Smart vermicomposter

What is vermicompost ?

Composting is an easy way to recycle household waste, in order to produce an excellent natural soil conditioner called compost. It is an aerobic method (which means it requires the presence of air) of decomposing organic solid waste, caused by microorganisms and mainly compost worms (that is why it is called Vermicompost). Those worms' life conditions are influenced by parameters as temperature, humidity, acidity of the soil, lightness or noise. Composting also produces a liquid called "Worm tea", which once diluted is an excellent organic fertilizer.

Eisenia andrei or **red wiggler,** one of the most used worm species for composting.

Worm tea, brown odourless nutrient-rich liquid.

Composting, what for ?.

Composting provides both household waste recycling and nutrient-rich fertilizer and soil conditioner production. Compost can be used in agriculture, and its use improves soil quality and biodiversity. It turns out to become more necessary, as european soil quality has been decreasing recently (45% lack of organic matter). Moreover, composting can be easily implemented, which allows a local household management, avoiding too many waste carriage. Indeed, waste is often buried, when a quarter of it could had been composted. Furthermore, composting doesn't release methane (a major greenhouse gas) as burying does, and it makes it easier for the soil to absorb carbon.

Looking after your compost

This composter implements the "millefeuille" method ; half the bin is composed of successive layers of shredded wood, worm litter, vegetal matter as food and shredded wood again. Then those layers are watered, the wood making it sure that there is a sufficient apport of carbonic matter. Then the layers are covered with cardboard (for worm reproduction) and with wet tissue to protect it from light. Those layers are added each time the worms are fed. The quantity of food given must be proportional to

First layers : wood, worm litter and food

Food and cardboard

the number of worms. Food must be cut in pieces to be easily digested by the worms. But more importantly, their food must be balanced between carbon and nitrogen content (the ratio carbon/nitrogen must be around 30)

At least once a week, it iry important to mix the compost bare-handed. This step is essential for the compost health, else it will smells rotten eggs and its quality will decrease.

WHAT TO FEED YOUR WORMS:

Yummy!	Yucky!
Anything green - especially the leafy stuff!	Citrus - no orange, lemon or lime
Fruits	Fats, Oils, Salad dressing
Vegetables	Breads & Cereals - can attract gnats
Coffee grounds & filters	Salts - no seasoned food
Tea bags	Meat - creates odors
Brown Paper, Black & White newspaper	Sugars- no processed food
Eggshells – crushed; adds calcium	Garlic, Onions - creates odors

In the bin's second half, there are crates which are used to collect the compost and get rid of the worms that are inside. Indeed, by putting compost into these crates, the worms will go back to the other side of the bin, where the food is, letting the compost in the crate worm-free. Each time worms are fed, proceed the same way, until the side with crates is full. The worm-free compost can be picked up and filtered to obtain the expected soil conditioner.

Worm tea is flowing by the dedicated tap in front of the composter. It is collected into a bucket, and put into bottles when there is enough.

More information by watching (in French) :
*https://peertube.scic-tetris.org/videos/watch/4d459d30-dae1-4edd-839e-bd0c86763d0e*

The point of owning a smart composter

Monitoring of temperature, humidity and pH data allows on one hand to optimize worms' life conditions, and therefore the composter efficiency. Indeed, the worms are proliferating in a environment which verifies following conditions : temperature between 15°C and 25°C, humidity between 75% and 85%, pH between 6.5 et 8. More worms there are, the most compost they can produce.

On the other hand, compost quality can be improved by quick identification of unwanted phenomenons (as fermentation or dryness). This identification is made by an overview of the parameters, and the problem can be quickly solved whenever it appears, making sure the compost quality doesn't decrease.

How does it work ?

