



# 开源硬件与MCU应用

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北京大学软件与微电子学院



嵌入式系统联谊会  
[www.esbf.org.cn](http://www.esbf.org.cn)



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# Agenda

- **OHS 2016**
- **OSHW**
- **OSHW Projects**
- **MCU Application**
- **OSHW in China**
- **Outlook**



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# OHS 2016

## ➤ History of OHS

- 2009, New York – OHANDA (OH & A)
- 2010, New York –OSHW Draft Definition
- 2011, New York – Arduino Presentation (Ecology)
- 2012, New York – Business Mode (OSHWA)
- 2013, MIT – Open Ecologies
- 2014, ROME
- 2015, Philadelphia



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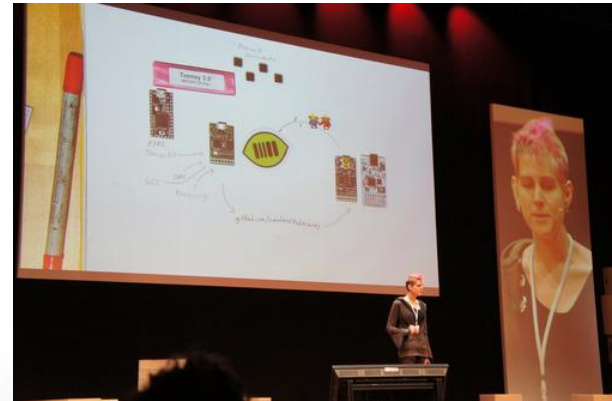
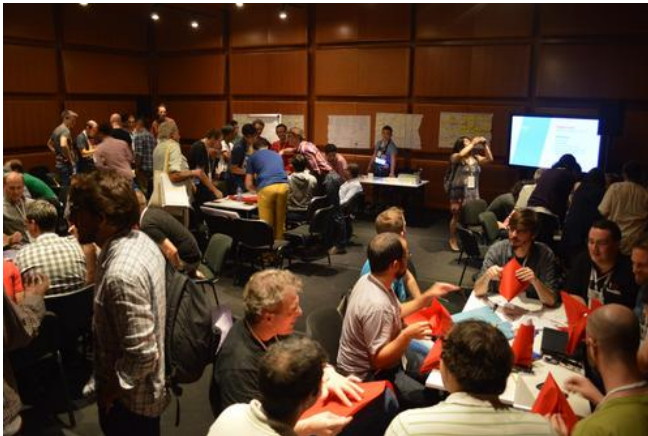
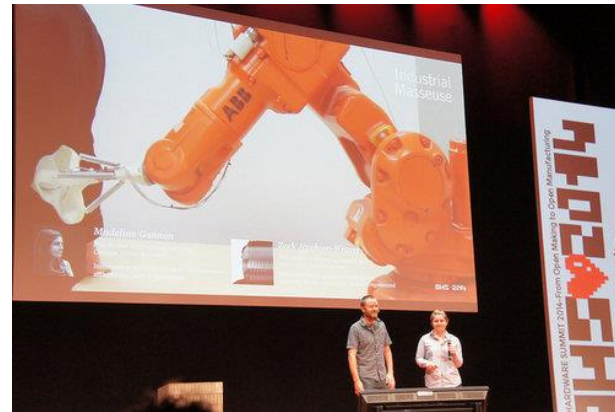
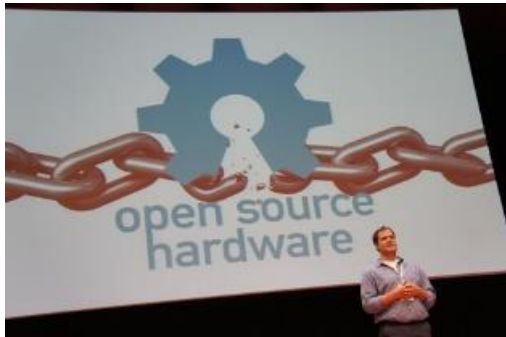


