EDAQuino-supported experiments in science education

Gergely MAKAN

Department of Technical Informatics, University of Szeged, Árpád tér 2, 6720 Szeged, Hungary

Ágota LANG

Faculty of Forestry, University of Sopron, Bajcsy-Zsilinszky u 4, H-9400 Sopron, Hungary

Berzsenyi Dániel Lutheran High School, Széchenyi tér 11, H-9401 Sopron, Hungary

János TRAUER

Attila József Secondary Grammar School, Csanád vezér tér 6, 6900 Makó, Hungary

Katalin KOPASZ

Department of Optics and Quantum Electronics, University of Szeged, Dóm tér 9, 6720 Szeged, Hungary

Mátyás BEJÓ, Barnabás MOLNÁR, Áron SZTOJKA

Soprobotics Workshop

SOP ROBOTICS

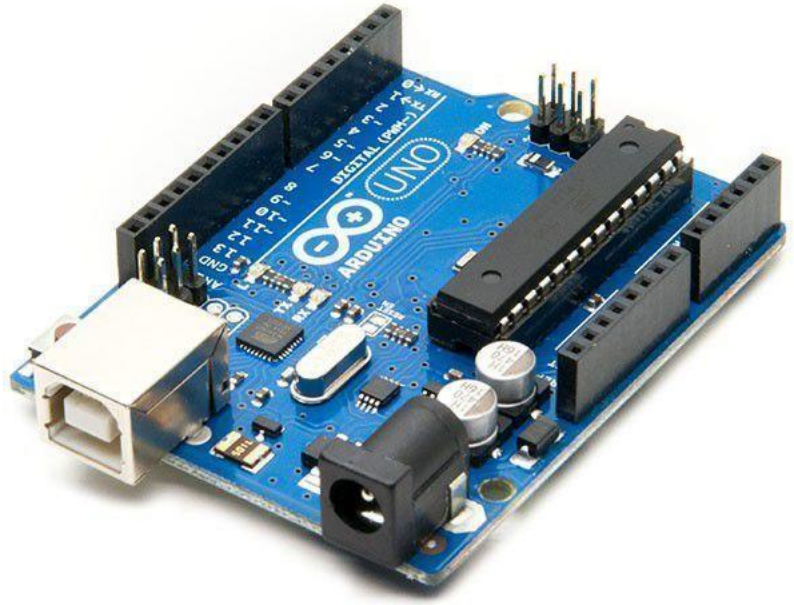
HAS Research Group of Technical Informatics Methodology

What is EDAQuino?

- EDAQuino is an completion for Arduino
  - Additional hardware and software have been developed
    - keep simplicity in focus
  - To support experimenting in education
    - Measurements with any kind of analog sensors

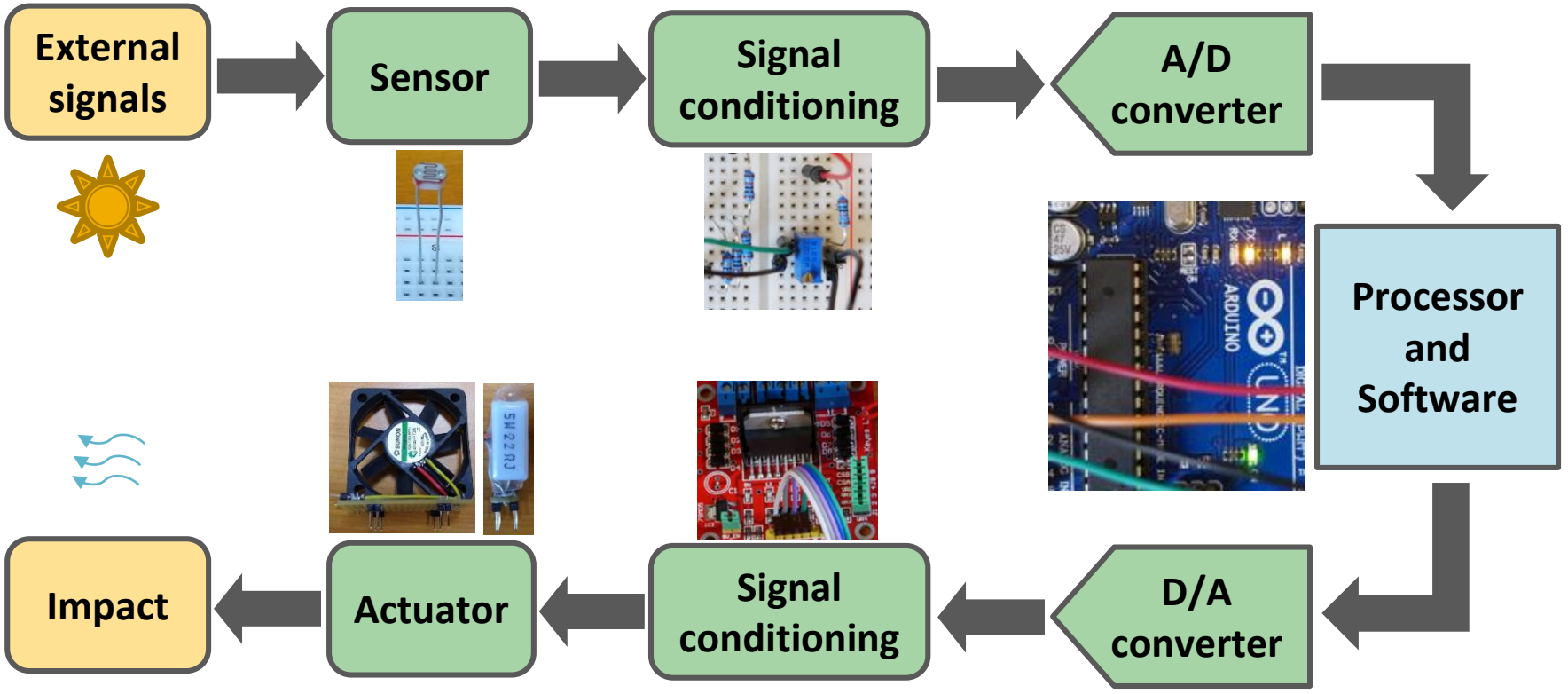
What is Arduino?

- Programmable circuit board (by PC)
  - It can measure, process and control things
- Widely spread worldwide
- Created for educational goal
  - Great opportunities for any kind of applicational field

