



Excellence in  
Software Engineering

# GreenHouse

«Java for Farmers»: Greenhouse monitoring and automation using Java, Raspberry Pi and multiple sensors

# More than 10 Billion ...



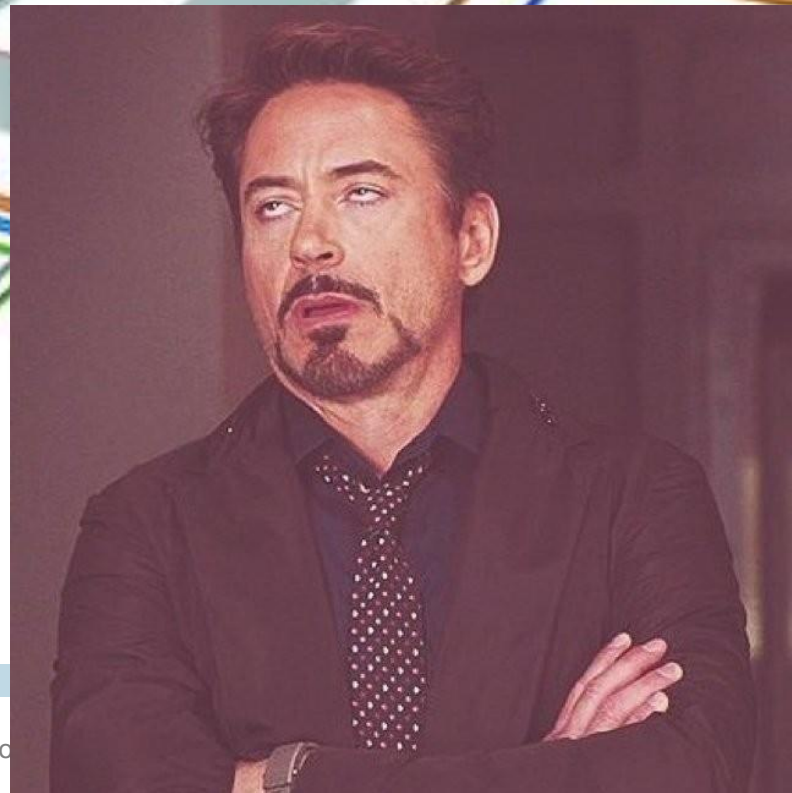
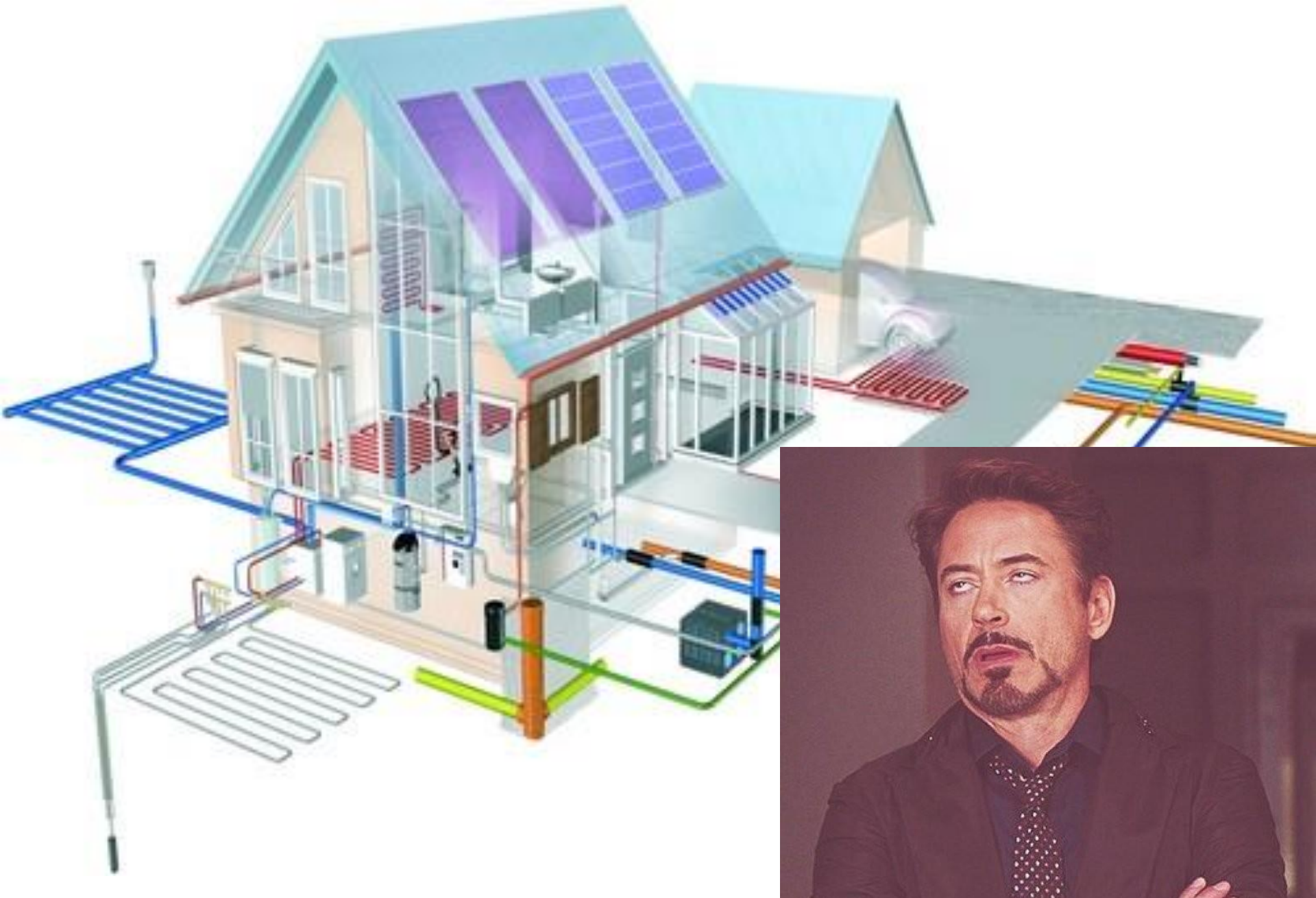
# Why is embedded Java?

