gateways are connected to this network via low-range radio, called LoRaWAN. This is how the technology is being advertised by skylab:

"The Internet of Things use-cases for this CENT-R network are myriad, ranging from city-light management to asset tracking to measuring climate data," said Remy de Jong Sr., CEO of SkyLab. "With the right sensors connected to this LoRaWAN network through Kerlink gateways, virtually every IoT use case is possible."[2]

2. www.skylab.nl

img 10

It seems like the next step in the development of smart city devices is connecting them all in one big network, like The Things Network, where all incoming data can be processed and monitored. I do not mean to paint these developments as a purely negative process, as there are many positive outcomes of these self regulating smart devices, adjusting immediately and efficiently to changes in their environment. Smart light poles can adjust the brightness according to the environment, saving energy. A lot of these tools are intended to foster energy saving and provide circular solutions. This being said, the privacy concerns of such a vast amount of easily updatable computers, which are black boxes for the users in many cases and often-times not updated for years, make them dangerous and vulnerable for attacks and abuse. The dangers of allowing these devices to facilitate the determination of movement flow and civil behaviour are to be taken seriously. Let's take Sidewalk Lab's proposal 'smart city' for Toronto as an example. The google funded company produces devices which can be attached and integrated into public spaces. The team hired privacy expert Ann Cavoukian to deal with the big privacy questions in this design proposal, who eventually resigned because the company rejected their proposal for privacy by design, stripping any collected footage from personal information, for example blurring faces immediately. With this proposal, there would have still been plenty of data to process, but no individual could be traced back. It is very worrying that this was a deal breaker for the company.

There seems to be a clear link between ubiquitous computing and ubiquitous gaming, two concepts that challenge peoples' perception of reality in the outer rings of the magic circle. In this final chapter, I am bringing the two sides together, in the shape of a prototype of a location-based game which interweaves these two research topics into one. My aim is not to do companies selling tracking devices a favour by showing how *fun* these systems can be. The German word for understanding is ''begreifen", which is related to "greifen", meaning "to grab". Understanding a complex topic is difficult from a distance. One way of understanding and feeling empowered is to try and replicate. This is why I am rebuilding a simplified *grabbable* prototype from the devices and structures I have found in public space. By constructing a technical prototype, I am coming closer to understanding the technical devices and how they are interlinked. From there, I am feeding a fictive narrative into this structure, which encapsulates the feeling of being lured onto the city streets, chasing landmarks of a secondary objective. For this I am making use of game design principles for narrative structure and environmental storytelling. How can we appropriate the previously discussed methods for play without labour and make them our own? What could a player's mod of the 'smart city' look like? Which elements of the before mentioned systems can I use, what platforms and engines would make sense and how could they support a narrative?

I was curious about the current status of smart city technology, what is implemented and why? What are future plans? Angela Rijnhart (Ethics Committee Secretary and Strategic Advisor municipality Enschede) was able to answer this question, talking me through the different types of sensor networks interlacing the inner city of Enschede. There are different sensors for different purposes. In order to measure the business of roads and the weight of trucks, pressure sensors are placed below the asphalt. Similar sensors are placed below public parking lots in order to measure when a car has not moved for a long time. There are sensors that measure water levels in order to prevent flooding. Parking garages scan license plates, which opens up a lot of personal data to the municipality, letting them know who is visiting and from which country. There is also an app called SMART app, which allows users to get green lights on bike lanes when biking through the city with the app on their phone. Another set of sensors are WiFi trackers, which have been implemented in public spaces in order to measure the amount of people in the spaces. This has actually escalated into a lawsuit from the Dutch Data Protection Authority (AP), since citizens were identifiable throughout the different WiFi spots, allowing for individuals to be tracked throughout the city, instead of simply being anonymously counted per location. To summarise, what Rijnhart revealed to me was a vast network of sensors hiding in plain sight. Citizens' movement is monitored through GPS and WiFi tracking of their phones and devices such as street lights adjust according to the proximity of an active user.

A recurring favourite seems to be GPS, or Global Positioning System, which assigns coordinates to its scattered modems, as they move over the shared map. This technology which has initially been built for the U.S. Army turned out to be a helpful navigational tool for everyday uses.

