



Solar-Powered Autonomous Planter

Laser-cut chassis • sensor-driven planting logic •
wall-avoidance • adaptive power conservation





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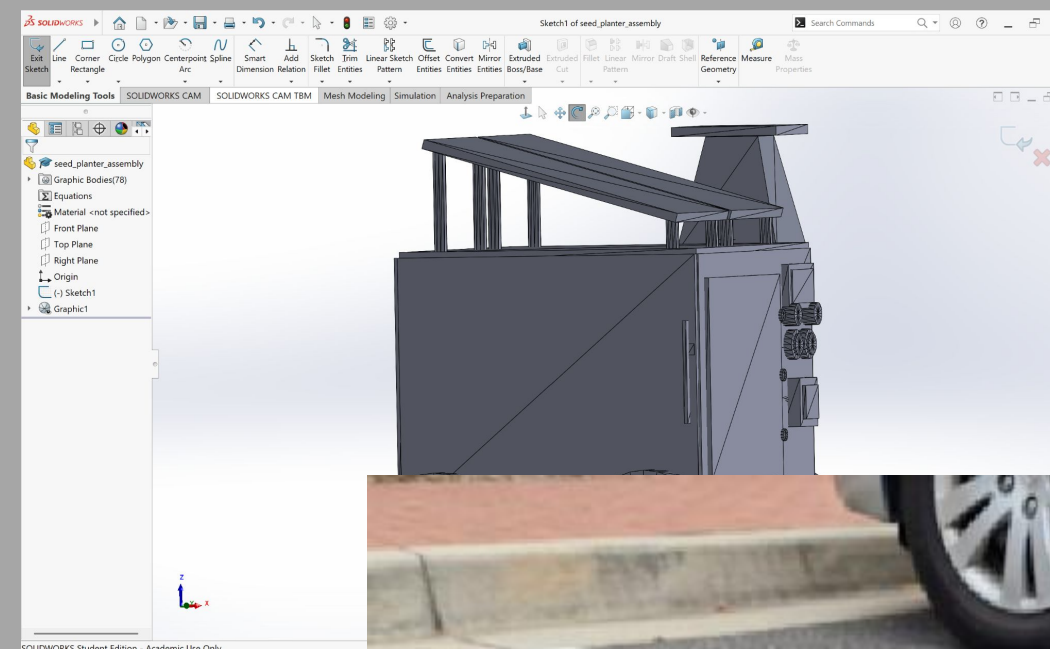




01.

Project Overview

- Autonomous rover that plants seeds while roaming a garden bed: plant → move a short distance → plant again, achieving 11+ seeds/minute.
- Laser-cut plywood box chassis with a clear acrylic window for easy view to the front of the electronics bay.
- Reads humidity, light, and soil moisture to decide whether conditions are suitable to plant: shown live on 2 status LEDs and LCD screen.
- An ultrasonic sensor detects walls/obstacles and changes heading automatically.
- A battery monitor triggers an adaptive low-power conservation mode to extend runtime on cloudy/low-light days & low battery.

