

UNIVERSAL AUTOMATED BLINDS
IMPACT OF NATURAL ELEMENTS ON MENTAL HEALTH

A Thesis Prospectus
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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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Slowly our society is evolving towards more futuristic technologies, especially in regards to daily home life. “Smart home” devices, the usual marketing term for these devices, have introduced easier aspects to the home living experience. These devices include fridges, smart speakers (Google Home/Amazon Echo), Ring (video doorbell), and more the list goes on and on. Though it might not seem as important as these other smart home devices, window blinds are a necessary improvement to smart homes. Manual blinds are tedious and forgettable, although automated blinds exist, they are expensive and require a complete replacement. Nowadays, home-owners have a list of quite a few tasks to accomplish in the day; adjusting blinds are not near the top of the list, but not adjusting blinds can be detrimental to their health. Studies have shown that exposure to natural elements and sunlight reduce impacts of stress, anxiety, and depression (Leather, 1998). This is prevalent now because of the stay at home order due to COVID-19 a majority of employees are working from home. A recent survey conducted by the Centers for Disease Control and Prevention reported 31% of adults were struggling with anxiety/depression (Czeisler, 2020, p.3).

The technical research and loosely coupled STS topic tackle the impact that automated blinds would have on the mental health of the stay at home employees due to the current pandemic. For the technical research, partnered with a team an automated device for blinds will be created that can be used by all home owners. The STS topic will focus on the impact and effect that sunlight and natural elements have on the mental health of employees. Under the guidance of Electrical and Computer Engineering Professors Harry Powell and Adam Barnes, with Computer Engineers Eddie Agyeman, Brandon Chan, Kwadwo Tenkorang, and I will develop fully automated blinds. Figure 1 shown on page 2 is a Gantt chart depicting the timeline of the deliverables for the STS topic and the technical project.

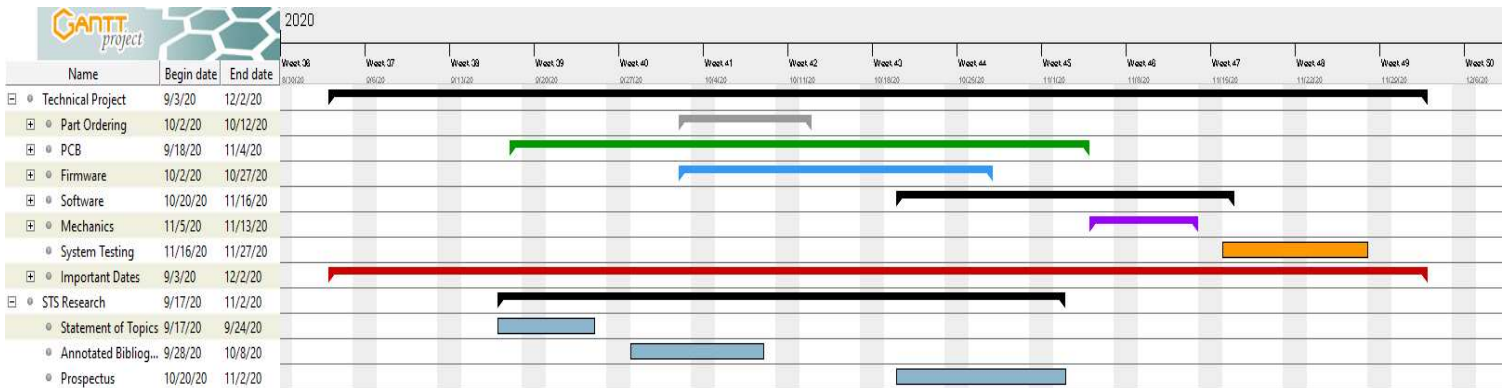


Figure 1: Timetable: Shows the time frame and due dates for both the technical project and STS deliverables (Dinare, 2020).

