To Play and To Be Played: Exploring the Design of Urban Machines for Playful Placemaking

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Within the paradigm of the smart and playable city, the urban landscape and street furniture have provided a fertile platform for pragmatic and hedonic goals of urban liveability through technology augmentation. Smart street furniture has grown from being a novelty to become a common sight in metropolitan cities, co-opted for improving the efficiency of services. However, as we consider technologies that are increasingly smarter, with human-like intelligence, we navigate towards uncharted waters when discussing the consequences of their integration with the urban landscape. The implications of a new genre of street furniture embedded with artificial intelligence, where the machine has autonomy and is an active player itself, are yet to be fully understood. In this article, we analyse the evolving design of public benches along the axes of smartness and disruption to understand their qualities as playful, urban machines in public spaces. We present a concept-driven speculative design case study, as an exploration of a smart, sensing, and disruptive urban machine for playful placemaking. With the emergence of artificial intelligence, we expand on the potential of urban machines to partake an increasingly active role as co-creators of play and playful placemaking in the cities of tomorrow.

Keywords: play, playable city, urban machines, placemaking, interaction design, public bench, urban prototype, smart city

1 INTRODUCTION

Against the smart city backdrop (Nam and Pardo, 2011), the advent of playable cities has brought a creative imperative to urban liveability. The fabric of the city is reconfigured for playful human experiences, with streets, buildings, and street furniture transformed into potential ludic opportunities through digital augmentation. The interweaving of technology with the urban fabric advances the implementation of creative solutions addressing not only efficiency but also the quality of city services, processes, and interactions (Calder, 2016; Ligthart and Ramjee, 2017; Mosco, 2019). Moreover, the functionalities of urban technology are adaptable to serve both pragmatic and hedonic purposes across different use situations, where the benefits of citizen participation, engagement, and co-creation are typically sought after by city-makers (Fredericks et al., 2016; Lim et al., 2018; Glas et al., 2019; Rodriguez Bolivar and Alcaide Munoz, 2019; Cardullo, 2021). With the increasing ubiquity of digital urban infrastructure, smart street furniture has grown from being a novelty to become a common sight in metropolitan cities. In the smart city paradigm, street furniture has primarily been co-opted into streamlining of city services through digital data collection and monitoring (Nassar et al., 2019). On the other hand, the playable city movement seeks creative opportunities for transforming street furniture as part of playful, digital placemaking.

However, the implications to urban environments having a new genre of street furniture embedded with increasing levels of artificial intelligence and autonomy are yet to be fully understood.

In this article, we explore the overlap between smart and play in the design of street furniture through an exemplar study of the ubiquitous public bench. Whilst traditionally public benches serve the purpose of providing seats for people, they continue to be appropriated for playful, creative, and entertainment purposes, most recently through the addition of digital technology. Drawing on the notion of urban machines for public spaces in contemporary digital culture (Del Signore, 2018), we re-conceptualise the public bench as a form of playful urban machine. The article presents an analytical tool in the form of a graphical axis, which illustrates key characteristics of playful urban machines represented by design precedents of public benches across the two dimensions of smartness and disruption. Through our analysis, we identified an under-researched category of public bench as smart, sensing, and disruptive, especially in regards to emerging technologies of artificial intelligence (AI) and robotic features. The application of AI, machine learning, and robotics opens up a design space of expressive, social machines for cities. Thus, we offer our version of the smart, sensing, and disruptive public bench to expand the concept of an anthropomorphic urban machine for playful interactions, through an urban prototype (Korsgaard and Brynskov, 2014)—*I Have Feelings Too*—deployed in a public festival setting.

With a design research process that connects real-world implementation and theoretical speculation, the urban prototype is regarded as both a technology probe (Hutchinson et al., 2003; Boehner et al., 2007) and a speculative artefact (Auger, 2013; Muller, 2013; Wakkary et al., 2015). We then reflect and speculate on what it means to play with and be played by urban machines and examine the possibilities of public benches in a future where urban machines become personified entities. Key to our thinking is a shift from primarily designing for playful humans to designing playful, not just playable, machines. The study concludes with the significance of such machines to the identity of places in which their role shifts from a plaything for humans to active co-creators of playful placemaking.

2 BACKGROUND

Empowering citizens to rewrite the services and stories of city life, the movement of playable cities (Nijholt, 2017) has been discussed as a contrast to the ideology of smart cities embedded with digital technology[1]. Despite so, it is a misconception to perceive the utilitarian use of digital technology as separate from the intentions of playfulness. Deliberating on the concept of playable cities, Nijholt (2020) highlights the synergistic relationship between smart and play and positions smart technology as pivotal for enhancing playful experiences. With our focus on the evolution of smart and playful

street furniture, the notion of playful placemaking provides a productive frame for understanding the potential of technology augmented street furniture to foster a sense of belonging by citizens in public spaces. The concept of urban machines is unpacked to provide a definition that takes account of the morphing of street furniture from an object to a machine, with increased autonomy and function, resulting in new and different affordances for design and use.

2.1 Technology and Playful Placemaking

As part of digital urbanism, most examples of playful street furniture seek to engage communities, stimulate public behaviour change, and advocate for the advantages of playable cities (Leorke and Owens, 2020). More importantly, these urban interventions form a stronger connection between people and place, with greater emphasis placed on lived experience through active participation rather than the mere provision of utility. That said, when designing street furniture to be playful, the subjectivity of human perceptions and situated conditions of the urban space heavily influence the process of interaction and resulting user experience. The act of playing also has an inherent association with children, games, and leisure. Hence, it is often deemed as a luxury to adults; secondary, unproductive, and non-essential. Coupled with the multi-layered complexities of public situations, it can be argued that the challenge of designing a compelling invitation to play is as important as ensuring a suitable fit of culture and environment for playing (Innocent, 2019). Considering the outcomes of placemaking, we acknowledge that the present and future developments of play in cities indicate a continued necessity to appreciate the effects of technology on the identity and experiences of places. Thus, we focus on *playful placemaking* (Innocent, 2016; Stokes et al., 2017; Luostarinen, 2019; Chew, 2020)—a variant of placemaking adapted from traditional and contemporary methods outlined by Jacobs (Jacobs, 2016), Whyte (Whyte, 1980), and other influential urbanism organisations such as Gehl[2] and the Project for Public Spaces[3]. Supporting urban liveability, it is a placemaking process involving the public as co-creators of city life by means of playful interactions designed for the built environment. In this context, the relationship between smart and playful street furniture can also be described as contrasting but interconnected—the former focusing on efficient productivity, the latter on vibrancy, and enjoyment. Playful street furniture designed with smart (digital) technology offers added capabilities for interaction and immersion. Conversely, smart street furniture made playful humanises technology to become more personal, engaging, and situated for users. This conversion of street furniture into urban machines follows the common understanding of the efficiency and intelligence portrayed by smart cities but also includes the ingenuity and novelty of creative technological applications.

Although a quick review of related literature reveals that the key themes of play (Huizinga, 1949; Caillois, 2001; Eberle, 2014),

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[1]https://www.playablecity.com/.

[2]https://gehlpeople.com/.
[3]https://www.pps.org/.

urban technology (Shin, 2009; Nagenborg, 2018; Nagenborg et al., 2021), and placemaking (Whyte, 1980; Jacobs, 2016; Hespanhol, 2017) are not entirely new concepts, opportunities arise from alternative ways of understanding those concepts when exploring the capabilities of technologies for the next generation of urban play. Designing existing technology for playfulness highlights the feasibility and limitations of contemporary urban play, while the emergence of new technology drives upcoming trends that provide indicators of future possibilities for playful placemaking. As robotics grows beyond the industrial and manufacturing context, urban robots are also granted autonomy to assist with package delivery[4], public space cleaning[5], and patrol surveillance[6] (Prassler et al., 2012). During events and festivals, other variations of robots and drones are programmed to perform and entertain; creating chalk drawings in a laneway (Hoggenmueller et al., 2020), performing aerial light shows (Fingas, 2016), and amusing people while serving drinks (Giuliani et al., 2013). Infused with artificial intelligence (AI), robotic machines designed to be playful and sociable remain useful but expanded in their feasibility as entertainment, artistic, or cultural representations. Hence, we see the likes of robotic pets or toys functioning as expressive and intelligent companions (Melson et al., 2009; Pelikan et al., 2020), an ultra-realistic robot artist who makes original artworks[7] (Newstex, 2020), and a social robot that became popularised as a non-human icon[8] (Turner, 2017). Once pervasive AI becomes fully integrated into the citywide network infrastructure, the potential of smarter, responsive machines deployed in public spaces to maintain and improve city life would then be actualised as a connected, digital ecosystem (Kirwan and Zhiyong, 2020; Ullah et al., 2020). We could then perceive urban machines as agents personifying the identity of different places and initiating interactions with humans. Being intelligent and expressive, urban machines would also become playful entities in public spaces—learning, facilitating, and co-playing with humans to generate meaningful urban experiences.

