UNIVERSITY OF THE AEGEAN

SCHOOL OF ENGINEERING
DEPARTMENT OF PRODUCT AND SYSTEMS DESIGN ENGINEERING

IOHIVE: Designing Interactive Systems for Sustainable Beekeeping

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IOHIVE Team

FOSSCOMM - Lamia,
November 20, 2022

About us

- Department of Product & Systems Design Engineering
- Interactive Systems Design Lab / IOHIVE team

What we do

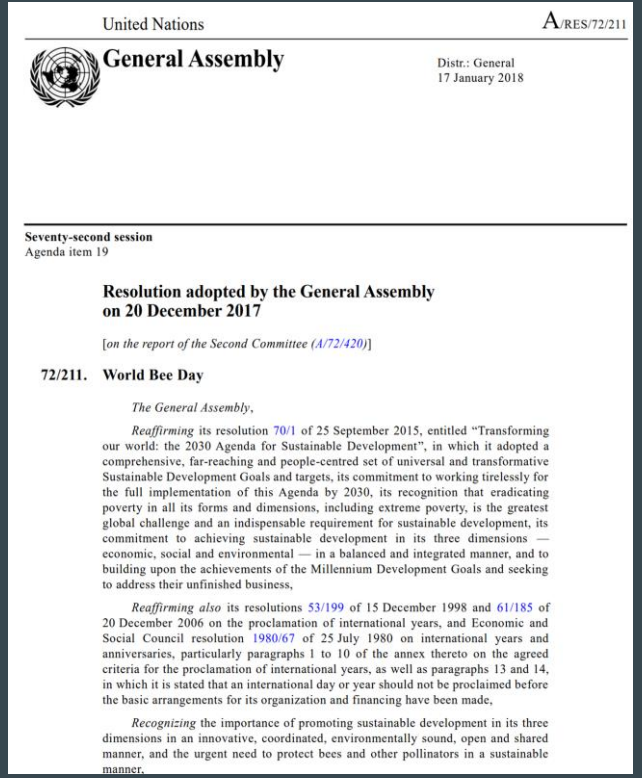
Design and Develop Interactive Digital Systems and Services for the Support and Horizontal Monitoring of Agri-Food Practices with focus on Sustainable Beekeeping

May 20, 2022 World Bee Day

Beekeeping is a widespread and global activity, with millions of beekeepers depending on bees for their livelihoods and well-being. Together with wild pollinators, bees play a major role in maintaining biodiversity, ensuring the survival and reproduction of many plants.

To raise awareness of the importance of pollinators, the threats they face and their contribution to sustainable development, the UN designated 20 May as World Bee Day.

We all depend on pollinators and it is, therefore, crucial to monitor their decline and halt the loss of biodiversity.



United Nations A/RES/72/211

General Assembly

Distr.: General
17 January 2018

Seventy-second session
Agenda item 19

Resolution adopted by the General Assembly on 20 December 2017

[*on the report of the Second Committee (A/72/420)*]

72/211. World Bee Day

The General Assembly,

Reaffirming its resolution 70/1 of 25 September 2015, entitled "Transforming our world: the 2030 Agenda for Sustainable Development", in which it adopted a comprehensive, far-reaching and people-centred set of universal and transformative Sustainable Development Goals and targets, its commitment to working tirelessly for the full implementation of this Agenda by 2030, its recognition that eradicating poverty in all its forms and dimensions, including extreme poverty, is the greatest global challenge and an indispensable requirement for sustainable development, its commitment to achieving sustainable development in its three dimensions — economic, social and environmental — in a balanced and integrated manner, and to building upon the achievements of the Millennium Development Goals and seeking to address their unfinished business,

Reaffirming also its resolutions 53/199 of 15 December 1998 and 61/185 of 20 December 2006 on the proclamation of international years, and Economic and Social Council resolution 1980/67 of 25 July 1980 on international years and anniversaries, particularly paragraphs 1 to 10 of the annex thereto on the agreed criteria for the proclamation of international years, as well as paragraphs 13 and 14, in which it is stated that an international day or year should not be proclaimed before the basic arrangements for its organization and financing have been made,

Recognizing the importance of promoting sustainable development in its three dimensions in an innovative, coordinated, environmentally sound, open and shared manner, and the urgent need to protect bees and other pollinators in a sustainable manner,

Source: https://bit.ly/3PAJRiz

Beekeeping and Cultural Heritage

- Beekeeping is not just a profession
- An activity with long history and traditional expressions
- The prevalence of skills, knowledge and good practice passed down from generation to generation
- Each place had its own unique identity
- List of the Intangible Cultural Heritage of Humanity

Beekeeping and Climate Change

- Bees are under threat. The bee population is constantly decreasing
- Human activities such as
  - changes in land use
  - intensive agricultural practices and the use of pesticides
  - pollution
- Pests / diseases (Colony Collapse Disorder, Varroa)
- It's not just about the honey
- Ensuring the world's food security

Beekeeping in the Cyclades: The challenge

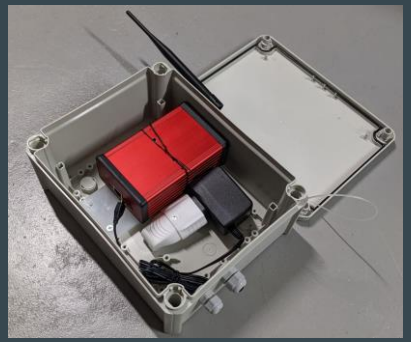
- Special environmental conditions
- Large variety of aromatic plants
- High quality products (e.g. thyme honey)
- Small production but high value
- No nomadic beekeeping
- Times of drought
- Tourism is a threat

