Desk Lamp

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ABSTRACT
The paper presents the development of a desk lamp prototype designed for individuals with limited fine motor skills that can adapt to different lighting needs throughout the day. The lamp is voice-controlled and uses an RGB LED to produce light of different wavelengths, which helps to avoid disrupting the user's sleep cycle. A photoresistor is installed on the top of the lamp base to detect the amount of ambient lighting in the environment and adjust the lamp's brightness accordingly. The lamp is powered by an adapter connected to a wall socket. The prototype provides a user-friendly and adaptable lighting solution for individuals with limited fine motor skills.

I. Introduction

The goal is to create a desk lamp that is voice controlled and uses a visible light spectrum of wavelengths 400 to 700 nm to aid users with limited fine motor skills and disabilities. We aim to provide ample productivity to the user through our use of different kinds of light at different points of the day.

The main key objectives of the desk lamp were intuitive controls (Appendix A). The intended user for this product is someone with limited fine motor skills and so having a voice controlled lamp would be the most accessible way of operating the product for this wide range of consumers. In addition, the light needs to be able to change wavelengths at different points throughout the day to make sure it does not interfere with the user's sleep schedule. It has been shown that using blue light late at night interferes with the body's natural ability to fall asleep as it blocks the hormone melatonin. Due to this phenomena, it was necessary that the light be able to change wavelengths from warm to cool using the same voice controls that could power the lamp on and off. Other objects to consider when designing the lamp was the cost and durability. While this product has several added features that are not always integrated in an average desk lamp, it was still important that the lamp be priced at an accessible price, as more accessible products are usually more expensive. As previously mentioned, the users of the lamp may have limited mobility and fine motor skills which means the lamp needs to be durable as it may be dropped or knocked over. The desk lamp should also be able to be portable as the user needs to be able to position it in various locations on the desk or work surface.

The innovative elements included in the desk lamp were the voice control and the photoresistor. As previously mentioned, the voice control was necessary in order to make the device more accessible to a wider range of individuals with limited mobility. The photoresistor was incorporated into our design to make the light responsive to different levels of ambient light around the desk lamp.

II. Methods

The final desk lamp prototype consists of a base enclosure which holds the arduino as well as the breadboard, a gooseneck, and a metal lamp shade which contains the LED. The base enclosure has several drilled holes along the sides and top in order to make room for the microphone which is connected to the voice module which will control the circuit and a smaller whole for the photoresistor which will read the ambient lighting in the room the desk lamp is placed in. There is one large hole in the top of the enclosure lid which allows for the gooseneck to be screwed onto the base. The gooseneck is screwed into the metal lampshade which contains the RGB LED. Inside of the rectangular enclosure is the circuit. The circuit consists of an arduino nano, a voice module, a photoresistor, and a breadboard. Soldered to the breadboard three MOSFETs, two resistors, and one RGB LED can be found. The MOSFETs and the resistors limit the current that is passing through to the RGB LED, causing it to change color when instructed via the voice modulator.

III. Results

To test some of our metrics we conducted a couple tests. First and most importantly we wanted to make sure our light provided enough of a spot light to illuminate a standard desk. To check this metric measured the spot size of a light with respect to the distance away from the actual desk (Appendix G). Because ideally the user will not have the lamp set up too high or too low we tested it in a range of 13-24 inches away from the desk lamp. From this testing we found that our light is effective in illuminating a standard desk. As well we tested the effectiveness of our light sensor in order to see if the lamp would accurately turn on and off based on ambient lighting. To do this we measured the output of the lux from the photoresistor and as well measured the lux through another external source (Appendix H). From this it was found that the sensor within the lamp was reading the lux to be a little lower, but still within a reasonable range. For this reason we can assume that the lux being read through will reflect accurately and could be off due to a small reason such as its position within the box.

IV. Conclusion:

The biggest lesson that was learned throughout the design and testing process was time management and the importance of a strict timeline. The largest issue we ran into was limited time as there were multiple constraints such as overlapping schedules and issues with parts coming in on time. These limitations meant that there was very little time left to address errors that arose during the production process. In order to avoid these issues in the future, parts should be ordered far in advance from the prototype deadline and an alternative plan should be constructed using provided parts as a last resort. A strict timeline and schedule that is compatible with all team members should also be created in order to ensure that the final prototype is completed on time.

