Thesis Project Portfolio

Hybrid Humanoid Robot (HHR)

(Technical Report)

Beyond Borders: Nepali Immigrants tangled in the Kafala system

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Introduction

Both my STS research project and technical capstone are centered around the theme of human labor. My STS research project focuses on the journey of Nepali immigrant workers from their home country to Qatar and their experiences in Qatar under the Kafala system and other restrictions. My technical capstone project involves building hybrid humanoid robots that are designed to work alongside humans or autonomously on Naval ships. During my technical project, I learned about how robots are used in various situations to enhance human collaboration. It was then that I questioned myself why are people still dying, especially in Qatar during the construction of the World Cup infrastructure. I took this opportunity to learn more about the migration patterns and experiences of these workers. My main goal is to simply educate and raise awareness about the hardships faced by these workers. I am not suggesting the idea of replacing these workers with robots; rather, I am taking this opportunity to understand more about the workers in construction fields that have to perform risky tasks.

STS Project

My STS research project focuses on how the Kafala system, a sponsorship based employment structure commonly seen in Gulf nations, like Qatar, leads to exploitation and violations of rights among migrant workers. In the paper, I walk through the journey of these workers, beginning in their homeland, where they must overcome the challenges of finding trustworthy labor recruitment agencies. I highlight a few prominent challenges they face in Nepal which forces them to leave the country. I focus on the unnecessarily difficult situations Nepali migrant workers experience, question the general beliefs about the Kafala system, and advocate

for changes to enhance the protection of worker's lives. I attempt to convey that while Qatar's progress in infrastructure and economy often steals the spotlight, the struggles faced by these workers unveil the realities of labor migration within this system. I include information from papers, reports, international organization and new articles. Most importantly, I interviewed two of my family friends that were involved in the construction of stadiums for the FIFA World Cup 2022. To understand the issues, I adopted the Social Construction of Technology (SCOT) framework developed by Pinch & Bijker. Using the SCOT framework, I analyzed how different social groups, such as labor recruitment agencies and companies wield their power. I examined how these agencies and companies use their power to suppress the human rights of these workers with less power and pull out the consequences they face.

Technical Report

My technical capstone project focuses on hybrid humanoid robots (HHR) designed for operation on Naval ships. I was assigned to this year-long project with 5 other mechanical engineering students. During the first half of the year, we concentrated primarily on product design aspects. Product design phase involved understanding customer needs, defining target specifications, generating and selecting concepts, project planning, and performing economic analysis. We understood specific customer needs which included a compliant wheel/foot mechanism capable of climbing a 63-degree ladder, maintaining efficiency on both flat and uneven floors, operating through teleoperation, and ability to walk over a watertight door. HHR is composed of sensors, actuators, microcontroller, power supply, and other mechanical components to achieve those functionalities. The advancement in robotics/automation aims to simplify human tasks by reducing the need for continuous and dangerous manual labor. We divided our team into three subgroups: mechatronics, ROS, and mechanical design. The

mechatronics group conducted research on different hardwares and integrated them into the system. I was mostly part of the ROS group and focused on software development using Python and C++ to control the microprocessor and execute desired commands on HHR. The mechanical group was responsible for designing the 3-D model of the foot mechanism and other subsections of the HHR system. In the second half of the year, we worked mostly on the physical assembly and testing of the HHR. We successfully controlled the HHRls movements using joystick buttons. Additionally, we were able to make the robot roll on the flat surface with extra support and attempt to climb up the ladder. We had the opportunity to use a 3D-printer, metal milling machine, and lathe to perform different manufacturing processes to create and machine parts. Although we were unable to fully incorporate all customer needs, we learned the complexity of designing and building robots. Upon completion, we realized the significance of the potential of HHRs in enhancing human lives.

Conclusion

I have gained a deeper understanding of human labor and technology working on these projects at the same time. Studying the challenges faced by Nepali migrant workers in Qatar made me question why we still use people for risky jobs. At the same time, building robots for Naval Ships showed me how technology can help with difficult tasks and enhance human lives. My technical project perspective made me wonder about the possibility of using robots to address the challenges faced by migrant workers in the construction sector. However, working on both my projects at the same time I realized in the case of the Qatar workforce, simply replacing these workers with robots is not suitable, otherwise a country like Nepal that is heavily dependent on remittance would face significant instability. Additionally, I realized the complexity of developing robots from scratch; it takes years to fully develop them. Working on

both STS and technical solutions, I realized that sometimes solutions that seem close or feasible are actually much further away than they appear and are not the best option. Overall, I learned that technology and society shape and influence each other in various complicated ways, and working on these projects allowed me to explore the dynamics between robots, power, and human rights within the context of labor migration.