Department of MECHANICAL ENGINEERING
THE UNIVERSITY OF UTAH

FIELD EQUIPMENT FOR EYE EXAMINATIONS

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MORAN EYE CENTER

BACKGROUND

According to the World Health Organization, there are 39 million blind people and 285 million with a form of visual impairment in the world. Four out of five blind individuals can be cured with modern eye care but those living in developing regions and countries with little to no access to the technology are unable to get the care they need. The Moran Eye Center combats this by sending outreach teams, providing eye exams and cataract surgeries to those in need, restoring sight to hundreds of patients in a week while training local physicians to provide the same care.

PROBLEMS & OBJECTIVES

Because of the lack of technology in the underdeveloped areas that the Moran Eye Center visits, these areas are often unable to provide platforms to support the head during examinations, reliable equipment such as tables, and charging options for some of their electronic equipment.

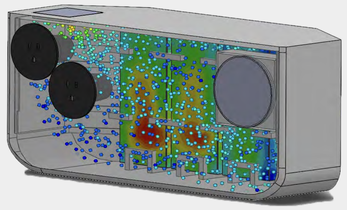
The objective is to create a portable technician's station that contains a detachable work table, a head support to stabilize the patient's head during eye examinations, and a power bank to charge necessary equipment. All components fit inside a Pelican™ Air 1615 case.

The portable slit lamp that Moran Eye Center currently uses plugged into its charging dock[1]

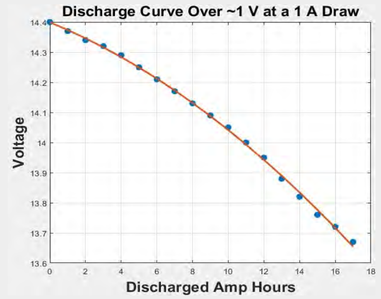
TESTING & RESULTS

Head Support:
Testing the 3D printed parts requires weights, ranging from 0.23 to 13.6 kg. Results show the head support is capable of holding a maximum of 11.3 kg before failure, when the weights are suspended by a string. Because the intended use requires a maximum of 5 kg, the head support proves to be successful in achieving its goal.

Power Bank:
For the testing of our power bank, we created the discharge curve shown below by drawing a 1A current from our power bank and measuring the voltage drop every hour, providing an idea of how the batteries behave under a load. CFD models were used to verify the effectiveness of the forced air cooling system.



A computational fluid dynamics simulation of the electronics housing showing the airflow from the cooling fan



The discharge curve created during power bank testing shows non-linear discharge behavior.

Work Table:
Testing the table consists of a finite element analysis to pre-verify that the table legs and supports on the underside of the lid would hold the desired weight of approximately 23 kg. When deployed, the table is capable of sitting at a working height between 61 cm and 102 cm with an expanded working surface of 144 cm wide by 47 cm deep and will support weight up to 18 kg.

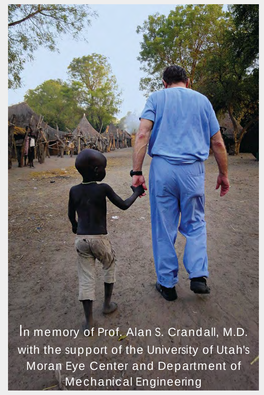
KEY DESIGN FEATURES

The main features of our portable technician's station are numerically labeled:

1. **Head Support**
   - Quick assembly
   - Portable and lightweight
   - Stores inside the case and attaches to multiple surfaces
   - Capable of holding a minimum of 10 pounds of weight
2. **Worktable**
   - Fold out table legs with adjustable height
   - Dual slide out tables create a larger work surface
3. **Power Bank**
   - Three Lithium-Polymer batteries provide a total of 444 Watt-hours of battery capacity
   - Enough capacity to charge all of Moran's commonly used equipment at least once during a workday
   - Exterior AC-power outlet powered by a 300 Watt inverter
   - Exterior USB outlets provide DC power to up to 4 devices simultaneously
   - Cooling system provides airflow to cool batteries when the case temperatures is high

CONCLUSION

To facilitate Moran Eye Centers' surgical outreach operations, the team would need a solution that was robust, versatile, functional, and easily maneuverable. The multifunctional storage case meets these requirements by giving the team additional areas for working space, providing reliable power when there is none, and allowing technicians to gather much more accurate and meaningful eye-related measurements. This is accomplished with minimal maintenance, further justifying its use in the field.



In memory of Prof. Alan S. Crandall, M.D. with the support of the University of Utah's Moran Eye Center and Department of Mechanical Engineering

1. https://www.insighteye2020.com/product/psl-classic-portable-slit-lamp/