

# What if robots love nature?



PLANTS &  
MACHINES

OpenTech Summit 2015



food scarcity

mega-cities  
industrial agriculture  
climate change



We're doomed!



vertical and urban farming

farmed here (Chicago)  
Green Sky (Singapore)



Hydroponic and Aquaponic

soilfree  
exact nutrient dosage  
symbiosis



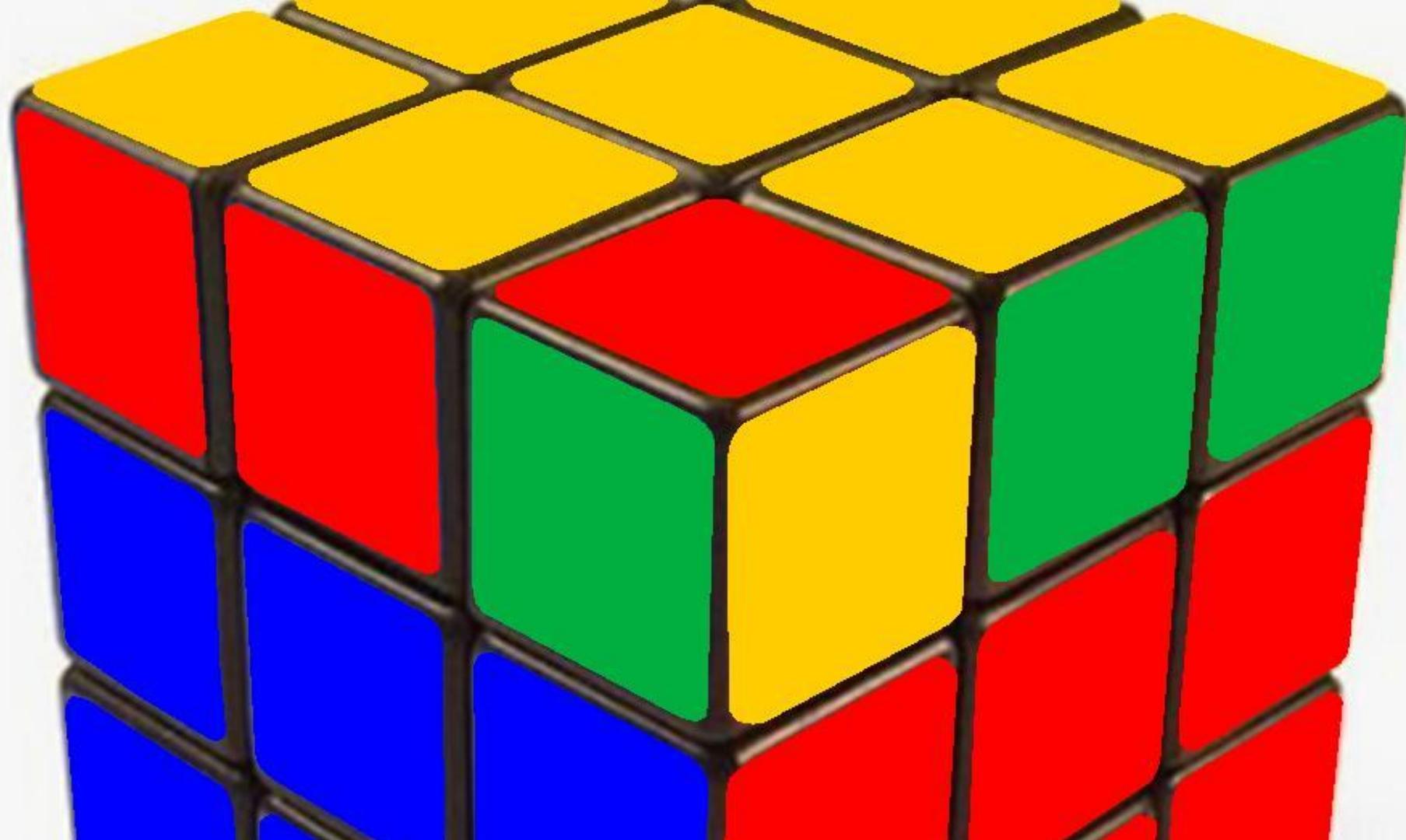
give nature a place to call home

temperature, humidity,  
light-spectrum, CO<sub>2</sub> ,  
PH, EC, DO...

