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Document Version
Final published version

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Citation (APA)
Lupetti, M. L., & Cila, N. (2019). Envisioning and Questioning Near Future Urban Robotics. In S. Colombo, Y. Lim, M. B. Alonso, L.-L. Chen, L. Feijs, J. Hu, L.-L. Chen, T. Djajadiningrat, S. Kyffin, E. Özcan, L. Rampino, E. R. Ramirez, & D. Steffen (Eds.), *International Conference on Design and Semantics of Form and Movement* (pp. 78-86). (International Conference on Design and Semantics of Form and Movement). https://doi.org/10.21428/5395bc37.d44e2913

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Envisioning and Questioning Near Future Urban Robotics

Abstract

Robotic services, which have started to appear in urban environments, are going to transform our society. Designers of these robots are not only required to meet technical and legal challenges, but also address the potential social, political, and ethical consequences of their design choices. In this paper, we present a workshop format with its related tools intended for enabling speculation about such possible futures and fostering reflection on potential socio-ethical implications that might support/oppose these futures. We report the results and discussion of one particular workshop case, in which the implementation of two particular robotic services for a city was envisioned and questioned, i.e., surveillance and delivery of goods. By discussing the results, we illustrate how such a workshop format might be beneficial for setting the agenda for a more conscious design of urban robots and orienting future research towards meaningful themes related to the emerging coexistence scenarios between citizens and robots.

Keywords

Future Scenario, Urban Robotics, Robot Capabilities, Robot Implications, Robot Conceptualizations, Design Workshop

1. Introduction

Provided by the advancements in sensor technologies, artificial intelligence, and smart materials, designers now have the opportunity to take on the exciting challenge of working with intelligence as a design material that can be used in form giving practices [1]. The idea of automata, which has been an object of speculation and pretense since the ancient times [2], can now be translated into tangible entities that are autonomous, intelligent, and might behave out of our direct control. The enthusiasm that may characterize this emerging design space, however, often tarnishes the contingent need for understanding how these novel autonomous artefacts and related services are transforming our society, and whether the future we are shaping correspond to our needs and aspirations as community [3]. Attributing reasoning abilities and autonomy to artificial artefacts, in fact, asks not only to meet technical and legal challenges, but also to address the possible social, political and ethical consequences of such a choice. In particular, automation and artificial intelligence need to be addressed and designed responsibly in public environments like cities, which are becoming more and more crucial as contexts for technological innovation [3-4].

The complex nature of coexistence scenarios emerging from the diffusion of these artefacts, hence, point

out the need for systematically envisioning how these near futures might look like. In this regard, the design discipline can play a proactive role by providing methods and tools for supporting speculation about possible futures, fostering reflections on potential political structures that might support these futures, and enabling a more conscious shaping of intelligent and autonomous artefacts [5].

With the aim of embracing this call to action, we present a workshop format developed within the context of the *"Things as Citizens"* research project from Delft University of Technology, as an approach to investigate near future scenarios of coexistence between people and autonomous artefacts in the urban environment. In this paper, we refer to these artefacts as robots, but it may be argued that the same reasoning and investigation may apply also for other autonomous or intelligent artefacts that may not be conventionally considered as robots, e.g. automated traffic lights. Given this intent of encouraging the envisioning of possible near futures and reflecting on recurring ethical dilemmas, a workshop format for "*envisioning & questioning"* was crafted and used in various academic and non-academic events.

In this paper, we report the results and discussion of a particular workshop in which we tackled two robotic services for a city, i.e., surveillance and delivery of goods, with non-experts. By discussing these results, we illustrate how such a workshop format might be beneficial for providing a barometer for the "state of the people" with respect to the practical and ethical considerations of living with robotic services, setting the agenda for future projects and orienting future research towards meaningful themes related to the emerging coexistence scenarios between people and autonomous artefacts in the city.

2. Envisioning and Questioning workshop format

The *Envisioning and questioning* workshop and its related toolkit resulted from a combination of methods and knowledge already familiar in fields like participatory city making, speculative design and responsible AI.