MyHive: Interactive platform for the adoption of bee hives

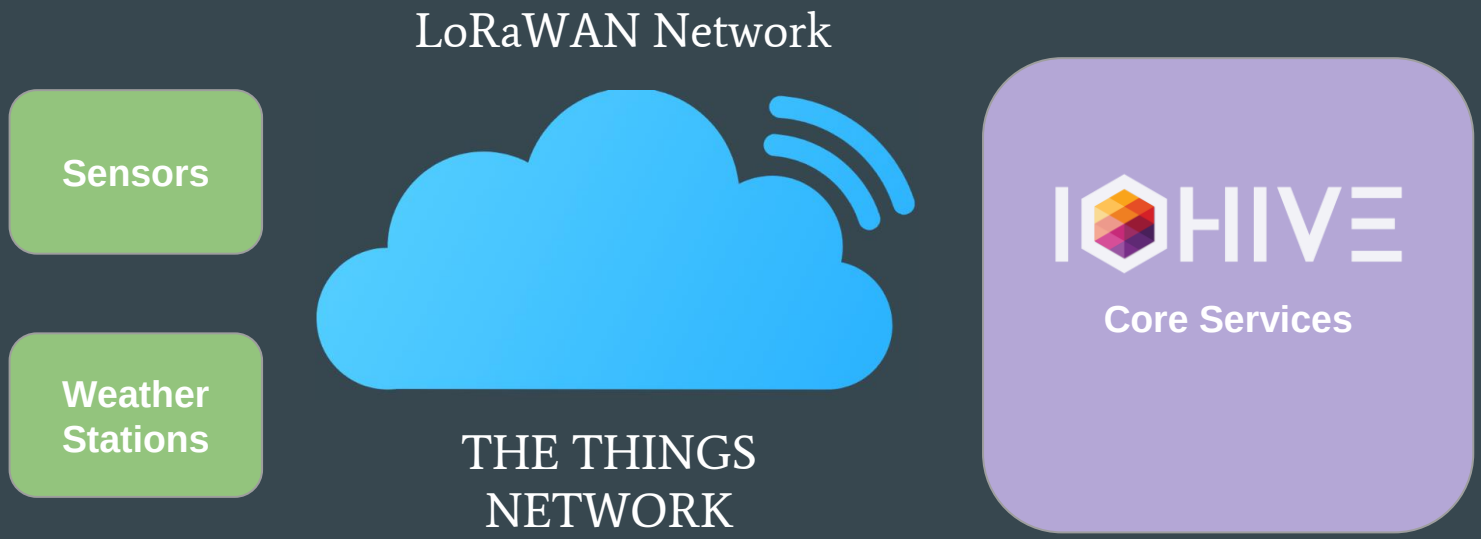
- A new approach to beekeeping and tourism
- Raising awareness
- Give value to local producers
- Roles
  - Beekeeper (monitor data / manage adoptions / schedule tours)
  - Adopter (learn / inspect / grab your honey)
  - Content creator (articles, interviews, blog)

IOHIVE: Internet of Interactive Hives

- Hive monitoring with autonomous sensors based on IoT solutions
- Application of LoRaWAN technology in Precision Beekeeping
- Data visualization and analytics
- Interactive Systems for Journaling of Beekeeping Activities based on Tangible and Wearable Interface



The idea


LoRaWAN Network
Sensors
Weather Stations
THE THINGS NETWORK
IOHIVE
Core Services

IOHIVE: Partners

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ
Μηχανικών Σχεδίασης Προϊόντων και Συστημάτων
Εργαστήριο Σχεδίασης Διαδραστικών Συστημάτων
www.syros.aegean.gr

ΕΛΓΟ ΔΗΜΗΤΡΑ
Ινστιτούτο Μεσογειακών και Δασικών Οικοσυστημάτων
Εργαστήριο Μελισσοκομίας
www.fria.gr

KUDZU I.K.E.
IOT Software & Hardware
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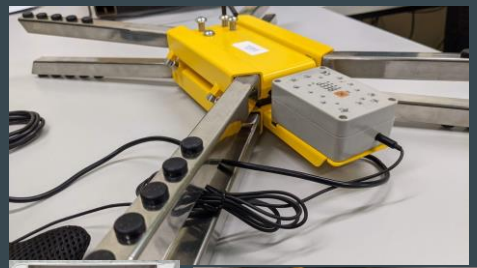
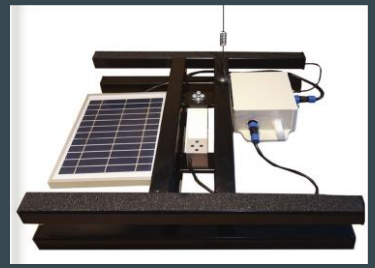
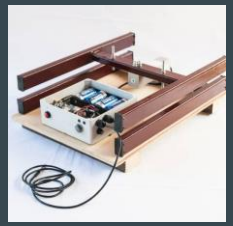
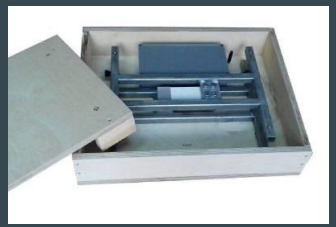
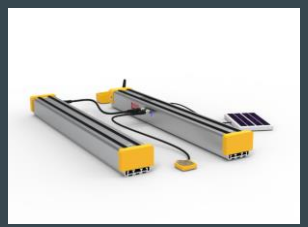
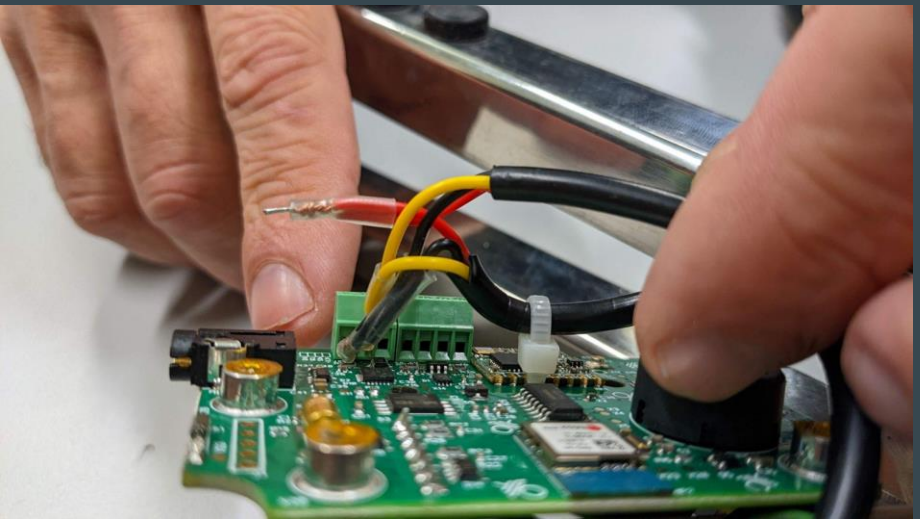
Sensors and weather stations