V. References

https://electronoobs.com/eng_arduino_tut165.php

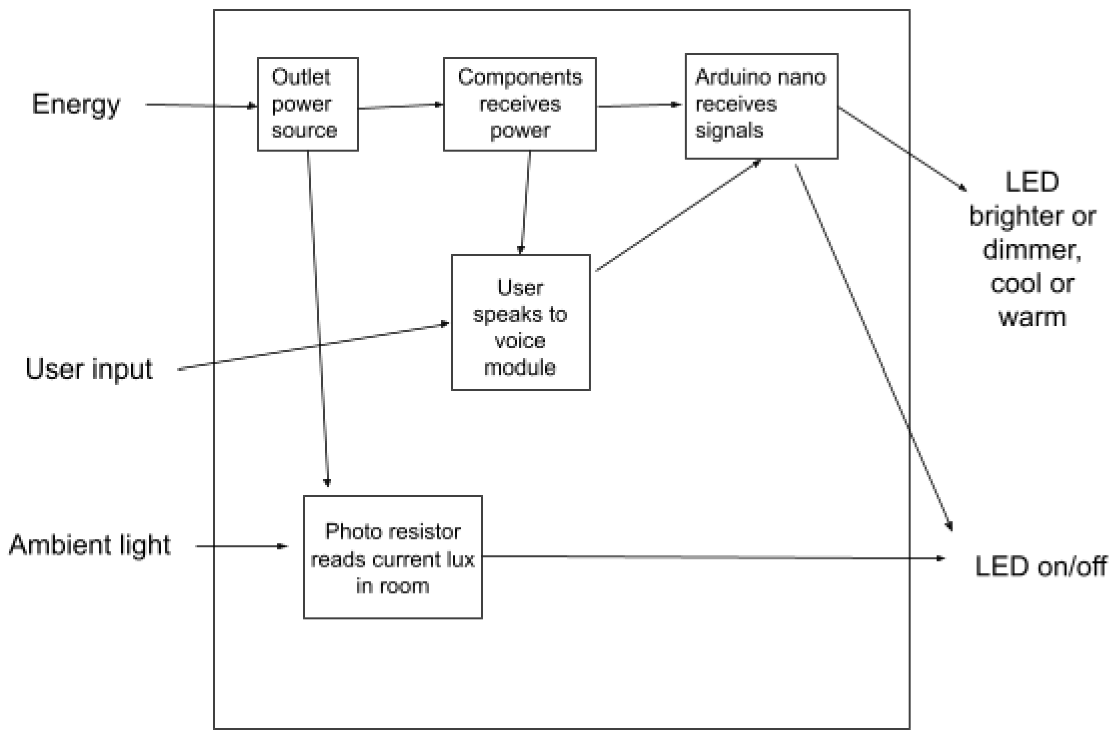
https://github.com/Starmbi/hp_BH1750

VI. Appendix

A. Objectives and their respective metrics

Objectives	Metrics
User-friendly	Easily turns on and off and listens to commands (number of times voice module picks up the command)
LED changes setting based on ambient lighting	Lumen output vs lumen input (lumens)
Durability	Can withstand 3 pounds of push (lb)
Cost	Total cost < $250 (dollars)
Lights up desk surface	Spot size (in)

B. Glassbox diagram



C. PCC table for metrics

Goals	Portability	Cost	Intuitive Controls	Durability	Light Range	Illuminate desk surface	Total
Portability	-	0	0	0	0	0	0
Cost	1	-	0	0	0	0	1
Intuitive controls	1	1	-	1	1	0	4
Durability	1	1	0	-	0	0	2
Light Range	1	1	0	1	-	0	3
Illuminate desk surface	1	1	1	1	1	-	5

