HomeLight

Making the Smart Home Brighter
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Abstract
Lighting color affects mood. I propose installing RGB lighting in the Smart Home kitchen and main open space.This lighting will automatically controlled by a control panel mounted on the wall, and will perform two routines automatically: a nighttime routine, and a daytime routine. It will also react to the current state of the house and its occupants by parsing house related data streams (controlled by the dashboard) and PIR motion sensors.

Product Description and Design
The system has four main features, including two special always-running routines. The system changes behavior depending on the time of year and day of the week. Natural sunset and sunrise times are determined by using online sources. System-specific sunset and sunrise are not the same as natural sunrise and sunset. System specific sunset and sunrise affect when the main routines are active. Natural sunrise and sunset are artificially offset earlier in the winter months. Sunset is delayed by 4 hours on Friday and Saturday night by default, configurable on the control panel.

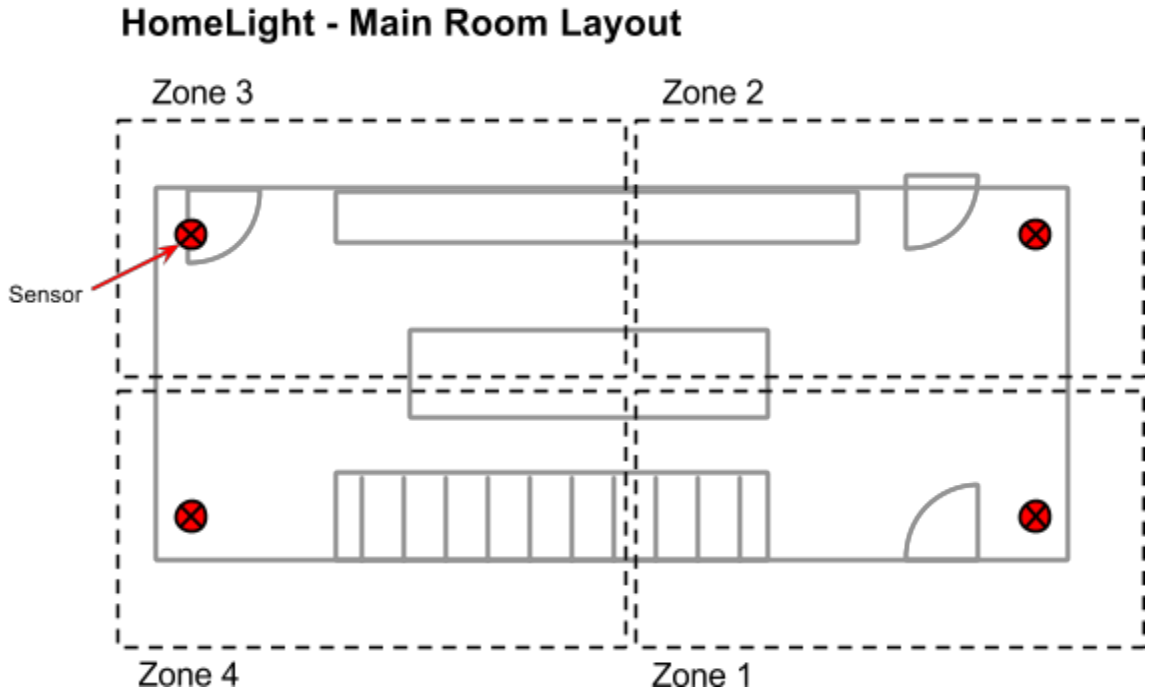
Color Temperature (Nighttime Routine) The lighting will change color temperature automatically depending on where the sun is outside. This will help residents sleep better, and will be healthier for their eyes at night. Making color temperature warm after sunset (lower than 4000K) has been shown to improve sleep, among other benefits. See appendix 1.

Year Round Summer (Daytime Routine) In the winter months, natural light is reduced and color temperature is increased because of more frequent cloud cover. My system ewill attempt to counteract this effect by using a feedback-driven color temperature and brightness lighting controller. The system will use several distributed light sensors connected to a control board. The system will constantly monitor in-house color temperature and brightness and automatically apply the correct amount and hue of light to create a net light that appears to be summer-like. I hypothesize that having summer-like lighting conditions in the house during the day will make residents feel better and will make the home a happier place to live. This mode will only take effect if the indoor light is lower than a certain level.

