SOLAR ENERGY & ELECTRICAL POWER

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Background

• Power crisis in Ghana
• Intermittent power supply
• Frequent electricity shortages
• Negative effect on economy and industry

Goals

• Improve current solar power resources
• Increase accessibility to electricity in the village
Developmental Problems that Need Engineering Solutions

1) Sustainable Solar Street Lighting
2) Solar School System
3) Electric Power Converter
4) Bicycle-Powered Generator
Deliverables

- At least one operating street light
- One operable home emergency power system
- At least one functional bicycle generator
- Educational materials
Solar Street Lighting

Problem
• Solar street lights of Akomadan Akrofoa were nonfunctional

Pre-Trip Solution
• Restore to a state of reliable functionality
• Redesign to ensure all components are easily accessible for maintenance

In-Country Solution
• Rewire control panel
Solar School System

Problem
• Solar panel system at local school was not functioning correctly

Pre-Trip Solution
• Rewire system in conjunction with newly replaced batteries
• Redesign wiring layout to make it easier to repair in the future

In-Country Solution
• Replace batteries and wiring
• Redesign wiring layout
Solar School System
Bicycle Generator

Problem
• Over 80% of people in Ghana own cell phones
• Grid power is very inconsistent
• Remote villages have no communication/electricity

Need
• Reliable, sustainable way to charge cell phones in the village

Solution
• Bicycle generator to charge cell phones
Bicycle Generator

Initial Research

• Past bicycle generator projects: IESL in Choluteca
  • Belt design much more effective (40:1 ratio of bicycle wheel to alternator)
Bicycle Generator

Initial Prototype Materials
- Motor: car alternator
  - Electromagnetic, internal regulator
- Belt (serpentine belt)
- Bike
- Stand

Other Materials
- Battery
  - 12 V, 18 amp hour deep cell
- Switch
- Inverter
  - 80 watt, voltage from 12V to 5V (USB included)
Bicycle Generator

Final Prototype Design
Bicycle Generator

Testing and Results

• Ensure bike was stable and find changes to initial design
• Ensure wiring was correct and create diagrams
• Did a sample charge on an iPhone and extrapolated result
  • Takes approximately 75 seconds to charge an iPhone 1% of its capacity
  • It would take around 2 hours to fully charge an iPhone from 0% to 100% charge
Bicycle Generator

Prototype to Ghana

Changes to be Made:

• Base was relatively unstable
  • Weld metal (angle iron)
  • Make base narrower
  • Threaded Rod

• Packaging
  • Wire ties
  • Electrical box
Bicycle Generator

**GENERAL DIMENSIONS**
- The height of the two vertical pillars must be at least 16 inches for stability.
- No net weight must be placed directly on the drive shaft. Instead, weights must be placed at the top of the bicycle frame.
- The base must be at least 16 inches wide to keep the bike in place when it is placed on the ground.

**NOTES**
- The bike will be held on the stand by the two vertical posts when the bike is placed on the stand.

**PURPOSE**
- The bike will be held on the stand by the two vertical posts when the bike is placed on the stand.

**DRAWING**
The drawing shows the overall dimensions and design of the bicycle generator stand.

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**Material:**
- Angle iron: 2 x 2 x 3 inches

**Dimensions:**
- Overall length: 27,000 mm
- Overall width: 14,000 mm
- Height: 12,000 mm

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**Additional Notes:**
- The bike will be held on the stand by the two vertical posts when the bike is placed on the stand.
- The base must be at least 16 inches wide to keep the bike in place when it is placed on the ground.

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**General:**
- The bike will be held on the stand by the two vertical posts when the bike is placed on the stand.
- The base must be at least 16 inches wide to keep the bike in place when it is placed on the ground.

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**Conclusion:**
- The bicycle generator stand is designed to hold the bike securely in place.
- The dimensions and materials are specified to ensure the bike is held in place and operates effectively.

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**References:**
- The design and specifications are based on previous engineering projects and research.
Bicycle Generator

Prototype Wiring

Updated Wiring
Bicycle Generator

- Bought materials in Kumasi before travelling to Techiman
- Bargained to keep cost low
Bicycle Generator

- Artisan suggested several changes
- SolidWorks model was crucial
- New design for the weakest part of the prototype
Bicycle Generator
Bicycle Generator

- Package materials to keep protected from environment
- Emphasis on simplicity
- Changed wiring diagram
Bicycle Generator

- Education was essential for sustainability
- Appointed one person in charge
- Left instructions and wiring diagrams
Cost Analysis

**Research and Development**
- $400 total to spend on all projects
- Spent $177.69 on prototyping
  - Donations
- $282.31 left to use on project implementation in Ghana
- Many parts we will be able to reuse
  - Alternator, serpentine belts, battery, threaded rod
Cost Analysis

Implementation in Ghana
- $282.31 left to use on project implementation in Ghana
- Spent $251.96 in Ghana
- Final project cost of $534.27 (over budget by $134.27)
- Left extra parts for future projects
  - Angle iron, wire, threaded rod

Replication Cost
- Approximately $368.98 to replicate bicycle
Sustainability & Ownership

Plan & Implementation

• Use materials bought from local Ghanaian vendors
  • Economy
  • Easily make repairs
• Encourage collaboration with locals
  • Sense of ownership
• Opportunity to create profit and jobs
Future Recommendations

• Recommend researching a kiosk-like system with solar panels to charge cell phones
• Make wiring more sustainable
• Use pressure sensor or other way to ensure bike is being ridden while charging
• In-depth analysis of local pricings
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