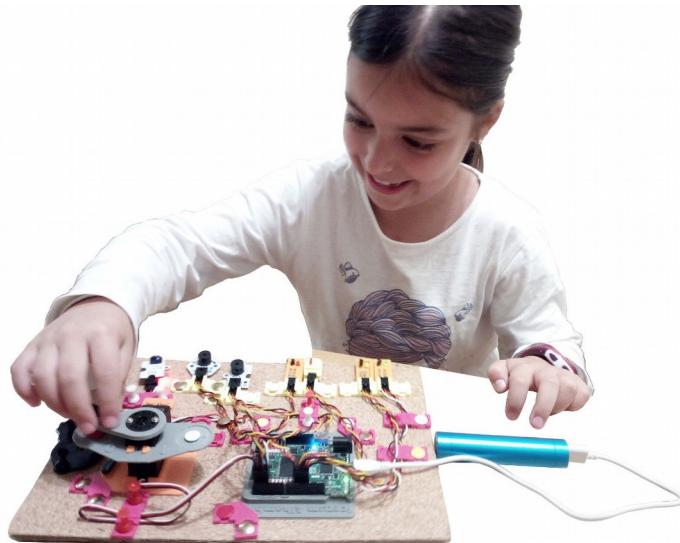


# Electrónica Digital Divertida con FPGAs libres



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



***Parte I: Viaje al interior de las nuevas tecnologías***

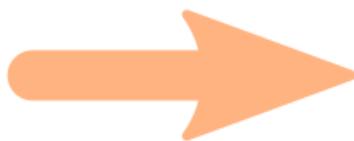
***Parte II: Electrónica digital y FPGAs Libres***