UNIVERSAL AUTOMATED BLINDS

COMPARISON TO EXISTING PRODUCTS

The technical project introduces a universal solution for the automation of blinds. Several automated designs have been developed, but these devices have ignored the function of privacy. The main devices in the market for automated blinds consist of complete replacement with a remote control to adjust the blinds or a timer setting (Yoolax, 2018). An expensive add-on, this device latches onto the blinds; it includes solar panels to conserve energy and a remote control to adjust the blinds (Vinogradova, 2018). One device exists that is a universal device that comes with a remote control, but this device does not include a privacy feature (Motorize, 2014). The privacy function activates if there are any movements outside near the window preventing any visibility within the home. This privacy function is important now as the current pandemic caused employees and students to begin working inside their homes. The objective of the technical project is to develop a device that automates blinds with a privacy function within the timeframe of one semester. This project is a great opportunity to get some hands-on experience with design, development, and testing of a device that was not a part of a class curriculum.

OVERVIEW OF AUTOMATED BLINDS DESIGN

The system design, to make implementation and explanation easier, contains four subsystems: sensing, actuation, communication, and power. Each of these subsystems can pass data between one another through the use of a microcontroller. A block diagram shown in Figure 2 describes the whole system and the relation of each subsystem.

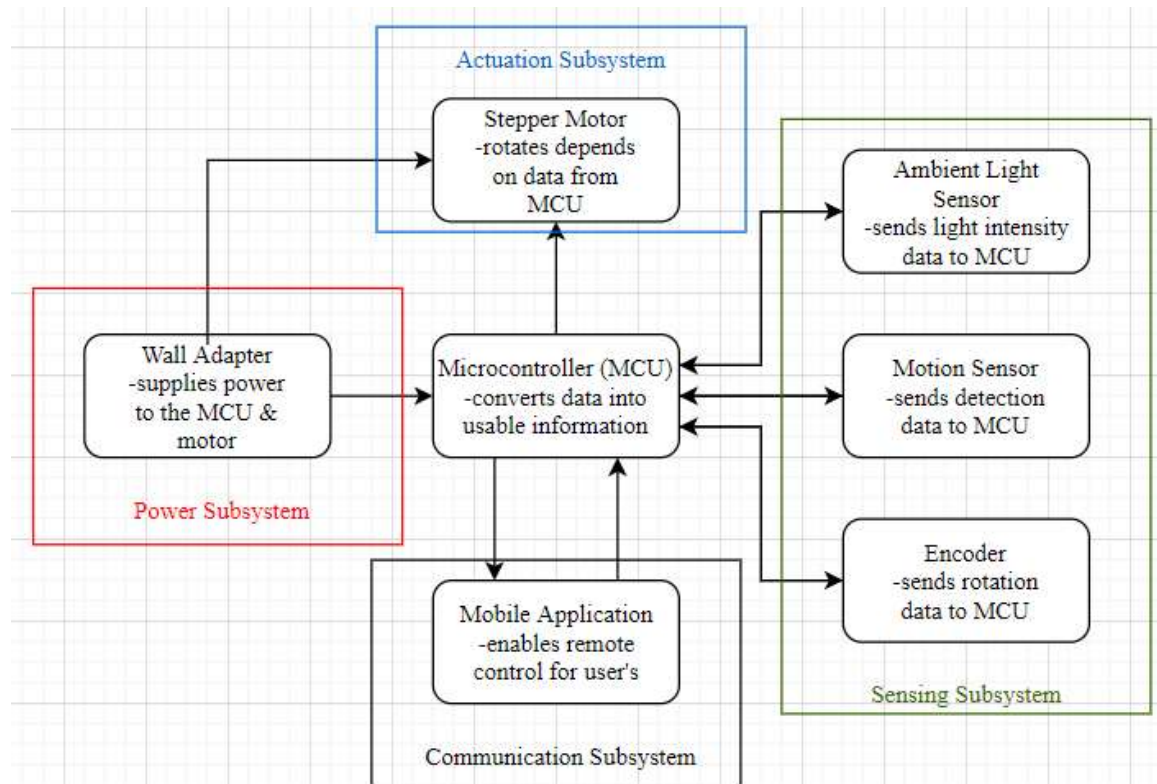


Figure 2: Automated blinds block diagram: Shows the interactions between the microcontroller and subsystems including the role of each component (Dinare, 2020).

