

# Prospectus

## Design and Construction of an interactive humanoid robot

(Technical Report)

## Incentivizing Pro-environmental Consumption

(STS Research Paper)

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## Technical Topic

Everyday new technologies are integrated into our lives. Some technologies have become particularly life like in their development, and some teeter on the line of discomfort. In robotics, there is a theory known as the uncanny valley in which as humanlike robots approach reality it makes people like them less because it becomes unsettling (Grabianowski, 2019). The team's goal was to create a humanoid robot, to get current and prospective students interested in mechanical engineering while keeping in mind the uncanny valley by setting out to design a robot that wouldn't cross this boundary into discomfort.

The team with a timeline of 15 weeks and a budget of \$600 originally focused on adapting a preexisting capstone design project. This existing project was a humanoid robot assembly consisting of a head, torso, and arms that were constructed primarily of aluminum. The initial goal was to create legs for this humanoid robot torso and head assembly. This quickly proved challenging for multiple reasons the first and more technical challenge was finding a way to support the heavy upper body that also presented the challenge of having a changing centroid. The changing centroid of this upper body could be derived from the arms being able to move and made it so quick decisions had to be made about how the legs would function and look. This brought about another challenge in that the team could not simply present a design without taking into account the design sentiments of the project's predecessors. To further elaborate, the leg design had to mirror the aesthetic of the current robot which was masculine and robust; this led to the idea of a cylindrical base resembling a skirt to be quickly discarded despite its benefit of added stability. Another challenge arising from the base and changing centroid was in deciding what choice of wheels would be used. The team wanting the greatest mobility decided early on that mecanum wheels would be the greatest choice overall. The mecanum wheels that would be needed to support the current robot proved to be too expensive to pursue and amongst the other issues led the team to adopted a new project.

The team with a new freedom of design set out to create a robot from scratch that would serve as an interactive tour guide for the Mechanical Engineering building with a focus on the Mechatronics lab. With this objective in mind, the robot would have to be able to maneuver around the second floor of the mechanical engineering building at the University of Virginia (UVA). To limit the challenges associated with the abandoned project, the team sought to downsize the robot. The new design would be between 1' and 2' tall and be constructed mainly from 3D printed material to reduce cost and weight. The robot would still keep its humanoid upper body but this would be mounted on a Rotunda base giving rise to its name Rotundaur. The inspiration of design stems from the centaur from Greek mythology, but instead of having the lower half of a horse this would be the Rotunda to highlight a uniquely UVA theme. This concept also pays homage to the Rotunda's neoclassical architectural style of ancient Greece. Outside of the appearance of the robot the team wanted to make the tour guide interactive. The interactive elements came in the form of having a controller to move the base of the robot, arms that playback motions based on human input, and lastly having a face that can display varying

emotions. With the added interactive elements, the team believes that the robot will be an effective guide to get students interested in mechanical engineering.

## STS Introduction

When walking the aisles of any store or browsing online we are presented with hundreds of thousands of buying options. Our purchases are driven by a number of factors including: price, and aesthetics to name a few, but when buying how many stop to think of how the items they buy affect the environment, especially when they are disposed of? Before answering this question, it is important to put into context the considerable role of the consumer in the shaping the waste management system.

As China has significantly reduced importing trash from the United States there has been a call for action to manage waste in a new way. It is important to mention the root cause behind the exportation of trash to begin with; this practice can be attributed to the Not in My Backyard (NIMBY) syndrome (Shin & Strohm, 1993). This sentiment is the ideology that while it is simpler and more cost effective to dump trash in a landfill no one would want their trash to be in close proximity to them so it is more favorable overall not only to dump waste products but also have it as far away as possible. This system persisted because there was a market; this was particularly popular in countries with developing economies because compensation for importing trash helped to stimulate economic growth (Shin & Strohm,1993). Historically environmental responsibility has been placed on companies through legislation that has mirrored the sentiments of a growing consumer base that is increasing their demand while having an increase in environmental consciousness (Shin & Strohm,1993). Though this has been the case in the past, it would be important to look into the role of the consumer in current recycling practices. More specifically in how the consumer can help in the reduction of waste products by choosing to support companies that are environmentally friendly?