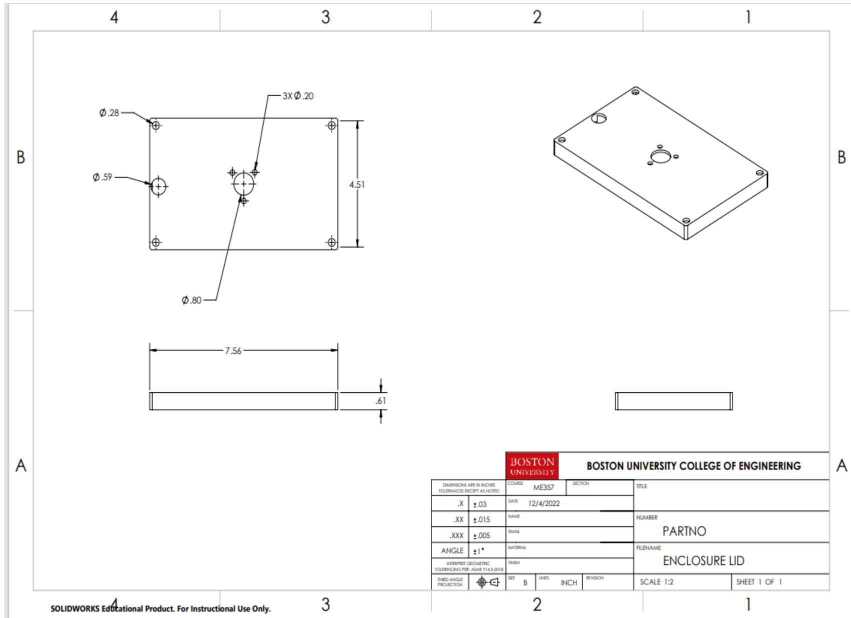
D. Parts list with cost per item and total cost

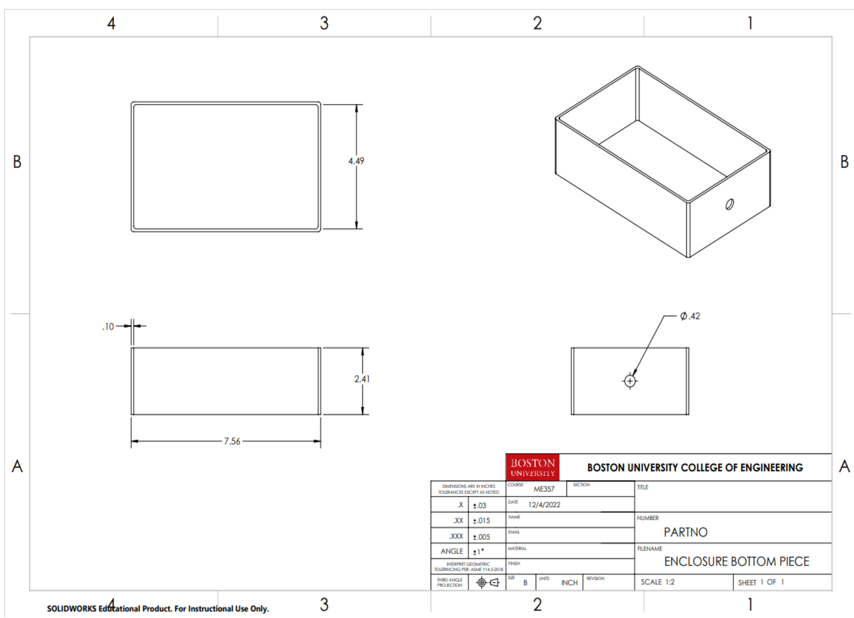
Part	**Cost ($USD)**
Chanzon 10W Grow Light LED	6.99
Voice module	29.99
Arduino nano	8.50
Power supply adapter	10.99
Adafruit BH1750 light sensor	4.50
Gooseneck	10.95
PCP plastic enclosure	23.50
	Total: $95.42

