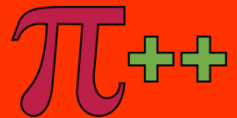


# A lesson of Physical Computing with Scratch: RPi, scratchClient and Arduino

Presentation for Pi And More 9½

Krefeld – 2017/01/14

Hans de Jong



# Weekendschool



- Generally parents tell their children: “Learn for later”. But what is later?
- “I want to become an engineer. Do you maybe know an engineer? I would very much like to meet one”

# Weekendschool

## Goal and way of working

- Bridge the gap between school and what is needed to live in society
  - Which is in more privileged families provided by the family
- Don't abandon them at the end: Alumni program
- Data shows: alumni have better professional prospects, are more self-aware, and feel more connected with society.
- Program includes training in presentation, research, debate, and conflict resolution – an allround character education.

## Classes provided

- |              |                     |                 |
|--------------|---------------------|-----------------|
| • Art        | • Mathematics       | • Safety        |
| • Medicine   | • Physics           | • Energy        |
| • Law        | • Programming       | • Journalism    |
| • Philosophy | • Film              | • ... many more |
| • Astronomy  | • Architecture      |                 |
| • Politics   | • Entrepreneur      |                 |
|              | • Language & Poetry |                 |

## Some numbers

- > 1000 students in 2016 between 10 and 14 years of age
- From disadvantaged neighbourhoods
- 3500+ volunteers
- Funded by 110+ sponsors (companies, individuals, foundations)
- Curriculum lasts for 2.5 to 3 years
- Over 2100 alumni
- Students are selected on motivation, not on IQ
- IMC Weekendschool founded in 1998, Trudo Weekendschool in 2009
- IMC Weekendschool has inspired 30+ other independent copy projects in The Netherlands (one of which is the Trudo Weekendschool).

## More information

- [www.imcweekendschool.nl](http://www.imcweekendschool.nl)
- [www.trudoweekendschool.nl](http://www.trudoweekendschool.nl)

# Curriculum of Programming

## Objectives

- Learn how to use keyboard, mouse and screen without causing health problems.
- Learn how to make programs in Scratch
- Learn that programming is about more than changing pixels on a screen (Physical Programming).
- Learn something about professional programming.
- Build something tangible that can be taken home.
- Let the children experience how powerful and joyful programming is.

## 3 lessons

- Each lesson is 2x 75 minutes with 30 minutes break inbetween
- Given to Weekendschool 2<sup>nd</sup> graders: 11 years old.

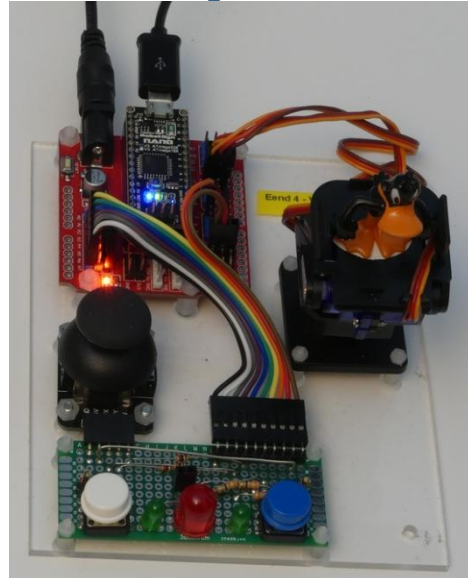
# The 3 lessons of the curriculum

## Lesson 1



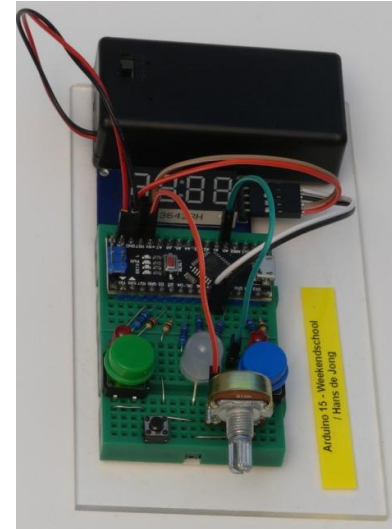
- Program a game in Scratch, output on monitor.
- 1 helper per 8 students.

