ID:	**SW-9**	 **Embedded**
SUPERVISOR:	**Dr Simon Winberg**	
CO SUPERVISOR:	**Justin Pead**	
TITLE:	**NeoPixels Sunrise Clock (NPSC)**	
DESCRIPTION:	This objective of this project is to create an intelligent bedside alarm clock system, called the NeoPixels Sunrise Clock (NPSC), that can promote healthy sleep cycles through proven lighting patterns [1]. Human activity is regulated by our 'body clock', which in the medical field is referred to as the 'circadian rhythm'. The circadian rhythm affects many physiological processes including eating, sleeping and rising patterns. It is also affected by the production of melatonin which is produced by the pineal gland. The pineal gland's activity is dependent of the amount of light received by the subject. Studies have shown that an exposure to light, if less than 30lux for 30 min, will not incur significant change to the production of melatonin which will thus not impact the circadian rhythm [2]. This project aims to use those figures to design a sunrise clock that can help to improve the sleeping patterns of the user. The light will be produced by neopixels, which will be used to produce the light. This project will simultaneously be investigating the suitability of neopixels for this application. Neopixels are easily programmable and each have a broad range of colours allowing for a wide range of light intensity and colour. The design of the NPSC will involve three components: 1) the NPSC core that will control the Neopixels, keep time and manage timers; 2) a touch screen (built into the clock) that will be used as a panel to perform basic configuration of the device; and 3) a Bluetooth interface and accompanying Android App that will be used for advanced configuration and testing of the clock. Depending on time availability, additional features will be included such as a workday morning vs. weekend morning wakeup settings, special day reminders or greetings, exercise reminders, and the like. The Android application needs be designed around be customizable so as to support future development where additional interfacing features could be added. For ethical reasons the NPSC prototype will not be tested on human subjects in real situations of either waking humans or inducing lighting to facilitate sleep at night. Instead the system will be tested based on recommendations from the research literature.	
DELIVERABLES:	Functional NPSC capable of producing light of 460nm with an intensity of 3.1 lux as mentioned in the paper "Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor". A code and design artefact repository, and full documentation, including a user manual, for anybody who wants to make use of the code or design resources, also need to be delivered. Description of future use of the device in study of the effect of light on the circadian cycle.	
SKILLS/ REQUIREMENTS:	Programming (Java and C/C++). Electronics (Schematics and PCB design). Understanding of hardware/software interfacing and communication protocols. Some experience in Embedded System design would be beneficial.	

ELO3: Engineering Design	The student will be expected to complete a creative hardware and software design, and integrate/incorporate components and perform hardware/software interfacing, provision of a well planned human/computer interface. Appropriate embedded system engineering methods and tools will need to be used to complete the design and implementation and to perform thorough and well structured system testing to verify and validate the system. The student will need to provide documentation of the hardware design (schematics documents, datasheets of component used, PCB documents), software (API of code with description of each module and its interaction with other modules, links to external program used). The lighting requirements need to be met and validated as per the research paper "*Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor*" published by The Journal of Neuroscience. Further validation requirements include: The device being able to simulate a sunrise pattern, Android application being able to adjust settings of the light colours and intensity, modifies alarm and clock settings as well as sunrise parameters.
EXTRA INFORMATION:	[1] George C. Brainard, et al. "Action Spectrum for Melatonin Regulation in Humans: Evidence for a Novel Circadian Photoreceptor". Journal of Neuroscience 15 August 2001, 21 (16) 6405-6412 (Available at: http://www.jneurosci.org/content/21/16/6405) [2] http://www.gelighting.com/LightingWeb/align/images/GE-Lighting-And-Sleep-Whitepaper.pdf
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