Open Farmer Kit
Introduction

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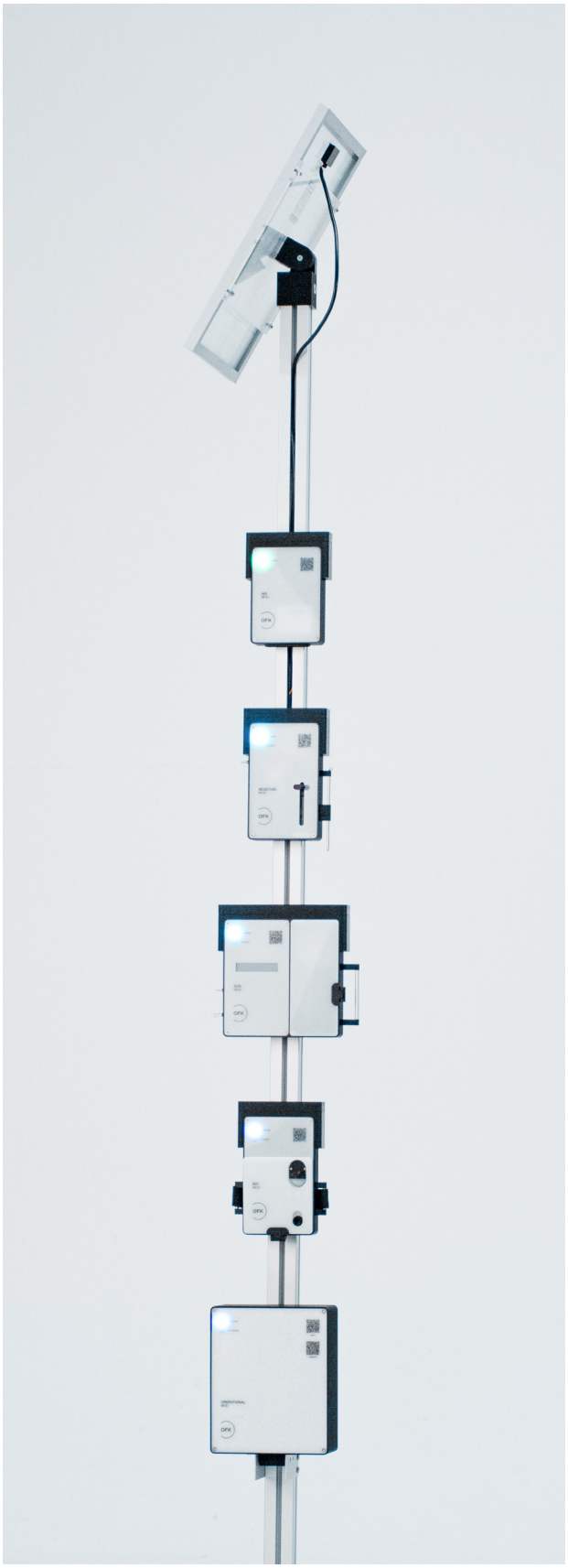
Open Farmer Kit



The modular and open-source monitoring station for urban and social farming

Open Farmer Kit is a modular open-source station designed to monitor environmental parameters and biodiversity in small-scale urban farming spaces. Conceived by Valentino Stella and developed with Lorenzo Silvestri, Matteo Mojoli, and Davide Formenti, in collaboration with Polifactory, Open Farmer Kit aims to transfer the benefits of precision agriculture into more social forms of urban farming. This promotes the transition towards collaborative agricultural practices supported by open science.

Open Farmer Kit is a semi-automated system powered by renewable energy sources that operates flexibly, allowing data sampling from different areas of interest. Constructed with easily obtainable electronic components and technologies available in makerspaces, it has a low cost, facilitating adoption and use by end-users.

Indeed, Open Farmer Kit offers the opportunity to create local networks for monitoring biodiversity and the health of agricultural ecosystems distributed in cities, facilitating the generation of open data useful to local communities.

Open Farmer Kit comprises five modular components along with an energy harvesting system. The initial four modules are dedicated to collecting data essential for cultivation and monitoring the microclimate within the city. The first module focuses on monitoring air quality, including temperature, humidity, and atmospheric particulate matter levels. Subsequently, two modules are designed for soil monitoring - one assesses water levels, while the other evaluates soil fertility and health. The final active monitoring module observes pollinator activity and diversity in the vicinity.

These four modules are mobile and can be detached from the station. The gathered data they collect is sent to the Operational module, that is fixed on the station. The Operational module is responsible for storing and uploading the data to the cloud. Additionally, it oversees the charging system for the other modules and manages the storage of energy from the solar panel, which constitutes the energy harvesting system.

