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THINK BIG WE DO™

Blitz

Energy Harvesting (Photovoltaic) to Power a Patient Tracking Bluetooth Angle-of-Arrival Locator

ZEBRA

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Project Motivation

The Blitz Locator Project aims to establish a comprehensive patient tracking system within hospitals, integrating a Bluetooth beacon module into standard wristbands produced through a Zebra printer and a Locator. The beacon, affixed to a patient's wrist, utilizes Angle-of-Arrival (AoA) technology, boasting a minimum 14-day battery life. The primary objective is to achieve a 99% accuracy in precisely locating a patient's room. AoA Locators strategically placed on facility ceilings monitor the area for Beacons using an antenna array, calculating the signal's angle of arrival. These Locators transmit acquired angles, including azimuth and elevation, to a Positioning Engine via Wi-Fi. The Engine then computes X-Y coordinates, ensuring sub-meter precision, potentially as precise as 30 centimeters (12 inches), through a well-placed network of Locators. The Locator would utilize energy harvesting to ensure that installation time is kept under two minutes, eliminating the need for wiring.

Key Accomplishments

PV Cell Evaluations: Evaluated and analyzed technical datasheets from Ambient Photonics, Epishine, WSL, Exeger, Dracula Technologies, Panasonic, Solems, Lightricity, Trony, and Power Film. We are documenting PV cell specifications to use for a Pros and Cons list. We contacted manufacturers for data that was missing from the data sheets. We've collected information related to voltage and current at the maximum power point, open circuit voltage, short circuit current, and power density. This information will be valuable as we decide which PV cell is best suited for the Locator.

Lux Data Collection: We researched key information for light meters and selected a professional-grade lux meter for testing. We decided to use the HOBO MX1104 data logger. We developed a method to test lighting conditions for different areas of a hospital. We measured the area of the room and took lux measurements at various locations and angles. We conducted lux data collection in non-patient rooms and general areas at Rhode Island Hospital.

PV Cell Testing and Solar Simulator: We ordered WSL, GCell, PowerFilm, Dracula, Epishine, Exeger, Ambient Photonics, Lightricity, and Panasonic sample cells for testing**.** We've designed a prototype solar simulation box to test photovoltaic cells under controlled settings **(Fig. 1)**. The device is 3D printed and has a variable removable light source. and the box doesn't allow outside light to affect the PV cell. With this device, we determined PV cell performance under specific lux conditions that simulate real hospital conditions.

Energy Storage: We researched energy storage methods and have explored using supercapacitors in conjunction with a lithium-ion battery because supercapacitors are devoid of heavy metals and detrimental chemicals, decreasing their carbon footprint when compared to lithium-ion batteries. We also researched different circuit configurations and their applications.

PV Cell Selection: We conducted testing using a source and storage element circuit design. This design allowed us to gather the necessary data required to determine which PV cells perform the best under various lighting conditions and angles. This data resulted in our top contenders that will be competing for their final implementation in the Blitz Locator design. For testing, we used an RC circuit consisting of a 3.3k resistor and a 0.47 Farad supercapacitor **(Fig. 2)**. The Nordic Semiconductor Power Profiler Kit II was used for current measure
ments.

Designed Angled Test Fixtures: These test fixtures are designed to hold a small breadboard that contains all the necessary equipment for our data collection process. Each tester is fixed at an angle ranging from 25-50 degrees and is used to test PV cells in real world settings **(Fig. 3).** The PV Angler was affixed to the ceiling using a magnet. The Power Profiler Kit II was used to measure current and charge. The specific spot on the ceiling was marked for uniform testing **(Fig. 4)**.

Anticipated Best Outcome

The best outcome is :

- A thorough assessment of selected photovoltaic (PV) cells.
  - Evaluation of diverse lighting conditions, different light sources, orientations, and size/surface area variations.
- Identification of the top two leading candidates for PV cells.
  - Pricing information for the specific form factor will be obtained, and discussions with Zebra Commodities will be initiated.
  - Development kits and/or samples will be acquired from various suppliers.
- Testing of power production capabilities of the various PV cells.

Project Outcome

We were able to meet the anticipated best outcome. Zebra Technologies was provided with a full report outlining the testing process, test results, and top two contenders for the final design.