- saves up to 80% Water
  - 5 to 10 times more outcome
  - saves up to 50% space
  - no weather related crop failures
  - less transporation
  - better climate within the city
  - it's all organic, yeah
  - less use of pesticides
- use of unused areas within the city
  - year-round crop production
  - new jobs within the city
  - Eliminates agricultural runoff
  - aquaponics: produces vitamins and proteins / vegetables and fish

technology  nature

vertical urban farming  
growing food in your  
hood





bringing nature home

indoor gardening  
feel, touch,  
enjoy



boxes

human  
nature  
interaction



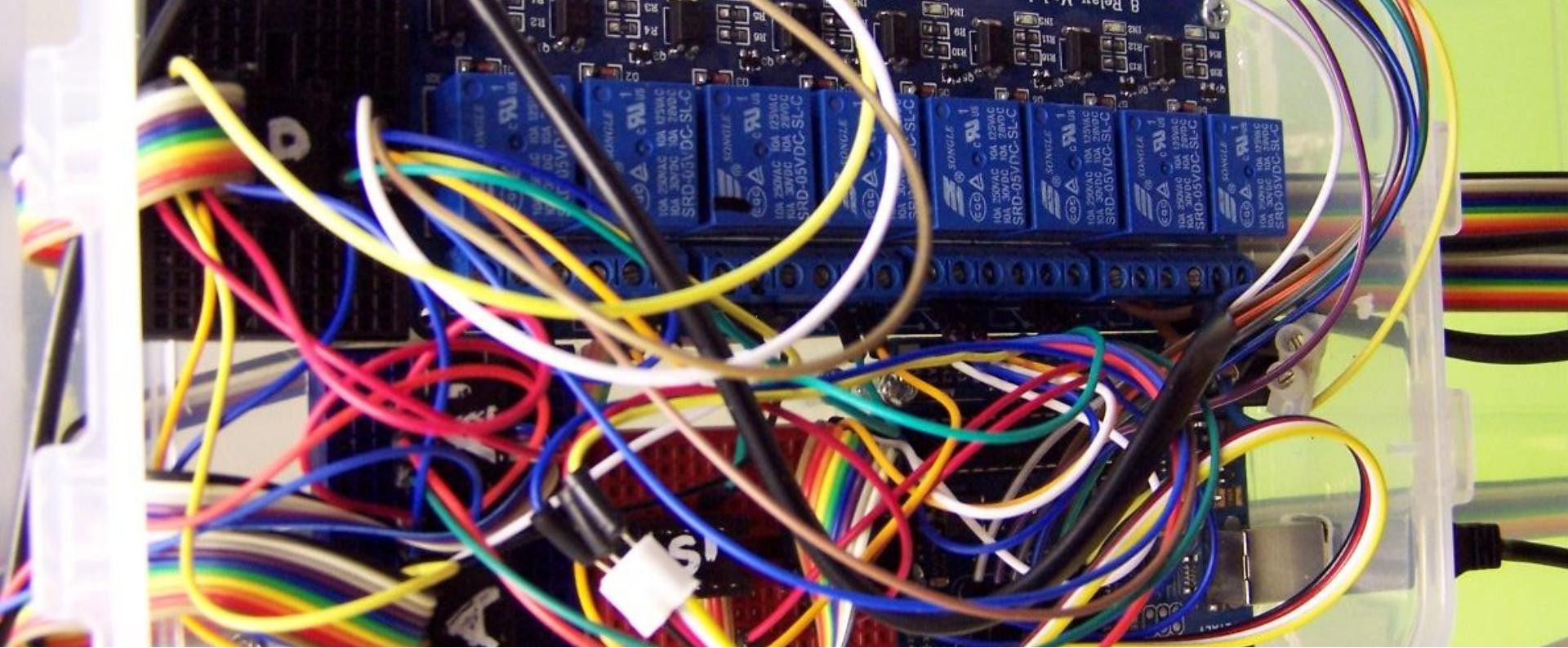
prototyping

stacked boxes  
automation  
interfacing nature



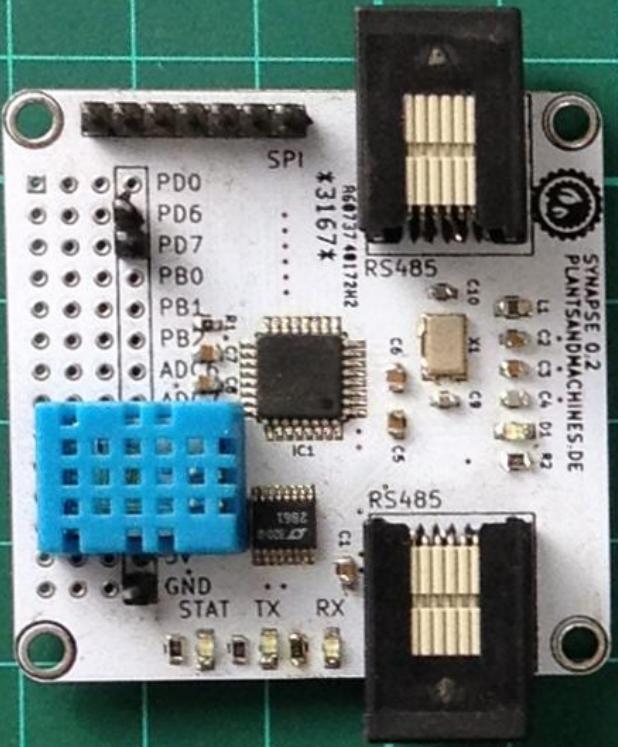
nature approves

gone wild  
cute, efficient  
hands on / hands off



what robots look like

cable porn  
spaghetti code



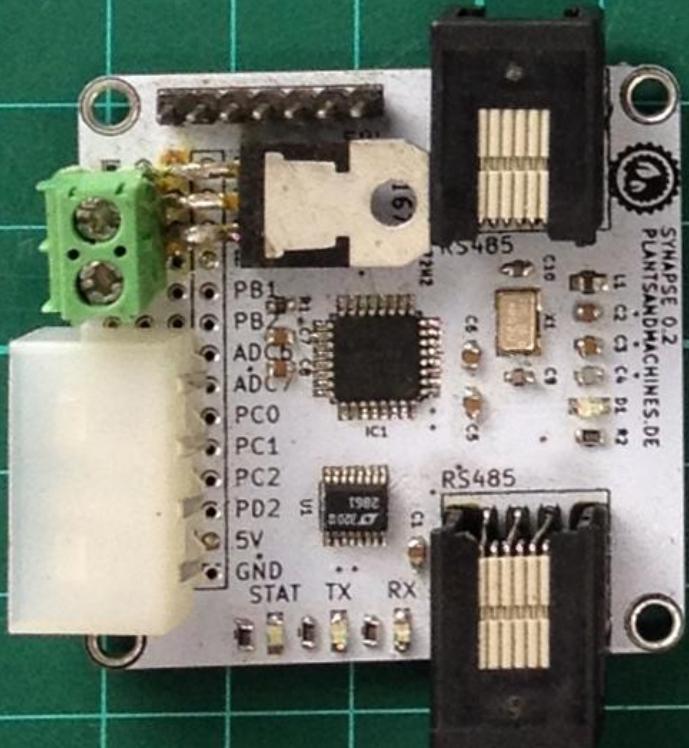
sensor node

i2c, twi, spi, adc  
rs485



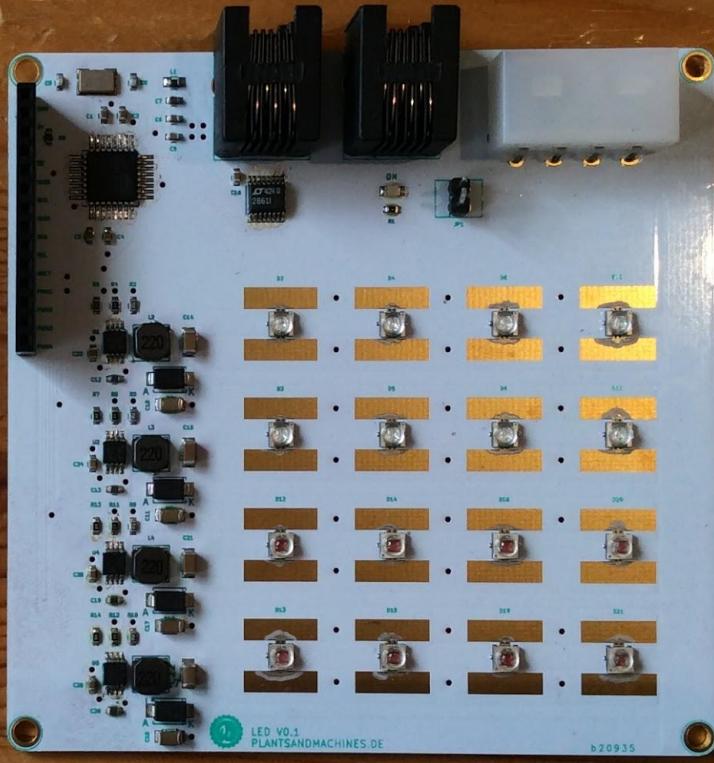
heart

data crunching  
state machine  
RS485, ethernet



motor unit

4 channel pwm  
0 - 12VDC  
RS485



power, light

ATX breakout board  
led grow light



robot - box integration

one data line  
one power line

### cress

Groth Setting

Spring Summer Autumn Winter

Leaflet | Map data © OpenStreetMap contributors, Weather from OpenWeatherMap

### pump

Control LED

Off On

Pump

Off On

Power: 75%

### fan

Control LED

Off On

Fan

Off On

Power: 40%



### LED-Array

Lights

Off On

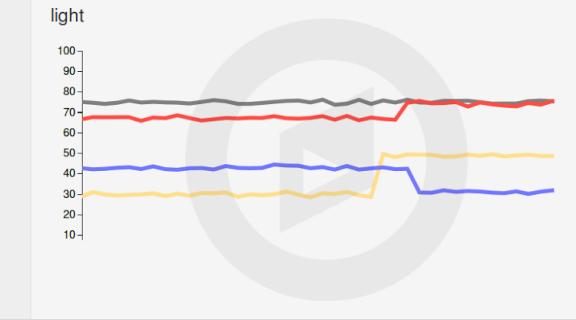
Light Composition:

cool white

warm white

red

blue



software

node.js  
mongodb  
angular.js

pump

Control LED

Off On

Pump

Off On

Power: 75%

 75%

LED-Array

Lights

Off On

Light Composition:

cool white

 0%

warm white

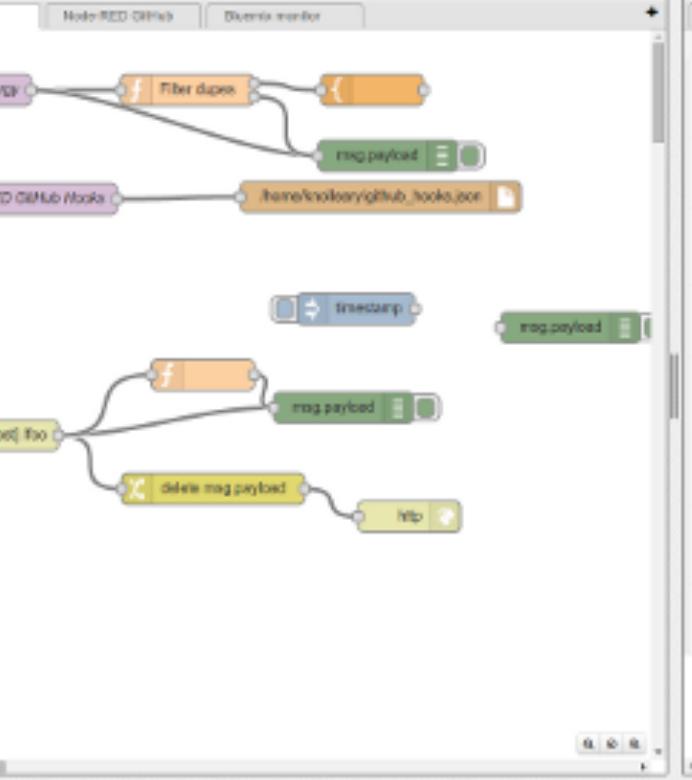
 100%

red

 0%

blue

 0%



Http

```
char* packetStr = (char*)malloc(packetLength + 1);
bus_debug_output( "allocated memory" );
udp.read( packetStr, packetLength );
packetStr[packetLength] = 0;
bus_debug_output( "recived Json:" );
aJsonObject *cmd_json = aJson.parse( packetStr );
free(packetStr);
// check incoming json
if (cmd_json) {
    aJsonObject *ptr;
    ptr = aJson.getObjectItem( cmd_json, "cmd" ); // check
    if (ptr) {
        aJsonObject* cmd = aJson.getObjectItem( ptr, "debug" );
        if (cmd->type == aJson_True) {
            in_debug_mode = true; // enable debug mode
        } else if (cmd->type == aJson_False) {
            in_debug_mode = false; // disable debug mode
            cmd->type = aJson_True;
        } else {
            cmd->type = aJson_False;
        }
    };
    cmd = aJson.getObjectItem( ptr, "report" );
    if (cmd) {
        if (cmd->type == aJson_True) {
            remoteIP = udp.remoteIP(); // enable debug mode
            STAT_ON;
        } else if (cmd->type == aJson_False) {
            STAT_OFF;
            remoteIP = INADDR_NONE;
            cmd->type = aJson_True;
        } else {
            cmd->type = aJson_False;
        };
    };
}
```

userlevel

click-i-bunti  
visual programming  
the real deal



## inventory

All you can learn, build and do. The inventory lists everything your robot can have, knowable or run. There are parts that give your robot a body to live in, sensors to feel with and actuators to muscle the world around. Check out the Sub-items to the right, like blueprints and parts



## life

life-forms are self organizing cell clusters that have pheno and geno-types. Some types are more for the phe others for the ge



## apps

apps are either parts of blueprints or standalone functionalities that you can run with your robot



## blueprints

Blueprints is a list of what you can build and run together with your robot



## parts

the pieces a blueprint is build from.



## system

```

10 , "requires": {"controllers": "brain"}
11 , "specs": [
12   "type": "blueprint details"
13   , "kind": "details"
14   , "version": "0.1"
15   , "boxes": 1
16   , "organism": "plants"
17 ]
18 , "notes": {
19   "warning": "may contain life and therefore require
20   , "info": "try with simple fish at first if you
21   , "danger": "plants and animals might get hurt in
22   , "success": "but it will turn out well if you foll
23 }
24 , "parts": ["powerSupply", "botProcessingUnits", "control
25 , "boxes": ["nano30l"]
26 , "controllers": ["brain"]
27 , "actuators": ["pump"]
28 , "sensors": ["airTemperature", "waterTemperature", "l
29 , "botProcessingUnits": ["raspberryPiBPlus"]
30 , "powerSupply": ["atxPowerSupply", "atxBreakOutBoard"]
31 , "setup": {
32   "step-1": {
33     "title": "get the stuff"
34     , "description": "collect all the parts listed i
35     , "image": "step-1.jpg"
36     , "imageAlt": "guy moving around collecting part
37 },
38   "step-2": {
39     "title": "assemble stuff"
40     , "description": "put this here and that there"
41     , "image": "step-2.jpg"
42     , "imageAlt": "graphic of putting stuff together"
43     , "images": [ "step-1.jpg", "geck.jpg" ]
44   , "setup": [ "atxPowerSupply", "atxBreakOutBoard"