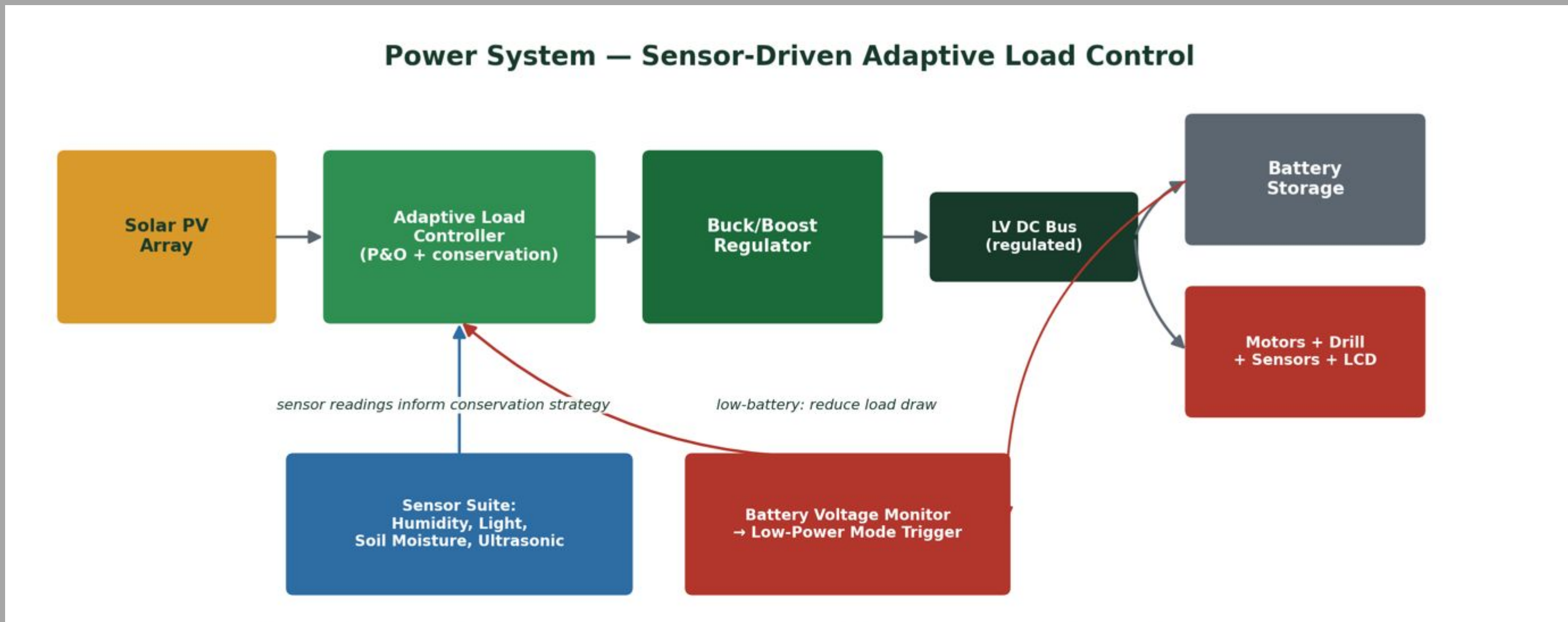




02.

System Architecture

Sensor readings and battery state directly drive the adaptive load controller.





03.

Sensor Suite



Sensors & Thresholds:



- Humidity Sensor: 30-85
- Soil Moisture Sensor: 25-75
- Light Sensor: 15+

User Interface:

- Red LED
- Green LED
- LCD screen

- Ultrasonic sensor triggers a pivot turn (and reversed heading) whenever an obstacle is closer than 20 cm.

3

sensor inputs
fused per decision

2+1

status LEDs
+ LCD screen live updates

20 cm

ultrasonic wall-detection
threshold



03. Planting Logic

- Humidity, light, and soil moisture readings are checked against acceptable planting ranges every sensor cycle.
- Green LED lights when all three conditions fall within range; Red LED lights otherwise.
- Planting only proceeds when conditions are suitable and seeds remain in the hopper; the rover still moves and re-checks continuously otherwise.
- The LCD reports live seed count and status messages ("Changing Direction", "Out of Seeds!").





03.