Figures

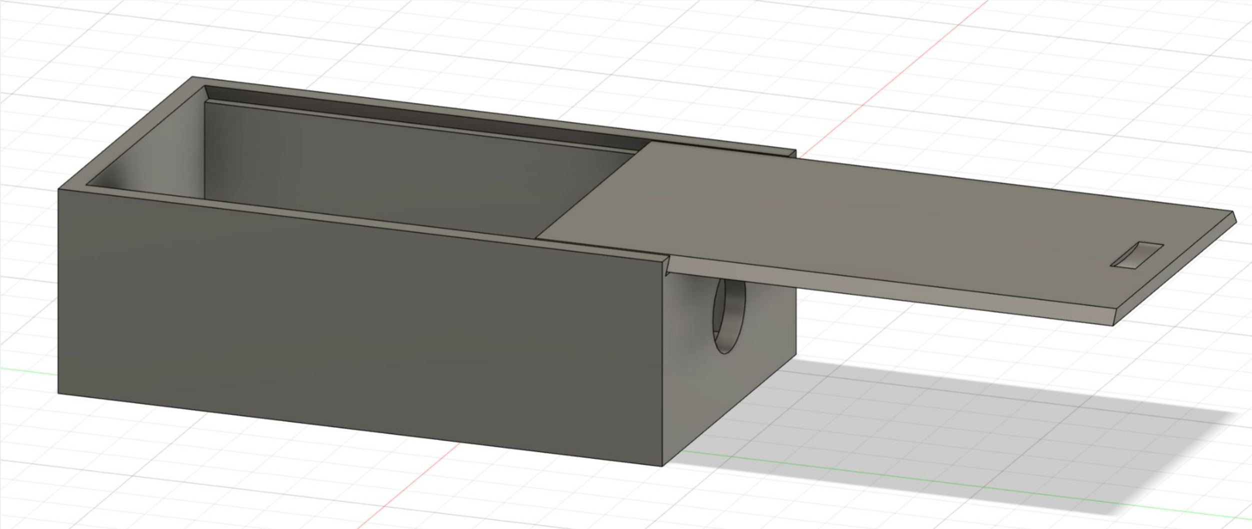

Fig. 1: Solar simulator box drawing in Fusion 360

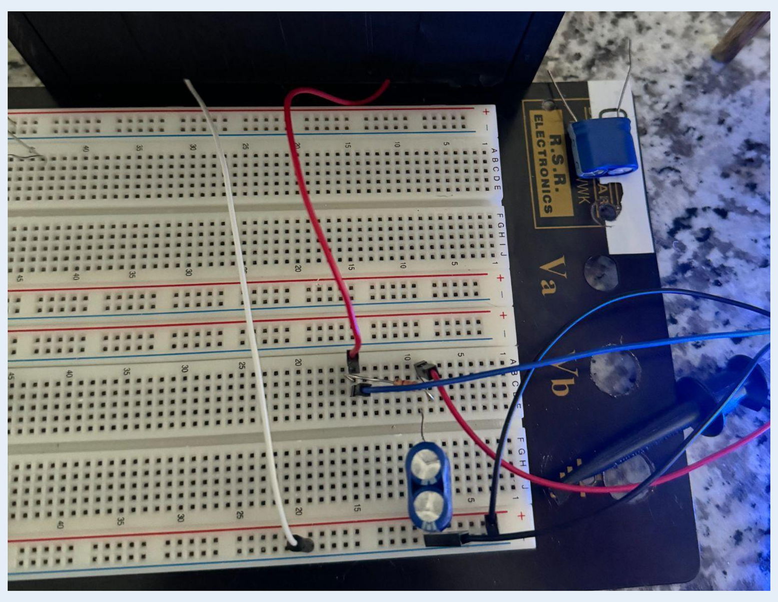

Fig. 2: RC circuit consisting of a 3.3k resistor and a 0.47 Farad supercapacitor

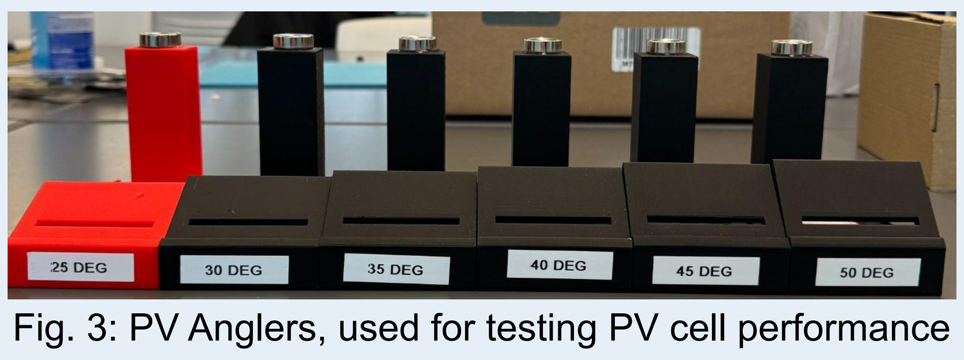

Fig. 3: PV Anglers, used for testing PV cell performance

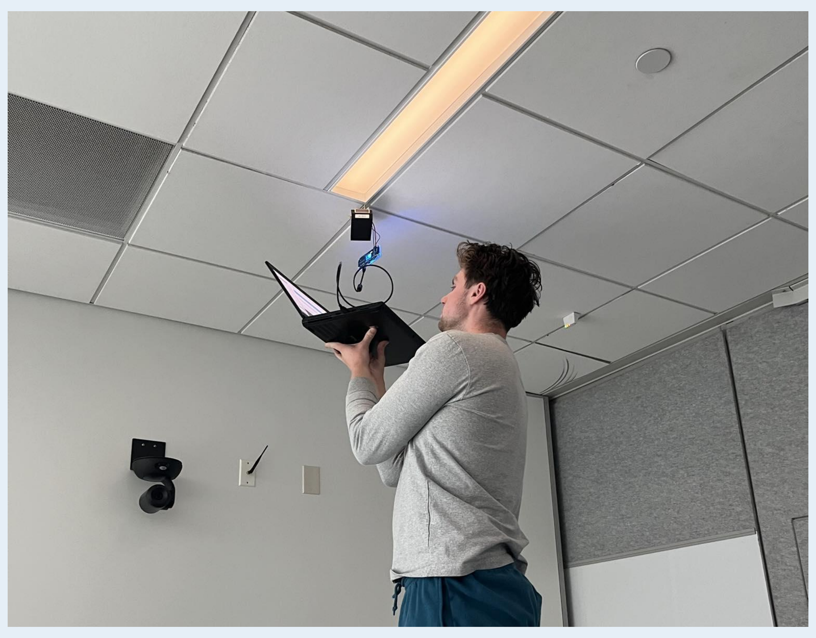

Fig. 4: Testing a PV cell at a specific angle with the PV Angler and Power Profiler Kit II

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