
Ethical Values in situated Cognitive Engineering

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Abstract

Modern warfare is characterized by an increased use of highly autonomous systems that create unprecedented capabilities to deliver military force. However, the dependency on such advanced systems creates several moral and legal challenges, which should be considered already in the design process. The central question becomes how to integrate values into system design. As such two methodologies are discussed. First, the Value Sensitive Design methodology specifically concentrates to embed values important to the (in)direct stakeholders. Alternatively, the situated Cognitive Engineering methodology establishes a sound and validated requirements baseline that is applied when developing many situated context dependent software packages. We propose to combine the methodologies yielding a methodology that allows integrating ethical values in highly autonomous systems using a sound and empirical design rationale.

Author Keywords

Ethics; Levels of Automation; Unmanned Vehicle; Values in Design;

ACM Classification Keywords

D.2.1. Requirement/Specifications: Methodologies;
D.2.10. Design: Methodologies; K.4.1. Public Policy
Issues: Human Safety

General Terms

Legal Aspects, Design, Documentation

Introduction

Modern warfare is impossible without advanced information-based decision support systems. When linked to precision munitions and delivery systems, these complex information systems create unprecedented capabilities to control the delivery of military force. But in the mean time, the dependence on these advanced systems, such as unmanned vehicles, generate moral and legal challenges, which are only beginning to be addressed.

In the United States, for example, the usage of unmanned aerial vehicles is increasingly applied in warzones. Under the reign of the Bush administration, drones were applied once every 40 days to one every four days in today's U.S. missions [6]. Also, the unmanned vehicle procurements costs in the U.S.A. are forecasted to hit 4 billion dollar in 2018 [6].

Today, military teams are challenged by increasingly complex operations also leading to moral and legal dilemmas [3]. In naval littoral operations, for example, asymmetric threats and restrictive legislative rules of engagement contribute to such dilemmas. An asymmetric threat is characterized as a civilian entity having a hostile intention, requiring an increased cognitive effort to properly distinguish it from a non-threat within a limited amount of time. An incorrect decision easily leads to an incorrect decision to use weapons. Military teams are additionally constrained in their actions by so-called rules of engagement. These rules severely constrict the use of active sensors types

and weapons in determining the intent of an unknown contact.

It can thus be stated ethical dilemmas increasingly emerge in the military domain and the question raises how to embed ethical values in the design process. Ultimately, we are interested to study the use of advanced systems to enhance decision making of military personnel in tactical circumstances. We examine how moral and legal objectives can best be implemented within the design and development of military command and control systems.

We believe that the design for such moral and legal ethical values is most methodological sound when Value Sensitive Design (VSD) and situated Cognitive Engineering (sCE) are fused thereby combining the best of both worlds.

Value Sensitive Design

The Value Sensitive Design (VSD) methodology [2] accounts for human values throughout the design process. A value is defined in a broad sense in that it extends the economic worth of a good and refers to what is considered important in life such as friendships, a cup of tea, or art. VSD stresses the iterative approach and acknowledges three investigation dimensions. First, the *conceptual investigation* allows identifying the stakeholders that are affected by the design as well as to determine the trade-offs among competing values. Secondly, the *empirical investigations* dimension studies how participants apprehend individual values in an interactive context while using the design/prototype. Third, the *technical investigation* focuses on how existing technology properties and underlying mechanisms support or hinder human values.

Situated Cognitive Engineering

The situated cognitive engineering methodology [4, 5] consists of, in correspondence with classical cognitive engineering methods, an iterative process of generation, evaluation, and refinement. Core of the sCE methodology is the theory-driven specification of value metrics and their empirical validation. A sound and empirical validated requirements baseline is established using a tree-tier a top-down development of functions:

1. The first component (derive) consists of an integrated analysis of the operational, human factors, and technological drivers or constraints. The determination of the stakeholders in VSD matches elements analyzed in the operation constraints and the critical values are seen as a human factors consideration. The technical investigation in VSD is similar to the technological drivers in sCE.
2. In the second component, a requirements baseline is specified and maintained with its *design rationale* consisting of claims that justify the requirements and use cases that contextualize and organize the requirements. These requirements and rationale are derived from component 1 (derive), and refined and validated from the evaluation results of component 3 (the test-refine).
3. The third component distinguishes three evaluation approaches: reviews, human-in-the-loop evaluations, and simulations. This component has a similar approach as the technical investigation in VSD.

The situated cognitive engineering methodology includes an explicit transfer of concepts & ideas into

situated support functions for the specific operational contexts.

Ontologies are defined as a representation of a world understandable to a computer. As such, an ontology provides a valuable candidate to describe the requirements, values metric, and use cases allowing to specify the values in a coherent and uniform way [1].

Goal

Within this workshop we would like to elaborate on our ideas on combining the two well-established methodologies that co-exist in different scientific fields. VSD is grounded firmly in philosophical sciences and is moving towards the design of novel systems determining the impact values have in these systems (and how to cope with these). sCE is grounded firmly studying interactions between humans and systems and has a long tradition towards designing complex systems for designated situations and different contexts. Combining the power of values in a structured and organized way using claims that justify requirements/values and use-cases to contextualize and organize the requirement/values provides a strong methodology additionally allowing an expect transfer of such requirements to various stakeholders. We will also present the sCET tool that assist the derivation of requirements and ethical values.

Conclusions

Future military operations are increasingly challenged by moral and legal dilemmas due to the changing nature of operations and the maturity level of complex (autonomous) systems. We propose to merge Value Sensitive Design and situated Cognitive Engineering to embed moral and legal objectives within the design and

development of military complex systems. The combination of methodologies generates a foundation of sound and validated requirements that consider ethical values that use an iterative approach.

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