Bilirubin Phototherapy Device

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Background

- Approximately 60-80% of newborns have neonatal jaundice
  - If untreated, could lead to brain damage or death
- Phototherapy is most common treatment for jaundice
  - Wavelength of 430 - 490 nm
  - Irradiance at least 30 uW/cm^2/nm
- High equipment costs limit treatment in developing countries
- Queen Elizabeth Hospital in Blantyre Malawi uses Blantyre "Hot Cot" as incubator, but available phototherapy treatment is limited

Fig. 1 Blantyre "Hot Cot" The phototherapy device needs to work with the "hot cot" that is currently used in the Queen Elizabeth Hospital

Mission Statement

Develop a phototherapy device for neonatal jaundice treatment to work with the Blantyre "Hot Cot" at the Queen Elizabeth Hospital in Blantyre, Malawi

Design Objectives and Justifications

Design Objective	Target Criterion
Meet American Association of Pediatric standards	Wavelength: 470 nm Irradiance: ≥ 30 uW/cm^2/nm
Power supply	230 V AC
Durability	> 5 years
Easy maintenance	< 5 components
Safe	Temperature of LED less than 40 °C
Portable	< 5 lbs
Inexpensive	~$200

- LEDs are inexpensive, have a long lifespan, and do not generate heat
- Wood is readily available
- A power adapter converts 230 V AC to 6 V DC

EOS Prototype

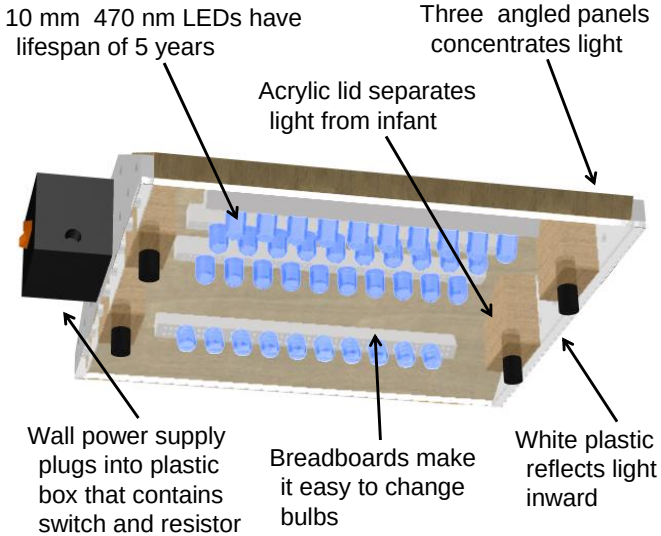

Fig. 2 Eos Device The Eos prototype uses 40 10 mm 470 nm LEDs attached to three angled panels to provide effective phototherapy

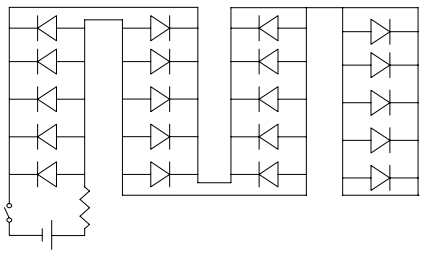

Fig. 3 Wiring Diagram The 40 LEDs are all in parallel to ensure that the array stays lit even if one light goes out. An AC adapter outputs 6 V to the circuit, through a 3 ohm 10 W resistor which limits the current to 25 mA per LED

Design Validation

Parameter	Result
• Wavelength • Used spectrophotometer	470 nm
• Irradiance • Used radiometer	36 uW/cm^2
• Temperature • Used thermometer to record ambient temperature	25 °C
• Cost	$65
• Weight	3 lbs

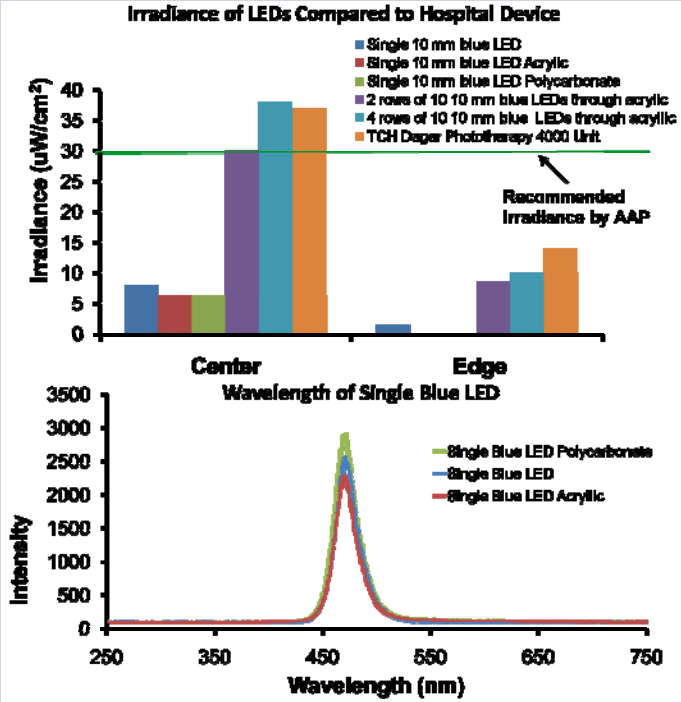

Fig 4. Irradiance and Wavelength Results The top graph shows the irradiance of various light configurations measured by a radiometer. 40 LEDs provide an equivalent irradiance to the hospital device. The bottom graph shows the wavelength of the LEDs. Acrylic and polycarbonate do not effect wavelength.

Discussion

- Final prototype fulfills design criteria
- 40 LEDs needed for effective irradiance
- Device is more affordable than any other commercially available phototherapy system
- Future research
  - Battery powered system
  - Ability to control intensity of light

References

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