Seed Dispensing Mechanism



11+

seeds per minute

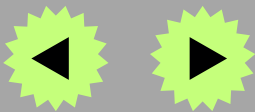
- A clear hopper on the right side holds the seed supply and is easy for the user to refill.
- A linear rail carries the actuator/drill down to bore a small hole; a seed then drops through the tube into the hole.
- A hopper level IR sensor confirms each seed drop and detects when the hopper runs dry.
- Drive → stop → drill → dispense → retract fits inside a ~5.45 seconds budget per cycle.

```
Command Window
Seed Planting Rover: Power System & Conservation Model

Bus output variation (adaptive): mean 2.8%, worst 6.8%
Energy loss reduction from adaptive control: 34.5%

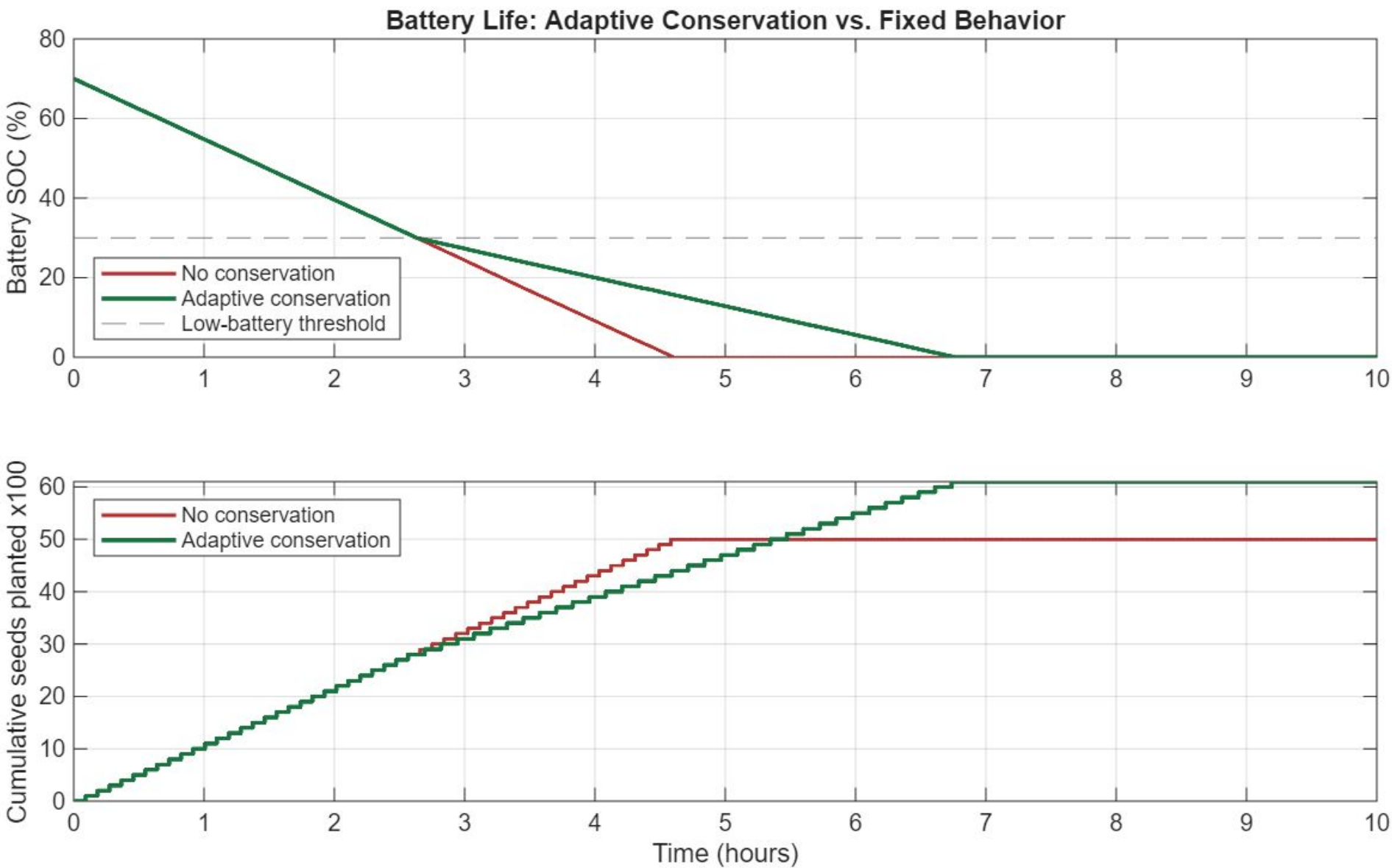
Low-battery adaptive conservation (10-hour simulated day):
  Without conservation : runtime 4.6h, 5000 seeds planted
  With adaptive conservation : runtime 6.8h, 6100 seeds planted
  Runtime extended by 47.0% via adaptive conservation

Seed dispensing throughput:
  Normal mode cycle time: 5.45 s/seed -> 11.0 seeds/min
  Low-power mode cycle time: 7.50 s/seed -> 8.0 seeds/min
```

04.

Adaptive Power Conservation



47%

longer runtime with
adaptive conservation

- Battery voltage below threshold engages low-power mode: reduced drive speed, slower sensor polling, intermittent LCD backlight.
- Simulated low-light day: conservation mode extends operating time and total seeds planted before depletion.



05.

