

Richard Balogh



Digitálne výrobné technológie

Digitálne výrobné technológie

- **Prednášky**
 - FEI, D-208, streda 9:00, **notebooky**
- **Cvičenia**
 - FabLab, streda 11:00, **podklady**
- **Exkurzia**
 - MicroStep Bratislava
 - **MakerFaire Vienna**
- **Projekt**
 - prezentácia, dokumentácia (wiki), **výrobok**

3. - 4. 6. 2023



<https://classroom.google.com>



Google Classroom

vbk7w35

<http://senzor.robotika.sk>



[AP Home](#) | [URPI](#) | [FEI](#) | [STU](#) | [Kontakt](#) | [English](#) | [Vítejte!](#)

| | |
|--|--|
| ZPOC 1 roč. BC Základy počítačov Ďalej... | ELSA 1 roč. BC AMT Elektronické systémy automobilov Ďalej... |
| NAVEZ 3. roč. BC Návrh elektronických zariadení Ďalej... | MISA 1 roč. IVIG MEMS Inteligentné senzory a aktuatory Ďalej... |
| AJ Ty v IT 2018 Workshopy AJ Ty v IT Ďalej... | DVT 2018 Digitálne výrobné technológie Ďalej... |
| SS CIM 1 roč. ING ROB Senzorové systémy CIM Ďalej... | WIKI (privátne) Tvorba dokumentácie Viac... |
| PKS 3. roč. BC Priemyselné komunikačné systémy Ďalej... | MMP 2010 Monolitické mikropočítače Ďalej... |
| DVPS 1 roč. ING APMA Distribúované vnorené počítačové systémy Ďalej... | Vyskum Projekty, publikácie... Viac... |
| Robotika (robotika) 3 roč. Bc. Cvičenia | Ludia Oddelenie automobilovej elektroniky, mikropočítačov a PLC systémov Viac... |

Tento server bol v rokoch 2015-17 prevádzkovaný a informačným obsahom plnený z prostriedkov projektu **KEGA 011STU-4/2015** s názvom Elektronické pedagogicko-experimentálne laboratóriá mechatroniky
Icon google car by Sheerford from the Neun Project

(c) 2017, UAMT FEI STU [Homepage](#) [Power status \(UPS\)](#) [Network Printer](#) [Manual](#) [Contact Us](#) [Q serveri](#)



Fablab Ilkovičova



Hľadáš iný Fablab?

← Vráť ma späť

Zoznam úloh (hodnotenie)

3T: nálepka alebo tričko – vinyl cutter

5T: prívesok – laser cutter

7T: minca, figúrka – 3D tlačiareň

9T: elektronický projekt

12T: Záverečná prezentácia projektu
(prezentácia, dokumentácia a hotový výrobok)

+ Priebežné tvorivé úlohy

Harmonogram

- **P1: úvod**
 - C1: FabLab: prehliadka a zoznámenie s priestormi
- **P2: elektronika (notebook)**
 - C2: FEI: schéma a plošný spoj
- **P3: bitmapy/vektory, rezanie (notebook)**
 - C3: FabLab: nálepka / tričko (10x10 cm)
- **P4: laser, materiály (notebook)**
 - C4: FabLab: prívesok (5x5 cm)

10,- € príspevok na materiál

Richard Balogh



Jozef Vaško

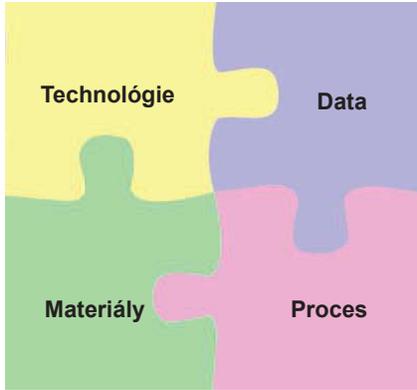


Kto?

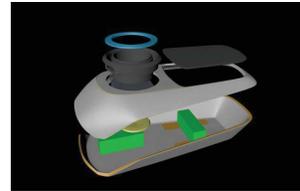
Prednášateľ: **Ing. Richard Balogh, PhD.**
miestnosť: D-110
mail: balogh@elf.stuba.sk
nepoužívajte ais na mail

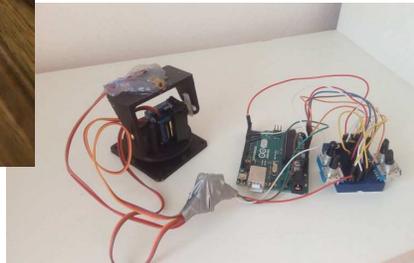
- Jozef Vaško
Pavol Krajčík, Terka Kaliňáková,... = FabLab
- A kto ste vy? Čo tu chcete?