2.2 Understanding Machines for the Urban Context

Taking reference from Nagenborg in his discussion on responsible urban innovation, we can understand urban machines through the definition of urban technologies, which "*refers to technologies that are shaping or are being shaped by city life*" (Nagenborg, 2018, p.2). As such, *urban technologies* cover a broad range of technology types, focusing on the interdependence between technology and the city. A design depicting an urban technology highlights distinct urban features and technological properties that are unique for the purpose of city-making. From this standpoint, urban machines can be understood as

being part of but also different from urban technologies. They are less all-encompassing and shift our focal point towards the self-contained, mechanical, and materialised forms of technology in cities. Breaking down the terminology, *urban* maintains a straightforward definition of "*relating to, or characteristic of a town or city*" (Urban, Adj, 2021), whereas *machine* has several connotations that are both rudimentary and philosophical. Through Deleuze and Guattari's theory of assemblage (or agencement) (Deleuze, 1987), a machine can be described as a collection or arrangement of various components composed and organised to establish logic and meaning. It is "*a composition of heterogeneous elements—subjective, social, technical, spatial, physical, and process-related—that delimits a series of conditions for the production of the real*" (Del Signore, 2018, p.6). An urban machine may portray a combination of hardware and software put together to serve one or more purposes in urban situations. It is also part of a larger assemblage that forms public spaces where the urban machine mediates the connection between people and place. Conversely, as a singular feature or component, an urban technology (such as geolocation tracking, machine learning, or programmable LED lights) is not necessarily an urban machine when it is perceived as separate from an assembled system.

As a whole, urban machines are "*a family of projects designed and developed to mutually enrich relationships between people, the space they inhabit, and the urban environment*" (Del Signore, 2018, p.6). We are not fixated on a particular category of machines, but we do recognise the diversity of urban machines that consist of both non-digital machinery operating on conventional mechanisms and modern devices integrated with digital computing systems. We also include the spectrum of multi-sensory, autonomous robots varying across levels of functional sophistication and replication that reflects or mimics the human body (Der and Martius, 2012; Kanniah, 2014). Although not all complex machines are robots, it is valid to consider all robots and drones deployed, functioning, and automated in public spaces as urban machines. It is also noted that urban machines exemplifying new technologies become common and pervasive when they are assimilated into the artificial structure of cities while appearing entirely natural in everyday life (Hård and Misa, 2010). Given our understanding and interpretation of urban machines, we can explain the augmentation or redesign of the public bench to be smarter and/or playful as an evolution process of the street furniture changing into a machine. With smart public benches, recent trends have illustrated a preference to support or add utility features that are directly or indirectly associated with public-sitting behaviour. Smart public benches like Soofa[9] and Synergy[10] are powered by solar energy and provide mobile device charging stations. Other technological features that are proven to be applicable options for the street furniture include free public Wi-Fi, integrated digital display for advertising, and LED ambient lights[11]. As the designs are refined with sensors, computation, and

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[4]https://www.starship.xyz/.

[5]https://fetchrobotics.com/fetch-robotics-blog/build-with-robots-fetch-robotics-and-the-city-of-albuquerque-launch-the-breezy-one-autonomous-disinfecting-robot-at-albuquerque-international-sunport/.
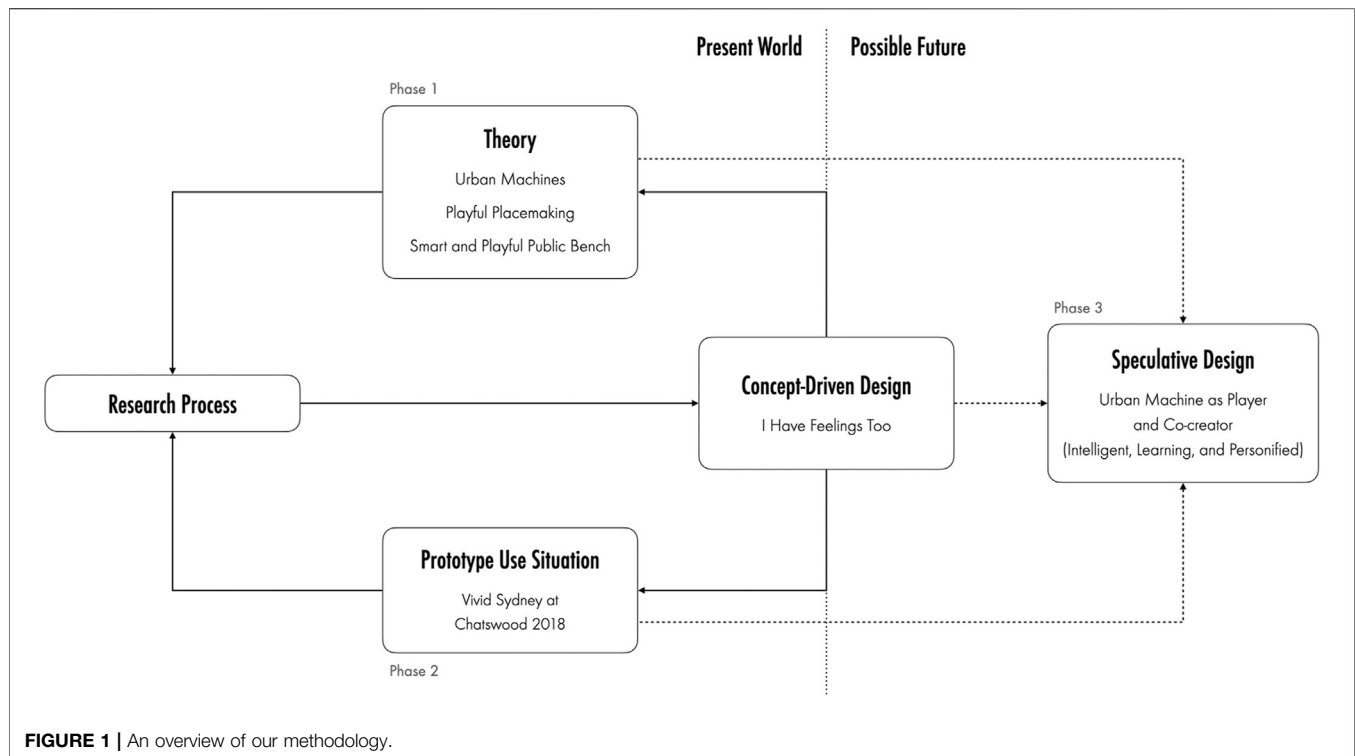
[6]https://www.knightscope.com/.

[7]https://www.bbc.com/news/uk-england-oxfordshire-48498853.

[8]https://www.hansonrobotics.com/sophia/.

[9]https://www.bizjournals.com/bizwomen/news/profiles-strategies/2018/03/smart-benches-help-cities-work-better.html?page=all.

[10]https://www.synergy.net.au/Global/solar-bench.

[11]https://www.specsolutions.com.au/connect/sedi.

FIGURE 1 | An overview of our methodology.

AI, they shift towards being more machine-like with capabilities to sense environmental conditions[12] (air quality, temperature, humidity), collect usage data (number of people, duration of use, energy consumption), and even optimise the display of ads relevant to passers-by[13]. In addition to having technological features, Smart Palm adopted the aesthetic shape of a palm tree to cater for the cultural context of Dubai in the United Arab Emirates[14]. Targeting specific groups of urban dwellers who commute on electric bikes and scooters, Steora Cyclo was also equipped with attached bike racks, high-powered charging, a repair station, and an air compressor[15]. Although there seem to be stark differences in the characteristics of *smart* and *playful*, they are not mutually exclusive when designing urban machines. Depending on the level of integrated smart technology, public benches can become urban machines that are both smart and playful with an overlap of purposes to maintain or disrupt urban activities. We expand upon this in our subsequent analysis.

3 METHODOLOGY

Our study combines scholarly analysis of design precedents, with a concept-driven speculative approach to design (see

Figure 1). In the first phase, we reviewed related literature on present developments of urban technologies and established an understanding of urban machines for the purpose of play in the future of placemaking. Focusing on existing designs of the playful public bench identified as an urban machine, we broke down various aspects of each design within the context of play and examined the impact on public-sitting activities. After selecting ten case studies that spanned a spectrum of variations on the common construct of the traditional public bench, we then conducted an analysis against two dimensions: the degree of smartness and the degree of disruption. The two dimensions are further elaborated and justified in the analysis section below.

In the second phase, we commenced the design, development, and evaluation of a concept-driven prototype. We adopted the Concept-Driven Interaction Design Research approach (Stolterman and Wiberg, 2010) and combined principles from the approach with speculative design (Dunne, 2013; Forlano and Mathew, 2014; Coombs et al., 2018; Wong and Khovanskaya, 2018). In doing so, we sought a theoretical analysis that is blended with the use situation of design to discuss the possibilities of urban machines for present and future developments (see **Figure 1**). With our methodology, we also deliberated on our public bench prototype to depict an idea of how humans can play with and be played by urban machines, rather than address a specific human problem or urban issues associated with the street furniture. We designed and developed *I Have Feelings Too* as a concept-driven prototype of a playful urban machine that explored anthropomorphising the public bench with digital technology for the purpose of playful

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[12]https://strawberrye.com/smartCityBench.html.

