Solar
Orienting
Adaptive
Robot

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Problem Statement

South Africa's Growth Rate to Slow Due to Blackouts

Isaac Kaledzi, Africa Feeds, April 18, 2019

South Africa Crippled by Rolling Blackouts, Weeks Before an Election

Norimitsu Onishi, New York Times, April 6, 2019

Strategic load shedding leads to blackouts across South Africa, hindering a thriving country's ability to innovate and stay connected to the rest of the world.

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Our Challenge

- Sustainable Living
  - ✓ Encourage Africa to utilize renewable resources
  - ✓ Utilize numerous sunny days
  - ✓ Reduce reliance of the power grid
  - ✓ Provide solution every person can have in the house

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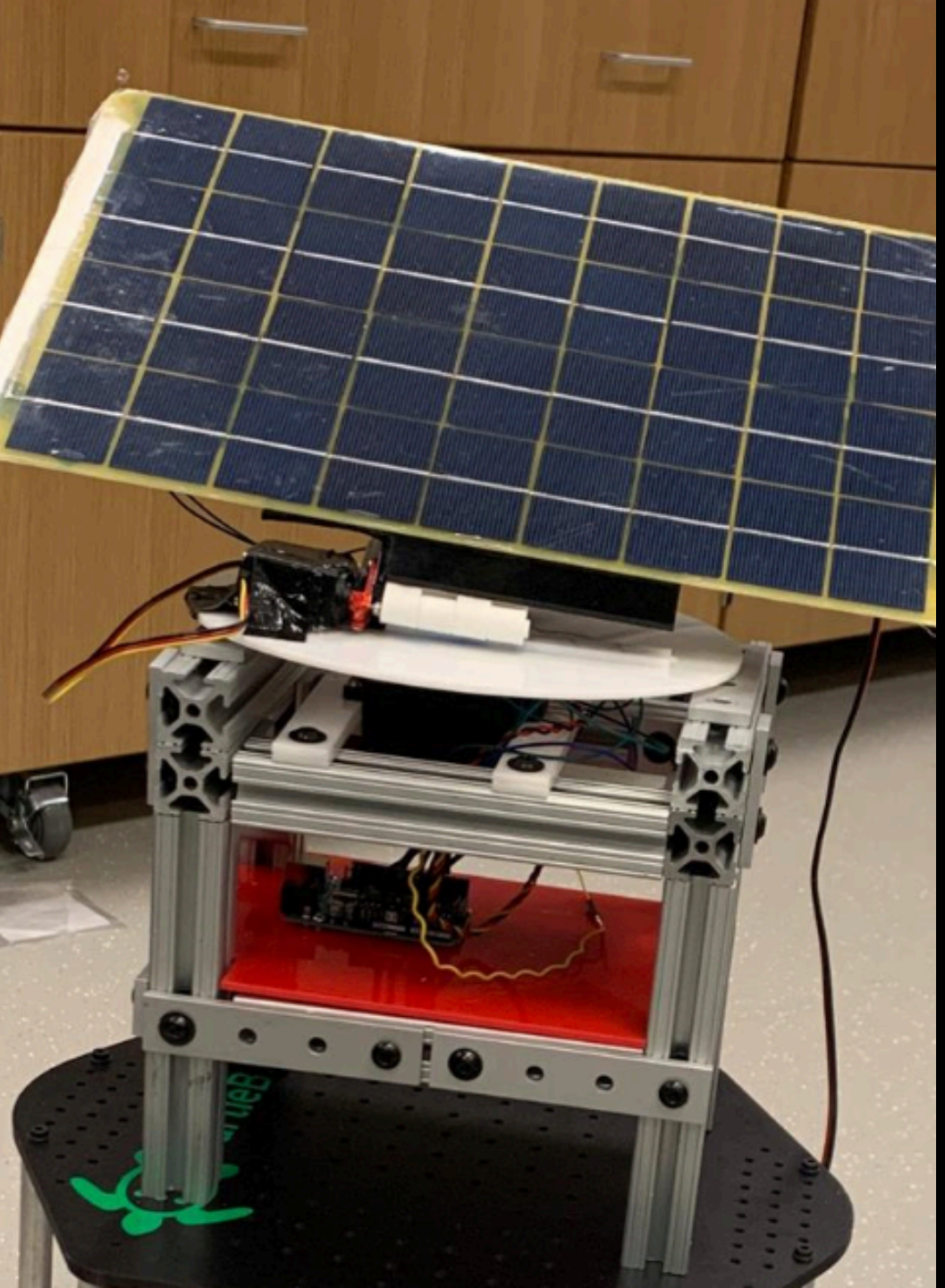
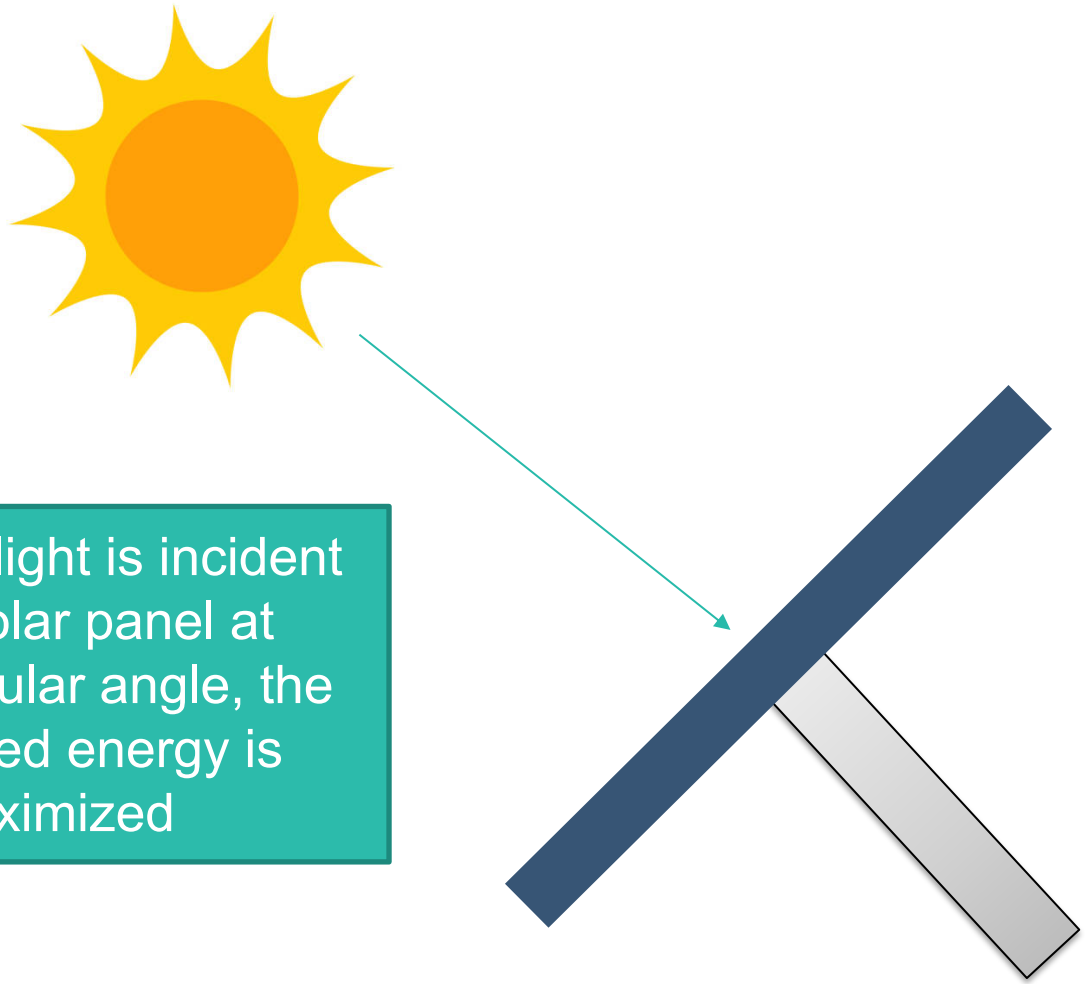


Our Solution

- An ultra low-cost personal solar charging station
- Rotates to follow the sun throughout the day
- Self contained
- Provides enough power to fully charge smartphone 6-8 times