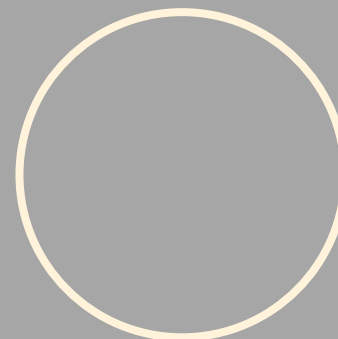
Bill of Materials

Highlights (Not a comprehensive list)

- Elegoo/Arduino Uno R3
- 4-channel motor shield
- DHT22 humidity sensor
- LDR light sensor
- resistive soil-moisture probe
- HC-SR04 ultrasonic sensor
- 16x2 I2C LCD

- red/green status LEDs
- Linear rail
- servo-driven drill
- hopper-level IR sensor
- custom PCB
- MDF





Results Summary

11+

seeds planted per minute

47%

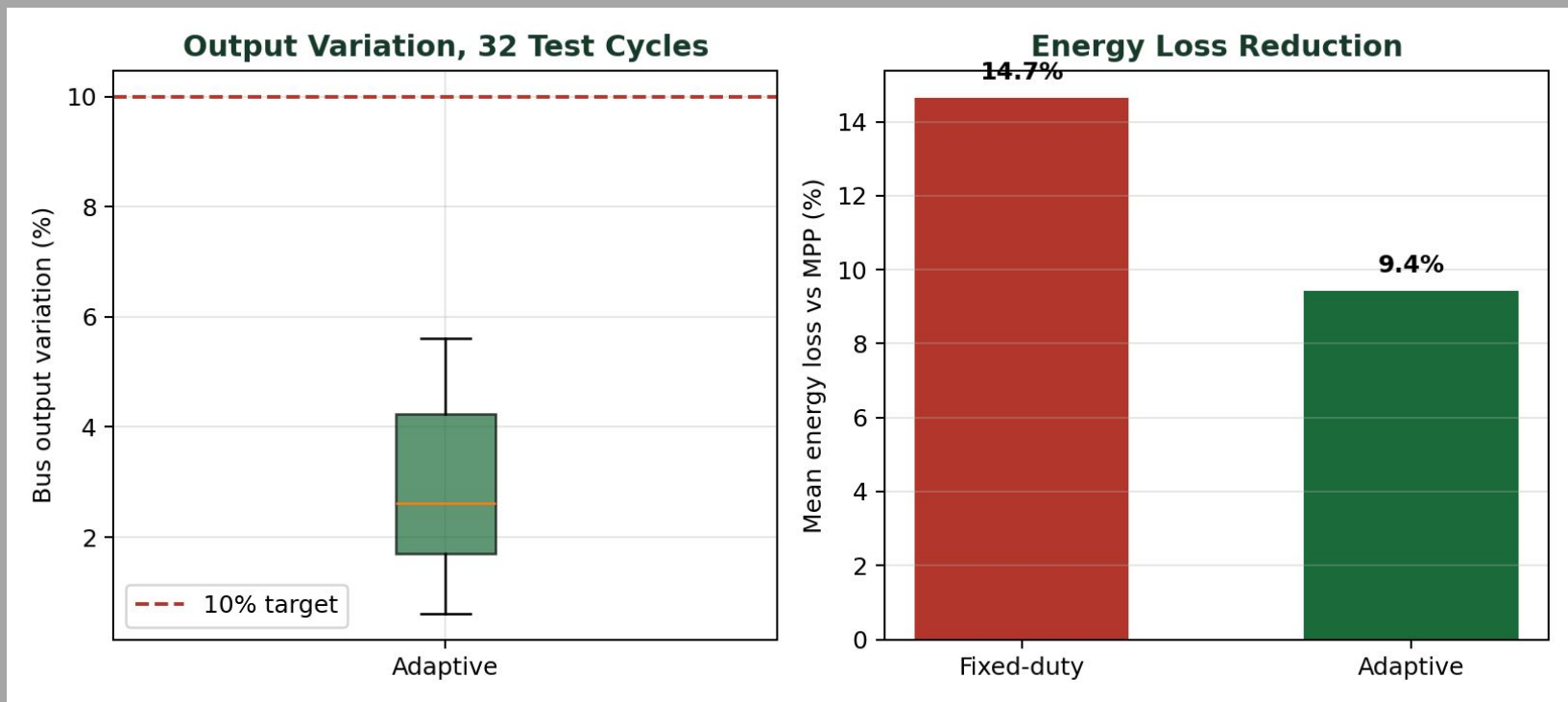
longer runtime with low
battery conservation

$\pm 10\%$

bus voltage variation
(adaptive control)

35.7%

energy loss reduction
vs. fixed-duty control





Engineering Deliverables

- 3D CAD assembly + 80+ individual part files
- Arduino firmware: full sensor suite, wall-avoidance, adaptive conservation, seed dispensing
- MATLAB model: solar_power_simulation.m + analyze_test_log.m
- Flowchart & power architecture diagrams





THANK YOU!