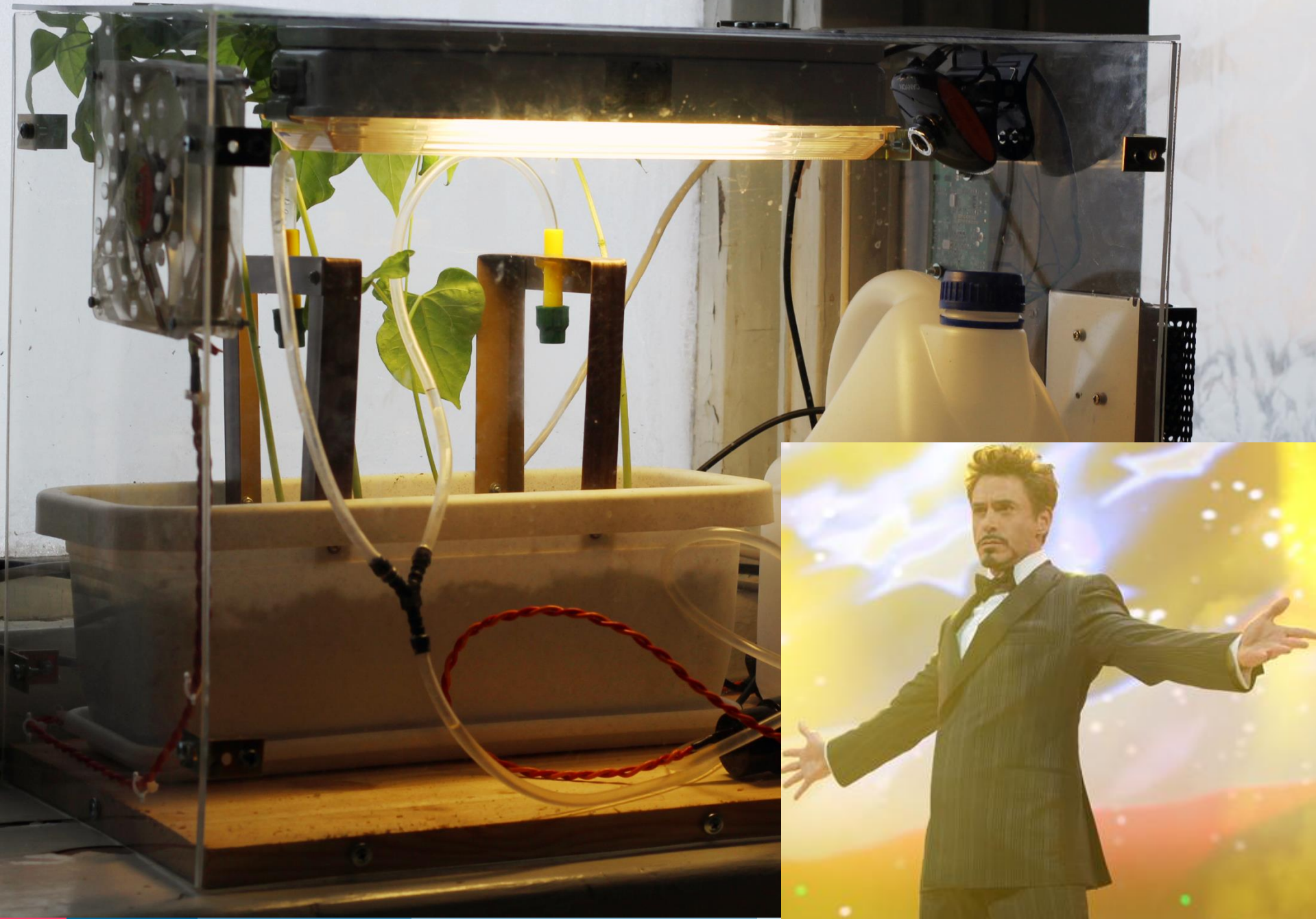
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- Java is one of the most popular application platforms on the planet.
- Optimized for Embedded
- High-Performance, Portable Applications
- Good APIs, Free Developer Tools
- Safety. Proven Security Model







