Freedom to Walk

A wearable solar garment exploring portable energy

by Mariam Baghdasaryan

This project explores the integration of solar energy systems into wearable garments designed for outdoor use. The goal of the project was to investigate how **clothing** could become an **interface between the human body** and **the surrounding environment** by collecting and storing **renewable energy** during movement.

Solar energy is already widely used to power buildings and infrastructure. However, much less attention has been given to personal-scale energy generation that can travel with the user. This project explores the idea that garments themselves could become small mobile energy platforms, capable of harvesting sunlight while the wearer moves through the landscape.

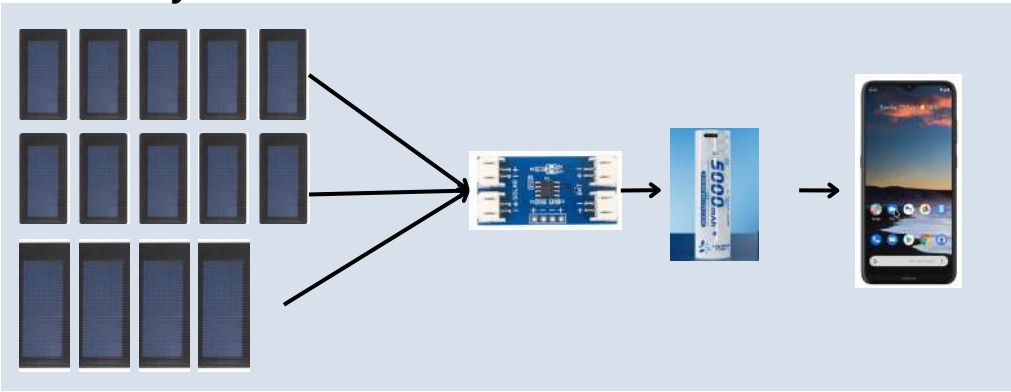
The concept was developed as a wearable prototype: a hooded neck garment positioned between a scarf, a hood, and a lightweight vest.

The design allows solar panels to be placed on the outer surface of the garment, where they can receive sunlight during walking or hiking. The energy generated by the panels is stored in a portable battery that can later be used to charge small devices such as a phone.

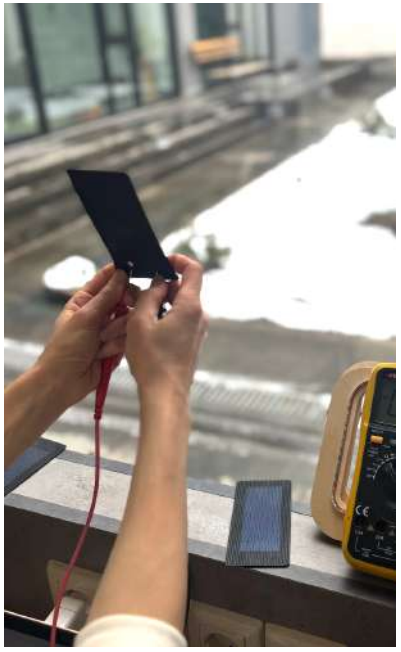
In this project, the solar energy system consists of small photovoltaic panels connected through a CN3065 solar charging controller to a 5000 mAh power bank.

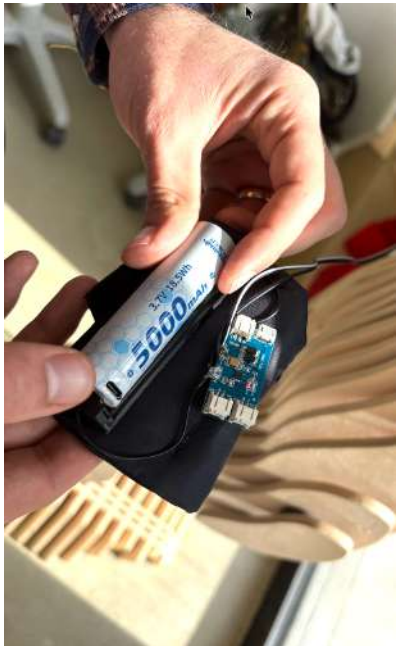
The panels were tested individually in both cloudy and sunny conditions to verify their voltage output before being assembled into a multi-branch system designed to remain within the voltage limits of the controller.