## Lesson 2



- Physical computing controlled from Scratch.
- 1 helper per 4 students.
  - Could also be done in 2 lessons.

## Lesson 3



- Program an Arduino Nano from RPi.
- Complete the electronic circuit of a game to be able to take home.
- 1 helper per 2 students.
  - Could also be done in 2 lessons.

9 Volt power  
(power of Raspberry Pi  
is too limited, and cheap  
microUSB cables cannot  
transport high current)

Arduino Nano with  
328p processor

Extension board  
(handy connections with  
3 pins per GPIO (VCC,  
GND and signal) to  
connect servos, power  
regulator)

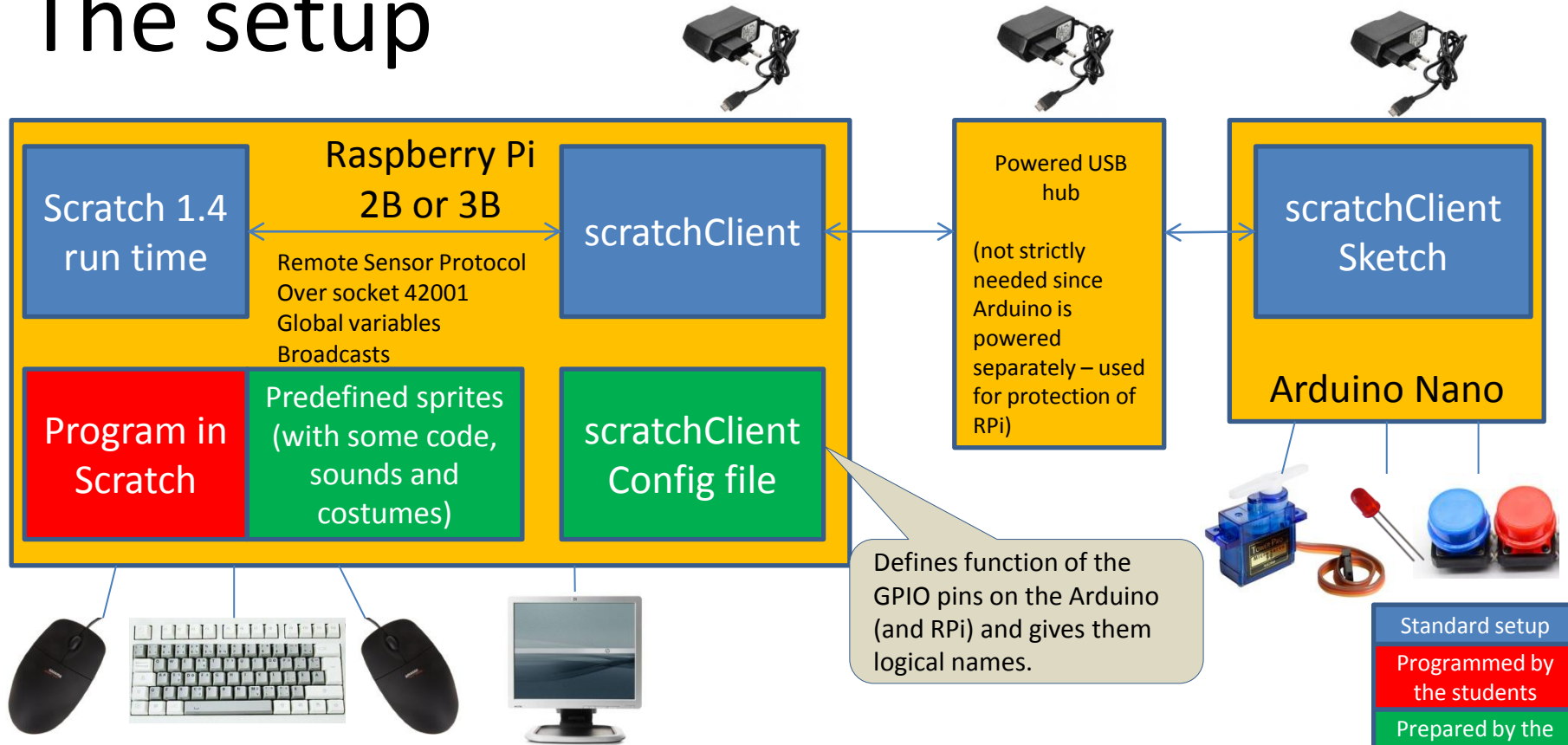
Joystick to  
demonstrate analog  
input

