



Pressure Measurement System

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Special Thanks

- Adviser – Alex Zehnder
- Ilimtiada – Juan Jose
- Eafit University
- Gibic UdeA
- Family, friends, collaborators

CONFIDENTIAL INFORMATION

LEVEL 1
SECURITY
CLEARANCE
REQUIRED

TOP SECRET

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|---|-------------|
| DATE: | ORIGINATOR: |
| SUBJECT: <i>Secret Resource Client Success</i> | |

Confidential

| DATE | ACTION | INITIAL |
|------|---------------------------|---------|
| | ORIGINAL DOCUMENTS | |
| | <i>Resource</i> | |
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Secret

CLASSIFIED

**DO NOT
PHOTOCOPY**

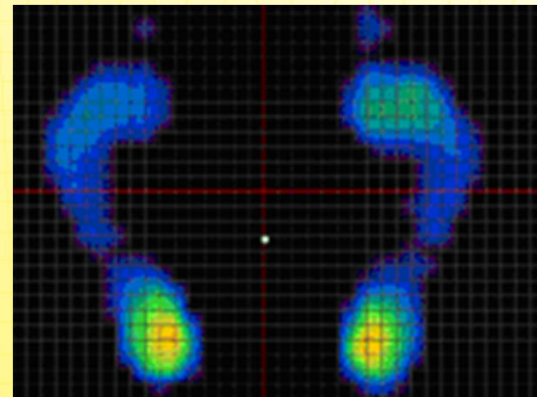
FOR YOUR EYES ONLY

• The information and documents of the project are private and confidential.

What is it about?

“Measure all what is measurable and what is not, make it measurable” – Galileo Galilei

- Biomechanics
- Insole design
- Characterize the step
- Software - Hardware



Context



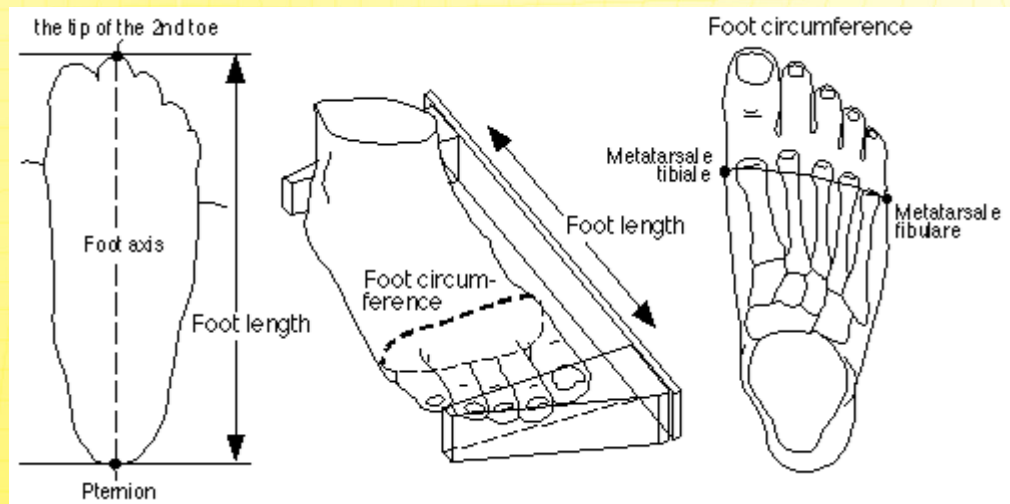
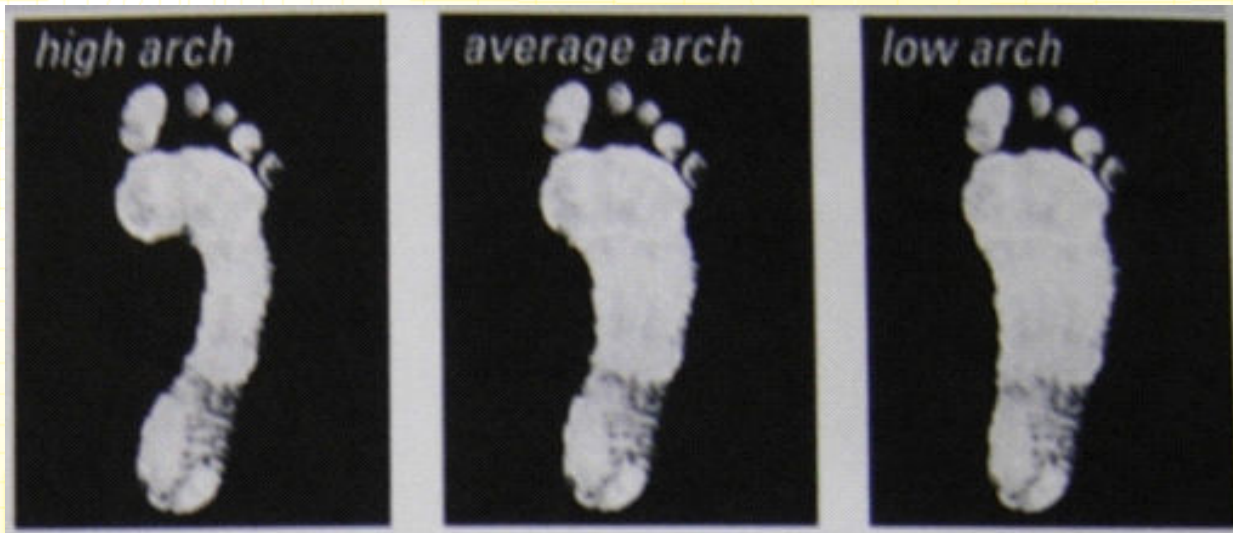
Objective

- Design and build a working prototype of a pressure measurement system for the company ilimitada SA, that at least performs similar to existing systems and that costs less than most of the systems in the market. While studying in eafit and working at ilimitada promote the cooperation between the industry and university doing research.

