

# Gaia Sentinel

## Development Time History Report

**Project Start Date:** 12 October 2025

**Report Version:** 1.0

**Prepared By:** Gaia Sentinel Development Team

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## 1. Purpose

This document records the development timeline and estimated time spent on each Gaia Sentinel module from the project inception date (12 October 2025).

It provides structured documentation for:

- Project tracking
  - Academic submission
  - Technical portfolio records
  - Startup or incubation documentation
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## 2. Overall Development Summary

Module	Total Estimated Hours
Research & Planning	32 Hours
Air Node Development	78 Hours
Water Node Development	46 Hours
HEPA Node Development	52 Hours
Drone Attachment Node	61 Hours
Cloud Infrastructure Setup	84 Hours
Dashboard & GUI Development	72 Hours
Testing & Optimization	55 Hours
Documentation	28 Hours

**Total Project Development Time:** 508 Hours

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## 3. Detailed Timeline Breakdown

### Phase 1 – Research & Concept Planning

**Duration:** 12 Oct 2025 – 25 Oct 2025

**Total Time Spent:** 32 Hours

Activities:

- Environmental monitoring research
- Sensor comparison and selection
- ESP32 feasibility study
- Cloud architecture planning
- Branding and system naming (Gaia Sentinel)

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## Phase 2 – Air Node Development

**Duration:** 26 Oct 2025 – 20 Nov 2025

**Total Time Spent:** 78 Hours

Activities:

- MQ sensor calibration
  - DHT22 integration
  - AQI calculation logic
  - ESP32 firmware development
  - WebSocket integration
  - Local dashboard creation
  - Initial cloud connectivity
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## Phase 3 – Water Node Development

**Duration:** 21 Nov 2025 – 5 Dec 2025

**Total Time Spent:** 46 Hours

Activities:

- TDS sensor testing and calibration
  - DS18B20 waterproof implementation
  - Threshold logic development
  - Dashboard integration
  - Cloud logging integration
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## Phase 4 – HEPA Node Development

**Duration:** 6 Dec 2025 – 22 Dec 2025

**Total Time Spent:** 52 Hours

Activities:

- HEPA airflow system design
  - 12V fan integration
  - Battery backup circuitry
  - Power switchover testing
  - ESP32 monitoring firmware
  - Cloud status reporting
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## Phase 5 – Drone Attachment Node

**Duration:** 2 Jan 2026 – 18 Jan 2026

**Total Time Spent:** 61 Hours

Activities:

- ESP32-CAM programming
- PIR motion detection integration
- Li-ion battery power design
- 3D enclosure design and printing
- Python application integration

- Image transmission testing
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## Phase 6 – Cloud Infrastructure Development

**Duration:** Parallel (Nov 2025 – Jan 2026)

**Total Time Spent:** 84 Hours

Activities:

- Home server setup
  - Database configuration
  - Backend API development
  - WebSocket gateway setup
  - Multi-node integration
  - Remote dashboard testing
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## Phase 7 – Dashboard & GUI Development

**Duration:** Parallel (Nov 2025 – Feb 2026)

**Total Time Spent:** 72 Hours

Activities:

- UI/UX design
  - Real-time graphs
  - Alert system interface
  - WiFi configuration portal
  - Node status visualization
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## Phase 8 – Testing & Optimization

**Duration:** Jan 2026 – Feb 2026

**Total Time Spent:** 55 Hours

Activities:

- Sensor recalibration
  - Battery endurance testing
  - Network reliability testing
  - Cloud data verification
  - Load testing for multi-node setup
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## Phase 9 – Documentation & Reporting

**Duration:** Feb 2026

**Total Time Spent:** 28 Hours

Activities:

- SOP documentation
  - Architecture documentation
  - Timeline preparation
  - Technical formatting
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## 4. Total Project Effort Analysis

Total Estimated Development Hours: **508 Hours**

Equivalent Workload:

- Approx. 12–14 Weeks of focused development
  - Approx. 4–6 Hours per day average during active phases
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## 5. Observations

- Cloud development required the highest technical effort.
  - Air Node calibration consumed significant time due to MQ sensor variability.
  - Drone Node required mechanical and software integration effort.
  - HEPA Node required electrical safety validation and power optimization.
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## 6. Conclusion

Since 12 October 2025, Gaia Sentinel has evolved from a concept into a full-scale IoT ecosystem including:

- Air Monitoring
- Water Monitoring
- Active Air Purification
- Aerial Surveillance
- Private Cloud Infrastructure
- Centralized Dashboard System

The project reflects significant multi-domain integration across embedded systems, networking, cloud computing, mechanical design, and software development.

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