Undergraduate Thesis Prospectus

User Automation and Authentication for the Mill's Laser Cutter

(technical research project in Mechanical Engineering)

Designed for Safety: Integration of Worker and Automation

(STS 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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General research problem

How do social groups adapt to automation? Automation is a constant in daily life, ranging from coffee makers to fully robotic factories. Many tasks done manually today may be easily automated as technology continues to improve. There is a measurable benefit to automation in improving health, comfortability, and safety of society. Studies of crash avoidance systems in automobiles could reduce vehicle accidents by up to 32 percent (Yue et al, 2018). However, according to Lee the dependence between people and machine can create unanticipated consequences, such as a reliance on automated warning systems instead of the warnings being a source of secondary information (2017). Understanding the relationship between people and automation is necessary for a safe and effective merging of new systems.

User Automation and Authentication for the Mill's Laser Cutter

How can an authorized user's attention at the Mill's laser cutter be insured during a running operation? The capstone project is advised by Dr. Gavin Garner, Director of Undergraduate Studies, for the mechanical engineering department and done in conjunction with Josh Holtzman. The laser cutting process must always be monitored by attentive and trained personnel. Under certain conditions, fire and toxic volatile compounds are possible. If a self-sustaining fire occurs, the user can swiftly intervene before excessive damage or injury occurs (ULS, 2018). There is a fume fan installed on the Mill's laser cutter, though leaving it on for long periods do cause unpleasant odors to be pulled from the Mill's drainage system.

The goal is to design a system that prompts the user to remain attentive during cutting and insures the fume fan is turned off while the laser cutter is not in use. We are required to design the system with mechatronics, to limit construction to use only the tools at UVA, to

include an authorized user override, and to remain under a $1500 budget. A current system to prevent laser cutting operation exist if the fume fan is not turned on, but only posted reminders are in place for the user to turn it off. Without a new system in place, the laser cutter will run unattended and the fan fame could be left on unintentionally.

We plan to design a chair on a guided system to move the user from the control computer to a proper vantage point in front of the laser cutter. A weight sensor in the chair will deactivate the fume fan after a set interval. We will design the guided chair system in Solid Works to determine proper dimensioning and placement of the components. A prototype will not be built do to the size of the construction. Success will be a reduced risk of fire and automatic shut-off of the fume fan.

Designed for Safety: Integration of Worker and Automation

How do critics and promoters of workplace automation influence its extent? According to the Bureau of Labor Statistics there were 2,811,500 nonfatal and 5,147 fatal injuries and illnesses reported for 2017 (BLS, n.d.). The top injuries that result in days of lost work are overexertion, contact with objects and equipment, and falls (NCS, 2019). Automating repetitive and labor-intense task in the workplace is commonplace, with the first documented example in 1888 (Kranzerg, 2017). Introduction of automation increases efficiency and can contribute to a safer workplace. However, concerns over the proliferation of workplace automation are expressed by many and include worker replacement, human and machine contact, and mental health (Horton et al, 2018).

Current research and practices work to address the inclusion of automation in industry. Companies such as Midwest Engineered Systems (MWES, n.d.) and Rockwell Automation (RA,

2019) offer safety training when providing companies with automation solutions, teaching employees how to safely interact with automation. Computer monitoring with deep learning software assess worker ergonomics and reports activities that put joints and muscles at risk of injury (Parsa et al, 2019). Implementation of driverless systems at an iron mine in Australia reduces fuel consumption and maintenance cost, decreasing the company's greenhouse gas emissions at the cost of jobs (Cosbey et al, 2016).

People have concerns or goals with the interaction between automation and the workplace. The Organization for Economic Co-operation and Development claims it seeks to "shape policies that foster prosperity, equality, opportunity and well-being for all" (OECD, 2019) by balancing automations benefits against its economic and social cost. The International Institute for Sustainable Development address social and economic development, including areas where jobs have lost to automation (IISD, 2018). Through its Division of Science Integration, the National Institute for Occupational Safety and Health make recommendations in the prevention of worker injury and illness related to technology in the workplace (NIOSH, 2019). McKinsey is a management consulting partnership that seek to increase client's revenue, with automation of task as a major recommendation (Chui et al, 2016). Law offices, such as Seyfarth's Workplace Safety and Environmental Law Alert Practice Group, help clients who were negatively affected by technology in the workplace to seek compensation (Clark et al, 2018). The Society for Industrial and Organizational Psychology "provide evidence-based support to policymakers" about how workers react and respond to new technologies and automation (SIOP, 2019).

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