***Parte III: FPGAs libres en educación***

# Productos electrónicos y circuitos

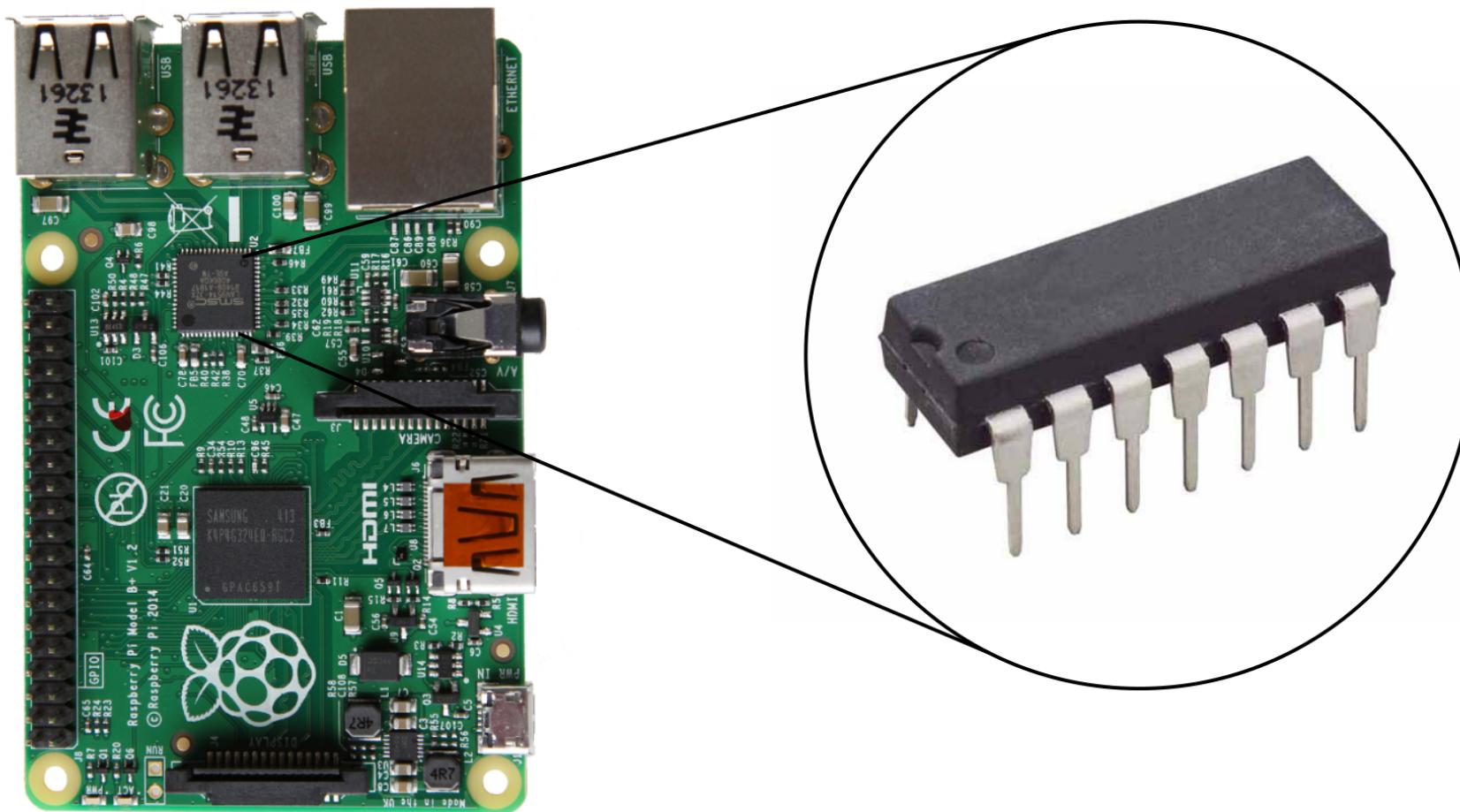


Producto Electrónico

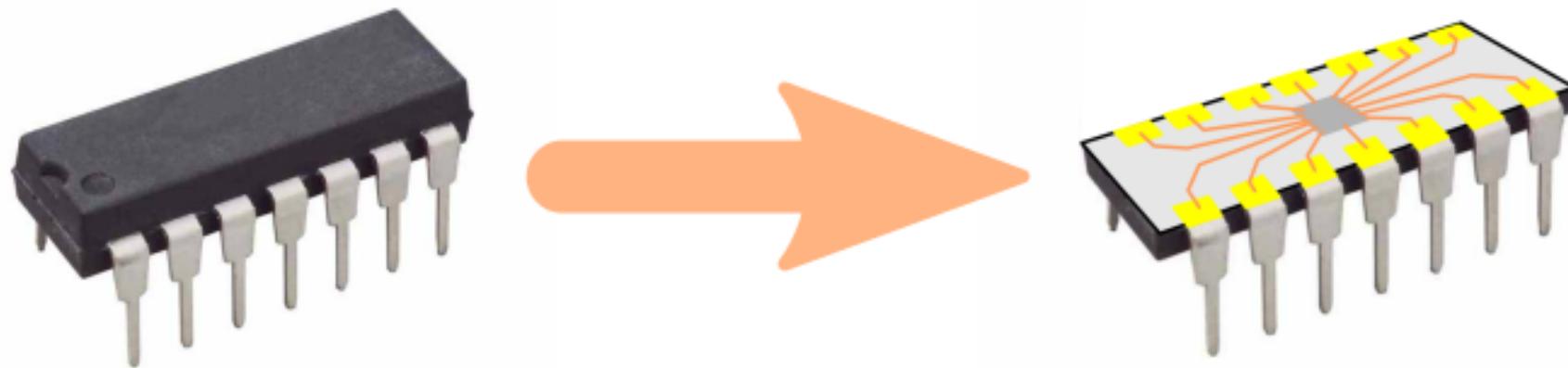


Circuito electrónico

# PCBs y Circuitos integrados

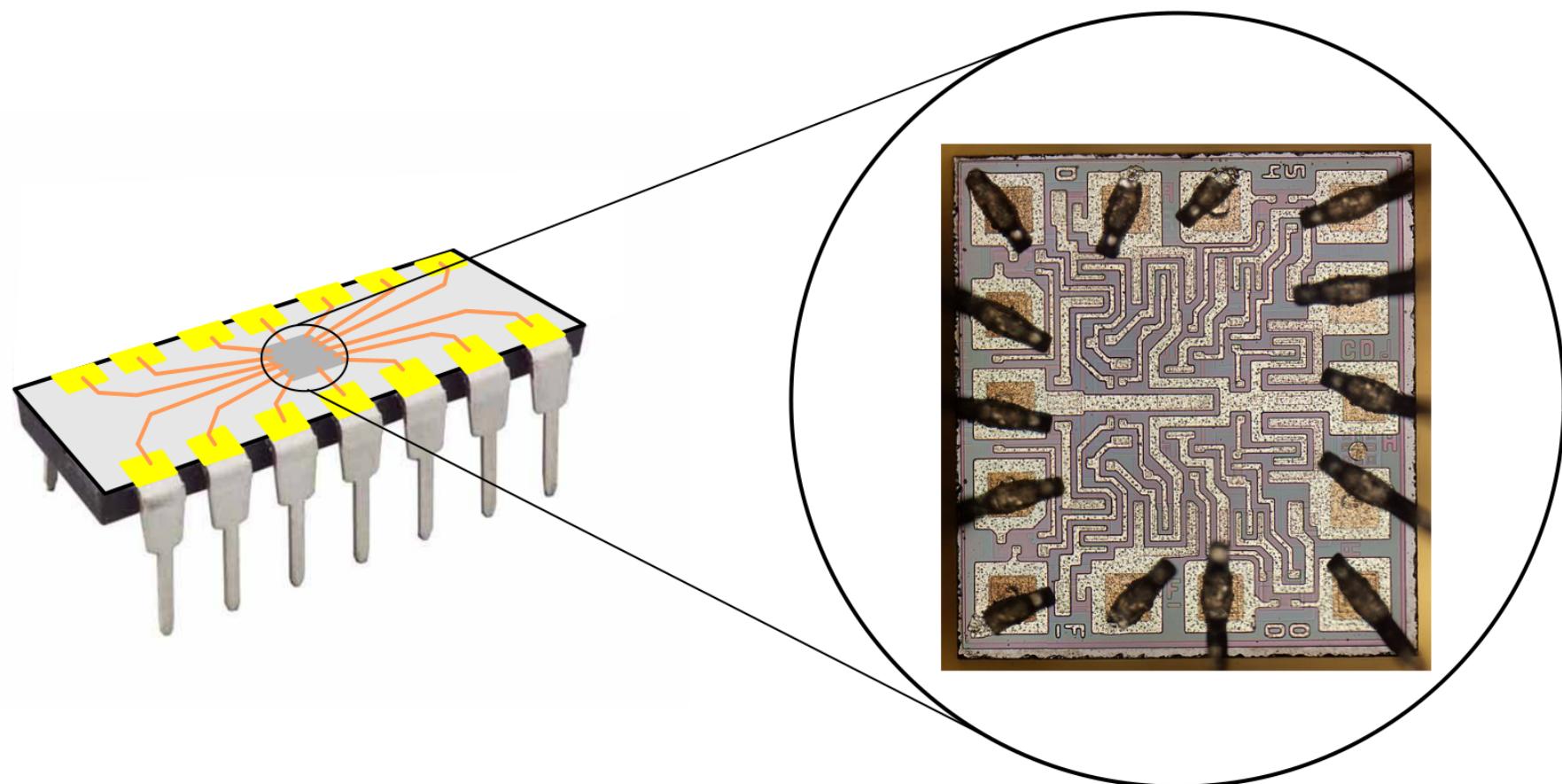


# Encapsulado y dado



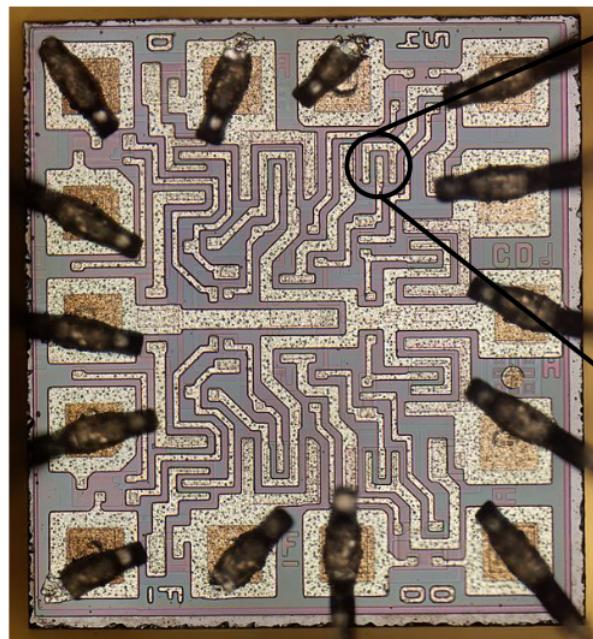
# Dado de silicio

*Demo:  
Proyecto 54/74*

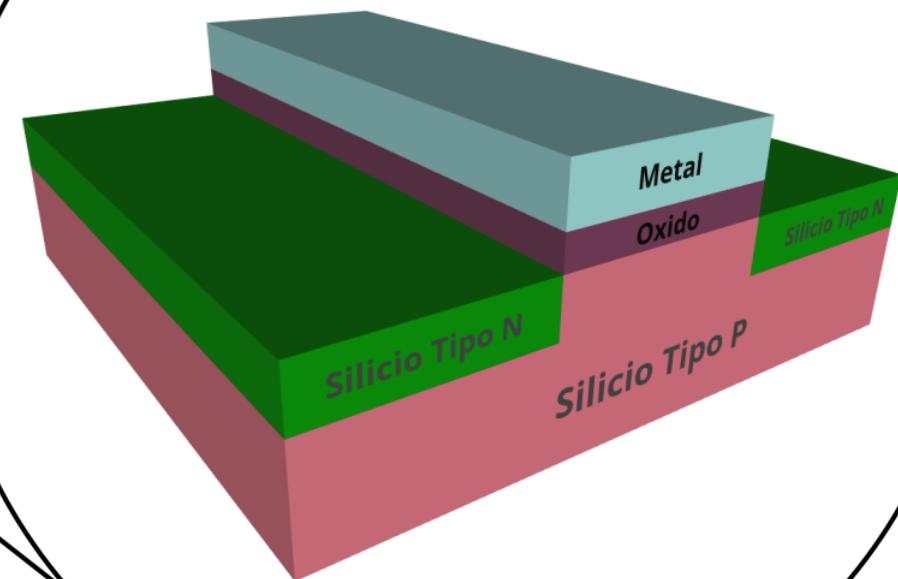


# Semiconductores

Dado

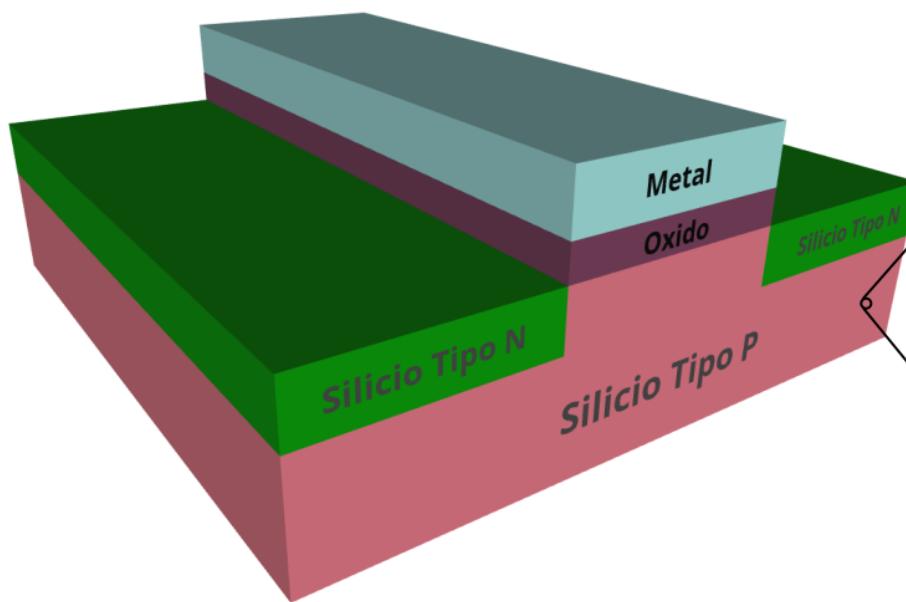


Transistor CMOS

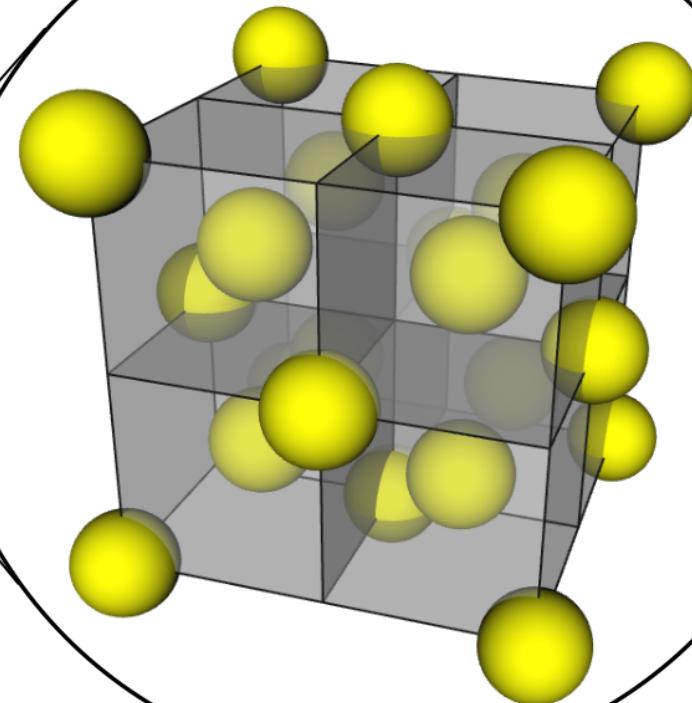


# Cristal de silicio

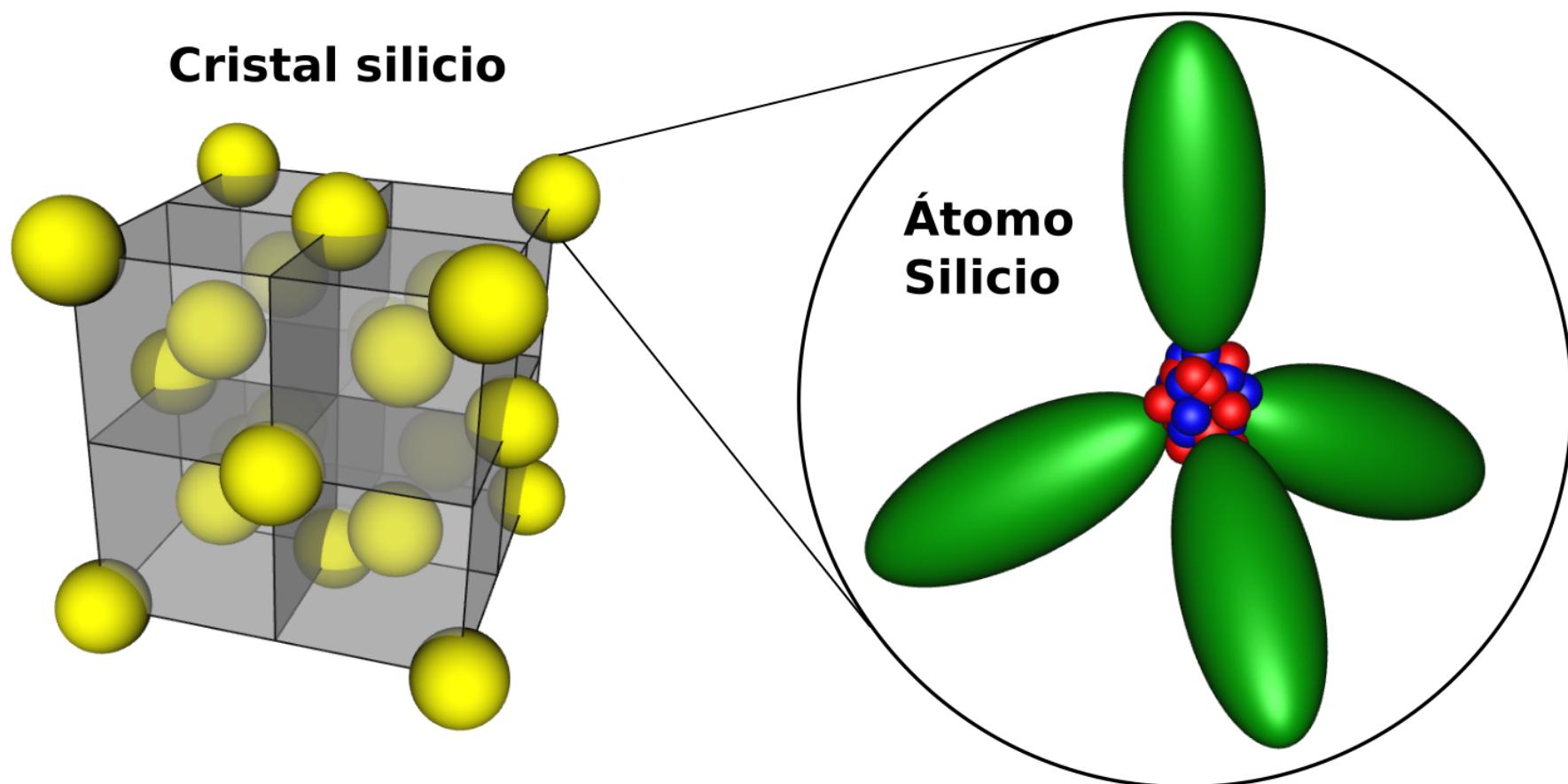
**Transistor CMOS**



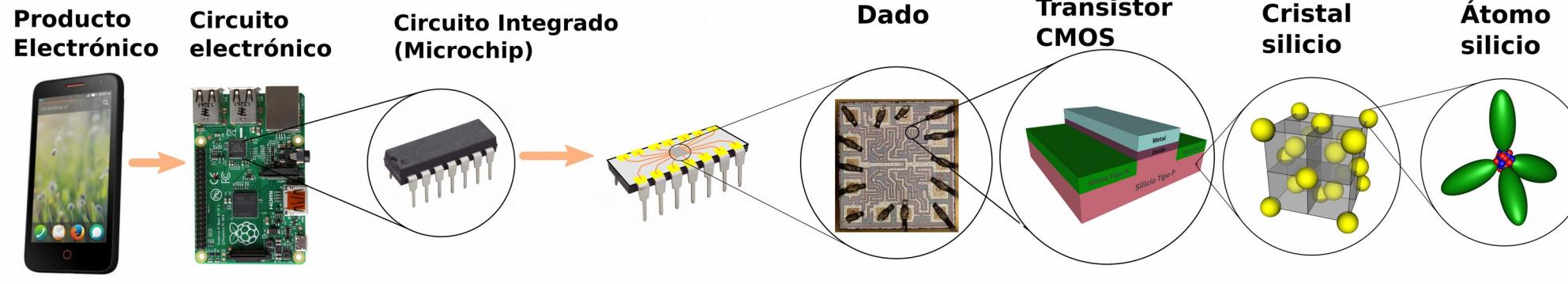
**Cristal silicio**



# Átomos :-)



# Del producto al átomo



# Niveles

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