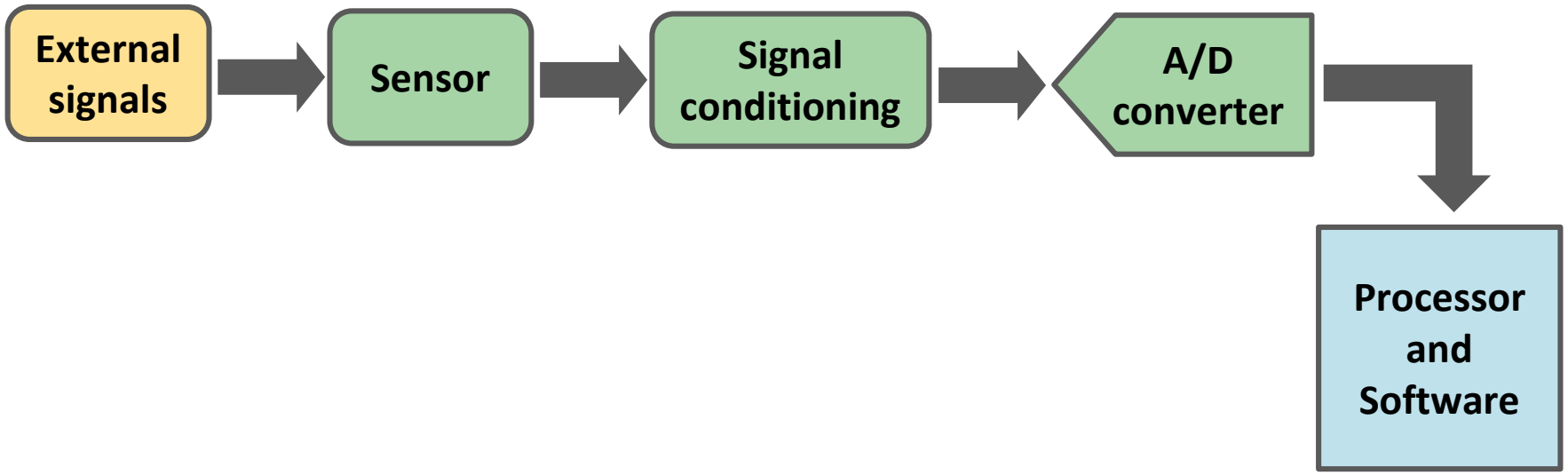


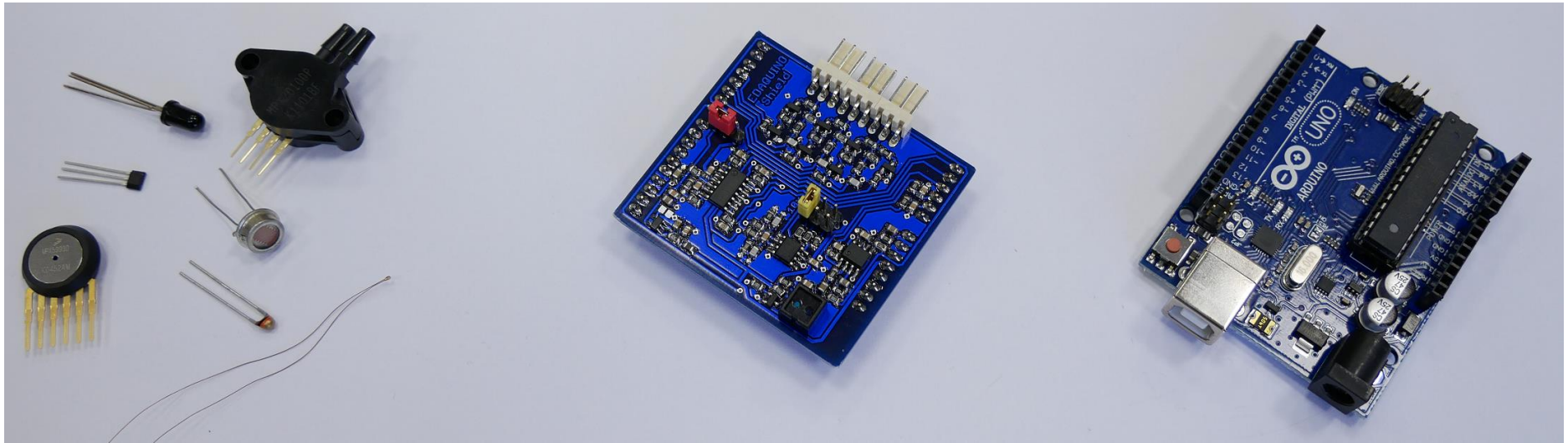
https://www.elektor.com/arduino-uno-r3

Today's devices

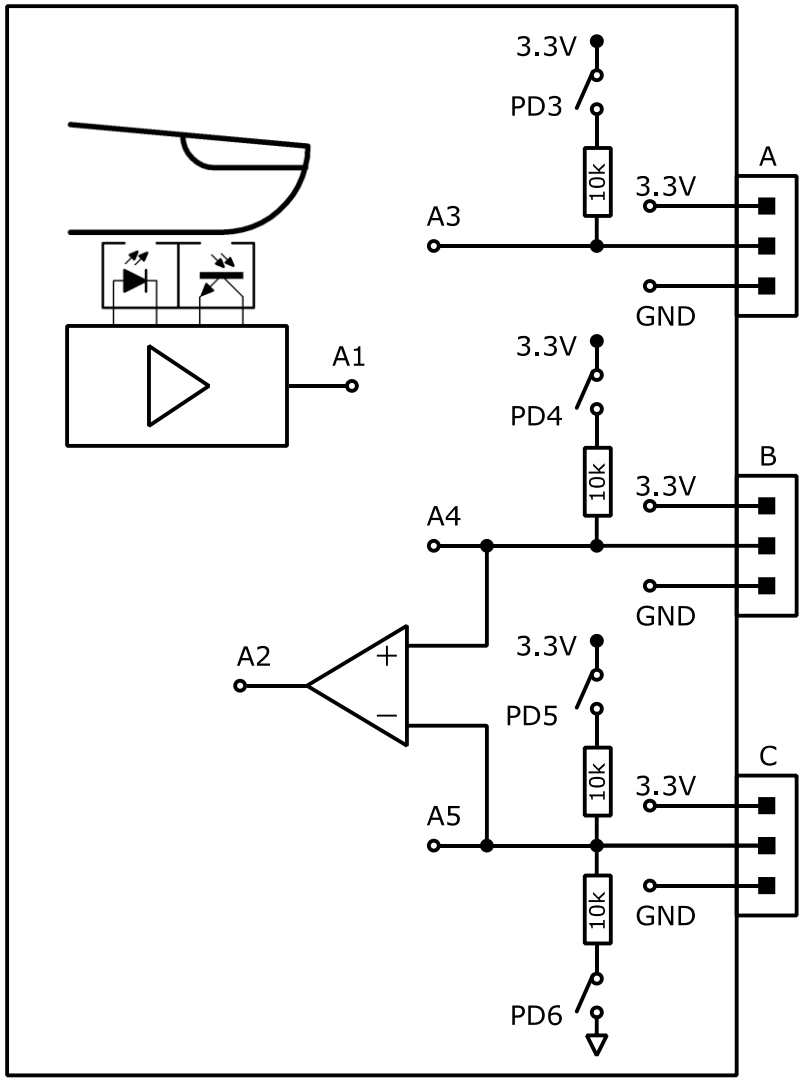


Arduino: cheap, simple, efficient, transparent

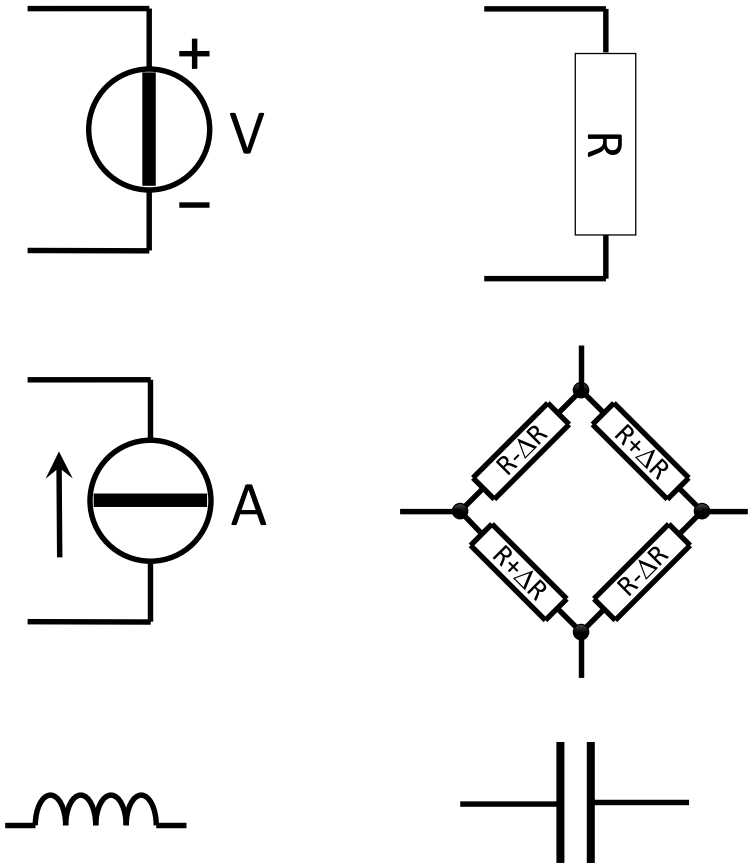




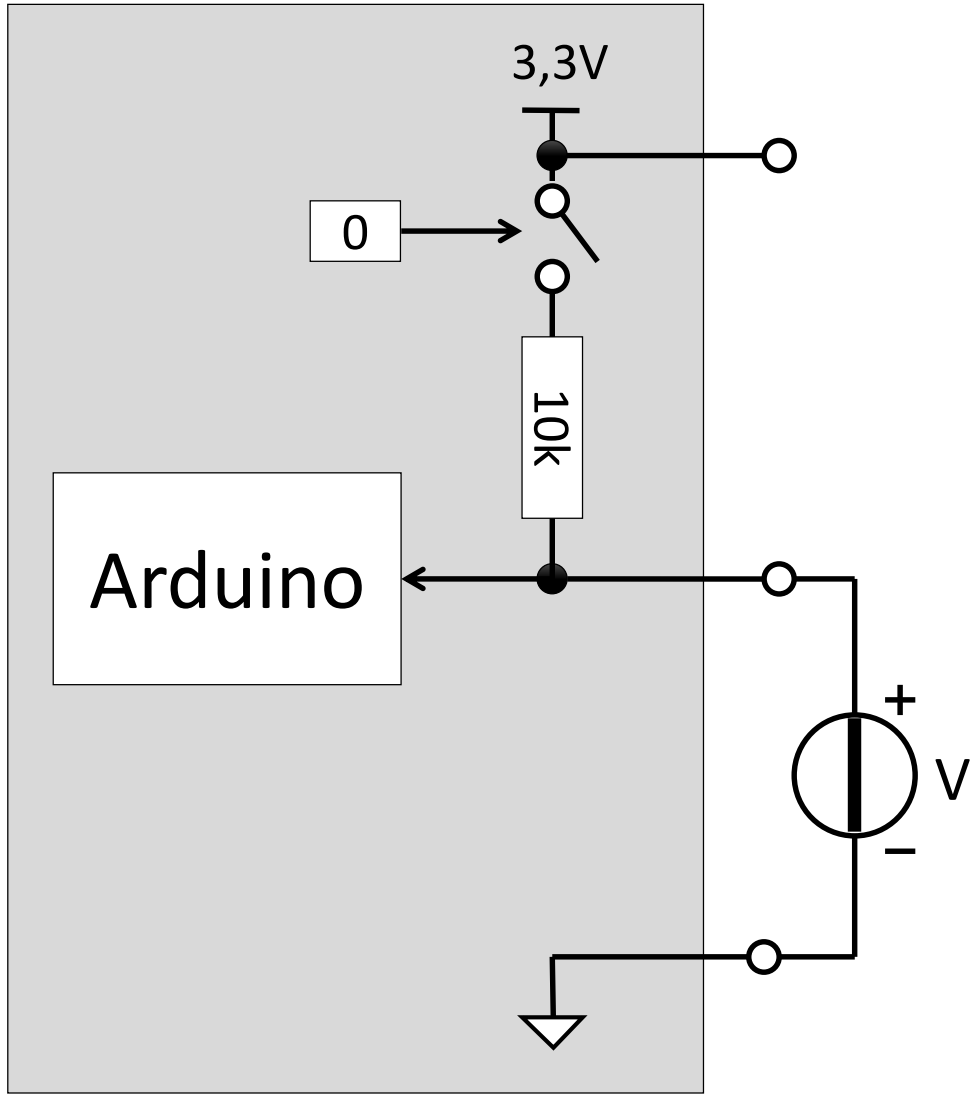
EDAQuino „shield” – one circuit/many sensors



Sensors equivalent electronic components

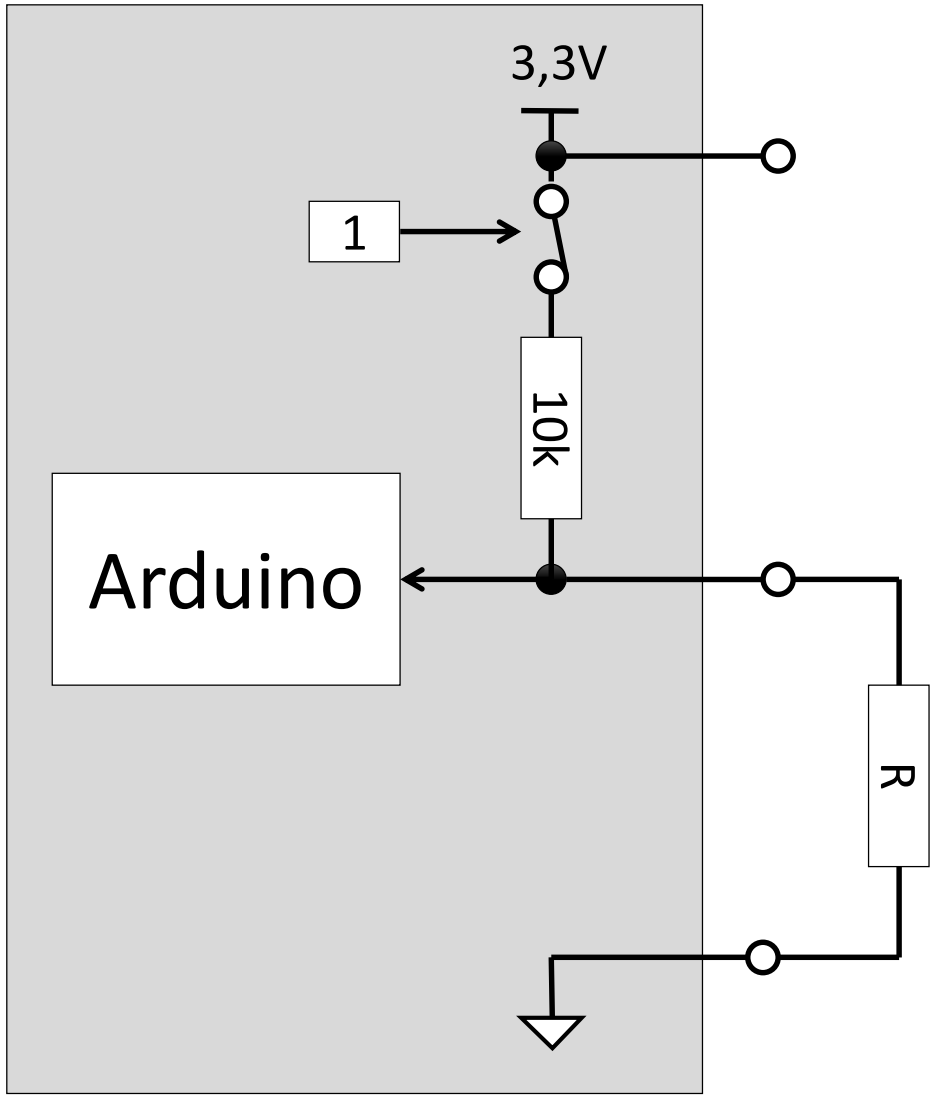


Voltage output sensors



- Acceleration
- Temperature
- Magnetic field
- Pressure
- Relative humidity
- pH
- …