USB connection to  
Raspberry Pi  
(optionally via a  
powered USB Hub)


Duck on a pan/tilt  
platform to  
demonstrate the  
use of servos

Buttons and LEDs to  
demonstrate basic  
input / output

# The setup



# The game

- Start the game by pressing the joy stick button (because it is there anyway)
- Red LED lites at random 
- When LED lites, the first one pressing their button gets a point
  - The duck turns to the person scoring and makes a bow.
- When the button is pressed without the LED being lit, the other gets a point
  - The duck turns to the one who pressed and shakes “no”.





# Demo of the game

Have a look at

<https://youtu.be/Qo1gnXNzhqE>

# Why using an Arduino\* for GPIO rather than the GPIO of Raspberry Pi?

- Arduino provides analog inputs.
- Arduino provides *hardware* PWM (Pulse Width Modulation), which makes controlling servos more stable.
- Arduino can support real time protocols (e.g. for controlling WS2812).
- Arduino GPIO pins are 5V tolerant.
- When making mistakes, blowing up an Arduino Nano is less costly (< 2.5 euro for a clone) than damaging a Raspberry Pi.
- When needing more GPIO pins, extra Arduinos can be added.
  - scratchClient supports this as beta.
- Easier setup and tear down in temporary classroom situations
  - Only needing to plug/unplug USB and power connectors.
  - Can be programmed to steer servos automatically to default position, ready for packing up.

\* Arduino Nano or Arduino Uno can be used

# scratchClient: things to know

## Installing

- Download scratchClient
  - [http://heppg.de/ikg/wordpress/?page\\_id=6](http://heppg.de/ikg/wordpress/?page_id=6)
- Unpack
- Install other packages as described in the documentation
- Adapt the config file for Arduino Uno (which is used for Nano as well)
- Use the Arduino IDE to program the scratchClient sketch in the Arduino
  - Note: when using Arduino clones, I have experienced problems with programming them from RPi with the Raspian release of 2016-05-10 and later.
    - Releases up to and including 2016-03-18 are OK
  - However, when NOT using the USB hub and when using Arduino IDE 1.8.0 and Raspian 2016-11-25 it works fine.
- Start scratchClient with the correct config file as parameter.
- Everything is described in the excellent documentation.

## Good to know about the scratchClient config file

- When disconnecting and re-connecting the Arduino, it may end up at a different /dev/ttyUSBx number.
  - However the config file refers to a fixed device name.
  - There is a program that will check at which port(s) – out of a range – there is an Arduino present and then dynamically adapt the ttyUSBx number.
  - This program is in beta.
  - For now – option 1:
    - Stop scratchClient
    - Disconnect the Arduino
    - Wait a few minutes
    - Reconnect
  - For now – option 2:
    - Duplicate the config file, adapt for different port numbers
    - Have a script that looks at the existence of the ttyUSBx number and then starts scratchClient with the correct config file.
- The input / output naming of the Arduino GPIO pins is counter intuitive.
  - See the comment in the file. It is reverse from what is expected.