Target Groups

- Orthopedics and Physiotherapy
- Medics, doctors
- Retailers
- Footwear Industry

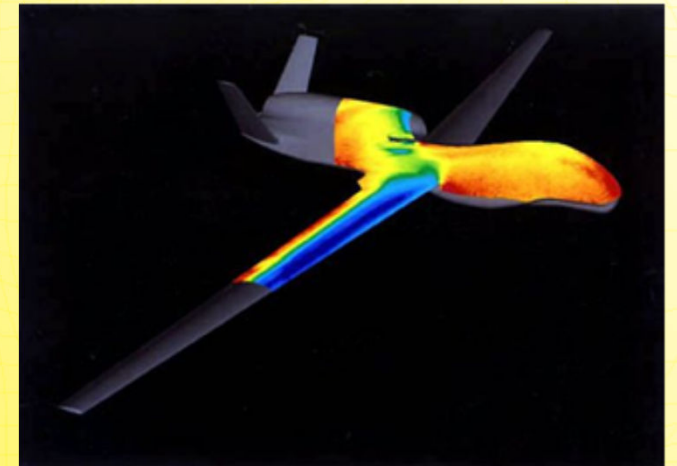
User Anthropometrics



Source:

<http://www.dh.aist.go.jp/research/centered/foot/footdim.php.en>

State of the art

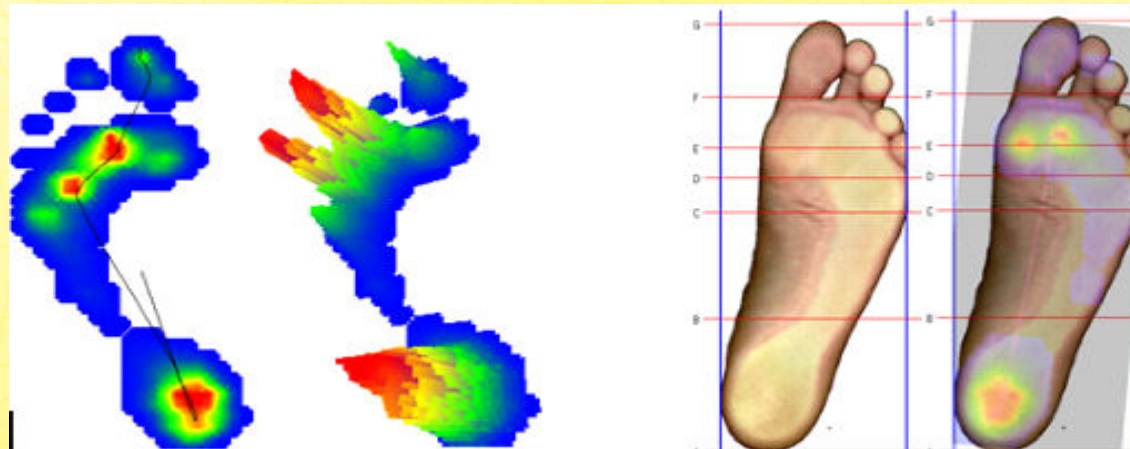




MediSuite

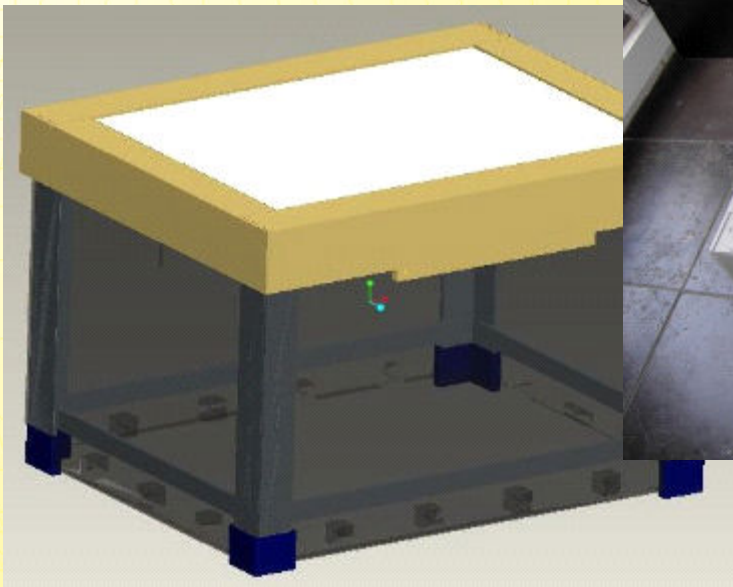


- Software for Gait and Motion analysis
- Pressure and picture analysis
- Force Plate, Camera, Scanner



