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Conducting Socially Aware and Value Oriented Investigations: a Case Study on the Violence Against Children and Adolescents

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Abstract

In challenging social contexts of technology design, such as those involving fighting the violence against children and adolescents, the consideration of human values is critical, as they influence people's social and cultural lives. Considering values when understanding a social problem is not a trivial activity due to the difficulty of working with abstract concepts, the complexity of people's lives, and the lack of artifacts and recommendations to support designers in this task. Drawing on the Socially Aware Design approach, this paper describes the use of value-oriented artifacts to understand the problem and to identify requirements for the design of a computational solution in this context. As a result, the problem of violence against children is characterized in a socially-aware manner: 58 stakeholders were identified in the problem domain, which led to an analysis of 60 challenges of the violence impact and of 31 proposals of solutions were mapped to face these challenges. Stakeholder's values in the fight against violence context were identified, which enabled the identification of 43 value-oriented requirements for potential technological solutions for the context.

Keywords: *Socially Aware Design, Values, Violence, Children and Adolescents.*

1 Introduction

Human values have received attention in the Human-Computer Interaction (HCI) literature as there is a growing need to understand them and use that understanding in more socially responsible computing (Becker et al., 2019). However, considering values in a system design is challenging as values are often intangible, abstract, and difficult to understand for technology professionals (Pereira et al., 2018). Understanding values is necessary so that it is possible to consider the values of the interested parties when designing a solution to a problem and raise awareness to the values that a solution is expected to promote. Considering values is even more important when it comes to critical contexts, as it involves people's lives and addresses sensitive issues of human existence and dignity.

Different stakeholders, with their values, needs, and social and cultural norms bring complexity to the design in the context of social problems, such as child violence. According to the World Health Organization (WHO), one in two children suffers some form of violence each year, which causes immediate harm to children, families, and communities, and has lifelong harmful effects that undermine the potential of individuals (WHO, 2020). The problem of child violence is social, and any intervention to advance solutions to this problem must understand the norms and values of the interested parties. Only an understanding of values and norms can enable a complete view of the problem that includes what people believe, value as important, and what guides their actions. Value understanding is also important to form an ideal scenario without violence. Working with values explicitly in a solution development can reinforce the communication of positive values and mitigate values that may cause violence and more harm.

Viewing a problem and its prospective solutions from the perspective of values allows us to reveal social and human aspects that can be left out in a technically-centered process. Knowing social aspects inform the development of technological solutions with an understanding of the possible impacts they may have on people's cultures and lives. This development occurs through the explicit and comprehensive gathering of information on what stakeholders value in their situated context and of problems and challenges in the social world that influence or are influenced by this valuation. Then, a design process can be consciously conducted to communicate the stakeholders' expected values for a solution and inhibit those that a solution should not reinforce. In the design process, technological development can be guided by the interested parties' ethical, moral, and social values and reinforce these values through technology.

Knowing how to identify and deal with human values is a challenge in HCI (Baranauskas et al., 2015) and necessary to develop a systemic and socially aware vision for Information Systems (Boscarioli et al., 2017). Theories, approaches, methods, and recommendations are needed to work with values, especially for Information Technology professionals, who often have technically-focused training and experiences (Pereira et al., 2018).

When dealing with critical themes, understanding the context and paying attention to values before defining

problems and involving interested parties is a matter of social and ethical responsibility (Ferrari et al. 2020). The authors used artifacts from (and inspired by) the Socially Aware Design approach to promote conversations and discussions among designers in the early stages of a game design. Similarly to our interest, the authors aimed at creating a shared understanding about the problem and to raise awareness about both context richness/complexity as well as the professional and social responsibility. Although not investigating the same domain, we share the understanding that early discussions and conversations are mandatory for an effective and responsible design.

To the best of our knowledge, previous studies have not dealt with a value-oriented understanding of violence against children and the development of solutions. Paim et al. (2020) developed political, cultural, and social requirements for a solution in the context of violence against women using participatory and feminist interaction design. While social and cultural aspects appeared in the discussion, the authors did not focus on bringing and using value-oriented artifacts for children stakeholders. Although value research exists in the field of Interaction Design for Children (see Yarosh et al., 2011, and Van Mechelen et al., 2020), these works do not explicitly tackle the problem of violence. Unlike these papers, our work involves value-oriented discussions of the problem of violence against children, which occurs in a social context where children and many other related stakeholders live and interact. This paper aims at advancing our capacity to deal with the challenge of conducting value-oriented design for Information Technology professionals and a need for methodological guidance and best practices when working with values (Winkler and Spiekermann, 2021). For these challenges, this paper creates a record and offers remarks for using value-oriented artifacts, and may serve as a guide for designers, including investigations of violence against children and adolescents in a socially aware and value-oriented way.

In this study, we articulate a set of artifacts from the Socially Aware Design (Baranauskas et al., 2013; Baranauskas, 2021) to support a value-oriented understanding of the child violence problem. We conducted a case study to characterize the problem of child violence, allowing further investigation of technological solutions for the problem. In the child violence problem understanding, the investigation involved reading and analyzing official documents and papers related to the theme and filling socially aware and value-oriented design artifacts to represent design information for the problem and its solution, reflecting on their outcome. This paper focuses on understanding and characterizing the problem in a comprehensive and socially aware way in order to reach the definition of system requirements. Problem understanding is a critical step to drive any information systems design process, specially in socially challenging contexts, such as violence against children. Thus, the development and implementation of a computational solution to face this challenge is part of future work.

As main results, this paper presents: i) the identification of 57 stakeholders in the problem domain, with the respective identification of 60 challenges, difficulties, and problems of the violence impact on children and adolescents, and 31 solution proposals for these problems; ii) the identification of what stakeholders value in the fight against violence context, and the identification of the respective cultural aspects from the context of these values; and iii) 43 value-oriented and systemic requirements for potential solutions in the problem context.

This paper is an extended version of a paper published at the Workshop on the Implications of Computing in Society (Silva Junior et al., 2022). The novel contributions in this paper are: i) an expanded version of the analysis and figures of the artifacts filling results; ii) an extended review of literature on related work; and iii) an analysis of the artifacts' use with 9 remarks representing lessons learned and aspects to keep in mind when conducting a value-oriented study.

The paper is organized as follows: Section 2 contextualizes values concepts and theories. Next, Section 3 presents related works of technological investigations to fight violence against children, including value-oriented ones. Section 4 presents our case study methodology with artifacts used. Section 5 presents our results, describing our understanding of the problem context through the artifacts and requirements for a prospective solution in the problem context. Section 6 presents our discussion, and Section 7 presents our conclusion and directions for further work.

2 Contextualization on Human Values

Friedman (2006) points out that a value refers to what a person or group of people considers important in life, and that values substantially depend on the interests and desires of human beings in a cultural environment. There are many definitions of values, and this paper adopts the definition that "*a value is something that denotes importance to somebody for something in some respect or capacity*" (Pereira et al., 2018, p. 6). This definition is grounded in a theoretical framework that includes Organizational Semiotics (Liu, 2000), Pierce's (1955) definition of signs, Friedman's (2006) broad definition of values, and Perry's (1926) interactional view of values. Pereira et al. (2015, 2018) definition of values has a solid theoretical background and enables us to understand values as a subjective construction situated in a social context, and then this definition was adopted in this work.

Values are learned and determined by culture (Hall, 1959). "*Culture influences what people pay attention to and what they ignore, the way they behave and the way they interpret someone else's behavior, what they value and what they do not"* (Pereira and Baranauskas, 2015, p. 69). According to Pereira and Baranauskas (2015), one can not fully understand values outside their cultural context, so if we want to address values in the design of interactive computing technologies, we must pay attention to the cultural context of values. The adequate characterization of the meaning of a value depends on the context since values

are socially dependent (Verplanken and Holland, 2002; Flanagan et al., 2005).

The literature on value already has recommendations, artifacts, and methods to support identifying values in a design process. Friedman (2006) introduces the Value Sensitive Design: an approach to technology design that considers human values throughout the design process. Drawing on Baranauskas' Socially Aware Design, Pereira and Baranauskas (2015) present the Value-oriented and Culturally Informed Approach (VCIA) to interactive systems design, which offers a set of artifacts and methods to support the explicit consideration of values and culture throughout the design process.

Design is a practical and creative activity with the aim of developing a product that helps its users achieve their goals (Preece et al., 2015). Thus, system design can be seen as the act of designing computational systems to help people in some aspect of their lives. This paper draws on the Socially Aware Design approach (Baranauskas and Bonacin, 2008; Baranauskas et al. 2023) to understand system design as problem understanding and development of a technological and interactive artifact in a systemic way. The Socially Aware Design "*offers a way of understanding system design as a social phenomenon*" (Baranauskas et al., 2023, p. 3). As Baranauskas and Bonacin (2008, p. 44) puts it, "*design process is a social construction of designers, users, and other stakeholders actively engaged in the problem setting as well as in the problem solution*".