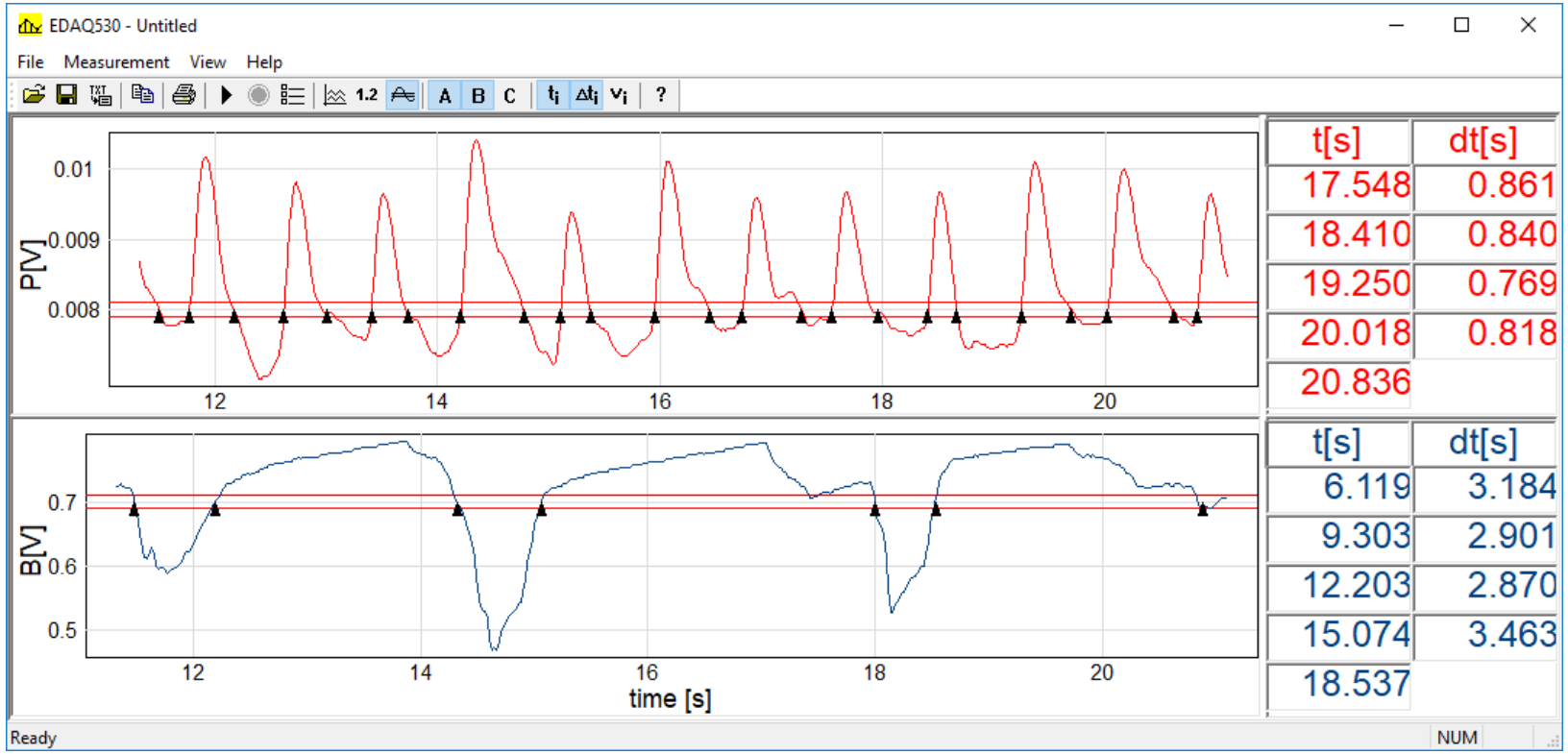
Resistance-output sensors



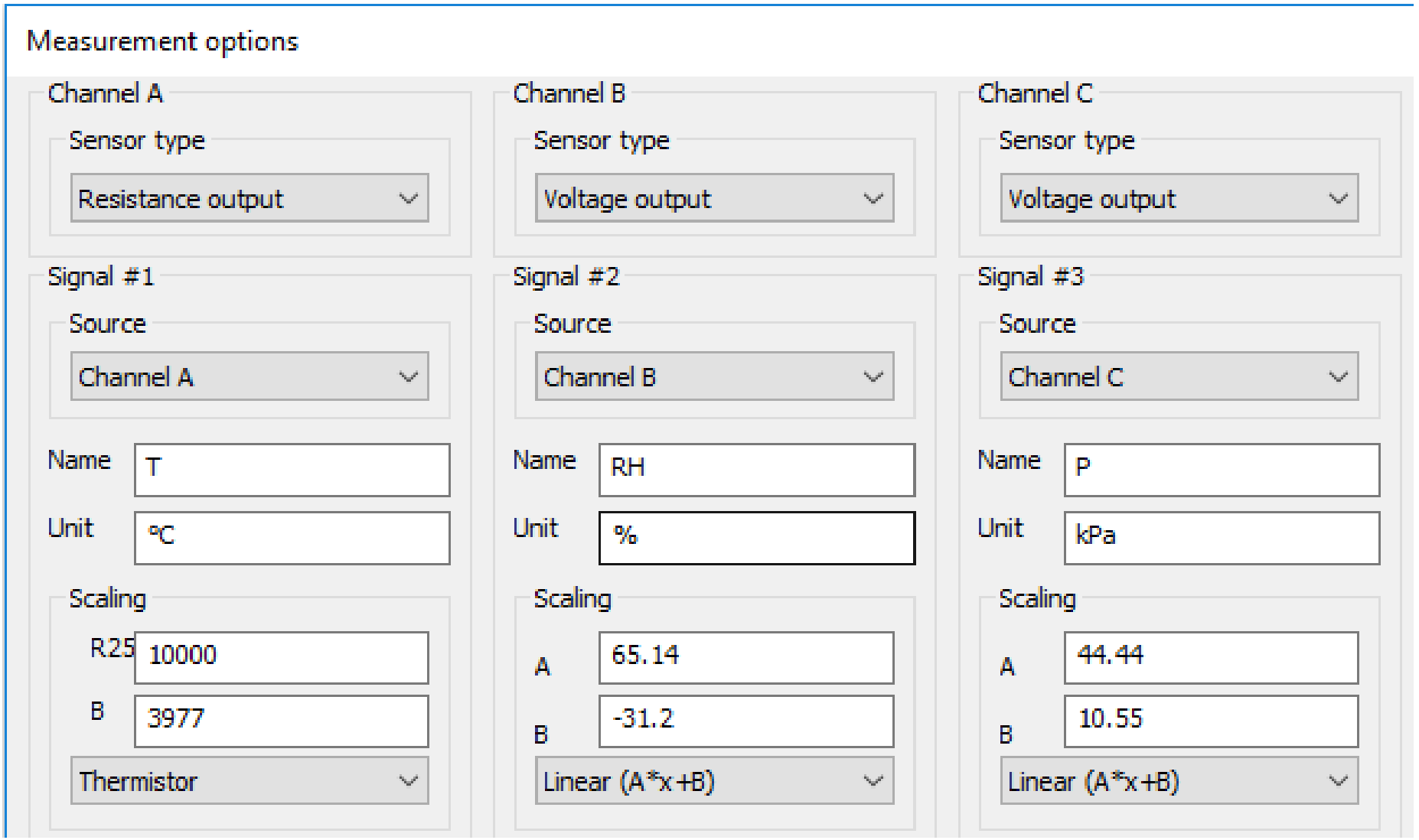
- Temperature
- Light intensity
- Pressure
- Force
- Displacement
- Rotation
- …

Software on PC

- Configure hardware (switches, sample rate)
- Receive data stream
- Processing data



User configures the sensors



Experiences in education

EDAQuino experiences in education

- Contributing teachers

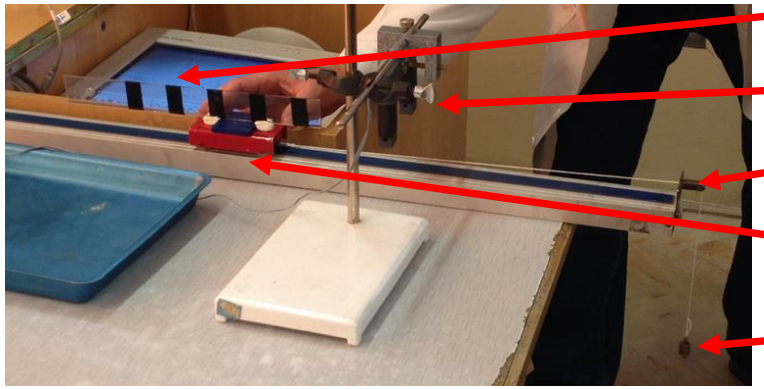
  - Enikő Erdélyiné Bérci (Balassi Balint Secondary School, Budapest)
  - Árpád Gutai (Miklós Radnóti High School in Szeged)
  - Norbert Horváth (Baar Madas Reformed High School, Budapest)
  - Ágota Lang (Faculty of Forestry, University of Sopron / Berzsenyi Dániel Lutheran High School, Sopron)
  - Anita Orbán (Déri Miksa Vocational Secondary School, Szeged)
  - Péter Szalai (Katona József High School, Kecskemét)
  - István Szittyai (Bányai Júlia Secondary Grammar School, Kecskemét)
  - Péter Tarján (University of Nyíregyháza)
  - János Trauer (Attila József Secondary Grammar school, Makó)
  - Fanni Vitkóczi (ELTE Trefort Ágoston Practice Grammar School, Budapest)

EDAQuino experiences in education

- Arduino with EDAQuino platform is a useable tool in physics education
  - Without programming
- Many physics teachers do not have enough capacities to learn programming
  - Our device allows teachers to focus on the experimental work
- Enables organizing student experiments
  - Can be also a tool of inquiry-based learning (IBL)
- With an expertise in programming and sensorics, realisable experiments can be widely extended

Experiments with a transmissive photogate

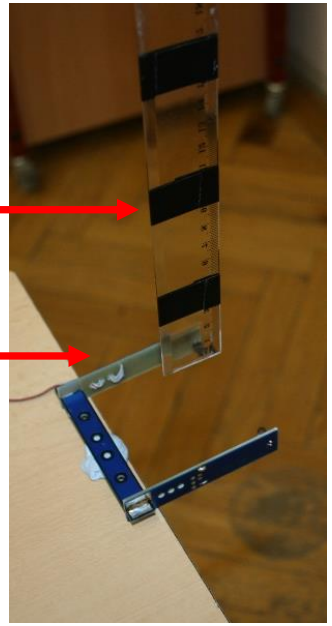
acceleration



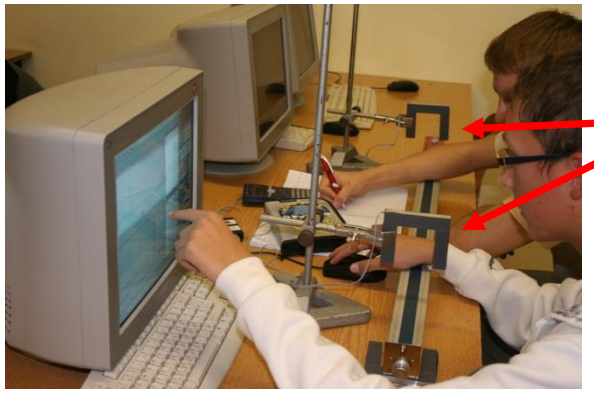
free fall acceleration

ruler with insulation stripe

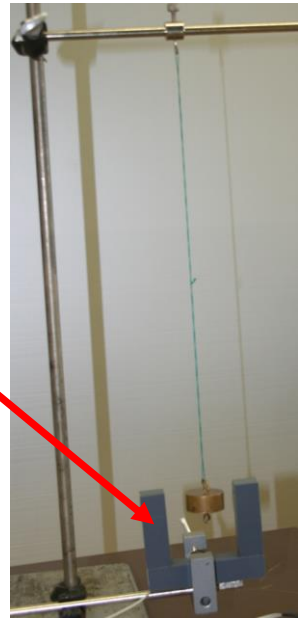
photogate



Collisions
(inertia, momentum)