First Approach – iPlate v1

- Force plate prototype developed in-house
- Image based analysis

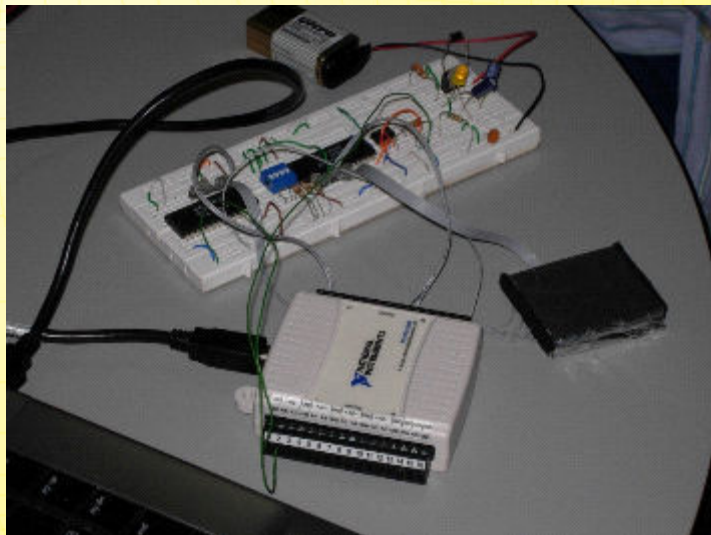
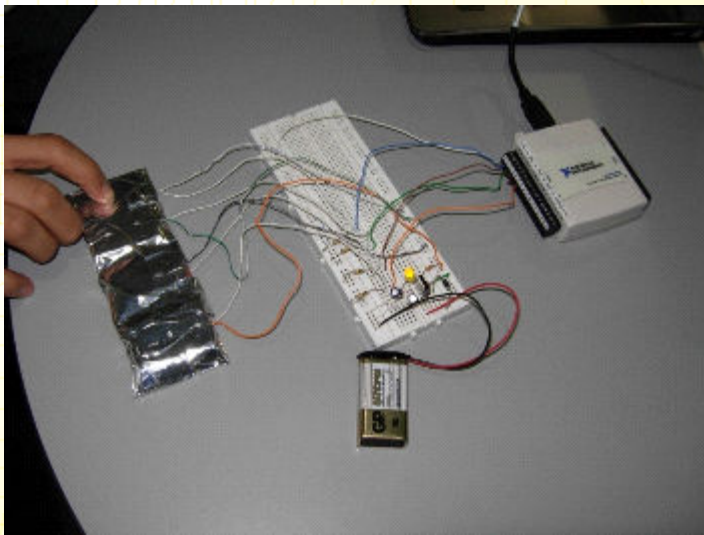