[13]https://include.eu/b2g/steora-smart-benches/city/

[14]http://bigd.es/en/portfolio/smartpalmen/.

[15]https://include.eu/b2g/steora-smart-benches/cyclo/.

| Name	Photo	Image Source	Utility: Can we sit on it?	Aesthetic Form: Does it resemble the common public bench?	Features: What has been added or changed to the bench?	Technology: How smart is the level of technology?	Playfulness: How can users play with the bench via its technological features?	Disruption: How will the bench support or disrupt existing public behaviour?
Example of Common Public Bench		https://upload.wikimedia.org/wikipedia/commons/c/c6/Street_bench_-_Diergaarde_Blijdorp_-_Rotterdam_-Wooden_planks.jpg	Yes	Yes	No added features or changes.	No technology	It is not designed to be playful. However, playfulness might be possible based on usage beyond sitting.	Baseline construct that fully conforms to the expectations of a public bench for sitting and associated activities.
The Porch Swings		https://www.universitycity.org/blog/porch-adds-custom-swings-gehl-studio	Yes	Somewhat Yes (combination of a bench and a swing)	Bench form is combined with structure and mechanisms of a swing to become a bench swing.	Simple and Mechanical	Design of bench is straight-forward for sitting and swinging. Enjoyment and fun may occur while people are playing with the swing.	Baseline construct of bench is retained. Swinging feature complements sitting experience and is minimally disruptive.
Why Sit When You Can Play?		http://www.theurbanconga.com/whysitwhenyoucanplayfl	Yes	No (looks like a redesign)	Wave shaped design with a marimba-like instrument integrated into its structure to create a section of musical seats.	Simple and Mechanical	People can play with the musical section of the bench to generate sounds and even collaborate to create music.	Redesign of bench still affords sitting and associated activities. New feature and behavior involving the musical section might be slightly disruptive to selected users.
Bench Go Round		http://www.georgezisiadis.com/bench-go-round	Yes	Somewhat Yes (with two combined benches facing in reverse)	Modified combination of two benches on an opposite rotation that resembles a merry-go-round.	Simple and Mechanical	People can choose to play with themselves or others sitting on the other side to spin around with the bench.	Baseline construct of bench is somewhat retained. Playful design can be disruptive for users who do not wish to play but are forced to participate by others.
2toTango		https://www.core77.com/posts/67085/This-Seesaw-Inspired-Bench-Takes-Two-to-Tango	Yes (with slight tilts)	No (looks more like a seesaw than a public bench)	Design of bench resembles a seesaw with mechanisms installed in the middle to balance between both sides.	Simple and Mechanical	Increasingly playful with more users as everyone plays with the seesaw feature in an attempt to balance the tilting seats.	Redesign of bench still affords sitting and associated activities. However, due to balancing mechanism, design can be disruptive to users who are sitting at the bench with other people.
Interactive Bench (Coeur de Pirate and Harrison Fun)		https://robocutstudio.com/portfolio_page/musical-bench-coeur-de-pirate/	Yes (with increased difficulty)	Somewhat Yes (which highlights the broken slats)	Sensors would trigger music samples via speakers in the backrest when they detect users trying to connect the broken slats by sitting at the edges.	Simple and Mechanical	Playfulness comes from the experience and challenge of trying different ways to sit and activate the sound trigger.	Despite maintaining form of public bench, broken slats and makes sitting and associated activities challenging with its playful design.
The Interactive Bench		https://interactivespaces.dk/the-interactive-bench/	Yes	Somewhat Yes (modular with different shapes)	With sensors and speakers, sitting actions can affect soundscapes and playback songs (system is programmable).	Sensing and Interactive	By interacting with the sensors, users can playfully affect the tempo or character of the soundscape.	Modular design with shapes that allow for sitting and associated activities. Enhances experiences of public bench with low levels of disruption through soundscapes.
The Playful Bench		https://sunep.net/the-playful-bench	Yes	Yes	Motion sensing device with visual light projections on bench to allow user interactions and play programmable games.	Sensing and Interactive	Users can play the three games visualised by light projections or engage in spontaneous, playful behaviour through their interactions.	Baseline construct of bench is retained. Light projections enhances experiences for those interested in the games, with low levels of disruption for those who choose not to play.
Mobius		https://www.makingworks.com/mobius	Yes	No (looks like a redesign)	Complete redesign into a circular bench with vibration sensors to affect the programmable LED lights within.	Sensing and Interactive	Since the bench will respond to human touch, people can play with its system and explore the lighting effects.	Redesign of bench still affords sitting and associated activities. Interactive lights enhances experiences of public bench with slight disruption due to its unfamiliar form.
I Have Feelings Too		Authors' Own	Yes	Yes (except for the prototype attachments)	With low-res LED matrix, speakers, and cameras, programmable digital eyes and audio commentary that react to the presence of humans are added.	Sensing and Interactive	Playing with what they think the benches would see (via "eyes"), people use bodily movements to trigger responses from the benches.	Baseline construct of bench is retained. Augmentation adds to experiences of public bench and can be disruptive to people who dislike or uncomfortable with design.
coMotion		Gronvall et al. (2014)	Yes	Somewhat Yes (with a simplified cuboid shape)	Shape-changing bench with force sensors, actuators as bench legs, and programmable bench behaviour.	Sensing and Interactive	Playfulness is viable with how the bench shape changes via programmed behaviour to encourage social interactions between strangers.	Simplistic form of bench allows for sitting and associated activities. Shape-changing feature can be disruptive to people who are uncomfortable with social interactions.

FIGURE 2 | Analysis of design examples as an urban machine through the lens of play.

placemaking. The prototype was deployed in an outdoor mall area in Chatswood, Sydney, Australia, as part of a public festival, Vivid Sydney 2018. We conducted a field study to observe human behaviour towards the prototype and sought to understand its effect on the surrounding atmosphere and identity of its location. Like a technology probe (Hutchinson et al., 2003; Boehner et al., 2007) in an actual use situation, the prototype uncovered the advantages and disadvantages of creating disruption with public sitting and utilising anthropomorphism as an approach to design urban machines. Data collection methods of in-the-wild observation and survey were approved by The University of Sydney ethics committee.

For the final phase of analysis and speculation, we positioned *I Have Feelings Too* as a speculative artefact (Auger, 2013; Muller, 2013; Wakkary et al., 2015) of the situated, everyday public bench. We then pursued the possibility of people being played by urban machines and deliberate on this notion as a proposal of future playful, playable living in digitised, intelligent cities.

4 ANALYSING DESIGN EXAMPLES OF PLAYFUL PUBLIC BENCHES

In our analysis of playful public benches, ten design concepts (excluding the basic form of public bench for a reference point) were examined to serve as case studies (see **Figure 2**). From this sample of designs, we selected public benches that were predominantly playful in ways that deviated from public-sitting norms to spark spontaneous human behaviour. We considered augmentations and/or redesigns across varying degrees of smartness to have an adequate spread of representations with urban technology. Given the small sample size, we focused on the quality and accuracy of our analysis, and only accepted examples that provided substantial documentation on concept, implementation, and interaction design. Information for each example was available online via a combination of sources with photos, videos, and/or written articles, except for *I Have Feelings Too*, which will be detailed in the following sections. Inclusive of both temporary and permanent installations, the case studies also illustrate different contexts

of urban situations and geographical locations but are similar in portraying an interpretation of what we could and should do with the public bench.

As playful urban machines, each design precedent was reviewed based on two dimensions (continua), corresponding to their level of 1) disruption and 2) smartness, to create four differing quadrants. Disruption is associated with the subversive nature of play that is found in playful experiences and approaches to design (Huizinga, 1949; Alfrink, 2015; Fuchs, 2018). It is emergent from our initial understanding of smart and playful benches and highlights the extent of how much an urban machine conforms or disrupts public-sitting norms, usage, and regulations. Smartness is derived from the broad topic of urban technology for smart and playable cities (Nam and Pardo, 2011; Calder, 2016; Ligthart and Ramjee, 2017; Nijholt, 2017; Nijholt, 2020; Mosco, 2019; Nagenborg et al., 2021). It depicts the spectrum of interactivity and autonomy that begins with minimal or simple use of technology and increases in sophistication as a design incorporates digital sensory systems, machine behaviour, and autonomous features. Based on this explanation, we would place ordinary public benches at an extreme end of the disruption continuum—compliant and conforming to situated conditions. Referencing the ordinarily recognised, everyday design, full conformance maintains existing human behaviour emerging around the street furniture that we call a public bench. It fulfils minimal ergonomic form to accommodate people sitting in public space without requiring unnecessary effort to perform the action. Its aesthetic qualities clearly communicate essential affordances and do not suggest any other purpose beyond the typical and expected. Moreover, its design conforms to the norms of its primary function for the context of its location—be it at a bus stop, in a park, or around an open plaza. While the usual experiences of a regular public bench are not particularly playful or fun, they are mostly safe, familiar, and appropriate. On the other hand, full disruption describes a public bench that challenges the accepted and known use of the street furniture, questioning its purpose and changing human opinions towards it. Hence, it is a design that goes beyond the basic function and assumed narrative of the object—a sense of defiance against the norms. Its aesthetic qualities introduce peculiar affordances to suggest atypical and unexpected purposes, which change how people perceive public sitting. While the new experiences may be playful and fun, such designs can also feel discomforting, unfamiliar, and risky.