# Cost and effort for the board

- See Bill of Material on the next slide.
- Material cost for a single piece: ca. **20 euro**, but you will get spare material for that amount.
- Material cost for a series for e.g. a school: can get **sub 20 euro**.
- Labour content (no compensation included in the cost): **ca. 2.5 hour**.
- Most components were ordered from Aliexpress.com.
  - Benefits
    - Extremely low prices.
    - Almost always shipped for free to The Netherlands, Germany and probably other EU countries.
      - Counterintuitive: the **smaller** the order, the more chance that there are no shipment costs.
  - Disadvantage
    - Never any data sheet and hardly ever precise specs.
      - So you will need to Google and find other sources. And sometimes just buy and try.
    - Delivery takes between 2 weeks and 2 months
      - Or arrives never (some 2% of shipments), but then refund is promptly done
    - Especially for power supplies: do not expect more than 50% of output current that is rated.
      - Otherwise it will overheat and blow up. Or the voltage drops way below what is needed.
    - Occasionally products are quickly running out
      - So make sure you order quickly the amount you need and some spare for the future.
  - Note: limit each order to max 22 euro (holds for all of the EU) if you want to avoid VAT, import duties and handling costs at the shipping company.
  - Secure payment possible (at least in The Netherlands: you can use IDEAL).

