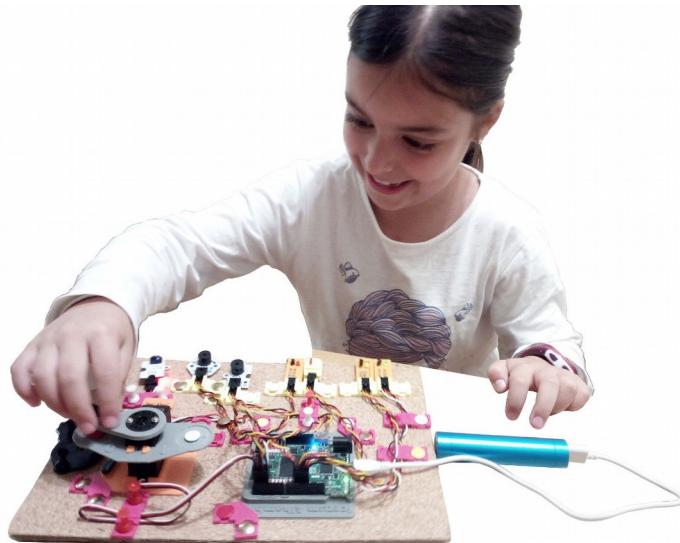


Electrónica Digital Divertida con FPGAs libres



Juan González Gómez
[@Obijuan_cube](https://github.com/Obijuan)
<https://github.com/Obijuan>



ETSI Telecomunicación. URJC
Campus de Fuenlabrada,
20 Noviembre de 2017



Parte I: Viaje al interior de las nuevas tecnologías

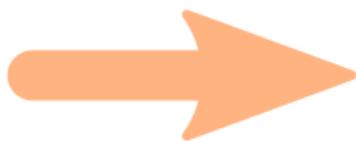
Parte II: Electrónica digital y FPGAs Libres

Parte III: FPGAs libres en educación

Productos electrónicos y circuitos

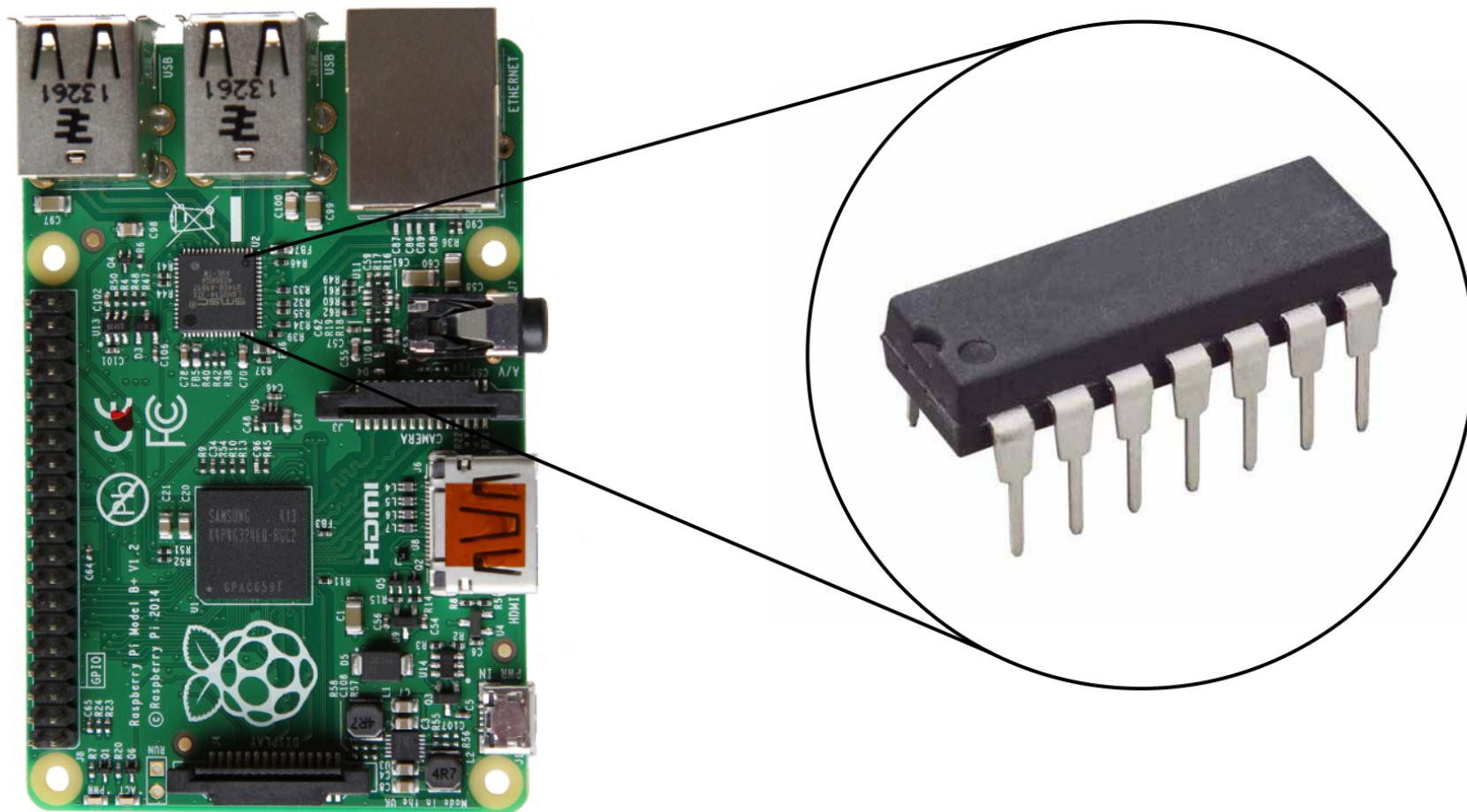


Producto Electrónico

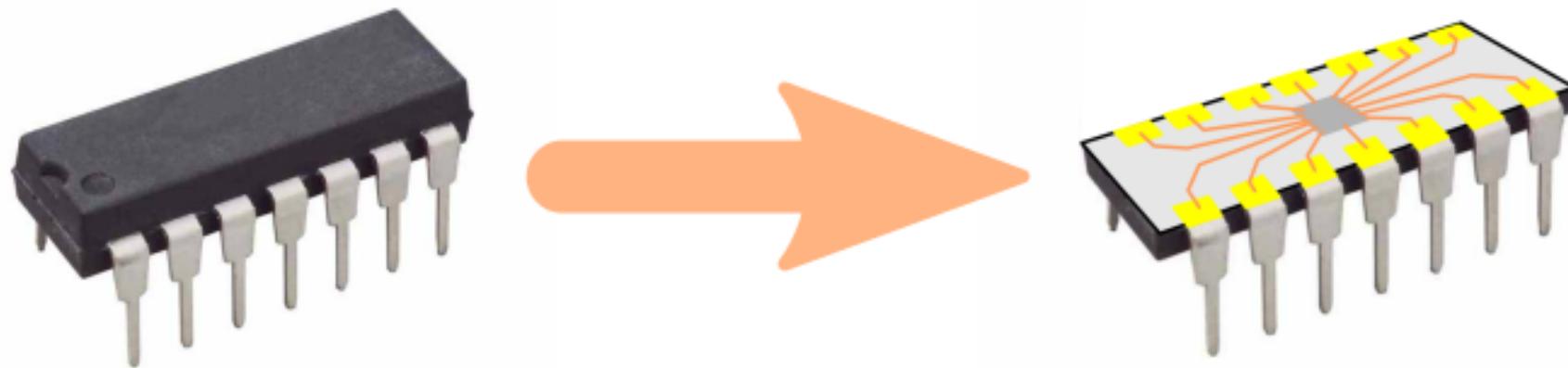


Circuito electrónico

PCBs y Circuitos integrados

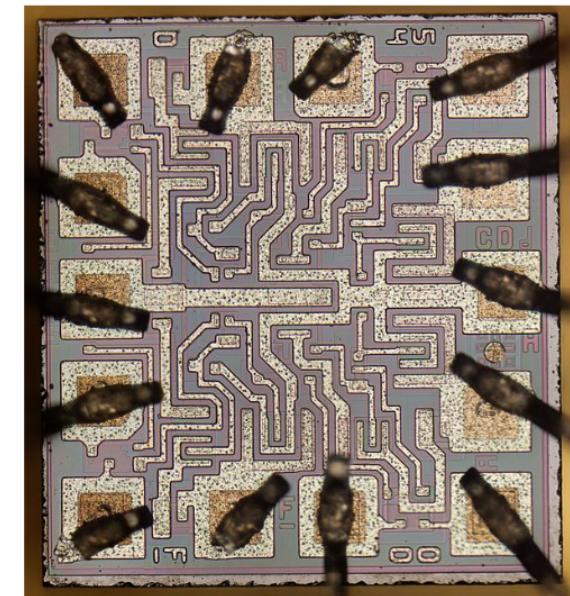
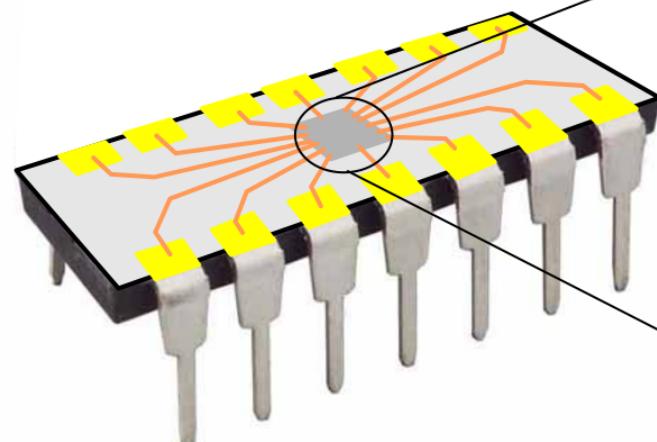