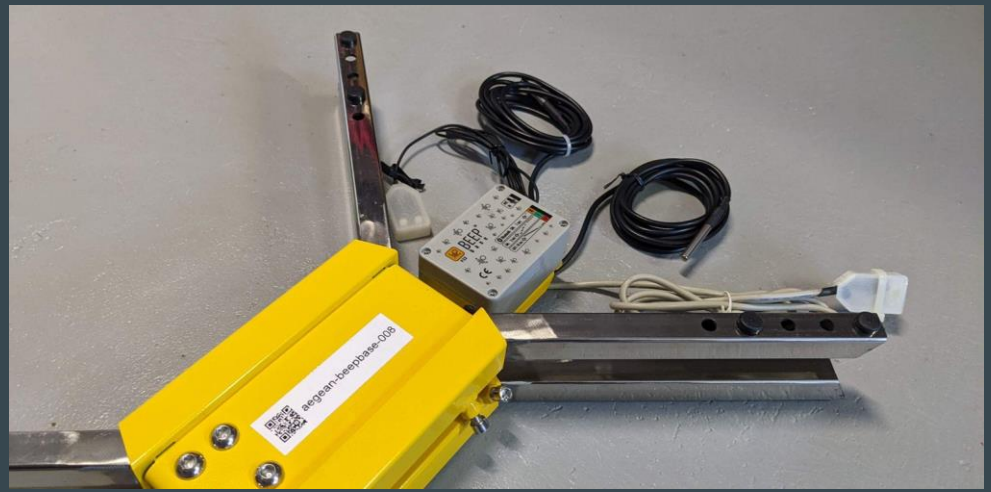





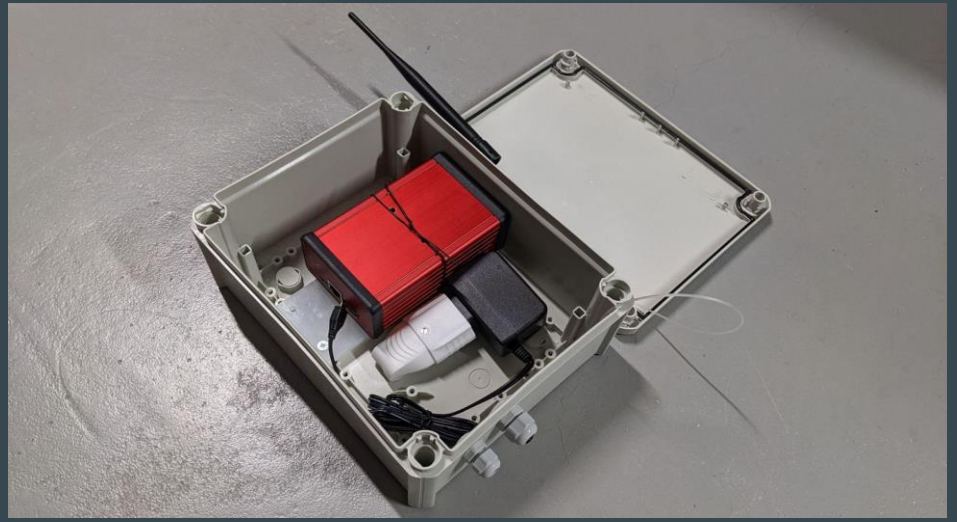



Beekeeping scale as Swiss army knife



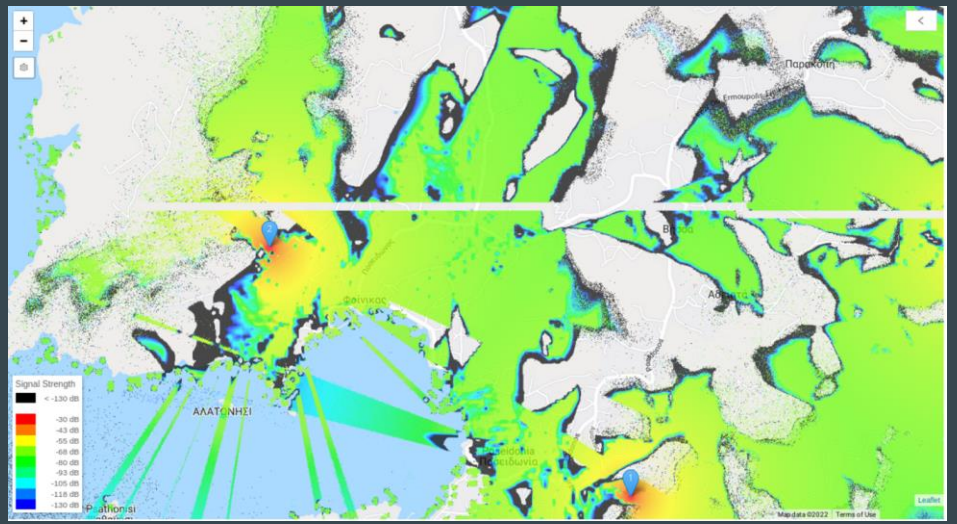


Network Installation Gateways at Syros and Paros island

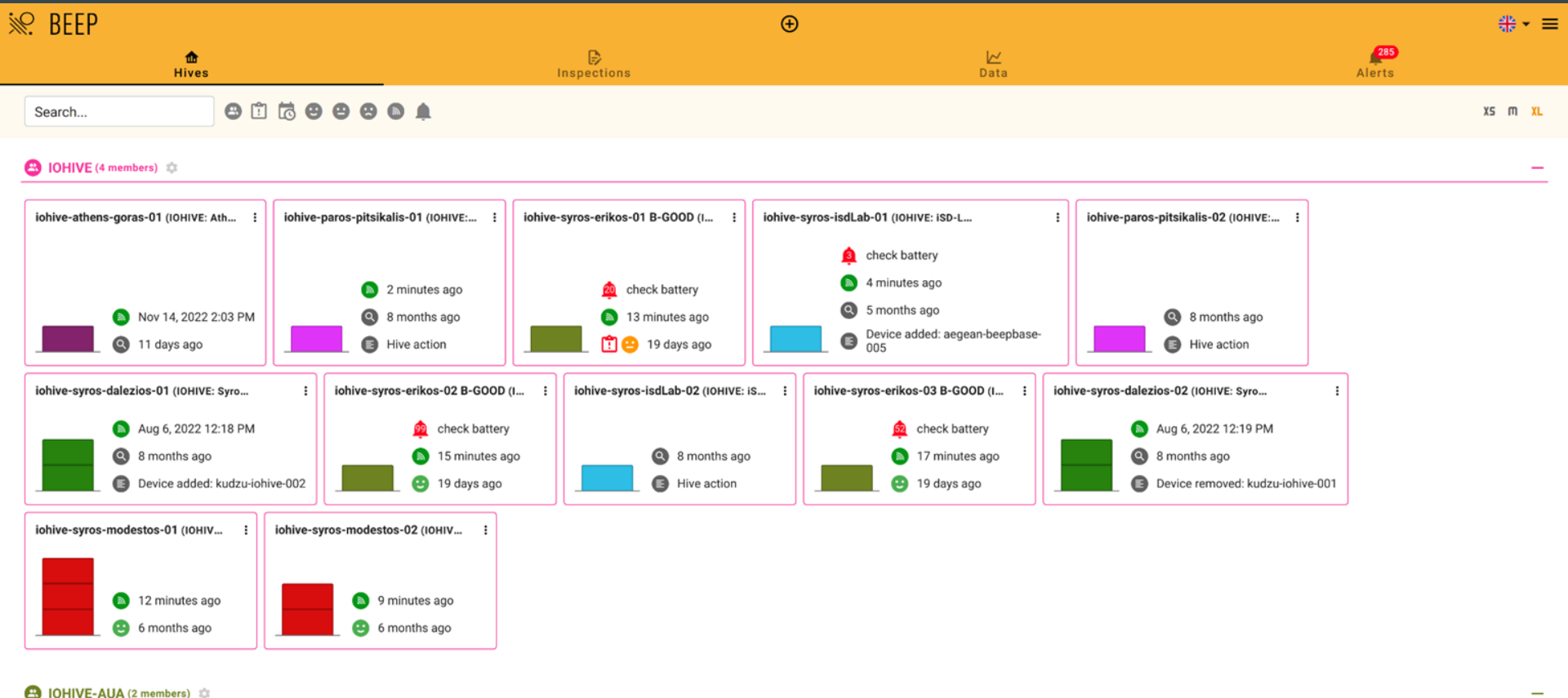


DIY LoRaWAN Gateways (e.g. RaspberryPi, LoRa Concentrator)