## ***Parte II: Electrónica digital y FPGAs Libres***

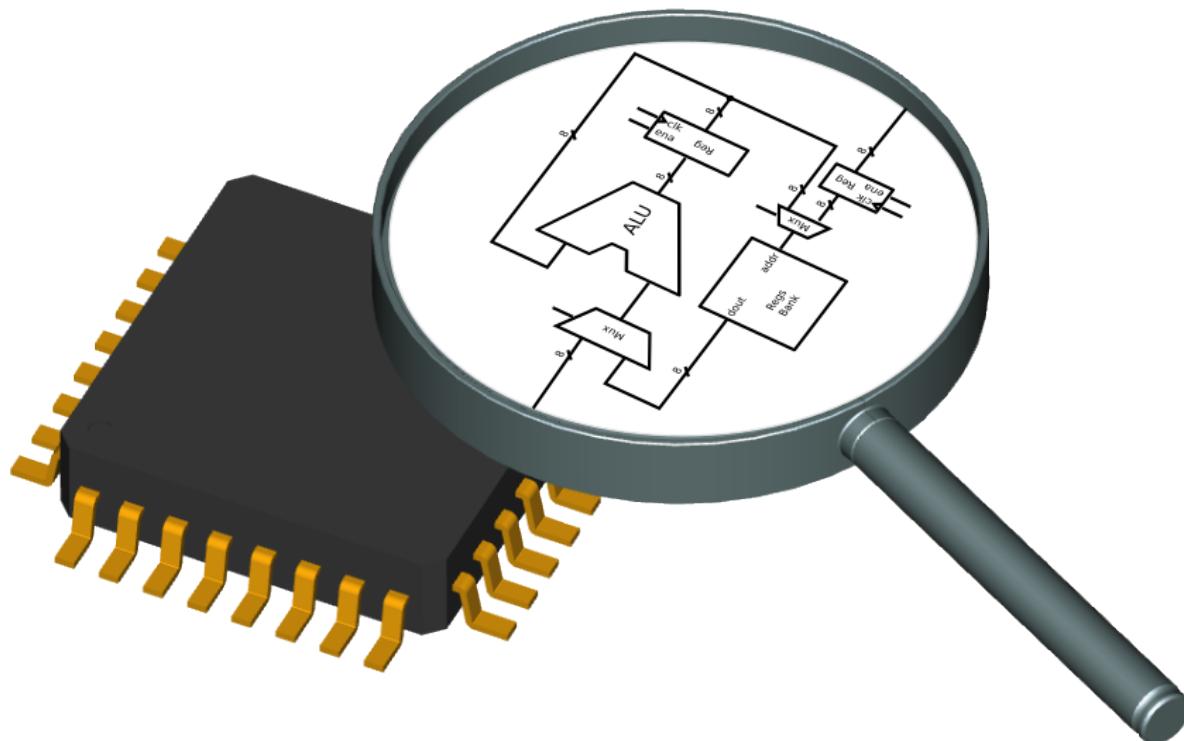
# Niveles

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



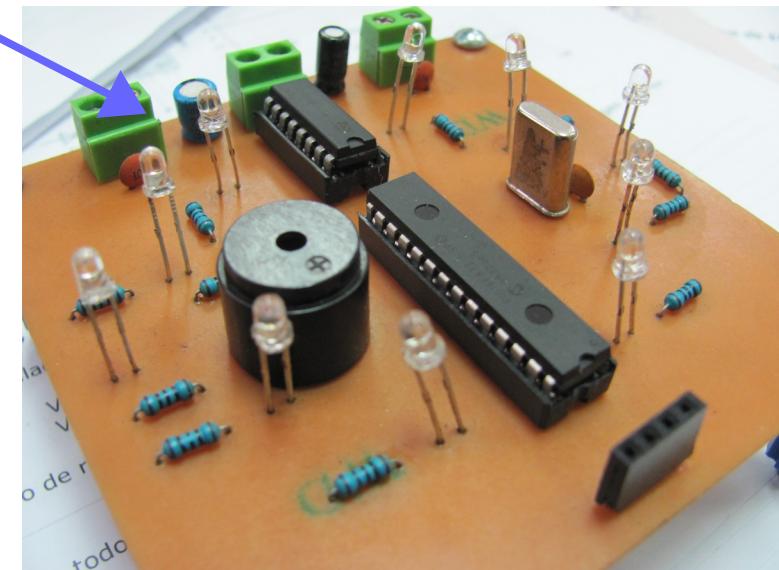
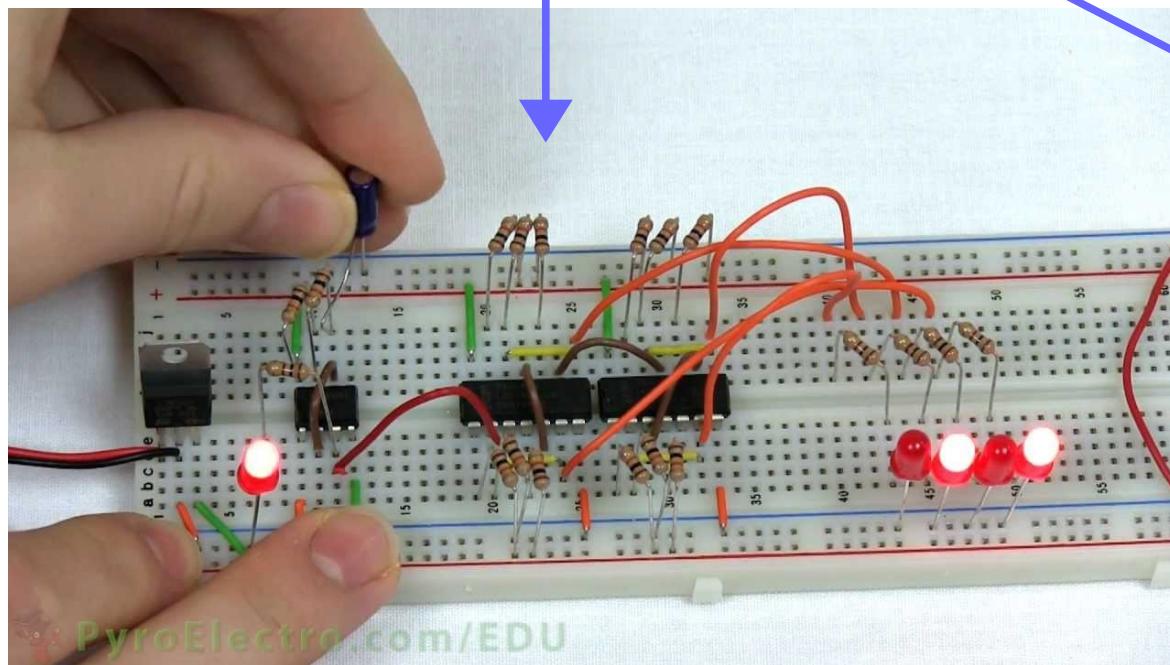
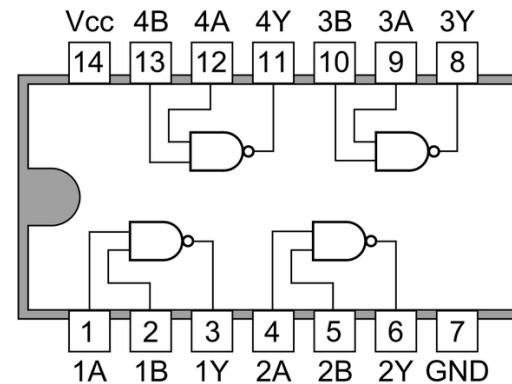
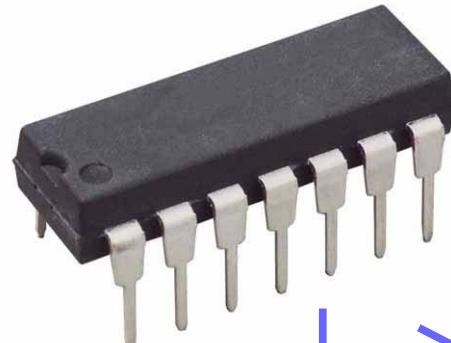
**Electrónica  
digital**

# Electrónica digital

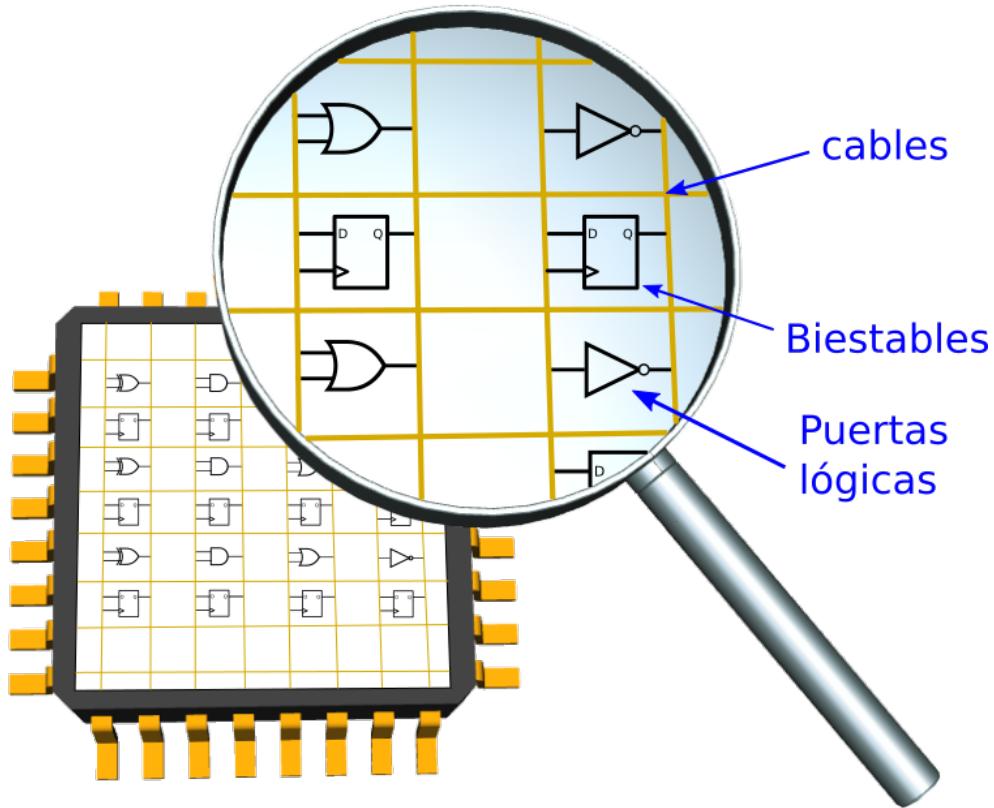


- Nivel de electrónica digital
- Información: Sólo 1s y 0s (Bits)
- Función: **Manipular, almacenar y transportar** bits
- Tres elementos: Cables, biestables y puertas lógicas

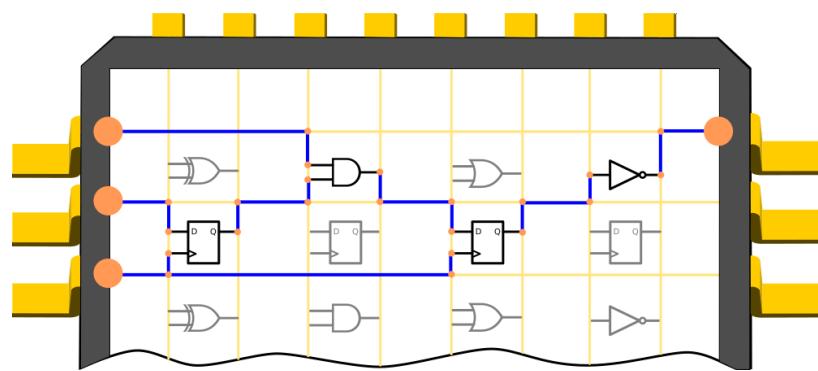
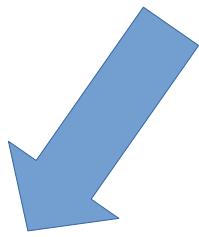
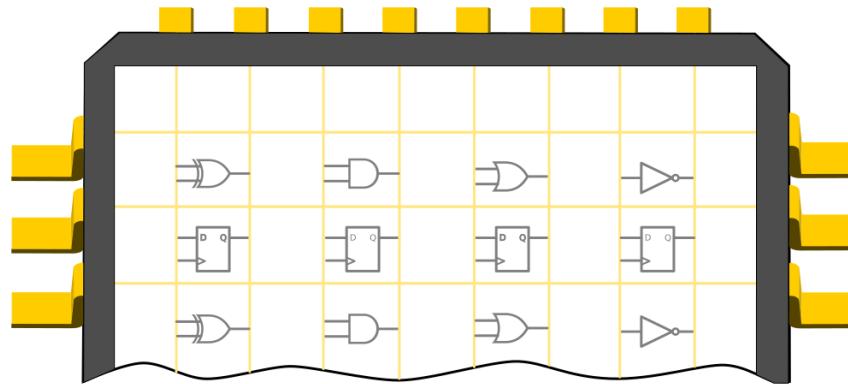
# ¿Cómo se hacen los circuitos digitales?



