**Thesis Project Portfolio**

# Hybrid Humanoid Robot (HHR)

(Technical Report)

# Predicting Future Transformations and Labor Market Changes in the U.S. Manufacturing Sector Due to Industry Use of Automation and Robotics

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis
(Executive Summary)

"Automation does not need to be our enemy. I think machines can make life easier for men, if men do not let the machines dominate them." – John F. Kennedy

No industry has witnessed the evolution and impact of automation technology more than manufacturing. This industry once dominated and solely operated by human workers, has transformed its assembly line production process into one carried out by the most cutting-edge autonomous technologies. The use of automation and robotics have been increasingly popular in many industries for their increased productivity, reduced long-term costs, and a high degree of precision. Consequentially, many hazardous and meticulous jobs can be replaced by these technologies, ultimately improving human safety and working conditions for millions of laborers. This is the long-term goal of my technical project outlined and sponsored by the U.S. Navy: to design and program an autonomous hybrid-humanoid robot (HHR) featuring 30 Dynamixel servo motors for use in various naval-ship settings.

As outlined by the customer needs set forth by the Navy, our goals as a team in this first-generation project consisted of building the framework for the robot to be operated through teleoperation, and to finalize the physical design featuring a compliant foot/wheel mechanism. For a hybrid humanoid robot capable of operating in both wheeled and bipedal settings, it is essential to incorporate a mechanism capable of translational movement on flat surfaces in wheeled settings and stability when operated as a bipedal robot. We were successful in this pursuit and created a 'flat-tire' wheel design that incorporates conical springs to achieve this compliant functionality. To maneuver appropriately in a naval ship setting, our goal as a team was to set up a system where the robot's 30 servo motors could be intuitively operated through a

single controller. We sought to have the robot successfully navigate a watertight door and climb a 63-degree ladder commonly found in ship settings. We were successful in the programming of a controller to operate the robot and were able to move the robot on flat surfaces. However, we were unsuccessful in the robot's ability to climb a 63-degree ladder.

In my STS research, I investigated the effect of automated robots on the development of the manufacturing industry within the United States, particularly for the future of work for existing blue-collar and production workers. There is strong evidence that the use of this technology is displacing existing workers and creating a dramatic shift in the demand for labor in this industry. I will use modern labor market segmentation theory and structural change theory to analyze and determine the effects of automation on this demographic's socioeconomic future. Through a utilitarian analysis of the effects of automation on the U.S. economy as a whole compared with its impact on this demographic of existing workers, I suggest that the U.S. should incentivize and promote the use of automated technologies within manufacturing and that the long-term socioeconomic impact on this population is marginal relative to the economic benefits of adopting automation.

By considering these technical and social impacts of technology, we can more clearly see how the use of tools and technologies can fundamentally alter the structure of society and how people function together. The creation of automated robots and their use within manufacturing will consequentially change the demand and type of labor required in many existing jobs while simultaneously displacing existing workers into other industries. Engineers need to understand how these technologies impact society beyond just their technical scope.

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