## Literature Review

It is important to first begin outlining work that has already been presented in the subject area. As mentioned before there is a growing concern about the health of the environment. This sentiment has brought about an increase in the importance of recycling. Though recycling may seem to be a step in the right direction in preserving resources it should be looked at as a last resort. There are many misconceptions in what can and can't be recycled and it may come as a surprise to many, but we can recycle a lot less than what we hope for. It would seem that recycling methods are not as refined to handle the volume that is recycled; therefore, a lot more ends up in landfills than perceived. This in turn highlights the importance of reduction of waste products by starting with consumer purchases. As mentioned before, although there has been an increase in environmental consciousness by consumers, consumer purchases do not align with this sentiment. This disconnect between consumers supporting green products and actually making purchases that reinforce these ideas is known as the "green purchasing inconsistency" or "green attitude behavior gap" (Joshi and Rahman, 2015). To bridge the gap this same study by Joshi and Rahman (2015) sought to look into factors that caused this behavior based on two different criteria, green purchasing intention and behavior. Intention

can be defined as a consumer's want to purchase green products while the latter focuses on the decisions the consumer actually makes. This study yielded a number of variables in which they could identify as independent variables for future studies.

Another study by Young, Hwang, McDonald, and Oates (2009) suggested studying the green consumer behavior when purchasing products in the United Kingdom. That is, they sought to investigate what was the thought process of those that were already engaging in favorable purchasing behavior to establish a model to guide others to this behavior. Through in-depth interviews which led to them finding relevant factors to consider when making a green purchase they were able to devise a green purchasing model. This model consists of five elements: general green values and knowledge, Green criteria for purchase, barriers and facilitators, product purchase, and feedback (Young et al., 2009). The model basically outlined in order for one to be a green purchaser they first needed to begin with that as a value, then look for green qualities such as high efficiency, then consider things that would stop them from making the purchase such as price, eventually buy the product and finally reflect on the feeling the consumer got from the purchase which would in turn influence their next purchase.

While The first two studies mentioned a focus on the consumer behavior (Cronin, Smith, Gleim, Ramirez, & Martinez, 2010) looked at the supply side in studying the implementation of green marketing strategies. This study suggested that the gap stems from a misunderstanding between green consumers and what is actually being offered by companies. This suggested that companies should consider their stakeholders and implement green innovation, greening their organization, and form green alliances (Cronin et al., 2010). That is companies should create greener products, tried to produce products in a more environmentally friendly way or partner with green organizations that may help better achieve the prior suggestions. This would in turn help encourage the consumer to make a green purchase in they are offered more in that area and have potentially a better understanding and trust in companies to provide environmentally friendly products.

A final facet that will be investigated was an approach by the Swedish government. This article set forth a plan where the state and municipal government sought to bridge the green attitude behavior gap ("Strategy for sustainable consumption", 2016). This article outlined focus areas such as: increasing knowledge, encouraging sustainable ways of consuming, and many more to then proceeded to list bullet points that can be seen as a cross between the norms and values that they wish to achieve.

#### Framework, Methodology, and Future work

To go about answering this question the social construction of technology will be utilized to identify the relevant stakeholders in order to shape an approach to reduce the behavior gap in green consumption. Once the stakeholders are determined it would be conducive to conduct interviews in order to determine how these groups perceive the problem. This could shed light on why existing incentives may be inadequate in bridging the gap and lead to not heavily investing time and resources in those incentives. This could also lead to seeing where the understanding of waste deviate in order to give rise to future work to be done in education. In

the sphere of education knowing where the knowledge of the topic diverges can help to develop specific courses and talks that will fit the need of the individual or group. By developing these tailored lessons, it can help to relieve some of the barriers that bar certain individuals from making green purchases. Other work that can be done in the future from defining the stakeholders are these groups can then be looked at from the framework of taking a policy subsystem approach. By segmenting these groups into the categories associated with that approach, that is based on being any combinations of being liked and/or having power, policy could be written to make green consumers a favorable group within that framework. In making green consumers a favorable social group it could encourage more consumers to mimic those behaviors to be a part of that group.

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