Value Sensitive HRI

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ABSTRACT

This paper will build a conceptual framework for Value Sensitive HRI, building on work that has considered values in HCI and information science. Value Sensitive HRI is a method based on design principles that consider the interleaved, dynamic, and sometimes conflicting stakeholders' values in human-robot interaction. We discuss how this approach will help design technology that better meets the values of all the stakeholders that surround a human-robot interaction and can even transfer agency from robots to people. We aim to share early insights regarding possible social impacts, identify under-explored real-world approaches and perspectives, and discuss future implementation challenges and guidelines for the shift to Value Sensitive HRI.

CCS CONCEPTS

• **Computer systems organization** → **Embedded systems**; *Redundancy*; Robotics; • **Networks** → Network reliability.

KEYWORDS

Value Sensitive HRI, Value Sensitive Design, Human Values, Agency

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1 INTRODUCTION

In the last decade, we have observed the growth of social robots as agents in society as service providers or complements to human services. We witnessed the insertion of robots into hospitals, restaurants, supermarkets, and a number of other public spaces. At the same time, we have recently witnessed the closure of a few robotic companies and the discontinuation of some robots [2]. This may have been related to expectations for cognition and behavior that matched that of humans, due to the appearance and behavior of the robot [12, 22]

Understandably, robot services have to be robust enough to work in unstructured social contexts such as a hospital or supermarket. At the same time, robots may offer specialized services, making them less relevant beyond a small core user group. However, if robotic services can be adapted to broader numbers of users, consumers, and business owners, the robot's chances of maladjusted service are likely to decrease.

A typical approach to developing robots for complex social settings has been to program them to learn and imitate human behaviors. Instead, we propose to shift agency to humans and provide them the tools to evolve the behavior of their robots. We believe this strategy can accelerate the transfer of human knowledge to robots and let people decide a meaningful rationale for the robot service: why are robots used, with what intention, and what for are robots used?

These questions can be answered by developing a deep understanding of human values and incorporating them into interactions with robots. Values are individual beliefs that motivate people to act in a certain way, which can be intrinsic like love, truth, and freedom, or extrinsic as recognition and approval [31], which can be socially influenced [8]. These values are variables beyond just some tasks that the robot can perform. They should represent the robot's basic behavior adopted accordingly to the people's values. Additionally, values are manifested through interactions with products, and, specifically with older adults, this becomes more critical as they experience a physical, cognitive, and emotional decline [9]. At this stage, adopting or refusing objects depends on how these objects reflect their values and personal identities [9]. In addition, what older adults value can change dynamically, even day to day, as they experience a decline [7]. This mismatch between people's values creates a gap with the robot usage objectives that can contribute to robots being abandoned, when in fact, if well adjusted, they can play a crucial and valuable role. In this way, it becomes relevant that the robot's behavior can be changed at the same pace as the person changes its core values.

However, a vast majority of the work developed in social robotics is based on laboratory experiments in controlled scenarios, a scientific and timely methodology for testing exact variables. Thus, there is a gap between these approaches and the robot's impact on

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people's life values and their ecosystems. Even the roboticists' own values are limitedly discussed in robot development [5]. One of the central values is "physical safety", based on engineering courses' syllabus [5]. Additionally, the values of the robot builders themselves will influence the final behavior [5].

To include people's inputs into a product development effort, researchers commonly use design methodologies that integrate target audiences in the process. A common approach is that of User-Centered Design (UCD), an iterative design procedure [1] that initiates its process with a context identification and understanding of users. After analyzing users' feedback, chosen requirements and design implementations help define the robot [15, 16]. It is a widely used design methodology and responds primarily to utilitarian needs in a given social context. Typically, the social context is defined first, before approaching target users' needs that uncover a robot's functional implementations. This earlier established social context creates a narrow margin for people to decide on values to address with the robot because the robot's intent is already established in the context. If a robot arrives at a social space with a predefined service that does not account for peoples' values, there is less space to succeed. Hence, there has to be a more significant insertion of people as researchers/designers to acknowledge people to extend their contribution beyond a mere participant [14].

Our work gives the first steps by starting exploring older adults' values using robots. We follow the Value Sensitive Design (VSD) approach, a method that inserts morals and values into the technological process stages [11], which has been adopted by multiple research fields. We propose Value Sensitive HRI (VS-HRI), taking UCD a step further by exploring ways to address people's values and intentions by providing people with tools to implement the robot behavior they want to see themselves. This distinction from UCD may seem subtle, but it is profound. The VS-HRI proposes that people's values are engaged before starting by providing agency that allows people to program the robot's behavior and teach it directly. VS-HRI answers the meaning and intention behind the robot usage.