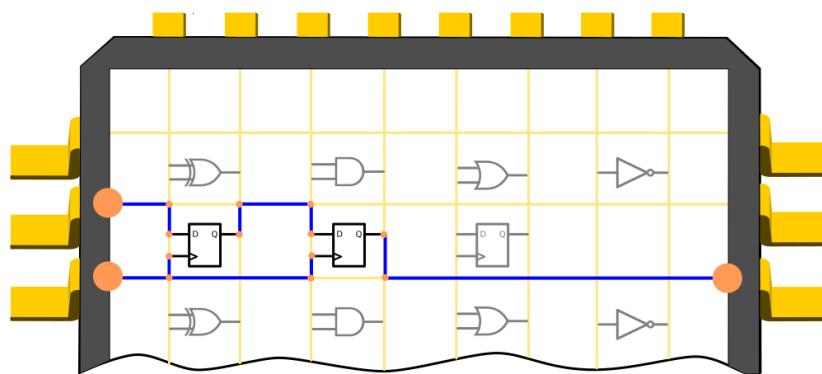
# Tecnología FPGA



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

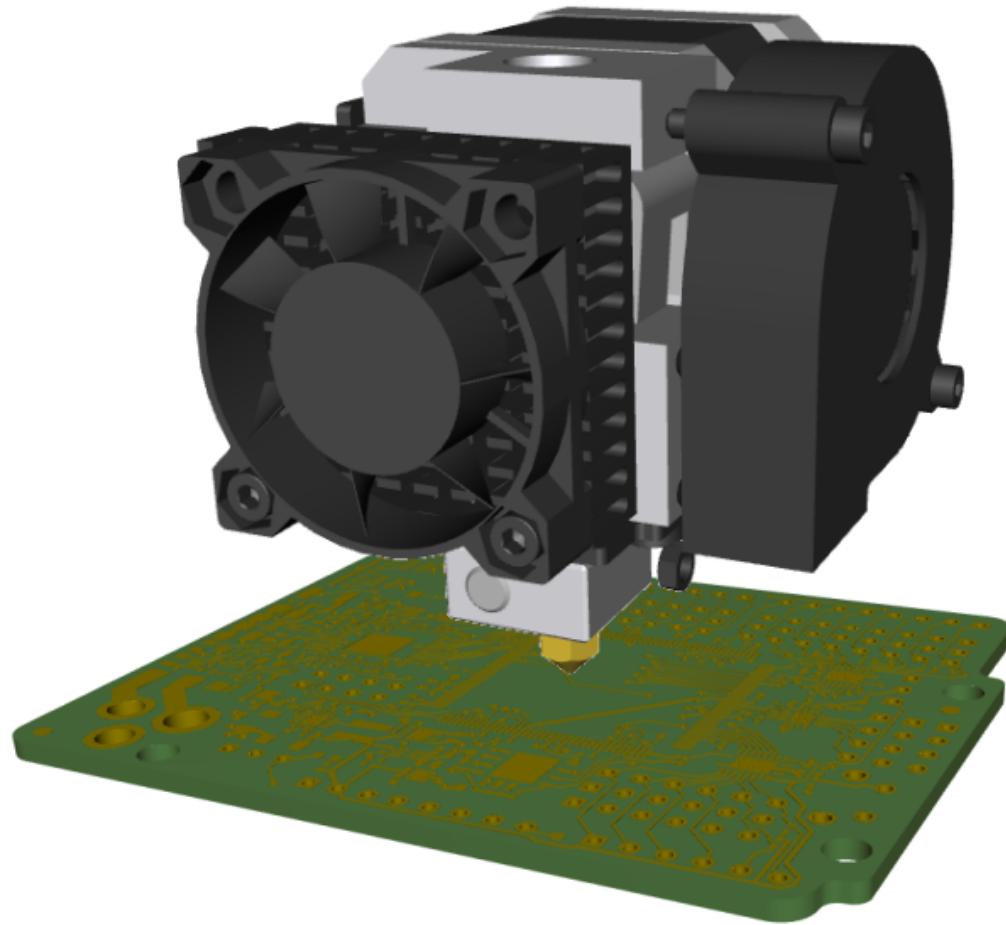


**Circuito 1**

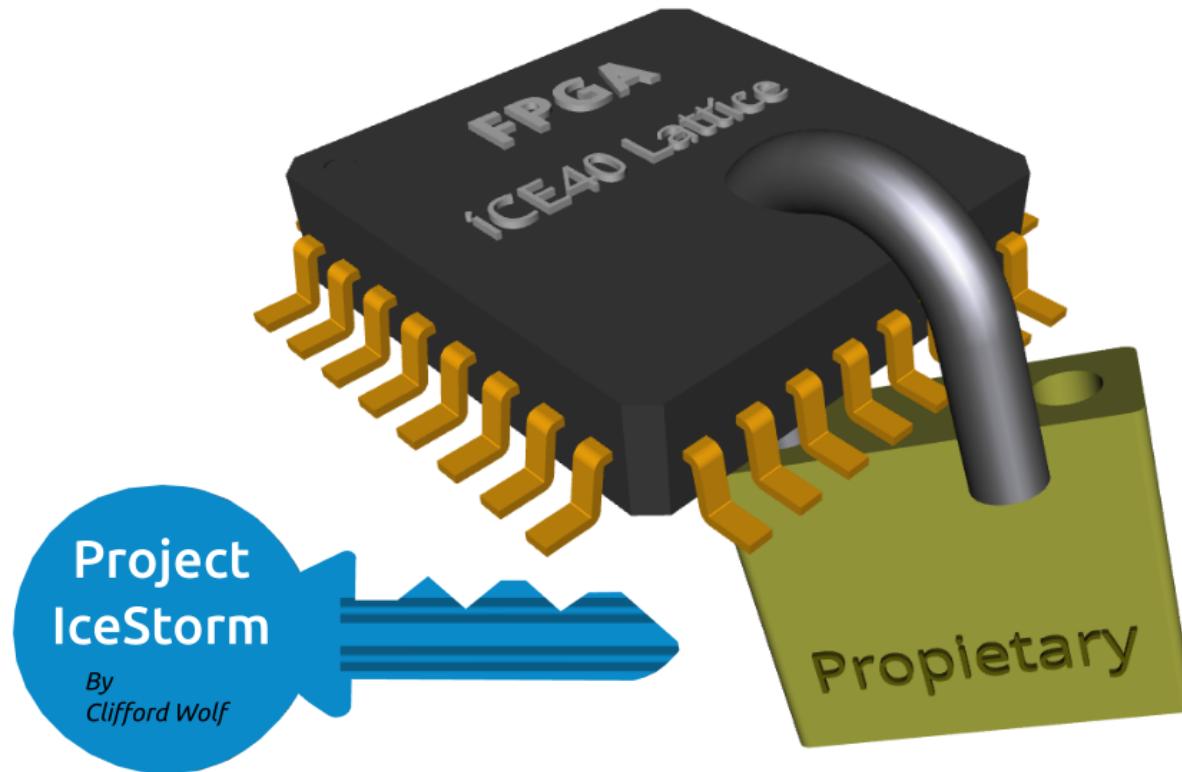


**Circuito 2**

**¡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

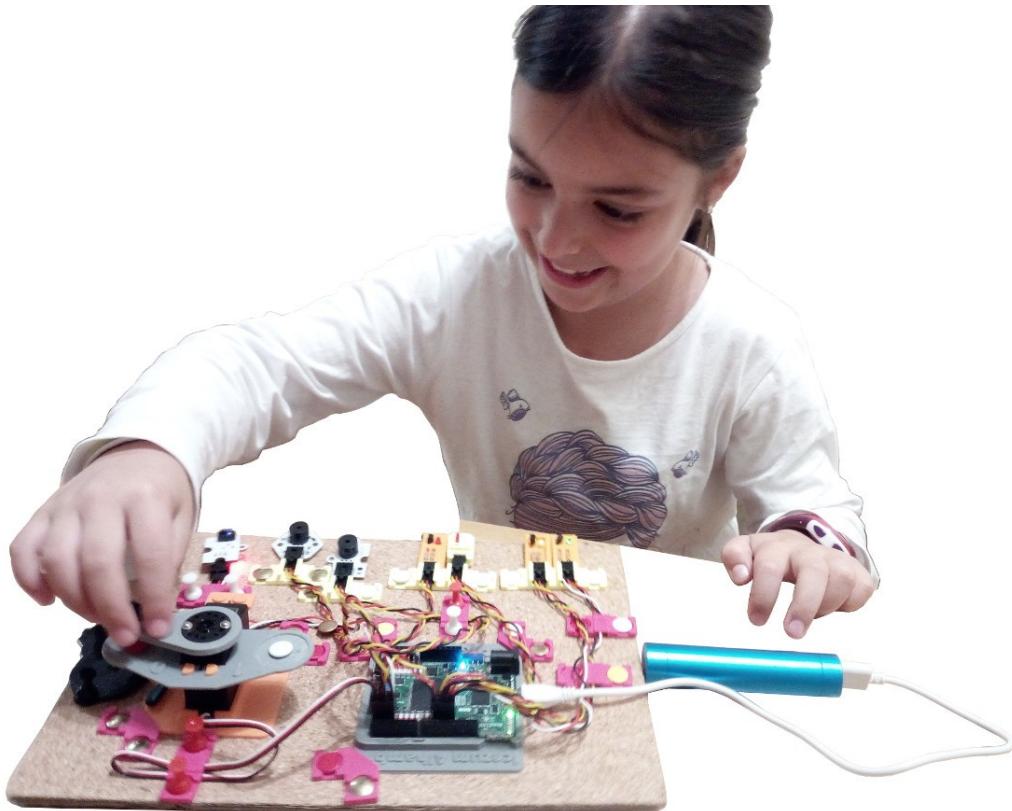


- Comunidad para **compartir conocimiento** relacionado con **FPGAs libres**
- Es el **clonewars** de las FPGAs, pero en modesto :-)
- Idioma: Castellano
- 522 miembros
- Cualquier pregunta / comentario / sugerencia → Correo a la lista :-)

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

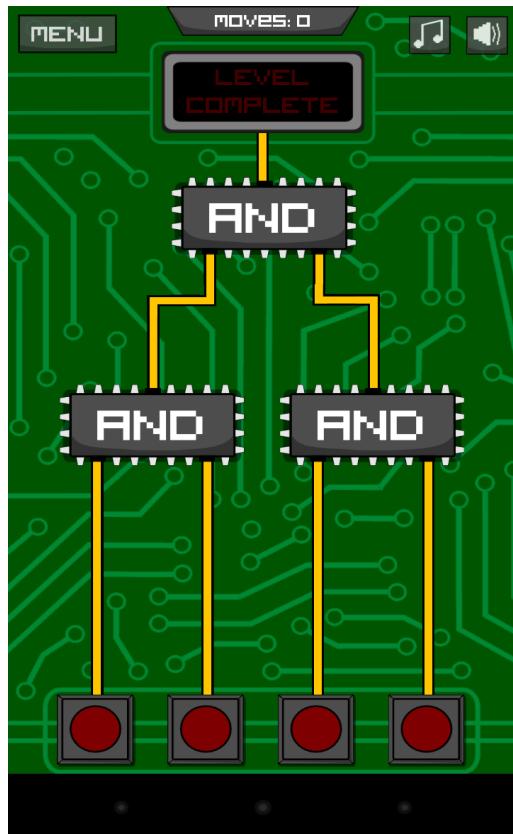
## ***Parte III: FPGAs libres en educación***