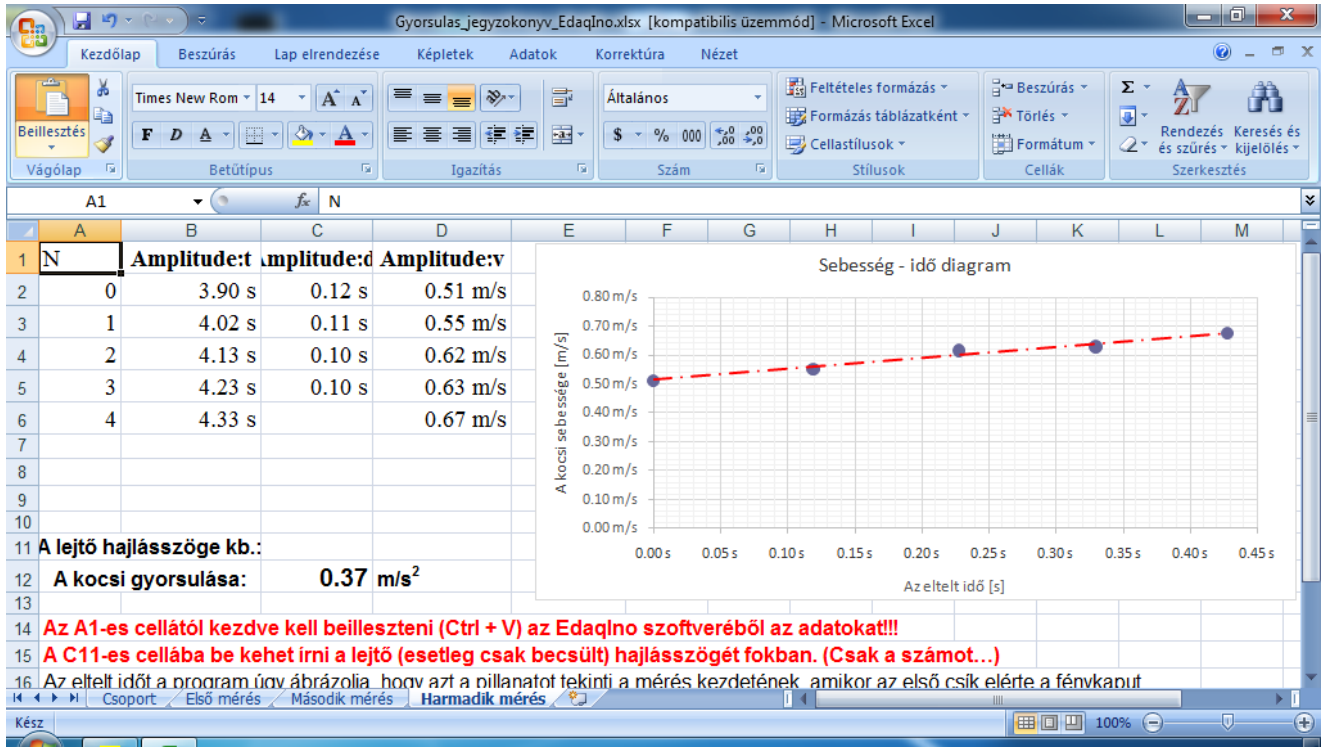


pendulum



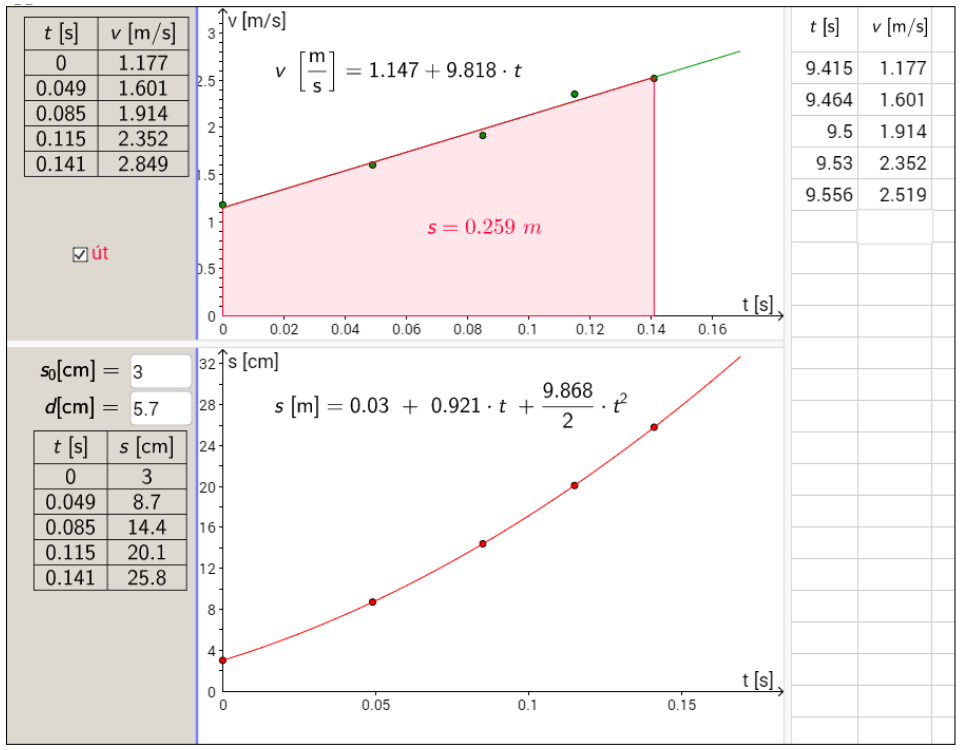
Measurement results in spreadsheets

Excel



N	Amplitude:t	Amplitude:d	Amplitude:v
0	3.90 s	0.12 s	0.51 m/s
1	4.02 s	0.11 s	0.55 m/s
2	4.13 s	0.10 s	0.62 m/s
3	4.23 s	0.10 s	0.63 m/s
4	4.33 s		0.67 m/s

Geomatech:
http://tananyag.geomatech.hu/b/511653#material/1465085

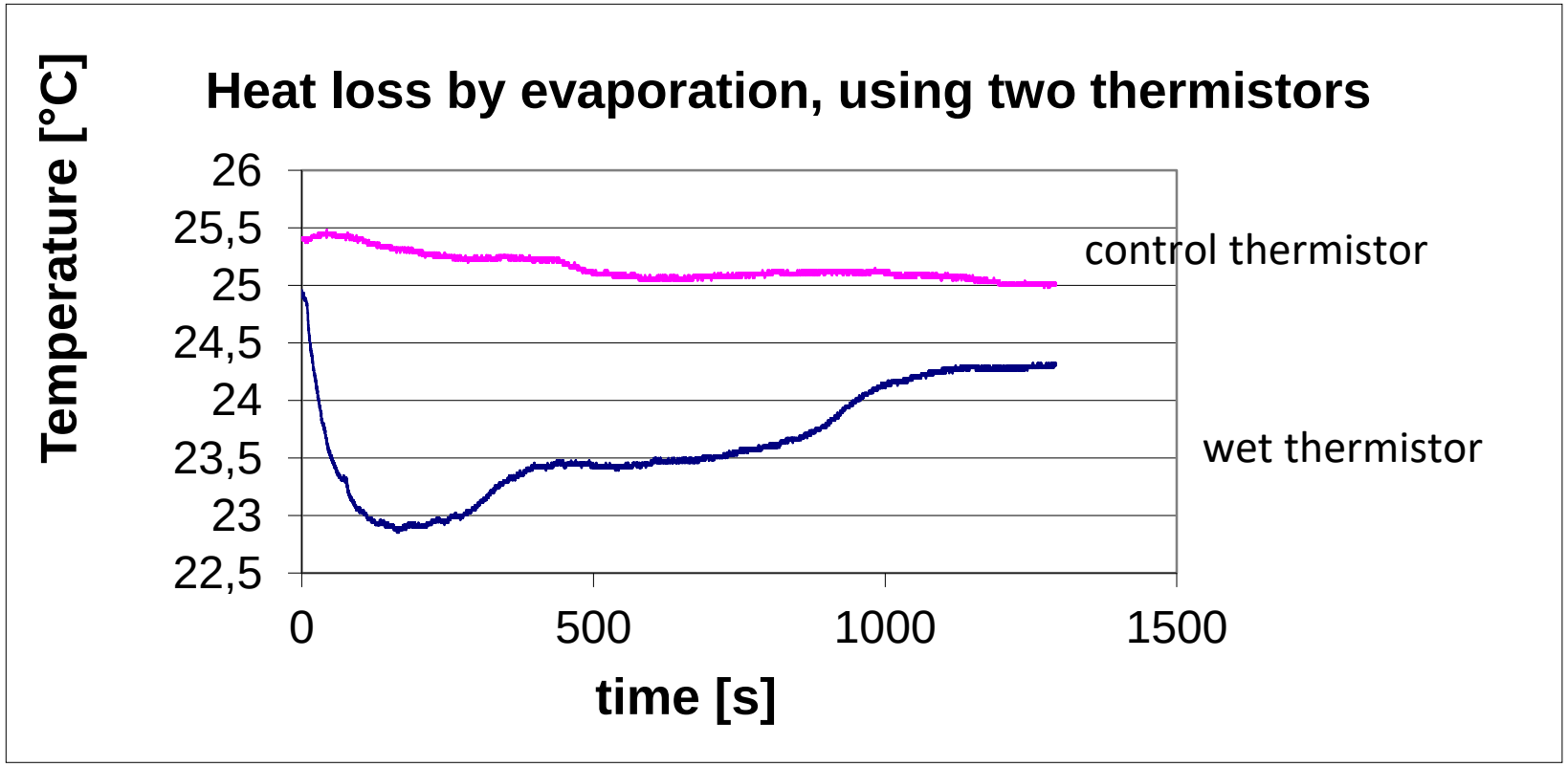


t [s]	v [m/s]
0	1.177
0.049	1.601
0.085	1.914
0.115	2.352
0.141	2.849

t [s]	s [cm]
0	3
0.049	8.7
0.085	14.4
0.115	20.1
0.141	25.8

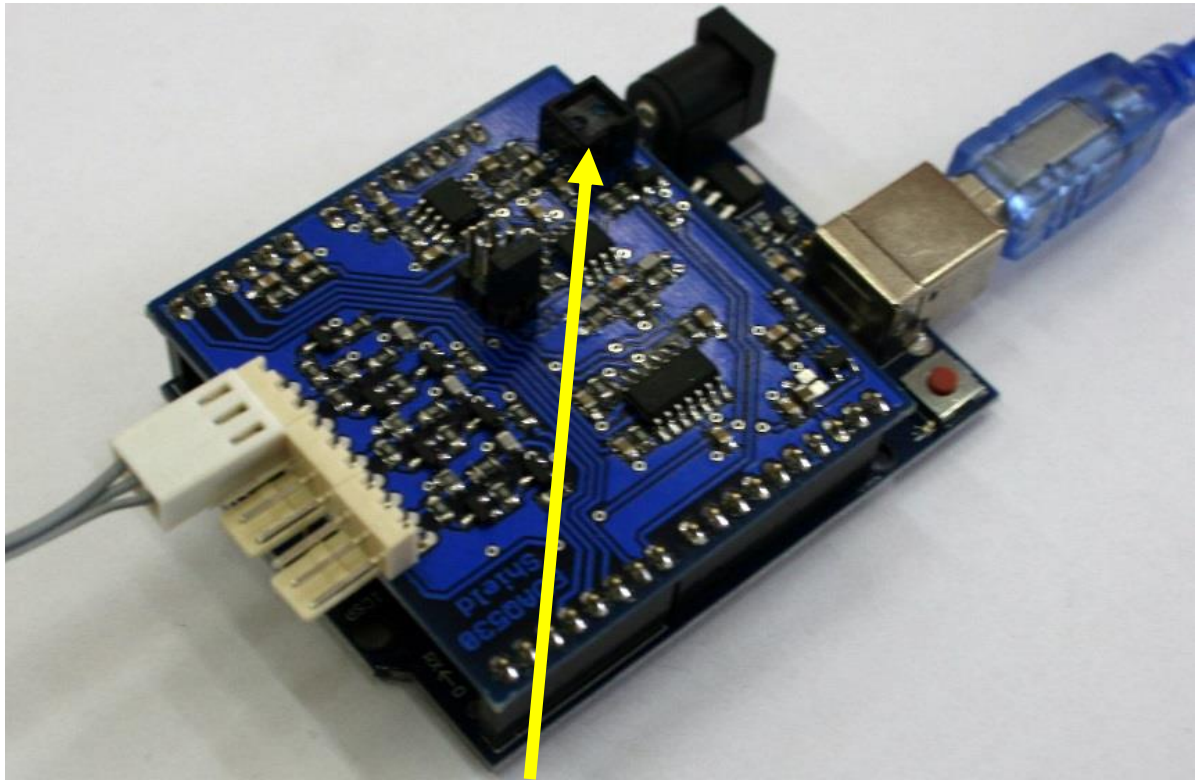
t [s]	v [m/s]
9.415	1.177
9.464	1.601
9.5	1.914
9.53	2.352
9.556	2.519