The field of participatory city making includes many toolkits developed for enabling collaboration among different actors, and therefore, was very rich to borrow from. We designed a set of materials (in particular, the Key Interactions Board, Critical Review Board, and Clustering Board) by referring to the consolidated design ideation toolkits meant for envisioning scenarios (e.g. [6-7-8]) and workshop formats for facilitating dialog [9-10] and eliciting values [11-12] among different stakeholders.

We involved speculative design in the customization of the materials and the workshop format to enable reflection. As mentioned earlier, our work is dedicated to the investigation of possible near future cities in which people will cohabit with robots. In particular, we refer to the work of Auger [13], who suggests that a crucial aspect for crafting speculations and dealing with the domain of the possible is to create *perceptual bridges*. These consist in a carefully crafted combinations of audience's perception of the world and the fictional elements, which can be achieved by designing artefacts that are familiar and provocative at the same time. Following the author's suggestion, we crafted our workshop format by analyzing the context of smart cities and its main developments and trends with the intent of building a sense of familiarity and plausibility, and at the same time, we introduced some provocative characteristics in the form of robotic services. In fact, we presented the novel automated services as initiatives of the Rotterdam municipality, which attributes rights and responsibilities to robots.

Finally, the provocative component used for fostering the speculation was defined by current debate and literature about the responsibilities related to the spread of AI and robotics. We examined the current debate about the attribution of rights, legal personhood, and citizenship to robots [14-15-16-17] and employed these as an inspiration when describing the robots in the Things Cards, as well as raised these issues during the discussion phase at the end of the workshop.

The resulting materials and the workshop format, which we refer as *Envisioning and Questioning* workshop, was then used in different contexts, including: education (for supporting a master thesis about an intelligent bike

with agency), an academic conference for facilitating the envisioning and discussion of near future robotics for children (IDC workshop by Charisi et al. [18]); and non-academic conferences for discussing the potential opportunities and challenges of robotic solutions for near future cities (Border Session Lab, The Hague, 2018; Drive Festival, Eindhoven, 2018; ThingsCon workshop, Rotterdam, 2018). In the following sections we report the procedure and results of the last workshop carried out during the ThingsCon 2018 Conference. This particular workshop was selected because of its specific focus on urban robotic services (main interest of the Things as Citizens project) and for the completeness of the documentation.

2.1 ThingsCon Workshop

The workshop was organized as a two hours activity, including an introduction presentation on the theme and practical activities carried out by the participants. In this occasion, the toolkit was customized to envision and problematize two main kinds of robotic solutions that are likely to widespread in near future cities, namely delivery robots and robots for surveillance (Fig. 1). In fact, there are already cases in which these two services are already being tested (e.g., Starship Technologies, Marble, Dispatch, Knightscope).

The proposed robotic services were presented through the Things Cards, containing a description of the robot's tasks and functionalities together with an illustration of the robot. These were introduced as an initiative of the city, which grants rights and responsibilities to these artefacts because of their contribution for the public. By emphasizing rights and responsibilities of robots, we aimed at addressing emerging problems of social roles and possible controversial relationships between humans and robots.

Participants. The workshop was attended by 9 people (7 female; 8 aged under 30). The participants were: 1 professional computer scientist, 1 experienced design researcher, 1 young design professional, and 6 design master students.

Process. The workshop was organized in six main steps:

- *Group formation and introduction to the robotic services.* Participants were invited to split in two groups, where they received a Thing Card describing one of the two robotic services, delivery or surveillance.
- *Ideation of key interactions.* The two groups were invited to think about what might be the key interactions among the robots and people in the city when the robot is seen as a member of the community with rights and responsibilities. Participants were