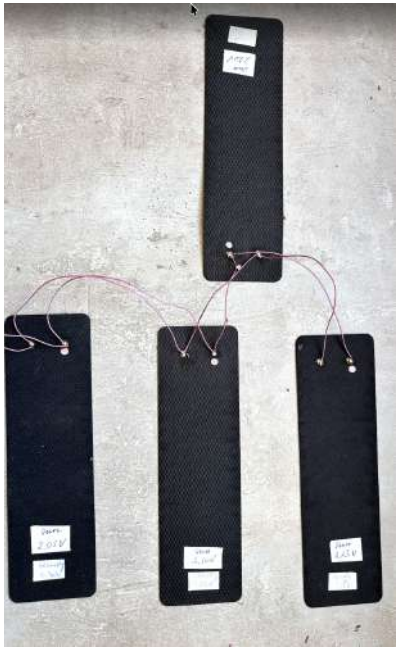
Electrical layout:



During testing, the assembled system produced approximately 6.2 volts under daylight conditions.



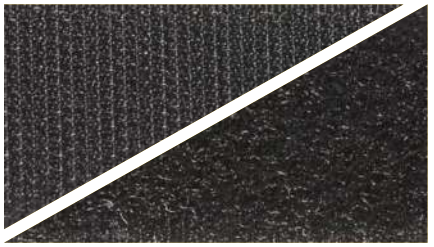




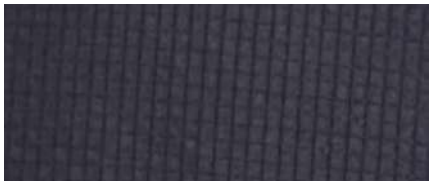
Garment layers

Flexible solar panel

- Amorphous Silicon
- Waterproof



Self-adhesive **Velcro tape**

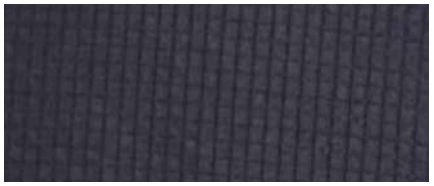


Shell fabric

- 100% Nylon
- Finish - WP, WPU, PU

Padding

Synthetic Down
100% Polyester



Shell fabric / Lining

- 100% Nylon
- Finish - WP, WPU, PU

To make the garment modular and maintainable, **magnetic snaps** were used along the central closure and to attach scarf elements to the vest structure. Solar panels are attached using velcro tape, allowing the electronic components to be removed when necessary.

For additional reliability, the solar controller and power bank are placed inside a separate removable module attached with velcro. This module can be placed inside a garment pocket or inside a backpack if desired.

System Performance and Results

The wearable solar charging system was tested outdoors under clear sunny weather conditions. During testing, the assembled system successfully generated and stored energy in a 5000 mAh power bank.

The prototype demonstrated gradual energy accumulation over time. Depending on sunlight intensity and exposure duration, the power bank charge increased from **0%** to approximately **33–66% within 4-5 hours** of direct sunlight exposure.

Charging performance was most effective when the solar panels were directly oriented toward the sun and remained unobstructed by shadows.

These results demonstrate that wearable solar energy collection is technically feasible even with a relatively lightweight prototype. While the charging speed remains slower than conventional charging methods, the system successfully proved the concept of portable energy harvesting integrated into clothing.

The project does not attempt to replace traditional solar energy infrastructure. Instead, it explores a smaller and more personal scale of renewable energy use.

By integrating energy generation into clothing, the project suggests a future in which garments can actively interact with the environment and collect energy as we move through the world.

Ultimately, this work investigates how wearable design might contribute to a more sustainable relationship between technology, mobility, and renewable energy.

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