

# Fostering Sustainable Consumption through the Development of Proactive, Human-centered Robot Systems

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**Abstract**—This work addresses the problem of *Responsible Consumption and Production*, one of the UN’s goals for sustainable development. The suggested approach is to exploit the potential that AI and smart devices have on influencing humans’ everyday lives and behavior. More precisely, we propose to develop intelligent robot systems that are both proactive and human-centered to decrease unnecessary consumption of the key resources food, water and energy in the user’s home. This a brief overview of the planned approach of an upcoming project.

## I. INTRODUCTION

Current production and consumption patterns are not sustainable. One of the sustainable development goals by the UN is therefore *Responsible Consumption and Production*<sup>1</sup>. Three key resources massively consumed by humans are food, water and energy. The UN reports that 1/3 of all food each year ends up rotting; by switching to energy efficient lightbulbs, the world would save US \$120 billion annually; 1 billion people do not have access to fresh water. At the same time AI and smart robots become more and more part of our everyday lives and influence humans and their behavior — smart apps helping us to lose weight, robot vacuum cleaners freeing us from household chores, smart cars deciding when to brake etc. These smart devices have the potential to influence and shape human behavior. Can AI and robots be a key for sustainable consumption?

## II. OUR APPROACH

We suggest to approach the problem introduced in Section I by developing AI that is both **proactive** and **human-centered**. By proactive we mean the system can take own initiative, take into account the context, anticipate and weigh different possible futures and different ways of acting against each other in different time perspectives, and can reason about what is desirable in what way [5]. By human-centered we mean the system reflects the broader preferences of the human: instead of trying to achieve some goal at any cost, and it should be aware of its uncertainty of what these preferences are [7]. For the purpose of achieving results that are **general** we set out to develop a formal model and corresponding computational methods for our theory of human-centered proactivity. We plan to study the field of persuasive sustainability systems with the goal to achieve, through technology and without coercion, human behavior

that reduces resource waste [6]. We will investigate how the AI fields context-awareness [3], activity recognition [8], planning [4], goal reasoning [1], and plan execution monitoring [2], and others inter-relate in and relate to the new field of proactivity.

## III. EVALUATION

The intended domains for empirical evaluation are a smart home including a mobile robot and a mobile app. A proactive smart home could lower the room temperature when it foresees the user will be out for a longer period but take the human’s preferences into account for when to increase the temperature again when the user returns. An intelligent robot can proactively cook food using remains of yesterday’s dinner and ingredients with soon expiry date and serving at the preferred time by the user. A smart app in a mobile phone proposes to take the bike to work instead of the car when it foresees there will be no rain, however, it will not make this suggestion when the user recently had a leg injury. It should be noted that we currently lack a methodology to evaluate the added value of proactivity in artificial systems in general, and its ability to achieve reduced resource consumption in particular. In our work we want to provide a methodology for systematic empirical evaluation to find out (i) whether our theories and methods generate and pursue own acting decisions; (ii) whether based on reasoning on the overall human-agent-environment system the theories achieve more desirable states (less resource waste, reduced consumption); and (iii) whether based on reasoning on human preferences the framework achieves human-centered behavior.

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<sup>1</sup><https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>