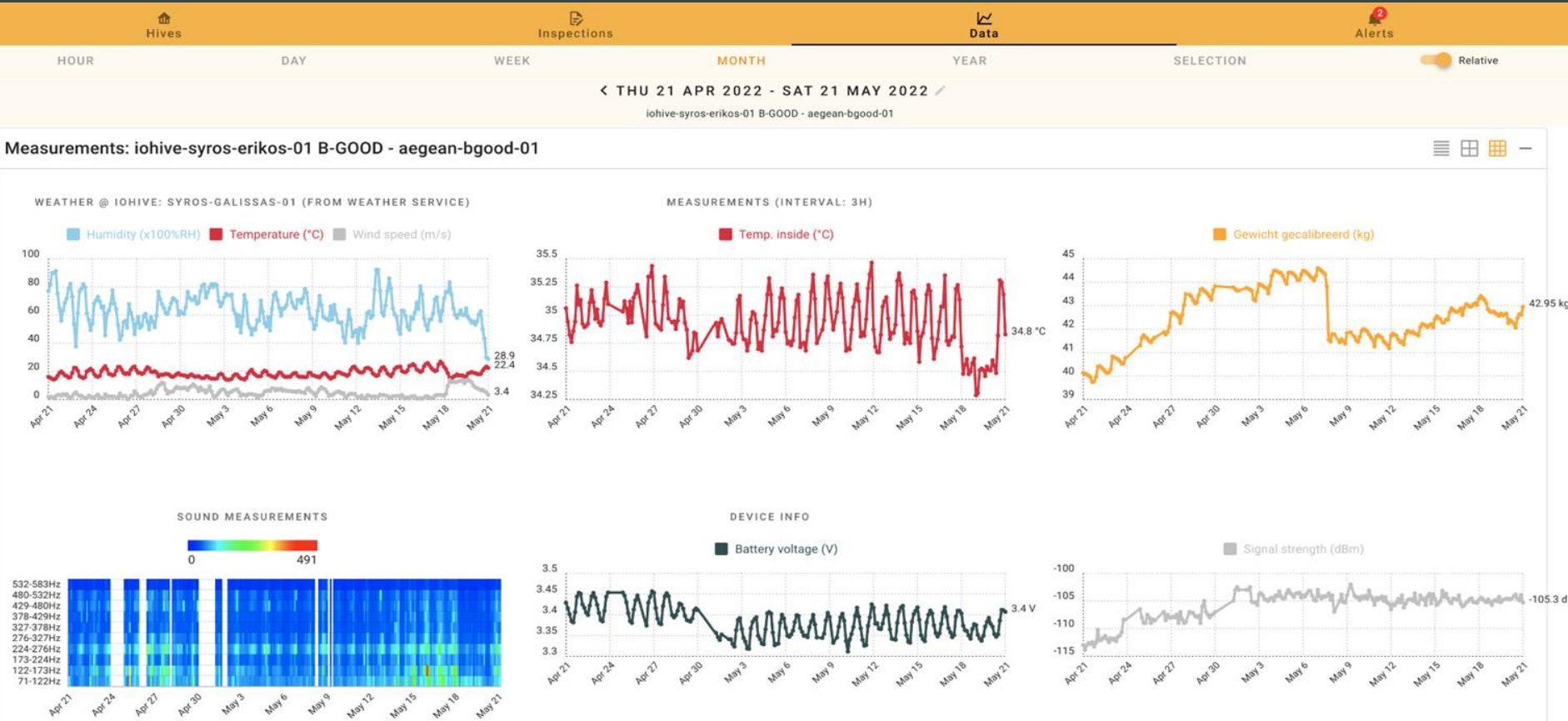
Gateway placement simulation



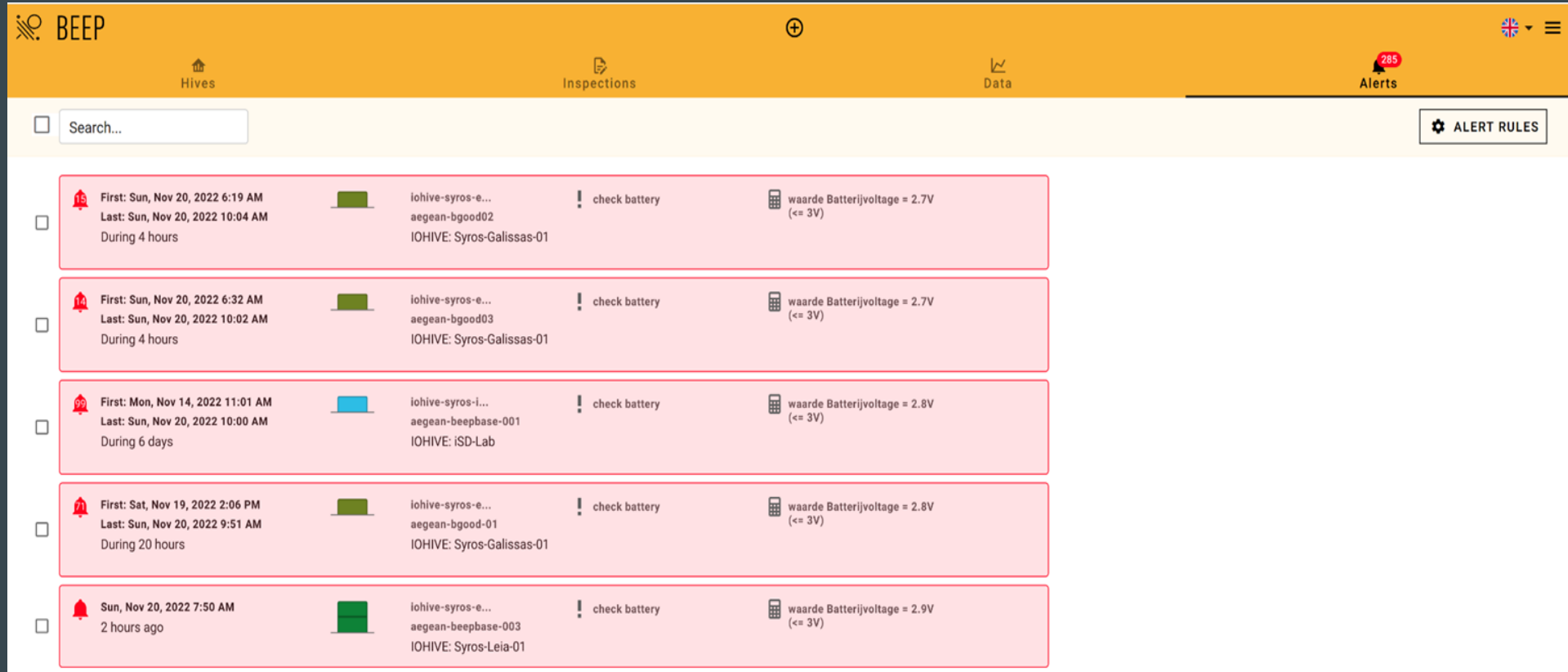
Hive management



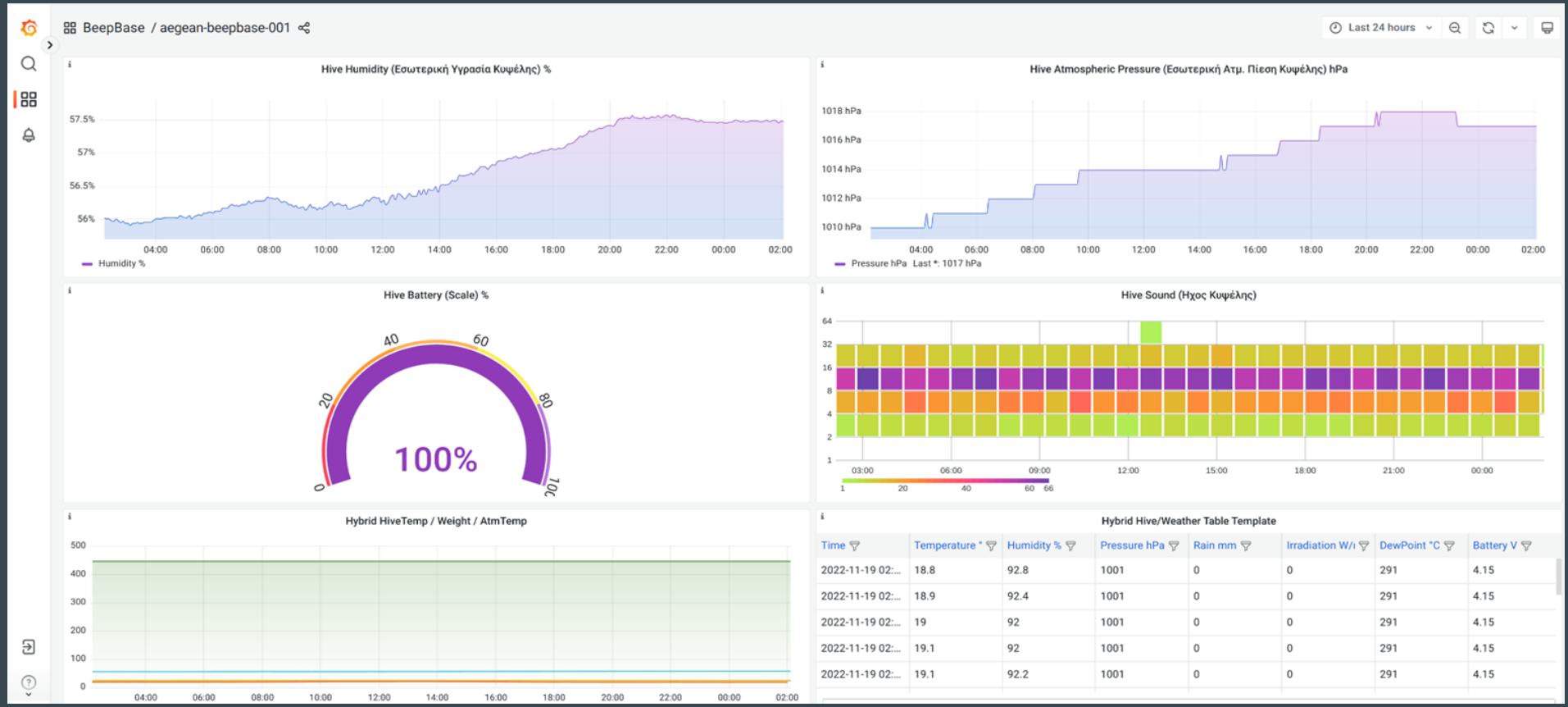
Sensor data visualization (BEEP app)