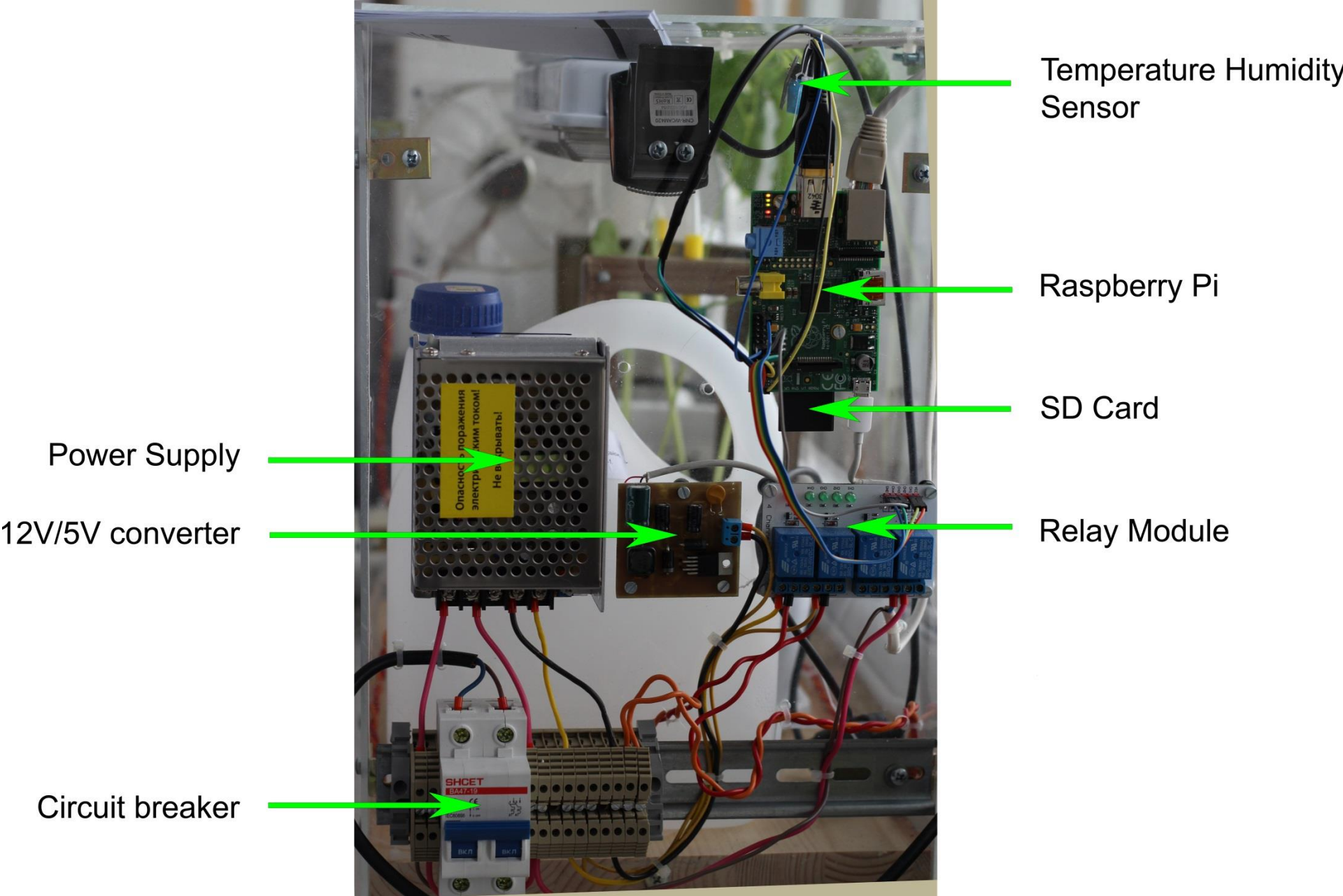


# Functionality

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- Light control
- Watering control
- Temperature and humidity monitoring
- Remote monitoring of current state of the greenhouse
- Automatic management of the greenhouse
- Automatic photographing process of plant growing
- Electricity failure/outage protection