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# OHS 2016

➤ Oct 7, Portland



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# OHS 2016

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biddle.law

intel



CIRCUITMAKER

AUTODESK

OSH Park  
Perfect Prompt Purple PCBs

seeed  
origin

minnowboard.org

Octopart

handibot  
smart power tool

tindie

Google



HACKADAY

SeeMeCNC  
3D Printers & More

PRUSA  
RESEARCH



beagleboard.org

oculus

PCB:NG

SCREAMING  
CIRCUITS  
a division of Milwaukee Electronics



PROTO  
CENTRAL

HardwareX

Maker Faire

MathWorks

Digi-Key  
ELECTRONICS

OPEN  
REX

U  
UltiMachine.com

LULZBOT

CROWD SUPPLY hackster.io

OSH Stencils  
The Proto PCB Stencil Maker

LBE Lunchbox  
Electronics



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# OHS 2016

## ➤ Sponsors

| Type              | Amount | Note                                  |
|-------------------|--------|---------------------------------------|
| General           | 2      | Intel, Google                         |
| Components & kits | 9      | Components 4, Kits 5                  |
| Services          | 9      | PCB 6, Design 2, Law 1                |
| Tools             | 2      | AutoDesk, Mathwork                    |
| Applications      | 7      | 3D Printer 5 , Oculus, Medical device |
| Others            | 5      | Hackers 3, Education 2                |



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# OHS 2016

## ➤ Presentations

| Type         | Amount | Note  |
|--------------|--------|---|
| General      | 7      | OHSW marketing, Ecosystem , Collaborative innovation space , OSHWA certification , The story of OpenMV , Manufacturing solution, women in engineering |
| ,Application | 6      | Embedis, Medical Instrumentation, Motor function detection, Space, classical Instruments, Park  |
| Platform     | 3      | <b>Seeed</b> , beagleboard, Intel   |
| Education    | 2      | Bit open physical computing platform for CS, Risk of OH in education  |



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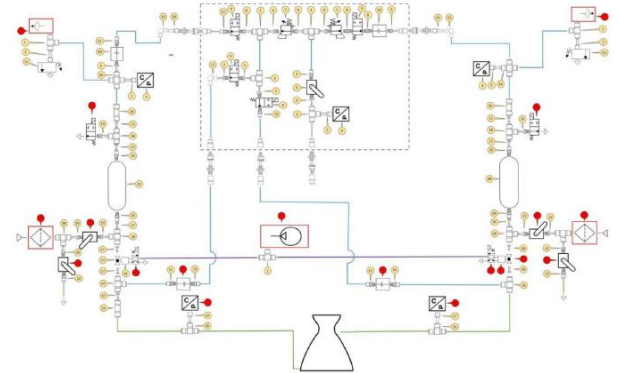
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## ➤ OHW in Space (psas.pdx.edu)



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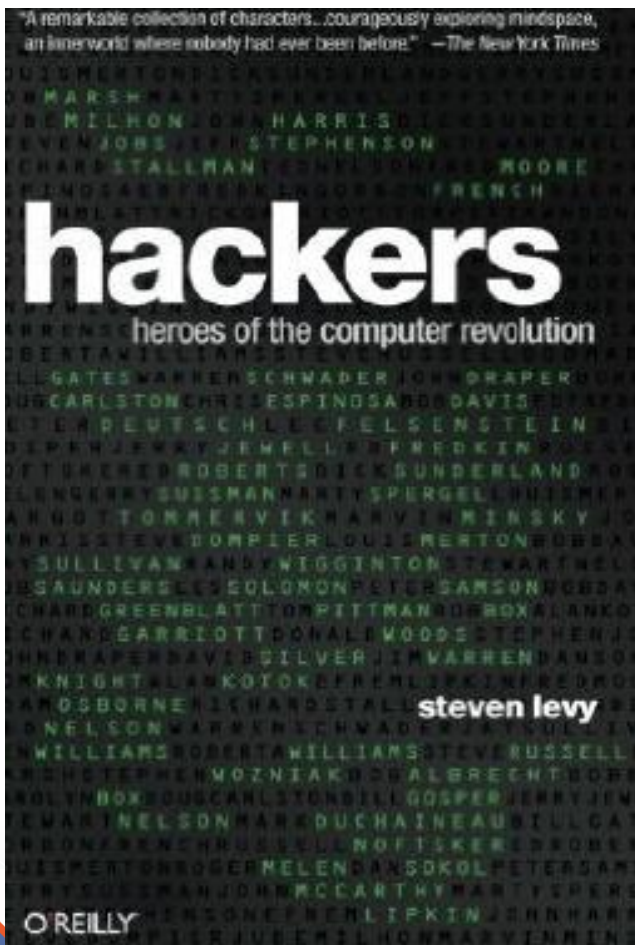


