Undergraduate Thesis Prospectus

Hybrid Humanoid Robot Advancement

(technical research project in Mechanical Engineering)

How Technological Change is Transforming Human Capital

(sociotechnical research project)

By

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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.

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Technical Advisor: Tomonari Furukawa, Department of Mechanical Engineering

STS Advisor: Peter Norton, Department of Engineering and Society

General research problem

How is human emulation in technological systems best pursued?

There has always been a struggle between technological advancement and the status quo. This debate is more charged than ever, with the emergence of GenAI and advanced robotics which aim to emulate human skills. Many industries are experimenting on how much of a role they can afford to give AI. In the agriculture industry, AgROS is a simulation environment farmers can use to import their farm layout and simulate physical unmanned ground vehicles, UGVs, working their farmland (Tsolakis, Bechtsis, & Bochtis, 2019). Chatbot personal secretaries in the corporate world have grown exponentially and show no signs of slowing down (Gkinko & Elbanna, 2023). Some argue that the necessary safety practices for these tools that aim to transform every industry are nowhere near as prioritized as product development. Even in its infancy, the AI industry has raised concerns in privacy, racial justice, and social justice. Groundbreaking tools are going to be introduced in the coming decades, however the net impact will depend on how our society's social framework puts these tools into practice.

Hybrid humanoid robot advancement

How may the versatility of a humanoid robot's mobility be improved?

This technical capstone project is under the Mechanical Engineering Department and is being advised by Tomonari Furukawa. Project collaborators include: Austin Davis, Yushek Sitoula, Orlando Sadek, Lucas Murphy, and Sagar Sapkota. Improving past efforts on a humanoid hybrid robot, with focus on designing a compliant mechanism to function as a foot and a wheel for the robot. A compliant mechanism is defined as any mechanism that achieves force transmission through elastic deformation. The project aims to create a robot for naval research that can operate in conditions unsafe for humans, specifically in a submarine where it would

need to climb steep ladders and open heavy doors. In emergency situations, the robot would be deployed to close doors, operate machinery, and escort crew members.The Defense Advanced Research Projects Agency, DARPA, hosts a competition which displays the current state of autonomous robots being used in surveillance, search and rescue, and maintenance applications. Current bipedal robots have autonomous capabilities, and can intelligently reason through their environment. But these robots have very rigid designs, incapable of adapting to fast changing terrain. Recent competitions and industry leaders are focusing on navigating uneven terrain such as underground taverns (Ackerman, 2022). Autonomous robots exist in industry today, what makes this design uniquely challenging is the use of compliant mechanisms. Rather than having the robot exchange between separate wheel and foot parts, the wheel/foot design needs to be one body that can expand into a wheel and compress into a foot easily. The project team is separated into Mechatronics, ROS, and Mechanical design teams. Starting with reverse engineering past team efforts, the mechatronics team will look to understand the controls of the existing robot while the ROS team masters autonomous controls using Robotic Operating Software (ROS). Then the Mechanical design team will focus on designing, prototyping, testing, and implementing a wheel/foot design into the existing robot. Lastly, all three systems will need to be implemented together through testing to create a fully functioning robot that can navigate the difficult terrain of a submarine with a compliant foot/wheel mechanism. The final product will be an autonomous robot that can intelligently navigate through uneven terrain using its foot/wheel. This robot can then be applied into a real submarine setting with the next focus on how a robot can fit into the tight organizational structure of submarines.

How technological change is transforming human capital

How are social groups competing to draw the line between desirable and undesirable applications of GenAI?

The emergence of GenAI has sparked discussion over its applications in human led industries. While the applications of GenAI have not been realized, this has not stopped social groups from debating the use of GenAI even in its early stages. A large number of companies are deploying AI and are already seeing its impacts. Samsung's semiconductor division allowed engineers to use ChatGPT, and workers used the platform to leak trade secrets (Mearian, 2023). In another case, Insight Enterprises used ChatGPT in its distribution center, saving money on mundane tasks such as updating product statuses and supply systems (Mearian, 2023). It's unclear if GenAI will have a net positive impact on human capital, but this will not slow down its deployment. Surveys done by Ernst & Young (EY), found that 53% of US CEOs expect to use GenAI to assist with research and development (Mearian, 2023). How are stakeholders drawing boundaries for this new groundbreaking tool that aims to change the way human capital works?