Encapsulado y dado



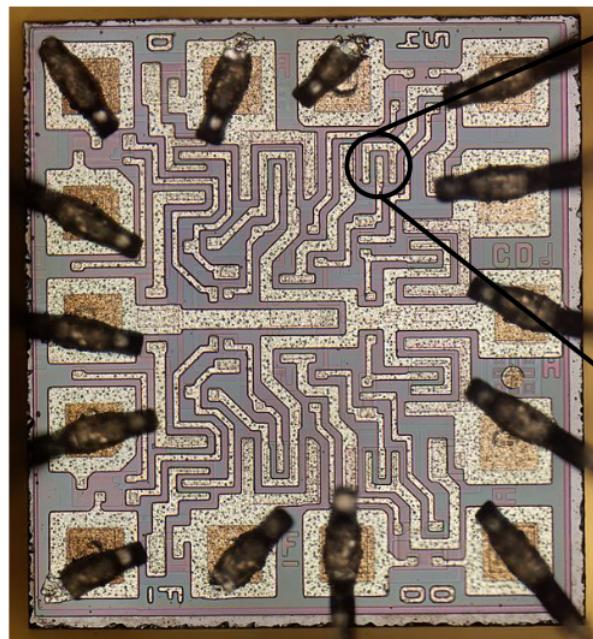
Dado de silicio

*Demo:
Proyecto 54/74*

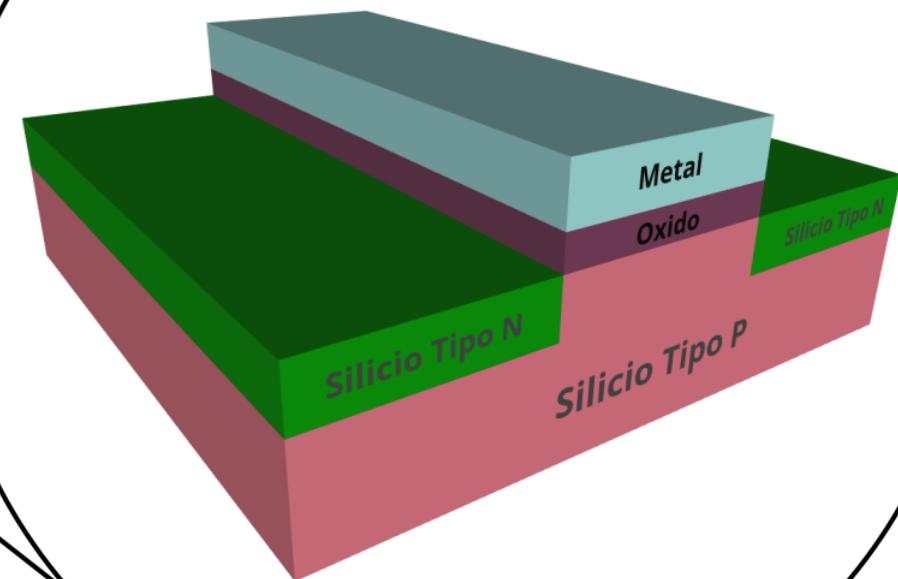


Semiconductores

Dado

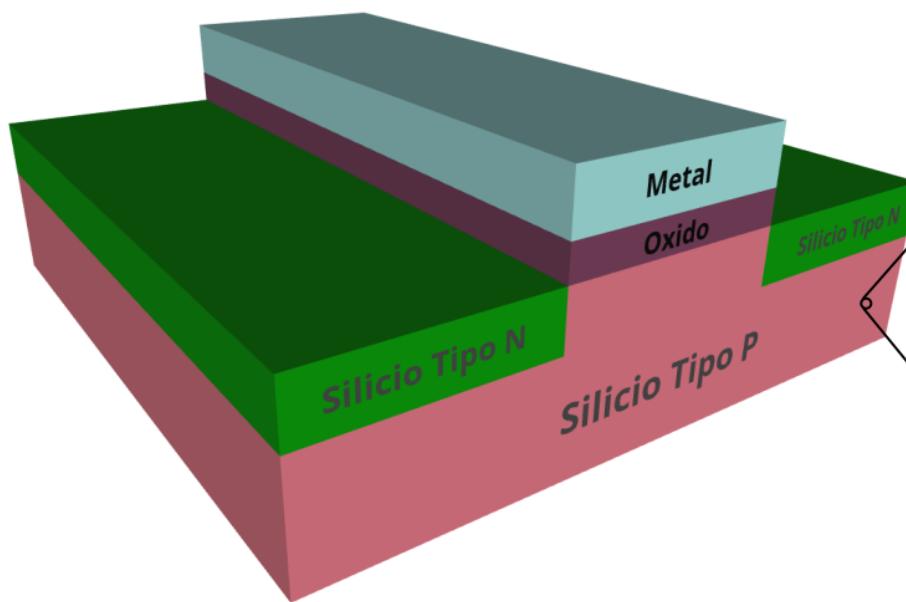


Transistor CMOS

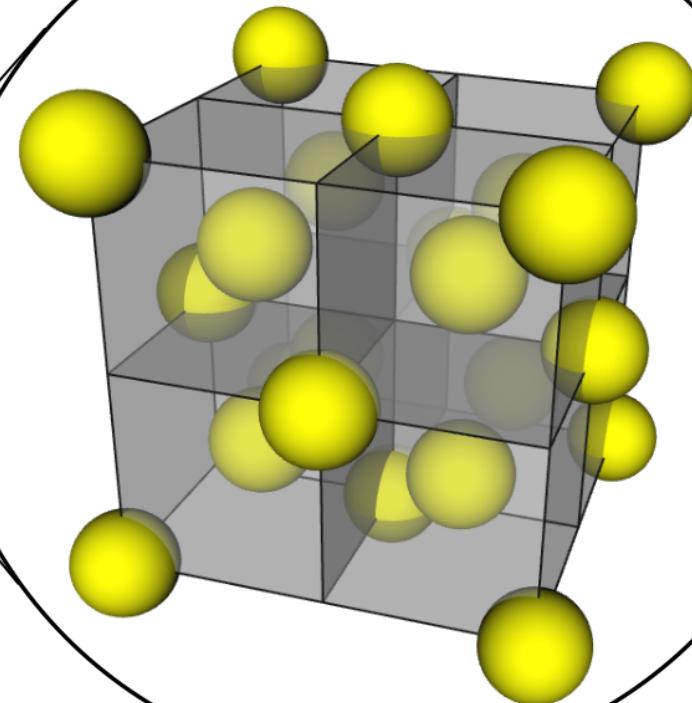


Cristal de silicio

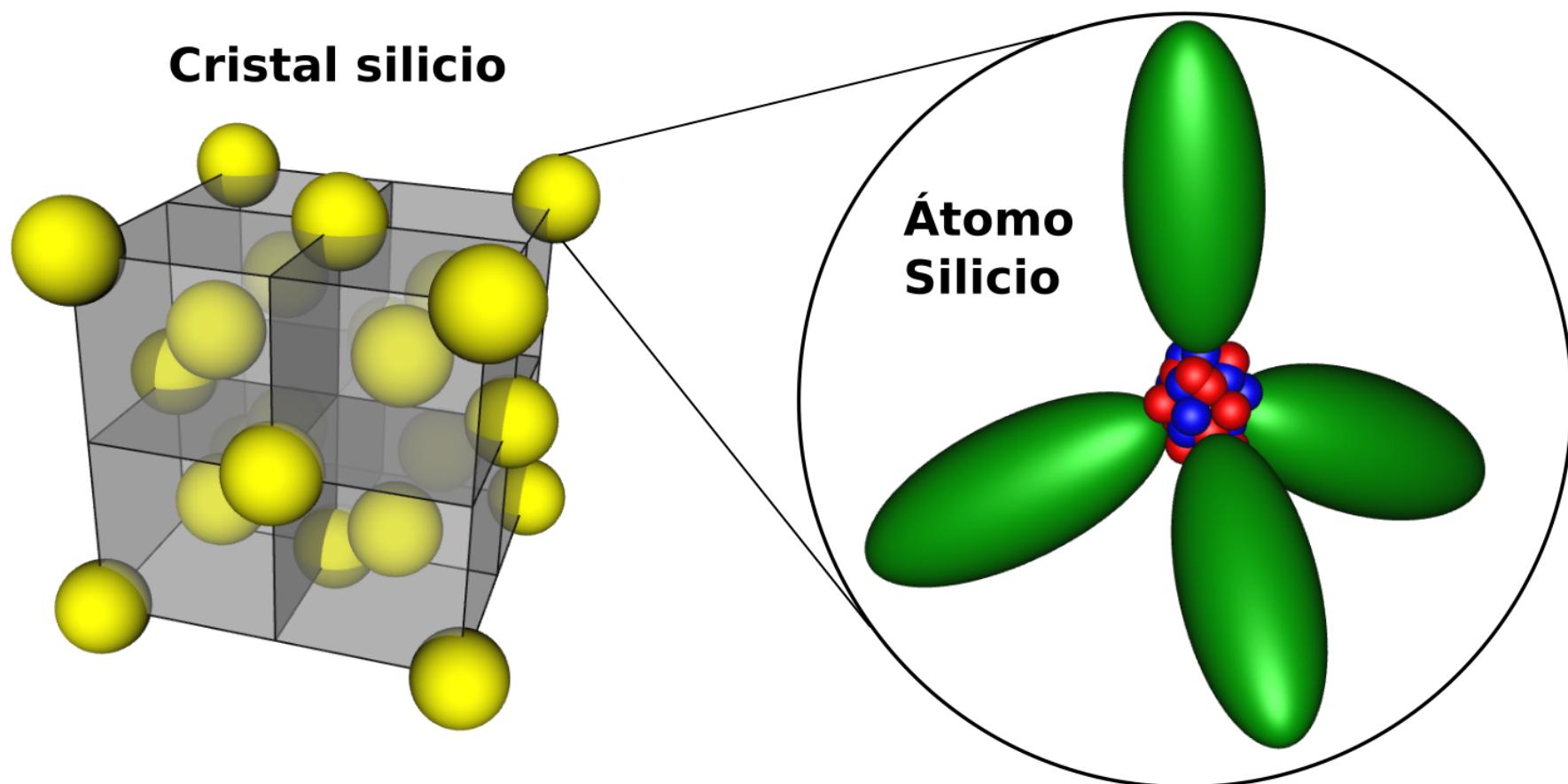
Transistor CMOS



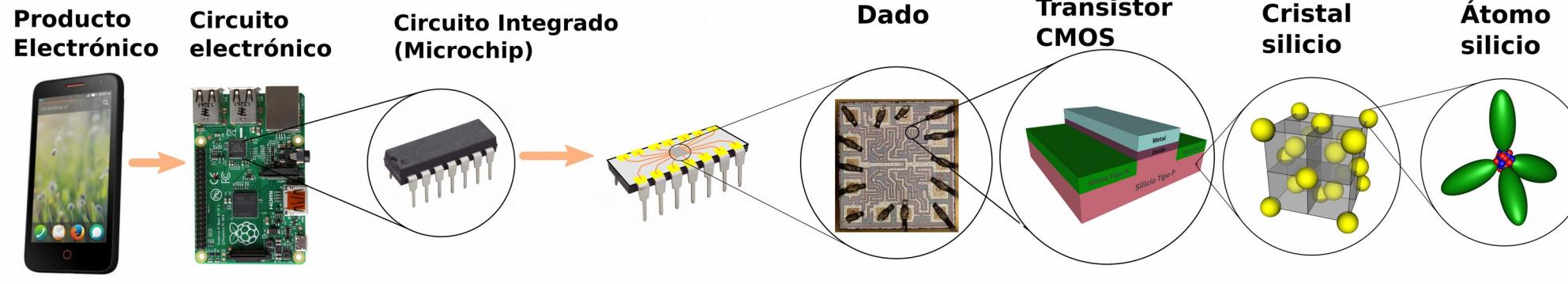
Cristal silicio



Átomos :-)



Del producto al átomo

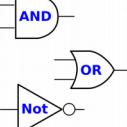
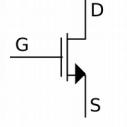
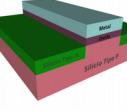
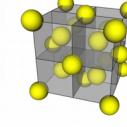
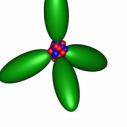


Niveles

	Nivel 7: Software
	Nivel 6: Microprocesador
	Nivel 5: Puertas lógicas
	Nivel 4: Transistor
	Nivel 3: Semiconductores
	Nivel 2: Materiales
	Nivel 1: Átomos

Parte II: Electrónica digital y FPGAs Libres

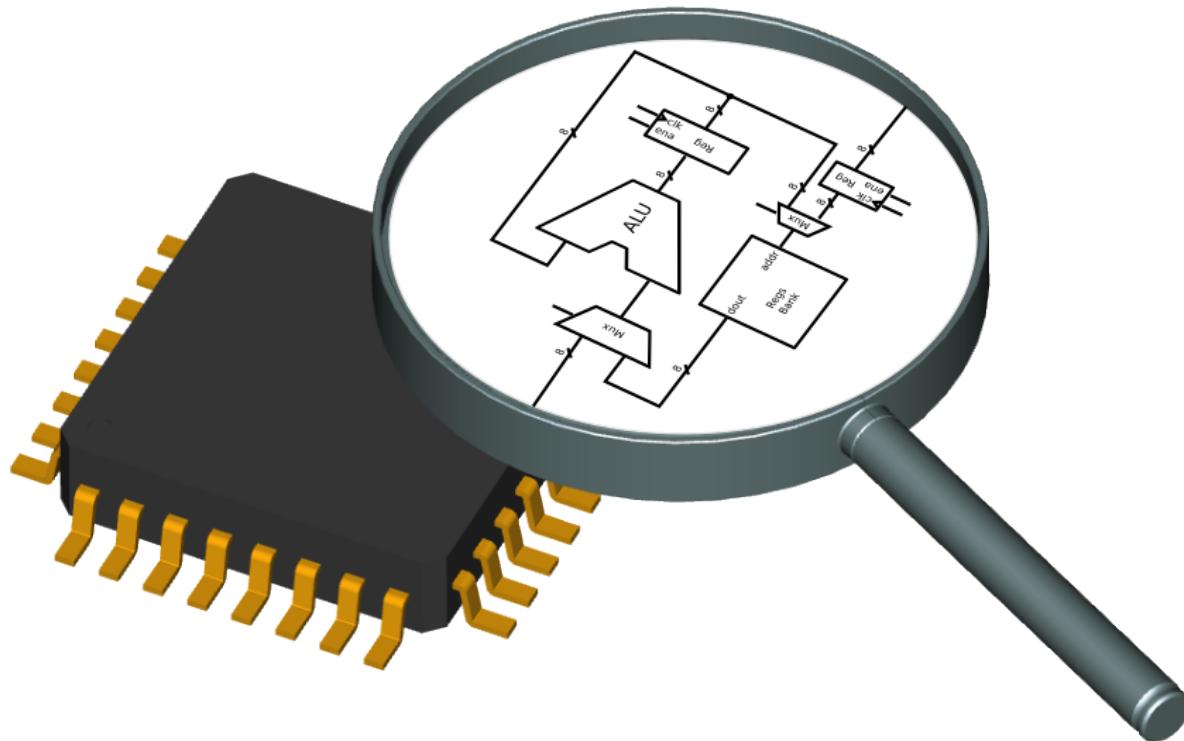
Niveles

	Nivel 7: Software
	Nivel 6: Microprocesador
	Nivel 5: Puertas lógicas
	Nivel 4: Transistor
	Nivel 3: Semiconductores
	Nivel 2: Materiales
	Nivel 1: Átomos