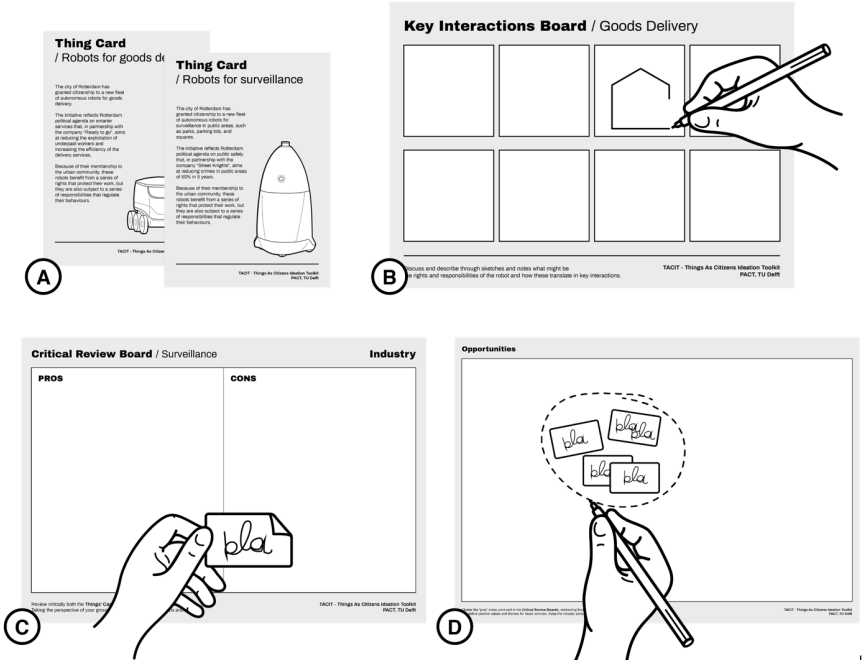

Fig. 1. Workshop materials: (A) Things Cards, sheets with a description and illustration of the proposed robotic service; (B) Key Interactions Board, A4 forms with white boxes for illustrating and taking notes about the possible key interactions and situations related to the proposed services; (C) Critical Review Boards, A3 forms with two sections for pros and cons where participants can put their notes sticking post-it; (D) Clustering Boards, A2 forms where participants were invited to collect and group the post-it about pros and cons and take notes of the emerging topics.

invited to describe their ideas through sketches and notes on the Key Interaction Boards.

- *Presentation and discussion.* Participants were invited to present their ideas about key interactions to the rest of participants who were invited to discuss them.
- *Critical review of the services and interactions.* All participants were invited to review both services and the related ideas of interaction. In this reflection phase they were invited to take notes on Post-its about the opportunities and challenges they could identify in each service, taking the perspective of citizens, industry or government. The Post-its were organized on the Critical Review Boards.
- *Clustering.* Participants were invited to take all the opportunities and challenges and cluster them according to the theme they related to. Participants were asked to abstract the specific notes into more generalizable topics.
- *Discussion and recap.* The reflections emerged during the clustering were summarized by two participants, one for the opportunities and one for the challenges, and the organizers recapped the activity.

3. Results

The materials produced through the ideation of key interactions (Fig. 2), the critical review and the clustering (Fig. 3) were reviewed and discussed both in loco with the participants and a posteriori by the authors with the intent of extracting insights. The two different discussion activities also correspond with the two potential functions of this workshop's results. On the one hand, the participants had the chance of identifying and discussing a series of emerging opportunities and challenges related to the specific cases presented in the workshop. This indicates that the workshop format would be useful for *setting an agenda* for collaborative work to be carried out between the citizens, government, and technology developers (e.g. focused on the actual development of a delivery or surveillance robotic service). On the other hand, the critical review of the results performed by researchers a posteriori was a useful way of generating knowledge for research in the area of responsible urban innovation and design. By interpreting both the explicit results that were reported in the clustering boards and the implicit results encoded in the situations represented in the ideation of key interactions, it is possible to identify meaningful and sensitive topics to *orient future research.*

In the following subsections we report a summary of the topics emerged from the participants' work and reflection, organized and discussed in three macro-themes identified by the authors through their subsequent analysis.

3.1 Data Related (In)abilities

Participants discussed the robots' distinct ability to go to places that humans may not go and see things that humans cannot see, using a large array of sophisticated sensors and processors, which significantly increases their capacity to collect and process personal data. They emphasized how, through these data, companies,