This view of design is informed by the Organizational Semiotics (Liu, 2000; Stamper, 1993; Stamper, 2000), which explores signs and their effects on social practices, as each organized behavior is affected by peoples' communication and interpretation of signs. Stamper et al. (2000) proposes a set of methods to deal with information and information systems in a balanced way, taking into account both the technological issues and the human and social aspects of information resources, products, and functions (Baranauskas and Bonacin, 2008). The Socially Aware Design understands that design is about being engaged directly in a specific design situation, where the design process is situated in a nested structure in which the informal, the formal, and the technical layers of information and interaction coexist. Thus, the Socially Aware Design is "*characterized by the relation of people with artifacts and design environment, experienced as a participatory sensemaking process*" (Baranauskas et al., 2023, p. 5). Several artifacts (informal, formal, and technical) are used iteratively by the participants with their experience, worldview and cultural values to enable a participatory sensemaking during this process (Baranauskas et al., 2023).

Despite the existence of value-oriented frameworks for interactive systems design, further investigations in the field are needed. According to Winkler and Spiekermann (2021), as few guides support the work of designers in the field, designers need methodological guidance and best practices, reproducible guides and methodological descriptions shared by experienced researchers to facilitate entry into the field and overcome initial barriers.

In this way, we apply the VCIA approach in this paper to understand the complex problem of violence against children. We chose VCIA because: i) it supports our interactional view of values, where value is understood as an interaction between a person valuing something as important in a situated context; ii) it is based on Organizational Semiotics and Socially Aware Design, which provides a solid and systemic understanding of a problem context, stakeholders and its culture, value and beliefs, approaching human and technical aspects in an integrated way when thinking about technological solutions; and iii) have value-oriented artifacts to support a design and evaluation process, since the problem understanding to thinking about a solution.

3 Related Works

Literature on violence and technology includes analysis of various types of violence enabled by technology, such as a survey to understand Digital Dating Abuse (Hinduja and Patchin, 2021) and a survey to investigate sexual harassment suffered by young women in online spaces (Salerno-Ferraro et al., 2022).

Literature also brings solutions to understand and fight the violence against children problem, such as a convolutional neural network framework to detect child abuse or violence in images from a surveillance camera at home or school (Himi et al., 2020); a co-design study with children to inform the design of a social robot to prevent bullying, where children envisioned values for these robots (Sanoubari et al., 2021); and a review of papers with a design or technology intervention against bullying (Iivari et al., 2021). However, to the best of our knowledge, only a few papers used a value-oriented analysis in an integrated way to understand or fight the problem in the technology domain.

Sultana et al. (2022) developed a study combating child sexual abuse in Bangladesh. The authors conducted surveys, interviews, and focus group discussions to better understand Bangladeshi child sexual abuse. They found challenges such as parents' lack of awareness, blind trust, and family honor receiving much higher priority than violence disclose. Some of these problems were related to Bangladeshi culture, where values are expressed and guide people's actions. They developed a tool named "ShishuShurokkha" that allows community members to report child sexual abuse incidents anonymously and inform the community about such incidents in their neighborhood, among other features. The authors recommend that local values and ethics, moral and religious perspectives, and cultural norms must be integrated into solution initiatives and consider local values when developing socio-technical systems. Although the authors recommend involving stakeholders' values when investigating a solution, this paper did not describe the use of value-oriented artifacts to conduct their investigations or to develop the tool.

Through a storytelling method with young teens, Bowler et al. (2015) generated a value-oriented conceptual framework for understanding and guiding social media design that might counteract or prevent mean and cruel online behavior. In the final phase of analysis, the authors utilized the value concepts of Cheng and Fleischmann (2010) to identify values embedded in design themes for social media found in storytelling activities with teens, reaching the following values: identity, responsibility and accountability, seeking help and support, empathy, social acceptance, justice, among others. The value-oriented artifact was used after the study was conducted, as a means of a final analysis of participants' storytelling. This paper's intention differs from our purpose: use different value oriented artifacts to understand and characterize a problem domain, and develop a technological solution utilizing core stakeholders' values as a design input.

Other papers report activities and recommendations that implicitly engage or communicate values. Iivari et al. (2021), for example, recommend "promoting friendships and compassion (...)" and "focusing on the group effort, all children being seen as capable to brainstorm and codesign for 'better' future". As these papers are already communicating values, treating values explicitly can maximize humanistic and protective actions and mitigate negative reverberations. Not using artifacts, methods, and techniques to address values restricts a design team on what values and how to propagate these values to later stages of a design process. When a design process does not consider values explicitly, designers can forget stakeholders' values in later phases, such as solution design and evaluation. Our paper addresses this issue by utilizing value-oriented artifacts that treat values explicitly.

On the one hand, some papers include values in their discussions but do not utilize value theories, design methods and techniques. When value artifacts are not utilized, the consideration of values depends on the designers' concerns and skills. Because of the technically-focused training and experiences in IT education, designers can ignore or misunderstand stakeholders' values. On the other hand, when value-oriented artifacts are utilized, they are usually not integrated from the earlier to the later stages of a design process. These not integrated value-approaches fragment data collection, analysis, design, and value evaluation, and a value-oriented activity only takes part in one design stage. For example, value can appear as a concept in qualitative discussions, after a technology was developed or intervention was conducted.

When values are not explicitly considered in later design stages, identified values may be forgotten and neglected when modeling, creating prototypes, and implementing the actual solution. Thus, in the very sensitive context of violence, not considering values directly and in an integrated way is a threat to provoke negative impacts. Our paper addresses this threat by working with a value-oriented approach that recommends artifacts used in an integrated way, from problem understanding to the identification of value-oriented requirements for a technological solution.

4 Case Study Methodology

Our case study is categorized as exploratory (Lazar et al., 2017), and its objective was to understand and characterize the challenging problem of child violence in a value-oriented way. Our premise is that only through a socially aware and value-oriented approach one can understand important aspects of people in context and how to defend these aspects in a solution to tackle the problem without causing more harm or unintended effects.

Motivated by this objective and premise, we used artifacts from Socially Aware Design (Baranauskas et al., 2013) and Value-oriented and Culturally Informed Approach (Pereira and Baranauskas, 2015). Figure 1 presents our approach with value-oriented artifacts to the problem understanding and prospecting of a solution. The design product emerges through several iterations of this process in which analysis, synthesis, and evaluation activities are intertwined (Baranauskas and Bonacin, 2008).

The Socially Aware Design draws on Organizational Semiotics (Stamper, 1993; Liu, 2000) to conceive a semio-participatory design model that offers a systemic view of how technology shapes human relationships in the world (Baranauskas et al., 2013). The Socially Aware Design is represented on the Semiotic Onion, which sees an organization as an Information System (IS) composed of the technical (technology design), formal (laws, rules and procedures) and informal (beliefs, behavior, values) levels of the domain. Different artifacts have been developed to support design activities, including value-oriented ones (Pereira and Baranauskas, 2015). The artifacts act as communication and mediation tools for different people experiencing a participatory meaning making process in a design environment (Baranauskas et al., 2023). Although each artifact in Figure 1 has a specific focus, all the layers of the semiotic onion are transversally considered. For example, when raising the interested parties, stakeholders are considered in different levels of involvement with the problem being discussed.

The three authors planned and reviewed this case study before its execution. In execution, the first author read the documents about child and adolescent protection and made an initial filling of all artifacts. Once filled, the second and third authors (with previous experience with Socially Aware Design) engaged in synchronous discussions to refine the artifacts' filling, questioning, changing, removing or adding information in artifacts. All authors reviewed the mapping and the discussions presented in this paper.

As initial input for the Stakeholder Identification Diagram and Evaluation Frame artifacts, we searched with keywords '*(abuse OR violence) AND (child OR adolescent)*' in Google and Google Scholar for documents (booklets, reports, papers) related to violence against children and adolescents, and excluded documents outside the theme.