In terms of smartness, the common public bench is also regarded as basic with "*No Technology*" integrated for the purpose of playful interactions. It has no digital augmentation of any kind or playful enhancements of existing activities associated with its surroundings. It is not intelligent and does not respond or react to the presence and behaviour of humans in any way. That said, it represents the baseline in terms of potential for playful redesign with urban technology. Installing "*Simple and Mechanical*" functions into a public bench, we then enhance existing activities of the street furniture or introduce new features that inspire playful human behaviour. At this technological level, specific parts of the public bench structure are made movable, adjustable, or reactive with materials, gears, and actuators. The components can be electronic and programmable, but the circuitry and mechanisms remain simplistic and operate on minor use of digital technology. Finally, smart, playful public benches can be described as "*Sensory and Interactive*". Embracing creativity and complexity in system design, these benches may be built with a combination of mechanical and digital features but are distinguishable by their adaptive capabilities for programming machine behaviour and content changes via digital means. They are also highly responsive to the presence and actions of humans through integrated sensors and devices. As we progress towards AI and machine learning, the public bench can also be redesigned as an intelligent and expressive urban machine with multi-functional roles and unique personalities.

Having established an understanding of smartness and disruption, we can categorise the case studies across four quadrants (see **Figure 3**):

4.1 Simple, Mechanical, and Conforming

Representative examples of the playful public bench are *The Porch Swings*[16] and *Why Sit When You Can Play?*[17]. In this category, the street furniture preserves key aspects of the common public bench while having new features that either complements the primary function of sitting or incorporates optional playing activities. The use of technology is also generally minimal or predictable. Despite being a combination of bench and swing, *The Porch Swings* adds pleasure and ease to the sitting experience by seeking to replicate the enjoyment of swinging on a front porch. Although *Why Sit When You Can Play?* has a different aesthetic shape and form, users can simply choose to sit and not play with the musical xylophone seats. Thus, playfulness is rather limited to the physicality of the public bench, with its design implying a natural association to safer, reasonable experiences that cater for the surroundings.

4.2 Simple, Mechanical, and Disruptive

Representative examples of the playful public bench are *Bench Go Round*[18], *2toTango*[19], and *Interactive Bench*[20]. In this category, the street furniture defamiliarises key aspects of the common public bench to encourage playful behaviour in a situation where sitting becomes secondary to playing—some users might even visit the public bench for the sole purpose of playing rather than sitting. The use of technology (with mechanical and electronic components) is essential but not complex. The physical construct of *Bench Go Round* and *2toTango* bear greater resemblance to their inspired form of a merry-go-round and seesaw respectively, which prompts usage and activities of play related to associated affordances. Likewise, *Interactive Bench* depicts a broken public bench and reinvents the act of sitting into an invitation to connect the bench slats and trigger music. Building on a creative
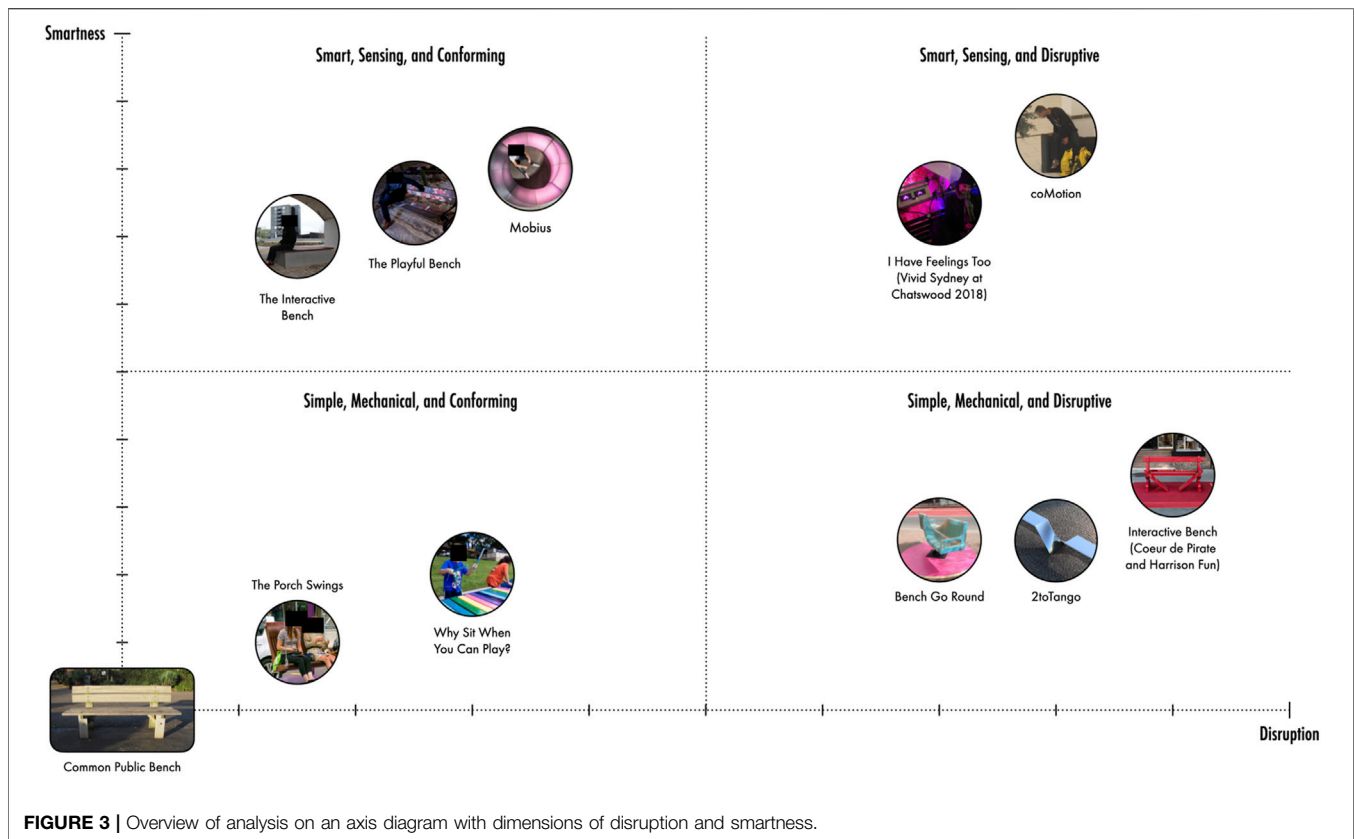
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[16]https://www.universitycity.org/blog/porch-adds-custom-swings-gehl-studio.

[17]http://www.theurbanconga.com/whysitwhenyoucanplayftl.

[18]http://www.georgezisiadis.com/bench-go-round.

[19]https://www.core77.com/posts/67085/This-Seesaw-Inspired-Bench-Takes-Two-to-Tango.

[20]https://robocutstudio.com/portfoliopage/musical-bench-coeur-de-pirate/.

FIGURE 3 | Overview of analysis on an axis diagram with dimensions of disruption and smartness.

interpretation of public sitting, the playful experience can occasionally be awkward and embarrassing, yet remains sufficiently light-hearted and enjoyable for the context of its location.

4.3 Smart, Sensing, and Conforming

Representative examples of the playful public bench are *The Interactive Bench*[21], *The Playful Bench*[22], and *Mobius*[23]. In this category, the public bench design balances between being a street furniture and an urban machine. It generally fulfils the usual expectations of public benches but also advances existing designs with new changes bespoke for the context of different locations. Digital technology and sensory systems are also integral in facilitating playful interactions that do not strongly interfere or interrupt public sitting. Without drastic changes to the overall form of a common public bench, *The Interactive Bench* utilises the existing human motion of sitting to trigger and control localised soundscapes and music. Similarly, *The Playful Bench* allows people to use their movements to play games that are projected as light visuals on the public bench. Redesigned with new shape and form, *Mobius* displays enhanced visual aesthetics with integrated light patterns that respond to vibrations. While it pushes the boundaries on what is acceptable, the smart and

conforming public bench remains focused on providing a sufficiently comfortable sitting experience and injects a sense of cohesiveness and inclusion into the identity of places.