# Electrónica digital divertida

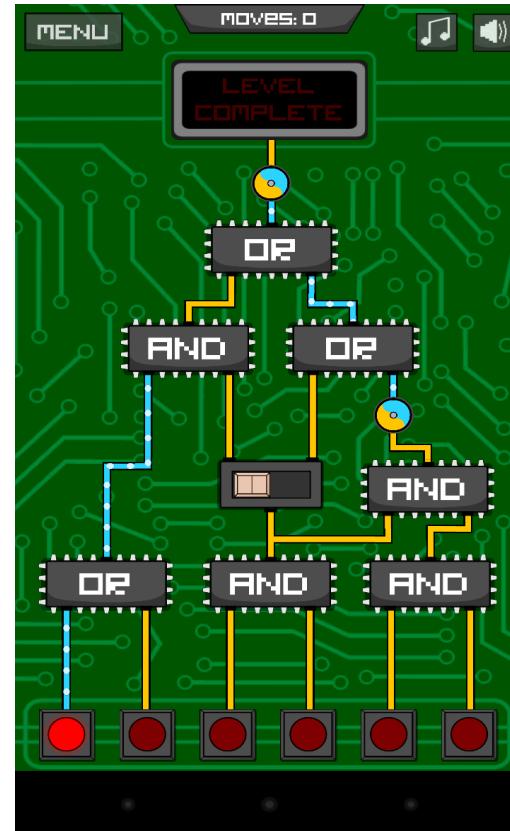


## Motivación

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



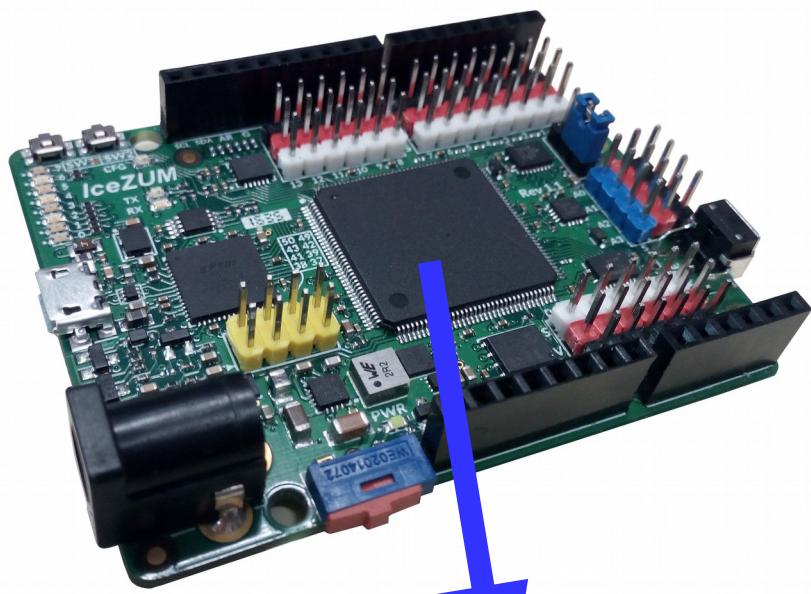
APP:  
Circuit  
Scramble



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

# Icezum Alhambra v1.1

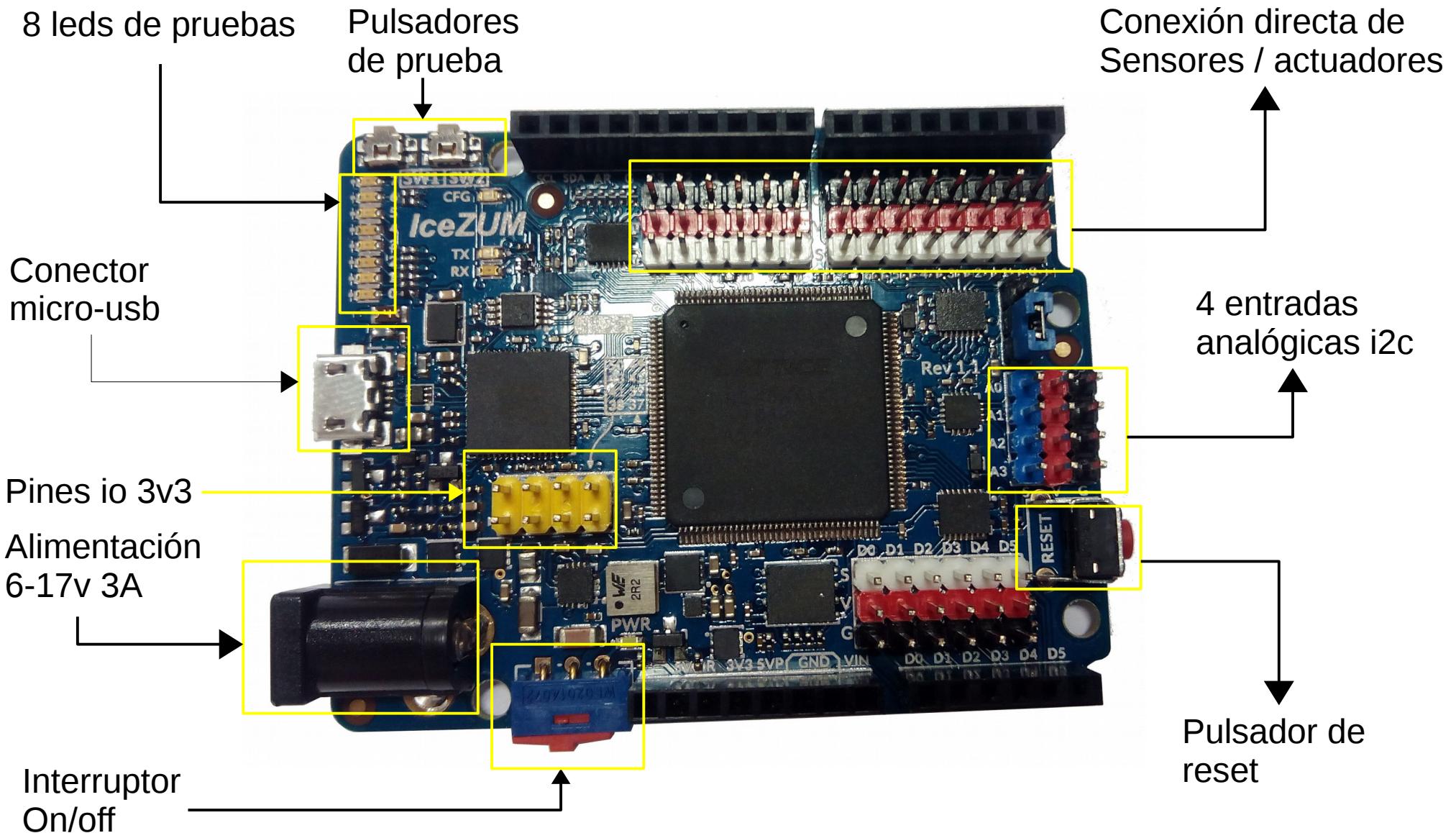
<https://github.com/FPGAwars/icezum/wiki>



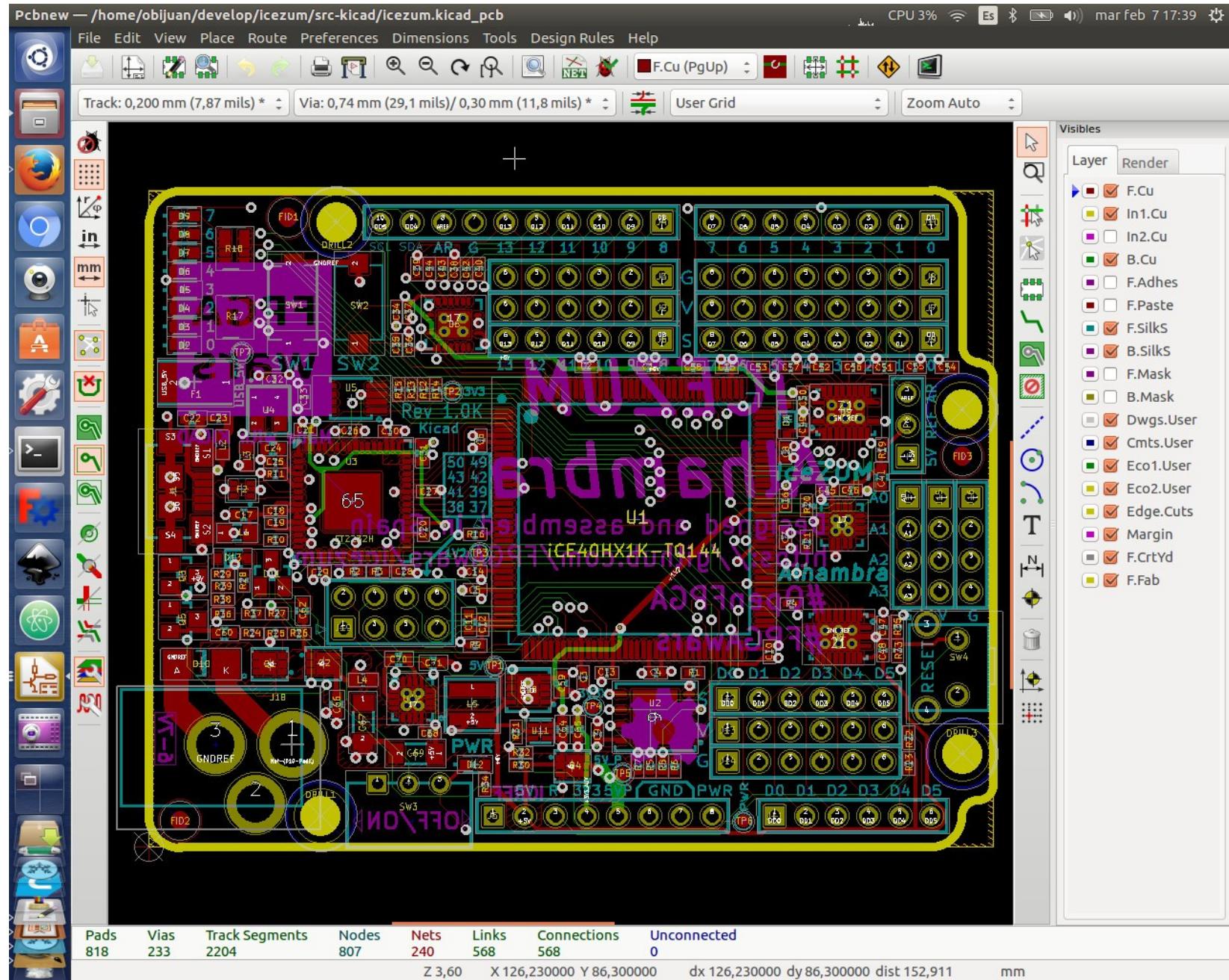
**FPGA Libre**

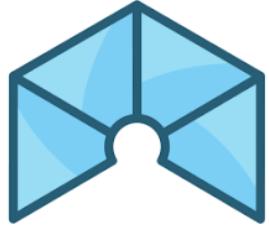
- Autor: **Eladio Delgado**
- Diseñada en Pinos del Valle (Granada)
- Arduino de las **FPGAs**
- Compatible Arduino
- Fácil conexión de circuitos externos/sensores/servos
- Reutilización de los shields de arduino
- 20 entradas/salidas de 5v
- 3A corriente de entrada
- Perfecta para hacer robots