Engineering Background

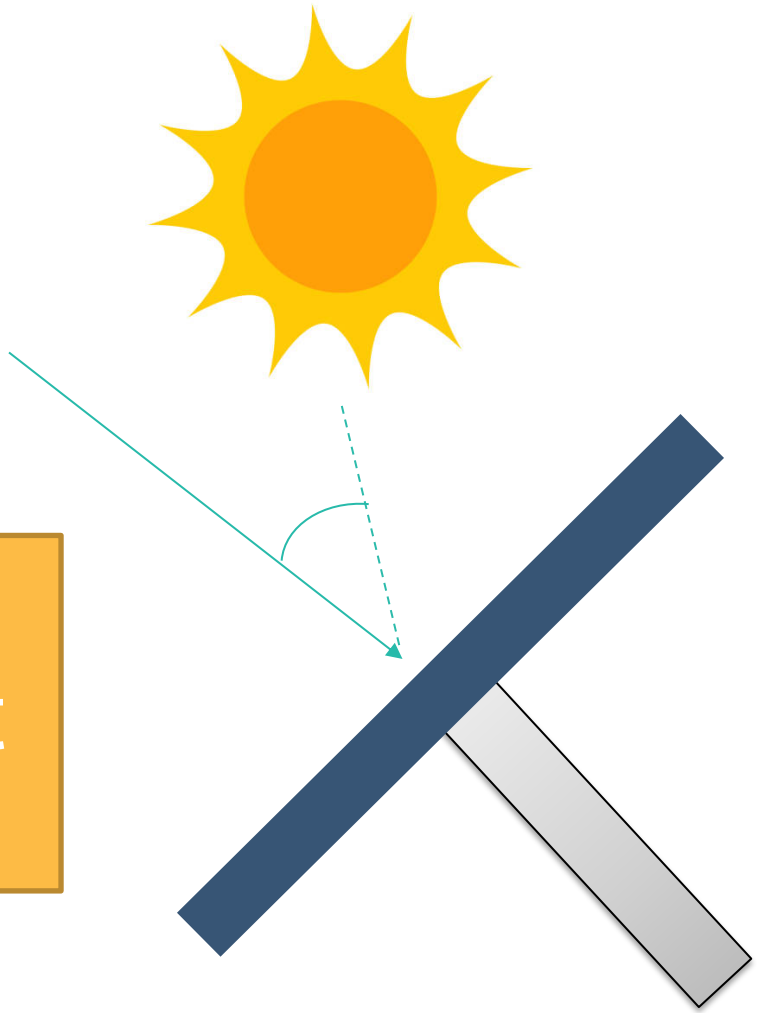


When sunlight is incident upon solar panel at perpendicular angle, the generated energy is maximized

Key Idea:

- Solar Panels are maximally effective when facing sun
- Sun follows predictable arc throughout day