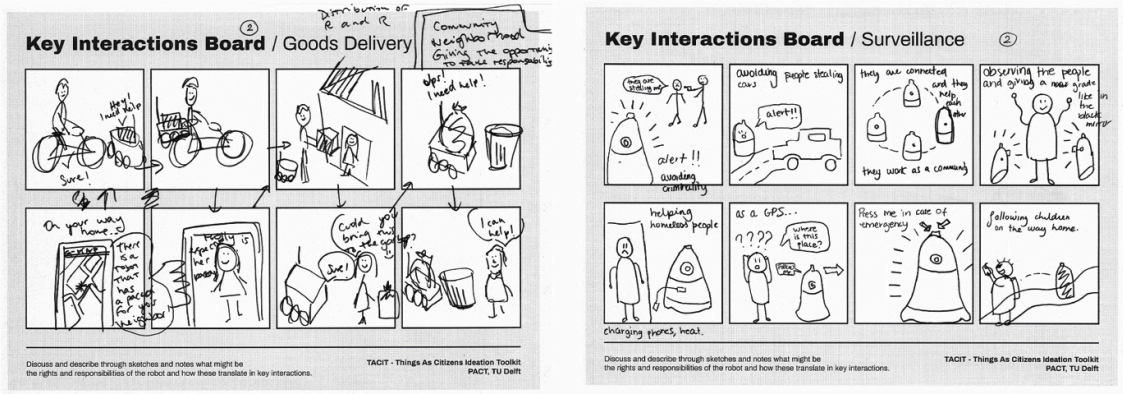

Fig. 2. Results of the ideation of key interactions. On the left: interactions with goods delivery robot. On the right: interactions with surveillance robots. In both cases, participants illustrations show how the robot's role may go beyond its main function and provide additional benefits for people.

Fig. 3. Participants engaged in the clustering phase of the workshop and final clustering boards.

government, and citizens gain new capabilities. For example, surveillance robots may increase the autonomy and independence of citizens. As envisioned during the workshop, children or elderly could be accompanied to their homes while being guarded from security threats by the robot identifying anomalies in its environment. This may provide them greater freedom to move around, knowing that they have a personal guard that will prevent problematic situations.

Despite this opportunity, however, participants largely stressed how such abilities also come with their own challenges, mostly in relation to privacy. Even if the surveillance robots are not meant for law enforcement, they can easily turn into Big Brother kinds of control, not only steering the citizens' activities, but also nurturing the feeling of being observed and evaluated. The participants envisaged situations such as the robot gathering information about citizens from their social media and using it identifying potentially "troublesome" people, the robot observing people and giving them a grade as in the TV series Black Mirror, or the robot anticipating crimes by using prediction algorithms and machine learning. Or given that these robots might well be financed by the governments or particular companies, the robot may be programmed to nudge the citizens into specific "government approved" behaviors. In other words, *the ability that the citizens gain* regarding to mobility may sometimes be *hindered by the "disability" they simultaneously inherit* regarding their privacy and freedom. There could be slippery slope towards authoritarian robotics, which might cause the citizens deliberately avoiding the robot.

Although less controversial, the participants also raised concerns regarding the delivery robots' potential to use the collected data for offering improved services. Functionalities such as face recognition to unlock the robot, detection of customer location for dynamic delivery, access to purchase history for a personalized service, and detection of the customer's age as a security check to deliver the parcel or not, were all envisioned as opportunities for a better service, yet come with the cost of invading privacy. Thus, the question here is whether the increased efficiency in delivery and the improvement of safety are great enough to justify the resulting restriction of the individuals' privacy and liberty.

Another issue that was discussed during the workshop was related to robot networks and flocks. While citizens may think of surveillance and delivery robots as single entities that autonomously operate in the city, it is more apt to think of them as networked devices. They can share the data they collect with other robots or control other smart devices in the city, such as traffic lights or self-driving cars. The participants envisioned scenarios where a flock of robots coordinate their actions to "catch" a criminal. However, if the mechanics of this data exchange is not understandable, it was discussed that the robot-robot communication would alienate and frighten the citizens. Again, the pragmatic benefits of having robots must be balanced against the people's right to data transparency.

These discussions point out how data, which is often referred to as a new design material and loaded with large promises for improved services and human experiences, may actually became a disabler. Especially if associated with the idea of autonomous robots that can roam around public environments, the capability of collecting and managing data can indeed represent a source of discomfort and negative attitude in people.