```

inventory, blueprints

one JSON  
to rule them all



robotic evolution

adapt  
evolve



cute robotic research stations

learning  
about Nature



put the bot back into botanics

caring  
for nature

# 20Mbps RS485 Transceivers with Integrated Switchable Termination

## FEATURES

- Integrated, Logic-Selectable  $120\Omega$  Termination Resistor
- 20Mbps Max Data Rate
- No Damage or Latchup to ESD:  $\pm 15kV$  HBM
- High Input Impedance Supports 256 Nodes (C-, I-Grades)
- Operation Up to  $105^\circ C$  (LTC2859H)
- 250kbps Low-EMI Mode
- Guaranteed Failsafe Receiver Operation Over the Entire Common Mode Range

## DESCRIPTION

The LTC®2859 and LTC2861 are low power, 20Mbps RS485/422 transceivers operating on 5V supplies. The receiver includes a logic-selectable  $120\Omega$  termination, one-eighth unit load supporting up to 256 nodes per bus (C-, I-grades), and a failsafe feature that guarantees a high output state under conditions of floating or shorted inputs.

The driver features a logic-selectable low-EMI 250kbps operating mode, and maintains a high output impedance over the entire common mode range when disabled or when the supply is removed. Excessive power dissipation

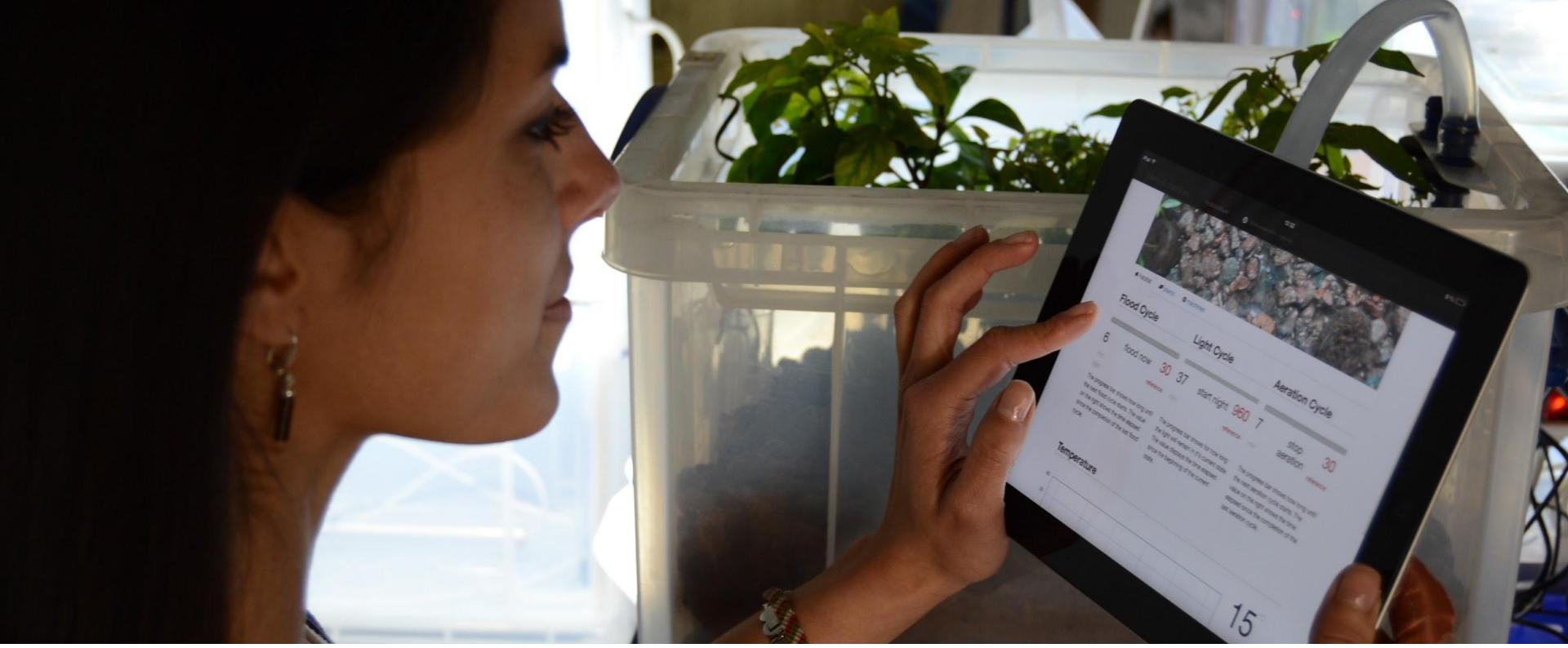
put the bot back into botanics

caring  
for nature



robots for the people

open source  
automation  
hardware



the internet of living things

open data  
what plants  
love



nature robots

minimizing  
the footprint  
of food production



the future

nature  
humans  
robots

# questions ❤ answers



@plants\_machines



/plantsandmachines

Sao Paulo – <http://www.marcuslyon.com/wp-content/uploads/2014/04/BRIC-II-Centro-Sao-Paulo-2008.jpg>