Engineering Background



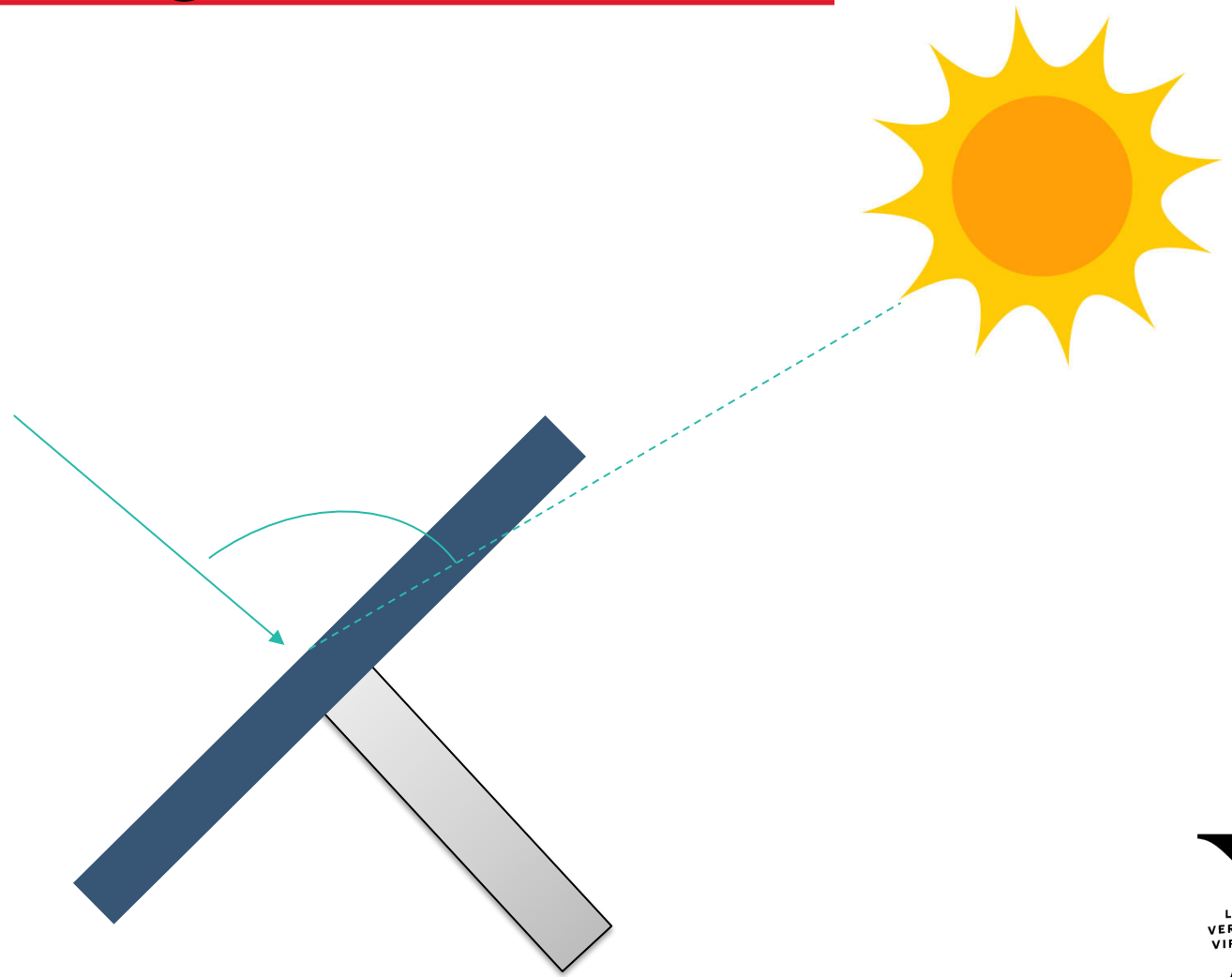
Less Efficient

Engineering Background

$$I_i = I_t \cos\theta$$

$I_i \rightarrow$ Irradiance Observed
$I_t \rightarrow$ Irradiance Emiited by Sun
$\theta \rightarrow$ Incident Angle