3.2 Beyond the Tool Paradigm

As expected, the workshop highlighted when designing robots for public environments, such as cities, not only is it essential to make the robot perform its tasks effectively, but also to consider other forms of *interactions that go beyond the mere function.* The robot, in fact, is usually expected to comply with social norms and human habits. What unexpectedly emerged from the workshop, instead, is how such non-task-oriented interactions becomes prominent if the robot is discussed in terms of citizenry relationships. Both in the case of delivery and surveillance robots, participants envisioned and critically discussed possible emerging roles of the robots which, because of their membership to the urban community, are expected to perform some kind of action that we may consider socially relevant. The participants conceived situations that involved positive interactions where people felt responsible to take care of the robots and vice versa, as well as negative ones which could compromise robot safety. In the following subsections, we illustrate two types of human-robot interactions that go beyond the primary robot function: *mutual care and self-defense.*

Mutual care. Participants conceived many situations in which fully autonomous robots ended-up needing a bystander intervention. These situations included robots breaking down, getting stuck, or even being damaged and vandalized by people. In these cases, participants envisioned an active role for human bystander who may intervene if the robot calls for help or even offer their help voluntarily, such as in a scenario where a citizen spontaneously cleans up a robot from spray paint. Interestingly, these "help scenarios" only occurred in relation to the delivery robots. This may be due to the nature of the task of these robots. Delivery robots are a service with an immediate practical benefit to the citizens, whereas surveillance robots would most probably be imposed on them by the government or companies (e.g., shopping malls, airports, etc.) evoking an uneasiness that comes from being observed and judged.

In many of the scenarios that the participants crafted, the robots also "returned the favor" in some ways or provided services that can be seen as forms of care towards humans. For example, participants envisioned situations where a delivery robot carried a first aid kit and contacted police in case of an emergency, or offered to throw trash in the dumpster after making a delivery. Similarly, other participants thought of surveillance robots could help tourists to find a place to stay or help homeless people to charge their phones or provide heat. In these perspectives, the robot becomes a social actor.

Self-defense. The participants also envisioned situations in which robots may be exposed to vandalism and violence, generating a reason for the robot to defend itself, e.g. by contacting security or carrying weapons such as built-in taser shocks. Participants were mostly problematizing the situation in these types of interaction scenarios, rather than taking a positive or negative position. In doing so, they compared the robots with the security officers, who are allowed to carry weapons for self-defense. This comparison raised a discussion that questioned to what extent it is appropriate for the police to have weapons during public demonstrations for example, and if we could expect the same right to apply to robots. But in this case, the participants reflected on whose legal and moral responsibility it will be, if a robot's self-defense action turns out to be harmful for the humans or break the law.

3.3 Practical Advantages vs Socio-Ethical Challenges

The discussions during the workshop stressed the robots' practical potential for improving the human performance in terms of efficiency, reliability, and economy, and therefore, improving the quality of life in urban environments. Nevertheless, both in the ideation and the clustering phase, we noticed how participants were counterbalancing the reflections on practical advantages with discussions on socio-ethical challenges.

The potential practical benefits of the robotic services—such as the opportunity for having more personalized delivery services or reducing risk of violence, crime rate and police budget—were constantly counterbalanced by several concerns. For instance, a recurring concern was that the possibility of having more efficient services might come again at the expense of privacy. A particular discussion was focused on if the delivery robots should know the content of the packages they carry. Some participants considered this to be acceptable in some scenarios, such as when a robot transporting alcohol is received by a minor at the door. Should the robot deliver the contents to him? Or, should it be able to detect the persons' age and decide accordingly? Similarly, the surveillance scenario raised several ethical concerns, especially in relation to the possibility of the robot's misjudgment and false accusations. Some of the participants created scenarios in which the robot pointed at innocent people due to its wrong data analysis algorithms, people misusing the robot (e.g. a person wrongfully accuses a neighbor because of an ongoing dispute), or after being hacked.

In addition to these issues, the participants also pointed out several advantages for companies, such as being exempted from following employee rights and overcoming issues typically related human employees, such as substitution in case of absence or paid leaves like pension, maternity, or holiday. But at the same time, they stressed how these are directly related to prominent issues of partial or complete replacement of tasks currently performed by a human being and consequent job loss.

Furthermore, the physical presence of a robot was also considered to create challenges for the city and impact the physical urban environment. The complexity and unpredictability of public spaces such as streets and sidewalks can cause malfunctions and collisions, the robots can crowd the sidewalks, or the presence of robots can force the city to alter its layout of buildings and roads for more efficient performance.