4.4 Smart, Sensing, and Disruptive

Representative examples of the playful public bench are *I Have Feelings Too* and *coMotion* (Grönvall et al., 2014a). In this category, the design skews toward creating an urban machine and is less concerned with preserving the nature of the street furniture type. It might fulfil the basic expectations of public benches as an urban object for sitting but quickly demands the attention of users to play with the urban machine. Although they are not fully subversive of the usual shape and form identified with the conventional street furniture, *I Have Feelings Too* and *coMotion* prioritise playful social interactions (over sitting) with and among people, which might be meaningful but not necessarily desired by users. Pushing towards smarter designs with digital systems, both examples redefine public benches as becoming artificially alive and active; the former using anthropomorphic emotional expressions and the latter shape-changing via programmed machine behaviour. Instead of being homogeneous and stereotypical, those examples also convey divergent concepts with sophisticated, intelligent, and learning designs. With the potential to develop unique character and personality, the smart and disruptive public bench is provocative and may evolve alongside its surrounding environment to shape the identity of places.

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[21]https://interactivespaces.dk/the-interactive-bench/.
[22]https://sunep.net/the-playful-bench.
[23]https://www.makingworks.com/mobius.

FIGURE 4 | Victoria Avenue Mall, Chatswood, during regular days. *Left:* The mall in the evening. *Centre:* Pre-existing public benches around the mall. *Right:* Pop-up food stalls during weekly night markets.

Although we are analysing the examples based on the context of their design and deployment, it should be noted that conformance and disruption are more evident in specific circumstances and remain subjective to individuals. The playful but disruptive public bench meant for a temporary, public festival might seem out-of-place and confusing for users in a permanent, everyday situation. On the other hand, a conforming, subtle form of playful street furniture in a mundane environment would be more preferable to emphasise key features that enhance daily activities. In a public setting, playful experiences can also be influenced by our preferences when playing, and how we think others are judging our actions in a social context. Hence, in the next section, we examine the playful public bench in a real-world situation to explore human behaviour when people interact with a smart, sensing, and disruptive urban machine.

5 CASE STUDY: I HAVE FEELINGS TOO

During Vivid Sydney at Chatswood 2018, we deployed *I Have Feelings Too* as a concept-driven prototype at Chatswood Mall (also known as Victoria Avenue Mall) in the suburb of Chatswood, Sydney, Australia (see **Figure 4**). Connecting various shopping malls and landmarks within the vicinity, the location consists of a wide pedestrianised street with storefronts along both sides and restricted vehicular traffic. With people moving to and from a nearby transport hub interchange, the overall street mainly functions like a thoroughfare, with some sections viable as plazas or gathering spots for human activities. Across the entire stretch of urban space, there are regular pockets of a sitting area with concrete and wooden benches for the general public to rest and relax. When seated in those areas, most people lingering at the pedestrian mall are observed to be eating, reading, using their mobile devices, or people watching while waiting for a meet-up. For the Vivid Sydney festival 2018 program, the local council included numerous installations and a junkyard-themed night market at the pedestrian mall. With a concept that builds on existing public benches and situated human activities, *I Have Feelings Too* was implemented within the junkyard market amongst curated scaffolding and makeshift store tents. Since the event lasted around 3 weeks, the installation focused on a temporary design that was seemingly an extension of the public

bench with detachable components, as opposed to modifying the physical bench permanently.

5.1 Concept-Driven Prototype and Technology Probe

As a concept-driven design, *I Have Feelings Too* explored the possibilities of humanised urban machines in the playable city through the redesign of public benches for playful interactions. It was inspired by the developing discourse of AI for smart cities (Allam and Dhunny, 2019; Kirwan and Zhiyong, 2020; Ullah et al., 2020; Cugurullo, 2021) and expanded on the growing potential of street furniture for digital placemaking (Tomitsch et al., 2015; Stokes et al., 2021). The concept is built on 1) the anthropomorphic approach extensively applied in human-robot interaction (HRI), 2) the personification of voice assistant with speech interfaces, and 3) an understanding of playful learning as part of machine behaviour development. It seeks the advantages of anthropomorphized technology to establish an emotional connection when humans socially interact with robots and machines (Cid et al., 2014; Lee et al., 2018; Salles et al., 2020). It also acknowledged the simple use of personified voice as an effective way for machines to communicate with children, parents, and the elderly across different circumstances (Yarosh et al., 2018; Kim and Choudhury, 2021; Poushneh, 2021). The concept was designed as an ideal of a playful, anthropomorphized public bench: emotional, talkative, and integrating AI with sensors and a voice system, which constantly learns to develop its personality—in sum, a smart, sensing, and disruptive urban machine that engages in conversation with users and becomes an expressive, social entity of a place.

In comparison to the ideal, we constructed *I Have Feelings Too* as a high-fidelity urban prototype mixing interactive and wizard-of-oz (Dow et al., 2005) features for the large-scale light festival. To serve the purpose of a technology probe (Hutchinson et al., 2003; Boehner et al., 2007), the goals of the prototype were to gather information about users and use of an anthropomorphized bench in the wild, field-test an abstraction of a learning machine that processes questions from users to evolve its personality and further elaborate our speculation of playful urban machines. In contrast to its ideal concept-driven design, we also made concessions to improvise our lack of access to specific technology and cater for the requirements of the festival (see **Figure 5**). Augmenting three existing public benches situated at

Design Type	Ideal Concept-driven Design	Urban Prototype as Technology Probe (Deployed in the Wild)
Design Implementation	Redesign of a public bench with in-built anthropomorphic features, sensors, and speakers.	Augmentation of three existing public benches with modular attachments and plug-in speakers.
Sensory Input	Combination of sensors (motion, sound, and image) working together to function as the sight and hearing of the urban machine.	Cameras to detect human movements and presence at the public bench via blob tracking with computer vision.
Visual Output	High-res digital display with wide range of generative eye expressions and visual icons.	Low-res LED matrix with pre-programmed eye expressions mimicking text-based emoticons.
Voice Output	Spoken answers and verbal expressions (real-time and responsive) are provided through speakers. Urban machine voice changes accordingly to match its current emotion, expression, and personality.	Spoken answers and verbal expressions (pre-recorded and pre-programmed) are provided through speakers. Voice-changing software was used to generate a robotic voice output with varying level of pitch to represent three extreme emotion types — joy, annoyance, and sadness.
Interactivity	Combination of sensor inputs would allow machine to constantly receive a variety of data from human activities occurring in its surroundings. With visual and speech interface, the machine would then converse with users by telling stories, answering questions, cracking jokes, and making comments based on its current emotion, personality, and the surroundings.	Camera input tracks movement and distance to determine which pairing of pre-programmed visual and voice expressions are visualised and played back for users. Each public bench has three pre-programmed states; **Standby** (moves eyes randomly with periodic comments about surroundings when there is no one), **Greet** (looks at the general direction of user and greets the person when someone is detected), and **Converse** (displays emotional eyes and cycles through voice responses when user lingers at bench).
Learning machine with developing personality	The urban machine would begin with an initial set of training data to mimic a preferred range of human emotional expressions and personality traits for deployment onsite. After it has been deployed, the machine will learn from its interactions with users and exposure to surrounding activities, resulting in an evolving personality with increased variety of responses and conversations.	Each public bench begins with a fixed extreme emotion that dictates their initial personality type and interactive voice responses (of likes, dislikes, and conversations). As part of simulating a learning machine, the personality of each public bench evolves with new voice responses added twice a week by designers, which were based on observations of human behavior during festival, feedback collected from survey conducted, and real-time weather conditions.

FIGURE 5 | Comparing key differences between our ideal concept-driven design and the urban prototype deployed.


FIGURE 6 | *I Have Feelings Too* deployed at Chatswood Mall during Vivid Sydney 2018. *Left:* The three anthropomorphized public benches. *Centre:* A user working at the joyous bench. *Right:* The gloomy bench further decorated during a stormy winter evening.

Chatswood Mall, the installation featured extreme personas of joy, annoyance, and sadness for each bench (see **Figure 6**). The prototypes detected the movements of people by using cameras (as sensor input) and created sound through hidden speakers (as voice output). Digital eyes were also implemented with low-res LED matrices (as visual output), pre-programmed to match voice output, so that the benches would react to human presence with a combination of audiovisual responses. In doing so, our goal as designers was to create a social situation enabling the previously inanimate street furniture to voice their thoughts and emotions through spoken words and audio manipulation of the pitch.

Although our prototypes did not incorporate an actual AI, we simulated the process of learning for the machine by manually collecting, processing, and generating voice responses for each public bench. An initial set of verbal expressions was created based on the context of the location and festival, and later expanded with additional responses throughout the event. Through usage documentation, feedback gathered from users, and environmental conditions, the personalities of the public benches developed specific likes and dislikes based on their emotional characteristics to communicate responses about people, place, and activities:

- *Joy*—The joyous bench was always happy and enjoyed the company of humans. With eyes representing the text-based emoticon of joy ˆ_ˆ when users were up-close or seated, this bench greeted visitors warmly with an excited "*Hello there!*", asked them "*How is your day?*", and remarked: "*Cow & the Moon has the best ice-cream!*". Overall, the joyous bench uttered 15 different voice responses, expressing how much it liked being a bench, befriending people, and taking selfies, among other things.
- *Annoyance*—The annoyed bench constantly declared its irritation and dislike for many things. With eyes representing the text-based emoticon of annoyance -_- when users were up-close or seated, this bench greeted visitors coldly with a displeased "*Hello.*", asked them "*Do I have to talk to you?*", and complained: "*People annoy me!*".

