Design and Construction of a Kinetic Art Weather Display
(Technical Paper)

The Colonization of Mars: Ethical Concerns Regarding the Future of Human Life
(STS Paper)

A Thesis Prospectus Submitted to the

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Jack Davis
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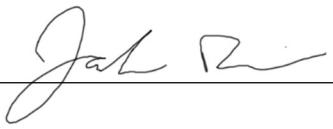
Technical Project Team Members
Lisa Accolla
Katherine Ellis
Adam Lenox
Joshua Rigby

On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

Signature  Date _____
Jack Davis

Approved _____ Date _____
Gavin Garner, Department of Mechanical and Aerospace Engineering

Approved _____ Date _____
Bryn Seabrook, Department of Engineering and Society

Introduction

The possibilities of space travel and the colonization of other planets are becoming more and more enticing to scientists and inventors, and now science fiction seems more realistic than ever before. Yet, those involved in the development of this technology often overlook a very important question: is it ethical? Does the creation of technology capable of allowing humans to colonize space fail to address the concerns that created this demand in the first place? The sociotechnical project proposal addresses the topic of colonizing Mars, and how sentiments regarding these efforts have changed over time. Since the moon landing in 1969, the focus of space exploration has shifted from its base in political turmoil to instead focusing on whether it is needed to ensure the survival of the human race. The paper will discuss this shift in thought as well as explore the factors, both societal and technological, that stand in the way of this accomplishment.

The technical project proposal is a weather display capable of showing outdoor weather patterns in an enclosed environment. Laboratory studies have shown that a lack of windows in a work space results in worse mental health when compared with those working in well-lit areas (Boubekri, 2014). The second essay describes the development of a kinetic art piece designed for those working in cramped areas with few windows. Kinetic art is a form of artwork that combines the traditional visual arts with mechatronic motion to accomplish a functional goal while being aesthetically pleasing (Gadney, 2017). The design is a display mounted to a wall that portrays the weather outside as time passes, utilizing rotating weather patterns and a sun and moon that displays the daytime or nighttime. It is possible to mount the display in any windowless location to better give an interpretation of time and weather in the surrounding areas. This paper explains the creation process of this device and the features that accompany it.

Technical Prospectus

The objective of the capstone project is to develop a functional piece of wall art that uses hidden mechanical movements and electronics to display various outdoor weather conditions. It will further be referred to as a kinetic art weather display or weather display. This idea was inspired by the conditions that students and researchers are under when they are working in the laboratories of the University of Virginia's Mechanical and Aerospace Engineering department, which are located in the basement of the Mechanical Engineering (MEC) Building at UVA. These labs have no windows and one can easily lose track of time, especially when personal protective equipment is being worn, making it difficult to check one's phone. Thus, the weather display will serve the purpose of informing users of the current conditions outdoors (rain, snow, clear, daytime, nighttime, etc) through pictorial means that are quick and easy to process with just a glance, while also being aesthetically pleasing. The kinetic art piece will also demonstrate important engineering concepts such as the modern-day synthesis of electronics and mechanical devices, as well as advanced manufacturing techniques such as 3D-printing, CNC machining, and laser cutting that allow for the construction of complex products with relatively low monetary and time costs.

A literature review yielded one product that is of a similar concept to the one developed by the capstone group. The "Weather Clock" by Bramwell Brown is primarily an analog clock, but it has a small display in the bottom portion that depicts various weather conditions with moving parts and what weather condition is displayed is dependent upon the information from an internal barometric pressure sensor (*Weather Clock,* 2020). From the following description, it

can be discerned that the capstone group's weather display will differ significantly from the "Weather Clock".

The display will be a circular design fashioned from wood using a CNC Mill, where the top half is a visible window for weather and the bottom will be space to store the mechanics that operate the weather changing devices. The viewing area will feature two transparent, semicircular acrylic sheets that are engraved with rain and snow patterns. These sheets, when illuminated by strips of LED lights, provide an artistic simulation of the current weather pattern. The design will also involve sun and moon figures that rotate around the display to indicate the day and night. Smaller features that will be included are a backlight that can vary brightness within the window, a UVA-themed background, an LED matrix display indicating time, date, and temperature, as well as interactive buttons that will allow manual control of the settings. The goal is for all these movements and displays to be dictated by a Parallax Propeller microcontroller chip that is connected to a Raspberry Pi single-board computer, capable of relaying weather and time data from an open-source application programming interface (API).