Not Efficient



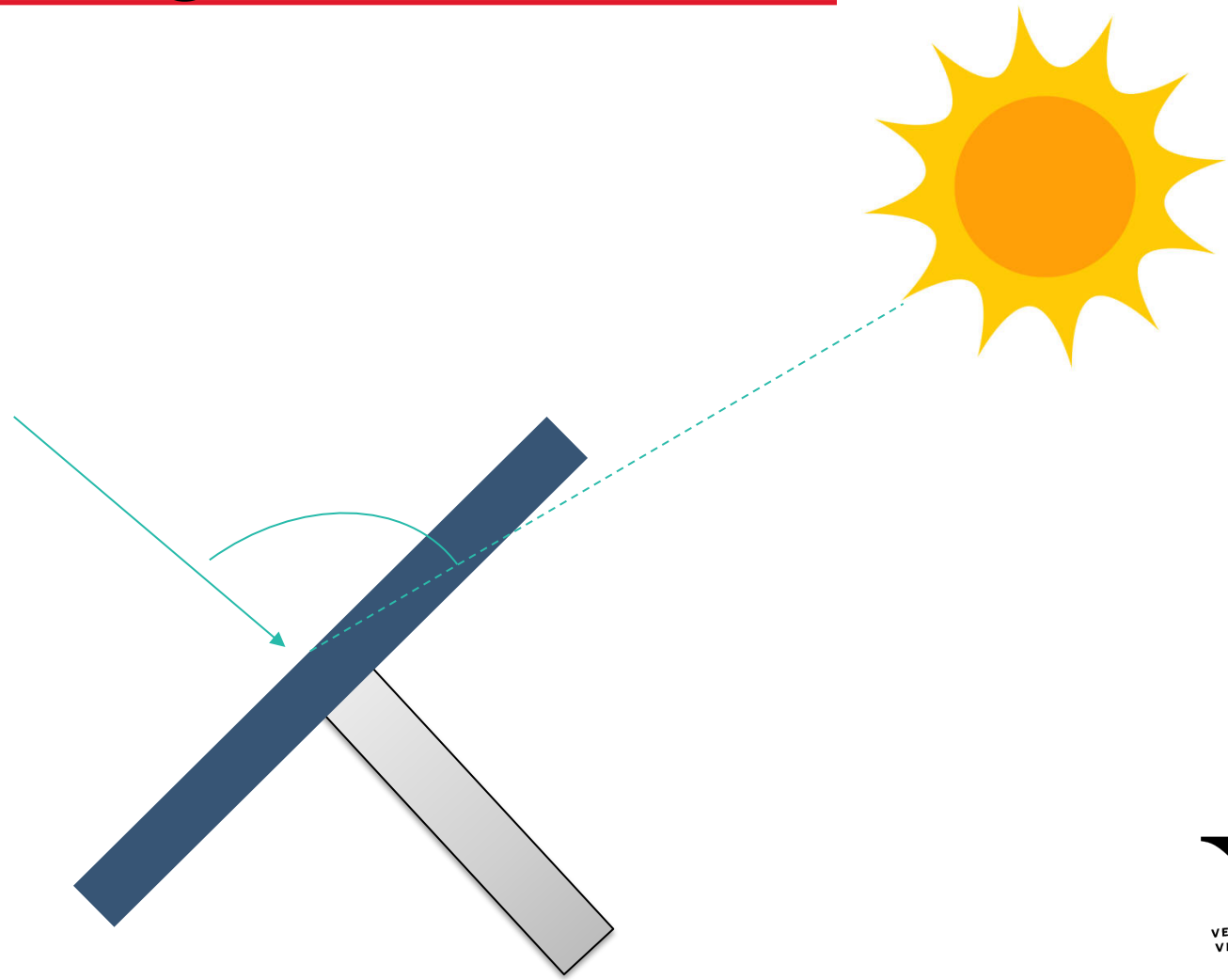
Engineering Background

$$I_i = I_t \cos\theta$$

$I_i \rightarrow$ Irradiance Observed
$I_t \rightarrow$ Irradiance Emiited by Sun
$\theta \rightarrow$ Incident Angle

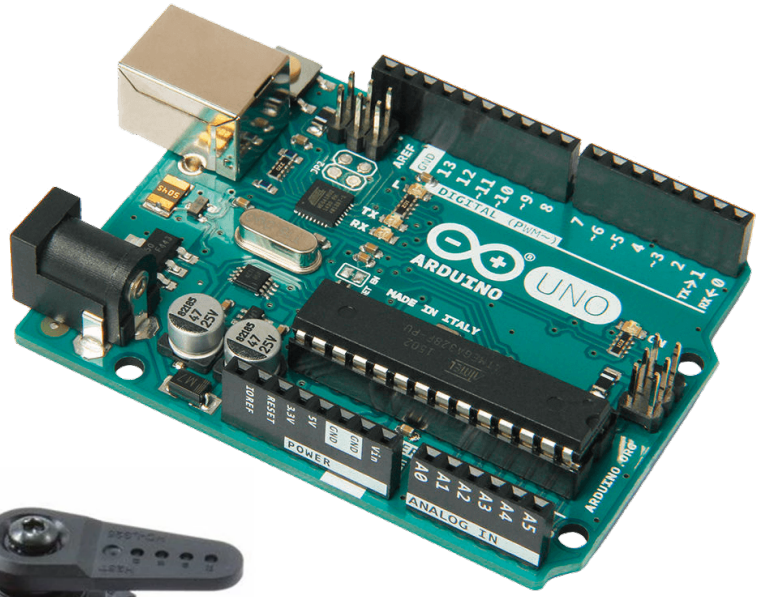
Position solar panel in 3-Dimensional space such that:

$$I_i = \max_{\theta} I_t \cos\theta$$



The New and Novel

- Larger solar farms make use of rotating solar panels to maximize electricity
- Rooftop mounted solar panels are expensive and labor intensive to install
- Generators are similarly expensive
- Our product shrinks the technology to a small table top appliance
- Meant to keep people connected during blackouts