FIGURE 7 | Understanding user behaviour through the stages of playful interactions.
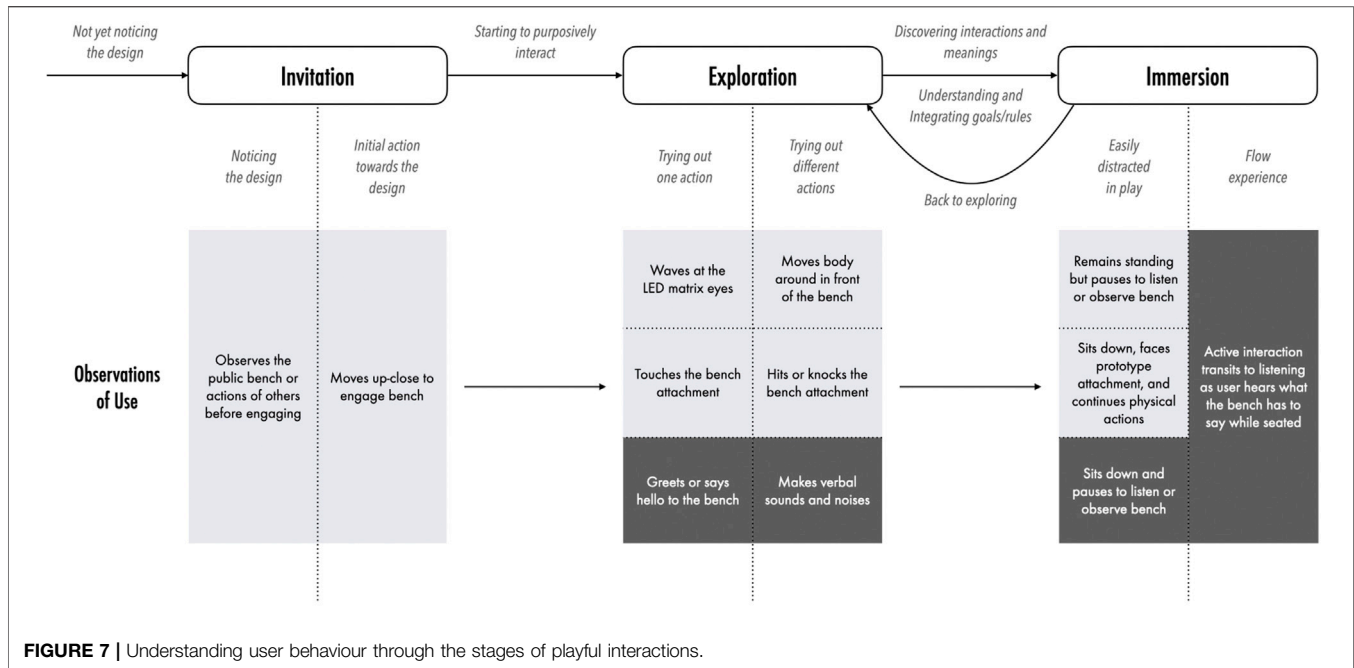
Overall, the annoyed bench uttered 14 different voice responses, expressing how much it disliked crowds, noise, rain, and being a bench, among other things.

- **Sadness**—The gloomy bench perceived the world as hurtful and depressing. With eyes representing the text-based emoticon of sadness u_u whenever users were up-close or seated, this bench greeted visitors with a melancholy tone "*Hey there.*", told them "*I feel so sad.*", and lamented: "*No one loves me.*" Overall, the gloomy bench uttered 15 different voice responses, expressing how people kept hitting and yelling at it, how lonely it felt, how it would like to befriend people on Facebook, among other things.
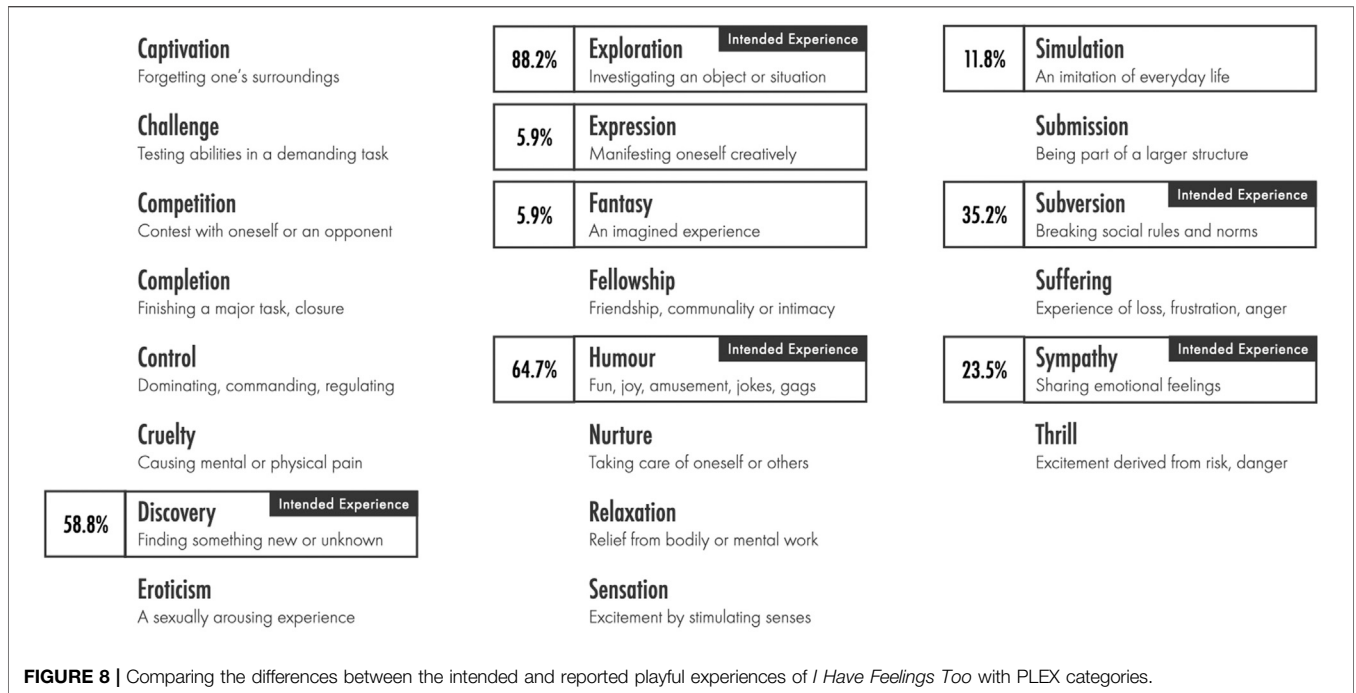
5.2 In-The-Wild Data Collection

Across the duration of the festival, *I Have Feelings Too* was active and running for 22 out of 23 evenings, with a power outage at the night market during an evening that prevented the operation. From Mondays to Thursdays, the installation was activated between 5.30 and 10 pm, while it ran till 10.30 pm on Fridays and weekends. This added up to 104.5 available hours for data collection. For the purpose of our observations, we had at least one researcher onsite for 14 evenings (observing for about 3 h per evening), comprising of various weekdays and weekends, which totalled to approximately 42 h. The entire process was primarily conducted with observation note-taking and focused on human activities across the three activity spaces of *Peripheral awareness*, *Focal awareness*, and *Direct interaction* (Brignull and Rogers, 2003), relative to the augmented public benches. Using photos as secondary visual data to complement the written observations, we recorded how people approached the installation, their exploratory behaviour, recurring attempts of interactions, and verbalised speech towards the benches (if any). We observed positioning and bodily movements during interactions and noted how the affordances of the anthropomorphized benches supported or limited playing.

We also conducted 17 onsite surveys with individuals (either alone or part of a group) to collect feedback on user experience and gather content input to generate new voice responses for the public benches. To cater for possible reluctance to participate from festival-goers, we restricted the length of our surveys to a mixture of only four multiple-choice and two open-ended questions. Each survey was done immediately after a user had interacted with the installation and was leaving the location. Fridays and weekends were preferred for conducting surveys as those days had larger crowds. The survey included questions about the 22 Playful Experience (PLEX) categories (Lucero et al., 2014), thoughts regarding interactions with the installation, and what users would ask the anthropomorphized public benches in a conversation.