This paper aims to highlight the first steps in defining Value Sensitive Design in the Human-Robot Interaction community and raise awareness regarding bringing out symbiotic benefits for robotic service developers and, ultimately, people who will use the social robots. We pretend to shift to the other side of the deterministic view of technology and shape robots better integrated into users' social values and ecosystems.

2 VALUE SENSITIVE DESIGN

Values are ethical guiding principles that help us navigate life in a purposeful way. Our intrinsic values lead us to the people, actions, and habits that are essential to our life and wellbeing. Being aligned with values helps us make decisions more consciously and assertively, focusing attention on what is important, who we want to be, how we treat ourselves, and how we treat others. Technology helps to shape people's lives, therefore, robots must obey people's values.

Different research areas are adopting Value Sensitive Design approaches namely autonomous systems [30], communication systems [26], artificial intelligence [23, 25], autonomous weapons [27], and robotics [20, 24, 29] showing awareness of the importance of value-sensitive design to make innovative decisions responsibly and ethically. However, it has not been discussed yet in the context of HRI.

As described by Friedman and Hendry, Value Sensitive Design is a method that inserts morals and values into the technological process stages [11], to create responsible innovations. Borning and Muller [4] state that one of the evolutionary points of value-sensitive design is the increase in the voice of participants in the search for values in VSD approaches. This is only achieved through the involvement of people in stages prior to the beginning of any concept or robotic project initiative.

To ensure human values are taken into consideration, Value Sensitive Design uses a tripartite methodology consisting of conceptual, empirical, and technical research. First, the stakeholders and ramifications of the technology are identified. Secondly, empirical investigations with mixed methods are performed to assess how stakeholders evaluate current technology according to their values. The last part cross-examines and explores how technology can be designed to be in alignment with previously accessed values.

3 VALUE SENSITIVE HRI

According to Greek mythology, Zeus is the weather God, controlling rain, clouds, and thunder. Let us look at robotic behavior as the weather on a specific part of the earth with a temperate climate. A temperate climate means mild weather. People living in these areas expect to have rainy days and also sunny days, but always within the same climatic balance.

Similarly, we have to develop the robot values as a temperate climate i.e. the robot actions can vary according to the values initially set. If the robot momentarily turns into a blizzard, this is unpredictable behavior, outside of a temperate climate, that can deteriorate the relationship with the person.

Consequently, we must develop strategies for robots to have behavioral modularity within barriers defined by values. The question is: Who has been playing like Zeus - the roboticist or the user?

Let us consider the application of Value Sensitive Design principles to HRI. To comply with its original definition, Value Sensitive HRI (VS-HRI) should follow the principles and theories of Value Sensitive Design regarding the inclusion of people's social and moral values. But further thinking, in a robotic context, we have to advance beyond the VSD method, by strengthening and defining the behavioral robotic barriers defined by values. A robot acts autonomously on people's behalf, assuming a form that can be interpreted as social. Thus, Value Sensitive HRI should design robot services adapted to people's values.

Value Sensitive HRI requires that users are provided with mechanisms to program/teach the robots themselves to act according to their environment and maximize their actions. We advocate a research approach that aims to invert the current paradigm in robot interaction by reaching people without a predefined robot service. VS-HRI allows for an unbiased approach in contrast to the usual pre-service ahead designed for a purpose before the final interaction with a person. One of the main aspects of VS-HRI is its consideration for the user's intentions when using the robot, without assumptions established a priori. Free choice actions

generate stronger attachment and experience of control over the outcomes than instructed actions [3]. Moreover, people perceive a higher sense of ownership and accomplishment when asked to set up a robot themselves [21]. This shift in people's agency creates empowerment in achieving their goals and values, opening opportunities to develop an approach that places people as directors of their acting scenarios [17] and orchestrates the "climate rules."

The similarity of values between people must also be acquired when a robot exists in the context. This humanitarian social similarity can be transversal in human-robot interactions. The communion between robots and humans can be as valuable as the portfolio of tasks the robot can execute. It is profound to the point that the robot and the human must respect the same principles and values. To discover people's values we have to access, through inquiries, observation, and investigation, the following questions:

- **Why do people use the robot?** What do people believe in, and what is the cause of their actions? People will dive into their innate drive to express themselves through the robot as a symbol of their values and beliefs.
- **How do people use the robot?** What actions do people take to achieve their purpose through the robot?
- **What do people use the robot for?** What do people do and gain by achieving their purpose with the robot?