industrial agriculture – [http://www.bitquill.net/blog/wp-content/uploads/2008/07/pack\\_of\\_harvesters.jpg](http://www.bitquill.net/blog/wp-content/uploads/2008/07/pack_of_harvesters.jpg)

drought California – [http://media3.s-nbcnews.com/j/news cms/2014\\_34/627566/](http://media3.s-nbcnews.com/j/news cms/2014_34/627566/)

[pc-140820-california-drought-01\\_df9e66504eb531798626153aae549f70.nbcnews-ux-1040-700.jpg](#)

DOOMED – <http://www.gify.com>

Farmed here – [http://www.huffingtonpost.com/2013/03/22/farmedhere-nations-largest-vertical-farm\\_n\\_2933739.html](http://www.huffingtonpost.com/2013/03/22/farmedhere-nations-largest-vertical-farm_n_2933739.html),

Sky Green Farm – <http://permaculturenews.org/2014/07/25/vertical-farming-singapores-solution-feed-local-urban-population/>,

lettuce with roots – <http://www.hydroponics-simplified.com/images/lettuce-harvested.jpg>,

urban organics – <http://www.urbanorganics.com>

mega city - <http://i.huffpost.com/gen/1332591/images/o-AIR-POLLUTION-DEVELOPING-NATION-facebook.jpg>

Rubiks cube – <http://memyselfandpi.net/tutorial/step7.html>

dancing girl - unknown, private archive

cat in a box - <http://www.iflscience.com/plants-and-animals/boxes-really-do-reduce-cat-stress> (26kot / Shutterstock)

ny rooftop - [http://images.nationalgeographic.com/wpf/media-live/photos/000/516/cache/earth-day-urban-farming-new-york-rooftop\\_51631\\_600x450.jpg](http://images.nationalgeographic.com/wpf/media-live/photos/000/516/cache/earth-day-urban-farming-new-york-rooftop_51631_600x450.jpg)

urban gardening - [http://www.bioland.de/fileadmin/dateien/Bilder/Im\\_Fokus/Urban\\_Gardening/\\_Prinz3.JPG](http://www.bioland.de/fileadmin/dateien/Bilder/Im_Fokus/Urban_Gardening/_Prinz3.JPG)

datasheet - <http://cds.linear.com/docs/en/datasheet/285961fc.pdf>