5.2.1 Observations of Use

The most basic form of the public bench as a street furniture provides seats to people as they relax, communicate, or partake in other associated activities. However, *I Have Feelings Too* is a prototype of the smart, sensing, and disruptive urban machine, which deems sitting as merely one of the actions triggering machine responses. In our analysis of observation data, we sought to identify common themes of playful user behaviour that were different from or disrupted the behavioural norms of public sitting. When seated and/or interacting with the urban machine, users were given an unspoken permission to freely participate in a lived experience that is distinct from the ordinary, mundane usage of street furniture. Inside the invisible boundaries that form the *magic circle* of play (Huizinga, 1949; Tekinbas and Zimmerman, 2003), they can explore with their movements or actions and attempt to converse with the public bench, yet, all the while, keep an open mind about embarrassing themselves during the process of playing. With the play lens outlining the stages of playful interactions (Bekker et al., 2014), we grouped similar acts

FIGURE 8 | Comparing the differences between the intended and reported playful experiences of *I Have Feelings Too* with PLEX categories.

of use and mapped our observations against each stage of *Invitation*, *Exploration*, and *Immersion* to breakdown but also structure our findings (see **Figure 7**). From this perspective, it is clear that the first stage of *Invitation* begins with how people make sense of the anthropomorphized benches and their augmented features—either by observing them or other users around. This quickly translates into direct interactions as a person approaches one of the benches and enters the next stage of *Exploration*, triggering responses with numerous types of behaviour. After experimenting with a series of actions, the user eventually arrives at the stage of *Immersion*, where direct physical interactions decrease and the actions transit into listening. Although our analysis of findings through the play lens provided a coherent overview and logic of human behaviour, we note that exploratory actions are not always organised and sequential in the chaos that comes with playful interactions. From the listing of six actions identified (in *Exploration*), users have been observed to engage the benches with any combination of behaviour and develop a preference for one or more actions in their interactions. The same chaos persists as users remain immersed inside the magic circle surrounding the installation, with different actions performed alongside listening as a way of multi-tasking in the flow between exploring and immersing.

Acknowledging that the anthropomorphized benches merged the affordances of both street furniture and urban machine, we observed that the social norms of public benches remained when people were playing: users generally avoided interacting with any bench that had occupied seats, unless sufficient sitting was vacant for more users. However, if everyone was standing and facing the bench while playing, interactions from multiple strangers with a bench at the same time were considered acceptable and appropriate. Furthermore, in our analysis, we found a pattern

of human behaviour (highlighted with darker grey boxes in **Figure 7**) that emerged as a possible variant of *playful sitting* for urban machines. Unlike the other case studies considered above, this variant of playful sitting requires users to participate verbally and listen to the urban machine while seated. Although our findings reflected the preliminary state of our prototype and only presented a snippet of actions indicating the beginnings of a conversing behaviour, they were aligned with the intentions of our concept-driven design with speech interfaces and real-time conversations for the public bench. Directing the focus of interactions away from the moving physical body or the sensations of active sitting, playful sitting could be achieved through the core activities of talking and listening by both humans and machines. In these circumstances, playfulness is found in the novelty and laughter of socially interacting via storytelling, jokes, pranks, and light-hearted banter. Similar to urban projects of chat benches[24] where people could seek a good conversation with one another, this approach to playful sitting through urban machines would reinforce the notion of public benches being a social resource and a place for people to belong.

5.2.2 Experiences of Users
In general, *I Have Feelings Too* also aimed to be a playful design aligned with the concept of ludic engagement (Morrison et al., 2007; Gaver, 2015), which seeks curiosity and ambiguity as desirable qualities of user experience. From our observation findings, the installation clearly gave users a sense of freedom that does not overly enforce an approach of fixed interactions and offers sufficient room for personal interpretations and uses. It

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[24]https://www.collaborativenewcastle.org/news/happy-to-chat-benches/.

appropriated the affordances of the public benches to "*support social engagement in ludic activities*" and "*allow the ludic to be interleaved with everyday utilitarian activities*" (Gaver et al., 2004, p.14). Utilising the PLEX categories, the ideal concept-driven design of *I Have Feelings Too* would provide *Discovery*, *Exploration*, *Humour*, *Subversion*, and *Sympathy*. Nevertheless, we expected users to report their playful experiences with some disparity in accordance with the technological limitations of our prototypes. Comparing intended against reported experiences (see **Figure 8**), the most selected PLEX category was *Exploration* at 88.2% (15 out of 17 users). This was followed by *Humour* at 64.7% (11 out of 17 users) and *Discovery* at 58.8% (10 out of 17 users). On the flip side, the remaining PLEX categories of *Subversion* and *Sympathy* were lower with 35.2 and 23.5%, respectively. Based on user feedback, we can derive that the installation was sufficient as an exploratory prototype of playful urban machines in public space. Users found the anthropomorphized benches humorous to an extent; however, almost half of them did not perceive the prototype to be a design of discovery. As for the less favourable statistics of *Subversion* and *Sympathy*, we can also infer a correlation between some of the simulated technology (such as AI, speech recognition) and the lack of specific playful experiences. However, more research is required to validate this hypothesis, namely that an increase in technological complexity of disruptive, real-time machine responses with emotional personalities would produce more profound experiences.

6 DISCUSSION

The insights above reveal the extensive scope of urban machines in smart cities, with recent trends on public bench augmentation and/or redesign suggesting greater potential for this street furniture type to support playful placemaking through AI and robotic functions. As a technology probe, *I Have Feelings Too* explored the design space of an anthropomorphized public bench inspired by machine learning and speech interfaces for playful, social interactions with humans. It was also an urban prototype that presented an example of the smart, sensing, and disruptive urban machine—testing a working model at use in a public situation and understanding the nuances of disruption for people using public benches. Our findings endorsed the validity and possibilities of future urban machines as players and co-creators of places.

6.1 Other Learnings and Constraints
There is an underlying expectation that anthropomorphized benches are still meant for sitting, with any additional usage dependent on affordances created by incorporating urban technologies into the street furniture. Without any instructions or support from other features, a public bench simply redesigned with a speech interface lacks the intuitiveness and would be incomplete as a smart, sensing, and disruptive urban machine. The inputs and outputs of verbal speech are less obvious and invisible for users during interactions, which need to be directed, logical, and timely. With an anthropomorphic form and visibility

of some in-built components (such as the digital displays and speakers), a secondary but familiar layer of physical affordance is added, differentiating the urban machine from ordinary public benches. As apparent with *I Have Feelings Too*, the inclusion of computer vision (or motion sensors) to track movement would also expand the depth of interactions beyond human voice and enable a more natural flow of playing from approach to sitting and conversing. Therefore, the public bench would know when someone arrives, dwells at the space, or leaves, which, in turn, determines when it should greet, be playful, and stop talking.

Besides interactivity between humans and machines, our case study also suggested opportunities for interactions among machines as part of playful experiences in public space. Since we were able to implement three anthropomorphic public benches in close proximity, the overlapping commentary from each bench also formed an incidental conversation between machines when the benches gave verbal responses about similar topics at the same time. Mentioning ice-cream from a food stall behind them or declaring their love/hate for people, the situatedness of the conversations resulted in serendipitous moments hinting that the benches might be gossiping or passing remarks about the people around them. From the perspective of a user, such occurrences are akin to being in the middle of a playful dialogue or comedic exchange. With elements similar to theatre improvisation (or improv), this scenario points to a possible future where the human could join a group of urban machines in a seemingly spontaneous yet collaborative effort to generate playful narratives of city life. Although it was not intended as part of our study, this form of interaction would also broaden the social dynamics around public benches to include a different form of co-creation.

Nevertheless, we acknowledge that the context of our case study does restrict our understanding of user behaviour and associated activities. The conditions of the public festival implied an inherent willingness and playful mindset of people to participate and interact with our prototype. In contrast to everyday experiences, the willingness of festival-goers to tolerate and enjoy disruption by the anthropomorphized public benches is much higher. Hence, our findings are centred on uncovering the types of actions and experiences that are divergent to the norms of public sitting and did not measure attractiveness and desire of use. Considering these constraints, *I Have Feelings Too* is only one example of what could be done for its specific urban situation, but at the same time, probes into the reactions of people to further an initial discussion on the future of this design space.