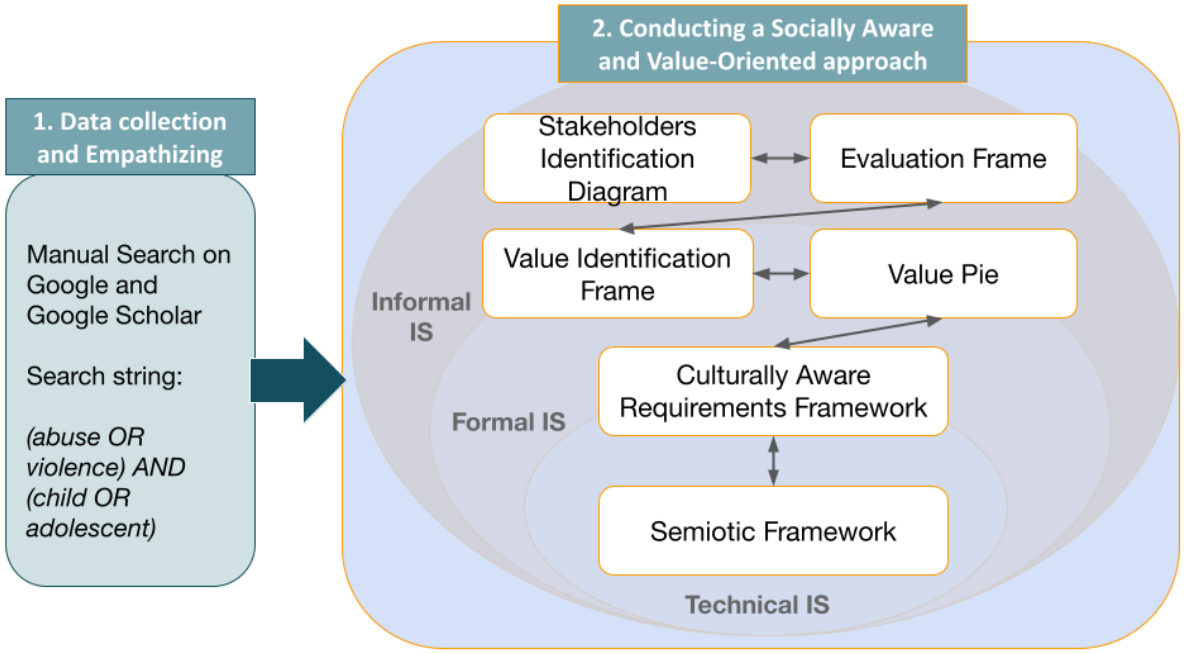

Figure 1. Conducted phases and Artifacts used in the study

As a result, we identified documents and papers on the context of violence against children and adolescents that enabled us to develop a problem understanding and empathizing with the problem context[1]. We used these documents as input for the artifacts. **Table 1** presents an overview of research procedures regarding the artifacts used, their input, actions and results. Following, each artifact use is characterized with the artifact description, its inputs and outputs.

Identifying stakeholders, their relevant issues, challenges, and pains is necessary to understand the problem context in a socially aware way. For this, we used the *Stakeholder Identification Diagram* (Stamper, 2000) as this artifact supports the identification and organization of stakeholders relative to five layers of different relations to the problem and operation of an information system.

The layers of the Stakeholder Identification Diagram are: i) Operation (problem or information system); ii) Contribution: actors and responsible for the problem; iii) Source: customers and information providers; iv) Market: partners and competitors in the problem or its solution; v) Community: legislators, spectators, the community at large.

Actions taken: To identify stakeholders in the problem domain we read documents and papers related to the problem of violence against children. In the papers' reading, stakeholders were identified and classified in a layer of the Stakeholder Identification Diagram. *Input*: documents and papers related to the context of child violence. *Output*: list of stakeholders, organized by layers of the Diagram.

Once we identify stakeholders in the problem domain, we can understand the issues, pains and challenges that these stakeholders suffer, as well as prospect how these problems can be faced. *The Evaluation Frame* (Baranauskas et al., 2013) artifact extends the Stakeholder Identification Diagram, reporting on issues present in the current situation or potential stakeholder issues, and ideas or envisioned solutions that have a potential impact on the design of the solution to the problem are also identified (Baranauskas et al., 2013).

Actions taken: Utilizing the reading of documents and papers related to the problem as a source, we filled the Evaluation Frame artifact for at least one stakeholder from each layer of the Stakeholder Identification Diagram. First, we analyzed their problems, pains and challenges, writing these issues in the artifact; then, we searched and identified existing solutions for addressing these issues, also annotating them in the Evaluation Frame artifact. *Input*: reading of documents and papers related to the problem. *Output*: List of stakeholders' problems and respective existing solutions.

After analyzing problems and challenges, what stakeholders value and think as important can be identified. Stakeholders' values can emerge from needs, beliefs and behavior from their situated context. Such identification must associate values with someone (e.g., a stakeholder) who thinks or feels something as important.

To identify stakeholders' values, we used *The Value Identification Frame* (Pereira et al., 2012).

[1] Documents and papers available in: https://osf.io/dr2eg/?view_only=b8ceac4059544be5a22cbb2ee667677b. Last access on 23/03/2023.

Table 1. Summary of artifacts used, input, actions taken and output

Artifact	Input	Actions Taken (method)	Output
Stakeholder Identification Diagram (SID)	Documents and papers on the context of violence against children /adolescents.	Read documents and papers about the problem; Record stakeholder mentions; Consolidate stakeholders in the SID.	List of stakeholders, categorized by their level of influence in relation to the problem.
Evaluation Frame	Documents and papers on the problem context; List of interested parties from the SID; Keywords.	Read documents and papers about the problem; Note down problems of a stakeholder; Search for solutions on Google with keywords up to the tenth page; Consolidate a single list of solutions.	List of problems and issues, as well as ideas and solutions related to a particular stakeholder.
Value Identification Frame	List of interested parties from the SID; Papers and documents on the problem context.	Read documents and papers to identify aspects valued by stakeholders; Group values by similarity; Associate values with a stakeholder; Analyze values-stakeholder relationship.	List of values raised from stakeholders' context.
Value Pie	List of values from the Value Identification Frame.	Consolidate single list of values from Value Identification Frame; Categorize values in the Value Pie culture areas and formality levels.	Values associated and categorized into an area of culture and level of formality.
Culturally Aware Requirements Framework (CARF)	Values from the Value Identification Frame and Value Pie for each stakeholder.	Select a culture area where a specific stakeholder value was identified. For this value, identify requirements that respect, communicate or inhibit that stakeholder's value.	List of value and culture oriented requirements associated with different stakeholders.
Semiotic Framework	Requirements produced by CARF.	Sorting CARF requirements on the Semiotics Framework; Identify new requirements from the levels of the Semiotic Framework.	Synthesis for a solution in the context of violence; requirements organized by level of formality.

This Value Identification Frame supports the identification of values related to different stakeholders who may be directly or indirectly interested in or affected by a solution to be designed (Pereira et al., 2012). Each stakeholder has a set of values that can cause or be impacted by the introduction of a solution to be designed, and it is the job of designers to map what these values are (Pereira et al., 2011).

Actions taken: for the most relevant stakeholder from each layer of the Stakeholder Identification Diagram, and grounded in the reading of papers and documents about the problem, we analyzed what values these stakeholders may bring to a problem domain. For each stakeholder's values, a reference from a document or paper that motivated the identification is pointed out. *Input:* the list of stakeholders from the Stakeholder Identification Diagram, and papers and documents related to the problem domain. *Output:* a list of values from the problem domain that stakeholders bring to a project.

Values are learned and determined by culture (Hall, 1959) and we can only fully understand values considering their cultural context (Pereira and Baranauskas, 2015). For a cultural understanding of values, we used *The Value Pie* (Pereira et al., 2014; Piccolo and Pereira, 2019).

The Value Pie is based on Hall's (1959) theory of culture, and it organizes values according to their formality, culture and interaction. For Hall (1959), values are culturally developed according to and between 10 Primary Messages Systems (PMS), or the basic building blocks of culture: Interaction, Association, Subsistence, Classification, Space, Time, Learning, Recreation, Protection and Exploration. Once the stakeholders' values have been raised, we use the artifact with 10 areas of culture to understand each value from the perspective of the culture, the relationships with other values, and the informal, formal and technical aspects of the problem context.

Actions taken: for one stakeholder, all their values were mapped in the Value Pie, where values could be categorized in a culture area or in the intersection of more areas, in the center or in the border of the artifact (level of formality). When the mapping was finished,

the values, their areas and their level of formality were analyzed to understand gaps, concentration of values and its formality nature. *Input*: values identified in the Value Identification Frame. *Output*: stakeholder values mapped in terms of culture areas and level of formality; knowledge about culture areas engaged in stakeholders' values, and its level of formality.

Thinking to represent the identified values as high-level requirements, we used *The Culturally Aware Requirements Framework (CARF).* This artifact supports the identification and organization of requirements related to different stakeholders' cultural aspects and values (Pereira et al., 2012). We used CARF to identify requirements related to each area of culture in which we raised values associated with stakeholders. The requirements are then value and culture oriented, informing a final solution that respects the identified value issues.

Actions taken: for each stakeholder value related to a culture area, requirements were identified to respect, communicate or reinforce that value and culture area in a technological solution. *Input*: list of stakeholders' values mapped in a culture area. *Output*: list of value-oriented requirements for a technological solution that respect, communicate or reinforce stakeholders' values.

To promote a systemic solution that considers the social and technical aspects in an integrated way, we used the *Semiotic Framework* (Stamper, 1993; Baranauskas et al., 2013). This artifact enables us to understand the gradual impact of the values, from high-level requirements of people's beliefs and values to technical requirements directly related to algorithms, technological features, and infrastructure.

The Semiotic Framework represents six layers of meaning that must be considered in the design of a system (Baranauskas et al., 2013): social world: the consequence of the use of signs in human activities; pragmatics: intentional use of signs and the behavior of their agents; semantics: relations between a sign and what it refers to; syntactic: the combination of signs; empirics: static properties of signs; physical world: physical aspects of signs. By using the Semiotic Framework artifact, we can consolidate the knowledge identified in previous artifacts in a systematic way, representing human/social aspects and technical ones.

Actions taken: the value-oriented requirements were organized concerning their level of formality. Requirements related to human and social aspects were mapped to the "Social World" level, for example. In contrast, requirements related to hardware and infrastructure were understood to belong to the level of "Physical World". *Input*: list of value-oriented requirements related to stakeholders' values and area of culture. *Output*: synthetic list of systemic requirements organized by level of formality, from the social world to the physical world levels.