# BoM (Bill of Material)

What	Where	Cost (euro) Free @ dec 2016 shipm.	#	Total cost	Remarks	Link
Pan / tilt platform	Aliexpress	0,37 Y	1	0,370		<a href="https://www.aliexpress.com/item/Hot-Sale-PT-Pan-Tilt-for-Aircraft-FPV-Dedicated-Nylon-PTZ-20g-for-9G/32318408962.html?spm=2114.01010208.3.17.emGyl4&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Hot-Sale-PT-Pan-Tilt-for-Aircraft-FPV-Dedicated-Nylon-PTZ-20g-for-9G/32318408962.html?spm=2114.01010208.3.17.emGyl4&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
SG90 servo	Aliexpress	1,12 Y	2	2,240		<a href="https://www.aliexpress.com/item/Free-Shipping-1PCS-LOT-SG90-9g-Mini-Micro-Servo-for-RC-for-RC-250-450-Helicopter/32246798112.html?spm=2114.01010208.3.19.2QRJMH&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Free-Shipping-1PCS-LOT-SG90-9g-Mini-Micro-Servo-for-RC-for-RC-250-450-Helicopter/32246798112.html?spm=2114.01010208.3.19.2QRJMH&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Duck	Aliexpress	0,23 Y	1	0,229	Sold per 40. Now sold out	
Arduino nano	Aliexpress	2,31 Y	1	2,310		<a href="https://www.aliexpress.com/item/Nano-CH340-ATmega328P-MicroUSB-Compatible-for-Arduino-Nano-V3-0/32572612009.html?spm=2114.13010608.0.0.4jDta">https://www.aliexpress.com/item/Nano-CH340-ATmega328P-MicroUSB-Compatible-for-Arduino-Nano-V3-0/32572612009.html?spm=2114.13010608.0.0.4jDta</a>
Nano expansion board	Aliexpress	1,51 Y	1	1,510		<a href="https://www.aliexpress.com/item/FreeShipping-NANO-and-UNO-multi-purpose-expansion-board-FOR-ARDUINO/1803703524.html?spm=2114.13010608.0.0.Yif9mN">https://www.aliexpress.com/item/FreeShipping-NANO-and-UNO-multi-purpose-expansion-board-FOR-ARDUINO/1803703524.html?spm=2114.13010608.0.0.Yif9mN</a>
Joy stick	Aliexpress	0,47 Y	1	0,470		<a href="https://www.aliexpress.com/item/Free-Shipping-Higher-Quality-Dual-axis-XY-Joystick-Module-PS2-Joystick-Control-Lever-Sensor-for-arduino/32280675624.html?spm=2114.13010608.0.0.Ck50On">https://www.aliexpress.com/item/Free-Shipping-Higher-Quality-Dual-axis-XY-Joystick-Module-PS2-Joystick-Control-Lever-Sensor-for-arduino/32280675624.html?spm=2114.13010608.0.0.Ck50On</a>
9V power supply	Aliexpress	1,69 Y	1	1,690		<a href="https://www.aliexpress.com/item/ALLSHOP-9v-1a-dc-power-adapter-eu-5-5mm-2-1mm-interface-Power-Supply-100-240v/32774734258.html?spm=2114.01010208.3.1.3cRB4l&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/ALLSHOP-9v-1a-dc-power-adapter-eu-5-5mm-2-1mm-interface-Power-Supply-100-240v/32774734258.html?spm=2114.01010208.3.1.3cRB4l&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Buttons	Aliexpress	Y	2	0,380	price is for 10. Note 3.	<a href="https://www.aliexpress.com/item/New-10-x-Tactile-Push-Button-Switch-Momentary-6x6x4mm/32307209787.html?spm=2114.01010208.3.1.aeQg3l&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/New-10-x-Tactile-Push-Button-Switch-Momentary-6x6x4mm/32307209787.html?spm=2114.01010208.3.1.aeQg3l&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Red LED 10 mm	Aliexpress	Y	1	0,930	price is for 10. Note 4.	<a href="https://www.aliexpress.com/item/10mm-Red-LED-Round-Light-Emitting-Diode-Transparent-Ultra-Bright-Lamp-Bead-Plug-in-DIY-Ki/32679401247.html?spm=2114.01010208.3.193.qG0xVG&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/10mm-Red-LED-Round-Light-Emitting-Diode-Transparent-Ultra-Bright-Lamp-Bead-Plug-in-DIY-Ki/32679401247.html?spm=2114.01010208.3.193.qG0xVG&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Green LED 5 mm	Aliexpress	Y	2	0,570	price is for 10. Note 4.	