6.2 Towards Urban Machines as Player and Co-Creator
Through our analysis of case studies, we utilised the mapping of quadrants to position and communicate our concept-driven design as it illustrates the potential of urban machines developing playful personalities and portraying humanistic attributes. Representing a smart, sensing, and disruptive design, *I Have Feelings Too* advocates a complex use of technological means to facilitate playful and expressive experiences. It also seeks playability through adaptive content
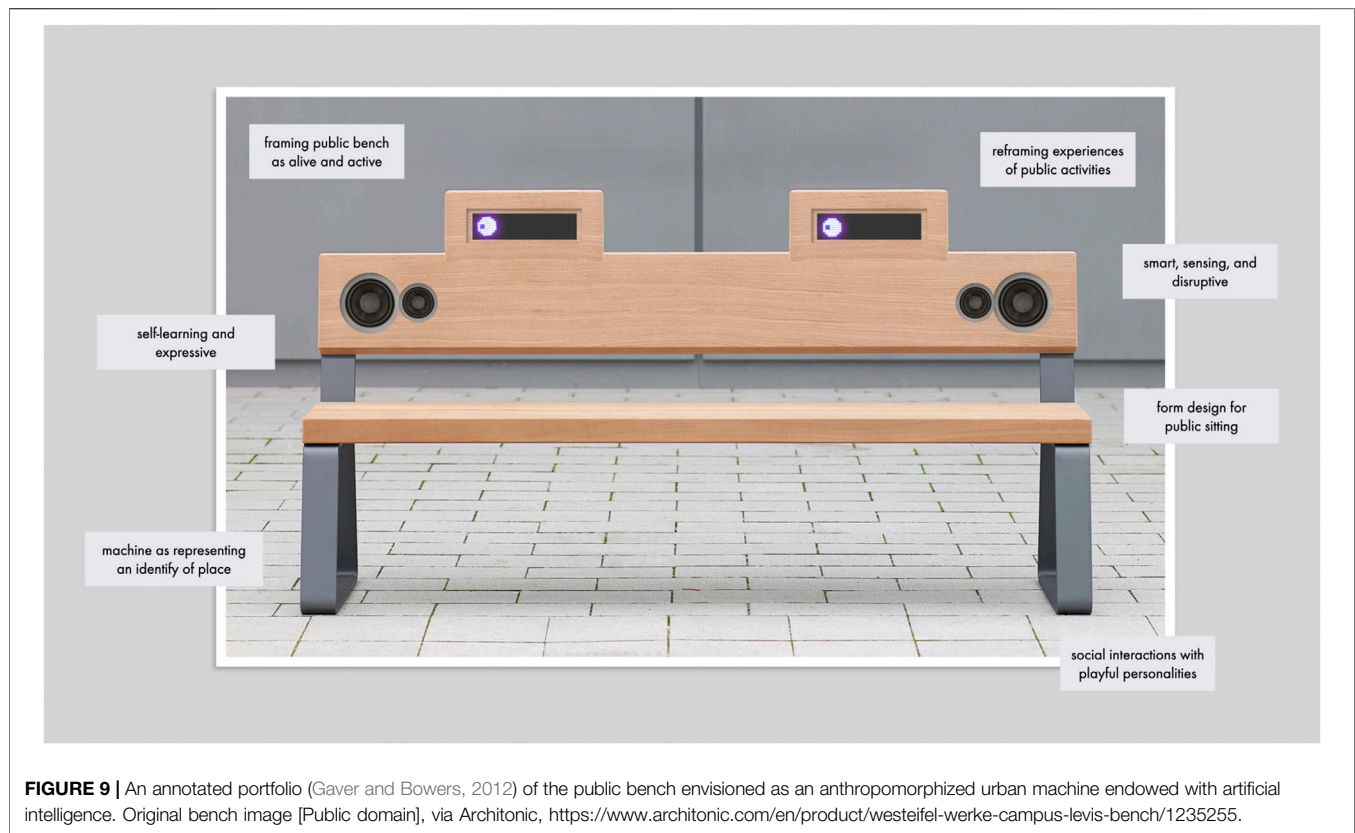
FIGURE 9 | An annotated portfolio (Gaver and Bowers, 2012) of the public bench envisioned as an anthropomorphized urban machine endowed with artificial intelligence. Original bench image [Public domain], via Architonic, https://www.architonic.com/en/product/westeifel-werke-campus-levis-bench/1235255.

changes and intricate interactivity with further potential for more advanced updates of its computerised system. In a possible world where the ideals of *I Have Feelings Too* are actualised, we speculate that leaps in the advancement of AI, machine learning, and robotics would rapidly progress the evolution of street furniture into urban machines. Redesigned with an anthropomorphic form, the public bench retains the existing affordance of its street furniture type and still provides the basic function of sitting with its overall structure. However, it also redefines established norms of design to include speakers, motion sensors, and speech interfaces, thus drastically changing user attitudes toward the public bench by giving it human-like features such as voice, sight, and hearing. Challenging our acceptance and understanding of an intelligent, learning, and personified public bench, the concept is disruptive by nature with its aesthetics, functions, and introduction of unusual social interactions in cities (see **Figure 9**).

Exemplified by our urban prototype (as a speculative artefact), public benches designed as learning and expressive machines also cease to be part of the background setting in a city filled with common urban objects and pervasive digital screens. Instead, they stand out as talkative, strange, and even annoying at times. Like humans, the personality of each public bench is unique with developed likes and dislikes, which constantly evolves to the circumstances surrounding its location. Regardless, the concept outlined by *I Have Feelings Too* postulates all personified public benches as players of the smart and

playable city. They are meant to be artificial companions of individuals and groups as playful entities of places. Predominately known for their capabilities to engage users in playful, social situations, the public benches would converse and play with humans and also encourage strangers to interact with one another while the street furniture serves as a mediator. Hence, the smart and playful public bench is no longer just a utility—it becomes an object of entertainment, a platform for expression, and a symbol of local culture.

Looking ahead beyond existing designs of public benches with dual functionalities of utility and play, *I Have Feelings Too* can also be envisioned as a future concept that positions urban machines to be co-creators of playful experiences in public spaces. From the perspective of placemaking with playful interactions, this notion of co-creation (Eggertsen Teder, 2019; Šuklje Erjavec and Ruchinskaya, 2019; Mengi, 2020) can be understood as a partnership or a collaboration between stakeholders with shared responsibilities in the process of making play. Since intelligent, learning, and personified public benches would be artificial, spatial entities that are representing the identity of places, they are also inevitably a "*Playmaker*" and a stakeholder of public space (see **Figure 10**). Learning from playing with humans while cultivating human-like features based on the changing landscape of its surrounding environment, urban machines will make play by automatically generating new personality traits, emotional expressions, and verbal responses for playful interactions. They may rewrite city
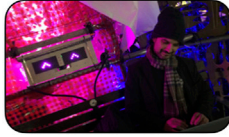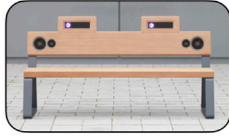
FIGURE 10 | Comparing key features in the evolution of the public bench into an urban machine representing as a player and co-creator.

stories, create new jokes, and try different pranks in order to expand their arsenal of playful activities. Alternatively, urban machines can also be programmed in ways that are not solely dependent on learning from how humans play. Beyond our concept-driven design with public benches, new genres have emerged with shape-changing interfaces and urban robots with examples like coMotion (Grönvall et al., 2014b) and Woodie (Hoggenmueller et al., 2020). Instead of us playing with them, these machines add playfulness to city life as spatial entities with their own behaviour in how they play humans and shape public situations.

As machine learning with AI progresses in the future of cities, the role of urban machines will shift from playthings for humans to active co-creators of play. Real-life urban machines for playful placemaking can develop localised personas and new narratives through their interactions with people and establish unique identities that are inherent to the overall atmosphere of a place. An urban machine can be supportive of existing urban practices and function as an entertainer to enliven an underutilised space by drawing crowds with performances. It can also be highly disruptive towards the mundane of social norms and transform into the neighbourhood prankster, pesky but memorable in its need to be the centre of attention via interactions with humans. With an appropriate fit of form, function, and meaning, the relationship between technology and cities is once again redefined, as the machine becomes the active agent molding public experiences to be personal and meaningful, changing a foreign space into a place of belonging.

7 CONCLUSION

In the context of the playable city, we sought to understand how the ordinary public bench could be repurposed and reframed as an urban machine for playful placemaking. Through a comparative study of design precedents and informed speculation, we analysed key examples of public benches that exhibited degrees of smartness and disruption through the lens of play. As smarter technology is embedded in public benches, more opportunities open up for technology-enabled playful transformations. In the examples we analysed, the intention of the designer was key to understanding how disruptive or conforming a specific design was, although the evolving urban context and user appropriation can also influence human perception and behaviour.

The notion of the urban machine is useful here to capture the growing agency of emerging technologies, in particular artificial intelligence. Our concept-driven prototype and speculative artefact, *I Have Feelings Too*, goes some way towards exploring a smart, sensing, and disruptive urban machine that is designed to be playful. Whilst not being a truly functioning AI, as a technology probe it gave us insight into how people might react and interact with a social group of anthropomorphic street furniture that communicates through emotional and verbal expressions.

Beyond the support of playing activities for humans, complex urban machines can be developed to display the playful nature inherent to sentient beings. As such, urban play designs are no longer limited to humans as primary players or activators of playful interactions. Instead, urban machines can act upon humans by being playful themselves to refresh novelty and

inspire participation, thus expanding on their potential to partake an increasingly active role as future co-creators of play in the cities of tomorrow.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by The University of Sydney—Human Research Ethics Committee. Written informed consent to participate in this study was provided by the participant's legal guardian/next of kin. Written informed consent was obtained from the individual(s) for the publication of any potentially identifiable images or data included in this article.

AUTHOR CONTRIBUTIONS

LC is the lead author, with LH and LL being the second and third co-authors, respectively.

ACKNOWLEDGMENTS

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