The Team

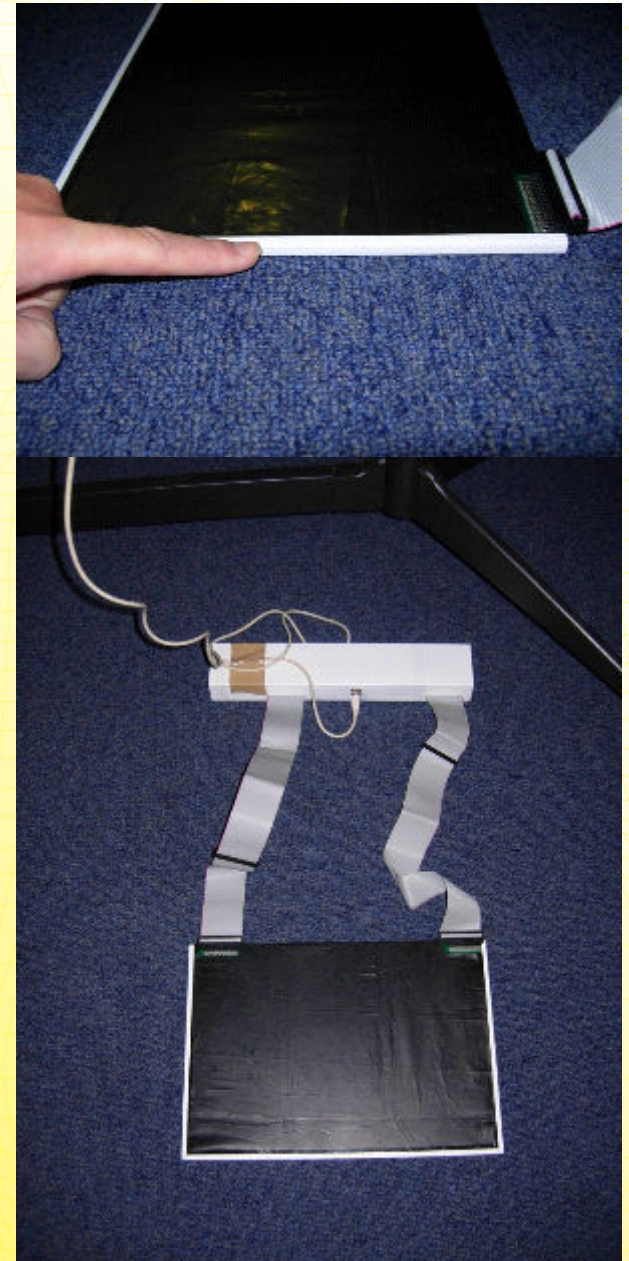
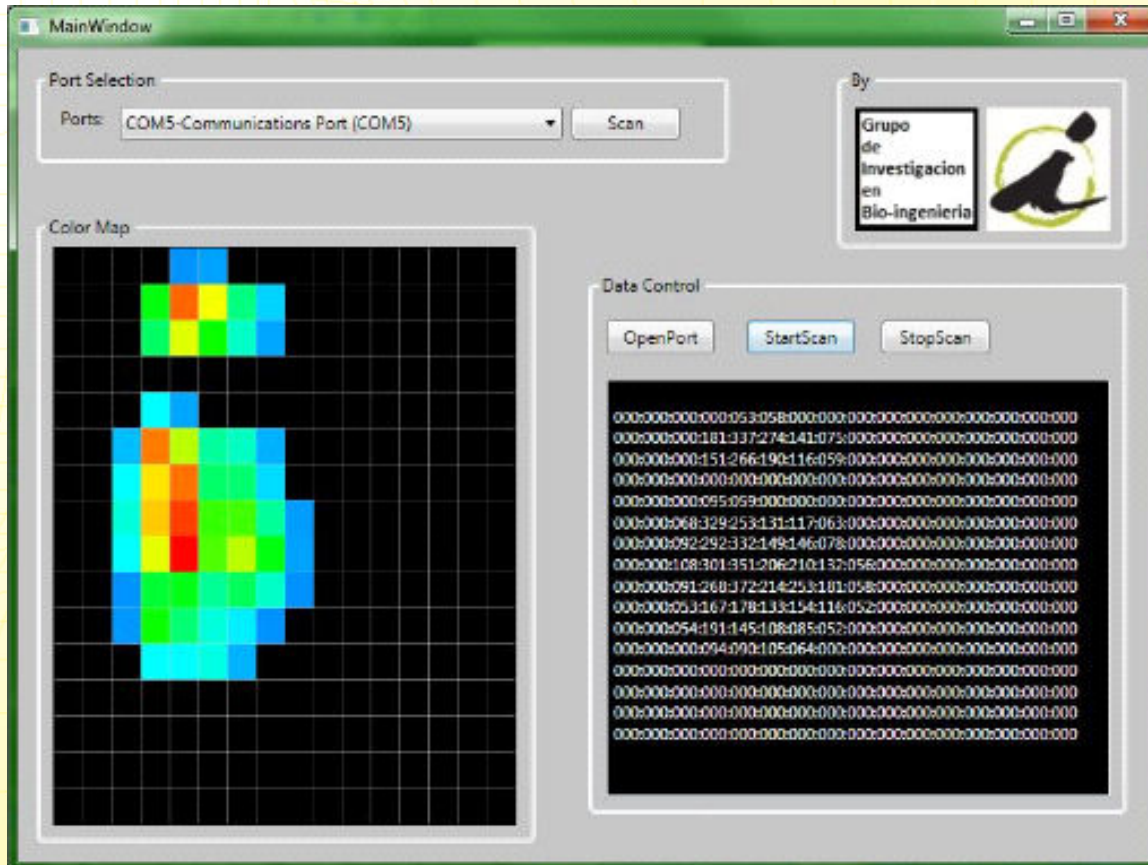
- Juan Camilo Vasquez
- Alez Zehnder
- Juan Diego Lemos
- Mauricio Hernandez
- Johnatan Gallego