"[...] there is an explosion of mobile and locative media which are now part of a technological network of signs produced and accessed globally that, at the same time, allow a precise and instant positioning within geographical places and territories which, in turn, could lead to a meaningful link with specific locations."[1]

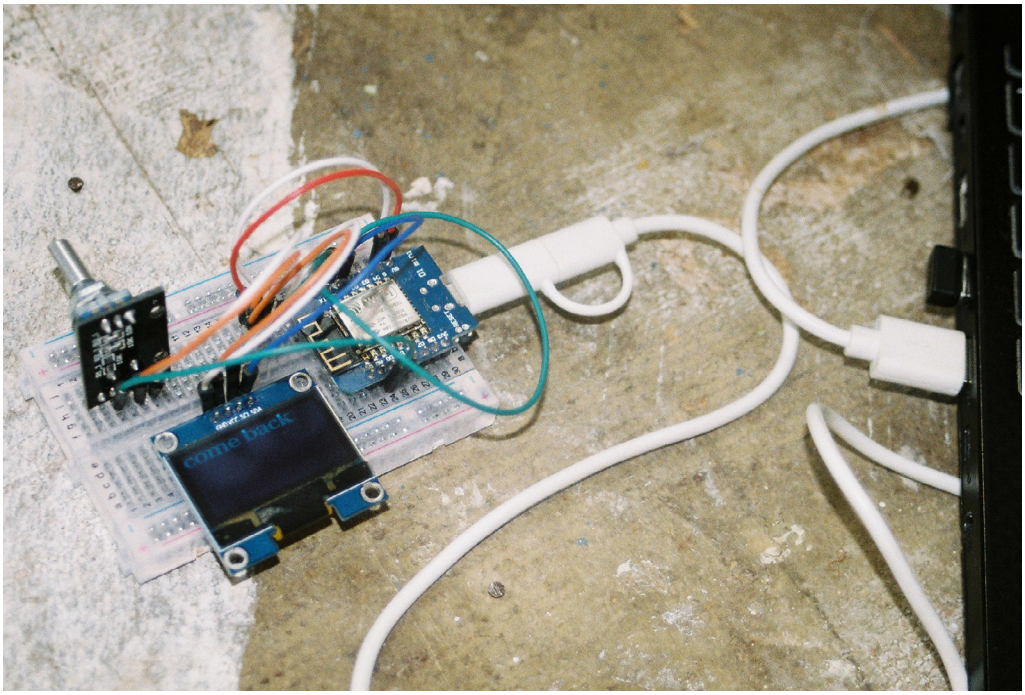
1. Firmino, R. and Duarte, F. (2010).

Another feature which derived from GPS is geofencing: a software feature used to draw geographic boundaries based on GPS or RFID information. Remember Pirates!? Imagine virtual islands drawn onto the map of the city. Based on whether you are in or outside of these boundaries is decisive for what functions are available and which content is visible within an application or other service. This virtual space is mapped onto the physical landscape. The main motivation for geofencing seems to be security, as its being used in security tags in clothes in shops and for car sharing services. But geofencing is not only used to prevent theft, it is also used in to target voters in political campaigns. Geofences can be drawn around a single building, a neighbourhood or an entire state in order to target people with relevant content in order to stir them to vote for one party instead of another.

I have compiled the following cornerstones based on the initial dream of mirror worlds and its application today, lending themselves to be used as game mechanics:

1. gateways transmitting real-time data
2. server processing real-time data
3. devices in public space influencing their environment
4. tracking individuals through handheld devices
5. behaviour prediction of individuals choices and paths
6. coordinates bridging two maps
7. virtual islands hidden in plain sight

img 11



img 12

In order to build a prototype, I started working with a mini Arduino equipped with WiFi. This module is called ESP8622. This would allow me to transmit real-time input from a web page to a remote LCD screen. In order to facilitate the remote communication, a server is needed. I opted for Node.js. But, we all know: it takes two to tango. The Arduino should be able to receive real-life input and feed it back to the web page. The webpage would function as a window to the mirror world, storing and visualising information, while at the same time getting to know the user in order to predict their paths through the city. Through the GPS on player's phones, I would be able to determine whether they have reached the area of a gateway. A gateway will be located in public spaces, ranging from night shops to abandoned buildings and is made up of the Arduino connected to the network, bridging communication between the worlds. The Arduino can be equipped with different sensors which can take note of the presence of a player. This way, once a player enters the playable area, lights could start flickering and sounds could turn on, reassuring the player that they have reached a gateway. These will be the main game mechanics I replicate from the mirror world.