Alerting mechanism



Extra data visualization (Grafana dashboards)



Inspections

Observation

Intervention

Journaling

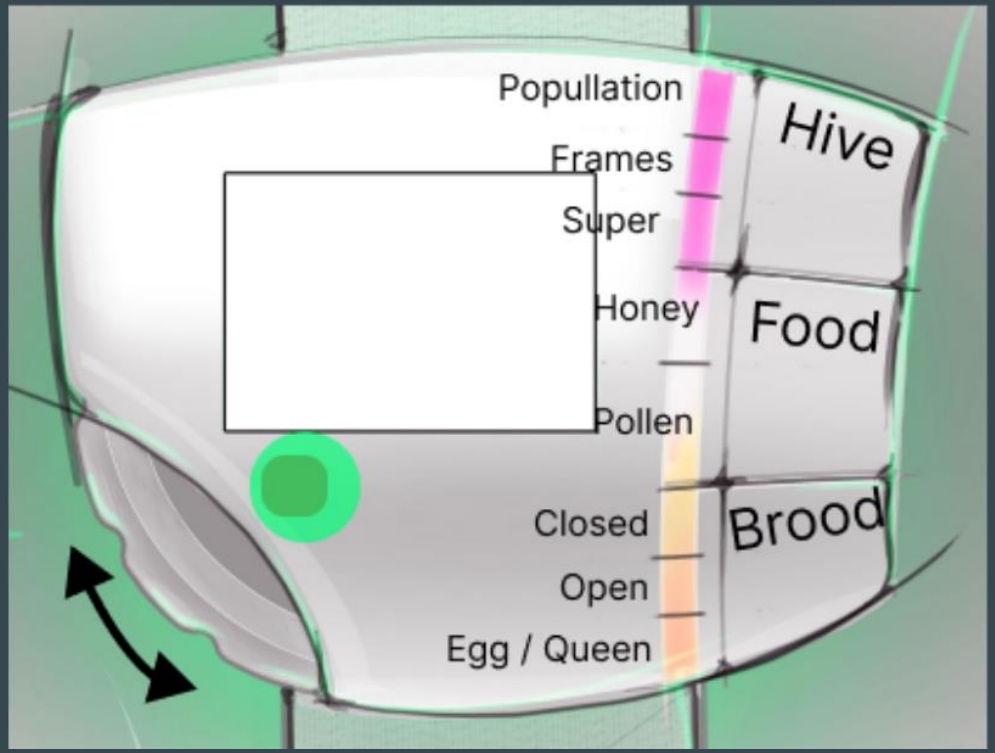
=>

← Inspections iohive-syros-modestos-02

Search...