# Icezum Alhambra v1.1

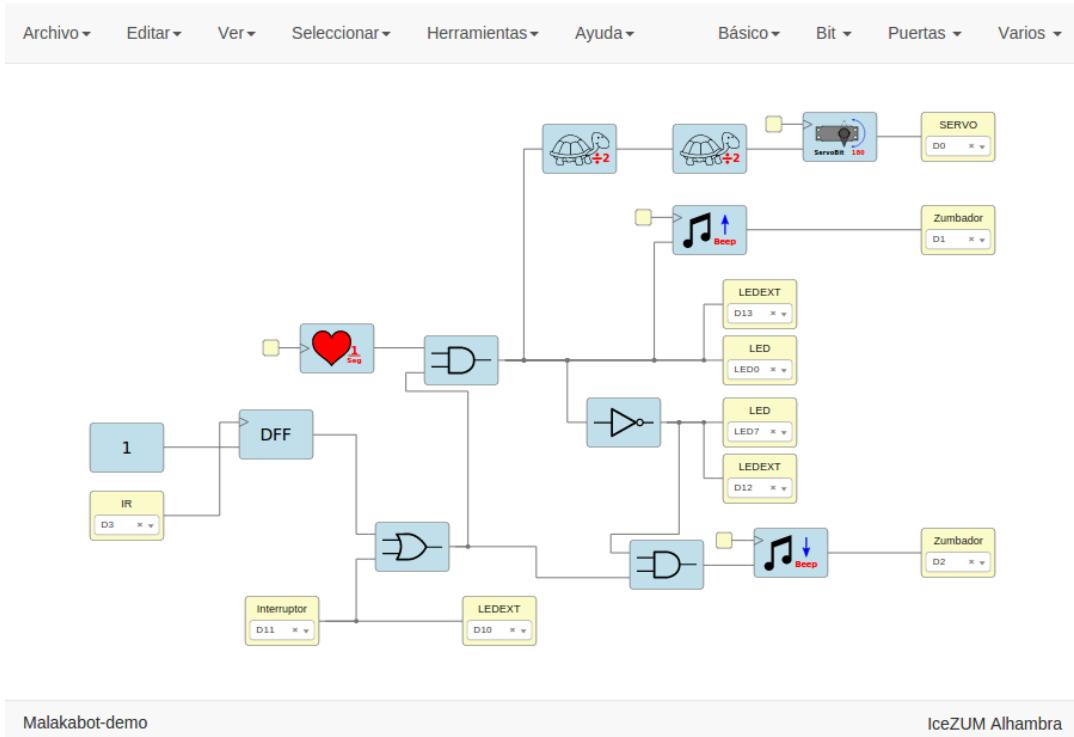


# Esquemas en Kicad





# Icestudio

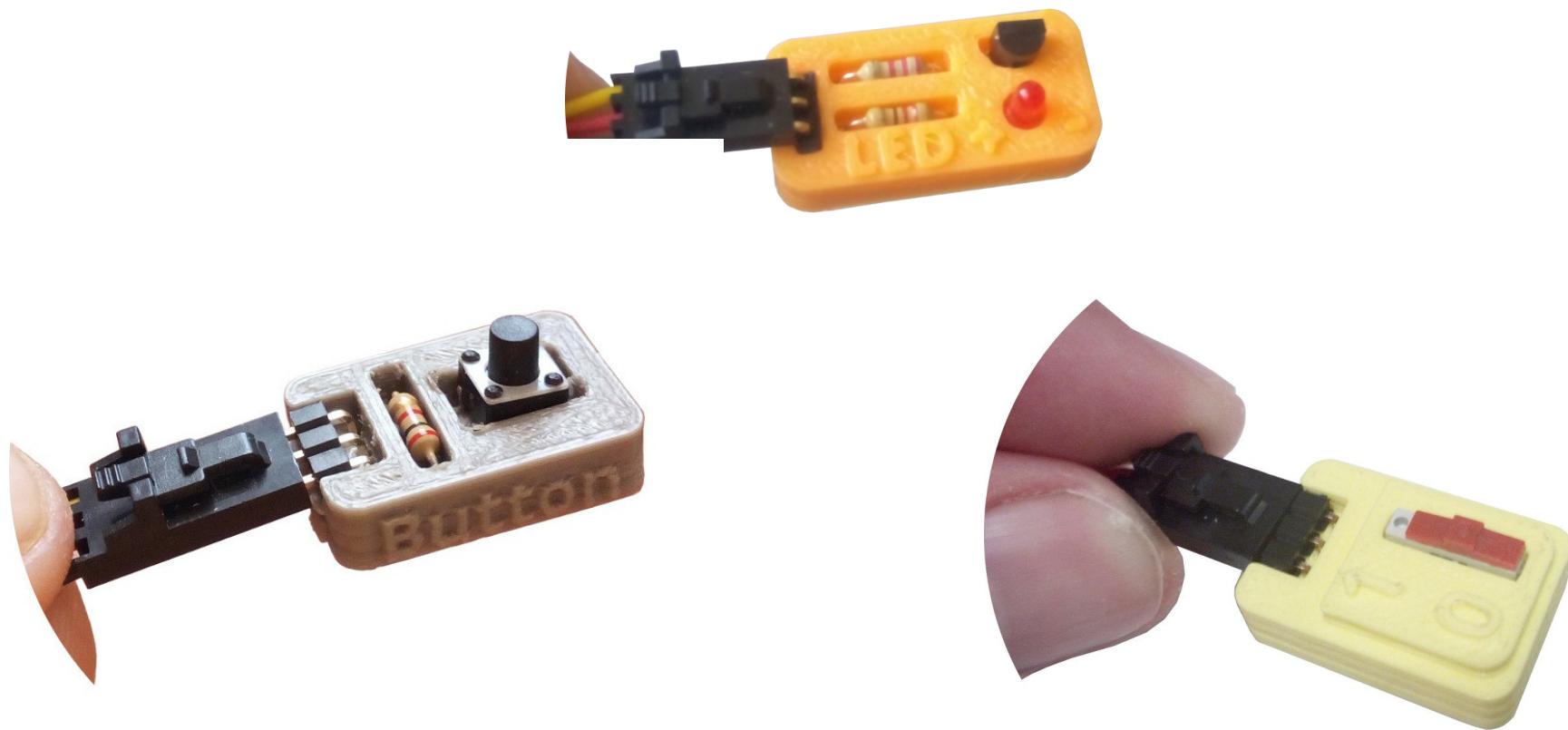


<https://github.com/FPGAwars/icestudio>

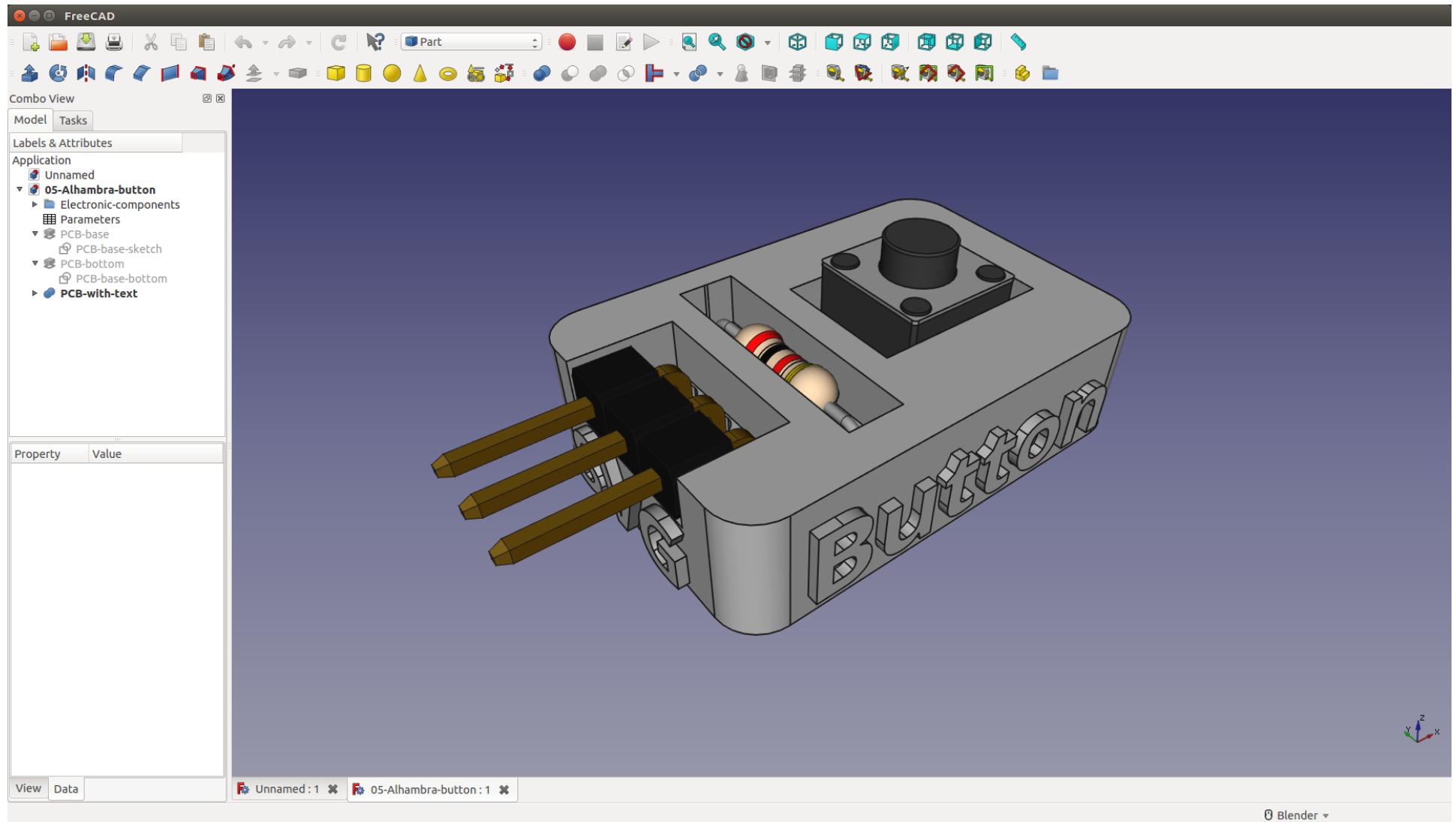
- Autor: **Jesús Arroyo**
- Electrónica digital para todos
- Herramienta visual
- Traduce a verilog

# Periféricos

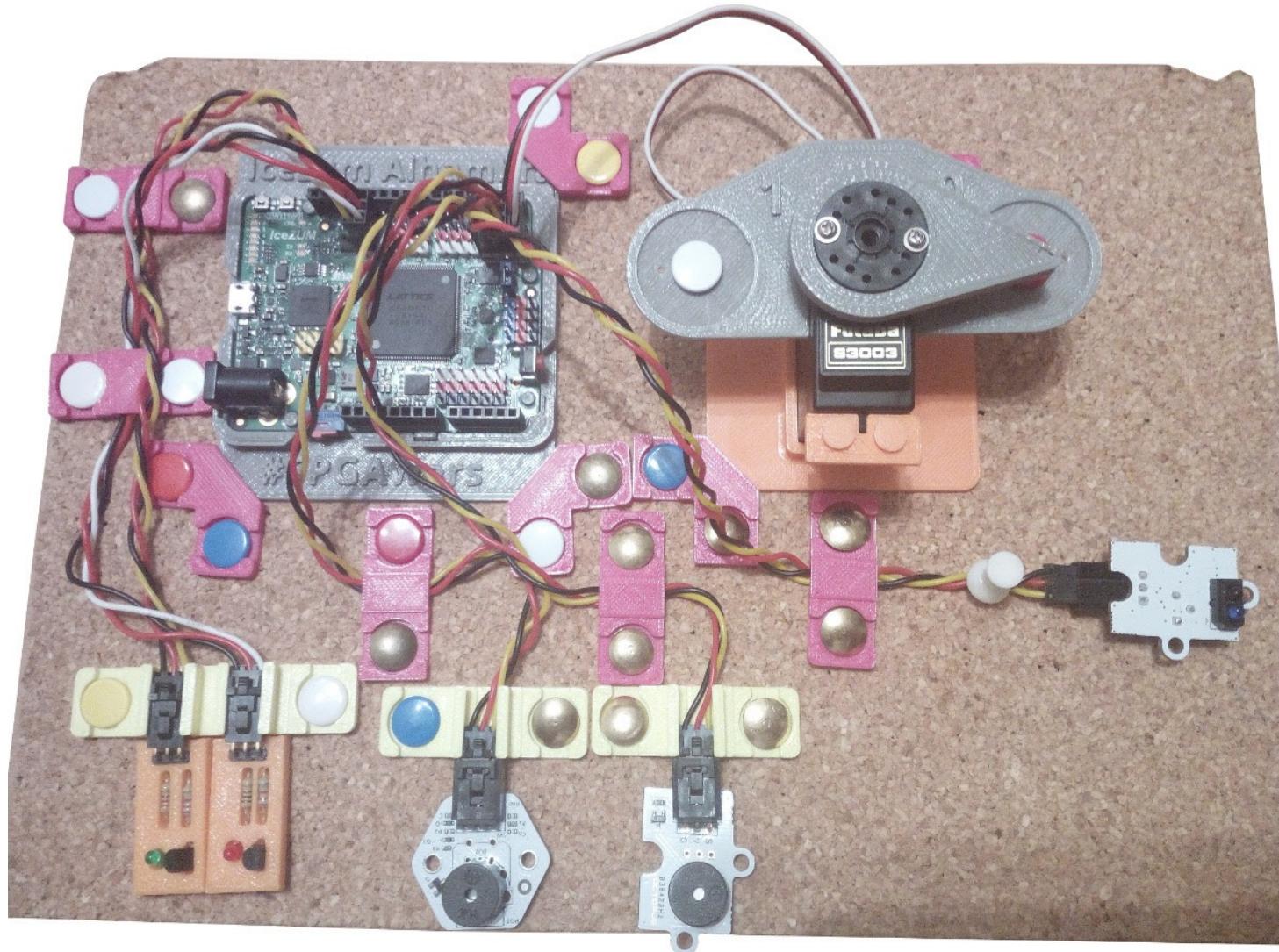
**PCBprints:** Mini-circuitos impresos en 3D



# Diseño en Kicad



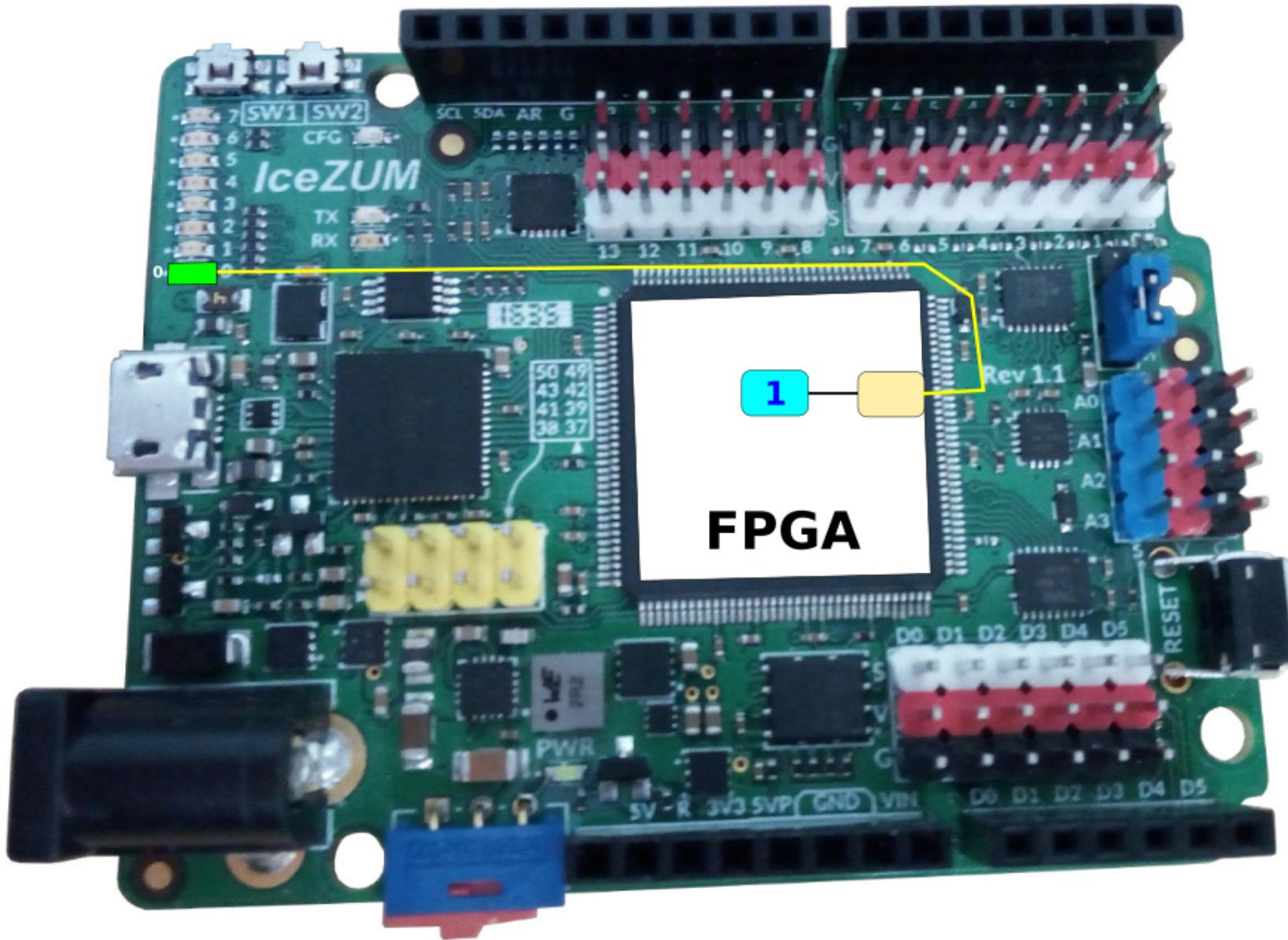
# ¡Empezamos!