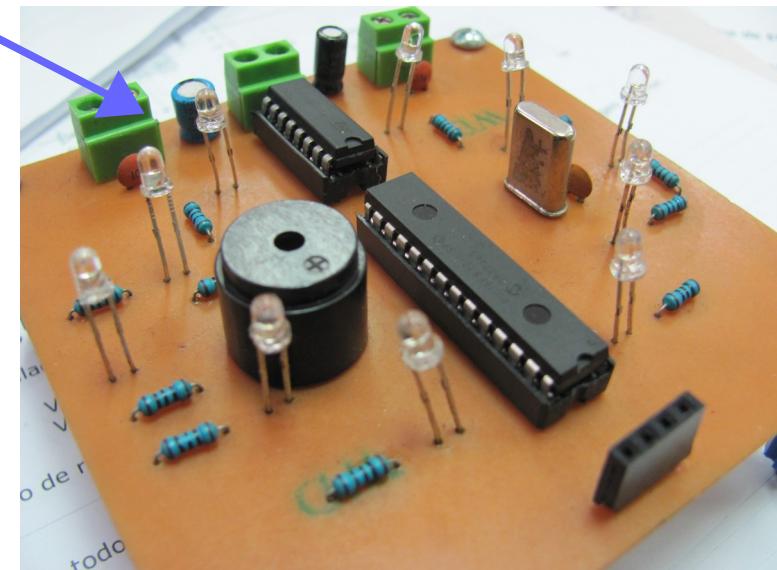
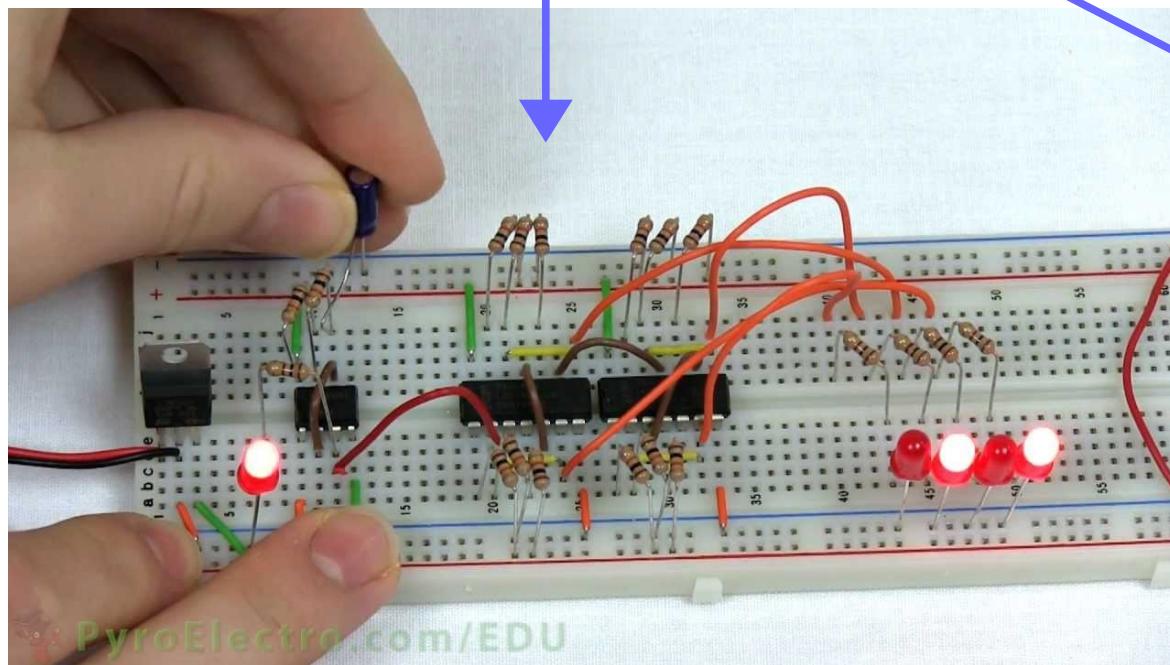
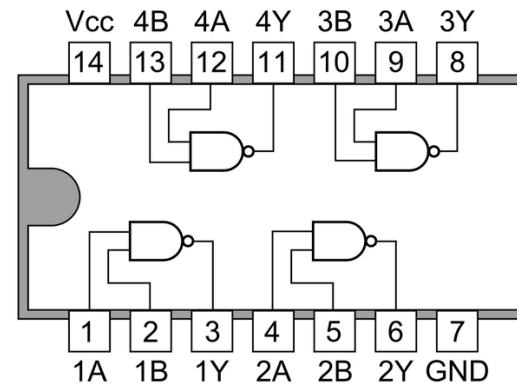
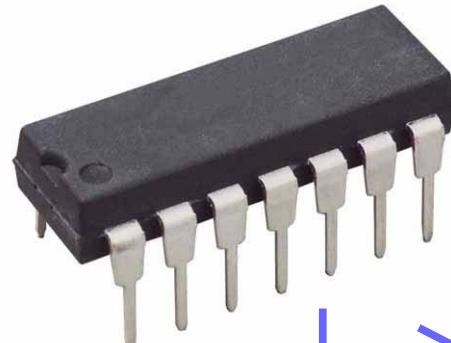
**Electrónica
digital**

Electrónica digital

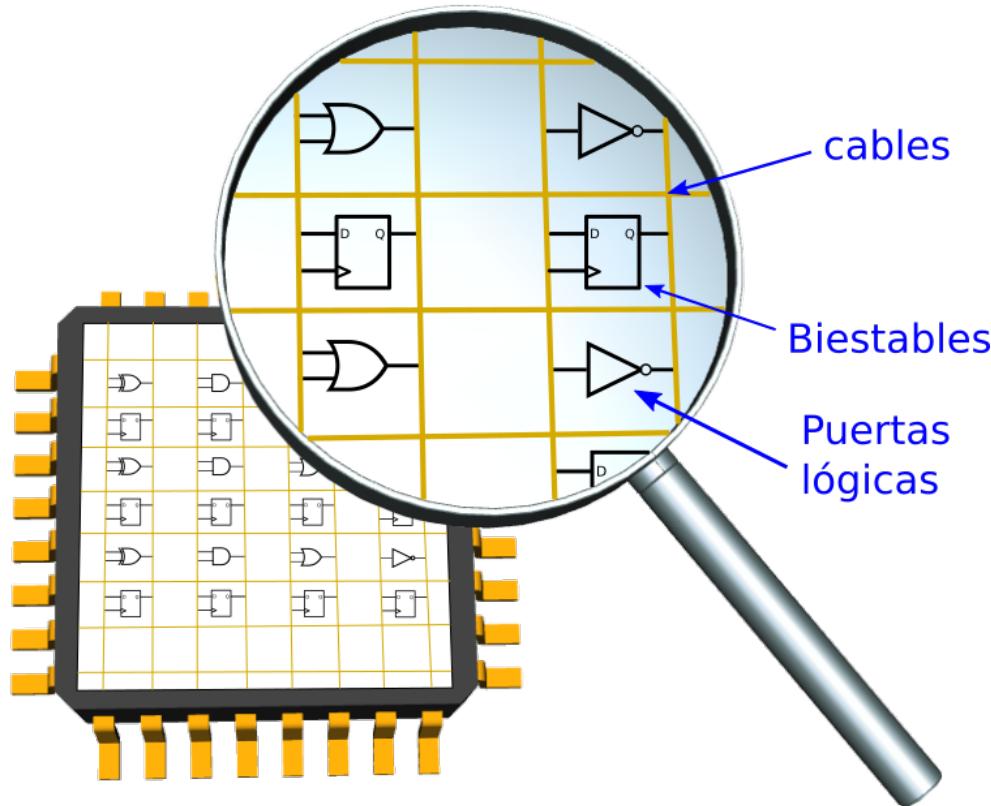


- Nivel de electrónica digital
- Información: Sólo 1s y 0s (Bits)
- Función: **Manipular, almacenar y transportar** bits
- Tres elementos: Cables, biestables y puertas lógicas

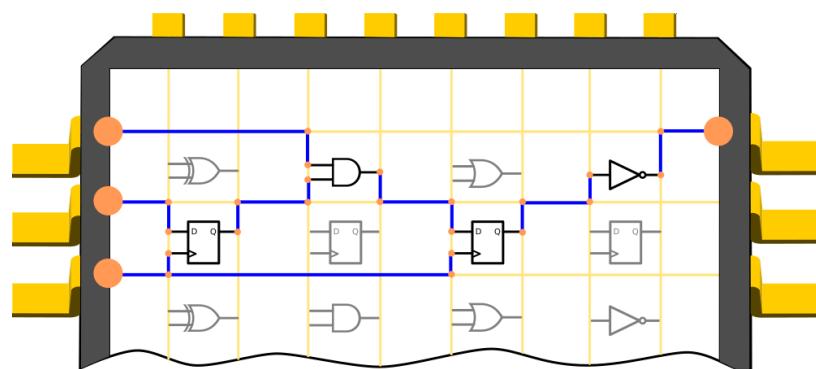
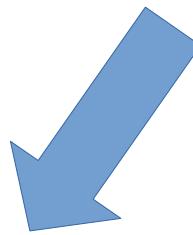
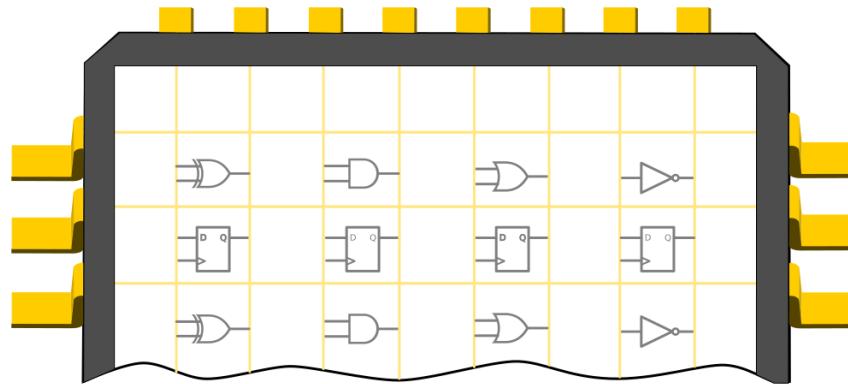
¿Cómo se hacen los circuitos digitales?



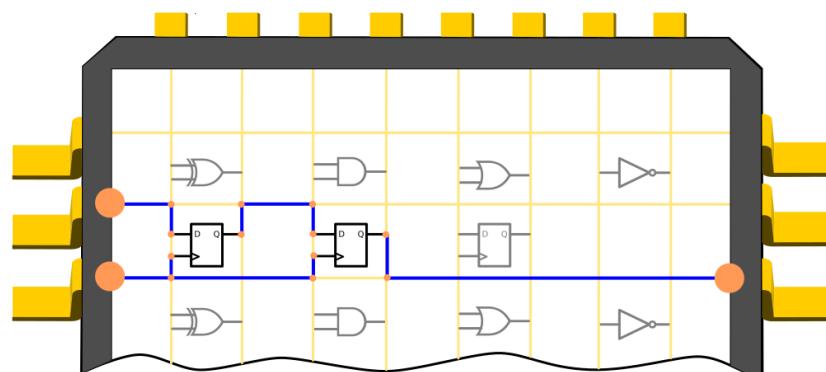
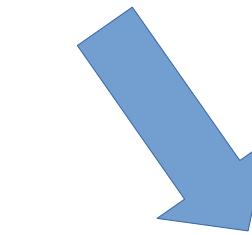
Tecnología FPGA



FPGA: Chip “en blanco” que contiene una matriz con los 3 componentes básicos: puertas lógicas, biestables y cables