4. Discussion and Conclusion

The results of the workshop indicated how the format met our dual interest in facilitating the envisioning of possible near futures enabled by emerging autonomous systems, while fostering reflections on potential ethical dilemmas. Both in the ideation and clustering phases, we noticed how the participants' discussions moved from very practical solutions to critical questioning of the possible consequences and controversial situations resulting from having robots providing services in the city. In a very short time frame, the workshop enabled the participants to elicit themes that we can acknowledge as relevant and topical for the current discussion in the fields of urban robotics and technology ethics.

For instance, the participants extensively explored the themes related to human-robot relationships, such as (1) human vandalism towards robots, acknowledged in academia as a crucial issue [19] which can create a barrier to the robots' diffusion in cities [20], (2) the open debate on how far the robots should be allowed to protect themselves from theft or vandalism [21], (3) the robots' ability to perform social rituals as enablers of long-term relationships [22], and (4) possible relationships of mutual care resulting from the social roles played by robots [23].

Similarly, the participants' reflections on the potential implications of robots also recall topics largely addressed in public and scientific debate, such as the potential flexibility and customizability of robotic services as breakthrough solutions for particular contexts (e.g. access to services from very remote locations [24]); or possible negative drawbacks for people (e.g. being subject to monitoring without consent [25], injuries [26], or job loss [27]) which lead to discussions about design protocols to prevent them [21-28].

This effectiveness versus legitimacy dilemma also frequently emerged during the workshop in relation to data and privacy. This is another prominent discussion in the techno-regulation for robotics literature particularly about who is deciding what data is collected, with whom it is shared, the purposes for which the data is processed, and the necessary security measures that need to be in place [21-28-29].

Although most of this discussion covers topics that would be recognized by researchers in the field of

urban robotics, what is particularly noteworthy is that these discussions were not raised by the workshop organizers, but by the participants who were experts in neither robotics nor ethics (although they obviously shared an interest in the topic of the workshop). Thus, the workshop resulted to be a particularly valid tool for enabling a meaningful conversation among non-experts on complex topics. We will continue conducting the same workshop among populations with diverse backgrounds such as social scientists, ethicists, municipal employees and robotics engineers in order to capture an even larger sample of issues that might help identify new directions in the future of urban robotics research.

Furthermore, in our opinion, the workshop can add two additional contributions to the existing debate about near future urban robotics. On the one hand, different from other kind of investigations that often remain on a speculative level, this activity enabled participants to ground their reflections on very practical examples and to situate ethical concerns into daily life practices, rather than extreme situations. On the other hand, through the discussion of controversial situations emerged from the envisioning activity, participants moved from discussions of practical implications to reflections on values and societal implications that go beyond the specific case of robots. As in the case of self-defense which led participants to talk about the appropriateness for police to defend themselves when engaged in public demonstrations, the problem of privacy related to the purchase of particular products such as drugs, and the controversial case of delivering alcohol to a minor and the question of whether it should be a responsibility of the personnel who is performing the delivery to discern if it is appropriate to deliver a product or not.

These two aspects, i.e. reflections grounded in concrete examples and discussions on the socio-ethical implications, summarize the dual nature of designing for near futures with autonomous systems. In fact, also in the three main themes emerging from the reflection on the results, we noticed how considerations of practical opportunities and limitations should constantly be counterbalanced by reflections on the possible socio-ethical impact that the envisioned robotic services might have.

This dual nature, we consider, should be reflected in the designer's approach, through a co-presence of a pragmatic and an idealist mindset. Designers are more and more asked to simultaneously understand and deal with new technological capabilities, reframe the conceptualizations of artefacts and technology, and envision the potential impact of their actions on a both specific and societal level. By embracing these dimensions, designers can engage in a constant dialogue with technical disciplines in order to develop a deep understanding of the potentials and limitations of technology, and with humanities, especially with philosophers and social scientists, in order to abstract from situated interactions towards socio-ethical reflections and questions of values.

Acknowledgements. We thank AMS Institute for partnering in the project, Elisa Giaccardi and Iskander Smit for their supervision of the research, ThingsCon organizers for inviting us to take part in the conference, and Vicky Charissi for her helpful suggestions and support wto improve the workshop format.

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