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# OSHW

## ➤ The advocate of OSHW



**Hacker:**

**Hacking is an art form that uses something in a way in which it was not originally intended.**



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# OSHW

## ➤ What's OSHW

Open source hardware

- Source files are **publicly** available for **anyone** to **use, remanufacture, redesign, and resell.**
- Openly released using a **license** providing specific rights to users **without paying royalties** to the original developers



Attribution-ShareAlike 4.0  
International

[http://creativecommons.org/licenses/by-sa/4.0/deed.en\\_US](http://creativecommons.org/licenses/by-sa/4.0/deed.en_US)



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# OSHW

- **Lays of OSHW**
  - **Hardware / Mechanical Diagrams**
  - **Schematics & Circuit Diagrams**
  - **Parts List (BOM)**
  - **Layout Diagrams**
  - **Core/Firmware**
  - **Software/API**
  - **Tools**



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# OSHW

## ➤ History of OSHW

- 1997, Bruce Perens, Open Hardware Certification Program  
“open hardware” brand mark; “openhardware.org”
- 1998, David Freeman, Open Hardware Specification Project
- 2007, TAPR, The first Open Hardware license
- 2009, Open Hardware Design Alliance
- 2010, OSHW 1.0
- 2011, OSHWA (oshwa.org)



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# OSHW

## ➤ Academia

Open Source Hardware, 2086  
 Open Hardware, 6805  
 Deep learning, 3422  
 2016/11/17

IEEE Xplore®  
 Digital Library

Access provided by  
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Search results for "Open hardware" showing 6,805 results. The interface includes a search bar with the query "Open hardware", search filters for "Basic Search", "Author Search", and "Publication Search", and a results summary: "Displaying results 1-25 of 6,805 for Open hardware".

Refine results by ?  
 Using open hardware in a harsh environment  
 Rodrigo Santos; Leo Ordinez; Gabriel Egger

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Search results for "Open Source Hardware" showing 2,086 results. The interface includes a search bar with the query "Open Source Hardware", search filters for "Basic Search", "Author Search", and "Publication Search", and a results summary: "Displaying results 1-25 of 2,086 for Open Source Hardware".

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Search results for "deep learning" showing 3,422 results. The interface includes a search bar with the query "deep learning", search filters for "Basic Search", "Author Search", and "Publication Search", and a results summary: "Displaying results 1-25 of 3,422 for deep learning".

Refine results by ?  
 Deep Learning of Part-Based Representation



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# ➤ Academia

Open Source Hardware, 8055  
Open Hardware, 6193  
Deep learning, 17493

# OSHW

ACM **DL** DIGITAL LIBRARY

acmdlTitle:(Open source hardware) **SEARCH**

Searched for *acmdlTitle:(Open source hardware)* [new search] [edit/save query]

Searched The ACM Full-Text Collection: 453,595 records [Expand your search to The ACM Guide to C

8,055 results found

### Refine by People

- Names ▶
- Institutions ▶
- Authors ▶
- Editors ▶
- Reviewers ▶

Result 1 – 20 of 8,055

- 1 [Open source hardware: freedom you can hold?](#)  
[Aaron Weiss](#)

ACM **DL** DIGITAL LIBRARY

acmdlTitle:(deep learning) **SEARCH**

Searched for *acmdlTitle:(deep learning)* [new search] [edit/save query]

Searched The ACM Full-Text Collection: 453,595 records [Expand your search to The ACM Guide to Con

17,491 results found

### Refine by People

- Names ▶
- Institutions ▶
- Authors ▶
- Editors ▶

Result 1 – 20 of 17,491

- 1 [Wide & Deep Learning for Recommender Systems](#)

ACM **DL** DIGITAL LIBRARY

acmdlTitle:(Open hardware) **SEARCH**

Searched for *acmdlTitle:(Open hardware)* [new search] [edit/save query]

Searched The ACM Full-Text Collection: 453,595 records [Expand your search to The ACM Guide to Co