<a href="https://www.aliexpress.com/item/5mm-LED-Emerald-Green-Diffused-Round-Light-Emitting-Diodes-Lamp-Bead-DIP-Plug-in-Through-Hole/32671838043.html?spm=2114.01010208.3.96.O8nPPQ&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/5mm-LED-Emerald-Green-Diffused-Round-Light-Emitting-Diodes-Lamp-Bead-DIP-Plug-in-Through-Hole/32671838043.html?spm=2114.01010208.3.96.O8nPPQ&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Right angle connector - 10 pins	Aliexpress	Y	1	0,890	price is for 10x40 pins	<a href="https://www.aliexpress.com/item/DSHA-New-Hot-10-Pcs-1-x-40-Pin-2-54mm-Pitch-Single-Row-Right-Angle/32701451750.html?spm=2114.01010208.3.1.8WkxAO&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/DSHA-New-Hot-10-Pcs-1-x-40-Pin-2-54mm-Pitch-Single-Row-Right-Angle/32701451750.html?spm=2114.01010208.3.1.8WkxAO&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Dupont shell 10 pins	Aliexpress	Y	1	0,023	Note 1	<a href="https://www.aliexpress.com/item/50Pcs-2-54mm-10P-Pitch-Dupont-Jumper-Wire-Cable-Housing-Female-Pin-Connector-Dupont-Plastic-Shell/32584850092.html?spm=2114.13010608.0.0.9DOqFf">https://www.aliexpress.com/item/50Pcs-2-54mm-10P-Pitch-Dupont-Jumper-Wire-Cable-Housing-Female-Pin-Connector-Dupont-Plastic-Shell/32584850092.html?spm=2114.13010608.0.0.9DOqFf</a>
Dupont shell 6 pins	Aliexpress	Y	1	0,022	Note 1	<a href="https://www.aliexpress.com/item/50Pcs-2-54mm-6Pin-6P-Dupont-Connector-Dupont-Plastic-Shell-Plug-Dupont-Housing-Pin-Header/32325424414.html?spm=2114.13010608.0.0.9DOqFf">https://www.aliexpress.com/item/50Pcs-2-54mm-6Pin-6P-Dupont-Connector-Dupont-Plastic-Shell-Plug-Dupont-Housing-Pin-Header/32325424414.html?spm=2114.13010608.0.0.9DOqFf</a>
Dupont shell 3 pins	Aliexpress	Y	1	0,018	Note 1	<a href="https://www.aliexpress.com/item/50Pcs-2-54mm-3pin-3P-Pitch-Dupont-Plastic-Shell-Head-Plug-Dupont-Housing-Pin-Header-Jumper/32451135789.html?spm=2114.13010608.0.0.59zctI">https://www.aliexpress.com/item/50Pcs-2-54mm-3pin-3P-Pitch-Dupont-Plastic-Shell-Head-Plug-Dupont-Housing-Pin-Header-Jumper/32451135789.html?spm=2114.13010608.0.0.59zctI</a>
Dupont wire 10 cm F/F	Aliexpress	0,64 Y	1	0,640	only 1/4 needed	<a href="https://www.aliexpress.com/item/40pcs-lot-10cm-2-54mm-1pin-feMale-to-feMale-jumper-wire-Dupont-cable/32226515120.html?spm=2114.13010608.0.0.oxao9B">https://www.aliexpress.com/item/40pcs-lot-10cm-2-54mm-1pin-feMale-to-feMale-jumper-wire-Dupont-cable/32226515120.html?spm=2114.13010608.0.0.oxao9B</a>
USB cable microUSB 1 meter	Aliexpress	0,48 Y	1	0,480		<a href="https://www.aliexpress.com/item/New-1m-3FT-Micro-USB-Charger-Charging-Sync-Data-Cable-for-Samsung-Galaxy-S3-S4-S5/3257939998.html?spm=2114.13010608.0.0.160S22">https://www.aliexpress.com/item/New-1m-3FT-Micro-USB-Charger-Charging-Sync-Data-Cable-for-Samsung-Galaxy-S3-S4-S5/3257939998.html?spm=2114.13010608.0.0.160S22</a>
180 ohm resistor. 1/4 W	Aliexpress	Y	3	0,570	price is for 100.	<a href="https://www.aliexpress.com/item/Free-Shipping-100pcs-180-ohm-1-4W-180R-Metal-Film-Resistor-180ohm-0-25W-1-ROHS/32481576565.html?spm=2114.01010208.3.166.LP8VW4&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Free-Shipping-100pcs-180-ohm-1-4W-180R-Metal-Film-Resistor-180ohm-0-25W-1-ROHS/32481576565.html?spm=2114.01010208.3.166.LP8VW4&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
1 kohm resistor. 1/4 W	Aliexpress	Y	3	0,570	price is for 100.	<a href="https://www.aliexpress.com/item/Free-Shipping-100pcs-1k-ohm-1-4W-1k-Metal-Film-Resistor-1kohm-0-25W-1-ROHS/32479506254.html?spm=2114.01010208.3.11.gE5Cq&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Free-Shipping-100pcs-1k-ohm-1-4W-1k-Metal-Film-Resistor-1kohm-0-25W-1-ROHS/32479506254.html?spm=2114.01010208.3.11.gE5Cq&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Perspex base plate 11x14 cm	Kunststofplatenshop.nl	N	1	0,640	Note 2	<a href="https://kunststofplatenshop.nl/product/plexiglas-helder-3-mm/">https://kunststofplatenshop.nl/product/plexiglas-helder-3-mm/</a>
