

## Introduction

- KSA hosts over **30 M palm trees**.
- The Kingdom is one of the world's leading **date producers**.
- Annual production reaches approximately **1.5 M t of dates**.
- Palm agriculture contributes significantly to the **national economy** and **food security**.
- Date production is distributed across **multiple regions** across Saudi Arabia.

## Problem Statement

High temperatures reaching **60°C** and the **large scale of palm farms** in Saudi Arabia make **manual inspection** inadequate, often delaying issue detection and highlighting the need for a more reliable and timely monitoring approach.

## Project Objective

Develop a **drone-based** system to monitor palm farms using **temperature, imaging, humidity, and CO<sub>2</sub>** data to detect problems, identify diseases, and support better decisions with less human effort.

## Constraints

Weight between **0.5–2.5 kg**

Sensors work in **10–45 C**

Setup time **≤ 15 min**

Data stored locally (**128 GB**)

Safety factor **≥ 2**

Efficiency **≥ 80%**

**RBAC** required

Electronics operate up to **60C**

## Specifications

Sampling rate: **≥ 1 Hz**

Sensor accuracy: **CO<sub>2</sub> ±50 ppm**

Temperature **±1.5°C**, Humidity **±3%**

Operated by one trained user

Mission coverage treated as a trade-off

Thrust-to-weight ratio **> 1.8**

Center of gravity within **±0.5 cm**

**Alert** with recommended action

**Email/OTP** authentication

File **validation system**

## Integrated Specifications

File **validation system**