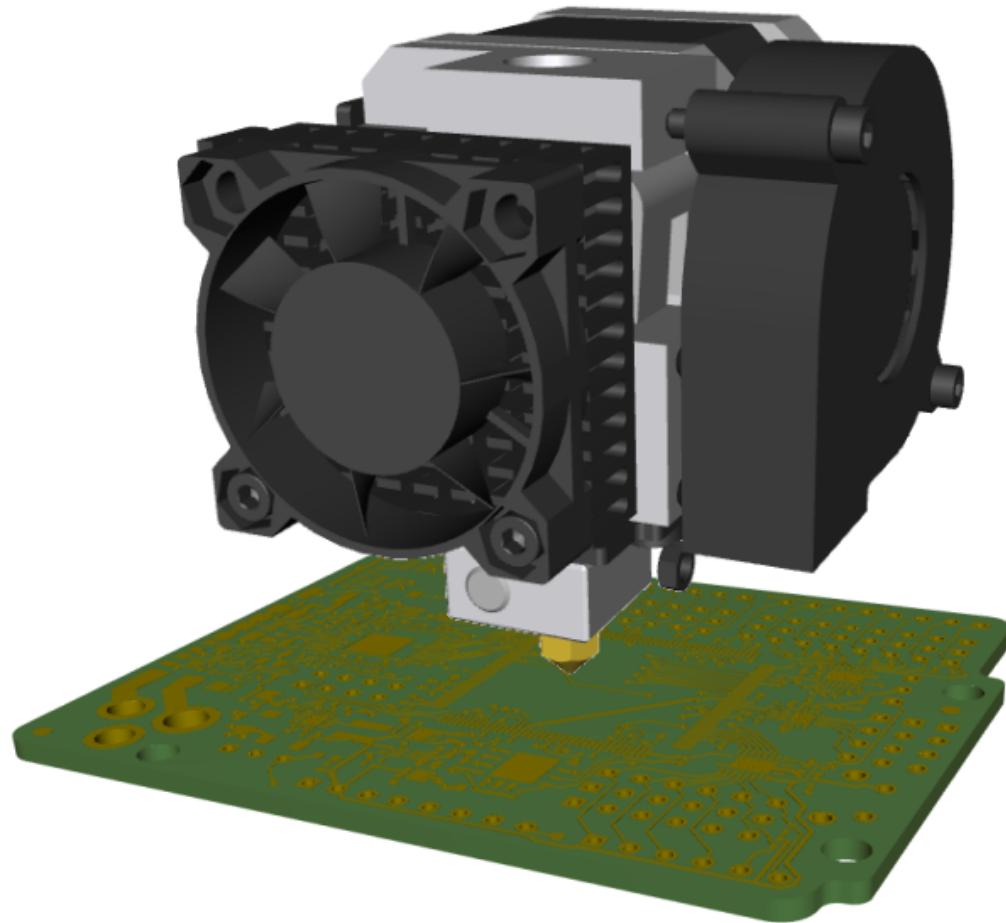


Circuito 1

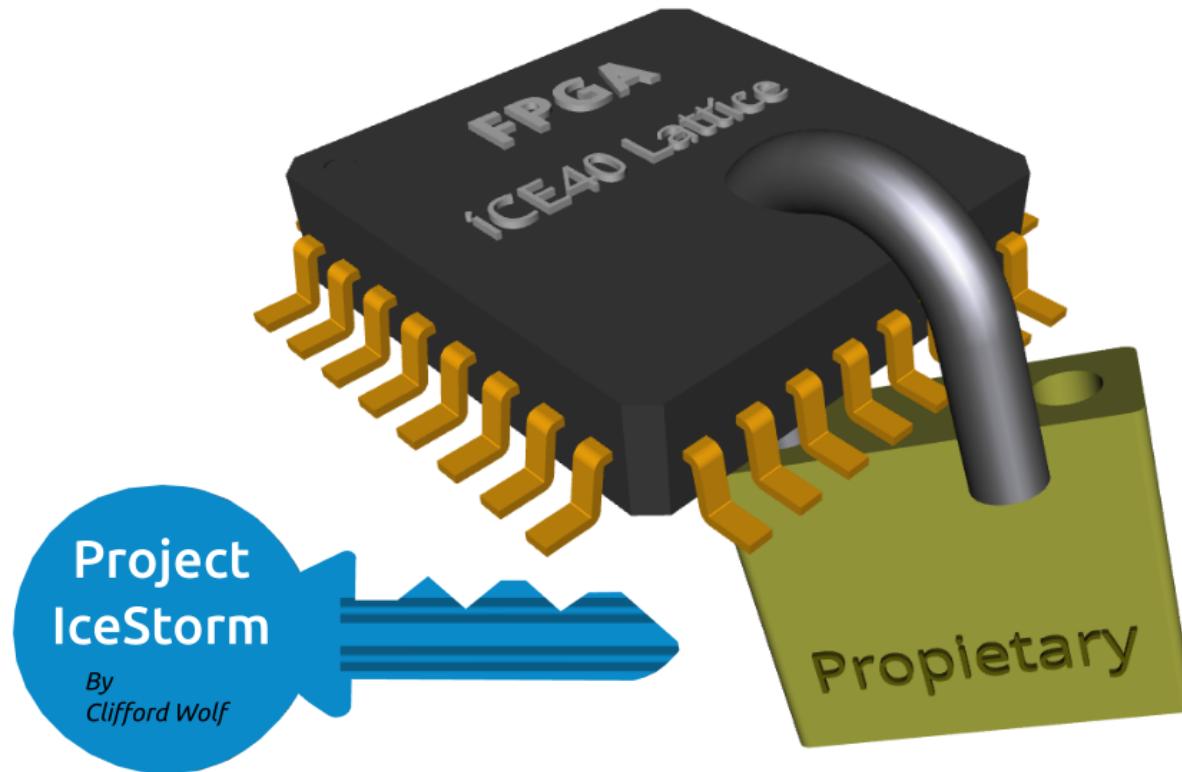


Circuito 2

¡FPGAs = Impresoras 3D de circuitos digitales!



FPGAs libres: El renacimiento



- Proyecto Icestorm (Mayo, 2015)
- La primera *toolchain* que permiten pasar de Verilog al bitstream usando sólo Herramientas libres

Comunidad FPGAwars

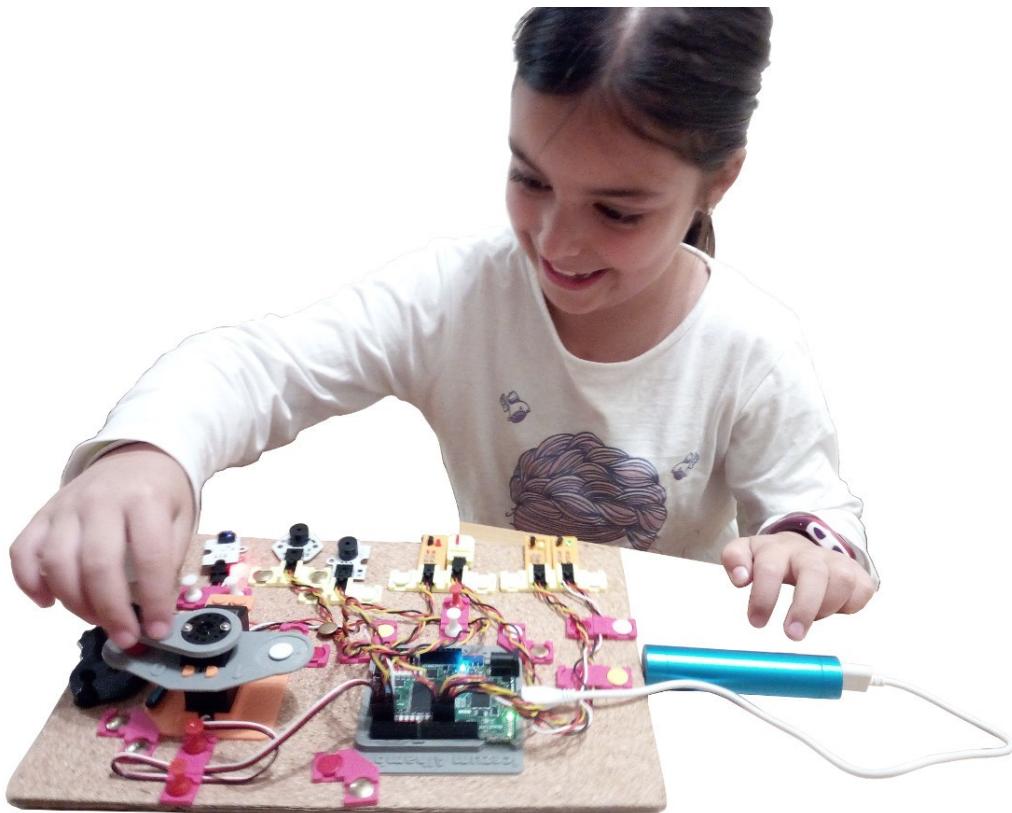


- Comunidad para **compartir conocimiento** relacionado con **FPGAs libres**
- Es el **clonewars** de las FPGAs, pero en modesto :-)
- Idioma: Castellano
- 522 miembros
- Cualquier pregunta / comentario / sugerencia → Correo a la lista :-)

<http://fpgawars.github.io/>

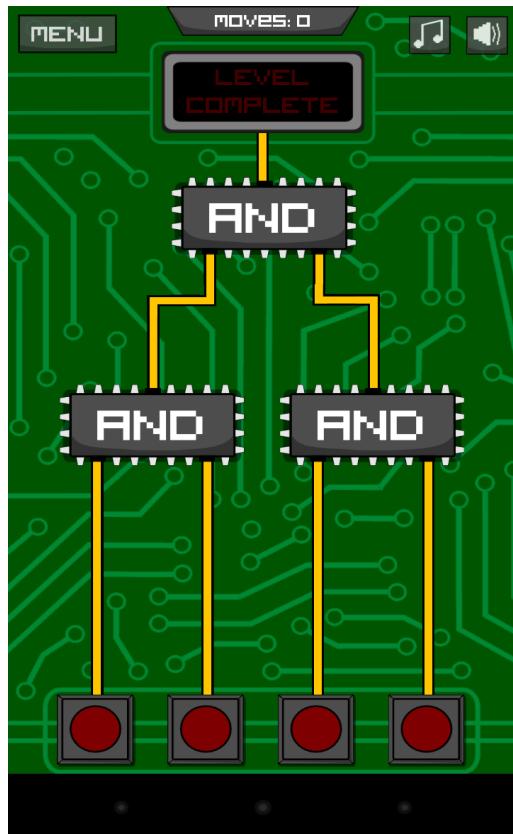
Parte III: FPGAs libres en educación

Electrónica digital divertida

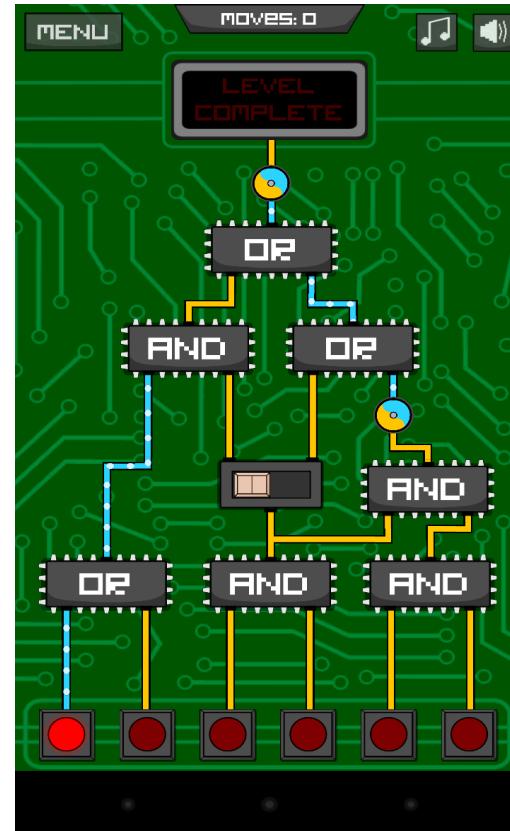


Motivación

¿Cómo podrían los niños y los no electrónicos diseñar circuitos digitales?



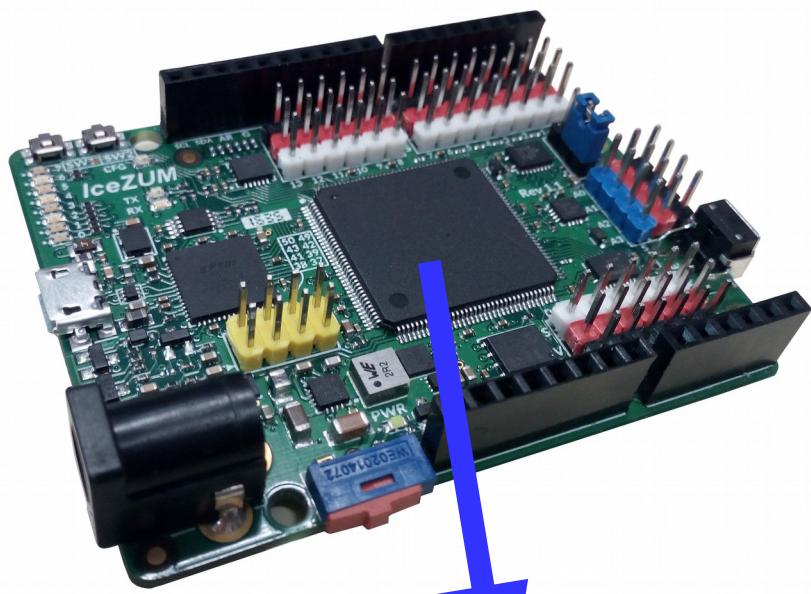
APP:
Circuit
Scramble



La electrónica digital es intuitiva y...
¡Divertida!