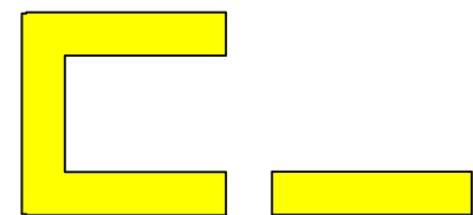
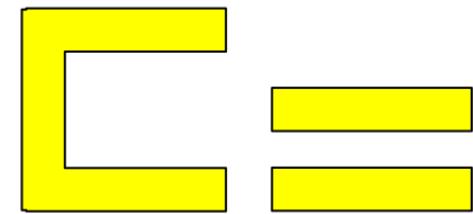
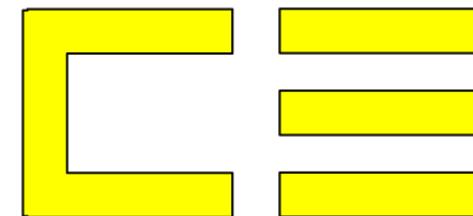
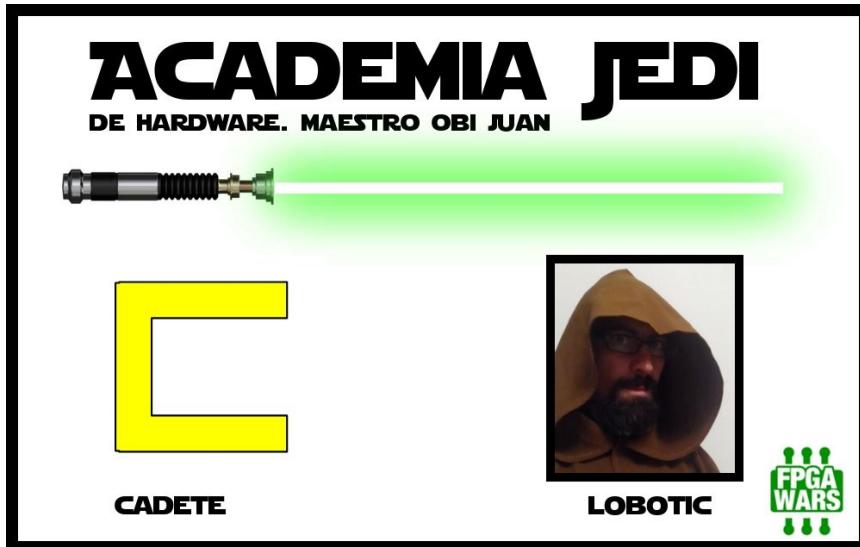
# Ejemplo 1: Hola Mundo



# 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](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.

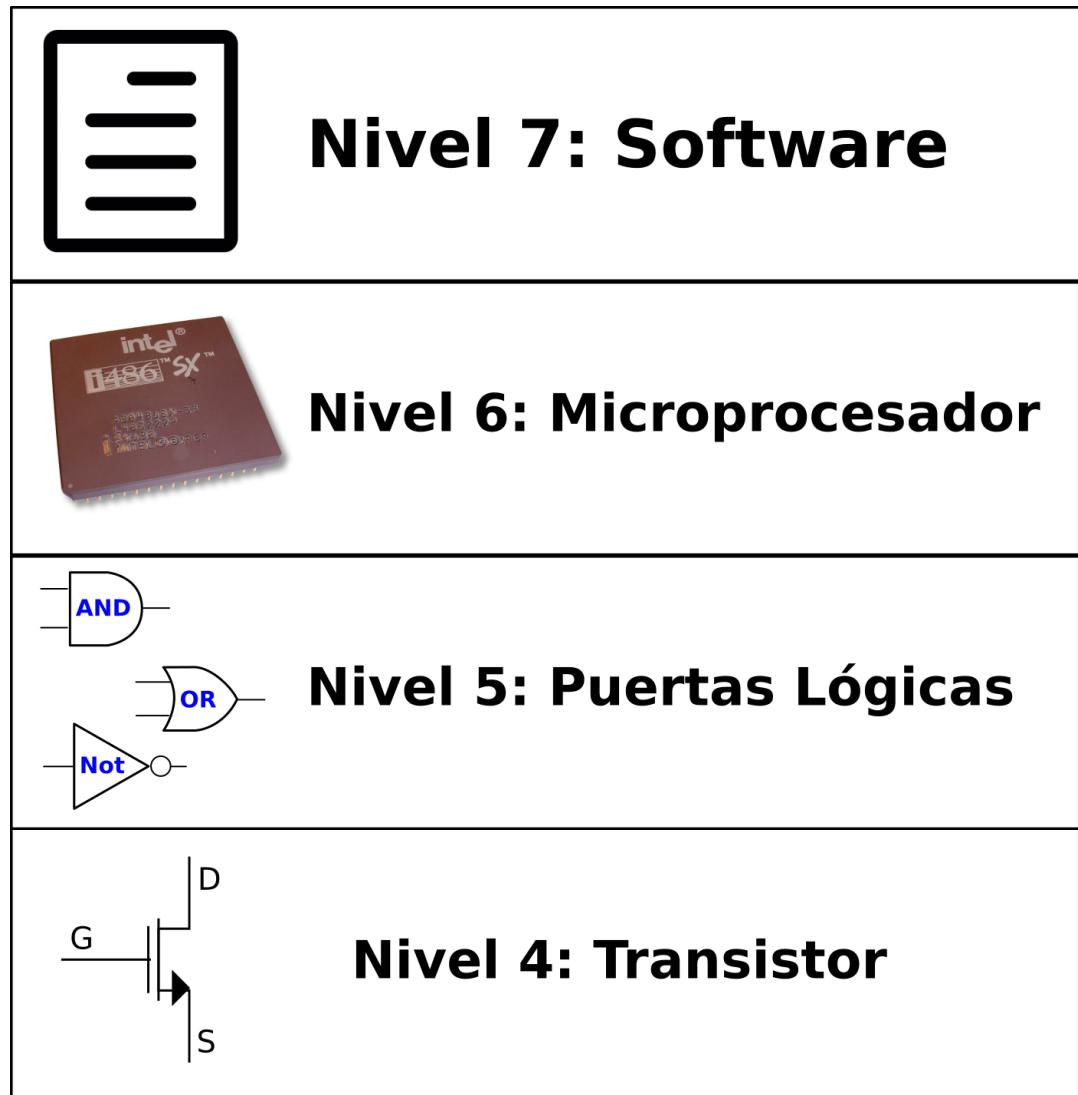
Sketch uses 496 bytes (35%) of program storage space. Maximum j  
Global variables use 10 bytes (7%) of dynamic memory, leaving I

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

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



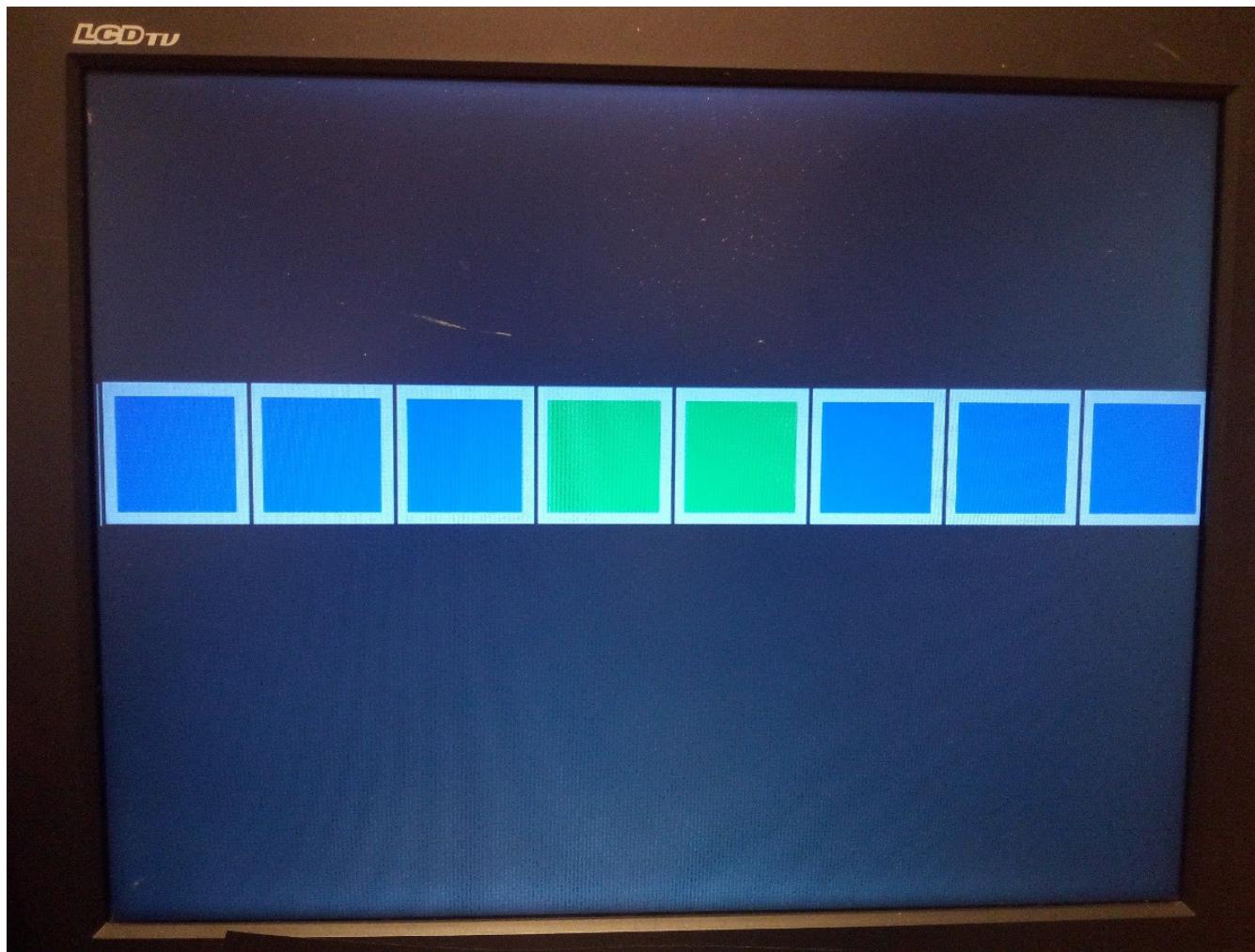
# Lattuino (II)