Data linked to **GPS (≥ 1 Hz)**

Completes **one mission/test**

Endurance **25–30 min**

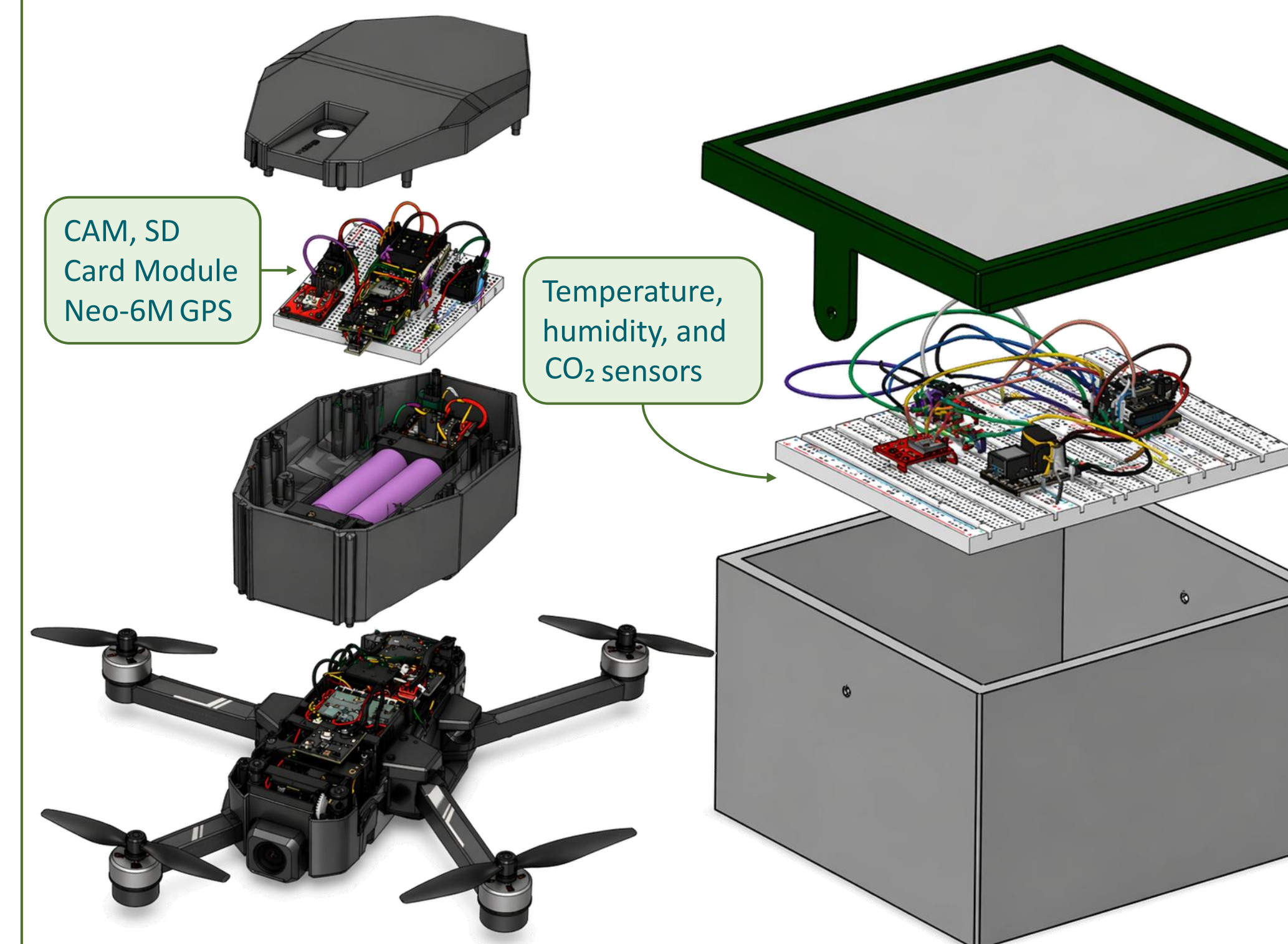
System **latency ≤ 3 s**

Proper sensor **placement** and **balance**

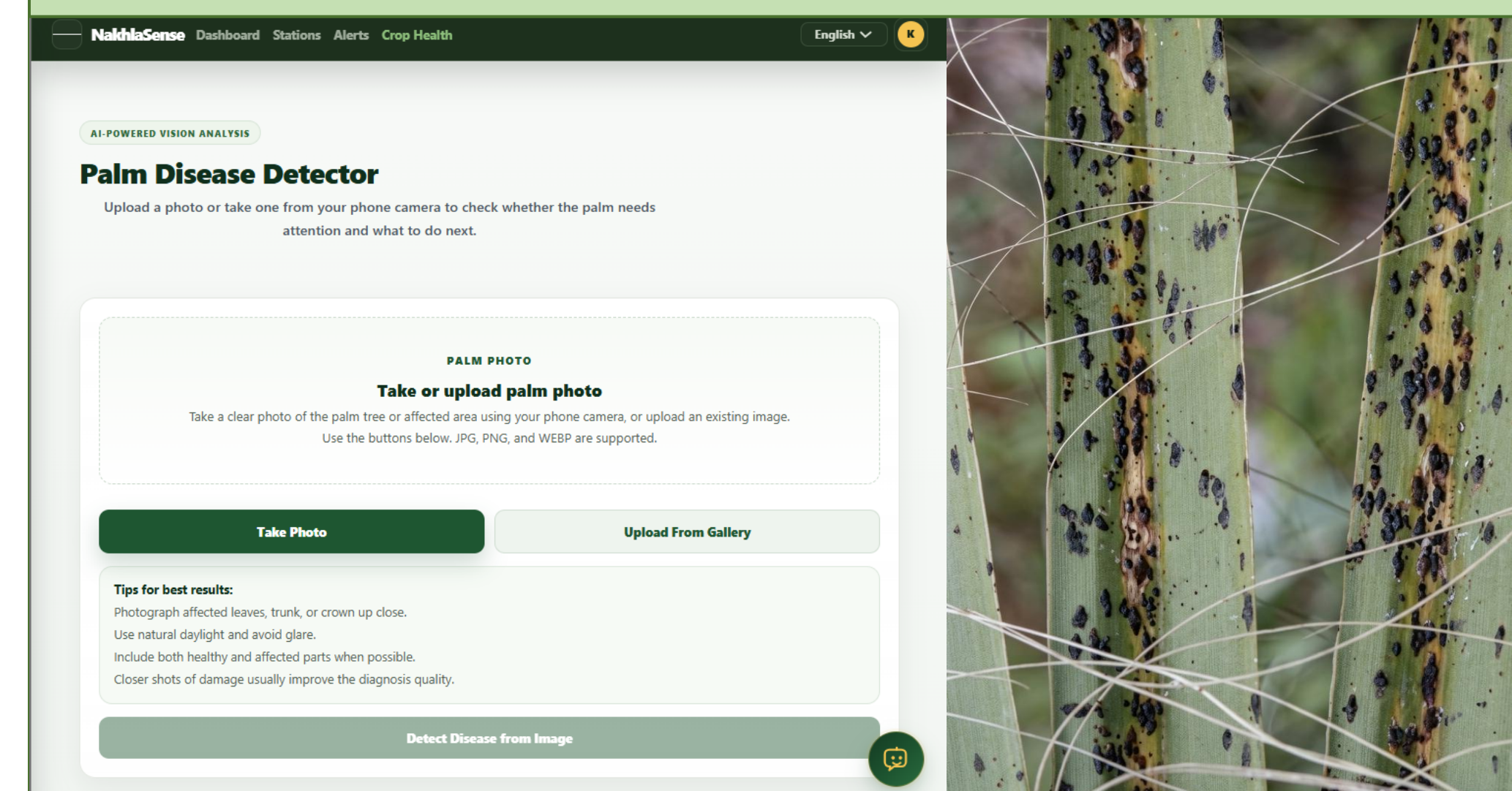
## Prototype Design



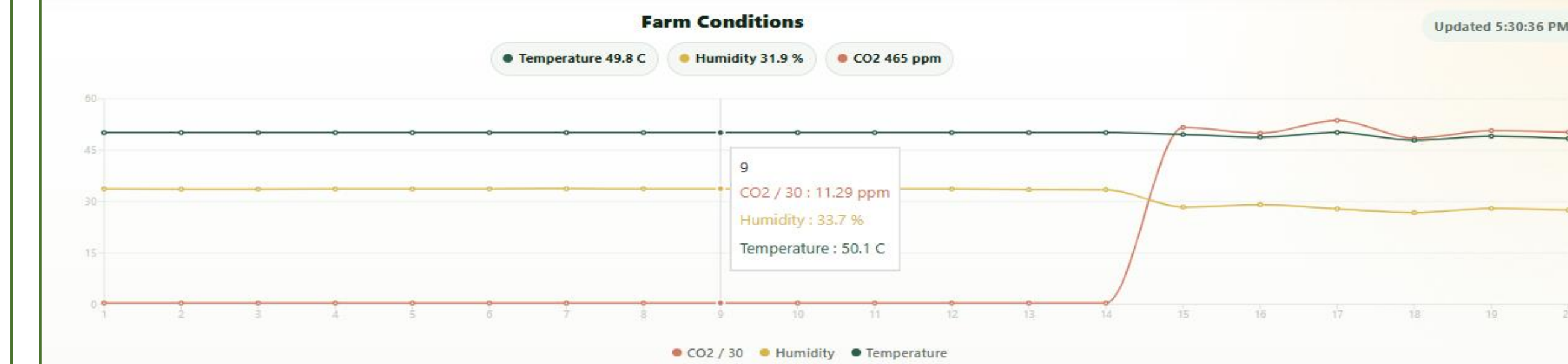
## Exploded Design



## Image Capture & Analysis



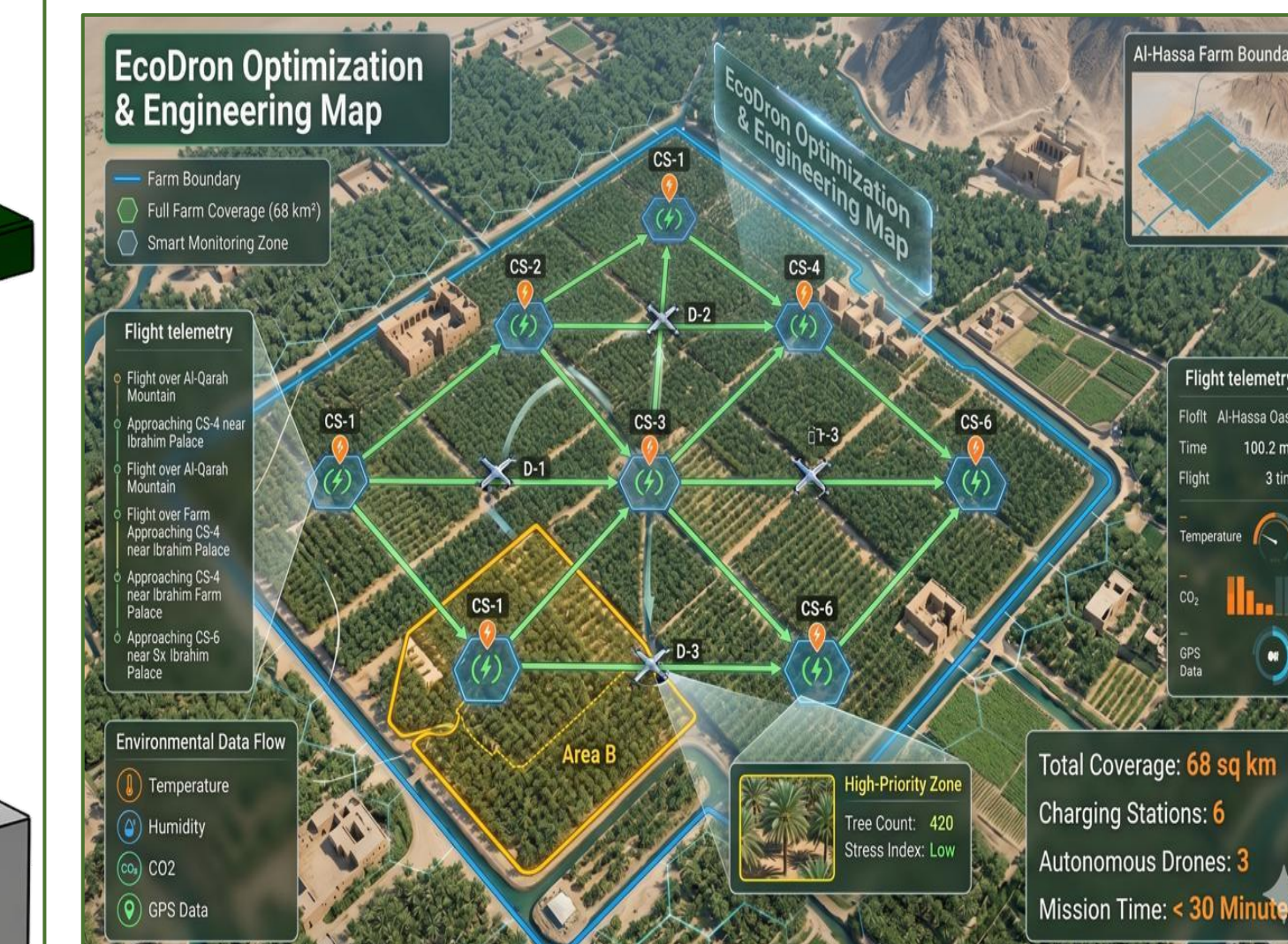
## Testing And Validation



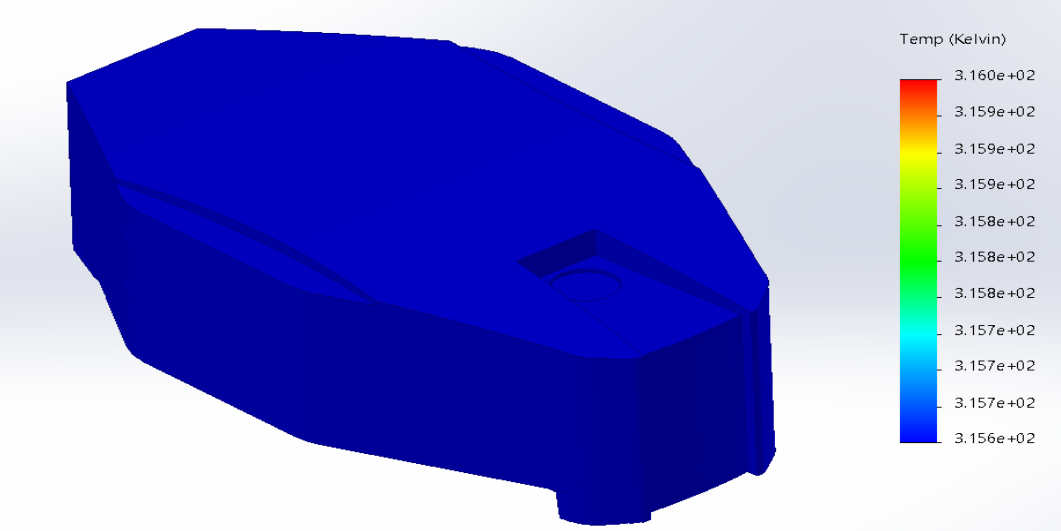
## Web Dashboard Displaying Sensor Readings