Icezum Alhambra v1.1

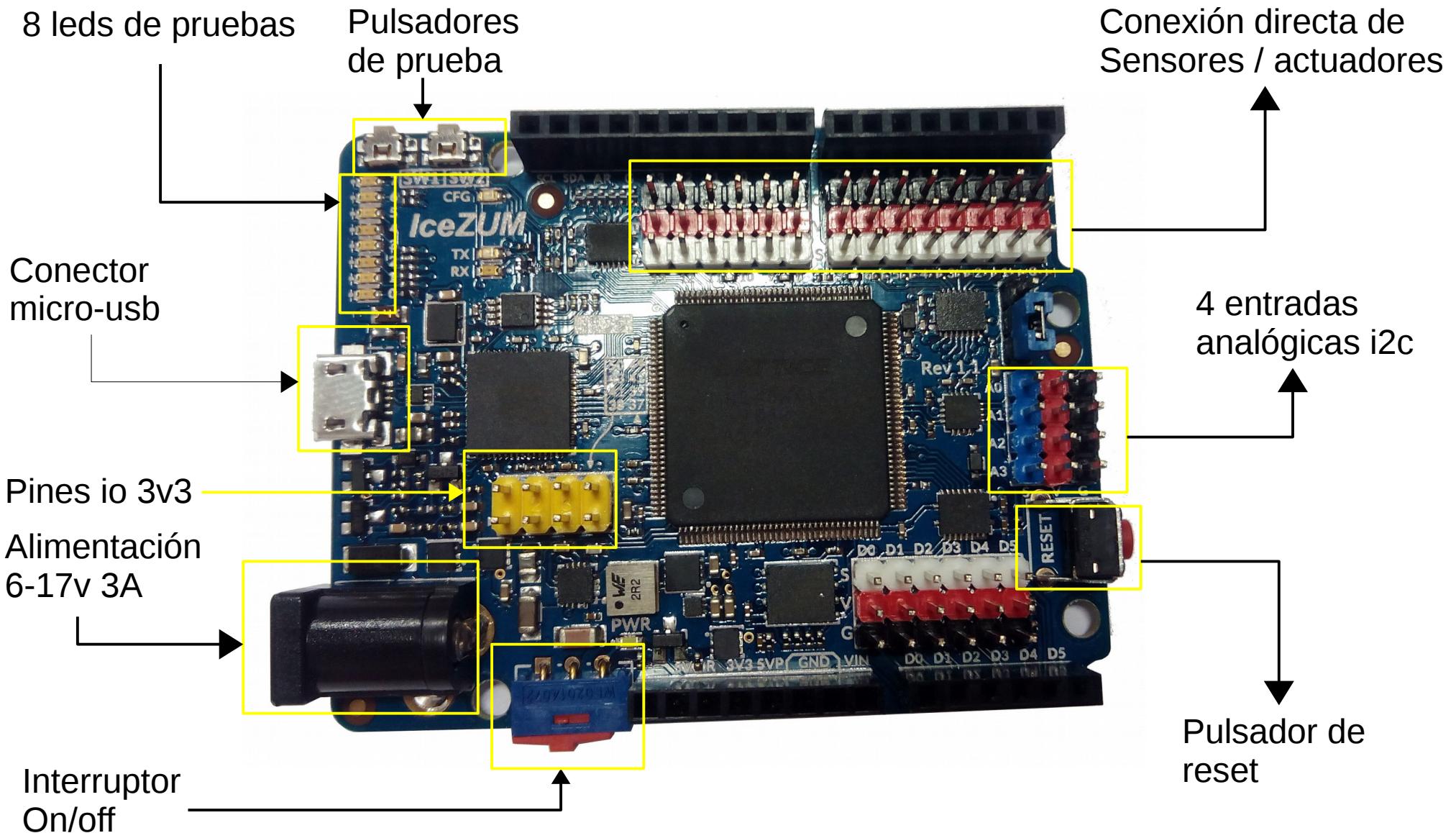
<https://github.com/FPGAwars/icezum/wiki>



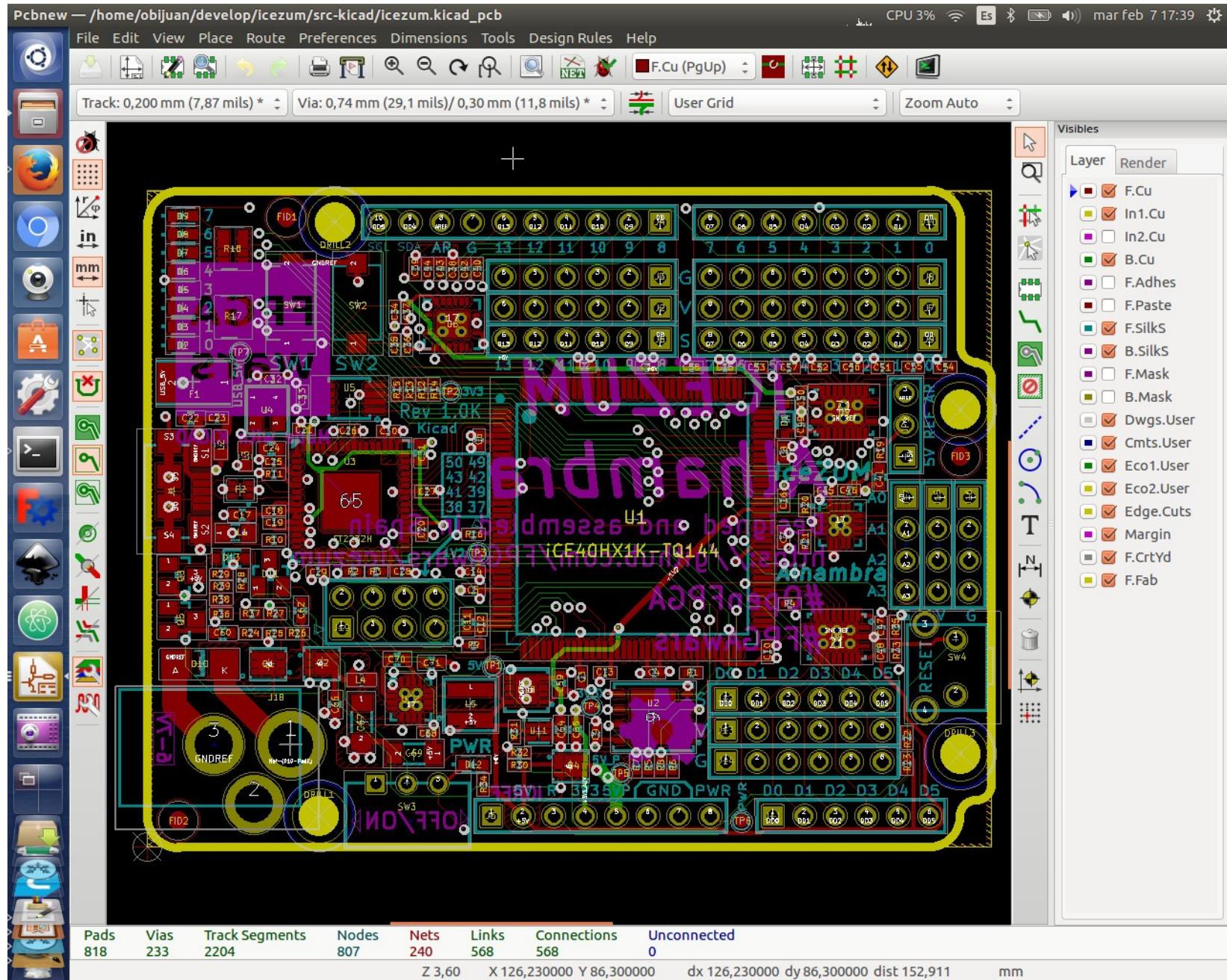
FPGA Libre

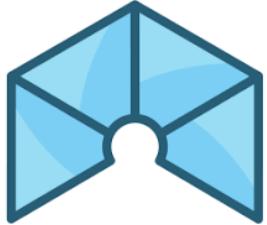
- Autor: **Eladio Delgado**
- Diseñada en Pinos del Valle (Granada)
- Arduino de las **FPGAs**
- Compatible Arduino
- Fácil conexión de circuitos externos/sensores/servos
- Reutilización de los shields de arduino
- 20 entradas/salidas de 5v
- 3A corriente de entrada
- Perfecta para hacer robots