Before engaging with critical stakeholders, designers need to develop their understanding and sensitivity to the problem as a matter of responsibility with the stakeholders' time and challenges (Ferrari et al., 2020). In this way, this work was done as an initial step aiming at the involvement of stakeholders in a participatory way in next iterations of problem understanding and design. Next iterations of this design process will involve stakeholders from the problem context in codesigning practices.

5 Results

This section presents the results of understanding the problem, the stakeholders, their values, and results from identifying requirements that a prospective solution should address. The artifacts completed with the raised information are open[2] and available in the journals' page through the paper DOI. We also present takeaways for each artifact use, stating authors' lessons learned and points of attention from the artifact's reflexive use.

5.1 Stakeholders Identification Diagram

We used the OpenDesign platform (Gonçalves et al., 2020) to fill in the artifact, resulting in 58 stakeholders (see Figure 2 for an excerpt of SID). The SID artifact helps to identify or recognize a wide range of stakeholders, including non-obvious ones that may influence the problem and a prospective solution.

Ignoring non-obvious stakeholders may compromise an understanding of a problem to be addressed. In the context of violence, the font of violence can be stakeholders that are not usually seen as violent, such as teachers in schools and even school administration. These non-obvious stakeholders can intensify or alleviate the problem as well as be adversaries or partners when considering adopting a solution.

In Figure 2, identified stakeholders are shown in each artifact layer. In the Contribution layer, obvious stakeholders, such as child, adolescents, and violence perpetrators are represented; non-obvious stakeholders also important in the context were identified, such as neighbors who can produce or denounce violence, and parents' ex-partners, which can be perpetrators of violence. In the Source layer, professionals and institutions who aim to understand the violence problem and to intervene against it and its effects were identified.

Also, the press and different professionals (education professionals in Schools, or caretakers in Shelters, Orphanages, Prisons and Social Assistance) are essential to help raise awareness of the problem and to intervene, such as noticing cases where violence is taking place and reporting violence in official channels. In the case of health-related stakeholders, they are essential to address the effects of violence, both physically, psychologically, emotionally and socially.

[2] Available at: https://osf.io/dr2eg/?view_only=b8ceac4059544be5a22cbb2ee667677b . Last access on 23/03/2023.

Figure 2. Stakeholder Identification Diagram filled with potential interested parties in the problem context

In the Market category, Councils and Institutions that work to develop strategies to prevent and resolve the effects of violence, and to implement public policies and monitor them were identified.

In the Community category, there are the stakeholders responsible for organizing the global discussion on preventing and combating violence. They are stakeholders of each nation (Public Ministry, Health, Justice, Prosecutors and Councils) and global stakeholders (WHO, UNESCO, UNICEF) that prepare general recommendations and public policies, monitoring the situation of violence and proposing general directions together with governments. These community stakeholders are relevant as they can define laws, norms and formal rules that guide the approach to confronting and dealing with violence.

In the analyzed context, stakeholders in the role of Abuser, Aggressor or Perpetuator of violence are varied. In general, abusers and aggressors are people close to the victim, such as family members, or people indoors with children or in the surroundings.

Identifying the different stakeholders makes evident the diversity of forces influencing the problem, and stakeholders' respective values reflect the complexity of social problems we want to understand. Technologies to cope with some aspect of the problem must consider the different forces of influence and different foci of violence.

5.2 Evaluation Frame

By using the Evaluation Frame, we raised 60 challenges, difficulties and problems of the violence impact on children and adolescents, and 31 solution proposals. Figure 3 presents a fragment of the artifact filled with stakeholders' problems from the Contribution and Source layers and possible solutions for these problems. The final list of problems and solutions is available with open access[3].

5.2.1 Stakeholders Problems and Challenges

Reading documents and articles was a source of information to fill in the Evaluation Frame artifact. In general, we can categorize the problems identified into three main categories: i) types of violence, ii) consequences of violence, and iii) underreporting.

[3] Available at: https://osf.io/ca7qp/?view_only=9baf868bc5ad4b3ea42c76c9b17f0f81. Last access on 23/03/2023.

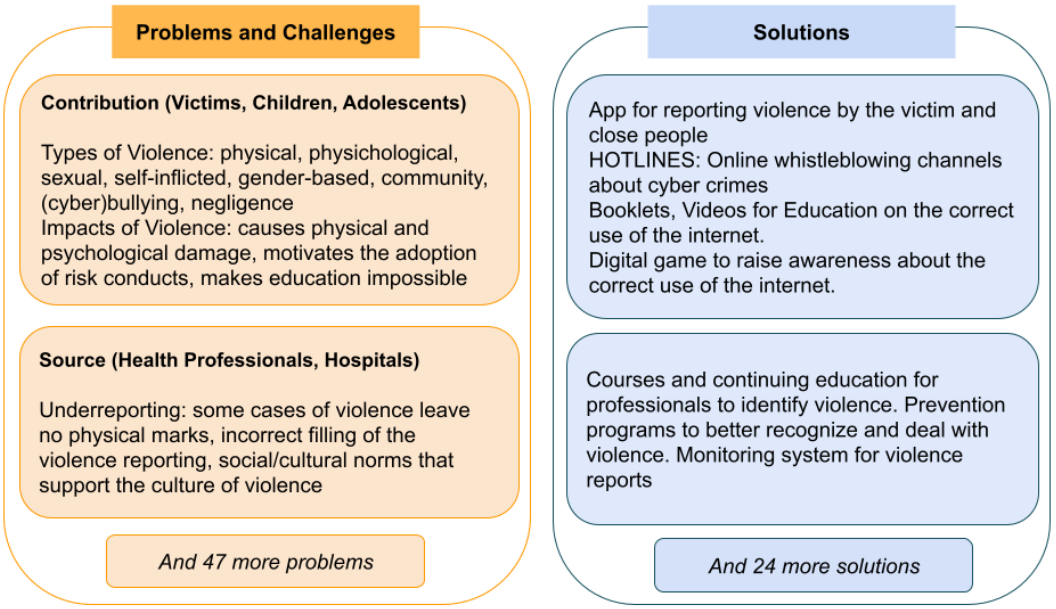

Figure 3. Fragment of the Evaluation Frame filled with example of challenges and ideas of solutions

We identified various types of problems: bullying and cyberbullying, child labor, self-inflicted, community, gender-based and structural violence, among others. The variety of challenges indicates that the problem is complex, composed of different types of violence that a child and adolescent can suffer.

As an aggravating factor, the various forms of violence are interrelated, sharing many risk factors: children may experience many different types of violence simultaneously and at different stages throughout their lives (WHO, 2020). Violence is not an isolated phenomenon and demands a greater effort to victims' protection, based on awareness of the different forms of violence that children can be subjected to.

Effects and consequences of violence were also identified, indicating its impacts on individuals and on the social world. Globally, violence causes economic impacts on society, caused by resources spended in caring for people affected by violence and preventing the full development of people (WHO, 2020; Platt et al, 2018).

At the individual level, victims can suffer immediate or long-term physical, psychological and social consequences, damaging child development in the physical, social, behavioral, emotional and cognitive sphere (Reichenheim et al., 1999). In the educational space, violence has serious effects, such as school dropout and low learning performance (Abranches, 2015; WHO, 2020).

Violence in childhood and adolescence also impacts victims in adopting risky behaviors to their health and well-being, such as: alcohol and drug abuse, depression, suicidal ideation and suicide attempts (Reichenheim et al., 1999; Abranches, 2015; WHO, 2020); as well as drug use, prostitution, involvement in abusive intimate relationships, delinquency and self-harm, and unsafe sex (Trajano et al., 2021; WHO, 2020).

The consequence of violence helps to continue a cycle of violence, causing children and adolescents who are victims of violence to suffer or cause this violence in the future as perpetrators for themselves or for others. Thus, the effects of violence are lasting and push away from the well-being of the various stakeholders involved in the cycle of violence.

Another category of problems was risk factors for experiencing violence during a lifetime. Children living with poverty, misery and hunger are at greater risk of suffering violence (Abranches, 2015; WHO, 2020). Poverty does not only involve the lack of economic resources, but a multidimensional poverty, when a family has no access to education, health, housing, nutrition, sanitation or water (Trajano et al., 2012). The very place where children live is a risk factor, because living in unsafe environments favors the occurrence of violence (WHO, 2020). Social, gender and ethnic inequalities are also risk factors for violence to occur (Abranches, 2015). People with physical and mental disabilities or disorders are at greater risk and more vulnerable to violence of all kinds, including sexual violence (Platt et al., 2018). Related to risk behaviors, using alcohol and illicit drugs, as well as early relationships are risk factors for the occurrence of violence (WHO, 2020; Reichenheim et al., 1999).

Finally, we identified factors that exacerbate the impacts of violence or make violence more difficult to tackle. The main aggravating factor is underreporting, which is the situation in which not all cases of violence are known, reported or taken forward when there is an attempt to report.