Študoval rádioelektroniku na Technickej univerzite v Košiciach. Pracoval v Ústave merania a meracej techniky SAV. Bol odborný zamestnanec novovzniknutého Ústavu pre výskum a vývoju zdravotných systémov Chirany v Bratislave. Od roku 1990 zmenil pracovisko a venoval sa projektovaniu a realizácii počítačových sietí a informačných systémov. O rok neskôr založili s kolegami akciovú spoločnosť, ktorej bol súčasne akcionár aj zamestnanec. Od roku 2013 je v Centre vedekotechnických informácií (CVTI) v Bratislave. Od novembra 2014 má na starosti prevádzku dielne Fablab.



<https://techbox.dennikn.sk/ploche-obrazovky-v-autach-coskoro-nahrada-tvarovane-displeje/>

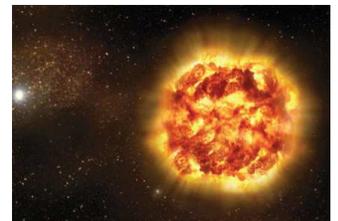
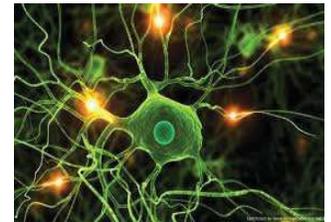
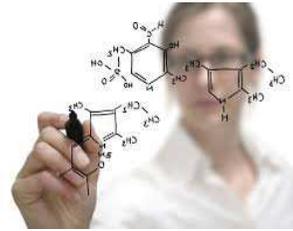




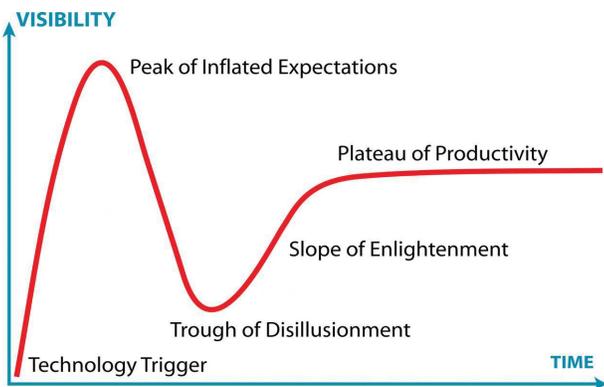
Gartner Top 10 Strategic Technology Trends for 2015

Forbes

- 1 **Merging the Real World and the Virtual World**
Computing Everywhere, The Internet of Things, 3D Printing
- 2
- 3
- 4 **Intelligence Everywhere**
Advanced, Pervasive and Invisible Analytics, Context-Rich Systems, Smart Machines
- 5
- 6
- 7 **The New IT Reality Emerges**
Cloud/Client Computing, Software-Defined Applications and Infrastructure, Web-Scale IT, Risk-Based Security and Self-Protection
- 8
- 9
- 10



Hype Cycle



Google Glass is Dead...For Now
By Aaron Marmik, Tech Times | January 21, 9:15 AM

3-D TV is Officially Dead (For Now) and This is Why it Failed
By Stephen Cass, Posted 7 Jan 2014 | 22:09 GMT

The Death Of The QR Code
Aaron Stroud on April 4, 2013 at 9:00 am

Rest in Peace Deceased SO...
Eric Wesoff, April 6, 2013

Three reasons why the Semantic Web has failed
Nov. 3, 2013 - 10:30 AM PST

Goodbye, Google Reader
"We launched Google Reader in 2005 in an effort to help people keep tabs on their favorite websites... usage has declined..."

Google
Google's announcement that it is withdrawing the company's Glass from the market for now may mark a humbling retreat by the company in its development of the much-ridiculed smart glasses.

Google
Google previously announced that the device will be graduating from the company's research arm, Google X, into its own... Google. In addition, Glass head by Ross will now... Tony Fadell, the founder of now Google... company who helped in the design of the iPod.

Google
Google stopped selling the current... Jan. 19, effectively ending the Experi...

Google
people to discover and... lowing, over the years... - Google, March 2013.