6,193 results found

### Refine by People

- Names ▶
- Institutions ▶
- Authors ▶
- Editors ▶
- Reviewers ▶

Result 1 – 20 of 6,193

- 1 [The OpenRISC processor: open hardware and Linux](#)  
[James Tandon](#)



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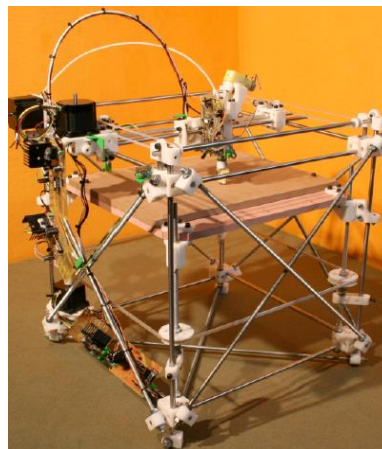
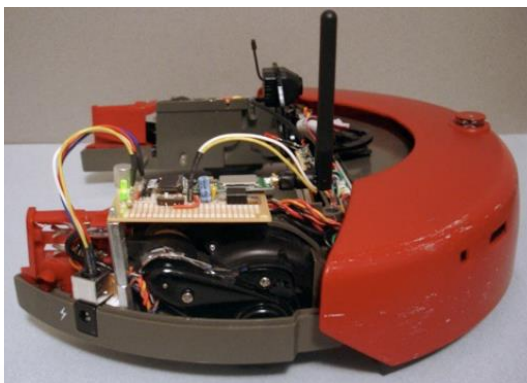
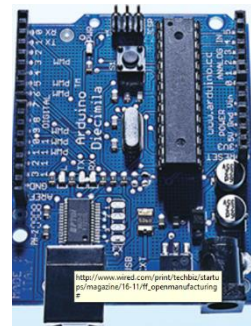
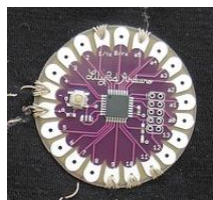
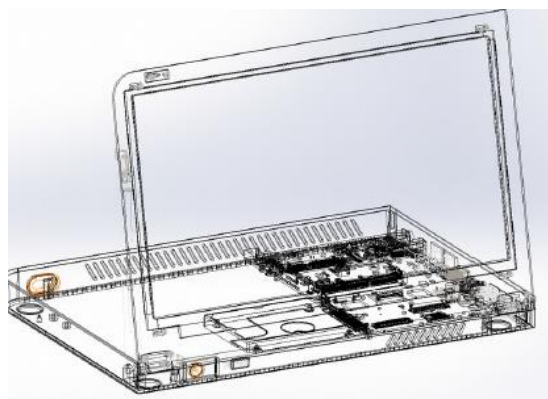


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# OSHW

## ➤ Opened hardwares



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# OSHW

## ➤ OSHW Changes.....

Design – More dependent on community

### Product

- Short time to market
- High reliability
- Low cost

Students? More practice opportunities on real Project & project



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# OSHW

## ➤ OSHW Community

### Creator

- New idea
- Original design
- Set and organize an OSHW project

### Maker

- Download project
- **Improve**
- Manufacture & Sell
- **Publish**

### Designer

- Download project
- Improve
- Publish

### User

- Buy product
- Download project
- **Improve**
- **Publish**





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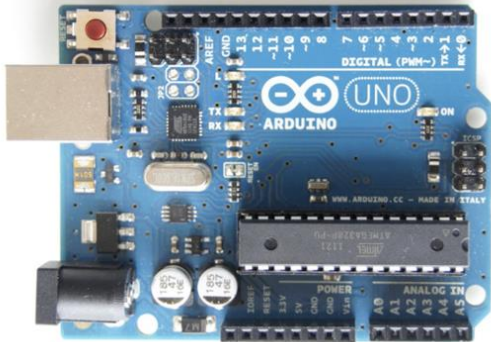
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# OSHW Projects