System Level Design

- Arduino Microcontroller
  - Runs compiled C-code sketch
  - 0.29 W consumed
- 2x high torque servo motors
  - 1.5 W consumed total
- Various laser-cut acrylic sheet
- 10 Watt (10 cm x 17 cm) cell array
- 80/20 T-Slot aluminum building frame
- 25800mAh Power Bank

8.21 Watts of Usable Power for End User

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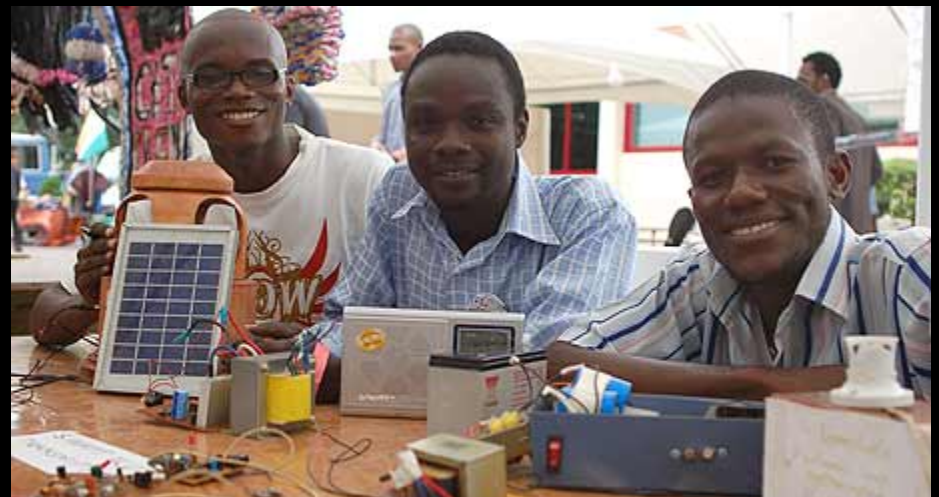
Target Audience

All Africans, especially:

Those without regular access to electricity

Those at risk of losing power due to grid cuts

Those hoping to reduce their carbon footprint



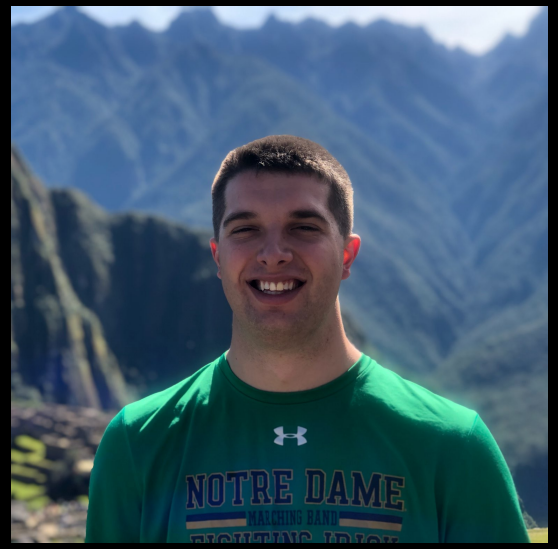
The Financials

- Cost of prototype ~$75
  - Using existing parts
- With refinement, cost could be halved to approximately $30
- Users pay a one-time fixed fee to purchase their own device
- Large solar arrays/on-board power can be included for and added surcharge
- Company could also provide maintenance/service as an additional revenue stream