Generally, identified problems involve stakeholders from different categories. Underreporting, for example, is a challenge for the family, neighbors, health professionals and hospitals. Thus, problems are not just for one stakeholder (and a solution will likely not have

just one type of end user), as the problems are influenced and influence different categories of people at the same time. A problem and its solution involving and impacting many stakeholders is a factor of greater complexity, as any solution will have to consider all these stakeholders, their influencing roles in the adoption and success of a solution and how a solution will impact different people during its implementation.

5.2.2 Solutions for Problems and Challenges

From the documents and papers selected by manual and exploratory search on Google and Google Scholar, we identified a total of 31 proposals of solutions in the problem context. Some of these solutions are presented in the "Solutions" block on the right side of Figure 3.

Solutions include good practice manuals, infographics, recommendations and educational materials against violence for primary and secondary education, and an online platform for education and training in the area of protection for victims. Existing initiatives seem to focus on the formal level, such as booklets, manuals, protocols, rules, legislation and textual public policies. In some cases, there are more comprehensive solutions, such as projects and programs that involve several other actions, such as lectures, holding events, publishing videos and texts.

Few technological solutions were identified, revealing a gap in the proposition of technical solutions that operationalize into computational systems, the formal aspects already raised in the form of considerations, guidelines, recommendations and good practices.

The Out of the Shadows Index study, prepared by The Economist Intelligence Unit, presents information on how 60 countries tackle the issue of sexual abuse and exploitation of children and adolescents. For Brazil, the Index concludes that the country has clear laws and institutions committed to fighting sexual abuse and exploitation against children and adolescents, however, progress is still needed to get them out of the picture (Childhood Brasil, 2020). Despite the existence of laws, recommendations and norms, existing work lacks technical initiatives to operationalize formal knowledge into concrete initiatives against violence.

5.3 Value Identification Frame

Table 2 presents an excerpt of the Value Identification Frame for Children and Adolescents, Health Professionals, CGI.br (Internet Steering Committee in Brazil) and WHO (World Health Organization) stakeholders.

The problems we identified in the Evaluation Frame brought mainly issues (negative aspects) and barriers to the full and healthy development of children and adolescents. The human values identified in context documents indicate an ideal scenario for full human development, because they reveal values opposed to the negative aspects and problem impacts. For example, "attention and care" values oppose "negligence", which is a form of violence against children; "conversation" opposes "isolation" and "the culture of silence" which contribute to keeping the cycle of violence.

Table 2. Excerpt of the Value Identification Frame

Contribution	**Values from Context Documents**
Children and Adolescents	Freedom from violence, Attention and care, Well-being, Defense and Protection, Accountability, Trust, Conversation
Source	**Values from Context Documents**
Health Professionals	Specialized professional service, Information confidentiality and Privacy
Market	**Values from Context Documents**
CGI.br	Citizenship, Transformed attitudes, beliefs, and norms, Privacy, Defense Strengthening, Accountability, Education
Community	**Values from Context Documents**
WHO	Changing toxic and harmful social norms and beliefs, Peace and promoting a culture of peace

In general, among the identified human values, we can point out values such as: Guarantee of fundamental rights for children and adolescents, such as access to health and education (Abranches, 2015); Justice for victims (WHO, 2020) and Social Justice (Reichenheim et al., 1999); child violence report (Trajano et al., 2021; Platt et al., 2018); Positive, Respectful and Healthy Social Bonds and Support Networks (Abranches, 2015; Neves et al., 2010; WHO, 2020; Trajano et al., 2021); and Awareness about the problem (Platt et al., 2018; WHO, 2020).

Figure 4 presents main values for some of the stakeholders. The left side presents values from the contribution layer and the right presents values from other layers of SID. Values for Children/Adolescents and Family stakeholders are on the left.

Figure 4. Values identified for a group of stakeholders

These values are associated with the basic rights of children and adolescents, and with essential aspects for their human development. Safety, protection, trust, justice, care, love and affection, support networks, healthy environments and relationships, are essential values for the full development of children and for creating a healthy environment for growth.

On the right side, Figure 4 presents other human values for Health Professionals, CGI.br (Brazilian Internet Steering Committee) and World Health Organization. The values are related to the context of educating and combating violence: sensitization, awareness, and education are essential for combating a culture of violence that impacts children and their families. Values related to the defense of children and adolescents symbolizes a commitment to change the current situation of the problem.

Health professionals, for example, value prevention against violence, specialized professional care, training and education, confidentiality of information and privacy.

These values indicate that Health Professionals value an education that allows them to receive, care for and deal with victims of violence and to share lessons learned and better ways of working in contexts of violence. Regarding the care that Health Professionals provide to victims of violence, consideration of the privacy, reputation, and consent of victims of violence are necessary to respect people's autonomy and prevent further abuses. Similarly, health professionals themselves value their own privacy, reputation and visibility, as they are often offended and persecuted for receiving and following up on reports of violence.

The artifact revealed the prevalence of values related to Safety, Trust, and Emotion and Affection for Children and Adolescents. For the Family, norms appeared as a value, indicating that formal mechanisms are needed to ensure that other values are respected: for example, financial and economic strengthening, which guarantees an environment with less conflicts and dignified living conditions. The artifact helped to identify values raised from the context, making explicit values to bring into the design process.

5.4 Value Pie

We analyzed children and adolescents' values in Value Pie, charting their values in the artifact ten areas and three levels of formality. The result of values for Children and Adolescents is shown in Figure 5.

The filled Value Pie reveals a concentration of values in the areas of Association (4 values) and Subsistence (2 values). These two areas indicate that the child exists and lives in relation to others, mainly to the Family and its members. Relationships, groups, conversation and trust are values that indicate the importance of a support network and social bonds that help the child to grow in safety (protection culture area) and create safe environments for them to survive.

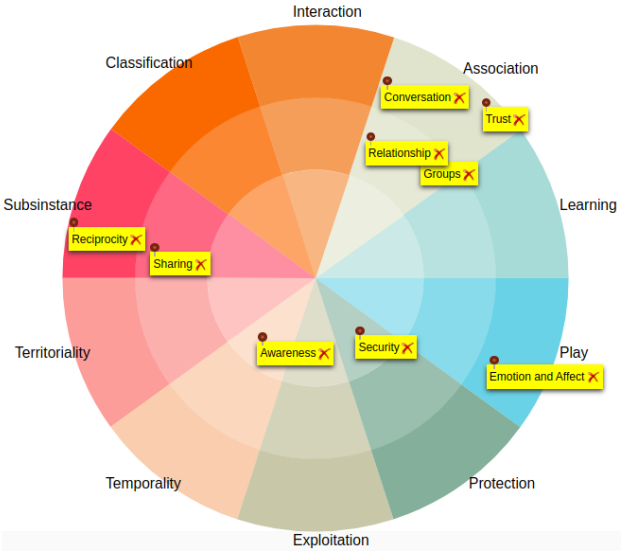

Figure 5. Value Pie with values for Children and Adolescents (Source: DSC[4])

The Value Pie also allowed us to identify value formalities and value gaps that could be brought into development. For example, for Children and Adolescents, no values were identified in the Learning dimension. However, if we take into account that children often do not understand what abuse is, learning about their own body and the limits of abusive actions can help a child in informal, formal and technical ways to find help and report violence.

Through the Value Pie artifact it is possible to perceive stakeholders' values and other gaps in values that become an opportunity to explore a technical solution. The Value Pie helped us to understand the values more deeply in their cultural context, interrelationships and levels of formality, and also made it possible to identify gaps in values that could be explored.

5.5 Culturally Aware Requirements Framework

Supported by the CARF artifact, we raised a total of 42 requirements, referring to the 10 culture areas and 23 values. Table 3 presents a fragment of the CARF filled with requirements for the Interaction area. Requirements identified in each area of culture represent stakeholders' values for a solution that will operate in the problem domain. In summary, we can point out main value requirements for a solution for each area.

In the Interaction area, for example, we found that a solution must respect children and adolescents as people with identity and rights in their interaction with a technological solution and with other stakeholders. In this interaction, a solution must promote values of justice and gender equity and reinforce norms and procedures that prevent people from not reporting violence.

[4] Available at: http://erytheia.nied.unicamp.br:3000/. Last access on 23/03/2023.

Table 3. CARF fragment filled with value-oriented requirements for different stakeholders

Culture Area	Requirements	Values	Stakeholders
Interaction	*A solution must presuppose the understanding and respect of the identity of the child and adolescent as a being with their own desires, experiences, opinions and needs, leaving aside the idea that the child is just someone to be controlled or dominated by an adult.*	*Identity*	*Children and Adolescents*
	A solution must reinforce organizational norms and procedures to be followed that prevent a problem from being underreported, as in cases where health professionals do not report to a system because they think they can solve the problem on their own.	*Norms*	*Health Professionals*
	A solution must align with the norms and values associated with an equitable vision of gender and justice, communicating this to users and not condone practices that promote violence through this solution.	*Norms*	*Ministry of Health*

Considering the Association area, a solution must interoperate information between institutions that fight the problem to strengthen a defense network formed by stakeholders. The association between people must have some kind of moderation, preventing more violence, such as violent comments or behavior.