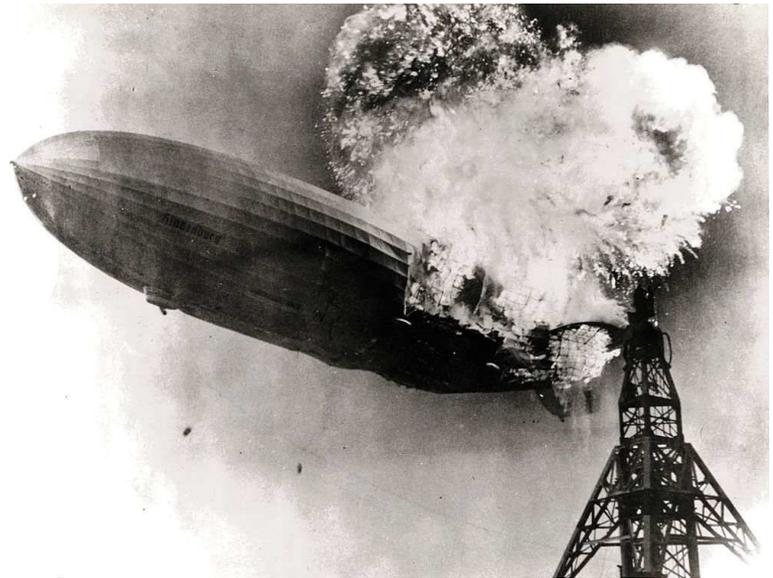
Google
The sad, inevitable... results of the VC... bubble and solar... shakeout

Google
When was the last time you scanned a QR code? Be honest. If it were hooked? Yes, that was a rhetorical question because I can't name a... that there is research that shows that an inc... what I haven't been able to find are... that.

3D TV



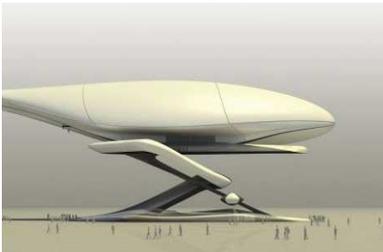
Virtual reality



Iridium



HD DVD



Top 10 Strategic Technology Trends

- 1 Computing Everywhere
- 2 The Internet of (any)Things
- 3 3D Printing
- 4 Advanced, Pervasive, Invisible Analytics
- 5 Context-Rich Systems
- 6 Smart Machines
- 7 Cloud/Client Architecture
- 8 Software-Defined Infrastructure and Applications
- 9 Web-Scale IT
- 10 Risk-Based Security and Self-Protection

Digitálna výroba



Analógový



Robert Kaliňák, 30. 5. 2016. Zdroj: Dennik N, <https://dennikn.sk/473801/kalinak-basternakovi-klame/>

$$\text{CIM} = \text{CAD} + \text{CAE} + \text{CAP} + \text{CAM} + \text{CAQ}$$

Počítačom podporované...

- CAD** – Computer Aided Design – ... návrh, konštrukčná príprava výroby
- CAE** – Computer Aided Engineering – ... vývoj (výpočty, simulácie)
- CAP** – Computer Aided Planning – ... plánovanie, technologická príprava výroby (technologické postupy, NC programovanie)
- CAM** – Computer Aided Manufacturing – ... výroba (CNC, DNC) podpora riadenia výrobných strojov a robotov
- CAQ** – Computer Aided Quality - ...riadenia kvality výroby (analýza porúch, systémy kvality)
- CAT – Computer Aided Testing – testovanie funkcií výrobkov, kontrolných meraní
- CAA – Computer Aided Assembly – uplatnenie pri montáži a expedícii výrobkov
- CAST – Computer Aided Storage and Transport - doprava a skladovanie
- CAO – Computer Aided Office – podpora evidencie a obehu elektronických dokladov

Digitálne revolúcie



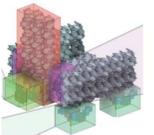
analog → digital communication



analog → digital computation



analog → digital fabrication



Univerzálna skladačka

ako vyrobiť hocičo

LEGO
3D tlač
Integrované obvody / CMOS



Chrám sv. Anny, Vilnius, Litva (r. 1500)



Radnice Prostějov, T. Lázná, VUT Brno (2022)