A main concern is how many jobs will AI kill or create? Proponents of AI argue that while AI will definitely replace humans for specific jobs, the benefit of new jobs outweigh these concerns. Opponents argue this shift will displace too much of the working population and the cost of learning new skills is too high. An important measure of this debate is how deeply executive leaders in organizations are thinking about these risks, amongst other factors such as potential savings or competitive advantages. A study done at the World Conference of Information Systems and Technologies, WorldCIST, aimed to "better understand the impact of AI on organizations, and how the availability of AI tools and associated risks could affect the organizational adoption of AI…" (Shuhaiber, 2022). This study surveyed industry leaders in the

United Arab Emirates, and determined that the most important factor in the adoption of AI is how many jobs it could kill or create. According to this study, executives are not fully committed to replacing large amounts of their workforce in order to save costs, but at the same time have not ruled out this possibility entirely. In the education industry, a study done about AI technologies' impact in higher education in China focused on what the classroom of the future might look like,“This research matched the knowledge points with the curriculum of each university to form a personalized educational AI knowledge map based on the different students in different disciplines” (Wang, 2023). Using AI to revolutionize education, this tool would keep teachers but aim to cut costs that high education schools spend on educational material, which is estimated to be 3 million USD a year (Wang, 2023). This study offers a possible solution to the debate over AI adoption, where human jobs are secured and AI is used purely as a secondary tool. A lot of the research done is conducted purely in a controlled setting, where stakeholders do not actually have anything at risk. A lot of the controversy surrounding AI comes from the fear of losing livelihoods or industries disappearing entirely, so further research needs to be done focusing on the possible socioeconomic impacts of AI and how stakeholders are planning to react in the real world rather than in a controlled environment.

Participants include prominent labor union, Writers Guild of America who’s recent strikes include a focus on the regulation of GenAI before the widespread use of this tool “This issue is not on the radar of anyone else running for the board and while I might sound like a paranoid lunatic talking about it today, in 10 years I’m confident you’ll be glad I brought it up now” (Maddaus, 2023). Writers in the WGA are seeking job security in the face of chatbots which can write movie scripts in a matter of minutes. Similarly another participant, Algorithmic Justice League seeks to call out a very crucial flaw in a majority of algorithms being used today.

The AJL's main goal is to call for major companies looking to implement AI tools to first look at the inherent racial bias that is strong in a large number of algorithms used today, "IBM should lead its industry peers, and each company should commit to provide at least one million dollars to support racial justice in the tech sector" (Buolamwini, 2020). More participants include OpenAI, who assures consumers that they are committed to the safe use of their tool, ChatGPT "We believe that powerful AI systems should be subject to rigorous safety evaluations" (OpenAI, 2023). Center for Human-Compatible Artificial Intelligence (CHAI) argues to improve AI's handling of safety issues "That is, it's not enough that an AI system seems to work – it must be possible to prove that it will work across a wide range of both expected and unexpected situations" (Russel, 2023). Groups such as OpenAI and CHAI argue that the only way to appease safety concerns is to ramp up AI integration in order to build strong context for AI tools which would make it safer to use. Finally, the Computer and Communication Industry Association is a global trade association that is currently lobbying against a lot of AI regulation policies that have been introduced recently, "it is still very early days for AI technology, and rapid developments are yet to come…any asymmetric regulation is likely to become outdated within a few years, if not months" (CCIA, 2023). Companies like Amazon, Google, IBM, and Adobe are all members of the CCIA, and argue that the fast paced nature of the AI industry cannot be regulated. CCIA also argues that a growing AI industry should be supported not regulated, and that any regulation will hurt future job opportunities and new players trying to enter the industry.

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