Temperature measurement



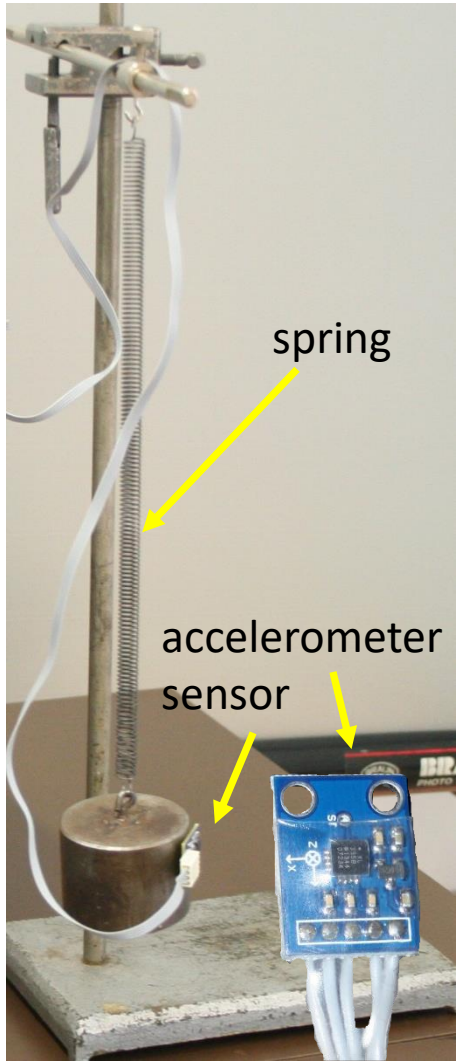
Plethysmography

Pulse wave

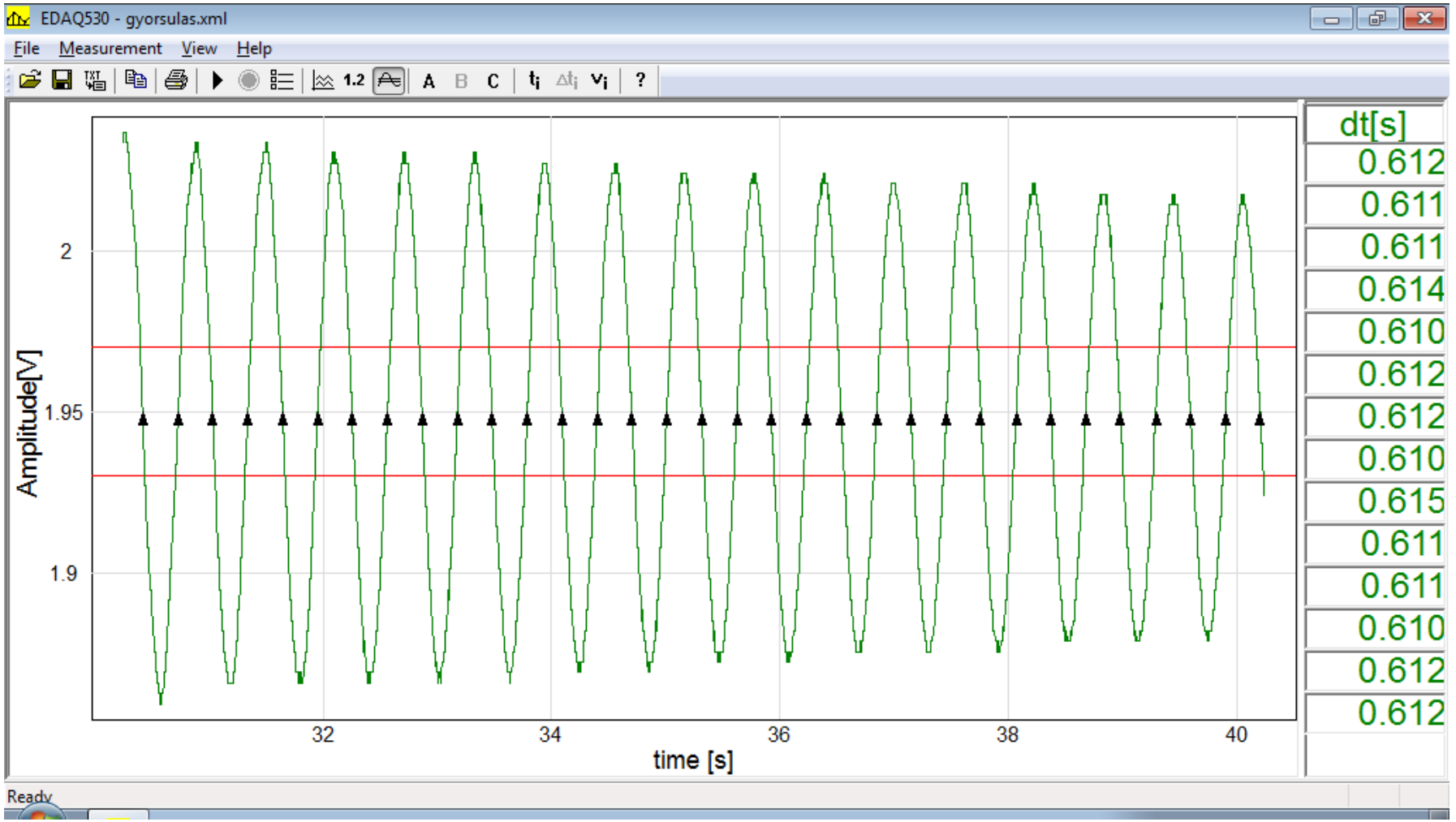


optosensor

Accelerometer sensor and vibration

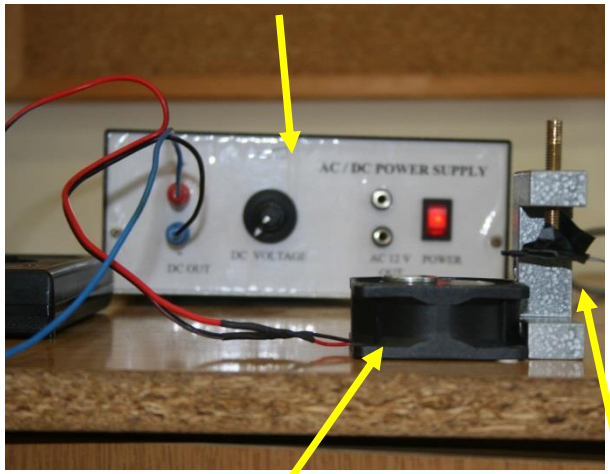


Acceleration vs time graph

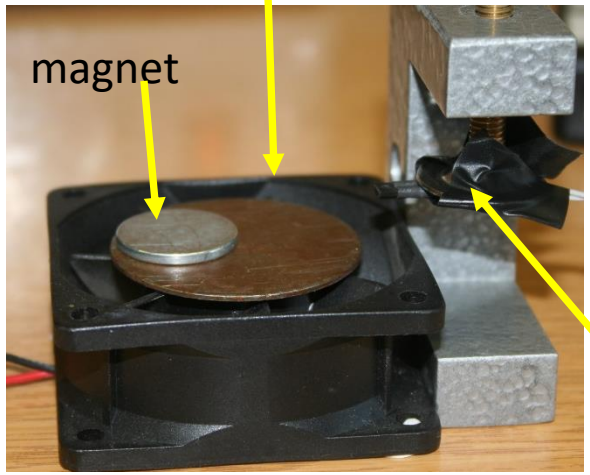


Hall-sensor: rotational frequency

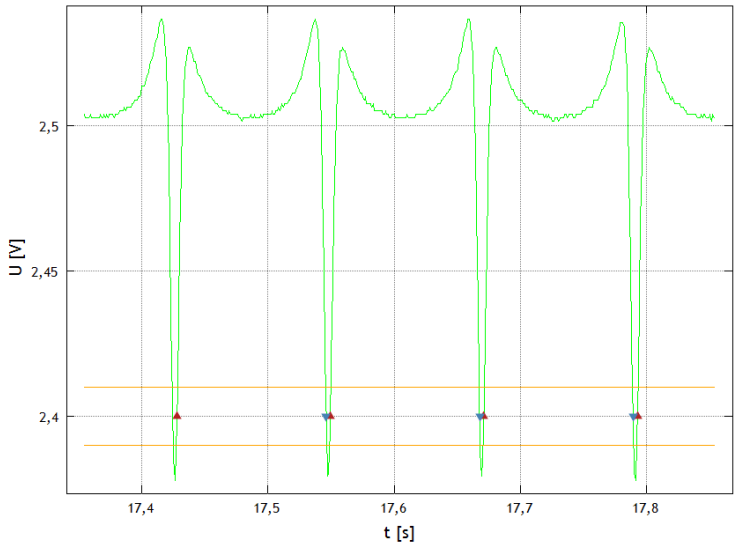
Variable DC power supply



Computer cooling ventillation fun

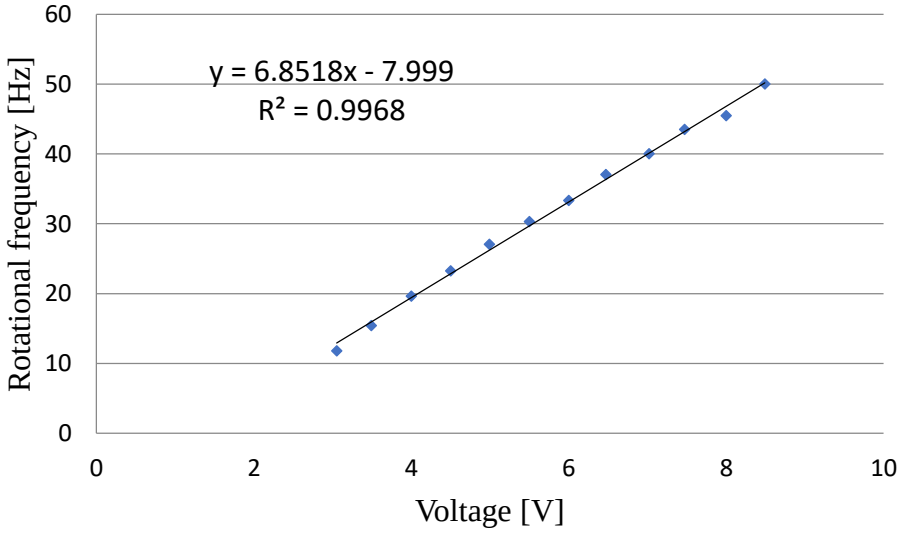


Voltage-time graph with level-crossing detector