## ➤ Development Board



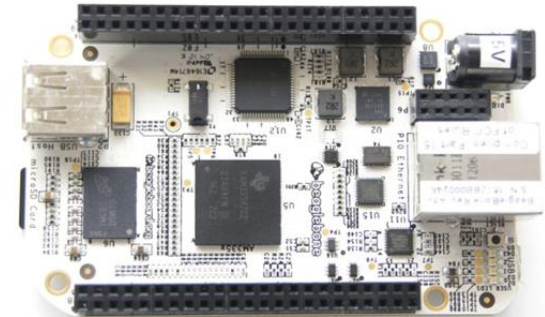
### Arduino Uno

- Massimo Banzi
- 2005
- Creative Commons
- AtmegaXXX



### Raspberry Pi

- Raspberry Foundation
- 2012
- BCM2835



### BeagleBone

- TI
- 2010
- OMAP3530



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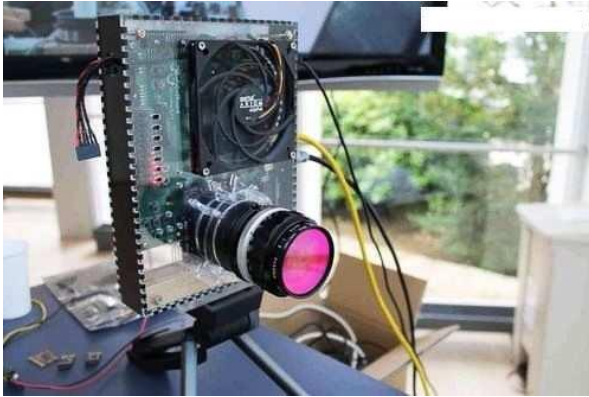


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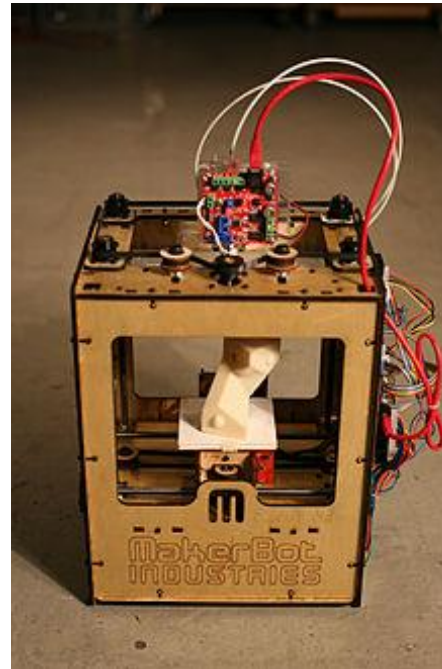
# OSHW Projects

## ➤ Applications



### Axion

- Open Source Hardware Digital cinema



### RepRap

- The first Open Source Hardware 3D Printer



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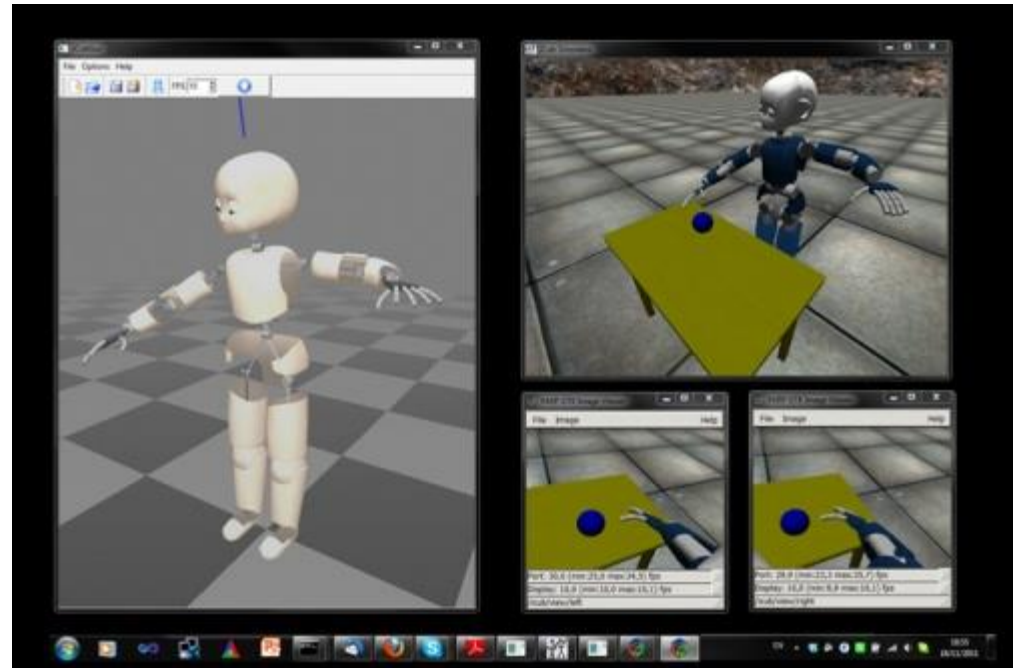
# OSHW Projects