Process



Results

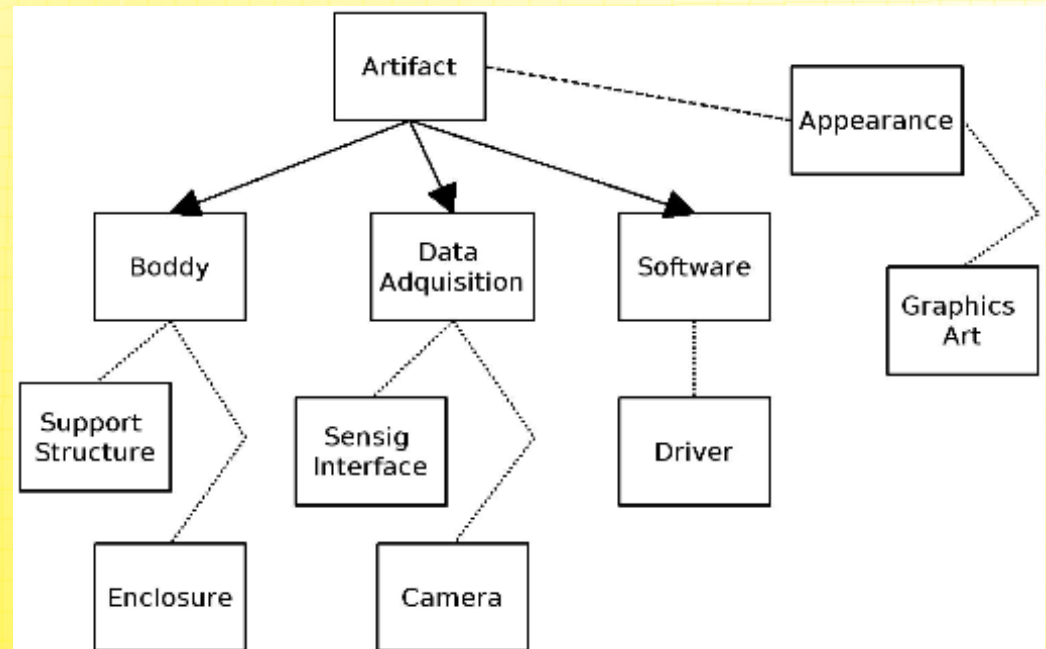


DEMO

DEMO

Secrets: The system

- Divided in 4 main subsystems :
 - sensor technology
 - data acquisition hardware
 - analysis-processing software
 - materials technology

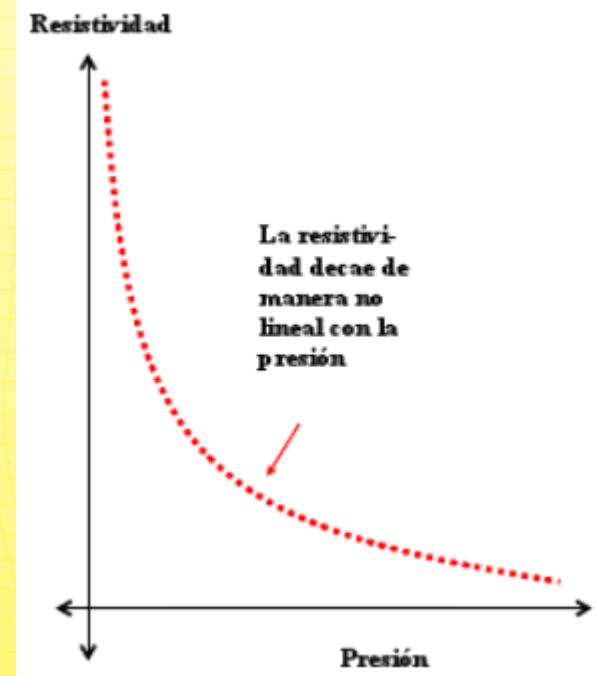
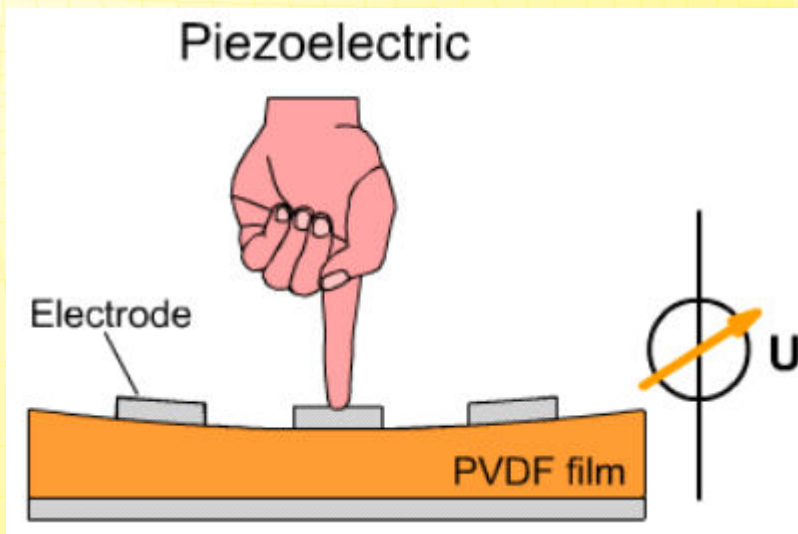
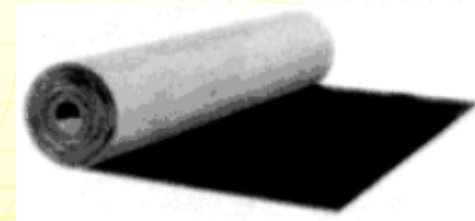


Secrets: Technologies

- Microsoft Visual Studio .Net
- CadSoft Eagle
- Microchip MPLAB
- Microchip Applications Driver
- National Instruments LabVIEW