The main difference with previous work on HRI, for the most part, is the search for values in an embryonic phase of the projects. The questions above stated are not set in a robotic project or conceptual development. A cross-cutting point in HRI studies that have partially or totally VSD in their genesis is the presentation of mixed-based empirical studies through focus groups sessions to find the values. The main difference between the works that have used VSD is their heterogeneity in collecting the values. They all demonstrate methodological freedom that allows empirical flexibility but in turn, are harder to replicate due to the multiplicities of application.

The **"Why, How, and What"** questions have to be accessed with all stakeholders present in shared spaces and how the robot can be a member and not a foreign agent. By responding to people's values, the robot can be a member of the shared space itself.

Currently, most social robotic scenarios have robots with features that society values. For example, with older adults, it is common for robots to help with routines, physical exercise, and physical or cognitive difficulties. These features are generally driven by what society understands an older adult should be doing or areas where help might be needed. On the other hand, scarce robot cases explore the Value Sensitive HRI approach. To have robots doing things according to what people specifically and personally want, we have to, first, allow people to program the robot, and, second, express their own intrinsic and extrinsic values. VS-HRI is vaster than understanding how people want to use technology; it understands how some activities can change depending on the fluctuation and oscillation of intrinsic and extrinsic values. VS-HRI can understand what people value and, with that information, comprehend a hierarchy of social robotics scenarios for the future. Afterward, by having people program and control the robot, we can understand people's deeper interests and intentions in robots.

4 THE CARRIER PIGEON CASE STUDY

The motivation for our case study starts in our past work. We have developed a robot with specific tasks and objectives to test in real-world scenarios i.e. care homes. While some people complied with the robot's goals, some people responded in an unexpected way. These participants did not want to do the tasks that the robot had stipulated [18]. They were asking for actions and commands that the robot could not perform. Exemplifying, the robot was not prepared to send messages, do household chores, or ask/pick up items that belong to older people [17].

In our next interaction, we designed a study where two groups in juxtaposed rooms were able to send messages and ask questions to one another by assembling a variety of tangible blocks to program a robot. This preliminary study was carried out with 22 participants, in which the intention was to explore the extension of people's agency and communication through a carrier pigeon robot. People could choose what kind of message to send or what task the robot would perform with the other group.

In a first contact with the system, most participants took a more conservative approach to control the robot, performing few actions. Notably, after this initial impact, the tangible piece that allowed for verbal improvisation through audio recording was widely used and became the interaction centerpiece. This was used with emotional intentions in which people wanted to make clear their affective intentions with their friends or staff. Additionally, it also served for people to challenge their creativity by creating competitive scenarios through riddles and proverbs, which the other group would have to guess. Gradually, the difficulty and degree of competition increased. Most importantly, the activity generated a democratic consensus based on dialogue in which the robot acted in accordance with the wills agreed within the group. This permanent negotiation of the tasks to be performed motivated cooperation that kept the group actively engaged. Our initial study showed us that there is potential for us to develop robot control environments that can allow them to enhance social interactions and on-the-fly tasks.

"Symbols help us make the intangible tangible"

Simon Sinek [19]

How people want to use the robot is partially connected to controlling the robot. How do people want to control it, and through what mechanism? In this way, the robot control should be carried out in a simplified and accessible way to enable usage. We co-designed a control interface focusing on tangible components to decrease cognitive barriers [17]. We used 3D symbols that signify actions to allow people to rationalize the actions they were commanding the robot to do. Through these blocks, people exercised their agency over the robot.

4.1 Emergent Challenges

When people have freedom of action, the harder it is to react or start. In this line, one of the challenges observed by us and mentioned by the psychologist is the difficulty experienced by older adults in performing a boundless task. When left with a blank sheet and asked to *"draw what you want"*, many old people leave the sheet blank because *"they do not know what to do"*, as mentioned by the psychologist. Thus, one of the future challenges will be initial guidance to unblock these hesitations.

Perhaps, for people to reach why and how they want to use the robot and with what intentions, crucial questions need to be asked. In order to have this rationalization, people might have to have some prior knowledge or context externally given to facilitate reasoning. Exploring willingness might require higher levels of guidance to increase critical sense and reflective capacity.

5 DISCUSSION

5.1 What is missing regarding values on HRI for technology to be brought to people's interests?

To use VS-HRI it is important we understand how all the stakeholders interfere in the social dynamics that might be imperceptible at a first glance. We usually focus on "what is the service and how people can do this", but we neglect other layers such as social dimensions and financial institutions, and in the meantime, the values end up touching these various spheres [10]. Everything we design will have an effect on social contexts. A robot introduced into an institution will interfere with the existing social baseline. The robot must pierce this social bubble in a behaviorally imperceptible way, merging its action with people's values and interests. For this to happen smoothly we have to first answer Why do people use the robot? How do people use the robot? What do people use the robot for? VS-HRI allows us to find these answers by providing deeper engagements and embedded research establishing people as decision-makers in the definition and rationale of the concept itself, offering the disruptive potential to create more meaningful human-robot interactions.