PCB board 3x7	Aliexpress	0,64 Y	1	0,640	Note 5	<a href="https://www.aliexpress.com/item/Free-Shipping-1set-5x7-4x6-3x7-2x8-cm-double-Side-Copper-prototype-pcb-Universal-Board-for/32278906575.html?spm=2114.01010208.3.1.8bN4H2&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Free-Shipping-1set-5x7-4x6-3x7-2x8-cm-double-Side-Copper-prototype-pcb-Universal-Board-for/32278906575.html?spm=2114.01010208.3.1.8bN4H2&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
spacers M2	Aliexpress	Y	8	0,765		<a href="https://www.aliexpress.com/item/25-Pcs-Nylon-Standoff-Spacer-M2-Male-x-M2-Female-5mm/32365215325.html?spm=2114.01010208.3.64.vrsL3B&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/25-Pcs-Nylon-Standoff-Spacer-M2-Male-x-M2-Female-5mm/32365215325.html?spm=2114.01010208.3.64.vrsL3B&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
spacers M3	Aliexpress	Y	8	0,970		<a href="https://www.aliexpress.com/item/Wholesale-25-pcs-set-Cheapest-Universal-Black-Nylon-Standoff-Spacer-M3-Male-x-M3-Female-6mm/32603041166.html?spm=2114.01010208.3.33.CmgC9&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/Wholesale-25-pcs-set-Cheapest-Universal-Black-Nylon-Standoff-Spacer-M3-Male-x-M3-Female-6mm/32603041166.html?spm=2114.01010208.3.33.CmgC9&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
nuts M2	Aliexpress	Y	8	0,840	price is for 50.	<a href="https://www.aliexpress.com/item/50Pcs-lot-M2-Nuts-2mm-Screw-Nut-Hexagon-Nut-Match-Copper-Cylinder-for-Robots-Good-Quality/3272587632.html?spm=2114.01010208.3.1.Uv2HoY&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/50Pcs-lot-M2-Nuts-2mm-Screw-Nut-Hexagon-Nut-Match-Copper-Cylinder-for-Robots-Good-Quality/3272587632.html?spm=2114.01010208.3.1.Uv2HoY&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
nuts M3	Aliexpress	Y	8	0,730	price is for 50.	<a href="https://www.aliexpress.com/item/20Pcs-lot-M3-Screw-Nut-Hexagon-Nut-Match-M3-Copper-Cylinder-3mm/32659135845.html?spm=2114.01010208.3.55.uC37p&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/20Pcs-lot-M3-Screw-Nut-Hexagon-Nut-Match-M3-Copper-Cylinder-3mm/32659135845.html?spm=2114.01010208.3.55.uC37p&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
countersunk screws M2 x 5	Aliexpress	Y	8	1,500	price is for 100.	<a href="https://www.aliexpress.com/item/70pcs-M2-black-countersunk-head-machine-screws-Flat-head-machine-screw-mechanical-screw-s8/32595913794.html?spm=2114.01010208.3.56.uwwGf&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/70pcs-M2-black-countersunk-head-machine-screws-Flat-head-machine-screw-mechanical-screw-s8/32595913794.html?spm=2114.01010208.3.56.uwwGf&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
countersunk screws M3 x 5	Aliexpress	Y	8	1,200	price is for 100.	<a href="https://www.aliexpress.com/item/M3-x-5mm-Cross-Flat-Head-Countersunk-Bolts-Machine-Screws-100Pcs/32759862916.html?spm=2114.01010208.3.59.9gydYl&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11">https://www.aliexpress.com/item/M3-x-5mm-Cross-Flat-Head-Countersunk-Bolts-Machine-Screws-100Pcs/32759862916.html?spm=2114.01010208.3.59.9gydYl&amp;ws_ab_test=searchweb0_0,searchweb201602_1_11</a>
Powered USB hub	Elektronika Online	N	1	2,000	Not strictly needed. Note 6	<a href="http://www.elektronika-online.nl/">http://www.elektronika-online.nl/</a>
Not calculated: soldering tin						
<b>Total</b>				<b>23,20</b>		
Note 1	Dupont shells are not strictly needed when building a few pieces. Cost is taken at the item price when ordering 50 or 100					
Note 2	The cost is when ordering minimally 10 euro. On top there is 14 euro shipping cost. However it is not strictly needed for building single pieces. You could use a piece of cardboard, MDF etc.					
Note 3	Not the same as in the setup. Those are 8,26 euro / 100					
Note 4	Costs are lower when ordering more					
Note 5	This is the cheapest to get a single piece. Better price is 2,34 euro / 10					
Note 6	Running out. Free shipment (in The Netherlands) above 100 euro					