Data transmission
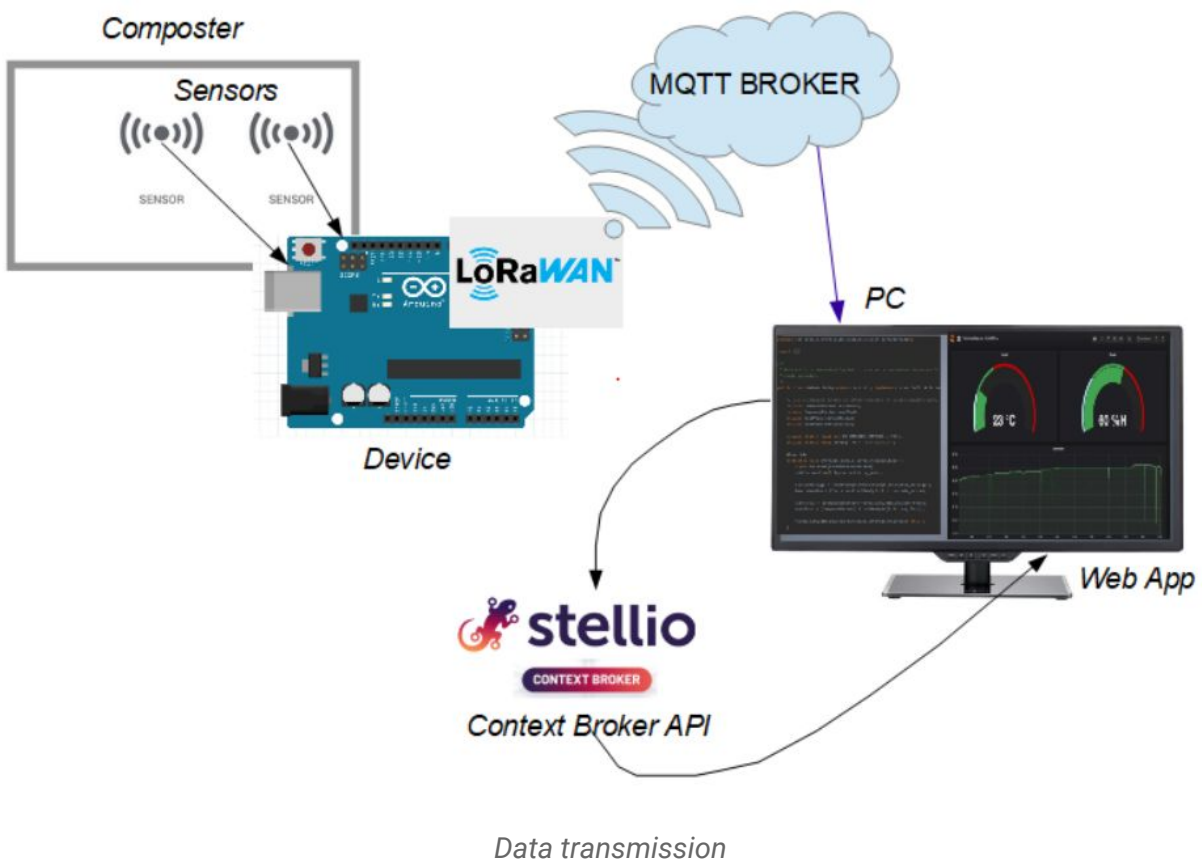
The device send temperature and humidity data every ten seconds by LoRaWAN protocol. The device appears as a box attached to the composter. It has a screen which display temperature and humidity, and buttons allowing to take care of the composter maintenance and to do pH measurements.

The composter

The device

The red button triggers a one hour timer, hour during which the device is not sending any data, which allows to take off the sensors and to feed the worms, mix the compost...and avoiding to collect data about the air around the composter, for it is not very relevant.

The two yellow buttons are for calibrating the pH probe, and the green button is for worm tea pH measurement. pH is then displayed on the screen.

The point of the device is to collect data about the compost, but by being quite autonomous, so the owner has nothing to take care of, exluding pushing the red button and taking off the sensors before feeding the worms. One can start by pushing the button and then forget about the device for the time they are taking care of the compost : they will just have to put the sensors back at the end.

Collected data are pushed to Stellio, a context API broker which gives an easy way to follow their evolution. A dashboard has to be implemented for this.

The device is plugged into the main supply, so a long power cable may be needed.

Precisions about the device functioning :

https://github.com/GuitouBDA/LombricomposteurConnecte/blob/guillaume/Notice%20d'utilisation.odt

Hardware

Board : Arduino The Things Uno

Shield

Adaptator 220V -> 9V to plug into main supply

LCD screen

Sensors:

Temperature : waterproof probe S18B20

Humidity : soil humidity sensor GT110

pH :probe and interface SEN0161 (DFRobot)

Ideas of further upgrades :

New functionalities could be implemented for the next version of this project. Weight sensors could be useful to collect data about the exact quantity of compost produced, by comparing the weight of the bin with the weight of collected compost. An ammonia sensor could also be added, because the presence of ammonia warns about the unbalanced carbon/nitrogen ratio, and allows the owner to react quickly.

The device could also become better-looking, by adding stickers reminding the function of each button, also improving the device's ergonomy.