3D tlač



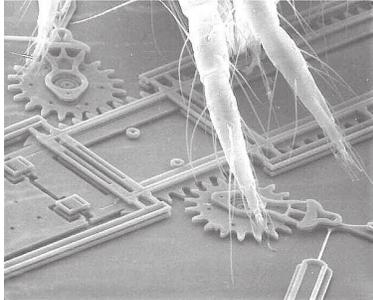
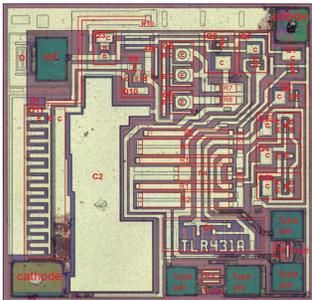
<https://www.3dwasp.com/en/3d-printed-house-tecla/>



PRINTABLE SCENERY © www.printablescenery.com

MEMS Micro-electro-mechanical systems

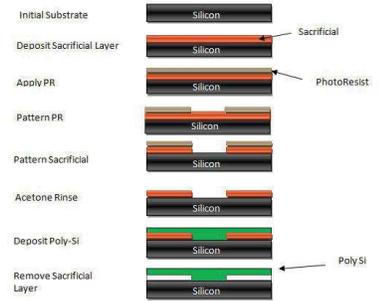
je označenie samotnej technológie ako aj produktov vyrobených technológiou podobnou výrobe integrovaných obvodov



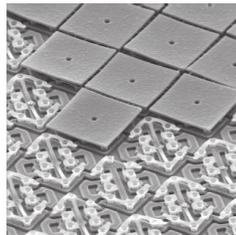
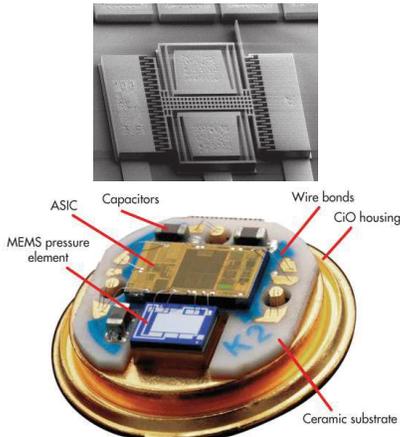
MEMS Micro-electro-mechanical systems



- Nanesenie fotocitlivej krycej vrstvy
- Osvit
- Vyvolanie fotocitlivej vrstvy
- Omývanie
- Leptanie
- Čistenie
- Puzdrenie



MEMS – inteligentný senzor a aktuátor



Máme problém...

$1 \text{ meter}^3 \text{ build volume} / 1 \text{ mm}^3 \text{ voxel} = 10^9 \text{ voxels}$

ink-jet printing = $10^4 \text{ drops/second}$

$10^9 \text{ parts} / 10^4 \text{ parts/sec} = \sim \text{day}$

$0.1 \text{ mm}^3 \text{ parts} = \sim 3 \text{ years}$

$1 \text{ micron}^3 \text{ parts} = \sim 3 \text{ million years}$

ink-jet head: $\sim 10^3 \text{ nozzles}$

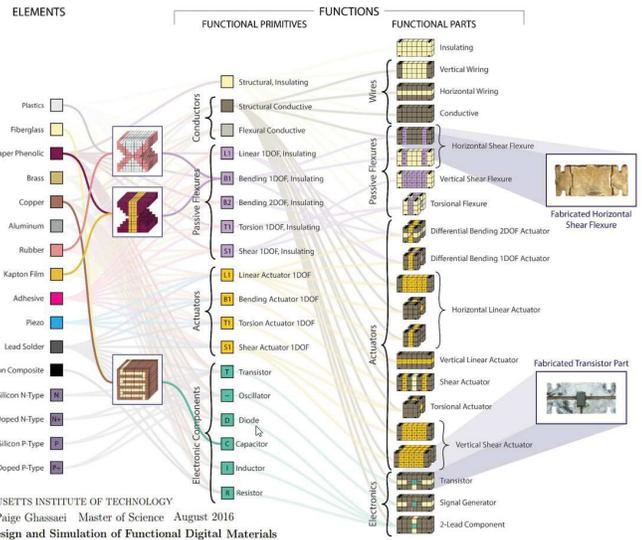
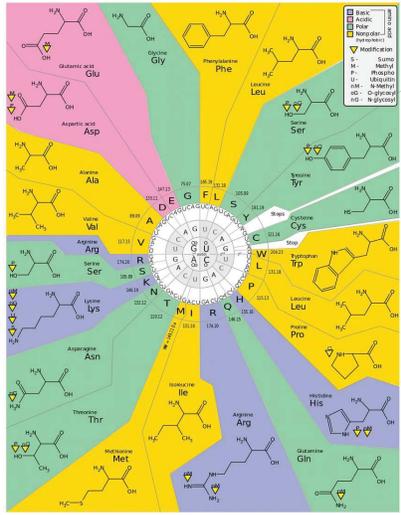
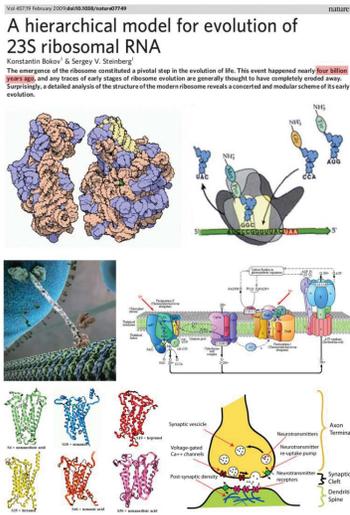
$3 \text{ million years} / 1000 = 3000 \text{ years}$