Regarding the Learning area, a solution must sensitize users about violent behavior and its impacts. A solution also must educate about the importance of violence reporting to prevent more violence from happening because of bystanders' silence.

In the Play area, there were identified requirements related to creating mechanisms to prevent users from enjoying violence in a solution environment. A solution can use games to make children aware of cyber violence and good behavior online.

In relation to the Defense area, a solution must respect the stakeholders' privacy and ensure the use of authentication and information security mechanisms. In addition to guaranteeing the feeling of security and privacy, a solution must have technical features and restrictions to operationalize security and privacy.

In the Exploration area, when supporting violence reporting, a solution must request only the relevant information as a violence report feature may be used in a scenario that calls for urgency. A solution also must be accessible to the greatest possible diversity of people with different socioeconomic realities.

Regarding Temporality, a solution must be available for as long as a user needs, and make visible the temporal aspects of the response time in a case of violence notification to avoid anxiety and despair about the lack of response or feedback. Concerning Territoriality, a solution must make sense and be able to be used in different spaces, physical and social, considering the demands and characteristics of these spaces.

In the Classification area, a solution must not allow and must have resources to avoid defamation of users' reputation. A solution must help people classify harmful everyday actions that are not normally seen as violence. Regarding classification aspects in the context, people are subject to different types of violence depending on the roles and positions they occupy. Gender, age, economic status and race are aspects that make a person more or less subject to suffering certain types of aggression – or put them in a position to commit these aggressions or inhibit reporting.

Finally, Subsistence requirements indicate the importance of guaranteeing the necessary infrastructure resources for a solution, favoring sharing of information between people and avoiding the sharing of content that promotes violence.

With CARF, values from different areas lead to a variety of identified requirements. The purpose of this requirements gathering was to discover and represent high-level and value-oriented requirements that must be met or can be explored for a technological solution in the child violence context. With this artifact it is possible to define requirements to create solutions aware of the mapped values.

5.6 Synthesizing Requirements with the Semiotic Framework

Aiming to develop a systemic view of a possible solution in the problem context of child violence, we used the Semiotic Framework artifact to synthesize and organize requirements considering social and technical aspects of a solution in an integrated way. This artifact has 6 layers that gradually represents requirements for a solution from social and human aspects such as stakeholders' values and beliefs until it reaches the technical levels, where the analysis will prioritize technological infrastructure, hardware and physical properties. Figure 6 presents a fragment of the Semiotic Framework filled with the requirements synthesis and organization.

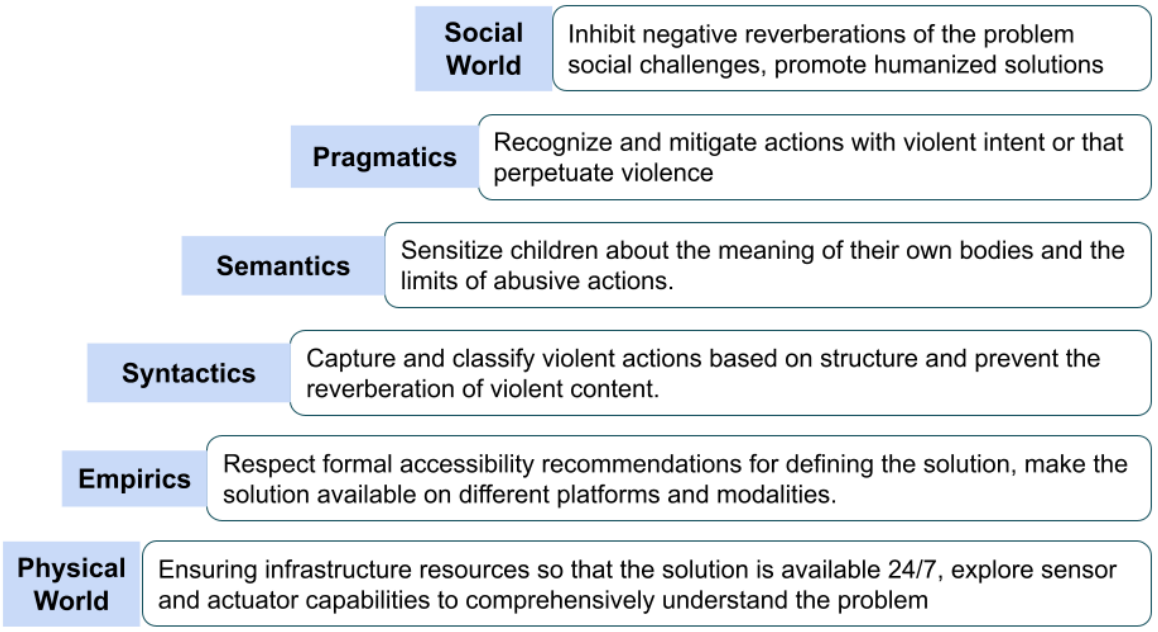

Figure 6. Fragment of the Semiotic Framework filled with requirements for a solution in the problem domain

In the *Social World*, a technological solution impacts human aspects such as beliefs, expectations, and culture. In this layer, technological solutions must reinforce human values of defense, commit to the values related to the human rights for children and their full development, and inhibit negative reverberations of the social challenges of the problem. An intervention strategy must promote humanized solutions, considering a network of actors involved in the cycle of violence, the social context of social inequalities and lack of rights, and respecting people's autonomy and dignity.

In *Pragmatics*, the intentions of stakeholders are represented in a technical solution. In this layer, a solution must maximize protection actions from different stakeholders, considering that multiple stakeholders can be part of a safety net. A solution must recognize and mitigate actions with violent intent or that perpetuate violence, strengthening social responsibility and protective actions by interested parties.

In *Semantics*, stakeholders' meanings and interpretations related to a solution are represented. In this layer, a solution must communicate a sense of privacy to ensure a feeling of security and protection for both the victim and the person receiving the report. Children can be sensitized about the meaning of their own bodies and the limits of abusive actions.

In *Syntactics*, formal structures, signs and patterns used in a technology are represented. In this layer, on one hand, a solution must communicate safety, care, reception and protection symbols, images and language; on the other hand, violent actions structure and pattern must be recognized and classified to prevent the reverberation of violent content.

In *Empirics*, issues of transmission, codification, frequency, variety, capacity, and efficiency are addressed. In this layer, a solution must respect in its codification formal accessibility recommendations for defining a solution, such as WCAG[5]. Regarding capacity, reduce solution size, if it needs to be downloaded, to speed up a reporting process and avoid using up a person's entire mobile data package.

Finally, the *Physical World* concerns hardware, infrastructure, physical properties, distinctions and means of representation. In this layer, a solution must use open technologies and standards to promote interoperability.

Ensure infrastructure resources so that a solution is available 24/7, because once the system is down, a victim can avoid making a report against violence. Considering that violence occurs also in physical location, a solution can explore sensor and actuator capabilities to comprehensively understand the problem, such as physiological data (pressure, heart rate, body temperature) and environment data, such as speed, location, ambient temperature and humidity.

6 Discussion

All artifacts were filled with information that represents a characterization of the child violence problem domain and prospective requirements for a technological solution. One concern in a design process is that stakeholders' values identified in initial phases are carried to later stages of design and how they were transmitted and transformed. The Figure 7 represents the mapping and transformation of values into value-oriented requirements for a children and adolescent "freedom from violence" value.

[5] Available at: https://www.w3.org/WAI/standards-guidelines/wcag/. Last access: 23/03/2023.