## ➤ Applications



### Tabby

- The first Open Source Hardware Automobile  
-OS Vehicle



### RobotCup

- The Open Source Hardware iCup  
-EU



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# OSHW Projects

➤ 112个开源项目([www.ohwr.org/project](http://www.ohwr.org/project))

| Type        | Amount | Note  |
|-------------|--------|---|
| Platform    | 49     | Arduino 14, Software tools 7                                      |
| Application | 55     | Robot 8, 3D Printer 3 , plane 3                                   |
| Cores       | 8      | OpenCore, OpenRisc, Espruino, LEON,RISC-V, GPLCPU, MIAOW, OpenHPI |



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# Agenda

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# MCU Application

## ➤ Opportunity

- Most of OHW Projects based on MCU (**69 from 112**)
- Arduino – Atmel AVR
- Pduino – Atmel AVR, ARM Cortex-Mx
- Gokit – STM32 FXXX



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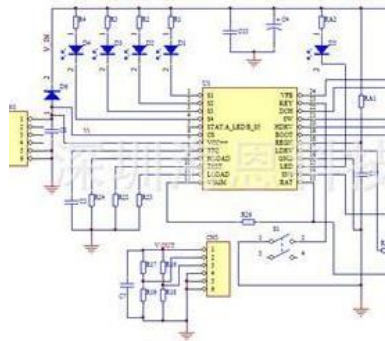
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# MCU Application

## ➤ Easier to design



```
calibrating blue channel, Blue channel
for(int i=1;i<midheight;i+=2)
{
    int lineoff=i*midwidth;
    for(int j=0;j<midwidth;j+=2)
    {
        *(pimage+lineoff+j)=btable[* (pimage+lineoff+j)];
    }
}
```



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# MCU Application

## ➤ Easier to Program

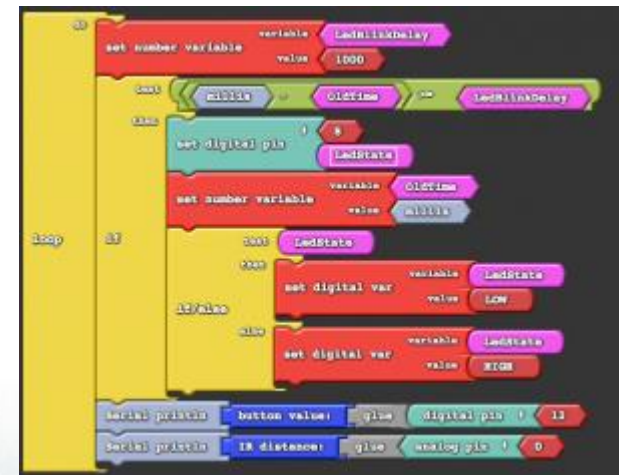
```
OEA=0x03;  
a_data=0x00;  
IOA=a_data; //re  
SYNCDELAY;  
SYNCDELAY;  
a_data=0;  
IOA=a_data;  
SYNCDELAY;  
// we are just using  
EP1OUTCFG = 0xA0;  
EP1INCFG = 0xA0;  
SYNCDELAY;
```

```
USB_Int2AutoVector equ $ + 2  
ljmp USB_Jump_Table ; Autov  
  
CSEG AT 53H  
USB_Int4AutoVector equ $ + 2  
ljmp USB_Jump_Table ; Autov
```



I/O .. .. .