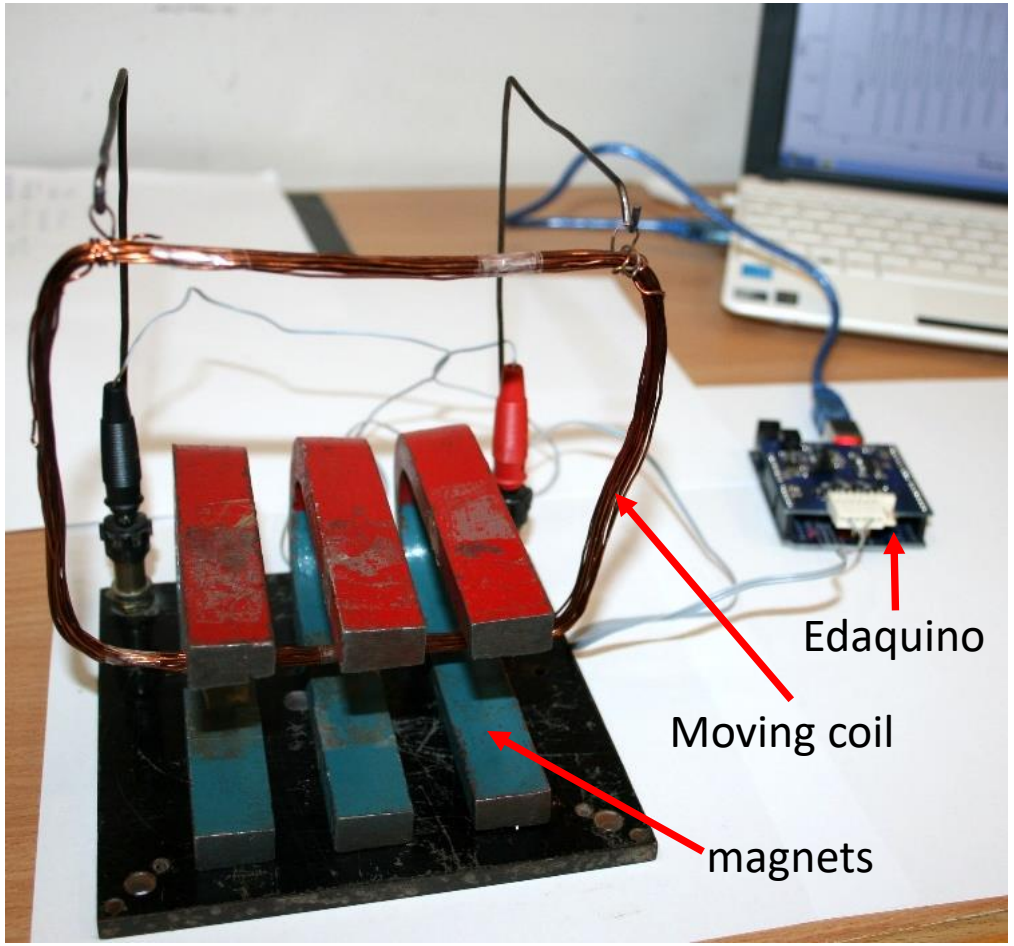


Hall-sensor

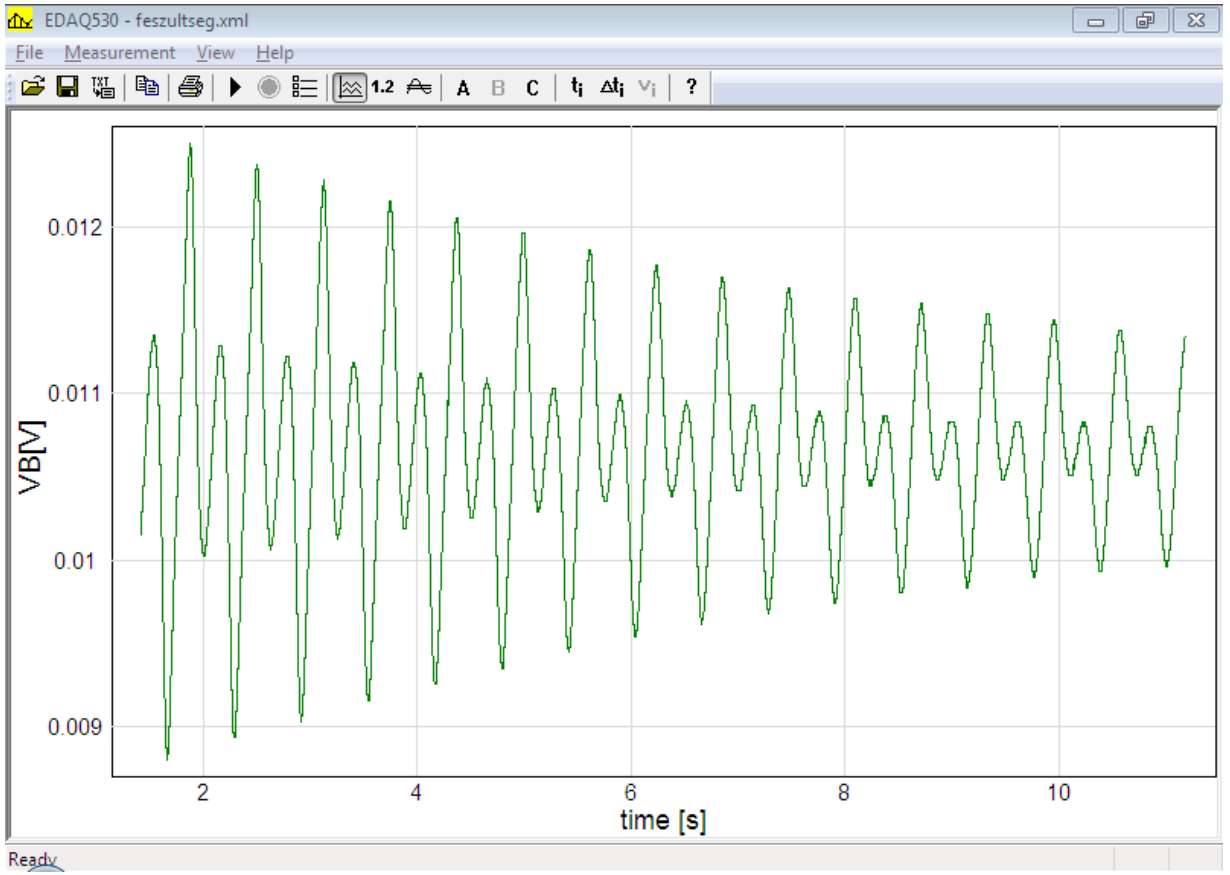
Relation between voltage and rotational frequency of a computer cooling ventillating



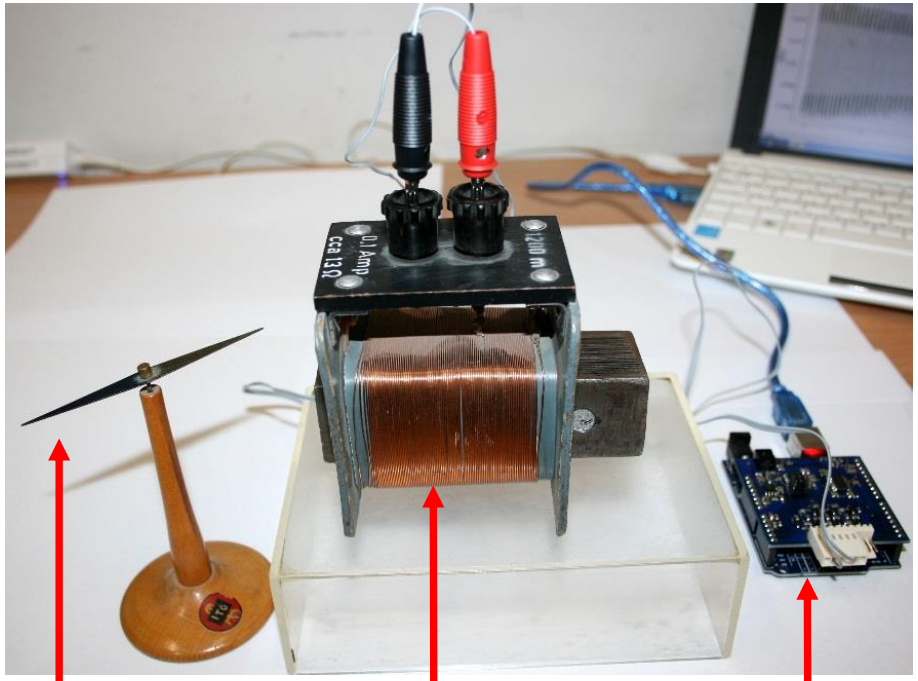
Demonstrate the electromagneting induction with measure voltage different between channel B and C



Voltage v.s. time (in real time graph)



Demonstrate the electromagneting induction with measure voltage different between channel B and C



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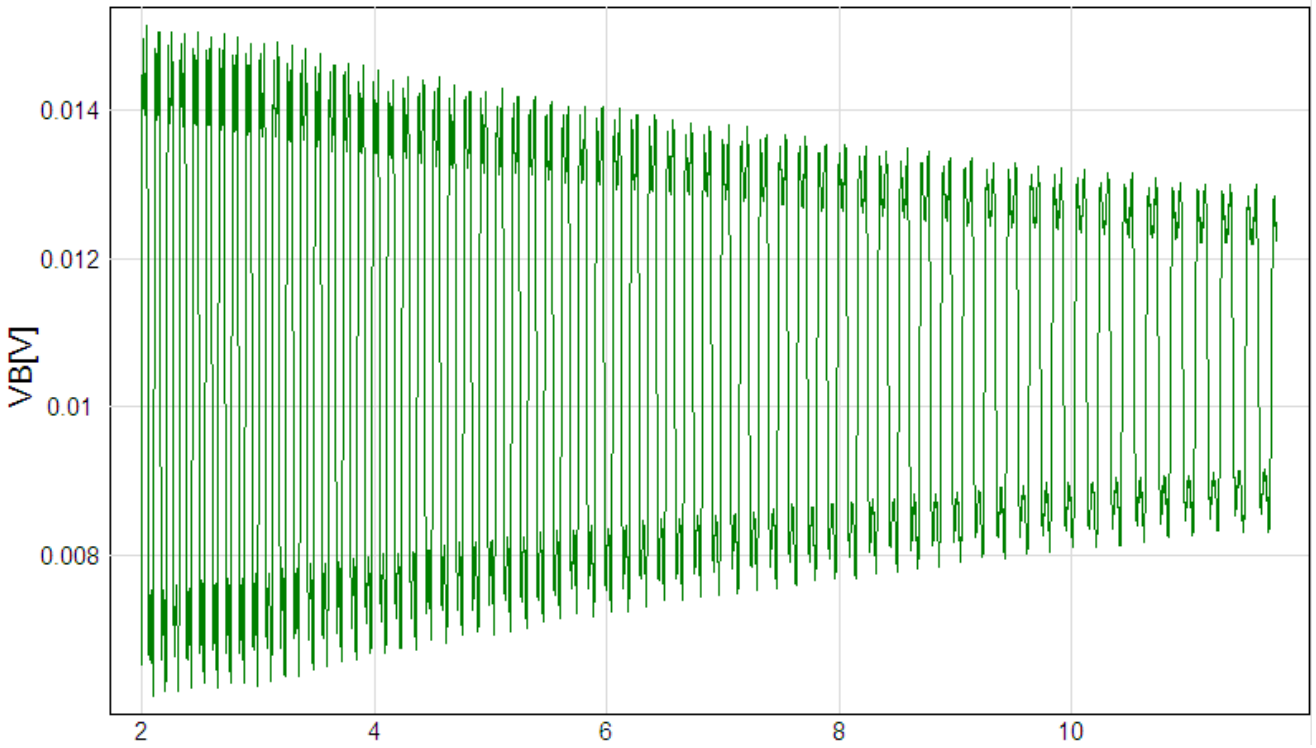