Inspections	May 19, 2022 11:46 AM	May 7, 2022 9:00 AM	May 4, 2022 8:58 AM	Apr 24, 2022 12:30 PM
Total impression	😊	😊		😊
Needs attention	No	No		No
Notes			*Device added: aegean-beepbase-007*	*Newly Introduced*
Remember				
Notification date				
— **Bee colony**				
Bee colony > Brood > Frames with brood	10	10		8
Bee colony > Brood > Presence	Yes	Yes		Yes
Bee colony > Queen > Presence	Yes	Yes		Yes
Bee colony > Size > Frames with bees	20	14		10
— **Food**				
Food > Stock > Honey	Yes	Yes		Yes
Food > Stock > Honey > Number of frames	5	4		2
Food > Stock > Pollen	Yes	Yes		Yes
Food > Stock > Pollen > Number of frames	2	1		0.5

IOHIVE wearable: concept development

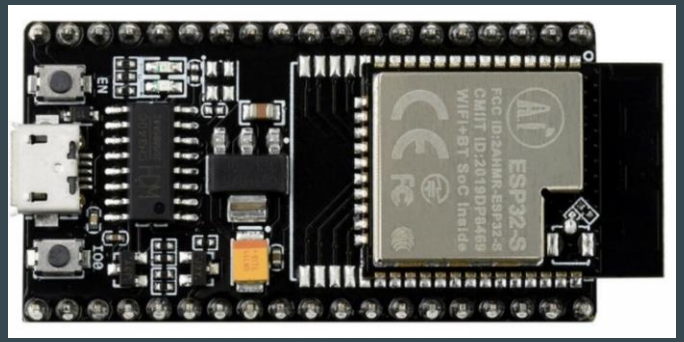


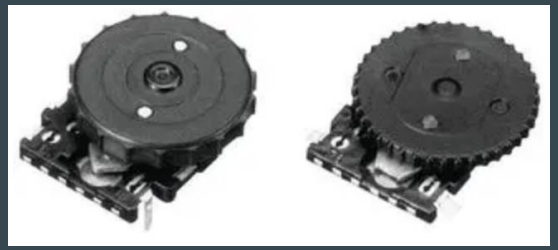
Minimal
Inspection Scenario

1. Hive identification
2. Number of frames
3. Frames with food
4. Frames with brood
5. Queen presence
6. Bee population
7. Overall impression
8. Needs attention