ribosome = $\sim 1 \text{ amino acid/second}$

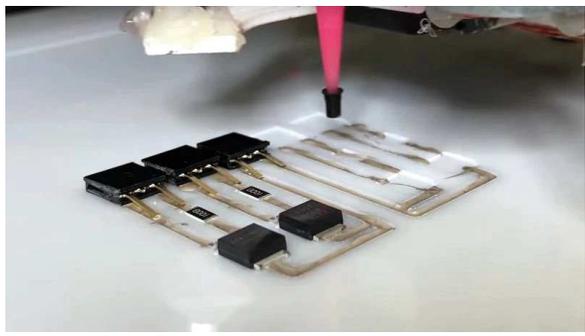
$\sim 10^5 \text{ ribosomes/cell}$

$\sim 10^{13} \text{ cells/body}$

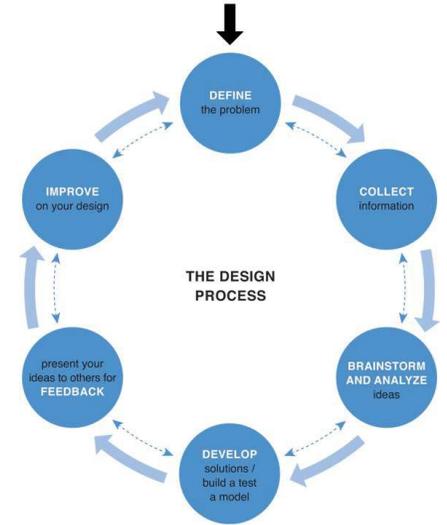
$10^{18} \text{ parts} = \sim 1 \text{ second}$



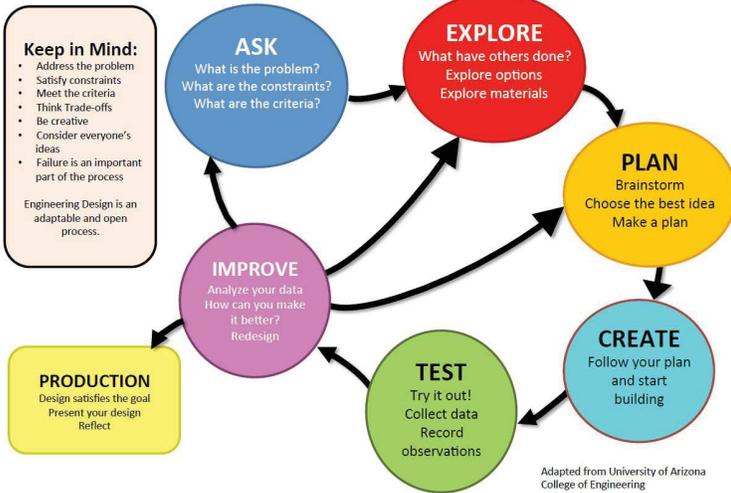
LaserFactory: An Electromechanical Assembly and Fabrication Platform Integrated with a Laser Cutter to make Functional Devices and Robots.