E. Morph chart

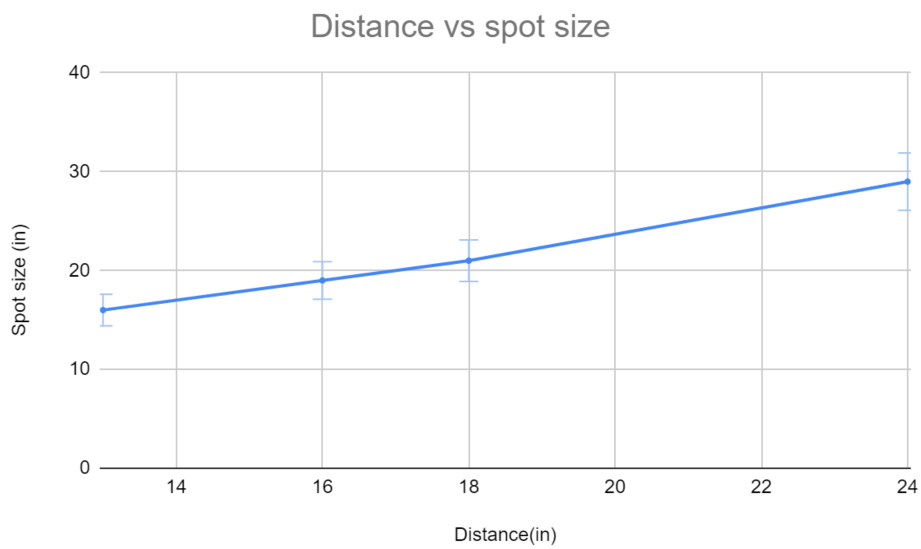
Function \ Means	**1**	**2**	**3**	**4**
Generate light / Change the brightness of light	Pressure sensor	Switch	Screw switch	Voice recognition
Recognize the brightness of outside / Change light spectrum	Sensor (Photoresistor)	Timekeeper		
Power source	Battery	Plug into wall	Rechargeable battery	Solar power
Easy-to-use	Large buttons	One large control pad	Ability to adhere to table-top (clip)	Voice recognition
Durable Structure	Flexible/Soft material	Shatterproof light bulb	Metal Alloy	3-D print
Identify product	Shape of product	Amount of light produced.		

F. CAD drawings for base of the lamp



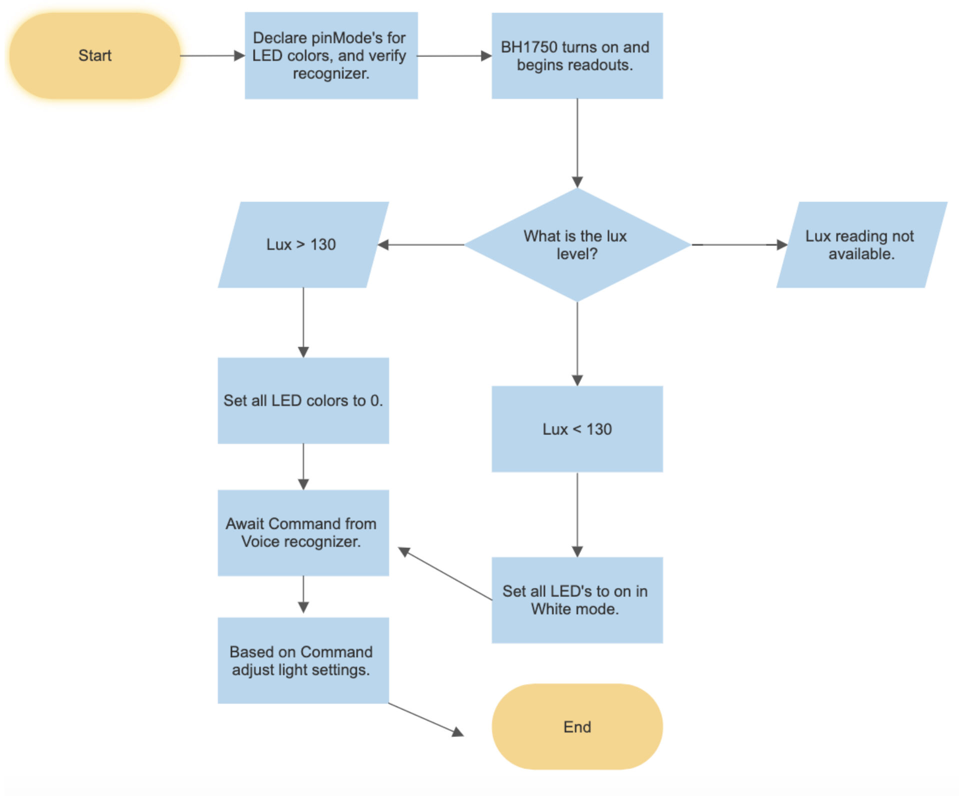


G. Graph for distance to table vs spot size



H. Graph of measured lux

I. Code flow diagram



J. Wiring diagram