

The ShiftCycle Eyewear Prototype

Rationale

According to the Bureau of Labor Statistics, in the U.S. there are 15 million night shift workers, including policemen, doctors, pilots, and workers in transportation, industrial and manufacturing jobs (Price). Working at night goes against the body's natural circadian rhythm, which lets the body know when to release hormones and regulates mood, alertness, temperature and other aspects of the body's daily cycle. Studies show that night shift workers face an increased risk of metabolic syndromes, cardiovascular diseases, and cancer (Price).

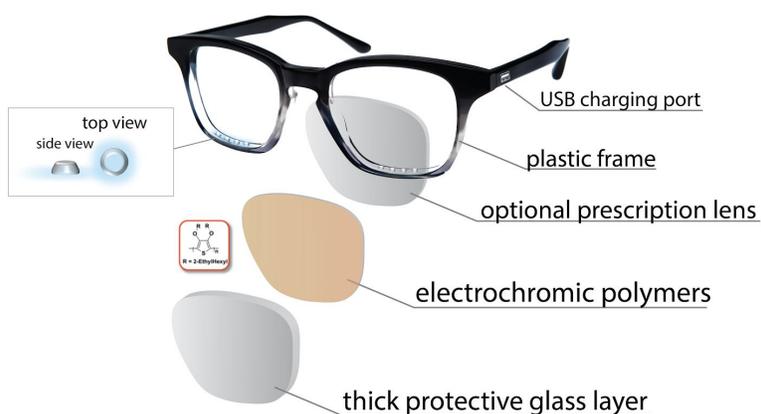
“Working against a person's natural sleep cycle causes sleep disorders, as well as fatigue,” says Bryan Vila, PhD, sleep expert (Price). This decreases overall safety, while on the job and driving home (Price). **Our proposed prototype, the ShiftCycle Eyewear will help workers stay alert during their shifts, get good sleep during the daytime and re-align their circadian rhythm.** We designed the ShiftCycle Eyewear after interviewing several family members, friends, and members of our community who work night shifts and suffer from its physical effects. We chose a prototype as our exploration method in order to create a device as a solution for the millions of night shift workers nationwide, and those in our community.

Project Description/Methodology

The ShiftCycle Eyewear will have several features that will help night shift workers maintain a healthy sleep schedule. It will utilize electrochromic polymer lenses that change color according to the user's needs. According to a study by Georgia Tech, “these films change color depending on the voltage applied to them. To maintain the colorless state, a brief refresh pulse needs to be applied approximately every 30 minutes; however, the colored state can be stable for

up to several days” (Osterholm). The lenses can tint to block certain wavelengths of light on a customizable schedule, eventually darkening to block bright light for the workers’ drive home.

In addition, the ShiftCycle Eyewear will feature green-blue light therapy to help workers remain alert and high functioning. The bottom frame of the ShiftCycle Eyewear will have small led lights that can shine (for a programmed time) 500 nm green-blue wavelength uv-free light underneath their eyes. Studies show that this light promotes alertness and concentration, even more effectively than a cup of coffee (Beaven). It also suppresses the body’s secretion of melatonin, which is a hormone that helps the body know it is time to sleep. Thirty minutes of green-blue light therapy a day is all it takes to reset circadian rhythms and boost energy levels for



the work shift (Sunnex Biotech). Green-blue wavelength light has been found to not damage the retina the way other light therapy has (Sunnex Biotech). This light therapy

also lacks the negative side effects of drinking caffeine, such as feeling jittery and having trouble falling asleep (Beaven). As the worker goes through his shift, the ShiftCycle Eyewear adapts to his needs. When the user arrives at their shift, the lenses will be fully clear, with no tinted lens. To protect tired eyes, the outer shatterproof layer will have an anti-glare coating. Three hours before the shift ends, the electrochromic polymer lenses will take on an amber tint to filter out blue light so that workers’ melatonin levels will rise, preparing them for sleep once they

return home. The glasses will darken to block bright light at the end of the shift for the drive home, so the worker can easily go to sleep. Studies show that “dark sunglasses and a strict sleep schedule can help increase performance and alertness for night shift workers, while still allowing adequate nighttime sleep on days off” (Walter).