The sensing subsystem consists of an ambient light sensor, motion sensor, and encoder. The light sensor measures the intensity of the sunlight coming through the window and can accurately adjust the blinds according to the user's preference. The motion sensor will detect if there is any movement outside near the window and will send a signal to the actuation system. The encoder keeps track of the position of the blinds and makes sure the motor does not turn the

wand too far. The actuation subsystem consists of the stepper motor and encoder. The stepper motor will adjust the blinds by rotating the wand in either direction. The motor can also be controlled through a coding interface and determine the correct position in cloudy weather; this will depend on the current time and ambient light measurement (Zhang, 2017). The communication subsystem consists of a Wi-Fi module that connects the physical device to a mobile application to enable remote control and calibration of the system. Finally, the power subsystem consists of a wall adapter that supplies an accurate amount of five volts to power the system. A positive side effect of these automated blinds is “reduc[ing] wasted energy by utilizing the available outdoor light” (Taufik, 2018, p.7).

DEVELOPMENT OF AUTOMATED BLINDS

For the technical project, my team has access to the National Instruments (NI) lab located within Thornton Hall. The equipment in the NI lab includes soldering supplies, a 3D printer, and digital/circuit analysis tools. The soldering supplies put the purchased components onto the printed circuit board (PCB). The 3D printer creates a mounting system and a tilting mechanism. The digital/circuit analysis tools help design the system and test the system to make it works in the way intended. The funds for the components in this device will come from the \$500 given by the University of Virginia.

The anticipated outcome for this technical project is a fully operational device that can be remotely controlled through a mobile application. With this outcome, we hope to experience the routine of development that we could potentially experience in the future. The technical research will be a scholarly article describing the technical approach and process of the design and implementation of automated blinds.

IMPACT OF NATURAL ELEMENTS

MENTAL HEALTH OF EMPLOYEES WORKING AT HOME

A majority of active employees are currently working from home, roughly about “42 percent of the U.S. labor force [are] now working from home full-time” while “33 percent are not working” (Bloom, 2020, p.1). However, this places a strain on employees as “a survey of more than 9,700 people, anonymous professional network platform Blind found that 66% of professionals believe working from home is ‘hurting their mental health.’” (Reisinger, 2020, p.1). A subset of these professionals indicated that they “feel isolated and are working more because there is no clear delineation between work and home” (Reisinger, 2020, p.1). This feeling of isolation harms the mental health of these employees as depression and anxiety are associated with loneliness and isolation (Caporuscio, 2020).

The STS topic reveals the impact that natural elements can have on stay at home employees, these natural elements include an environmental view and sunlight. A study concluded that employees who were exposed to more natural elements experience weaker role stressors and anxiety than their counterparts (An, 2016). This indicates that natural elements have a positive effect on employees. Additionally, another research paper concluded that sunlight penetration increased levels of job satisfaction and employee well-being (Leather, 1998). Businesses should look into this device because not only can automated blinds be energy efficient, it can possibly raise the overall satisfaction of their staff.

IMPACT OF THE PANDEMIC ON EMPLOYEE’S

The articles referenced already discuss the impact of natural elements, but do not explain this during the pandemic. A complication exists because of the current pandemic which has

harm the mental health of a majority of employees. Figure 3 shows mental health problems employees face now because of the current pandemic directly or indirectly.

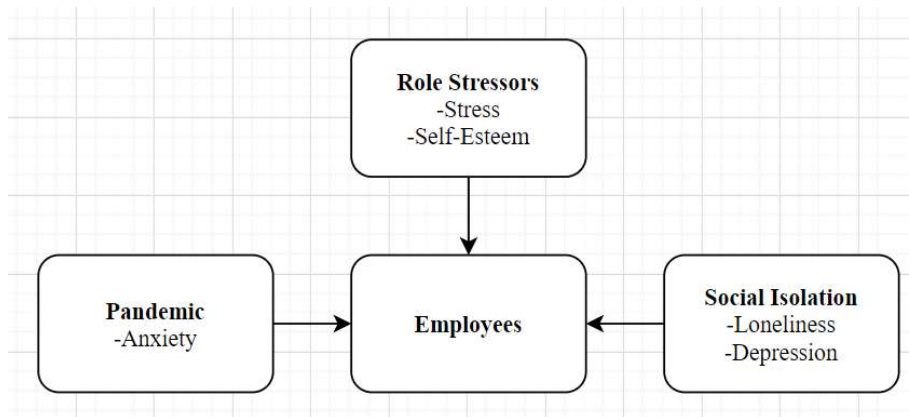


Figure 3: Issues weighing down on employees mental health: Each issue pointing to employees relate to a certain mental health problem that has been caused directly or indirectly by the current pandemic (Dinare, 2020).