Icezum Alhambra v1.1

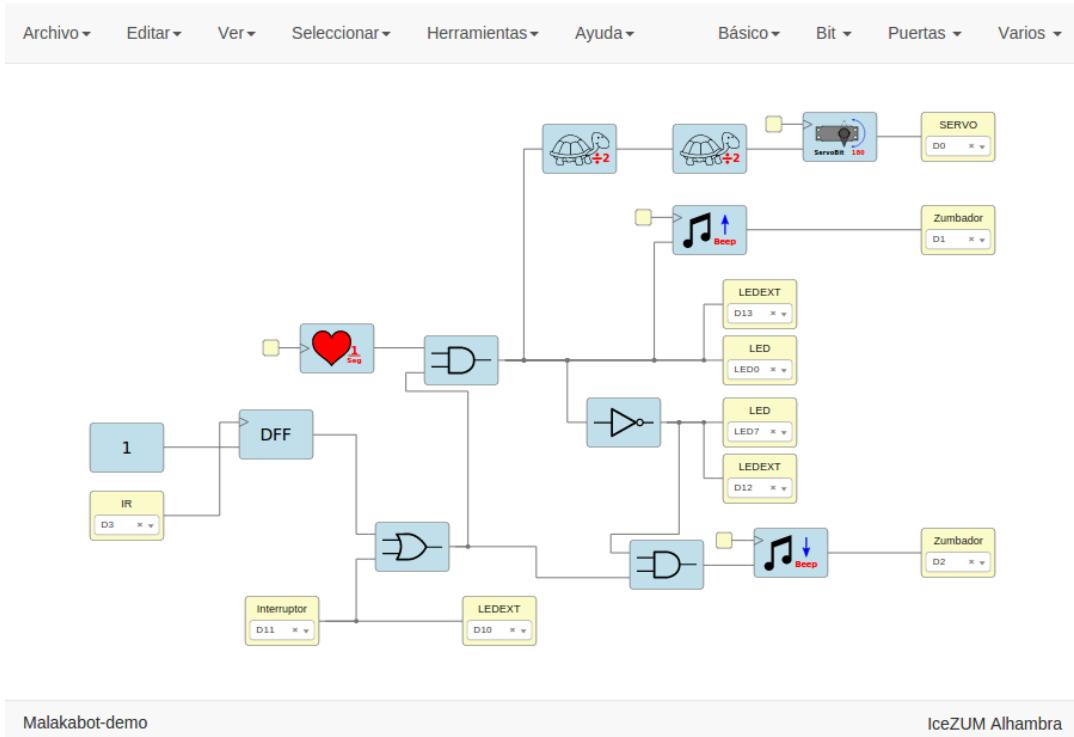


Esquemas en Kicad





Icestudio

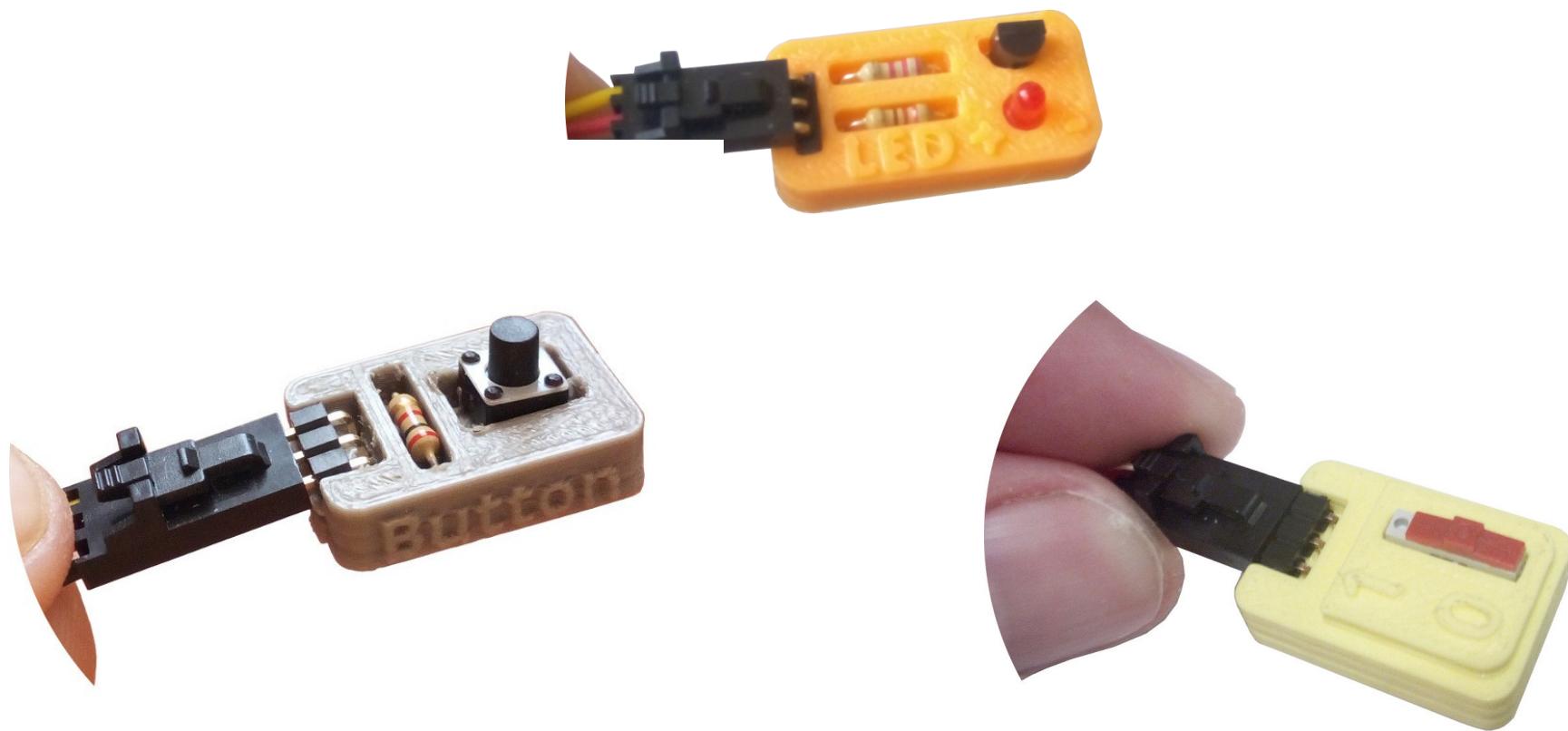


<https://github.com/FPGAwars/icestudio>

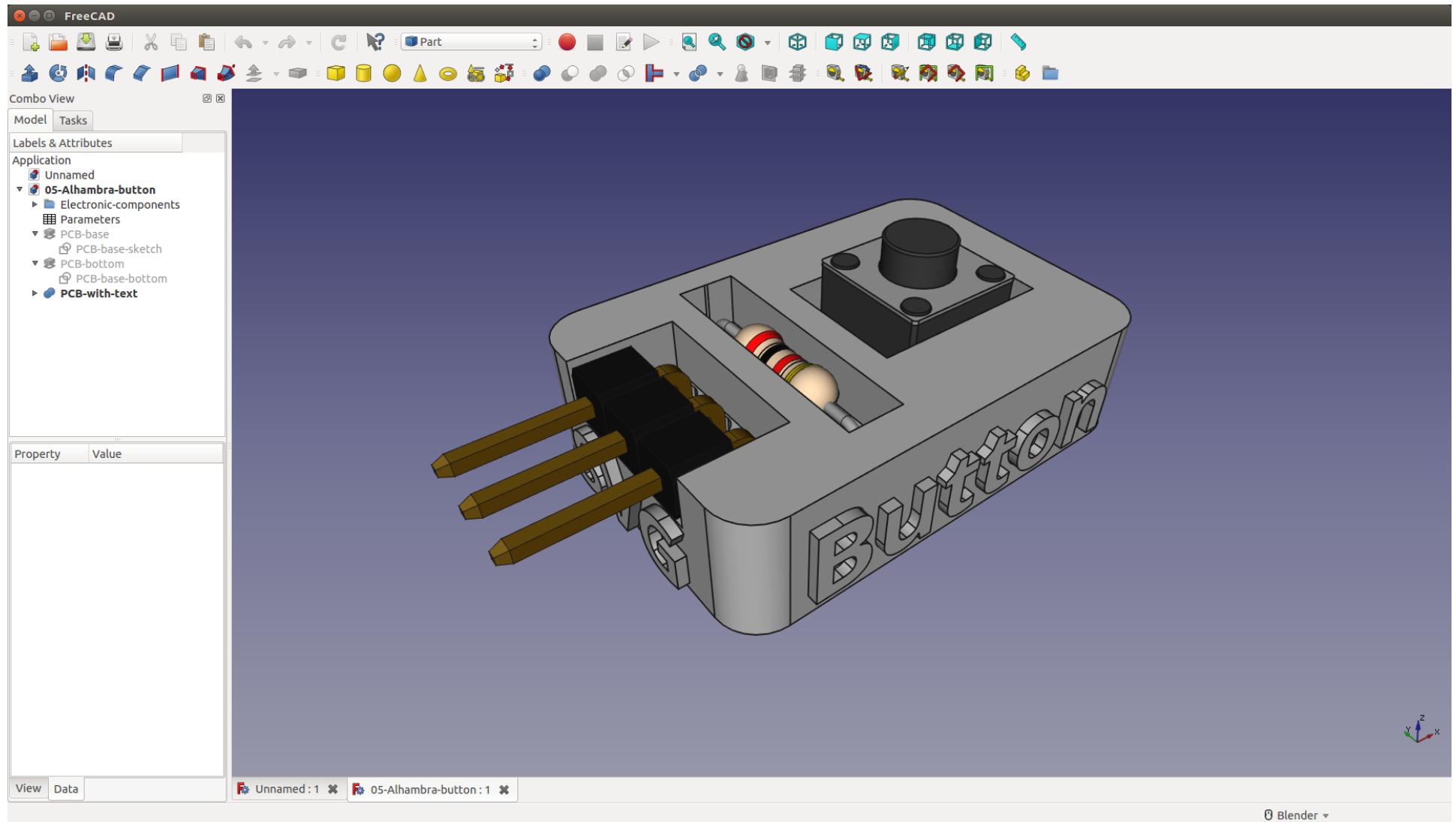
- Autor: **Jesús Arroyo**
- Electrónica digital para todos
- Herramienta visual
- Traduce a verilog

Periféricos

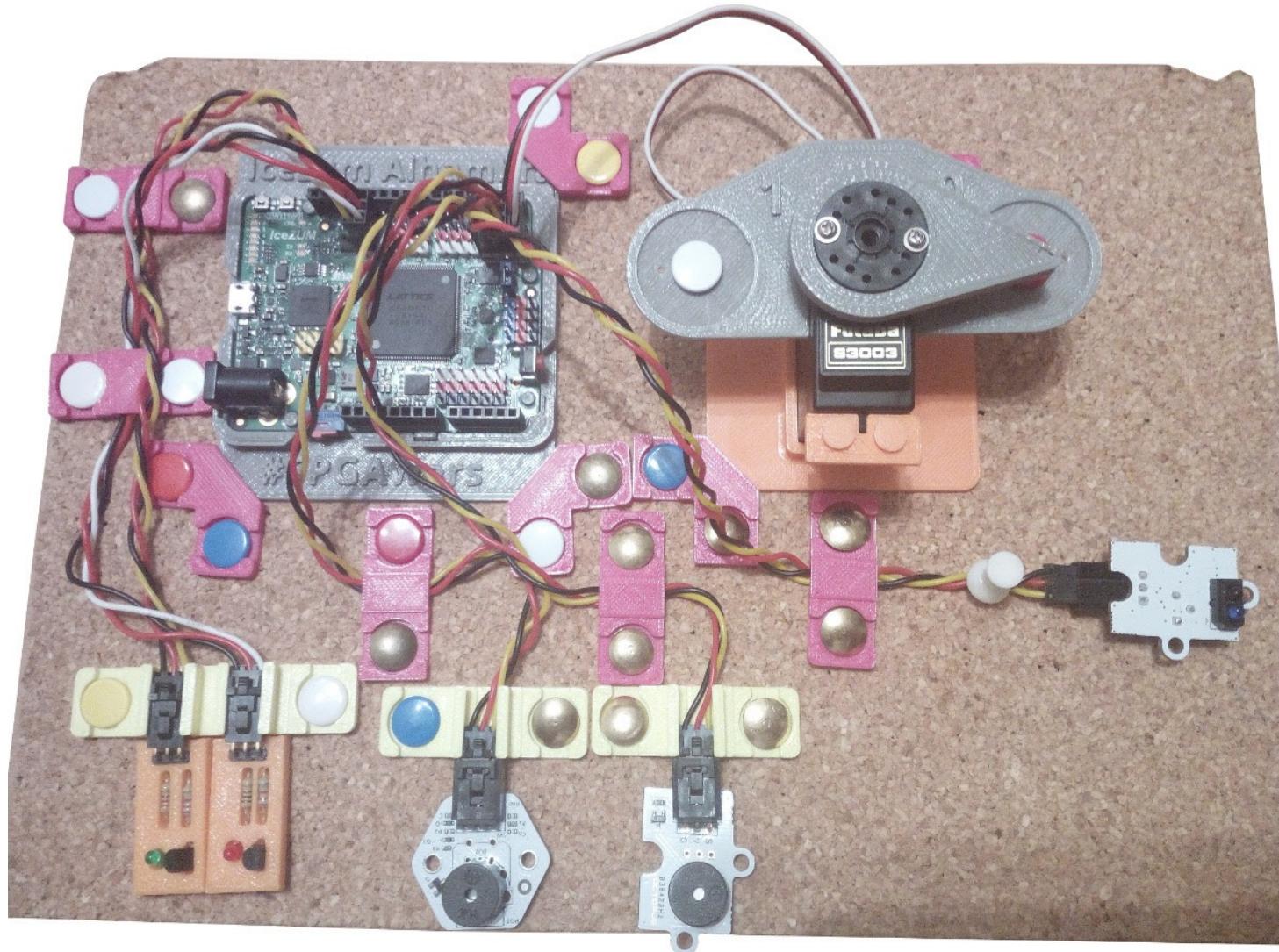
PCBprints: Mini-circuitos impresos en 3D



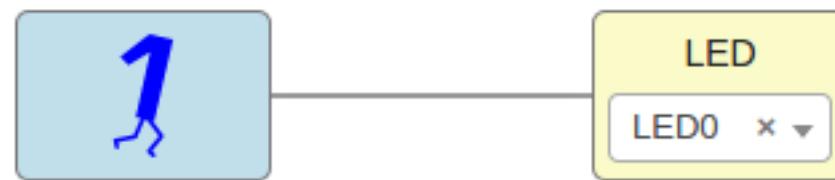
Diseño en Kicad



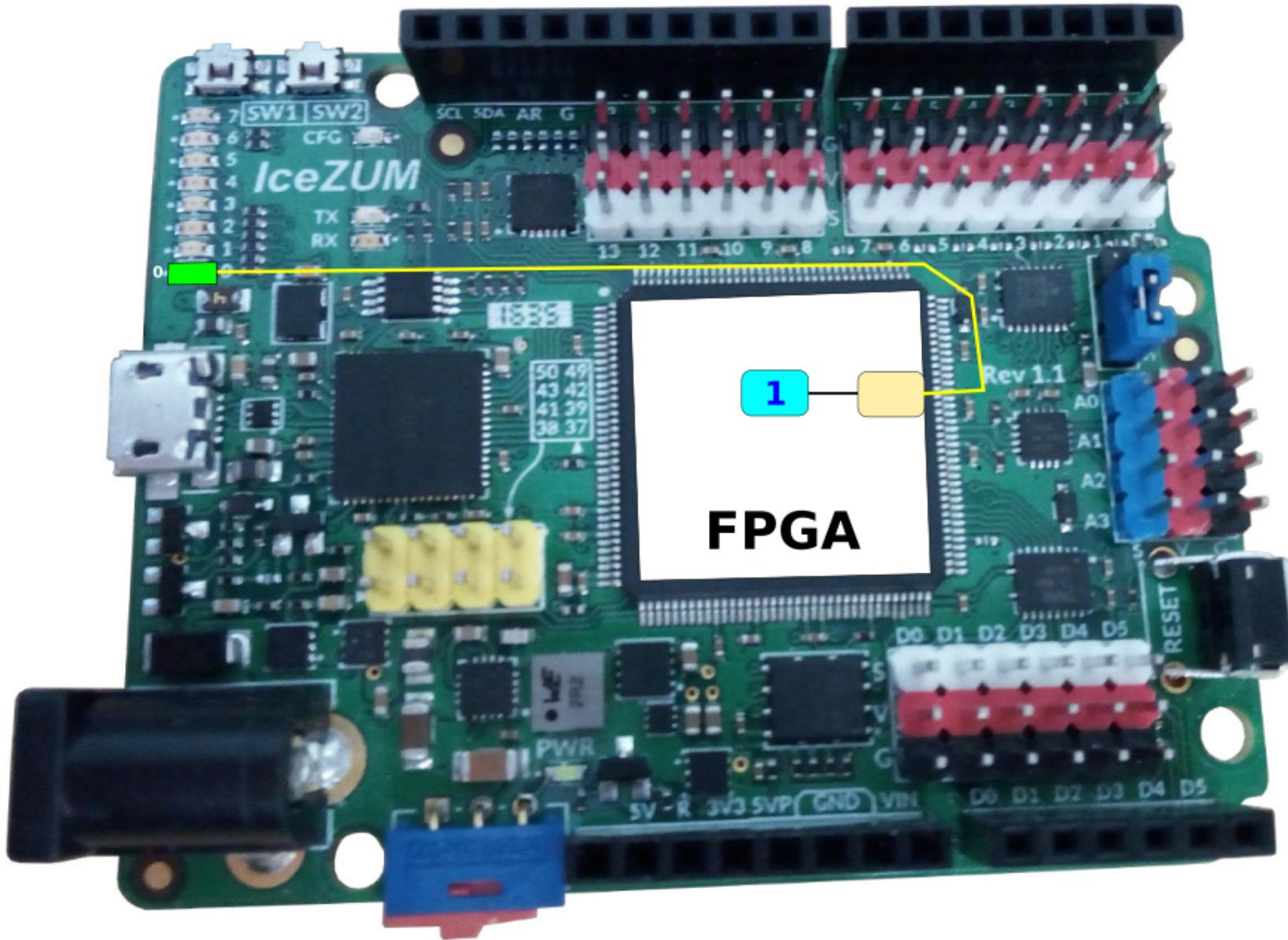
¡Empezamos!