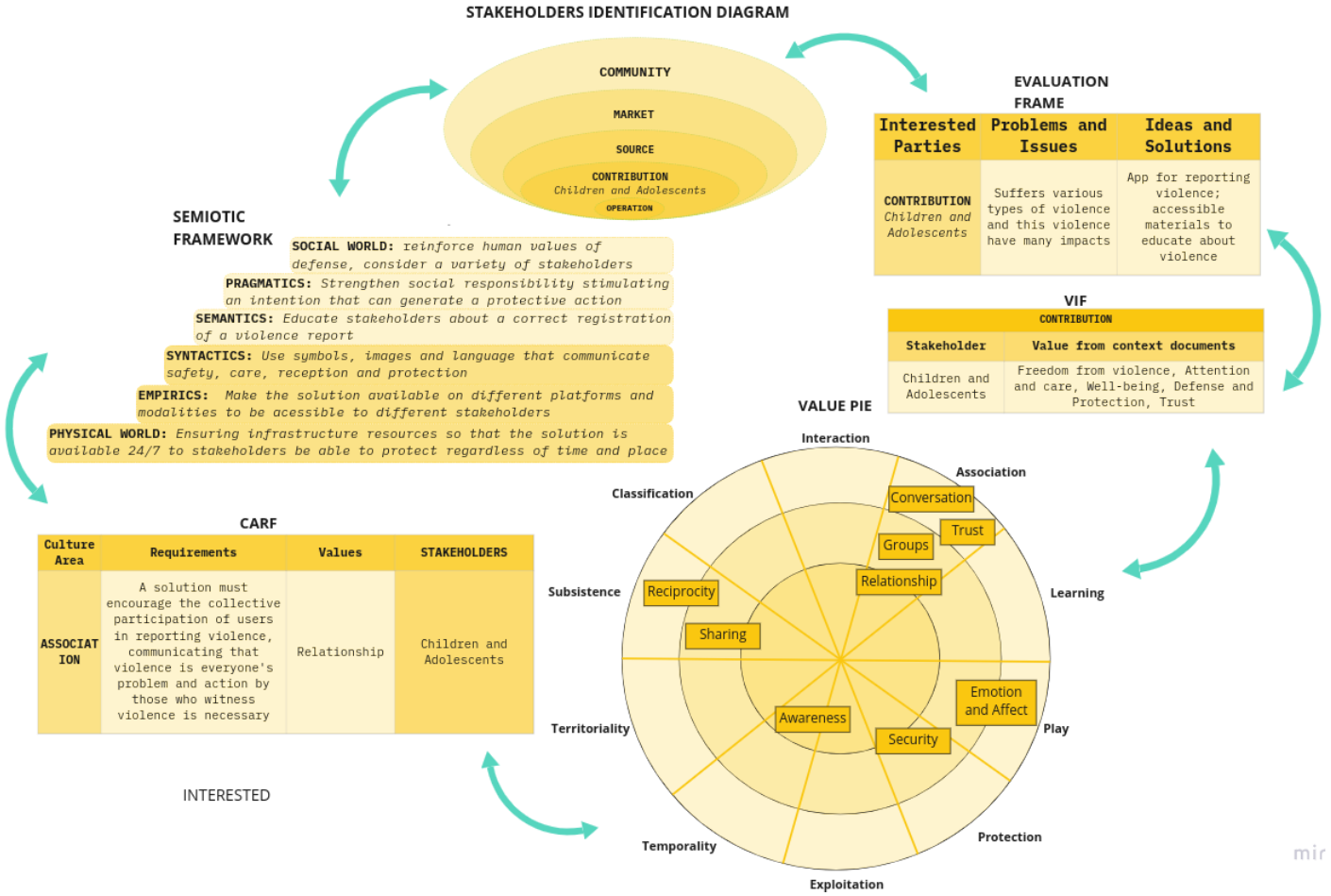

Figure 7. Tracking of a value in VIF and understanding its cultural context in Value Pie to a solution requirement in the CARF artifact

In Figure 7, children and adolescents' main problems are related to the various and inter-related types of violence that they suffer, which motivates the value of freedom from violence. Understanding the cultural context of a value is fostered by the 10 Hall's areas of Culture in Value Pie, revealing the relation with the Protection area, its values of protection and an interaction with the Association area, where many values were mapped. Understanding children's values in cultural areas reveals that their protection may be weakened or reinforced in children and adolescents association with other stakeholders, where collective values of relationships, groups, conversation and trust are important.

Motivated by the value and cultural analysis, features of a solution were represented in CARF artifact, for example the requirement of a solution encouraging the collective participation of users in reporting violence, communicating that violence is everyone's problem and action by those who witness violence is necessary.

Finally, the systemic aspects mapped on the Semiotic Framework represent human and technical aspects for a solution in an integrated way. In human levels, a solution must reinforce values of defense and the intention of different stakeholders to protect childrens and the way of doing it. In technical levels, a solution structure and symbols must communicate a sense of protection for stakeholders, and provide the solution on different platforms and make it available 24/7 to enable stakeholders to report violence when necessary.

Mapping and tracing how values are transmitted to later stages of a design process and how information about values influence requirements, models and prototypes are relevant to understand what stakeholder values were considered and how they were protected or inhibited by a design team.

Mapping values also can help to understand how human values can be represented when developing a technological solution and what value representations are useful in each design stage. Understanding the various representations of a value can reveal insights to capture and identify values in the designer's practice and to better conduct a value-oriented process overall.

We understand that the design of an interactive system must start by considering the informal level of the domain, to advance to the formal and technical levels. The way our design process was conducted supports this view of design, where the stages, artifacts and their combination is one example of a value-oriented and socially aware process to design interactive systems in the situated context of fighting violence against children. The value-oriented and socially aware artifacts are flexible and allow refinement from the problem understanding stage to requirements. Thus, our way of

combining artifacts and method of use is replicable for other situated design contexts of problem understanding and a solution ideation, depending on the designer's purpose and needs.

6.1 Discussion about values and methods

The different artifacts allowed us to move from understanding the problem domain to thinking about a technological solution. This movement was guided and informed by a theoretical and methodological basis - the Socially Aware Design - that considers informal, formal, and technical layers of a society.

Considering the challenge of violence and a solution that may affect different stakeholders, a solution design must balance human aspects and technological aspects in different stages of a design process. A development process must be systematic: human and social aspects, such as values, beliefs and culture must be considered as much as technical ones such as tools, devices and technology. This systemic nature of the process can be represented explicitly as a remark.

Process Remark 1. *Use a systemic approach that considers, in an integrated way, the human and social aspects as much as technical ones when designing technological solutions in challenging contexts.*

Justification. If a systemic process does not occur, designed technical solutions may ignore human necessities and experience. On one hand, considering only human and social requirements can overlook technical aspects that are important to implement and develop a factual technology that will operate. On the other hand, considering only technical aspects can neglect important values and social aspects that will define if a problem is being solved or not and impact in a solution adoption by stakeholders.

Considering values, the informal layer contains peoples' values and its motivations in informal and social interactions; the formal layer has the organization of formal meanings and intentions, such as laws and norms that communicate values; and the technical layer represents the technical artifacts, such as technologies, software and other computational systems that operationalize values. Values of informal and formal aspects of society affect technology design, and once a technical design is produced, it also affects stakeholders' values from formal and informal layers back.

The artifacts we used enabled a value-oriented understanding of the problem domain and think of value-oriented requirements for a solution. Using six artifacts was important to not only capture stakeholders values, its context and motivation, but to transform identified values in design information for a solution. We could think of transforming value-oriented requirements into software models and prototypes to enter the technical level implementing an actual solution. This technical development is part of future work.

Each artifact brings a lens of analysis. Because we are using specific artifacts, we can point out a remark that summarizes a knowledge and premise explicitly about the process conducted.

Process Remark 2*. Specific methods must be used to represent informal, abstract and unclear stakeholders values when developing or evaluating a technology.*

Justification. When values are not explicitly addressed with specific artifacts, methods and techniques, designers count only with their own expertise to work with values. In the case of inexperienced designers, not having value-oriented artifacts restricts what values designers are capable of identifying and how designers represent and propagate values in a design process. If values are not explicitly considered, they may be forgotten or neglected in later phases of a solution design, development and evaluation.

To understand what people value, firstly we need to understand who are the stakeholders in the problem domain. Stakeholder Identification Diagram artifact focuses on finding stakeholder broadly. For us, this artifact was important to understand that violence can come from various sources and that various foci of influence affects a development and adoption of a possible solution against violence. Finding stakeholder broadly can be represented as a remark.

Process Remark 3. *Identify stakeholders including non-obvious ones before working with values.*

Justification. If stakeholders who have influence in the problem / solution are ignored, their values can affect a solution without a design team knowing its effects. In violence contexts, for example, the protection and safety of children can be put at risk.

The Evaluation Frame allowed us to understand the different challenges and issues that people face. This empathy process and problem understanding is important to contextualize and motivate possible values for stakeholders. Finding what solutions exist in the problem domain also enables us to understand what values are being engaged by stakeholders in their efforts to solve the problem. The motivation and actions to find stakeholders and its problems and challenges broadly can be expressed in a remark about the process conducted.

Process Remark 4. *Create a value-oriented understanding of the problem domain to better characterize and motivate the identification and representation of stakeholders' values.*

Justification. Considering the development of a solution to resolve situated problems or challenges, what stakeholders value and think as important can be identified to model a design and drive a development of a solution. In this way, designers will be aware of values that may pass unnoticed and features for a solution may be developed to respect these values.

The Stakeholder Identification Diagram and the Evaluation Frame artifacts allowed us to understand a problem domain and contextualize information to work with values. The Value Identification Frame artifact allowed us to think and identify values for a specific stakeholder in different levels of influence on the problem or solution in a situated context. The Value

Identification Frame artifact represents the pair "stakeholder-values" before thinking about technical requirements and features. Before developing a solution, first we think about what stakeholders need and value, understand the interaction between various stakeholders' values and possible conflicts. This aspect of the process can be represented as a remark.

Process Remark 5. *Identify and represent values for stakeholders with different influences in the problem domain and its possible solution.*

Justification. In our view, a value is something that denotes importance to *somebody* for something in some respect or capacity. Thus, to conduct a value-oriented approach, values from stakeholders (*somebody*) are identified and represented in a way that permits a technological solution to be developed in a value oriented way. Textual, visual, auditory, interactive or other forms of representation can be used for value representation.