These issues introduce feelings that harm the mental health of these employees. The pandemic has caused a increased levels of anxiety within our society. This anxiety could come from unknown job security, the virus, or health issues. The role stressors discuss the effects that employees’ jobs have on their mental health which; this can occur without the pandemic, but has increased during the pandemic (Reisinger, 2020). Social isolation can increase feelings of loneliness as there is little to no physical communication between friends and/or family. Ensuring the health and safety of these employees previous studies have shown an improvement of mental health through natural elements. A study conducted in 2016 suggests that sunlight has a more powerful effect than other natural elements on mental health outcomes, additionally sunlight “was positively related to [a decrease in] anxiety” (An, 2016, p.12).

ACTORS RELATIONSHIP WITH THE AUTOMATED BLINDS

The objective of my STS research is to shed some light on the positive effects that natural elements have on the mental health of stay at home employees. A Social Construct of Technology model (SCOT) (Pinch & Bijker, 1987) can describe the relationship for this device with the social groups in the network. Figure 4 below shows this relationship and the factors of each social group.

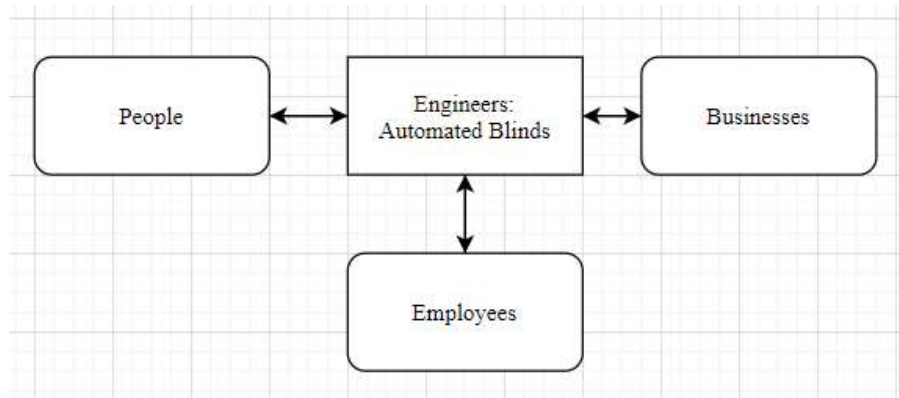


Figure 4: SCOT model automated blinds: describes the relationship between social groups (Dinare, 2020).

The key relationships in the SCOT model are between the artifact and the employees, people, businesses, and engineers. The employees have a certain need for the artifact as discussed above; they would be using this artifact at home to let some sunlight into their workday. Interpretive flexibility with the automated blinds can be seen with the different actors, for employees it should be a way to positively impact mental health. Engineers on the other hand could use the design to create supplemental components or fix any issues with the device. People's view on the artifact should be to use the device for automation of adjusting blinds. People and employees would also provide information to engineers on the privacy setting of the blinds and any faults that occur. Businesses on the other hand could use these blinds for energy

efficiency and job satisfaction within its staff. These businesses can also provide a fund for research and improvement for the artifact and illicit help from the engineers.

Increased awareness on the subject of mental health and minor prevention that can be conducted daily is the anticipated outcome of this research. The STS research will be a scholarly article discussing the impact that an automated blind would have on the mental health of the stay at home employees due to the current pandemic.

RELATIONSHIP BETWEEN NATURAL ELEMENTS AND MENTAL HEALTH

The technical project is the design and implementation of a device that allows sunlight to penetrate through a room through the automation of window blinds. This device will have the possibility to decrease levels of stress, depression, and anxiety for the actors which will be discussed through the STS project. The STS project will delve into the relationship between actors and the automated blind system, specifically focusing on the impact of natural elements on mental health. The positive impact that natural elements have on mental health problems are discussed throughout the STS research. And although these problems can be mitigated through natural elements they cannot be “solved” which should be the main concern on mental health.

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