# VGA: Monsterled

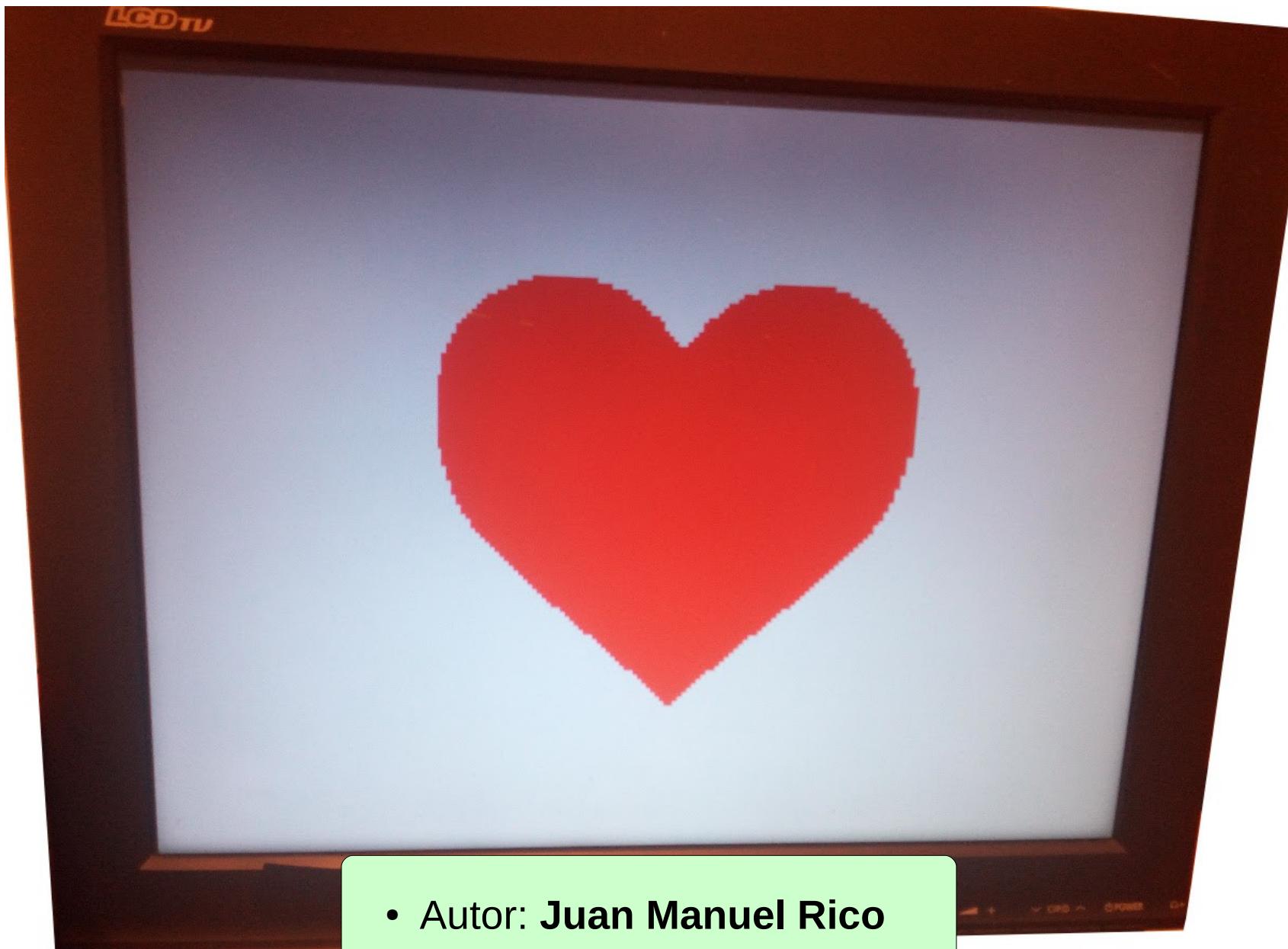


# Screen-leds



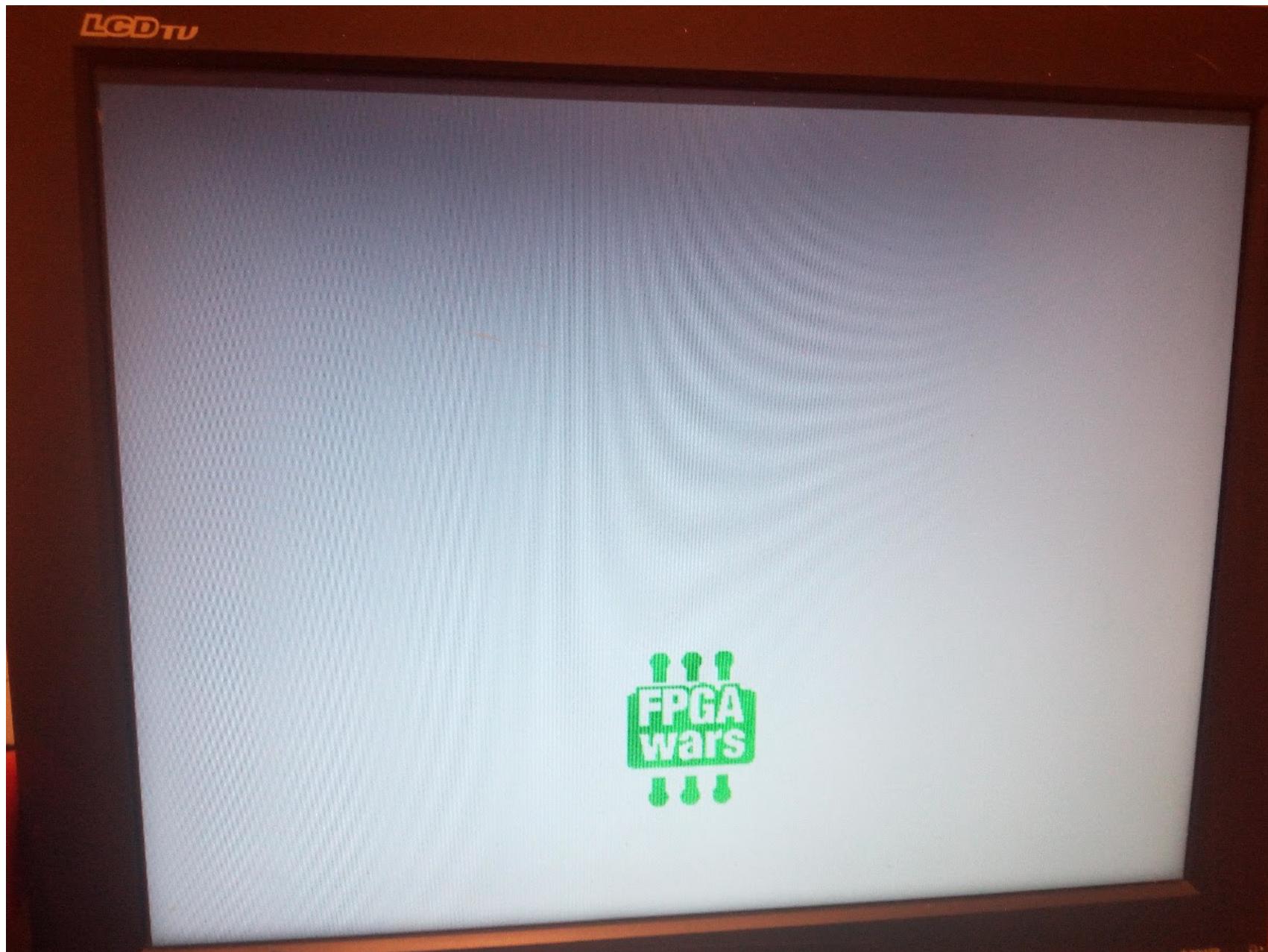
- Autor: Juan Manuel Rico

# Screen-heart

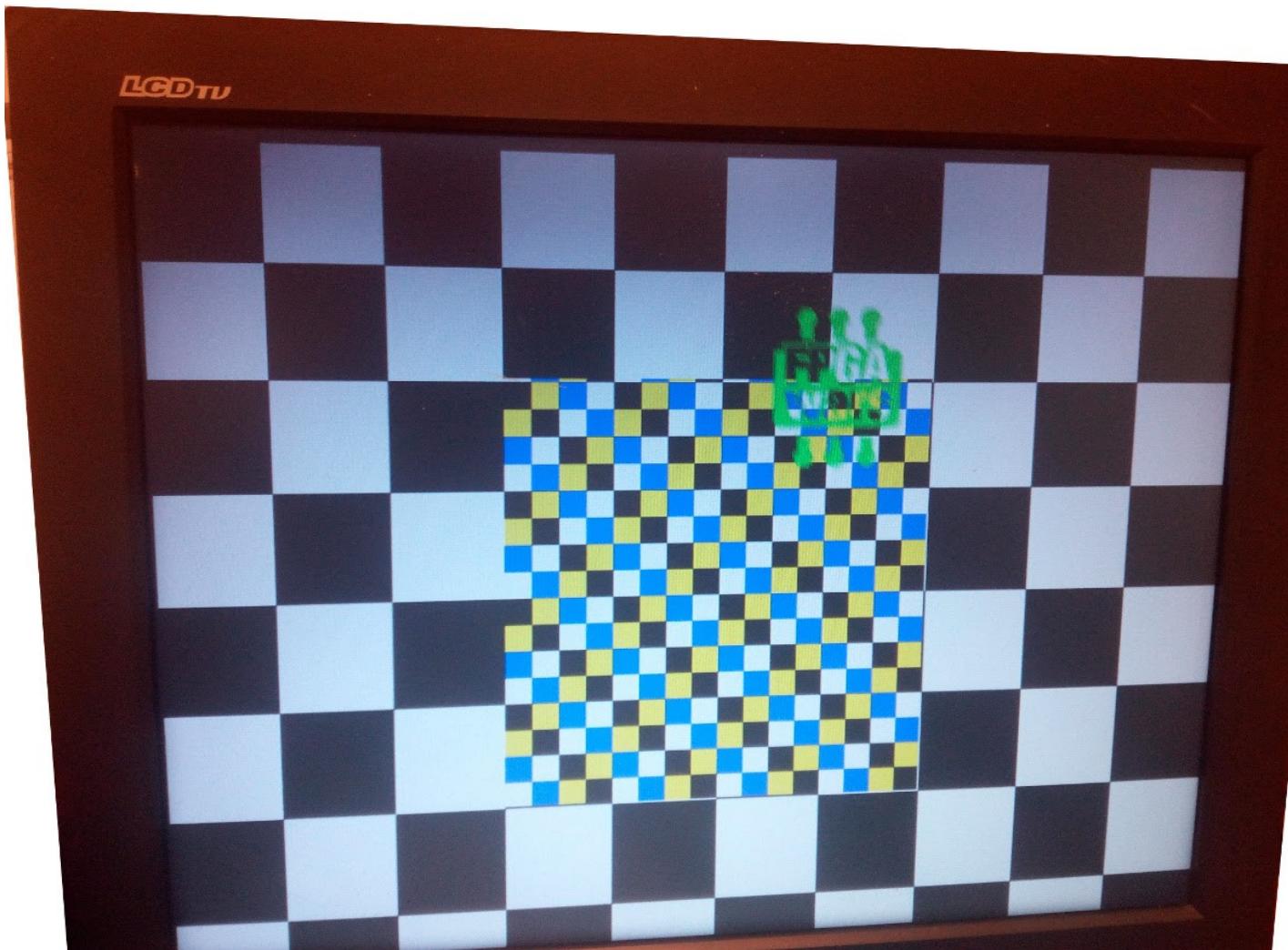


• Autor: Juan Manuel Rico

# Screen-logo

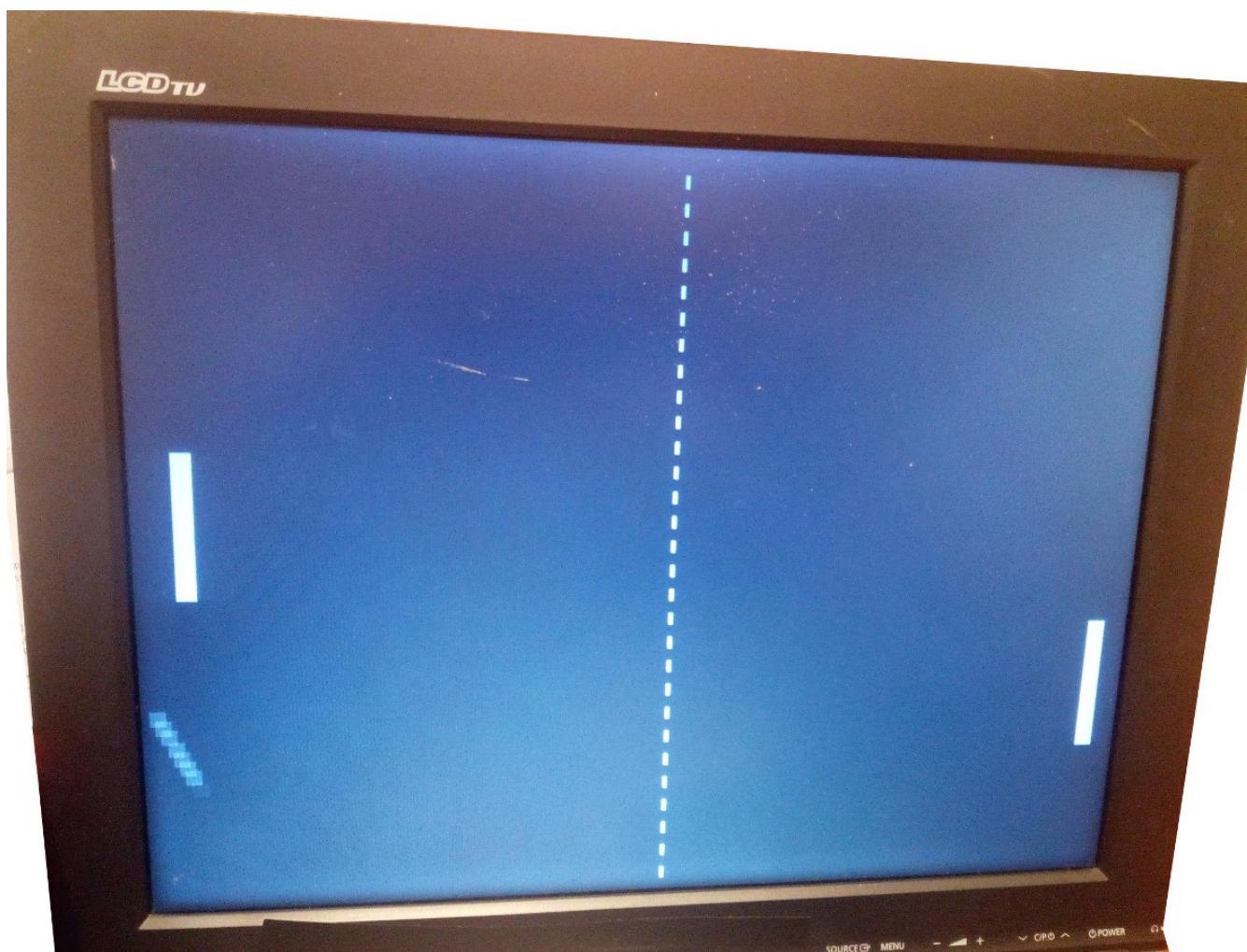


# iPXs



- Autor: **Sergio Cuenca**

# pong

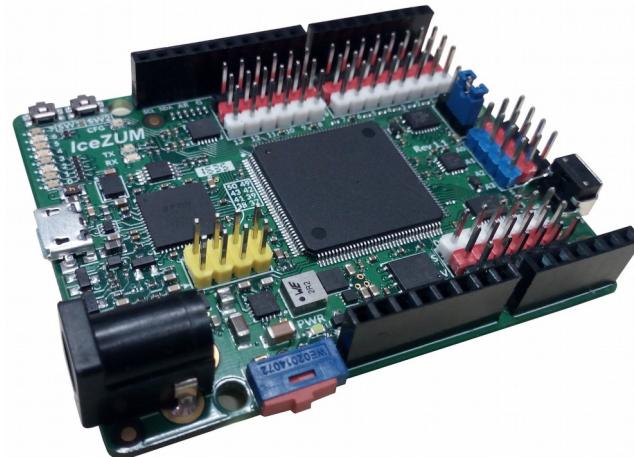
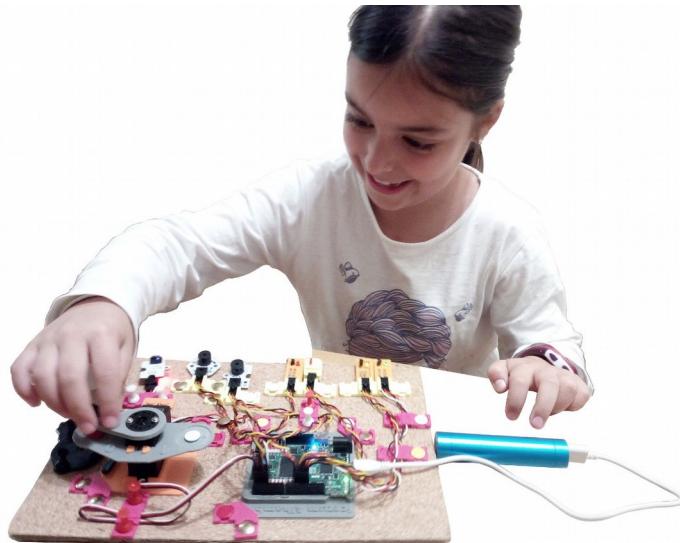


• Autor: Juan Manuel Rico

# ¡Que las FPGAs libres os acompañen!



# Electrónica Digital Divertida con FPGAs libres



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



Escuela Superior de Ingeniería  
Universidad de Cádiz  
28 Noviembre de 2017