Chapter 3.1 String of Pearls

In March, I video called Avinash Changa, an immersive theatre maker, to talk about his most recent play involving different perspectives and VR, called "Orphée | L'Amour | Eurydice". In this piece, visitors can choose which role they would like to embody, and depending on their choice, will either go through the experience in VR or audio based. We had an interesting conversation about non-linear narratives and tools which help involve participants in the storyline without going too far off the scripted path. In Avinash's play, participants would unknowingly become performers and dancers to the other group, by using the movement based interface within VR. To him, the narrative tool "string of pearls" is powerful, as it defines core moments of the storyline which

every player should experience to some degree, allowing for some small deviation and variation per stage next to those key moments. This allows the player to feel a sense of agency and choice, without losing a sense of immersion and reason. He also talked me through ways of creating an illusion of a bigger space in VR, making people feel as if they are moving through many rooms of a building even though they might be walking in circles in real life, as previously discussed with "Half Life Alyx". In "Orphée | l'Amour | Eurydice", Changa constructed a physical building of various rooms, which the participants walk through as their eyes are covered with VR glasses. While in real life, they will be walking back and forth through the same couple of rooms, in VR, they are reaching new floors and spaces within the environment.

I also had an interesting conversation with Niels Leenders from Gamelab Oost about non-linear storytelling methods, and accepting different player behaviours and attitudes as they move through the intended pathways. He introduced me to the concept of 1+1+1=5, which addresses environmental storytelling and the way players make their own assumptions based on objects and clues they encounter. How can players discover past events of a storyline in their own way? I will rephrase the example Leenders brought up during our conversation: Let's say you step into a room, the bed unmade, closet doors open. On the bed there is an open diary. Now, the player has to add all these three breadcrumbs and add them up to their expectation of what has happened in this space previously. 1+1+1=5. Hm, this doesn't add up! Is Leenders bad at math? Well, the remaining two elements are the players' experience and the assumptions they form based on those. He also made me understand that there is no need for players to have insight into the world building, it can exist as the invisible foundation connecting landmarks and events in the storyline in a cohesive and logical order.

Right. So what happens when you blend all of this up and sieve it to make a narrative soup for a location-based game? I will make use of my initial inspiration, sleepwalking as the way in which the main character encounters a creature in the city streets. As the characters' sleepwalking habit gets out of hand and they eventually leave their bedroom, out into the night, they start noticing messages and signs. Strange sounds and blinking lights. As they follow and seek out the origin of the messages, the creature, they are being pulled further and further away from their path. The creature lives below the asphalt and seems to have some kind of magnetic pull, moving the main character to designated areas of contact. Over the course of many nights, the two grow a strong affection. As the character awakens, the creature seems to have vanished along with the dream. Yet, without remembering their nightly visions, they start noticing lights and sounds in public spaces reacting to their presence. The creatures' eyes and senses are limited to the electronic devices scattered around town, and has lost track of the main character. The moment the actual gameplay starts, this strange encounter will be in the past, and the creature is calling out to players via a website to locate the main character, which seems to have disappeared off of its map.

img 13

"A game only exists when its being played." [1]

1. Garcia, A. and Niemeyer, G. (2018).

If a game only exists when it's being played, and the enforcement of crowd control in public space resembles game structures, could we stop playing? Could we break free from the constant fear of being persuaded or even manipulated to behave and move in ways which complete an objective other than our intrinsic free will? In this research, I seeked out the precise moment when the bottle drops and the dream is over. You followed along as I wandered across interlacing grips. *Where is this dream coming from?* I asked myself. Applying smart devices to regulate citizen's mobility and actions in public space is a threat to their personal pathways and perception of reality, and should be closely regulated by experts who have an understanding of the dangers of such systems. Invisible borders are all around us, and the moment we recognize them, we can challenge our own perception of their boundaries.

By constructing a prototype of a ludified system making use of smart devices as my graduation project, my aim is to provide a tool for myself and others to understand the workings of the real-time city. Not only in terms of technical requirements, but through emotional experience. So, has anything changed since Gelernter wrote about mirror worlds in the early nineties? Well, I was not born yet in 1992, so who am I to decide? From my perspective, the initial vision did not take surveillance capitalism with its long fingers into account. It's written from a very citizen focussed stand point. Today, we realise the grip companies are having on our virtual and physical lives, manipulating us constantly as they get to know us through our preferences. As I was looking into surveillance and crowd control technologies, I wanted to show the systems in place, without exaggerating their capabilities. I am still not an expert on this. I just want to take a closer look at the structures hiding in plain sight which might influence and counter our free will. Now that I have formulated my vision of the potential and dangers of a ludified smart city, it's time to celebrate ways of dancing on the structures of its system.

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