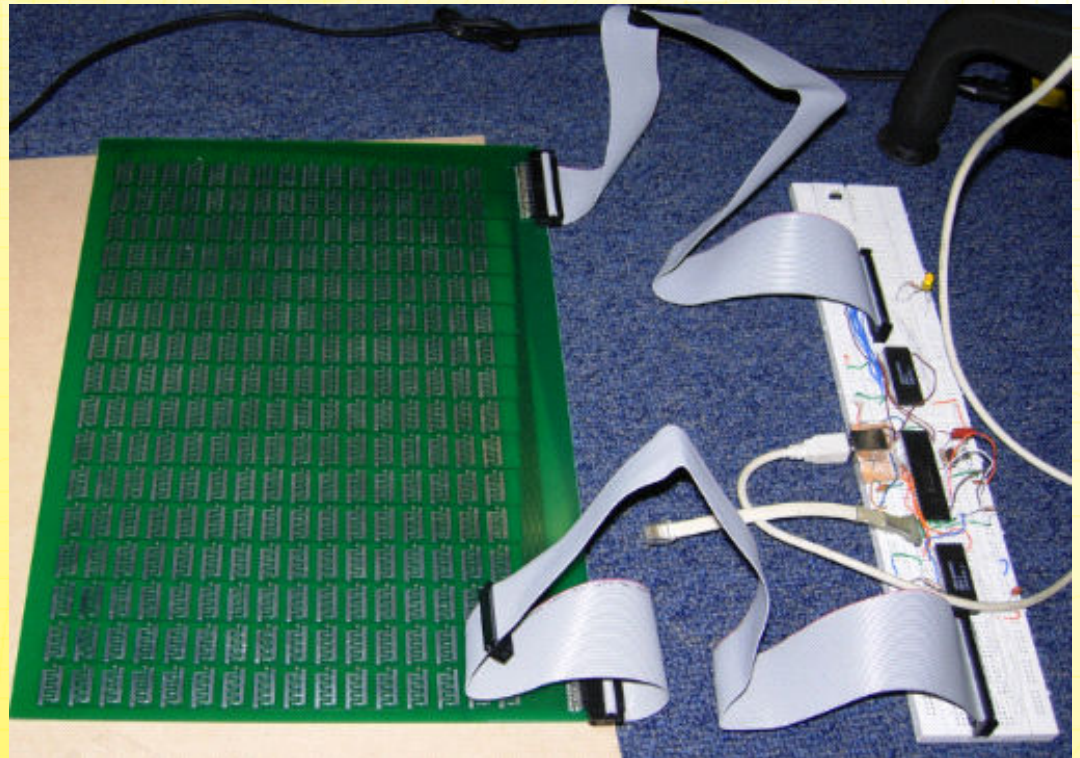
Secrets: the sensors

- Piezoelectric principles
- Conductive sheet for electric field shielding
- Carbon impregnated polyethylene



Secrets: electronics

- 256 (16x16) sensors
- PIC controlled
- Serial to usb
- USB interface
- Multiplexers
- Voltage dividers
- USB powered



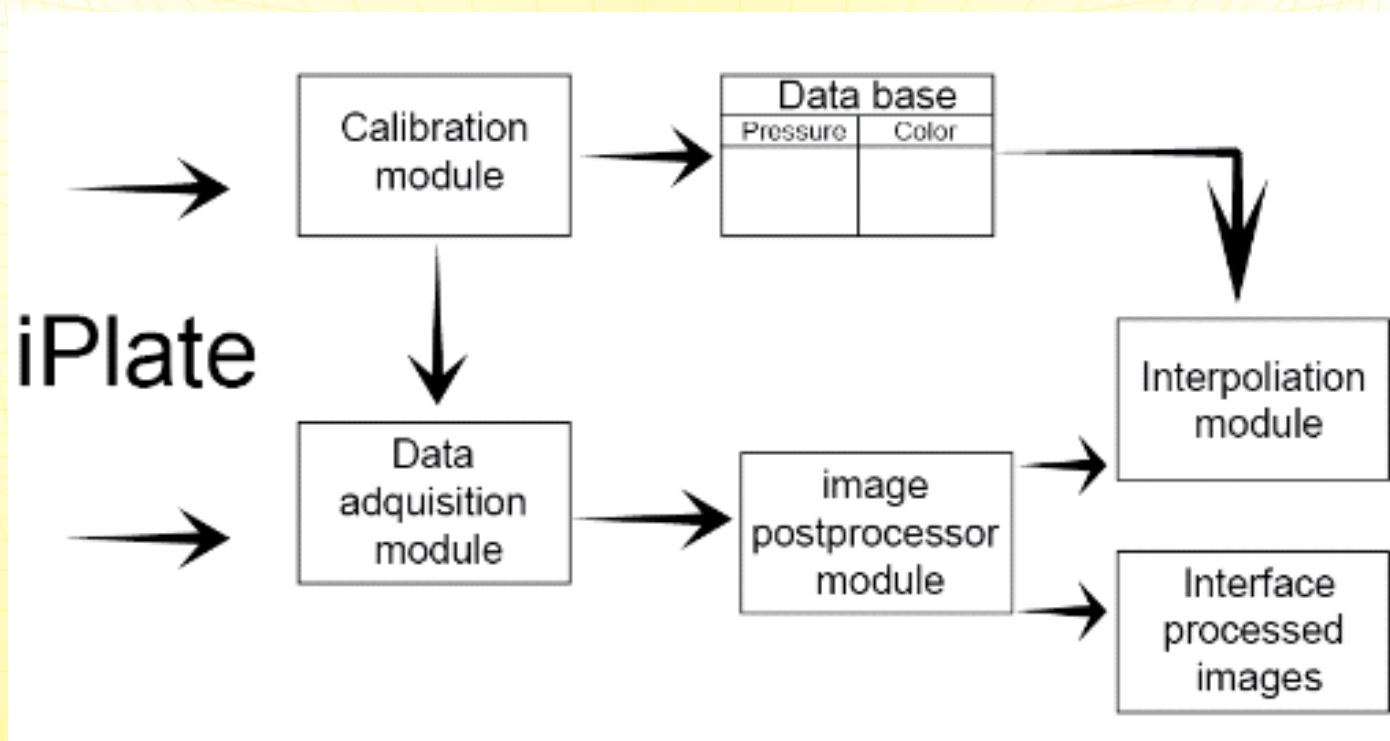
Secrets: communication

- COM port using Microchip driver
- PC sends “@”
- The system sends row back 65 chars:

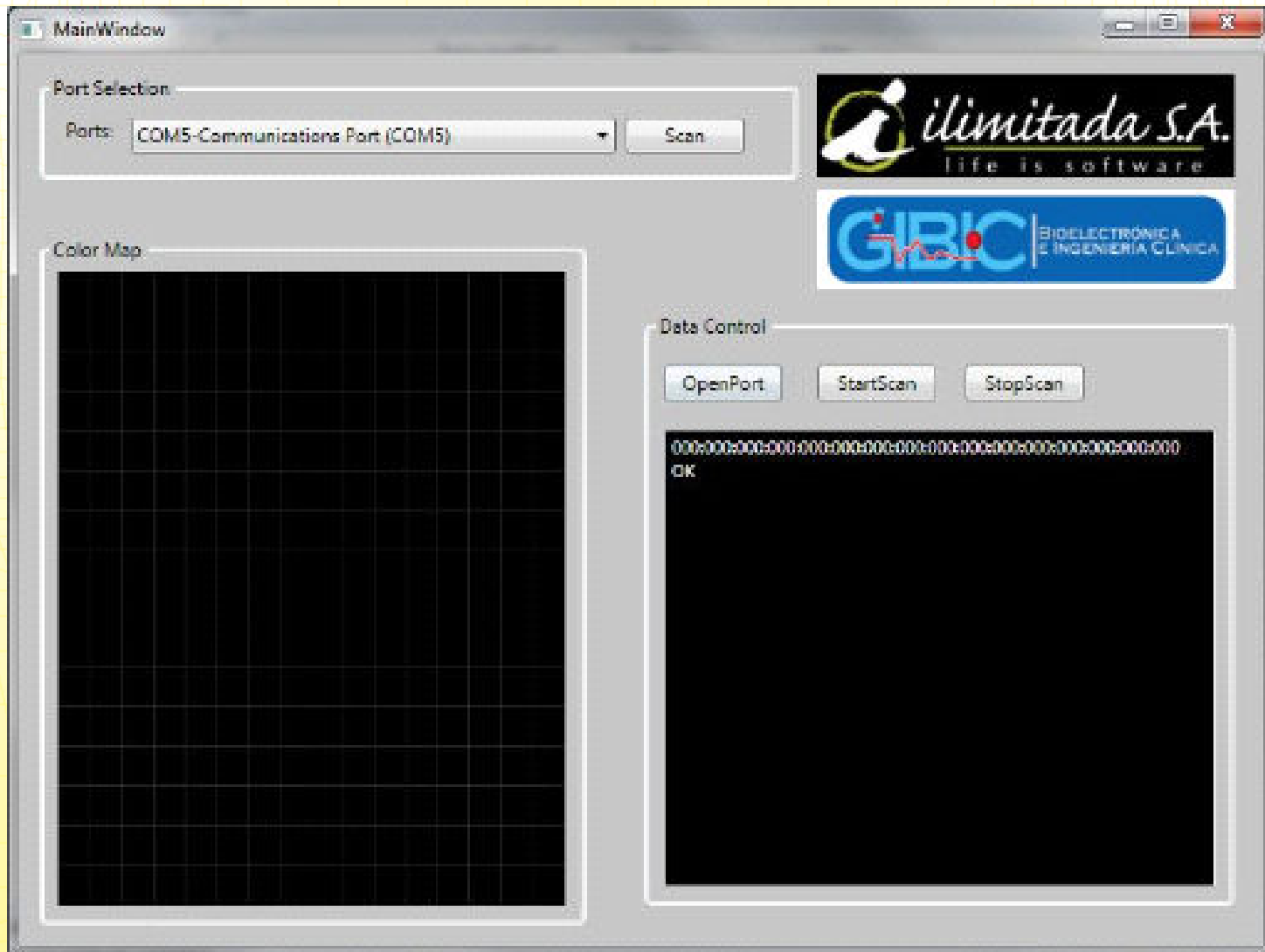
051:700:128:345:788:788:800:549:330:124:780:123:320:234:456:180:null