Temperature Humidity Sensor

Raspberry Pi

SD Card

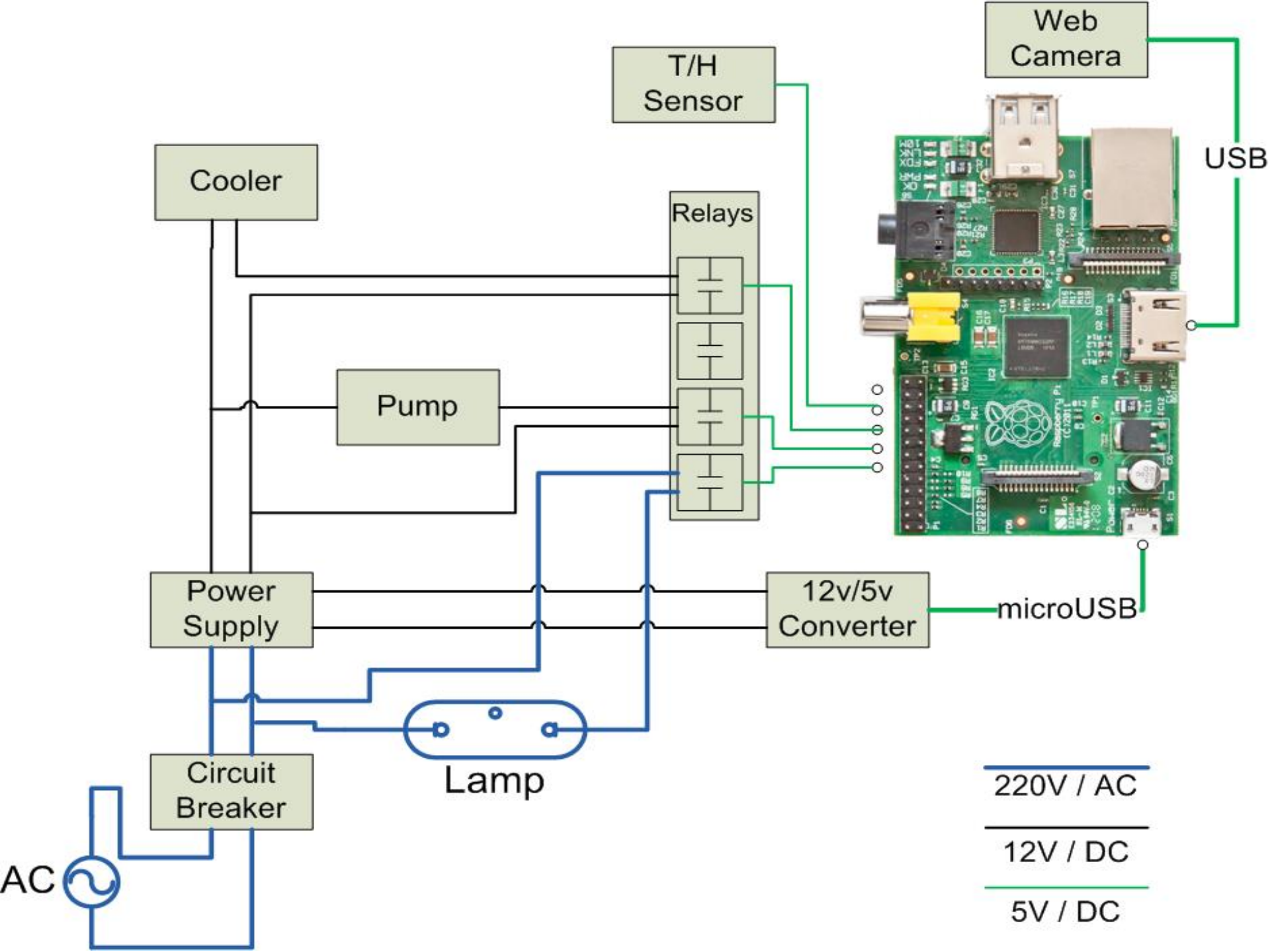
Power Supply

12V/5V converter

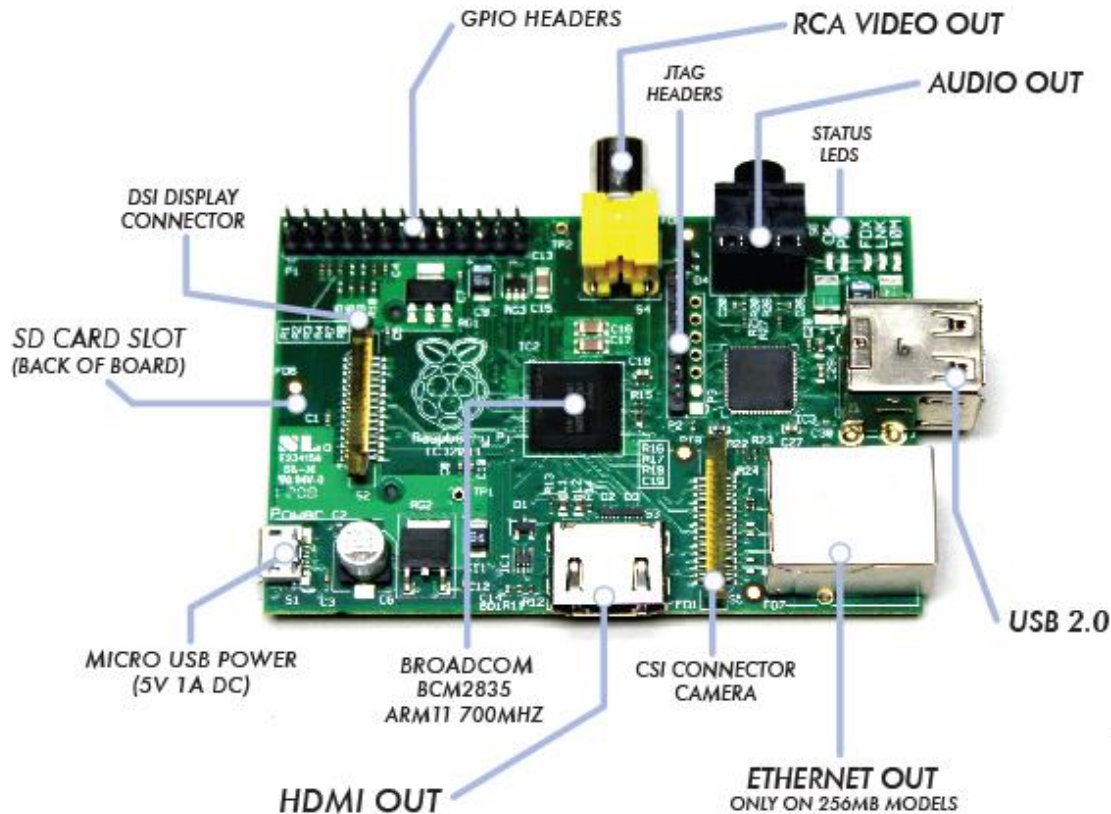
Relay Module

Circuit breaker





# Raspberry Pi



- ARM v6 ARM11, 700Mhz
- 512 MB RAM
- 2 x USB
- Ethernet RJ45
- HDMI, Composite
- Raspbian (based on Debian)