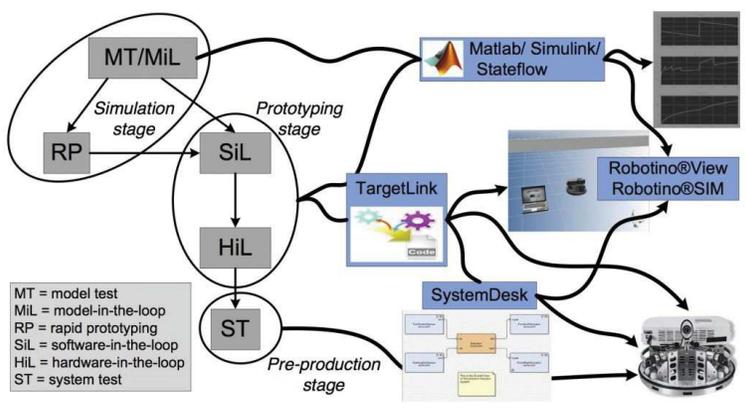
<https://hcie.csail.mit.edu/research/laserfactory/laserfactory.html>
<https://youtu.be/RzCAqVwZYCc>



Engineering Design Process



Model driven design



Projekty



**Connected
Cocktail
Machine**
Grand Prize winner of the
Elektor/Espressif ESP32
contest

By Quentin Therond (France)

<https://www.elektormagazine.com/labs/connected-cocktail-machine>



2. JSON table of cocktails

```

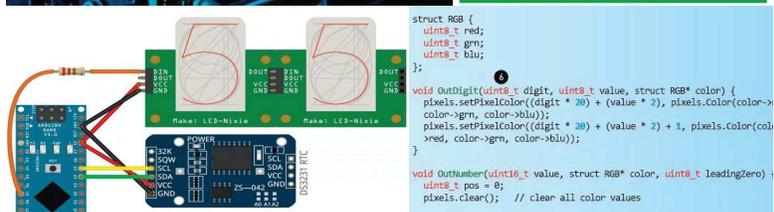
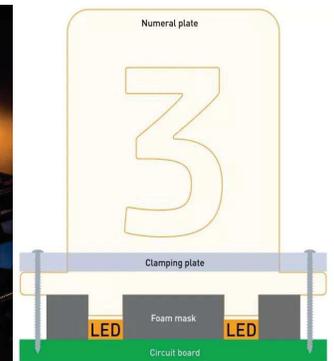
"tails": [
  "cocktail": {
    "name": "sirop de menthe",
    "ingredients": [
      "ingredient": {
        "name": "menthe",
        "measure": 1
      }
    ],
    "ingredient": {
      "name": "eau",
      "measure": 5
    }
  }
]

```



LED "Nixie" Display

<https://makezine.com/projects/led-nixie-display/>



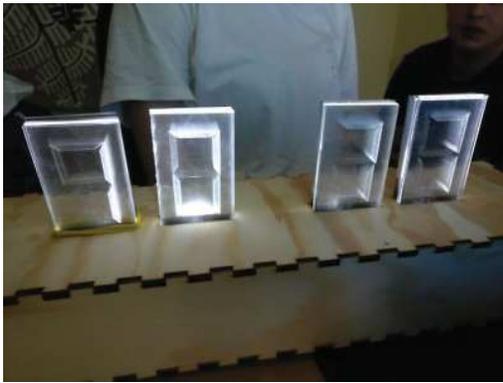
```

struct RGB {
  uint8_t red;
  uint8_t grn;
  uint8_t blu;
};

void OutDigit(uint8_t digit, uint8_t value, struct RGB* color) {
  pixels.setPixelColor((digit * 20) + (value * 2), pixels.Color(color->grn, color->blu));
  pixels.setPixelColor((digit * 20) + (value * 2) + 1, pixels.Color(color->red, color->grn, color->blu));
}

void OutNumber(uint16_t value, struct RGB* color, uint8_t leadingZero) {
  uint8_t pos = 0;
  pixels.clear(); // clear all color values
}

```



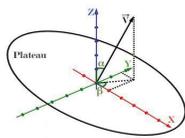
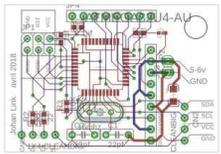
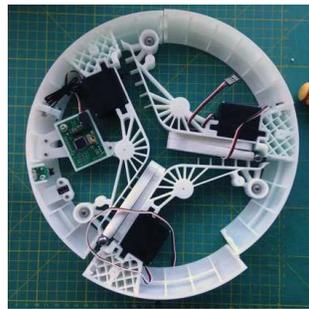
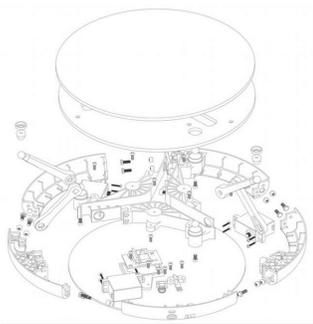
Adriána Selepová, Oliver Lachkovič