Air module

The Air module operates in complete auotnomy and does not need to be handled by the urban farmer. It monitors air temperature, humidity, PM 10 and PM 2.5 levels hourly and transmits them to the Operational module. An LED indicator “RUNNING” will light up whenever the module is collecting and sending data. In case of malfunction or failure to send data, it is possible to remove the module from the structure by pulling it off its base.

Moisture module

The Moisture module measures soil moisture. It is equipped with a moisture sensor, a GPS to geolocate the measurement, and a LoRa module to send the data to the Operational module. A slider allows the farmer to slide the sensor into the ground, while a stake on the side helps with securing the module ans stabilize it during the testing phase. Perform monitoring whenever you consider it necessary.

Soil module

The Soil module deals with the monitoring of soil health and fertility. It is equipped with the HI3895 soil test kit from Hanna Instruments. The kit reliably measures the most important elements for plant growth, namely pH, nitrogen (N), potassium (K), and phosphorus (P). The module contains the essential materials for analysis, such as testers, pipette, test tubes and result comparison cards.

Soil should be tested prior to seeding, planting and fertilizing as well as when other soil, manure or compost has been added and not only when the plants do not seem to be in their best condition.

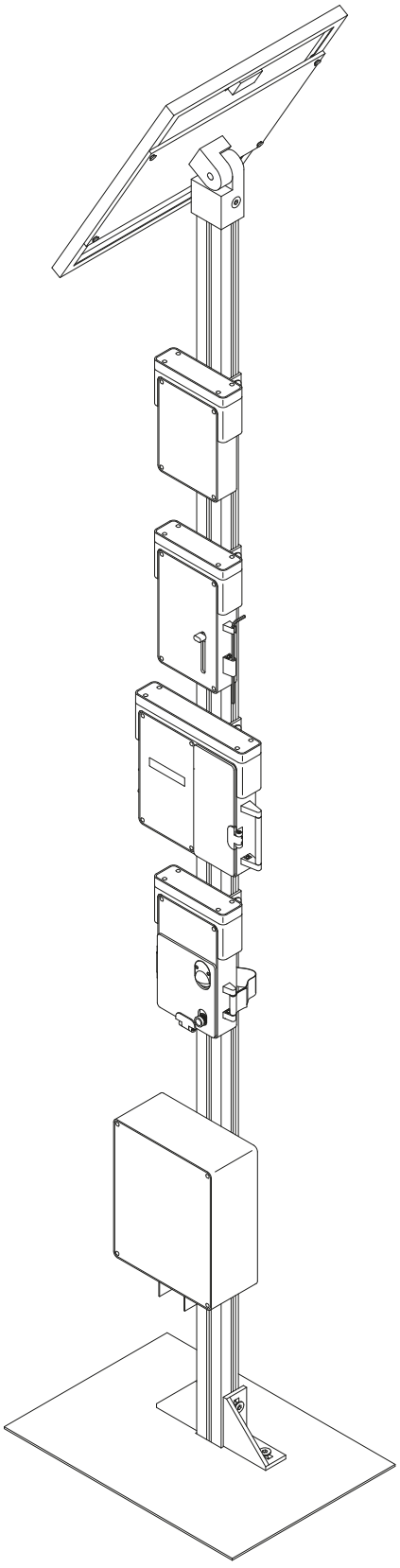
Bio module

The Bio module monitors the presence and variety of local pollinators. It is equipped with a PIR motion sensor, a camera, and an SD card. On the front of the module is a flip-top with colored stickers that act as an attractor for pollinators. The PIR sensor, when it detects motion, gives input to the camera to take a picture, which is saved on the SD card. A Velcro strap allows the module to be placed in different places by attaching it to poles, trees, branches, or various supports. Each monitoring session should last around three hours, preferably at pollinator activity time, such as in the morning.

Operational module

The Operational module is responsible for receiving data from the various modules and uploading it to the cloud server. It is equipped with a LoRa module for receiving data, an SD card for temporary data storage, and a WiFi shield for uploading data to the server.

The module also handles the sorting of energy from the panel for charging the monitoring modules. The module has two LEDs, "CHARGING" and "RUNNING," the first indicates the actual operation of the battery and power sorting system. The second indicates when the module is uploading data to the server.



Data journey

- **Air module**
  Temperature
  Humidity
  PM 10
  PM 2.5
  → **LoRa transceiver** (Sending mode)

- **Moisture module**
  Soil humidity
  → **LoRa transceiver** (Sending mode)

- **Soil module**
  pH
  Nitrogen
  Potassium
  Phosphorus
  → **LoRa transceiver** (Sending mode)

- **Bio module**
  Number of pollinators
  Pollinators's diversity
  → **LoRa transceiver** (Sending mode)

- **Operational module**
  → **LoRa transceiver** (Receiving mode)
  → **WiFi shield**

- **Cloud server**