- Values go from 0-1000
- Ascii encoding
- 16 rows

Secrets: software architecture



Secrets: GUI



Secrets: device/port detection

```
using (var searcher = new ManagementObjectSearcher
    ("SELECT * FROM WIN32_SerialPort"))
{
    string[] portnames = SerialPort.GetPortNames();

    var ports = searcher.Get().Cast<ManagementBaseObject>().ToList();

    var tList = ( from n in portnames
                  join p in ports on n equals p["DeviceID"].ToString()
                  select n + pSeparator + p["Caption"]
                  ).ToList();

    foreach (string port in tList)
    {
        cbx_Ports.Items.Add(port);
    }

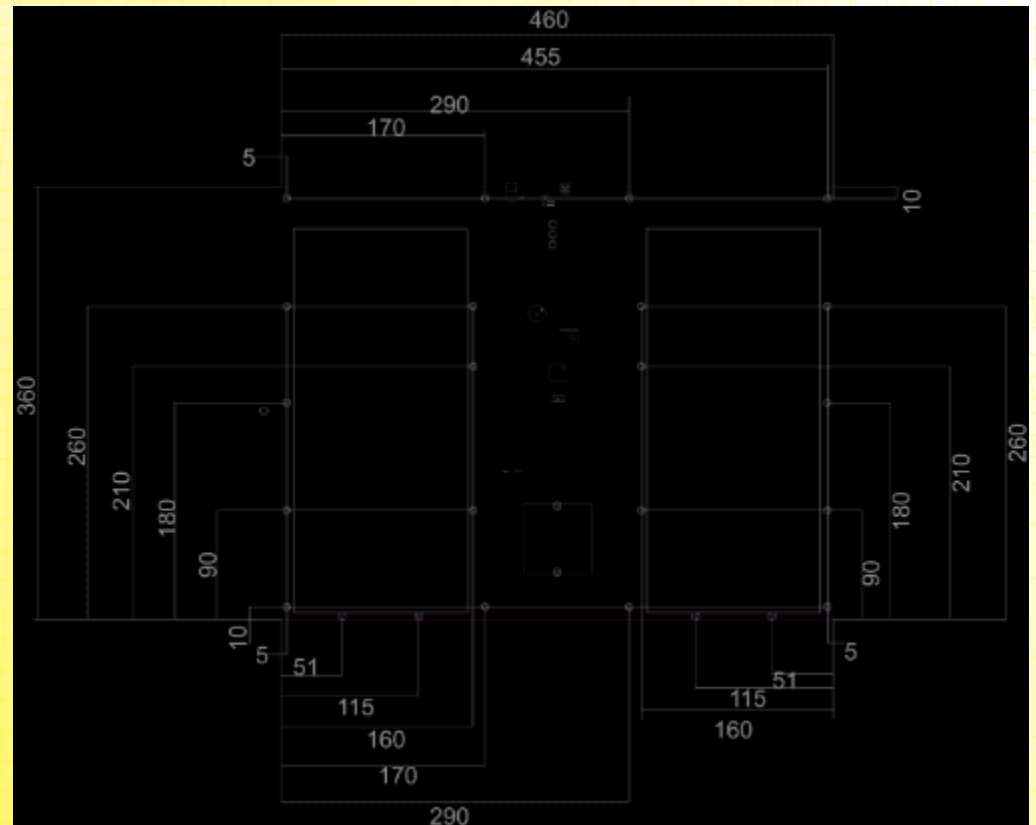
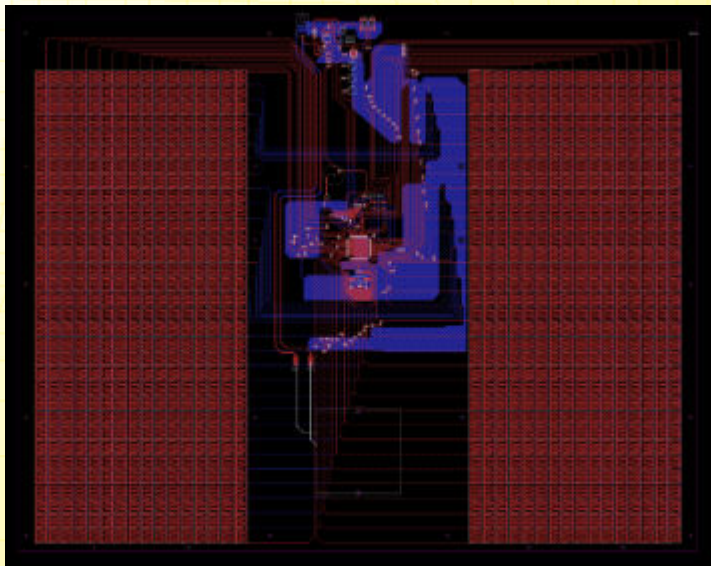
    cbx_Ports.SelectedIndex = 0;
}
```

Secrets: Rainbow function

- Get the weight of that number in the interval [0-255] value
- Calculate the interval
- Null values are painted black
- Find out in which interval it is
- [0-255] When blue is max, ramp up green
- [256-511] When Green is max, ramp down blue to zero
- [512-767] When blue is zero, ramp up red
- [768-1023] When red is max, ramp down green to zero
- Wird things are painted pink

Next steps: Next prototype

- 512 (16 x 32) sensors



Next steps: calibration procedure

- Use a object with known area to contact the force plate top surface and put a known load on top of it; repeat this with several different loads.
- Once all the information is collected there will be a set of load values and a set of corresponding frames.
- Then calculate the pressure for each case using $p = \text{load/area}$, where the area is constant and known for all cases.
- After this analyze the frame and calculate the average color and with these values build a function of pressure values and colors.

Next steps: production

- Need to convert the prototype in a sellable product
- Design and improve manufacture of components
- Find a partner for production
- Get volume discounts

Thank you very much!

Questions???