Ball Balancing PID System

by Johan Link



<https://www.instructables.com/id/Ball-Balancing-PID-System/>



| Modulo | Attivo in senso orario | Attivo in senso antiorario |
|--------|------------------------|----------------------------|
| 1 | 100 | 100 |
| 2 | 100 | 100 |
| 3 | 100 | 100 |
| 4 | 100 | 100 |
| 5 | 100 | 100 |
| 6 | 100 | 100 |
| 7 | 100 | 100 |
| 8 | 100 | 100 |
| 9 | 100 | 100 |
| 10 | 100 | 100 |
| 11 | 100 | 100 |
| 12 | 100 | 100 |
| 13 | 100 | 100 |
| 14 | 100 | 100 |
| 15 | 100 | 100 |
| 16 | 100 | 100 |
| 17 | 100 | 100 |
| 18 | 100 | 100 |
| 19 | 100 | 100 |
| 20 | 100 | 100 |
| 21 | 100 | 100 |
| 22 | 100 | 100 |
| 23 | 100 | 100 |
| 24 | 100 | 100 |
| 25 | 100 | 100 |
| 26 | 100 | 100 |
| 27 | 100 | 100 |
| 28 | 100 | 100 |
| 29 | 100 | 100 |
| 30 | 100 | 100 |
| 31 | 100 | 100 |
| 32 | 100 | 100 |
| 33 | 100 | 100 |
| 34 | 100 | 100 |
| 35 | 100 | 100 |
| 36 | 100 | 100 |
| 37 | 100 | 100 |
| 38 | 100 | 100 |
| 39 | 100 | 100 |
| 40 | 100 | 100 |
| 41 | 100 | 100 |
| 42 | 100 | 100 |
| 43 | 100 | 100 |
| 44 | 100 | 100 |
| 45 | 100 | 100 |
| 46 | 100 | 100 |
| 47 | 100 | 100 |
| 48 | 100 | 100 |
| 49 | 100 | 100 |
| 50 | 100 | 100 |
| 51 | 100 | 100 |
| 52 | 100 | 100 |
| 53 | 100 | 100 |
| 54 | 100 | 100 |
| 55 | 100 | 100 |
| 56 | 100 | 100 |
| 57 | 100 | 100 |
| 58 | 100 | 100 |
| 59 | 100 | 100 |
| 60 | 100 | 100 |
| 61 | 100 | 100 |
| 62 | 100 | 100 |
| 63 | 100 | 100 |
| 64 | 100 | 100 |
| 65 | 100 | 100 |
| 66 | 100 | 100 |
| 67 | 100 | 100 |
| 68 | 100 | 100 |
| 69 | 100 | 100 |
| 70 | 100 | 100 |
| 71 | 100 | 100 |
| 72 | 100 | 100 |
| 73 | 100 | 100 |
| 74 | 100 | 100 |
| 75 | 100 | 100 |
| 76 | 100 | 100 |
| 77 | 100 | 100 |
| 78 | 100 | 100 |
| 79 | 100 | 100 |
| 80 | 100 | 100 |
| 81 | 100 | 100 |
| 82 | 100 | 100 |
| 83 | 100 | 100 |
| 84 | 100 | 100 |
| 85 | 100 | 100 |
| 86 | 100 | 100 |
| 87 | 100 | 100 |
| 88 | 100 | 100 |
| 89 | 100 | 100 |
| 90 | 100 | 100 |
| 91 | 100 | 100 |
| 92 | 100 | 100 |
| 93 | 100 | 100 |
| 94 | 100 | 100 |
| 95 | 100 | 100 |
| 96 | 100 | 100 |
| 97 | 100 | 100 |
| 98 | 100 | 100 |
| 99 | 100 | 100 |
| 100 | 100 | 100 |

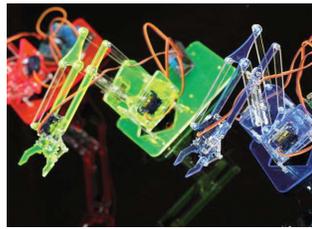
SMART CITIZEN KIT URBAN SENSING AMBIENTAL MONITORING

- + Data-Processing Board with Wifi connectivity
- + Arduino compatible
- + Ambient Board
- + SCK enclosure
- + SCK Solar panel charger
- + Free web platform registration
- + iOS application for SCK
- + Private RESTful API Key
- + Online Forum
- + Online Documentation