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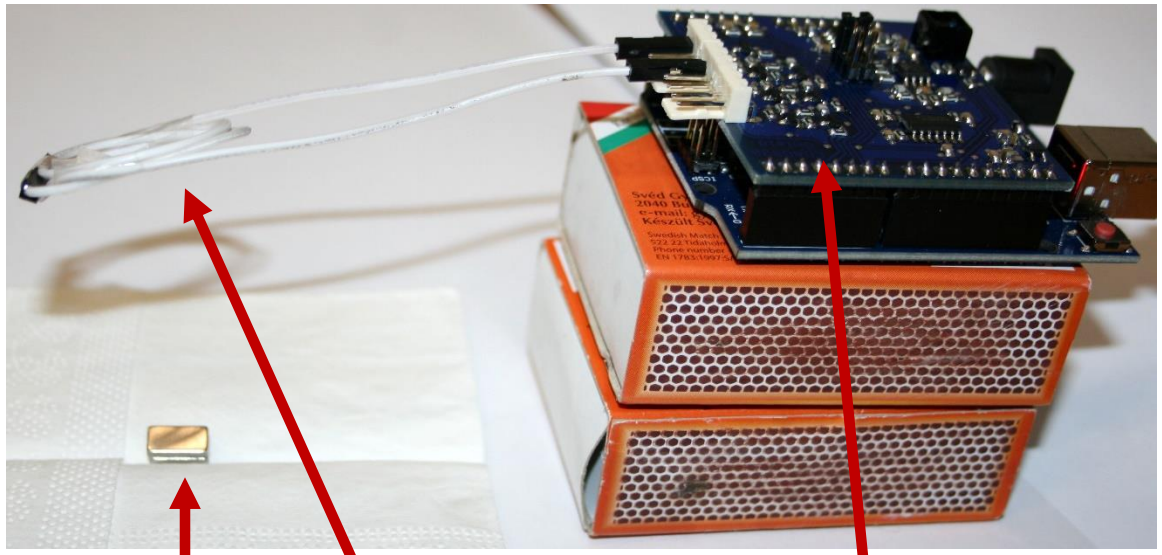
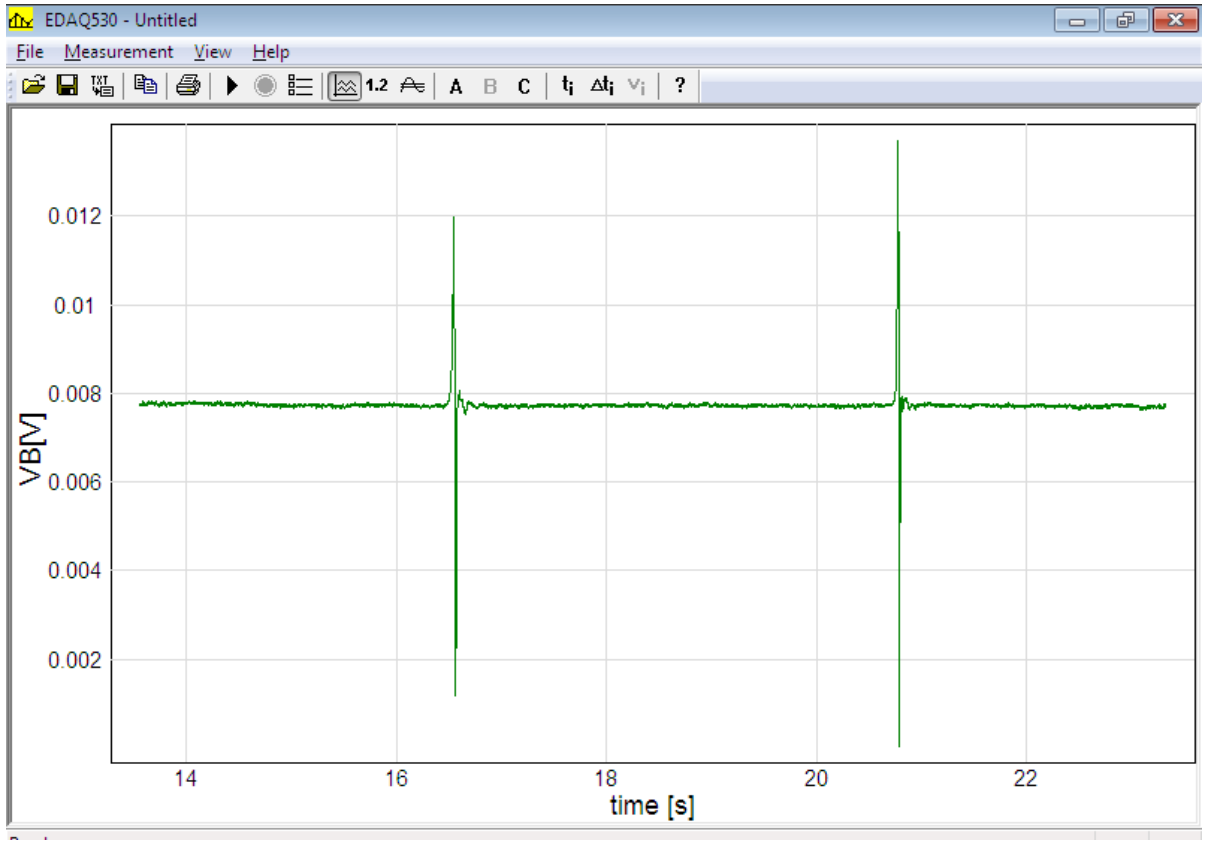
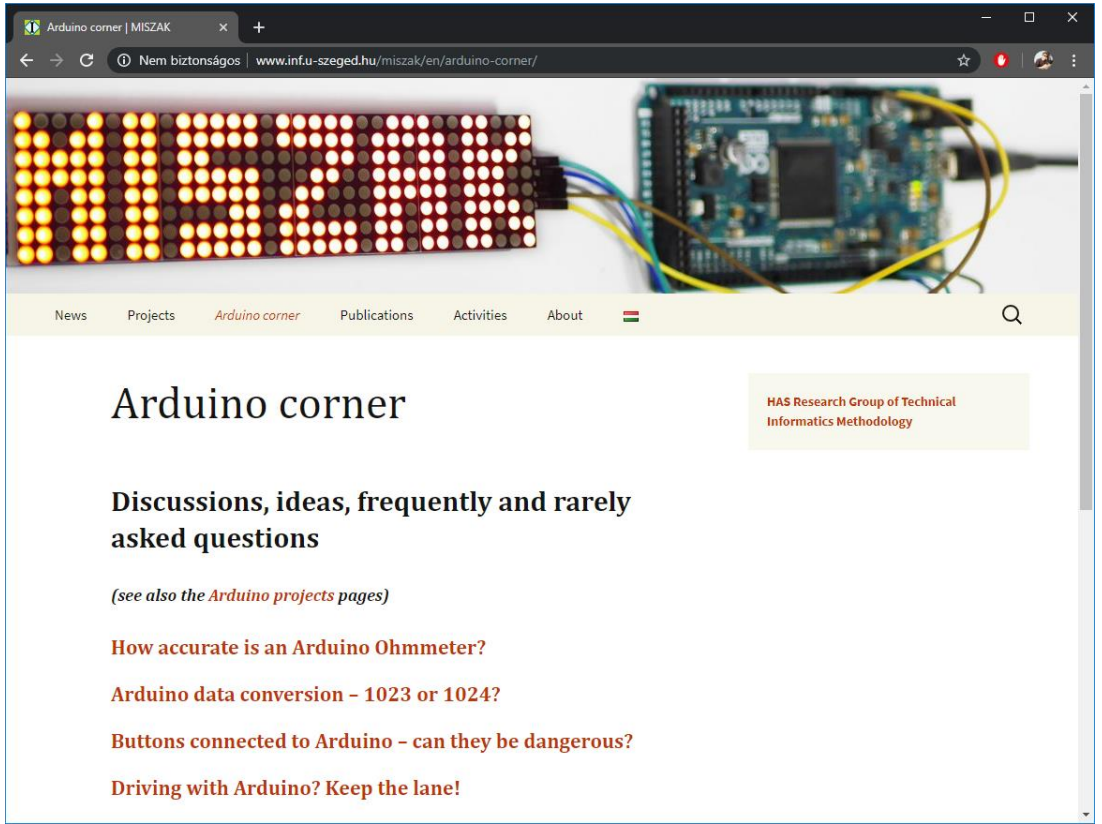


Voltage v.s. time (in real time graph)



Webpage – MISZAK

- More information is available at: http://www.inf.u-szeged.hu/miszak/en/
  - Publications
  - EDAQuino (open source)
  - Videos
    - EDAQuino
    - Arduino
  - Arduino projects



Installation

Installation – from pendrive

- Copy EDAQuino-master folder from pendrive (only in case of personal notebook)
- In EDAQuino folder, install arduino-1.8.9-windows.exe (only in case of personal notebook)
  - Please do all driver installation when messages pop up
- Run edaquino.ino (click ok on folder creation message)
- Connect the Arduino board to the notebook with the USB cable
- *Wait some seconds for the driver installation*
- In the Tools/Port menu choose the biggest number of COM to connect Arduino IDE and Arduino Uno

Upload the firmware and start the software

- Click on the right arrow to compile and download the code to the Arduino 
- Open the edaquino-com.exe
- In Measurement/Select port menu also select the biggest number of COM
- Go to the Measurement/Options menu to set the right parameters for the experiments

Installation (online)

- Connect to wifi network
  - SSID:
  - Password:
- Download Arduino IDE from www.arduino.cc/download_handler.php
- Install Arduino IDE
- Download softwares from github.com/miszak-mta-szte/Edaquino
- Unzip
- Run edaquino.ino (click ok to folder creation message)

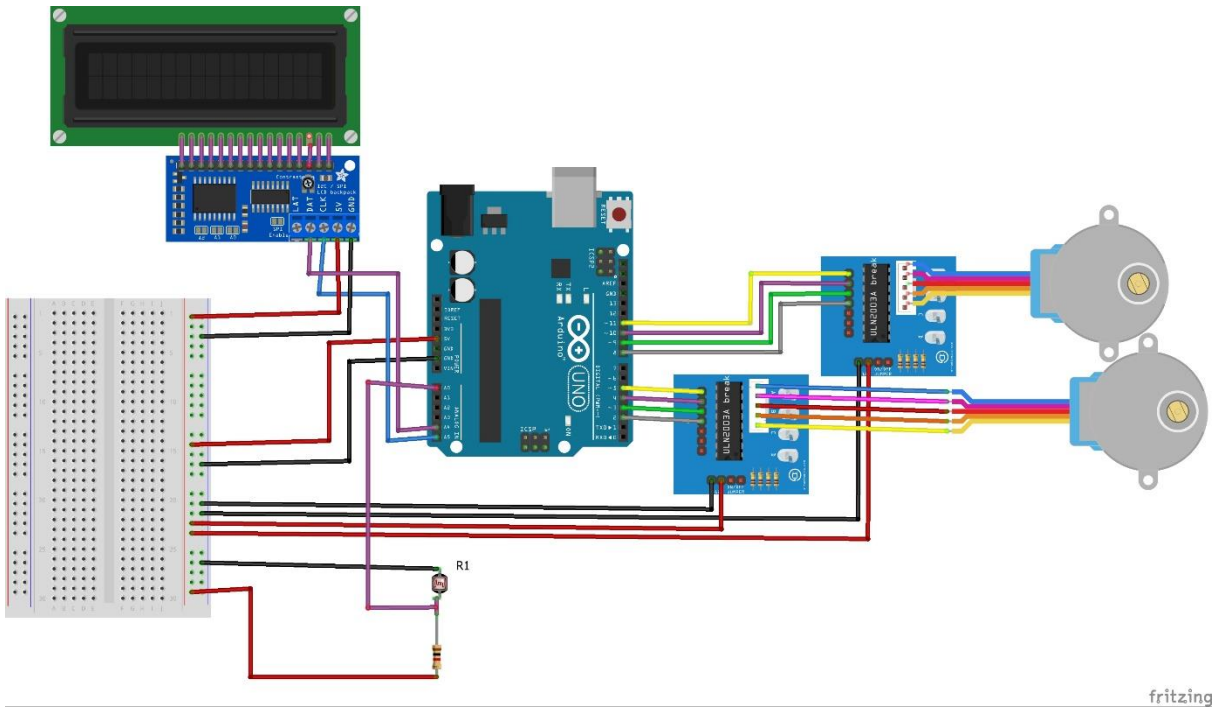
Let’s do some experimets!

Experiments

1. Measuring the value of gravitational acceleration
2. Temperature measuremet
3. Plethysmography – pulse wave measuremet
4. Magnetic induction measuremet
5. …

Determining the focal length with Arduino

Determining the focal length with Arduino



circuit

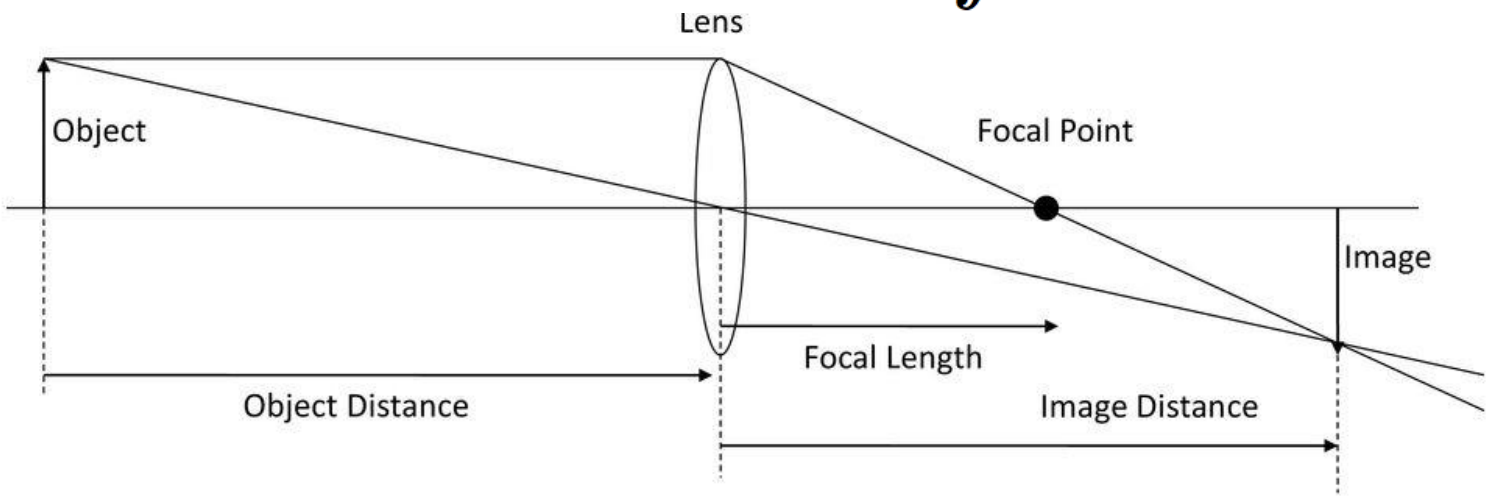
```
* Udemy.com
* Using Photoresistors (LDRs) with an Arduino
*
*/

// pin assignments
int LDR = 0;

// initialize the serial port
// and declare inputs and outputs
void setup() {
  pinMode(LDR, INPUT);
  Serial.begin(9600);
}

// read from the analog input connected to the LDR
// and print the value to the serial port.
// the delay is only to avoid sending so much data
// as to make it unreadable.
void loop() {
  int v = analogRead(LDR);
  Serial.println(v);
  delay(1000);
}
```

code

Determining the focal length with Arduino

Imaging Equation

$$\frac{1}{i} + \frac{1}{o} = \frac{1}{f}$$



Determining the focal length with Arduino: The Algorythm

Moving lightsource
→Object distance (o)