The Right Team of Engineers

Alekandr Tunik
B.S. Electrical Engineering & Computer Engineer ‘24

Lee Milburn
B.S. Computer Science & Computer Engineering, ‘23



Nathaniel Hanson
B.S. Computer Engineering

M.S. Computer Science

Currently studying for Ph.D. Computer Engineering, Robotics Concentration

Experience
+
Education
+
Passion

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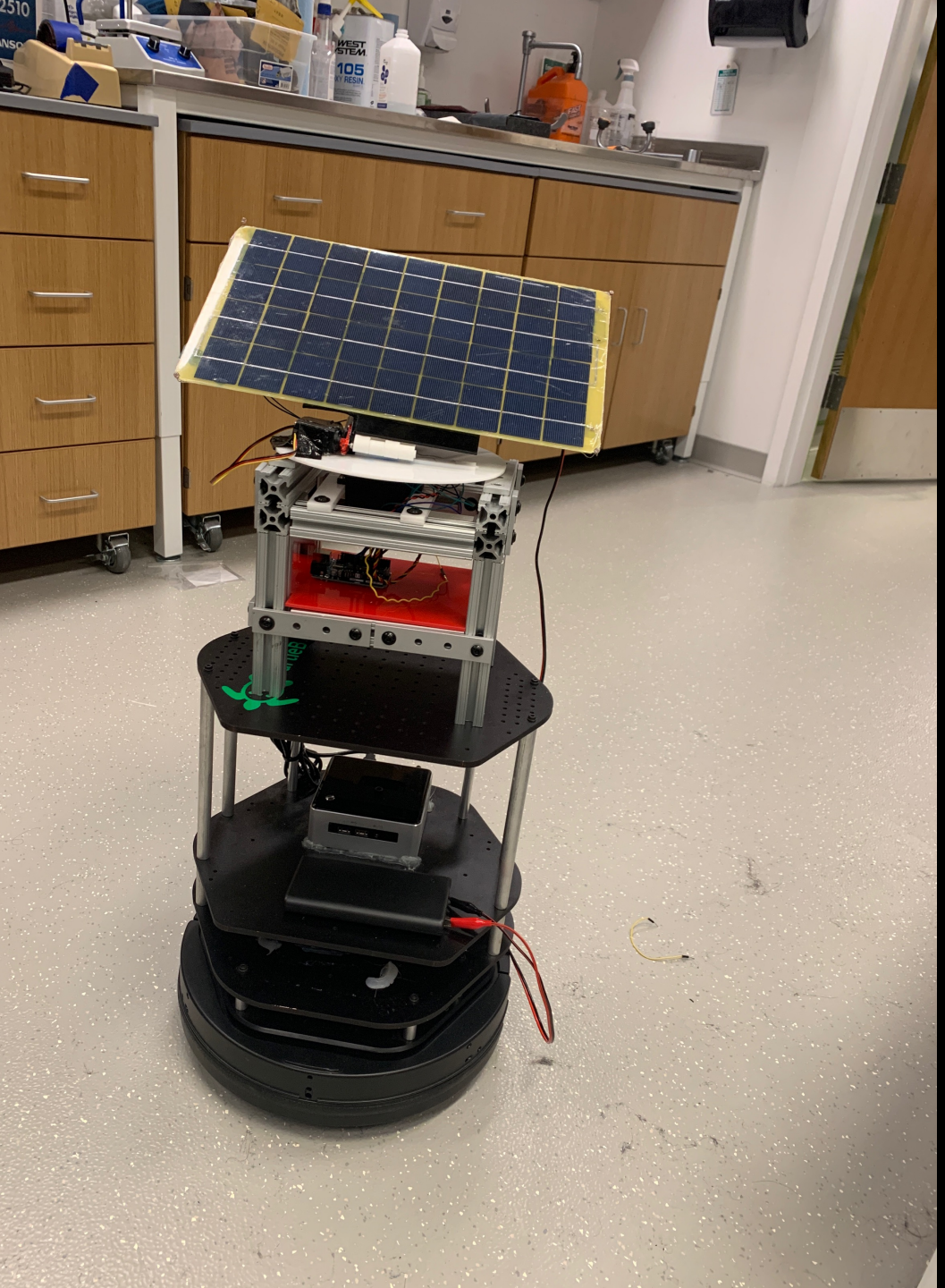
Feasibility

- Built MVP over the course of a single weekend
- Parts are commonly available
  - Minimize cost for end users
  - Ensure device can be fabricated IN Africa FOR Africa
- Solar power is a well proven technology
  - Able to provide power to battery pack and charge cell phone
- Given a longer development cycle, we can continue to weatherize and test prototype

Commercialization

- Connections to a manufacturer
- Completion of second/third iteration prototypes
  - Refine hardware selections
  - Created closed shell device
- User interviews
- Creation of dedicated integrated circuit
  - Minimize power draw



Future Developments

- Integration with robotic base to find optimal position for sun irradiance absorption
- Creation of web application to coordinate position and deployment of power bots to locations in need of electricity

Thank You!