The worker can pre-program their weekly work schedule on a computer so the glasses will know generally when to perform their functions and communicate this to the ShiftCycle Eyewear through its USB port. Voice control will allow adaptation as needs change. ShiftCycle Eyewear can be charged through the USB cord and will be powered by a Li-ion rechargeable polymer battery. And, of course, lenses could be prescription. While designed for night shift workers, ShiftCycle Eyewear would also benefit anyone who suffers from sleeping disorders or seasonal affective disorder. The green-blue therapy feature would allow users to program their body clock for alertness, while the electrochromic polymer lenses would allow them to filter out those lights that suppress melatonin secretion and make it difficult to fall asleep.

Next Steps

While many of the technologies for ShiftCycle Eyewear exist today, given more time and materials, there are several next steps we might take with additional resources:

- We would investigate a battery for the ShiftCycle Eyewear that would be bio-powered.
- We would develop a miniature eye scanning device like an OCT scanner that would detect macular degeneration and glaucoma, to put in our glasses. It would scan the eyes daily for signs of disease because night shift workers are at increased risk of eye disease.

With ShiftCycle Eyewear, night shift workers who protect us each night will have the protection they need!

Bibliography

- Baris, Steve. Police Officer. Personal Interview. 20 Sept. 2016.
- Beaven CM, Ekström J. "A Comparison of Blue Light and Caffeine Effects on Cognitive Function and Alertness in Humans." *Plos. Plos*, 2013. Web. 10 Dec. 2016.
- Elsevier. "Rotating night shift work can be hazardous to your health." *ScienceDaily*. *ScienceDaily*, 5 January 2015. Web. 20 Sept. 2016.
- Grimm, Greg. Park Lieutenant. Personal Interview. 12 Sept. 2016.
- Hackney, Joseph. Airplane Mechanic. Personal Interview. 22 Sept. 2016.
- Hitti, Miranda. "Night Shift Work May Cause Cancer." *WebMD*. *WebMD*, 30 Nov. 2007. Web. 15 Oct. 2016.
- "Light Used for Melatonin Suppression." *Tecnis*. Abbott, 4 Feb. 2010. Web. 30 Jan. 2017.
- "Lithium-ion Battery." *Wikipedia*. Wikimedia Foundation, n.d. Web. 30 Jan. 2017.
- Österholm, Anna M. , et al., "Four Shades of Brown: Tuning of Electrochromic Polymer Blends Toward High-Contrast Eyewear," *ACS Applied Materials & Interfaces*, 2015. Georgia Tech. Web. 20 Nov. 2016.
- Price, Michael. "The Risks of Night Work." *Monitor* 42.1 (2011): 38. APA. American Psychological Association, Jan. 2011. Web. 24 Oct. 2016.
- Sasseville, A., and M. Hebert. "Using Blue-Green Light at Night and Blue-Blockers During the Day to Improve Adaptation to Night Work: A Pilot Study." *Progress in Neuro-Psychopharmacology & Biological Psychiatry*. U.S. National Library of Medicine, 3 July 2010. Web. 4 Jan. 2016.
- Schmerler, Jessica. "Q&A: Why Is Blue Light before Bedtime Bad for Sleep?" *Scientific American* (2015): n. pag. *Scientific American*, 1 Sept. 2015. Web. 15 Nov. 2016.
- Shanks, Lori. "Green Light Affects Circadian Rhythm." Division of Sleep Medicine Harvard Medical School. Harvard College, 2006. Web. 12 Dec. 2016.
- "Shift Work and Sleep." *Shift Work & Sleep*. Ed. Christopher Drake. National Sleep Foundation, 2017. Web. 8 Oct. 2016.
- "Spectral Sensitivity of Light Therapy and the Photic Pathway to the Biologic Clock to the Brain" *Sunnex Biotech*. Sunnex Biotechnologies, n.d. Web. 12 Dec. 2016.

Walter, Laura. "How Night Shift Workers Can Implement a Realistic Sleep Schedule."
EHSToday. EHS Today, 4 Dec. 2008. Web. 3 Nov. 2016.