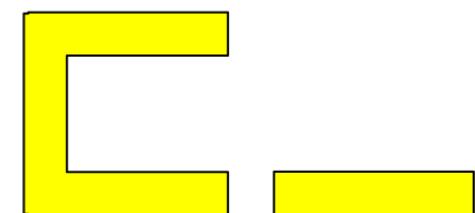
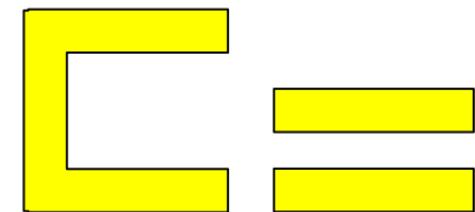
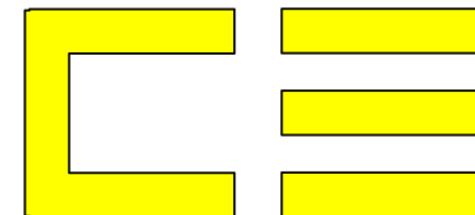
Ejemplo 1: Hola Mundo



Hola mundo: Implementación física



Tutorial de electrónica digital para makers con FPGAs libres



<https://github.com/Obijuan/digital-electronics-with-open-FPGAs-tutorial/wiki>

Larby: Robot modular



- Servos conectados directamente a Icezum Alhambra
- Configuración mínima pitch-pitch
- Módulo impresos en 3D

Lattuino

https://github.com/INTI-CMNB/Lattuino_IP_Core



Lattuino_Counter | Arduino 1.8.2

File Edit Sketch Tools Help

Lattuino_Counter

```
// Lattuino Stick
// 4 bit counter

#define D1 14
#define D2 0
#define D3 1
#define D4 2
#define D5 3

#define DELAY 8

byte counter = 0;
int ledPin[] = {D4,D3,D2,D1};

Done uploading.

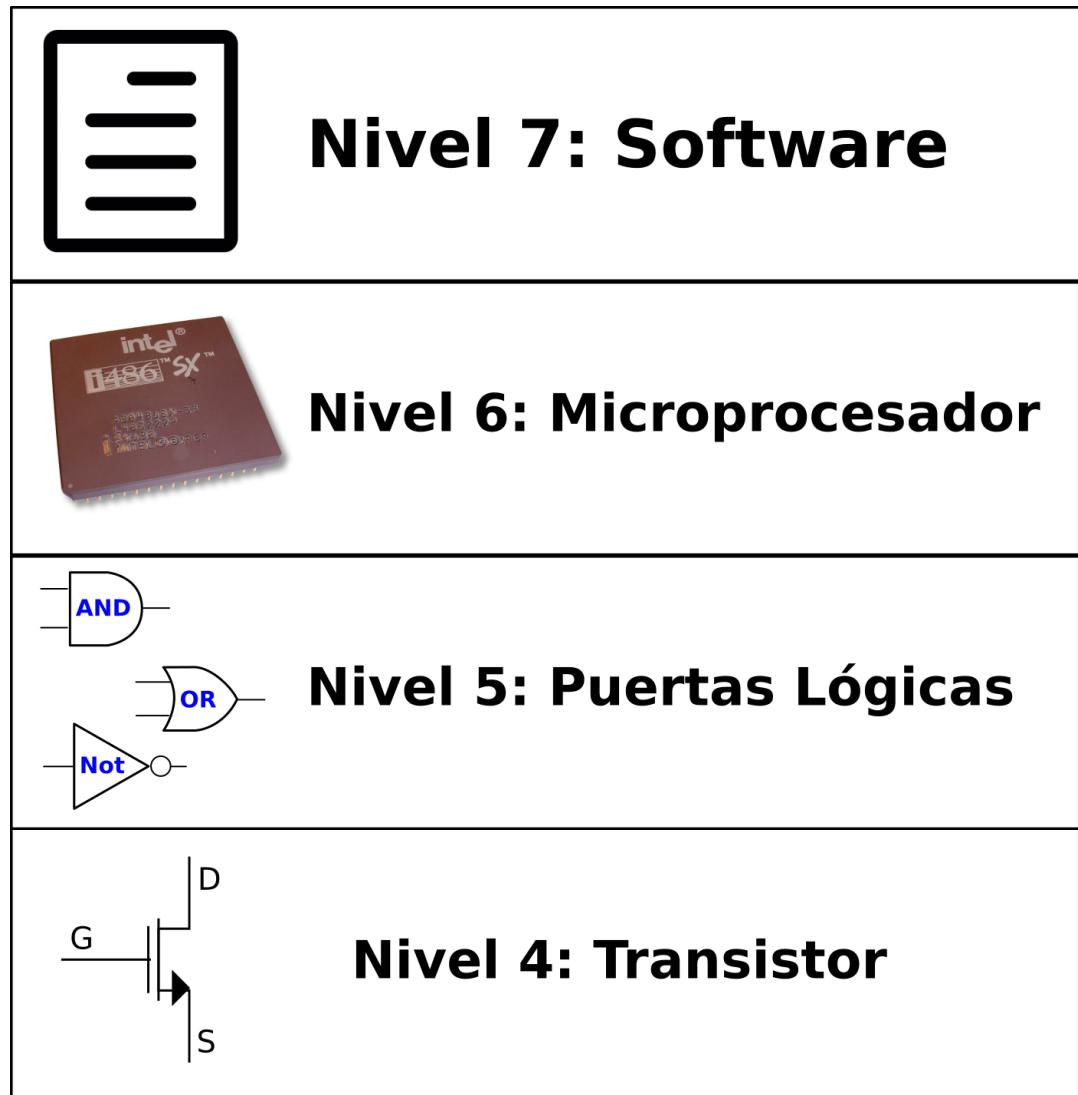
Sketch uses 496 bytes (35%) of program storage space. Maximum j
Global variables use 10 bytes (7%) of dynamic memory, leaving I

Lattuino Stick (2k) on /dev/ttyUSB1
```

- Autor: **Salvador Tropea**
- Core de Arduino para FPGA
- Lattice Ice40 (1k, 4k, 8k)
- Migrando a Icestudio



Lattuino (II)



