Alternative Power Source for Dental Hygiene Device

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Contents of Presentation

1. Problem Statement
2. Objectives/Constraints
3. Design Overviews
4. Battery Design
5. Manual Design
6. Conclusions
7. References

Problem Statement

NAU Department of Dental Hygiene

- Humanitarian work in remote areas
- No electricity available to power Wig-L-Bug
- Needed an alternative power source in December

Objectives and Constraints

- Must be able to operate device for 10 hours
- Cannot weigh more than 20 lb
- Must be able to fit in 22 ×18 ×10 in container (Airplane carry-on)
- Must be able to charge on 220V 50hz power (If battery)
- Must be able to charge in 8 hours (If battery)

Design Overviews

First Semester: Battery Design

- The Battery Design uses a large Li-polymer battery to power the Wig-L-Bug
- The battery power source was completed in November, and used successfully in December.

Second Semester: Gearbox Design

- The Manual Design uses a gearbox to convert high torque, low speed cranking into a high speed, low torque output.
- The manual power supply has been thoroughly tested by the design team.

Battery Design

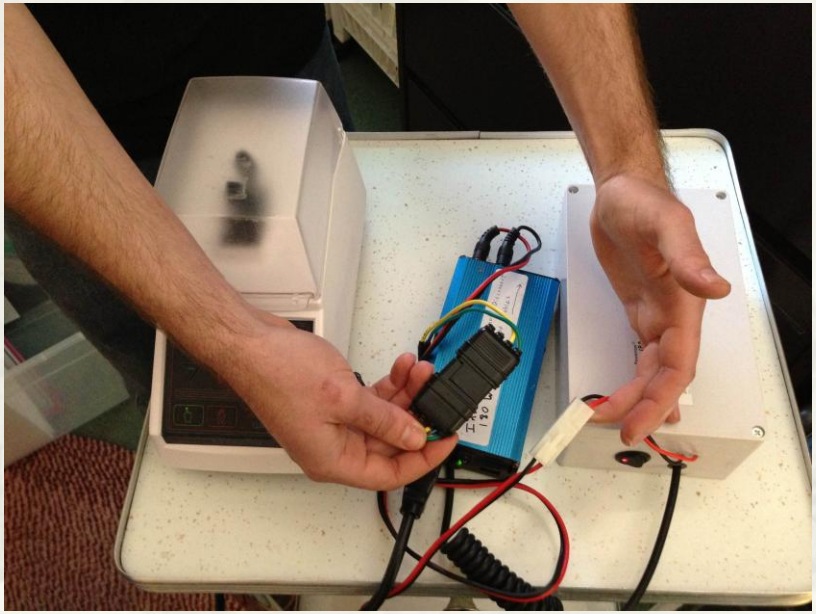
Details

- The maximum output power is 180W
- The energy capacity is 240Wh
- The output voltage is regulated to 12V
- The battery weighs 4lb

Battery Design

Details

- The inverter converts 12V DC to 120V AC
- The output waveform is pure sine wave
- The minimum operating efficiency is 90%
- The inverter weighs 1lb



Battery Design

Costs

	Cost
Battery	$322.95
Charger	$36.95
Inverter	$85.00
Total	$444.90

Battery Design

Testing

- A 50W light bulb was powered continuously for 4 hours and 45 minutes
- It took 8 hours to fully charge the battery from zero percent state of charge
- The cycle was completed 5 times to make sure the battery was not defective

Battery Design

Use in India

“The Dental Hygiene Team, with the assistance of Engineering Team 15 made a difference in the lives of the Tibetan people at the Mainpat Refugee Settlement in India this past December. ” – Maxine Janis

Gearbox Design

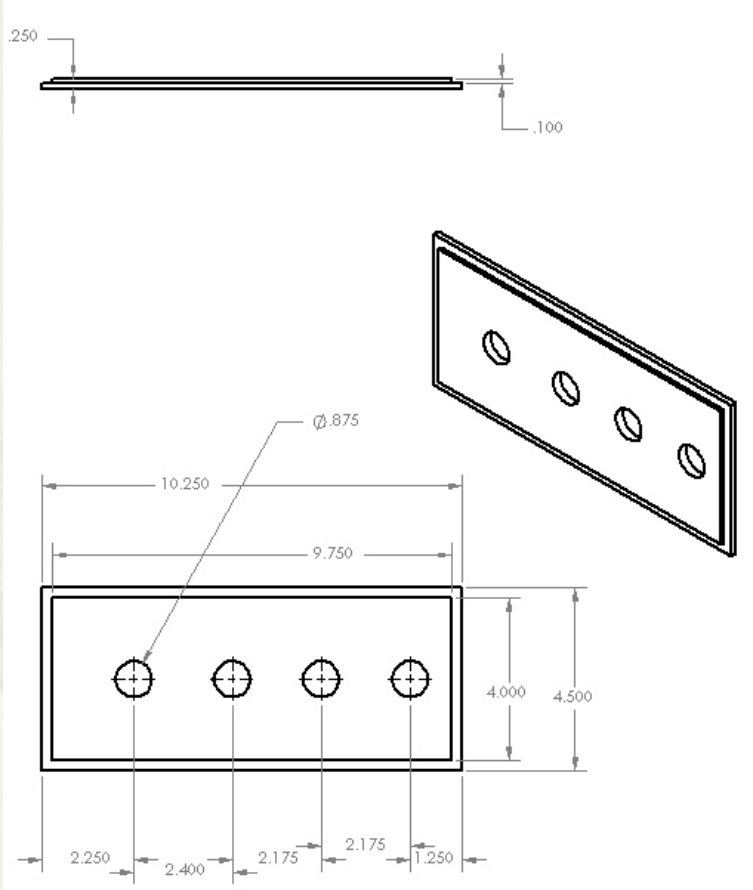
Details

- Steel Gears convert 60 rpm input to 4000 rpm output.
- Cam mechanism converts rotary output into eccentric motion.
- Requires about 50 watts input for 10 seconds

Gearbox Design

Details

- Polycarbonate housing was cut using CNC mill
- Housing was glued together using a rubber-based adhesive
- Shafts are supported by ball bearings for reduced friction



Gearbox Design

Costs

	Cost
Gears	$195.00
Shafts	$7.50
Bearings	$18.60
Polycarbonate	$25.20
Glue	$7.50
Handle	$26.40
Total	$280.20

Cost Comparison

	Cost
Battery Design	$444.90
Gearbox Design	$280.20

Advantages and Disadvantages

Battery Design

Advantages

- Could provide continual power
- Convenient

Disadvantages

- High dependence on the local conditions

Gearbox Design

Advantages

- No dependence on electricity
- No setup time
- Cheap

Disadvantages

- Requires manual power

Conclusion

- Department of Dental Hygiene needed a power source for their Wig-L-Bug
- Constraints are met by both designs
- Battery Design was a complete success
- Gearbox Design probably would work
- Battery design is more convenient, but the gearbox would work without power

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Questions ?