# Hardware and Software

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## Hardware:

- Raspberry Pi
- DHT11 Digital Temperature Humidity Sensor Module for Arduino
- 4-Channel 5V Relay Module Expansion Board for Arduino
- Power Supply SQ0331-0014 12V, 60Wt (for LED strip)
- 12V/5V converter
- SD Card
- Cooler
- Web camera
- Water pump

## Software:

### Back-end:

- Java SE Embedded 7
- JNI/C (for sensor)
- pi4j
- Servlets

### Container: Jetty

### Front-end:

- HTML/JS

# Software example: Light control

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```
// инициализация
```

```
GpioController gpio = GpioFactory.getInstance();
```

```
GpioPinDigitalOutput light =
```

```
gpio.provisionDigitalOutputPin(RaspiPin.GPIO_07, "Light",  
PinState.LOW); // подключились к пину 7
```

```
light.setShutdownOptions(true, PinState.LOW,  
PinPullResistance.OFF); /* задали опцию, чтоб на выходе из  
приложения этот пин отключался (чтоб свет тух) */
```

```
// управление
```

```
light.high(); // включить пин
```

```
light.low(); // выключить
```



What about a life  
demo?

# Retrospective

Task Name	Work (days)	Duration
<b>Greenhouse. Release 1.0</b>	<b>33</b>	<b>Aug, 2013 – Jan, 2014</b>