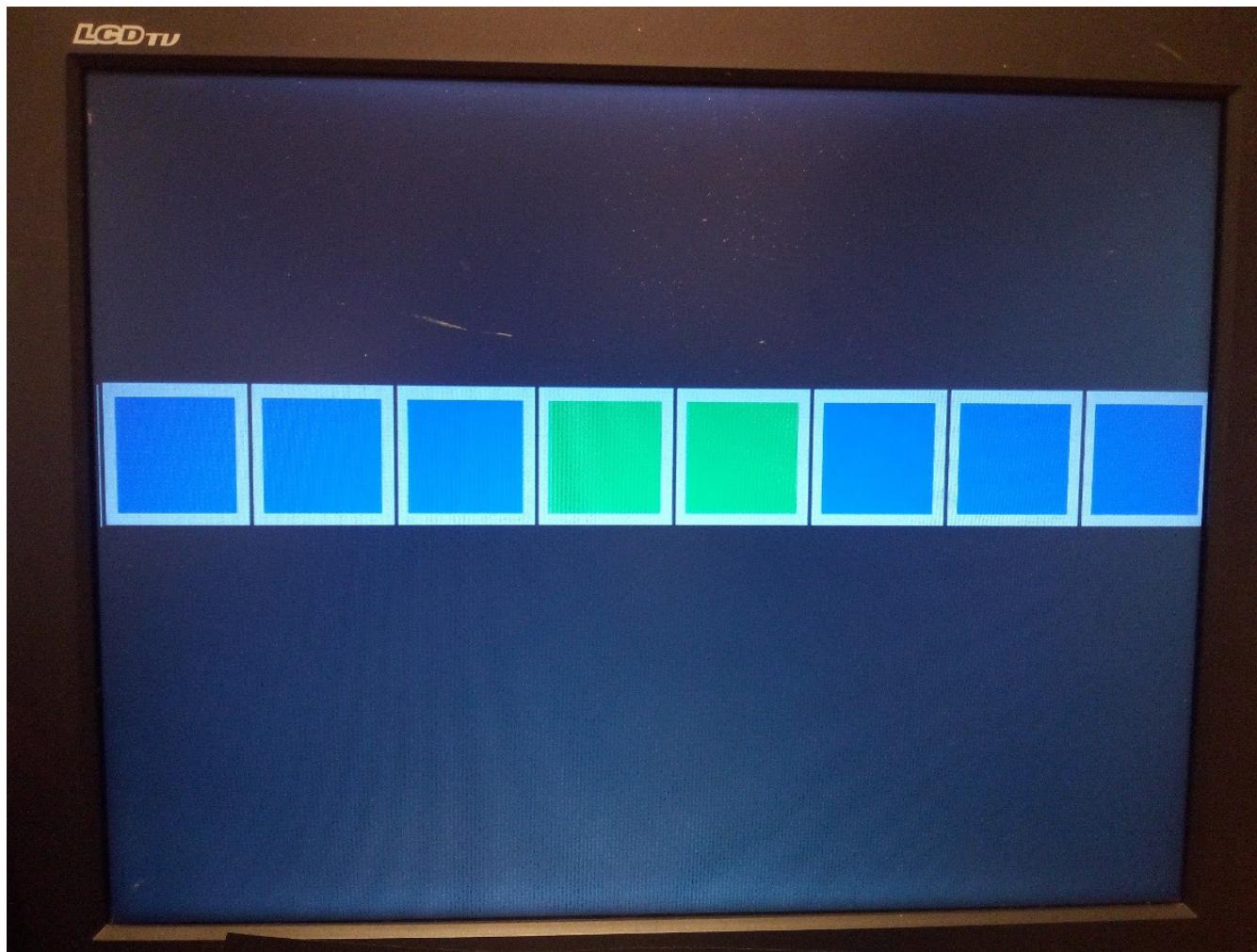
Lattuino

FPGAs

VGA: Monsterled

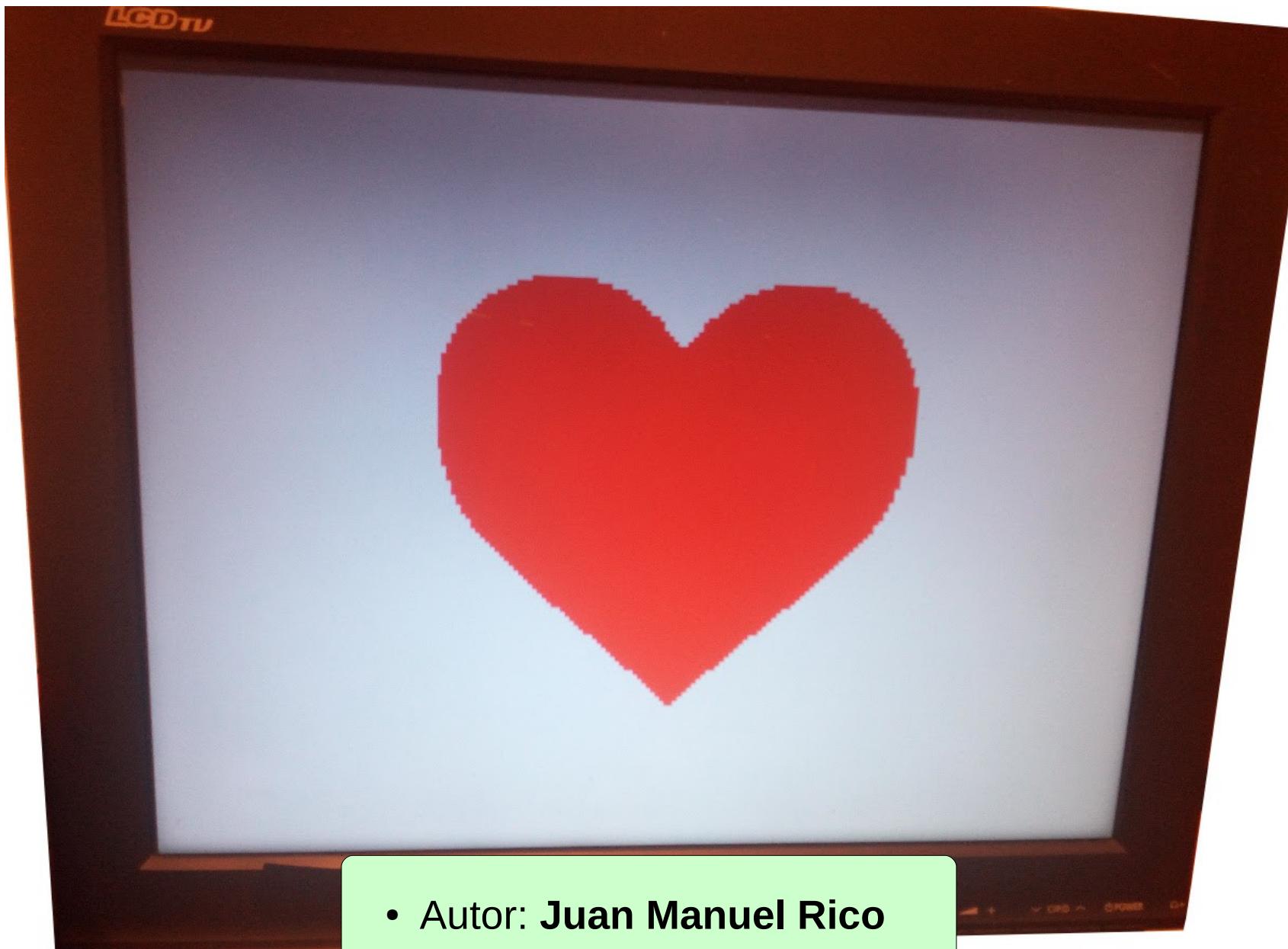


Screen-leds



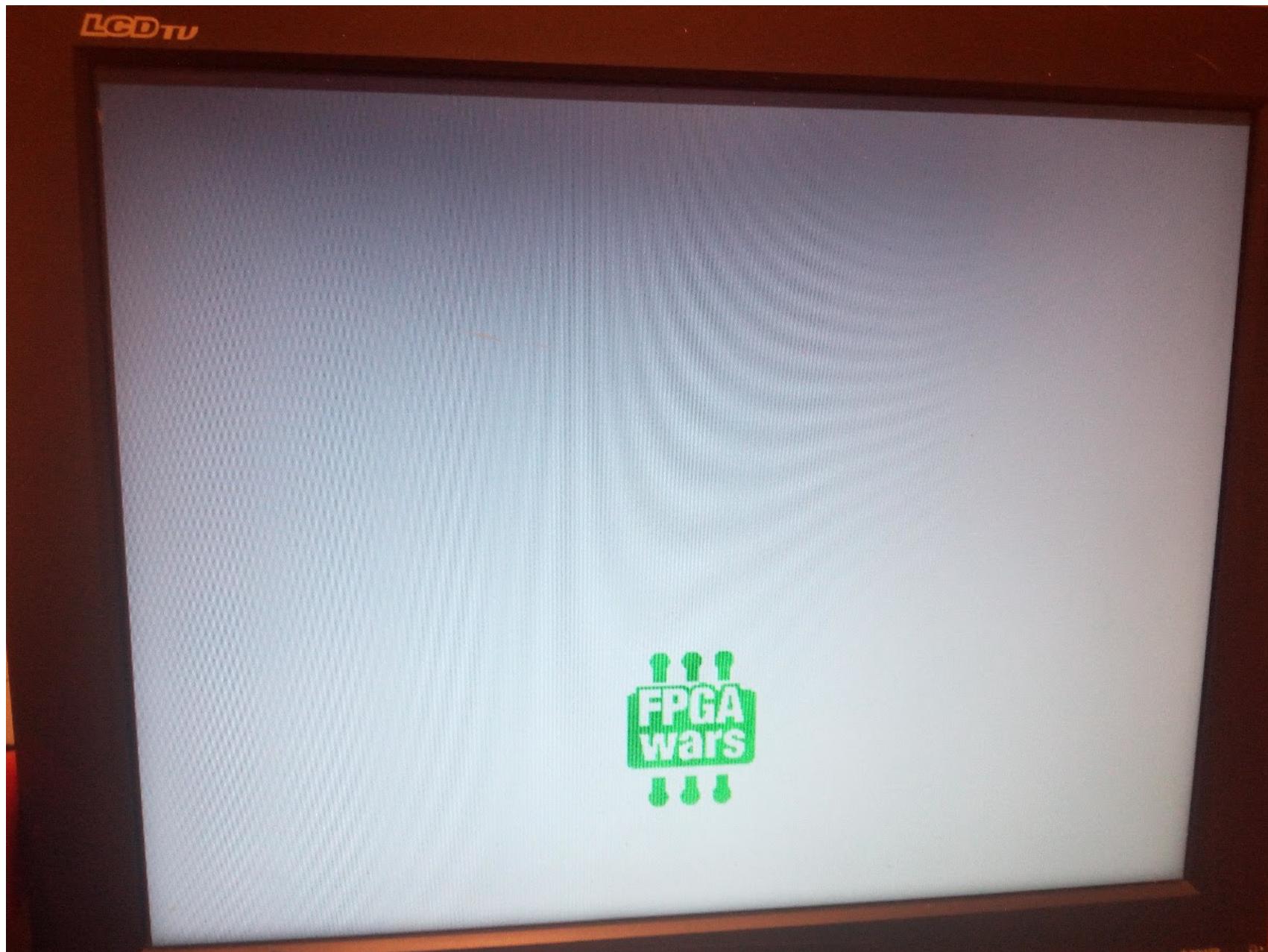
- Autor: Juan Manuel Rico

Screen-heart

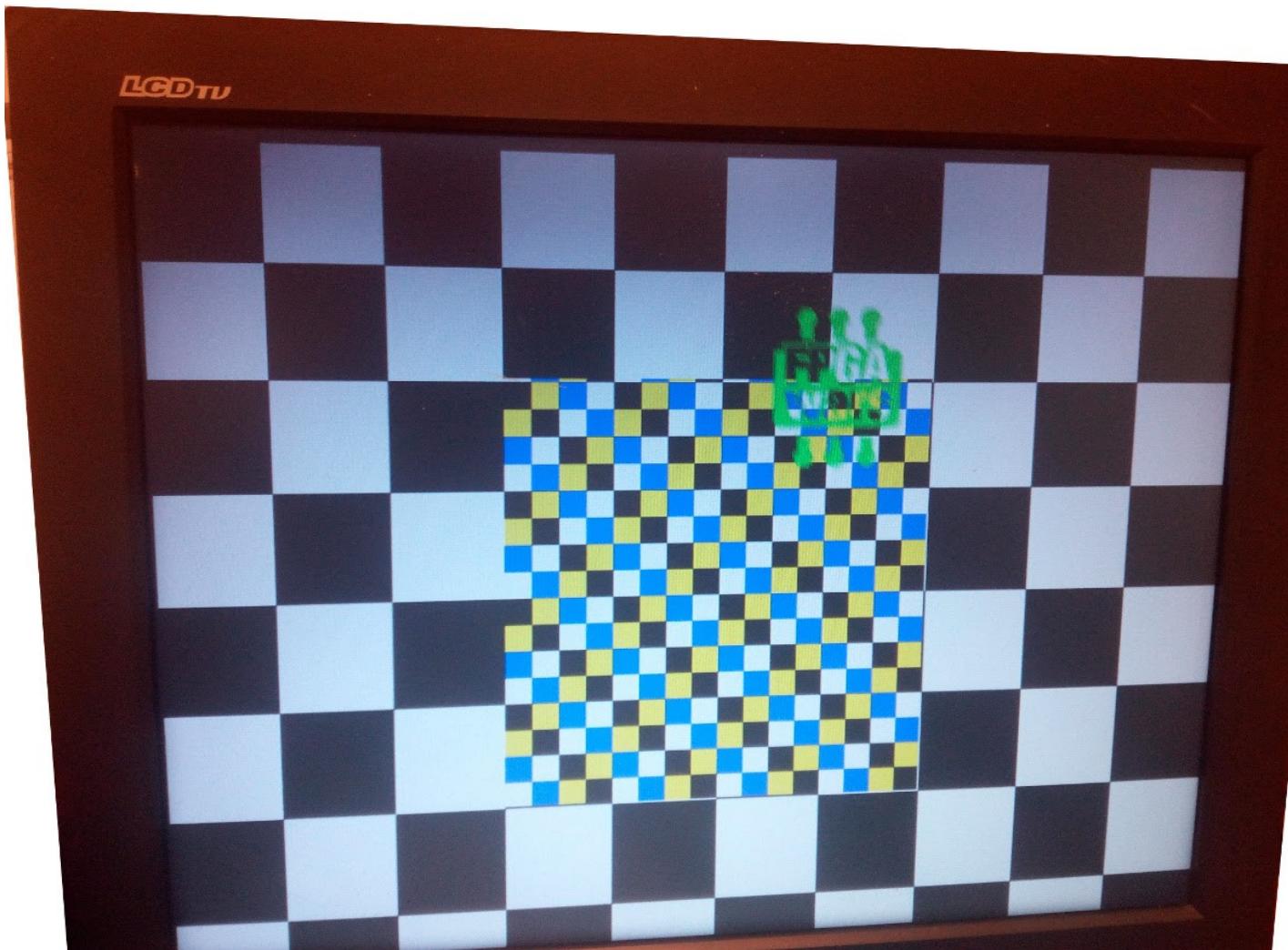


• Autor: Juan Manuel Rico

Screen-logo

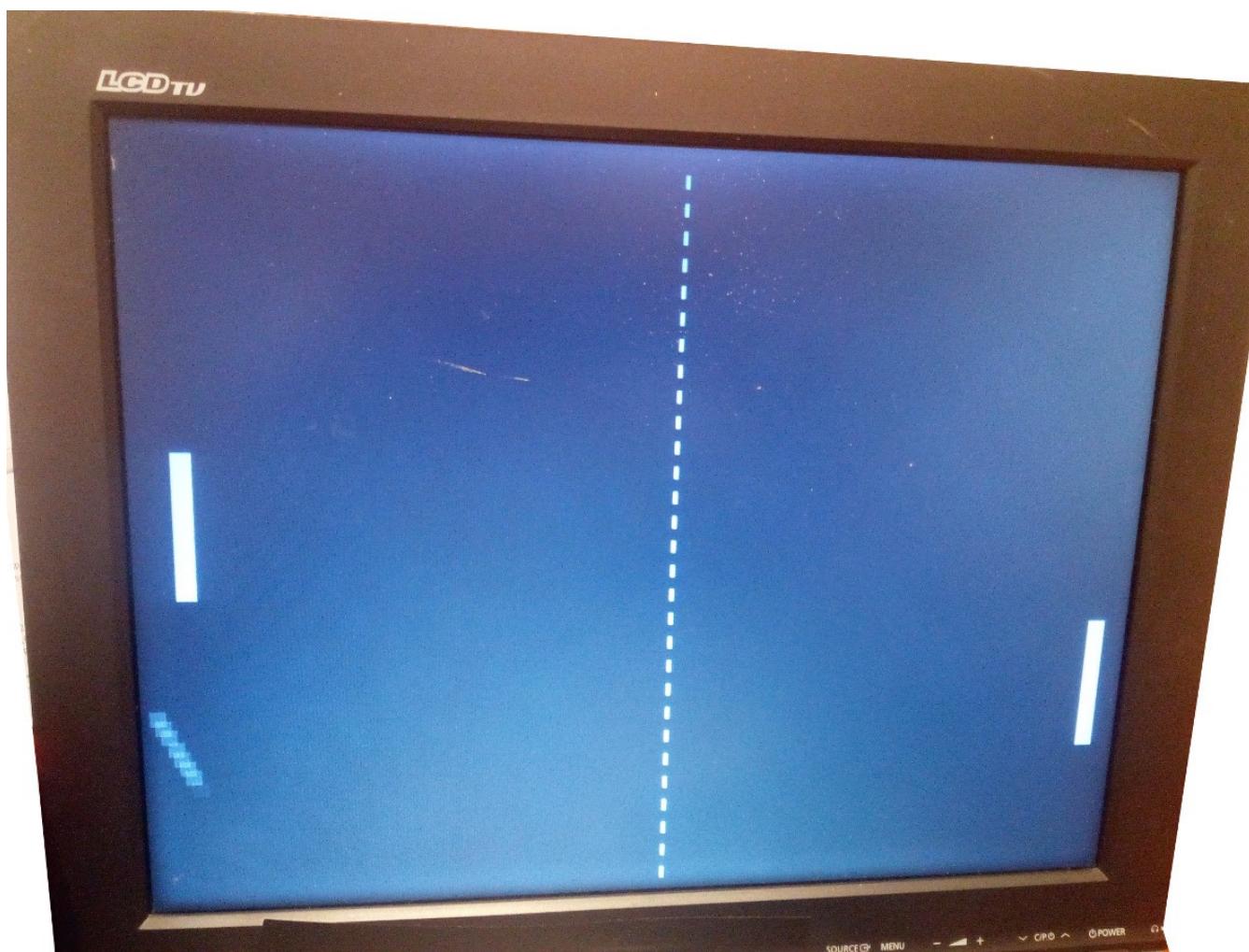


iPXs



- Autor: **Sergio Cuenca**

pong

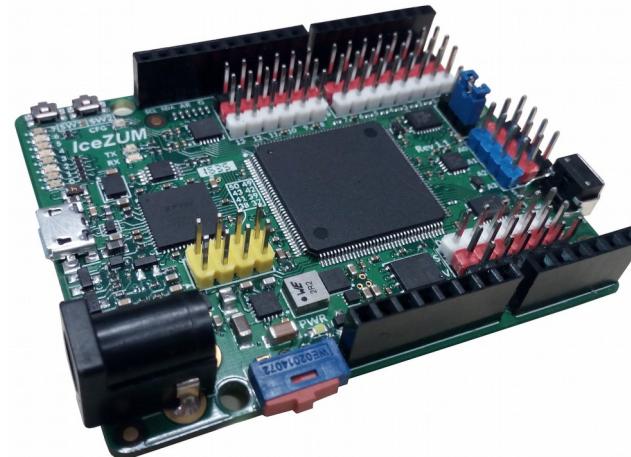
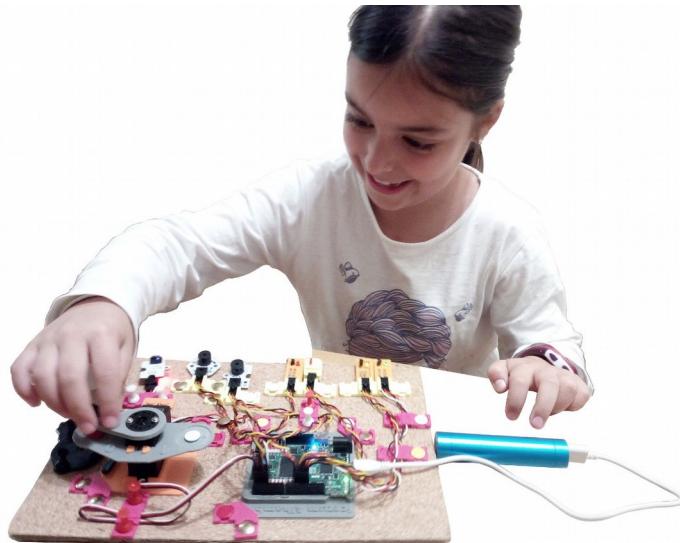


- Autor: Juan Manuel Rico

¡Que las FPGAs libres os acompañen!



Electrónica Digital Divertida con FPGAs libres



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[@Obijuan_cube](https://github.com/Obijuan)
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20 Noviembre de 2017