Scenes The house be configurable for multiple color ‘scenes’. These scenes will consist of programmable colors. Changing scenes will be possible by interacting with the control panel. It will also be possible by accessing a web app. Color scenes can be set for a certain amount of time (1 hour, 2 hours, 4 hours) before the house defaults to its automatic nighttime and daytime light routines. One scene will allow for changing of

light hue based on sound amplitude (music) recorded by the control panel microphone.

House State The control panel can be connected to the Smart Home calendar. When a new calendar event is about to begin, the house will pulse the event color to warn its users. If there is a fire or other emergency, the house should pulse red repeatedly. If there is a Duke Alert, the tablet could flash red a few times. The house will light automatically with motion or sound, depending on the time of day. At night, 80% dimmed lights in individual zones will activate for one minute upon sensing motion or hearing a loud noise nearby. On dark days, lights will activate at full brightness for 30 minutes upon sensing motion or hearing sound. The house will keep a memory of all motion and sounds. When there is no motion or sound in the house for more than a day, the house will go into a low-power state where the daytime routine is shut off and the nighttime routine is changed to a "security" mode. This mode will occasionally turn on certain light zones at night, simulating how a home with real occupants would be lit. Finally, when users finally return to the home after a period of inactivity (motion sensor tripped), the home will flash in welcome and return to a normal state.