5.2 We want robots to have part of our genetic code of values and beliefs. How embedded are our values into the robot in our context?

The insertion of a robot in a social environment without an agenda makes its agenda become the people's agenda. A robot that had its values fully embedded in its functioning will be a robot that will be just another piece in a social context, therefore acting imperceptibly because it is expected to act according to the expectations. Evolutionarily speaking, we do not want a setback in social dynamics when we insert a robot into a social context. We want a social advance anchored on a behavioral preparation based on values that help us design better robotic agents. A landscape that is already established and remains, apparently, unchanged with the insertion of the robot would be considered a successful blend.

At the moment, we have robots that, added to all the benefits that they bring and the dynamization of social environments, still have a scant insertion of human values in their DNA.

In addition, most robots have a specialized service, leaving limited room for people to use them more personally. For example, our case study makes room for the exploration of effective altruism, which advocates acting for the benefit of others. VS-HRI can contribute to allowing exploring people to help others, and take action on that basis. This principle can be demonstrated through a priority use of the robot for external social assistance. For example, to promote long-term well-being through communicative social bonds that reduce existential crises derived from long-term care [27]. Reduce the manifested isolation due to disconnection from the outside world, mainly if limited in terms of physical abilities [13]. And also, help in the feelings of inability to express oneself and aversion towards feared dependence [28].

5.3 How can we determine if a robot acts according to a particular value?

A value that is being addressed is a value that is being demonstrated by meeting expectations. The robot has to have an expected final behavior that converges and matches human behavior and values. We defend that, when a robot arrives at the institution, it should have previous moral training by the very people who will use and work with it. The robot service should be implemented and not be *"the elephant in the room"* and be precisely a useful bagatelle, ready to merge into the room's dynamics.

Unintended behavior is an urgent problem that we see in artificial intelligence. This disruption in artificial intelligence is called by some researchers *"The Alignment Problem"* [6]. Artificial intelligence is rapidly dominating and influencing some aspects of our lives, in which algorithms make decisions for us. Machine learning algorithms learn from data without being explicitly programmed [6]. This means that the systems can face correct answers, but also wrong or morally dubious answers. Decisions will be made according to this previous learning, which will bring behavioral flexibility depending on the interconnected learning biases. How can we ensure that these decisions are the ones we want and best suited to people's beliefs and values?

Likewise, in the social robotic world, within the recent robot's insertion into society, we are now in time to include people's values on the table at this embryonic stage: asking them whether they want a robot and, if they do, what do they want to achieve through a robot and based on what intentions. Accordingly, Value Sensitive HRI arises from the preventive perspective of an ethical collision between human values and social robots. We advocate an unbiased future where people can determine their own robots' actions to match their values.

How can we prevent and avoid this misalignment concerning social robots, making them cooperate with our values, beliefs, and wishes? Should we then develop a behavioral architecture that derives from these variables that are human values and beliefs? How do we establish a framework that allows this flexibility of values and behavioral fluidity previously adjusted? How can social interactions be restructured through this robotic technology? What transformations will robots bring?

5.4 Limitations

We propose a robotic approach that allows people to express themselves disconnected from previous biases caused by algorithmic strings, and according to their values. However, we are aware that the freedom of action through the robot ends up in its physical abilities and motor skills. In this way, and based on the robotic state of the art, there will always be a maximum task ceiling tied to mechanical and hardware specifications. Furthermore, regardless of the robot control method used by people, from accessibility and ease of use perspective, the sequence of actions and commands should have a reasonable finite number.

6 CONCLUSIONS

We urgently need to ask ourselves what direction we want to take as a society with robots near in the future and what role people's values will play in designing that future. This transformation will emerge into our daily lives through values that reflect our identities and polarize us in the desired direction as a society.

With this paper, we argued that the Value Sensitive HRI could contribute to the insertion of human values in the domain of Human-Robot Interaction. Inspired by Value Sensitive Design, we discuss the most commonly used methodological conceptualization and take a complementary step forward to insert human values in the design method. The result is a proposal for future developments in robotics or HRI scenarios that ethically respect people's motivations and intentions in using robots. We hope and consider that the findings of this work can be generalized to other users and other contexts of use.

Future work will need to deeply question people's values and meanings and what implications translate into robot services and tasks. Society needs to reconsider the design of robots; What aspects of social transformation through robots expressing our values can we aspire to? How can the robotic design live up to expectations? Ultimately, at the final stage of development, robots will be close to being a third entity; hence it is vital the adaptation to people's values.

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