SENSOR BOARD

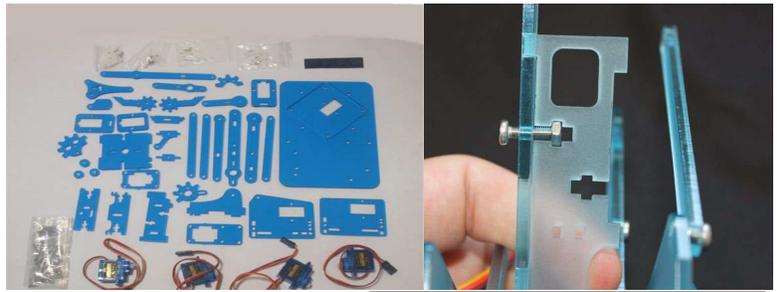
www.smartcitizen.me





<https://www.thingiverse.com/thing:298820>

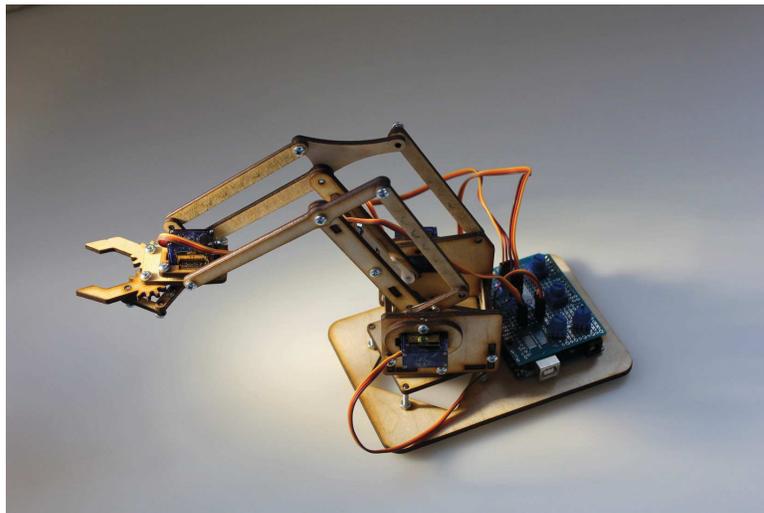
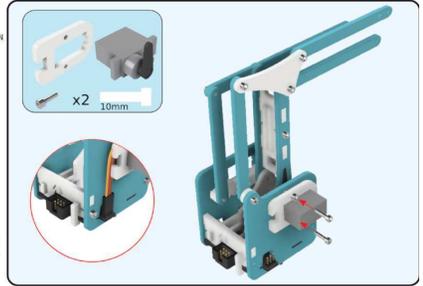
<https://www.instructables.com/id/MeArm-Bu>



```

8 MeArm:MeArm()
9   mainInstance = this;
10  setServoPins(MEARM_DEFAULT_BASE_PIN, MEARM_DEFAULT_LOWER_PIN);
11  marcel.addCmd("moveJointsTo", _moveJointsTo, false);
12  marcel.addCmd("moveBaseTo", _moveBaseTo, false);
13  marcel.addCmd("moveLowerTo", _moveLowerTo, false);
14  marcel.addCmd("moveUpperTo", _moveUpperTo, false);
15  marcel.addCmd("moveGripTo", _moveGripTo, false);
16  marcel.addCmd("openGrip", _openGrip, false);
17  marcel.addCmd("closeGrip", _closeGrip, false);
18  marcel.addCmd("getServoState", _getServoState, true);
19  marcel.addCmd("version", _version, true);
20  marcel.addCmd("pause", _empty, true);
21  marcel.addCmd("resume", _empty, true);
22  marcel.addCmd("stop", _empty, true);
23  #ifdef ESP8266
24  marcel.addCmd("updateFirmware", _updateFirmware, true);
25  marcel.addCmd("updateUI", _updateUI, true);
26  #endif //ESP8266
27

```



Wearable



Rekapitulácia

- P1: úvod
 - C1: FabLab: prehliadka a zoznámenie s priestormi
- P2: elektronika (**notebook**)
 - C2: FEI: schéma zapojenia a plošný spoj
- noste si počítač
- myslite na projekt dňom i nocou



Richard Balogh

Ústav automobilovej mechatroniky
FEI STU v Bratislave

balogh@elf.stuba.sk

<http://www.robotika.sk>