The team creating the display is formed by Lisa Accolla, Jack Davis, Katherine Ellis, Adam Lenox, and Josh Rigby. The capstone group's general plan is to prototype the various mechanical movements to see if they are viable. Then, the entire project will be modeled in a computer-aided design (CAD) software to determine the placement of all the components and overall size of the project. Once the modeling is complete, the weather display will be constructed with traditional techniques as well as new, advanced manufacturing techniques such as 3D-printing, wood CNC milling, and laser cutting acrylic. The project is set to be completed in November 2020.

STS Research Paper Prospectus

The modern society is driven by a need to invent and discover, consistently popularizing new creations that can improve and enhance everyday life. In a world led by technological development, among some of the most impressive feats are those made in the field of space travel. In recent years, private companies have emerged as frontrunners in the industry. In one case, the founder of SpaceX, Elon Musk, has promised to have humans land on the surface of Mars within the next two decades with the eventual goal of forming a one-million-person colony (Platt, 2020). However, for all this idealism and optimism, the colonization of Mars is far more complex than it appears. In order to understand it completely, it is important to look historically at movements concerning space.

The moon landing in 1969 served as a turning point in human history and the cap of a politically charged race between the United States and the Soviet Union for the claim of being the nation that landed the first human on the moon (Jouhki, 2019). This event marked a landmark in technological innovation and launched countless new missions and programs in the hopes of furthering humans' knowledge of space. Although in recent years no human has set foot on the moon, probes, satellites and space stations are now located on multiple planets in order to further human discovery (Benson, 2019). The concept of colonization of another world was already at the forefront of countless minds, as it was formally addressed in 1967 by the United Nations before the first man ever landed on the moon (*Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies,* 2021). This was treaty was formed in the heat of political unrest, and its authors were skeptical of any one nation holding an advantage on another world.

Today, the context of space exploration has shifted from satisfying political agendas to becoming potentially necessary for survival. Many scientists, such as Stephen Hawking, have expressed their concerns, claiming that the human race has "'reached the point of no return'" (Gohd, 2017). Other advocates claim that this endeavor is the most important project in human history, as its success could guarantee the safety of trillions of human lives (Thompson, 2018). In spite of these points, however, many argue that the human race should not pursue Mars as an alternative to the Earth. Kramer describes the "justice between generations" owed by the former generations to "leave the Earth in as good a condition as we find it" (Kramer, 2011). Others, such as Chris McKay, a planetary scientist, say that the cost of reaching Mars is almost impossible of attaining without it serving as a purely governmental operation (Jones, 2017). Other limitations are simply the extents to which the human body is able to withstand the environment on Mars, which hosts variable oxygen levels, low gravity, and harmful radiation (Straume, 2010). Some scientists argue that there are possible biological enhancements that could allow humans to better adapt and survive in these climates, but even then, some claim that the prospect of experimenting on a human body is unethical as well (Szocik, 2020). Even basic human functions, such as their ability to see properly, could be damaged upon arrival to Mars (Aleci, 2020). Coupled with these problems are those posed by human nature itself, including how to define laws and regulations on a new world. Laws on Earth may not apply to colonists living in completely different manners without the established society of the world we know now (Levchenko, 2018).

An important STS framework for this analysis is the social construction of technology (or SCOT), which describes the nature of how society drives technological development and implementation into human life (Klein, 2002). In this paper, the use of SCOT allows for the comparison of sentiments regarding colonization efforts through the lens of the social and

political factors that were in play during each era. By using SCOT as a tool to analyze the colonization of Mars, the societal factors behind the various landmarks in the history of space exploration, the varying importance of multiple factors in society and their impact on technological development will be established and related to each other. Another potential STS framework for this analysis is the technological fix, which is a problem that relies on a technological solution to address a problem that has other political, social, or economic oversights (Newberry, 2005). The concept of a technological fix allows for the observation of the colonization of Mars in a new light and studies whether it would be justified in light of the hardships it would require to get to the planet.

The research question is: Does the change in historical context justify the need to colonize Mars? Analysis of this debate will be done using a vast array of literature such as articles and essays composed by experts in the various fields pertaining to space travel. The analysis of government actions, laws, and historical data will add important insight as well. The information will be organized chronologically, moving topic by topic to provide wholistic and pertinent research with clear synthesis at the end that directly references the research question.

Conclusion

This proposal introduces two diverse and intricate problems. The topic of colonizing Mars is growing more prevalent as technology develops in the field of space travel. However, the context in which this technology was created is just as important in understanding the motivation behind this innovation. The technical project is a synthesis of electronics and moving mechanisms to create a permanent weather display useful for years to come. It uses common

fabrication techniques and a knowledge of 3D modeling in order to make a product that is both novel and useful for students and researchers working in windowless labs.

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