The URLs are in the Excel file on github. See slide 16.

# What can scratchClient do further?

- As well control all the GPIO pins on Raspberry Pi.
- Run on a Windows PC and in combination with Arduino provide physical computing to Scratch running on Windows.
- Monitor the hardware state from a browser.
- Watch all the variables in the RPis from a central Windows PC.
- Allow to use Arduino Uno instead of Arduino Nano.
- Allows to use predefined configurations for experiments.
  - Minimizing the trouble with I/O configuration.
- Keep apart multiple connected Arduinos and address the right GPIO pins on the correct Nano (in beta now).
  - So the number of connectable peripherals is virtually infinite.

→ My conclusion:

**scratchClient is the ideal software to bring physical computing to Scratch!**

# Try for yourself?

- Attend my workshop at 13.00 today
  - You can there try it out for yourself (2 people per workplace setup)
  - **Registration mandatory** (with the Pi And More organisers)
  - Hurry up, because the amount of places is limited
- Workshop will be in English (presentation, material, support)
- There will be German spoken support in addition to English
  - Gerhard Hepp, author of scratchClient, will be present.
- You will learn how to configure scratchClient, control hardware from Scratch, build up a test board and – if you want – take a look at the game.

# More information

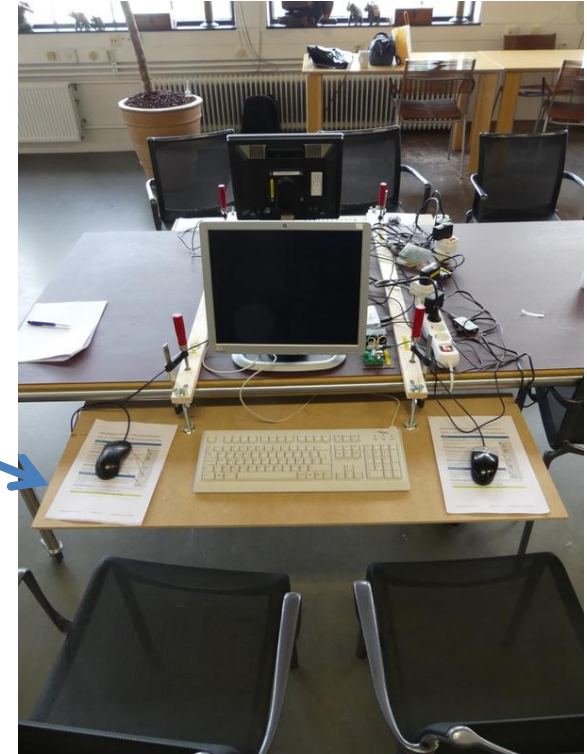
- This presentation, source files of the game and workshop material
  - [www.github.com](https://www.github.com) and search for *Weekendschool* or for *PiAndMore*
- scratchClient
  - [http://heppg.de/ikg/wordpress/?page\\_id=6](http://heppg.de/ikg/wordpress/?page_id=6)
- Scratch
  - <https://scratch.mit.edu/>
- Scratch on Raspberry Pi
  - <https://www.raspberrypi.org/forums/viewforum.php?f=77>
- Raspberry Pi
  - <https://www.raspberrypi.org/>
- Arduino
  - <https://www.arduino.cc/>



# Making a workplace for 2 students

- Raspberry Pi 3B
  - With power supply
  - With 16 GB microSD card
- Second hand monitor HP1750 or HP1740
- Second hand keyboard
- Second hand mice (2x)
  - so they can each use a mouse and can be instructed: learn to use your left hand for the mouse as well.
- MDF 9mm board (better: 2x 4mm with 12 mm filler in between)
  - See further the pictures
- For 2 workplaces opposite of each other: 2 laths, 4 clamps, 4 threaded rods M8, 4 nuts, 8 large washers, 12 butterfly nuts.
- 84 liter crates of RUB (Really Useful Boxes, <http://www.reallyusefulproducts.co.uk/>) can very precisely contain 4 monitors (2 dismantled from their pedestal) and cables.

Ergonomics:  
keyboard at the  
correct height to  
teach children  
to pay attention  
to how they sit  
when using  
computers to  
avoid medical  
problems (RSI)  
later in life.



# Questions?