PacketID	ImageName	GroundDate	GroundTime	GroundLat	GroundLon	TempC	RH	AbsHumidity	CO2ppm
469	/img_39.jpg	18/04/2026	23:50:47	26.383459	50.025475	27.68	42.73	11.42	410
470	/img_40.jpg	18/04/2026	23:50:48	26.383459	50.025475	27.68	42.83	11.45	410
471	/img_41.jpg	18/04/2026	23:50:49	26.383459	50.025475	27.68	42.91	11.47	410
472	/img_42.jpg	18/04/2026	23:50:50	26.383459	50.025475	27.68	42.96	11.49	411
473	/img_43.jpg	18/04/2026	23:50:51	26.383459	50.025475	27.7	42.95	11.5	411
474	/img_44.jpg	18/04/2026	23:50:52	26.383459	50.025475	27.66	42.93	11.47	411
475	/img_45.jpg	18/04/2026	23:50:53	26.383459	50.025475	27.7	42.85	11.47	412
476	/img_46.jpg	18/04/2026	23:50:54	26.383459	50.025475	27.68	42.82	11.45	412
477	/img_47.jpg	18/04/2026	23:50:55	26.383459	50.025475	27.67	42.83	11.44	412
478	/img_48.jpg	18/04/2026	23:50:56	26.383459	50.025475	27.68	42.82	11.45	412
479	/img_49.jpg	18/04/2026	23:50:57	26.383459	50.025475	27.68	42.76	11.43	412
480	/img_50.jpg	18/04/2026	23:50:58	26.383459	50.025475	27.68	42.69	11.41	412
481	/img_51.jpg	18/04/2026	23:50:59	26.383459	50.025475	27.67	42.68	11.4	412

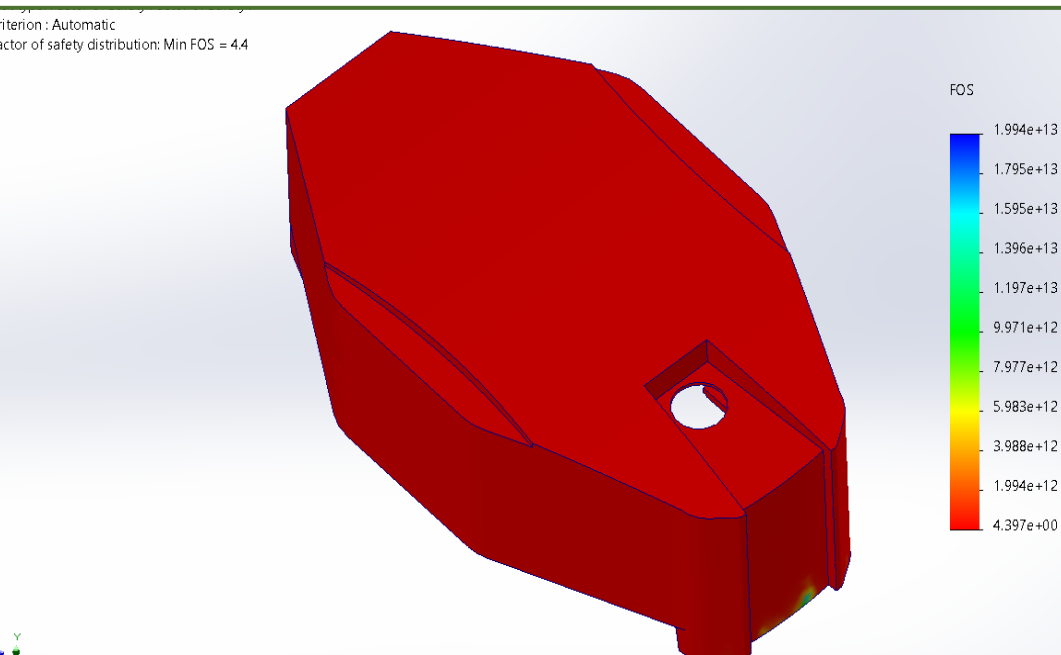
## Drone Images & Time-Stamped Ground Data



**Optimize stations and routes, excluding restricted zones**



## Heat Simulation



## FoS Simulation

## Conclusion

Drone-based inspection system provides an **efficient solution** for smart agricultural monitoring using integrated drones and stations. Future improvements include developing a custom PCB and optimizing the system for scalable deployment. Compared with conventional monitoring methods, it enables **faster** and **wider** field inspection for **smart farming** applications.