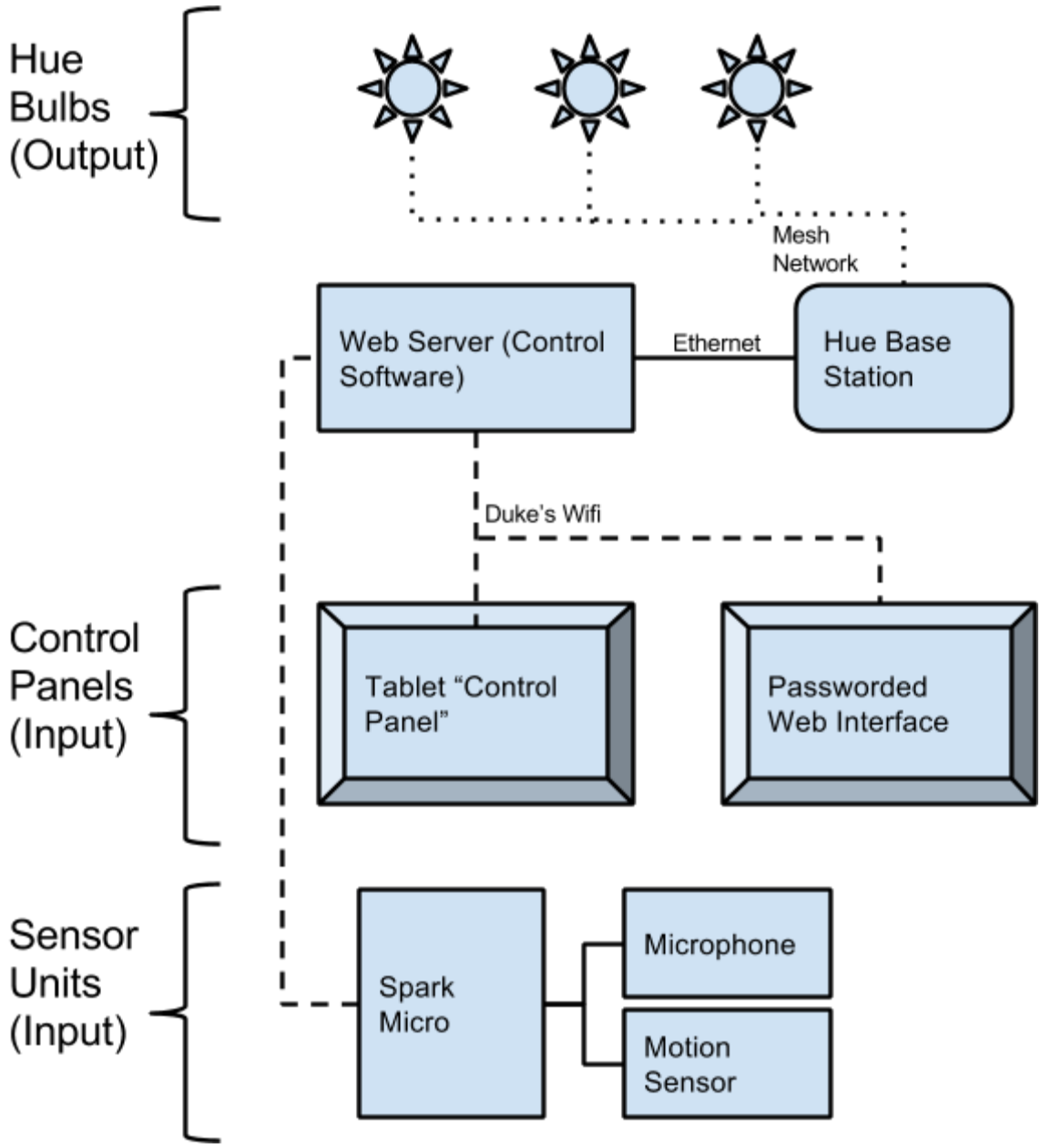


System Layout

Product Implementation

The system controls 20 RGB LED mesh-networked Philips Hue bulbs through the Hue base station then over TCP/IP on Hue's CLIP REST interface to the control panel. The system uses four sensor boards which are networked over the Duke wifi network to the control panel. The control panel is an Android tablet running the "Control Panel" app. This app is simply a wrapper for a true web app running on server with a static IP in the SmartHome. This web app will also be accessible outside of the tablet interface, but

require a password.



System Architecture Diagram

BOM

Item Name	*Amount*	*Price (Single unit)*	*URL*
Hue A19 Bulb	17	59.97	http://www.amazon.com/Philips-431643-Personal-Wireless-Frustr

			ation/dp/B00BSN8DN4/
Hue Starter (3 Bulbs, Base Station)	1	188.99	http://www.amazon.com/Philips-431643-Personal-Wireless-Frustration/dp/B00BSN8DN4/
RGB Led Strip Lighting (94 feet)	3	26.89	http://www.amazon.com/It-Mall-Water-resistant-Flexible-Lighting/dp/B00JYVEQ42/
Nexus 10 Tablet	1	378.99	http://www.amazon.com/Google-Nexus-10-Wi-Fi-only/dp/B00ACVI202/
Perm. Tablet Mount	1	84.99	http://www.amazon.com/Padholdr-Large-Tablet-Holder-PHFLHMB/dp/B00I00SNL0/
Spark Core w/ Chip Antenna	4	39.00	https://www.spark.io/
Spark Shield	4	20.00	https://www.spark.io/
Power Adapter	4	5.06	http://www.amazon.com/2000mA-Regulated-Power-Supply-1-35mm/dp/B005CVNH1Q/
Protoboard Shield	4	12.99	http://www.amazon.com/Protoshield-KIT-for-Arduino-R3/dp/B006SJR97Y/
PIR sensor	4	9.95	https://www.sparkfun.com/products/8630
Microphone and amp breakout	4	7.95	https://www.sparkfun.com/products/9964
		Total Price (Without Corporate Sponsorship)	$2132.93

Timeline

Phase 1 (Now - Winter Break)

Write letter to Philips Lighting requesting Hue
Prototype sensor PCB shield for Spark Core
Design home layout for sensors
Build sensors and integrate them into network and power

Capture sample set of “summer” data on a sunny day

Phase 2 (Winter Break - April 1st)
Install Hue and accent lighting
Install control panel
Make control panel android app
Connect devices together
Build scene selection
Write flux algorithm
Sensor feedback integration
Write sad algorithm

Phase 3 (March 1st - End of Academic Year)
Testing
Publish poster

Considerations
Transitioning the home to new lighting
- What will we do with the old lighting? (20 bulbs. The Philips Alto lighting doesn’t work, so I wouldn’t bother replacing it.)
    - **Save it**
    - Donate it to improve lighting on other parts of campus
    - Innovations lab
- Is Hue bright enough to replace the old lighting?
    - **Hue is 600 lumens. The Cree BR30s we have also produce 600 lumens.**

Stakeholder requirements
- Are the residents on board with light experimentation on mood?
    - **They will have the option to temporarily disable the system for 2 hours if needed**

Research
[1] https://justgetflux.com/research.html
[2] http://www.3drender.com/glossary/colortemp.jpg

Implementation Resources
http://10.181.25.128/api/loganrooper/lights
http://www.developers.meethue.com/documentation/getting-started
http://www.tutorialspoint.com/json/json_java_example.htm
https://github.com/lrdawg99/huejava

Current Bulbs: https://www.1000bulbs.com/product/58669/CREE-LBR30A9250D.html
Hue:
http://www.amazon.com/Philips-431643-Personal-Wireless-Frustration/dp/B00BSN8DN4/