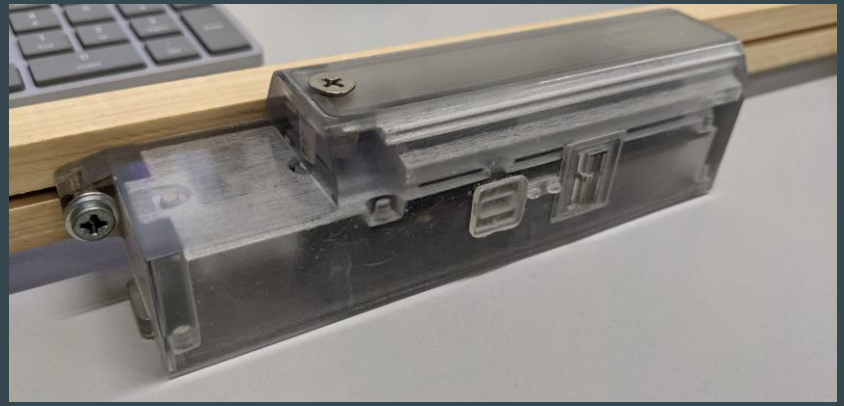
IOHIVE wearable: concept development

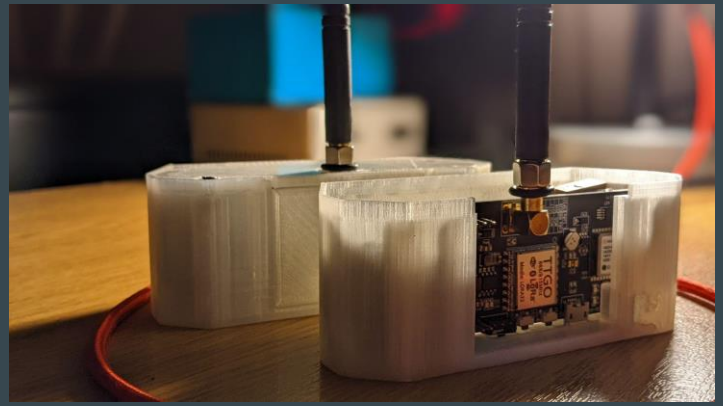
IOHIVE wearable: component list

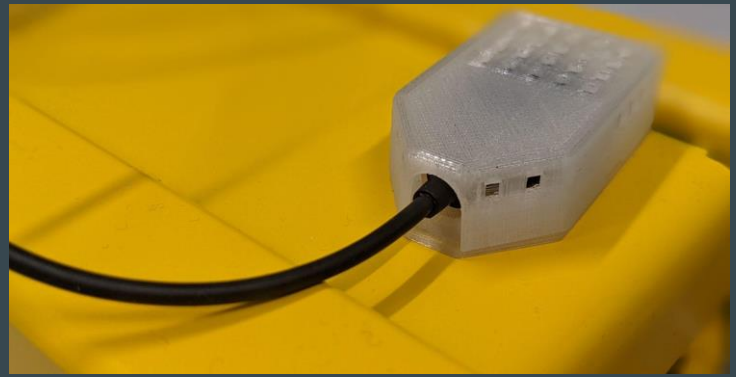




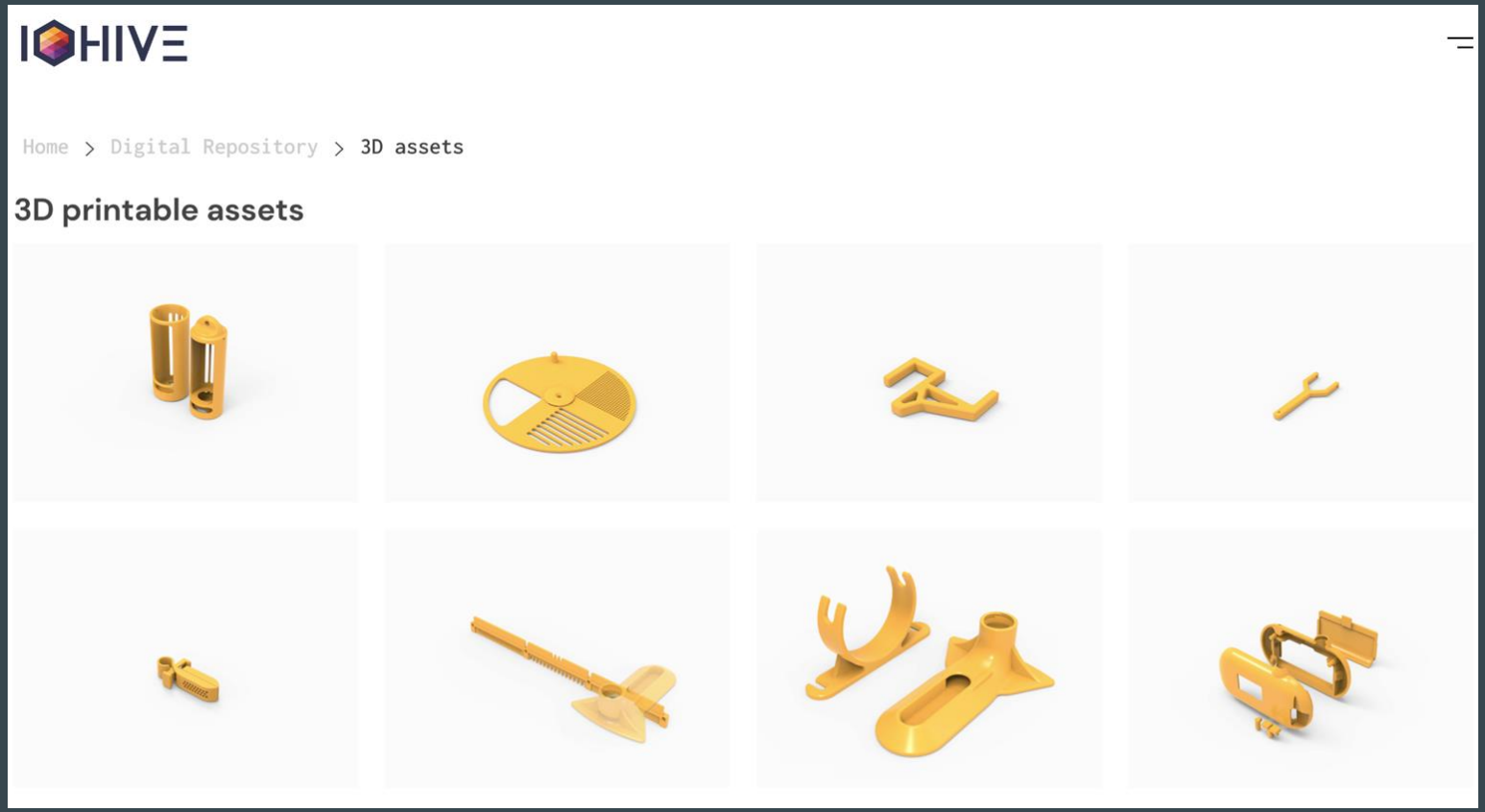
Systems prototyping







Repository with 3D printable assets (~40 assets)



Example of 3D printable assets

Bee Queen Cage IOHIVE

Designed by:

Nikolaos Politopoulos
npol@aegean.gr

Summary

Bee Queen Cage.

Parts

1. Inner - Download
2. Outer - Download

Print Settings

Printer: Flashforge Guider 2S

Material: PLA

Rafts: On

Supports: Auto

Resolution: Standard

Infill: 15%

Post-Printing

Insert the inner part into the

Hive Modular Door IOHIVE

Designed by:

Nikolaos Politopoulos
npol@aegean.gr

Summary

Hive Modular Door.

Parts

1. Feeder Cap - Download
2. Gate - Download
3. Seal+Airflow Cap - Download
4. Hive Modular Door L - Download
5. Hive Modular Door R - Download

Print Settings

Printer: Flashforge Guider 2S

Material: PLA

Rafts: On

Supports: Auto

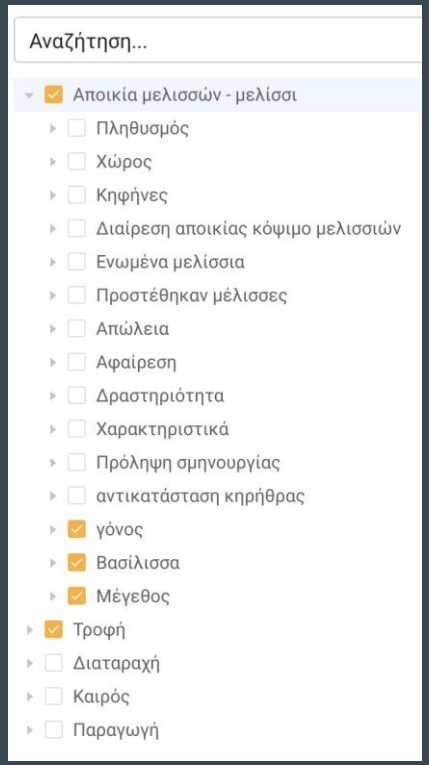
Resolution: Standard

Infill: 15%

Post-Printing

Print and assemble the door according to
model.

Other activities



Next steps

- Create open datasets
- Create Data API for researchers
- Wearable implementation and evaluation
- More inspection scenarios
- LoRaWAN on Helium
- Use GIS technology (e.g. blossom areas)
- BeeXML - Exchange data about bees and beekeeping
- Create an open testbed and community

These were only a few examples on how technology can help for sustainable beekeeping.

Beekeeping has long history and carries a rich cultural heritage.

By a multidisciplinary approach, let's discover the most important "worker" of nature, the bee!

Thank you!
v.nomikos@aegean.gr
IOHIVE
MYHIVE

Links

- https://myhive.aegean.gr/
- https://iohive.aegean.gr/
- https://www.syros.aegean.gr/el
- https://www.facebook.com/DPSDE
- https://www.facebook.com/isd.aegean
- https://www.facebook.com/IOHive
- https://www.youtube.com/@iohive1426
- https://www.un.org/en/observances/bee-day
- https://www.youtube.com/watch?v=el-Z5tgyQXY
- https://www.thethingsnetwork.org/
- https://github.com/beepnl/BEEP