The Value Pie complements the previous artifact, bringing in the different areas of culture of Hall to contextualize and characterize each value and its level of formality. Since values are determined by culture, thinking about different cultural areas allows one to understand neglected cultural aspects in previous analysis. Not considering cultural aspects can implicate in not understanding the actual characterization of a stakeholder value. The values' level of formality analysis may reveal whether value identification gives priority for technical aspects instead of informal and formal ones, for example, something that may happen when this analysis is conducted by designers or programmers. The level of formality enabled a systemic analysis of values, categorizing informal, formal and technical values.

Process Remark 6. *Consider the cultural context of stakeholders' values to better characterize it and understand gaps or propensity of values.*

Justification. Value can be completely understood only by considering culture where stakeholders live and give importance to things. Peoples' culture involves shared norms, collective ethical and subjacent expectations that influence people's values. In a school culture, for example, students can value freedom from violence but at the same time may not understand specific behaviors, such as bullying, as a form of violence.

Once stakeholders' values are understood in their situated context, we can think of values in terms of a technological solution. The identified values must be translated to requirements, models, diagrams or prototypes in the development process. Artifacts to represent and model values in various levels of formality are needed for a design team to develop a value-oriented solution. This also can be represented in a remark about the conducted process.

Process Remark 7. *Transmit as input to later stages of a design process value-oriented design information to not lose or forget stakeholders' values when developing a technological solution.*

Justification. Stakeholders' needs and expectations can be neglected if their values are not used as design information to influence technological design in later stages of a solution development.

The CARF artifact started the process of thinking about a solution in a value-oriented way. This artifact represented for us a moment to start thinking more about a solution, where stakeholders and their values appeared as an input, orientating the requirements elicitation. This artifact produced broad requirements that allow values to be tracked. In later phases of a design process these requirements will be transformed into design models, prototypes and source code. Since each requirement is related to a stakeholder value, a value can be identified for any design model or prototype motivated by a CARF requirement. The CARF artifact allowed the transition of information from the problem domain, such as values and stakeholders, to a solution domain, thinking about requirements that respect and enable different interests in relation to the technological solution. The artifact made it possible to bring informal aspects from people's lives and transform them into information for a solution, keeping a trace of the origin of the requirement when relating to stakeholders and their respective values.

The identified requirements, therefore, have a value-associated nature, which represents something that is important to someone in some respect or capacity. Requirements represent desires and needs of different stakeholders for a given solution, so they are represented in an abstract and comprehensive way, without technical detail. Identifying these requirements is a discovery step, representing for a solution what it must or could have, leaving as a future step to define how these requirements will be operationalized or implemented, which in turn is a step of requirement specification. The choice of using requirements to represent value inspired aspects of a solution can be represented in a remark.

Process Remark 8. *Identify solutions' requirements representing features and characteristics to communicate, defend or inhibit a stakeholder value.*

Justification. The identification of value oriented requirements can serve as a starting point of the solution ideation. Requirements can represent ideal features or characteristics that operationalize, reinforce or mitigate values where the level of a requirement abstraction or detail can be specified according to the necessity of a design team. Requirements will serve as a bridge between a stakeholder value and a technical solution, representing important aspects of a solution inspired by a value. These requirements will, in later phases of a design process, be transformed into more technical models, prototypes and source code.

Finally, the Semiotic Framework allowed us to understand a solution in a systematic way, considering different levels of formality from human and social to technical aspects. Considering a systemic analysis is important to consider human and technical aspects holistically. Both aspects must be considerate and the Semiotic Framework artifact allowed us to identify from human and social requirements and to gradually think in technical aspects until the physical and infrastructure

ones. This aspect of the development of a value oriented solution can be represented in a remark.

Process Remark 9. *Consider both human and social requirements with technical ones when developing a technological solution.*

Justification. Identification of requirements that consider social and technological aspects in an integrated way allows different aspects of a value to be gradually represented and it becomes more apparent how a value is represented in a solution.

Table 4 presents a summary of all remarks pointed out in this paper, also presenting how these remarks impacted our research. These remarks can serve as recommendations for other designers working in challenging social contexts and for those that will conduct value-oriented technological development. Designers could combine these artifacts to characterize and develop a shared understanding of their problem context, as well to ideate value-oriented requirements for building a technological solution. For replicating this design process in other situated contexts, we offer these remarks to represent recommendations and indications of what must be considered and what actions must be performed when conducting a value-oriented process for designing interactive systems.

7 Conclusions

The violence against children and adolescents is a complex social problem, where many stakeholders have different challenges and conflicting values that impact the problem and its solution. When addressing social problems, we must start in early stages of a design process with a socially aware understanding of the context capable of considering the interested parties and the values they bring. We presented and used a set of artifacts to create a value-oriented understanding and arrive at prospective requirements for a potential solution, mapping stakeholders, challenges and values.

Through these artifacts, we understood that violence is affected by different stakeholders' forces during life and a solution must consider different types of users; these stakeholders bring values related to a desire for social and human development, such as safety, network support and family strengthening; and these values related to the violence prevention against the victim have is related to the Association area of culture, revealing that a solution needs to address the violence problem by engaging, exploring and enabling safe and healthy relationships and environments. In violence context, violating values can promote perpetuation of violence and more suffering of children and their families.

For example, an asymmetry of power between children and adults occurs in real life scenarios. Adults' values (e.g monitoring or controlling) could overcome younger stakeholders' values (e.g., privacy and care). Because of this asymmetry, a design team needs to use techniques, methods and artifacts to treat values explicitly, which can reveal what guides stakeholders actions and reveal values from hidden and underlying stakeholders. If we do not consider value in an explicit way, deep desires and needs of stakeholders that affect their life can be disrespected by a technical solution, at best preventing a solution from being adopted, and, at worst, promoting conflicting values, such as values that reinforce violence.

As threats to validity and limitations, we conducted an exploratory search for papers and materials, not a systematic one, therefore we may have missed relevant material for analysis. However, the analysis presented in this work does not intend to be exhaustive or to offer any generalization. Rather, the purpose was to illustrate a socially aware and value-oriented process to tackle the problem, presenting artifacts and steps followed to gather information about the problem context and to raise requirements for a solution in the context of violence against children and adolescents. This study represents early phases of a design process intended to develop a solution in a situated context of fighting violence against children. Stakeholders from the problem context will be involved in next iterations of this work to create, evaluate and discuss together the understanding of the problem and ideate a technical solution.

The analysis reveals how violence against children has many challenges of different stakeholders, affecting stakeholders' values and lives. We argue that, in order to deal with a problem of this magnitude, it is necessary to adopt a systemic and situated approach that addresses stakeholders, their problems, values, culture and requirements at different levels of formality.

These results reveal that there is much information about values to be considered when developing a technological solution in a situated social context. The value consideration must not be restricted only to problem understanding or analysis, but in later stages where a solution will be developed using specific artifacts to represent and model values.

New challenges can appear when working with values in contexts where the line between the social, digital and physical aspects of a solution is blurred, for example investigating how to represent and model values for the development of Internet of Things or Ubiquitous Computing technologies. Thus, further work involves expanding the study to think about challenging technological development contexts such as Internet of Things, Pervasive and Wereable, and designing a ubiquitous technology system for the context of protection of children and adolescents based on values.

Finally, utilizing these results as an input, the next iterations for this work will involve domain stakeholders in participatory discussions and hands-on activities to develop together a shared understanding of the problem and to design a technical solution that intervenes in this problem.

Table 4. Summary of remarks identified in this work and related actions

ID	Process Remark	Related Actions
1	Use a systemic approach that considers, in an integrated way, the human and social aspects as much as technical ones when designing technological solutions in challenging contexts.	Socially Aware Design and Value-oriented and Culturally Informed Approach views a information system design in a systematic way using the Organizational Semiotics as theoretical basis.
2	Specific methods must be used to represent informal, abstract and unclear stakeholders values when developing or evaluating a technology.	Specific artifacts from Socially Aware Design and Value-oriented and Culturally Informed Approach were used as methodological basis.
3	Identify stakeholders including non-obvious ones before working with values.	Stakeholder Identification Diagram were used to identify stakeholders broadly.
4	Create a value-oriented understanding of the problem domain to better characterize and motivate the identification and representation of stakeholders' values.	Together with the Stakeholder Identification Diagram, the Evaluation Frame artifact was used to identify stakeholders challenges and pains in the problem domain, and solutions to solve these problems.
5	Identify and represent values for stakeholders with different influences in the problem domain and its possible solution.	The Value Identification Frame artifact was used to help identify and represent different values from different stakeholders from the problem domain.
6	Consider the cultural context of stakeholders' values to better characterize it and understand gaps or propensity of values.	The Value Pie artifact was used to better understand values, culture area gaps and value concentration.
7	Transmit as input to later stages of a design process value-oriented design information to not lose or forget stakeholders' values when developing a technological solution.	Stakeholders' values identified in the Value Identification Frame and Value Pie artifact were used as input when designing a solution in the CARF artifact.
8	Identify solutions' requirements representing features and characteristics to communicate, defend or inhibit a stakeholder value.	The CARF artifact was used to identify value-oriented requirements for a solution.
9	Consider both human and social requirements with technical ones when developing a technological solution.	The Semiotic Framework artifact was used to allow the organization and identification of systemic requirements for a solution.

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