→

Moving photoresistor
Measuring light intensity

→

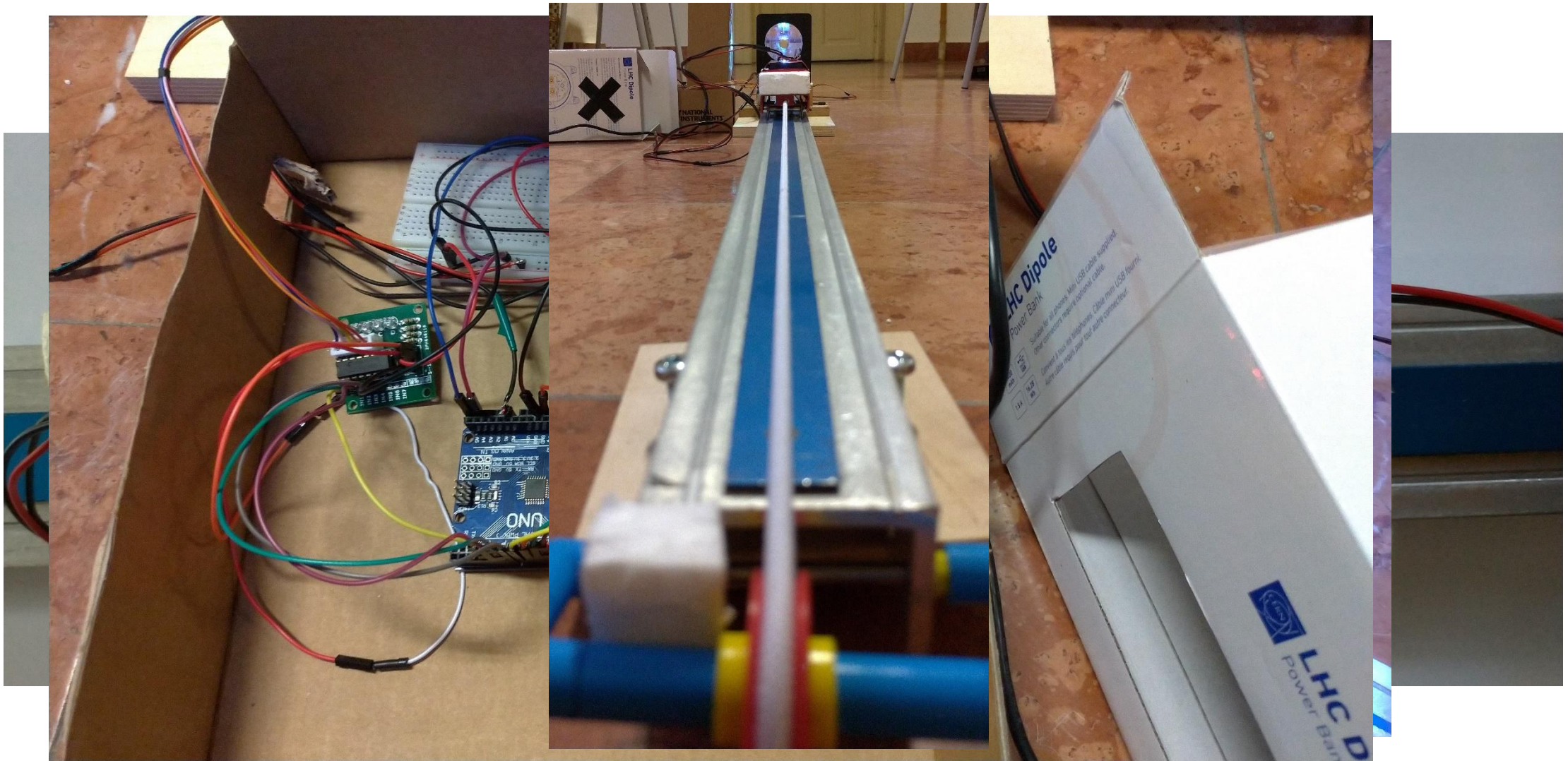
Finding the position of the max intensity (i)

→

Calculating the focal length

Repeat 15 *cm* < o < 60 cm

Determining the focal length with Arduino: the Hardware



„Falling Drops”: measuring with GPS

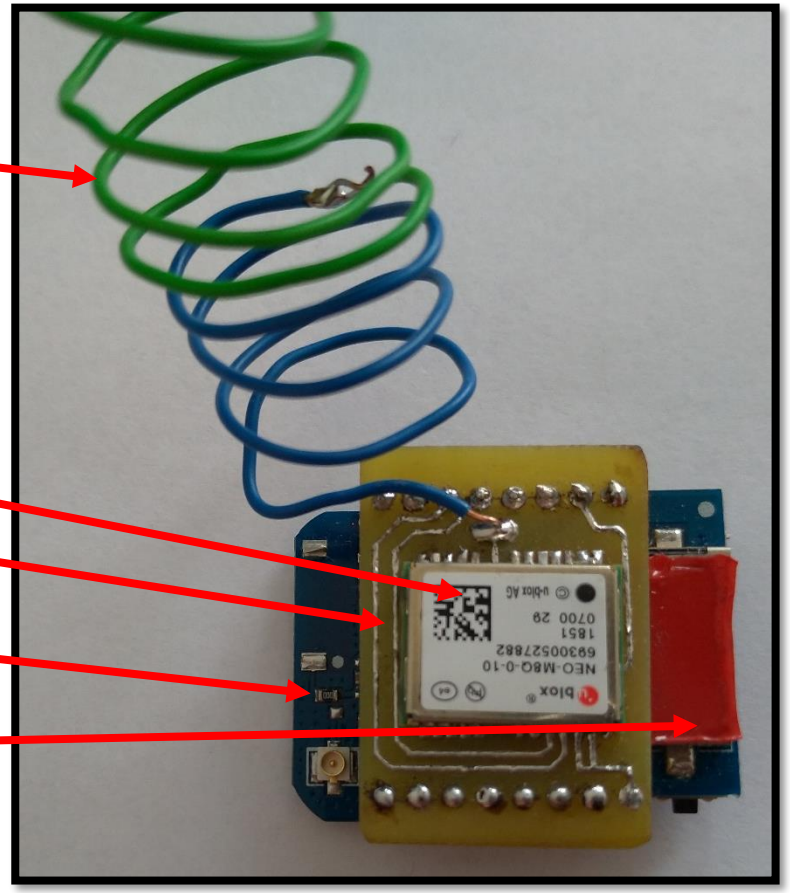
wire antenna

GPS

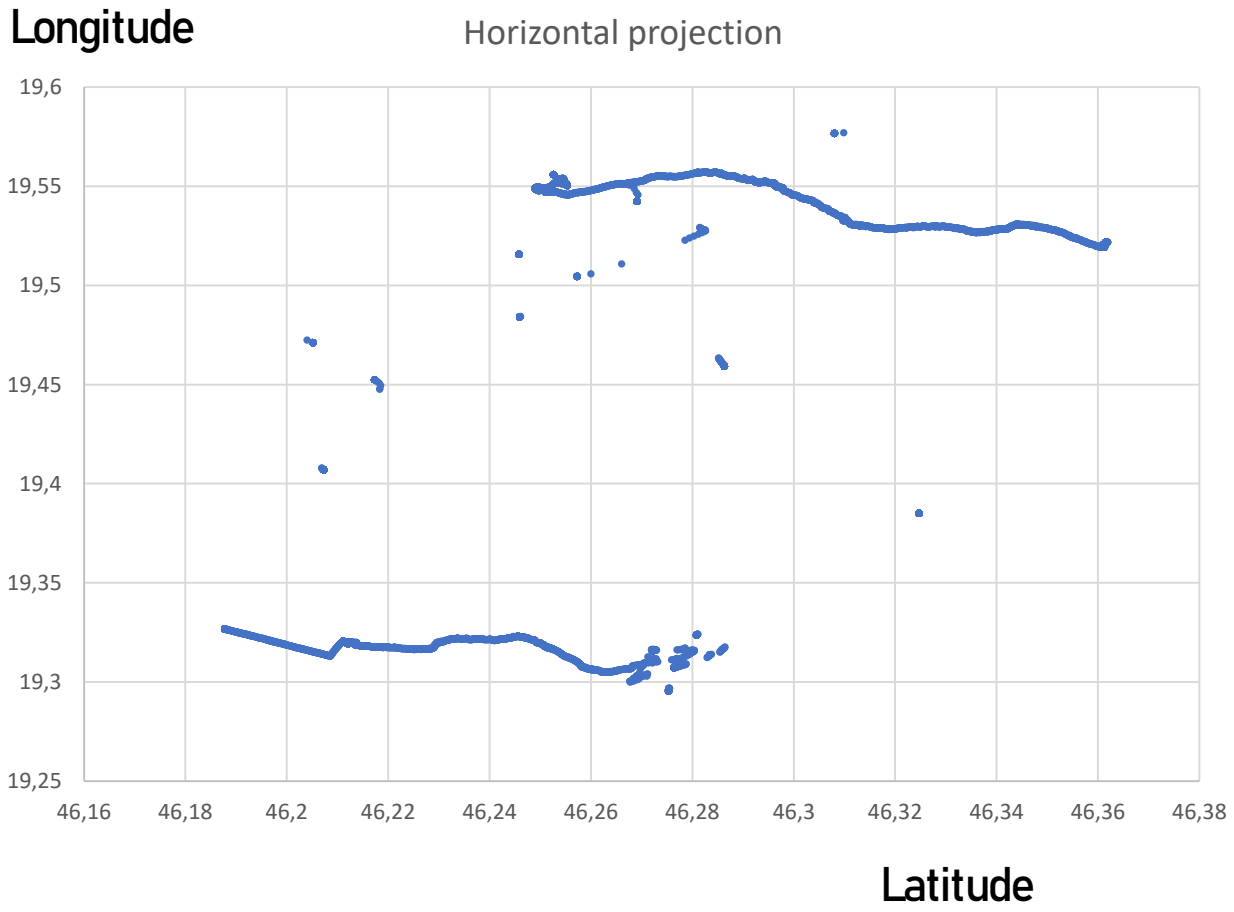
self-made PCB

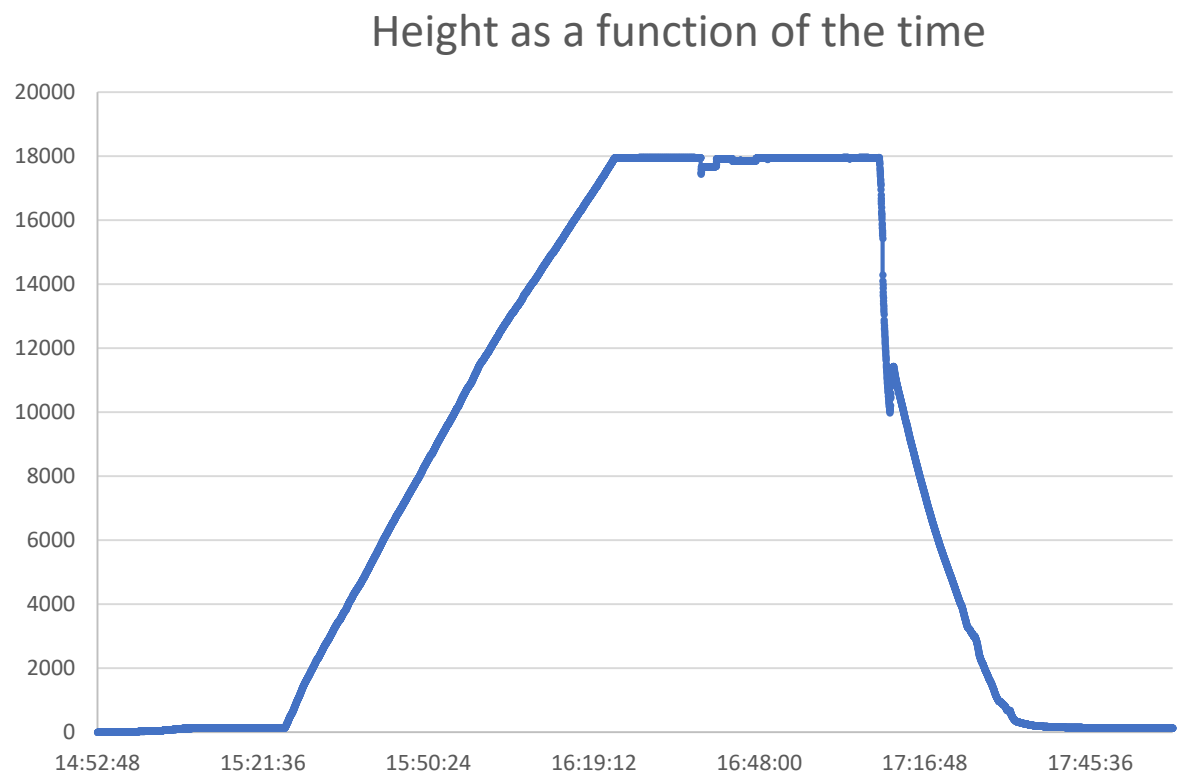
Wemos microcontroller

micro SD card



„Falling Drops”: measuring with GPS





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Thank you!

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- www.noise.inf.u-szeged.hu/edudev/