<b>Hardware</b>	<b>8</b>	<b>Aug, 2013 – Dec, 2013</b>
Find/Buy hardware	4	Aug, 2013 – Nov, 2013
Mount hardware	3	Oct, 2013 – Dec, 2013
Hardware tuning	1	Oct, 2013 – Dec, 2013
<b>Software</b>	<b>25</b>	<b>Oct, 2013 – Jan, 2014</b>
Requirements	1	Sep, 2013
Design	2	Oct, 2013
CLI version	12	Oct, 2013 – Dec, 2013
GreenHouse driver	5	Oct, 2013 – Dec, 2013
UI version	16	Dec, 2013 – Jan, 2014

# Problems

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- 220V + water
- Power supply >60 Wt
- Raspberry Pi + Humidity Sensor
- Raspberry Pi + Web Camera
- Availability of components

# Future plans

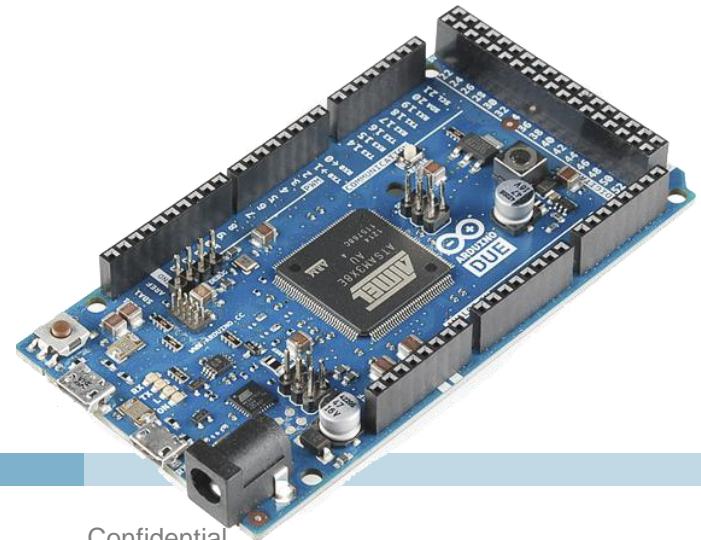
Yocto project for GreenHouse – 5 commits related to Java submitted and approved



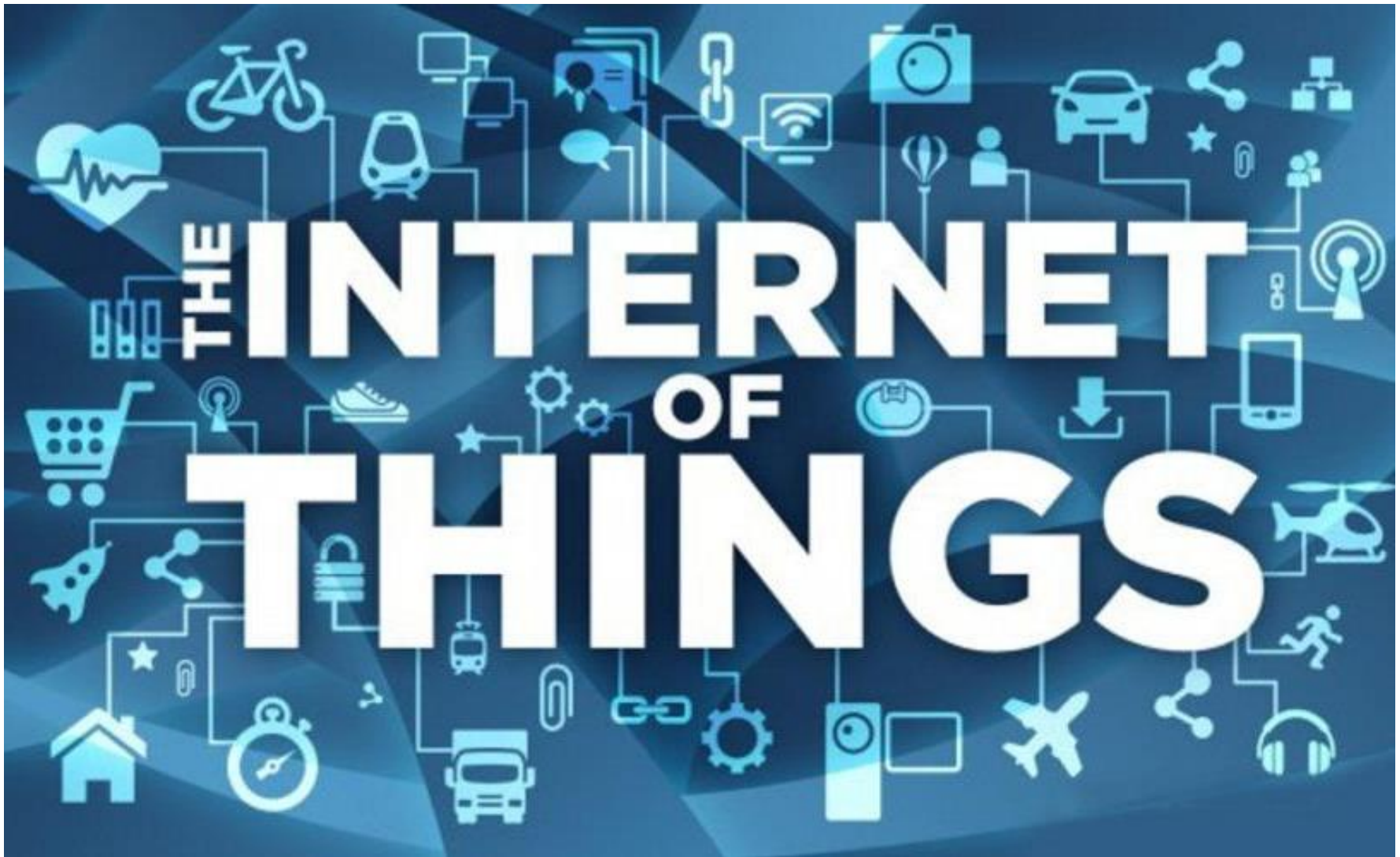
- **Release 2.0. Java embedded. Low performance HW**

**yocto** •  
PROJECT

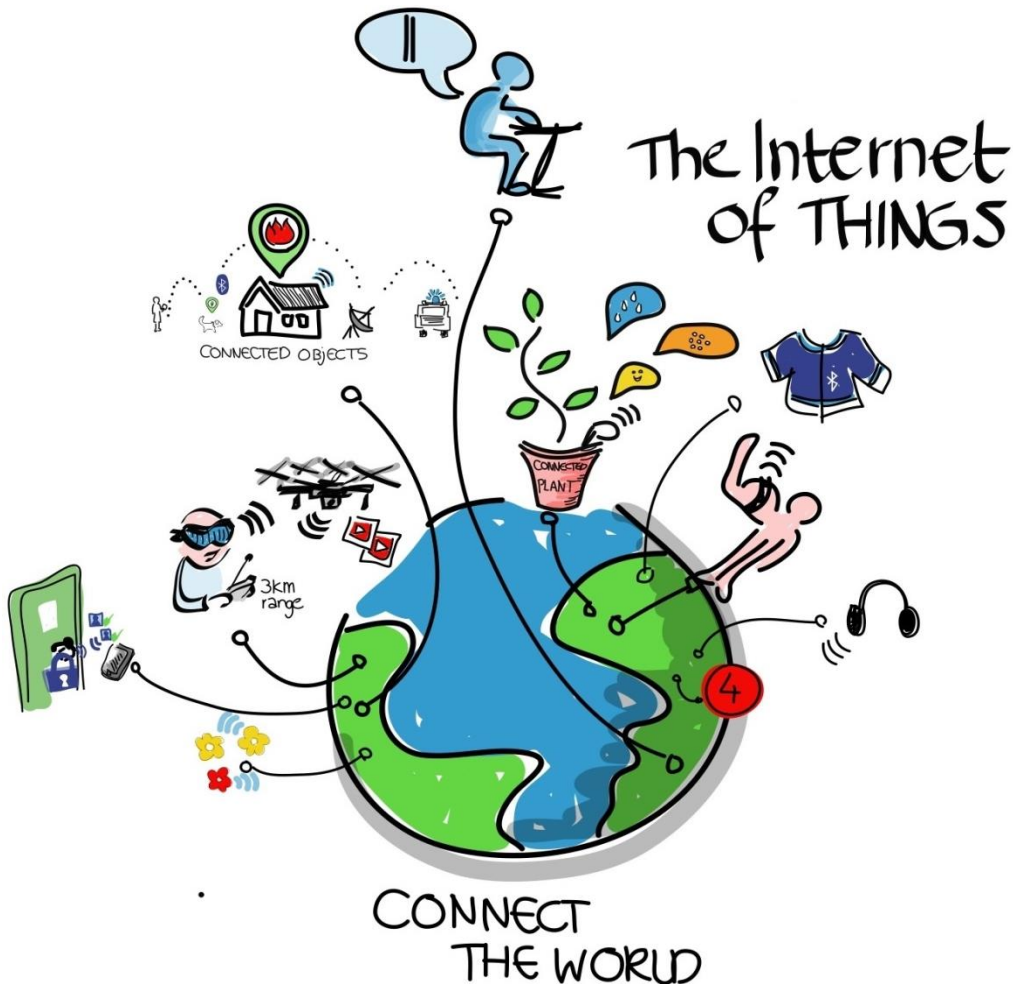
- **Scalable to industrial production**







# What's IoT Developer Challenge?



The challenge rewards developers who create well-implemented, innovative and useful application using Java Embedded with devices, boards or other Internet of Things (IoT) technologies



# IoT Developer Challenge 2014 winner

<https://www.java.net/challenge>

## PROFESSIONAL CATEGORY

### Smart Greenhouse Project - Belarus



A full-featured, automated greenhouse to grow your indoor plants with peace of mind. Remotely control and monitor light, temperature and humidity. Check the growing process remotely with time-lapse photography. Created with Java Embedded, Raspberry Pi, Pi4J, Arduino, Jetty and multiple sensors.

Source code: <https://bitbucket.org/Temdegon/greenhouse>

Team members: Dzmitry Yasevich, Pavel Vervenko, and Vladimir Redzhepov

Among hundreds of projects competent jury recognized

“Smart Greenhouse” project as a **winner** in the **Professional Category**;

Promo Video

<http://goo.gl/3VrFGJ>

# Q&A



# Useful Links

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- Oracle Java ME Embedded main page
  - <http://www.oracle.com/technetwork/java/embedded/overview/javame/index.html>
- Raspberry Pi main page
  - <http://www.raspberrypi.org>
- GreenHouse Repository
  - <https://bitbucket.org/Temdegon/growbox>
- GreenHouse home page
  - [GreenHouse](#)

# Authors

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## GreenHouse Release 1.0

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