- pinMode()
- digitalWrite()
- digitalRead()
- analogReference()
- analogRead()
- analogWrite()



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# MCU Application

- **Independent to chip**
  - **Standard Interface**
    - **Function**
    - **IO interface**
    - **Arduino (AVR, Cortex-M, STM32, C51, Galileo)**
    - **Raspberry Pi, Beaglebone, .....(on Linux)**
  - **Application based on OHW board**
    - **Mikrokopter, Mamba 3D, irrduino, .....(Arduino)**







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# OSHW in China

## ➤ The haven of Geek



**Open Hardware Summit 2017  
Shenzhen**



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# OSHW in China

## ➤ Academia

### ➤ 万方数据库, 2870

### ➤ CNKI, 152

1  [开源硬件：撬动创客教育实践的杠杆](#) (被引用 12 次)

[期刊论文] 《中国电化教育》 [PKU] [CSSCI] - 2015年4期 魏亮 祝智庭 Luo Liang Zhu Zhiting

创客教育(Maker Education)是信息技术使能的创新教育实践场, 开源硬件(Open Source Hardware)则是实践者手中最重要的工具。该研究分析、梳理了开源硬件的概念、历史与发展; 阐述了开源硬件的优势及其对创客教育的三方面影响...

关键词: 开源硬件 创客 创客教育 Open Source Hardware Maker Maker Education

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2  [基于开放源代码的硬件设计方法研究](#) (被引用 1 次)

[期刊论文] 《电子与信息学报》 [ISTIC] [EI] [PKU] - 2007年7期 麦宋平 张春 杨昆 王志华 Mai Song-ping Zhang Chun Yang Kun Wang Zhi-hua

可重用性是当今超大规模集成电路设计的必要元素, 与传统的封闭源代码付费IP相比, 开源硬件以共享设计文档和IP模块的方式为硬件设计的重用提供了更加彻底有效的解决办法, 基于开源硬件的SoC设计方法以其开放性和灵活性正被...

关键词: 开放源代码 开源硬件 处理器设计 设计流程 设计方法学

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3  [基于开源硬件与虚拟仪器的智能农业监测系统设计](#) (被引用 1 次)

[期刊论文] 《电子技术应用》 [ISTIC] [PKU] - 2015年4期 王凡 杨亮 Wang Fan Yang Liang

为了智能化采集农作信息, 高效利用农业资源及实现智能农业, 设计了基于开源硬件的智能农业监测系统, 系统以开源硬件Arduino为核心控制器, 配合光照传感器、土壤水分传感器、温湿度传感器、二氧化碳传感器采集农作环境参数, 利...

关键词: 智能农业 开源硬件 传感器 虚拟仪器 LabVIEW intelligent agriculture open source hardware sensor virtual instrument LabVIEW

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# OSHW in China

## Education

[北京Arduino开发实战培训班](#) | [上海Arduino培训中心](#) | [武汉Arduino...](#)



☆ 曙光第497期Arduino培训班圆满结束。[2016-7-17] ☆ 子股份 RF CMOS射频集成电路设计企业培训圆满结束。[ ☆ 曙光第518期Matlab培训...  
[www.51qianru.cn/Arduin...](http://www.51qianru.cn/Arduin...) - 百度快照

[面向中小学的Arduino机器人课程:课程设计\\_谢作如\\_新浪博客](#)

2014年3月2日 - 标签: [arduino](#) 机器人教学 教育 分类: [Arduino](#)系列 其实前面提到@择,也是基于对机器人课程的设计,要涵盖哪些内容,要做哪些实验。虽然机器...  
[blog.sina.com.cn/s/bo...](http://blog.sina.com.cn/s/bo...) - 百度快照 - 4121条评价



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TanJiuShiJian

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## 将开源硬件引入电子实训与创新实践的教改初探

唐敏, 金一鸣

(上海电力学院 创新创业工程训练中心, 上海 201300)

摘要: 分析典型开源硬件特点, 探讨将其引入电子实训与创新实践的教学。笔者根据已开展的Arduino开源硬件进行电子实训与创新的教学情况, 认为将开源硬件引入电子实训与创新实践可以使更多学科、更大群体学生深入开展电子实训, 有利



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## ➤ Webs

- [www.oshina.net/hardware/](http://www.oshina.net/hardware/)
- [www.openhw.org](http://www.openhw.org)
- [www.eeboard.com/tag/开源硬件](http://www.eeboard.com/tag/开源硬件)
- [www.geek-workshop.com](http://www.geek-workshop.com)
- [www.elecfans.com](http://www.elecfans.com)
- [www.eepw.com.cn](http://www.eepw.com.cn)
- [www.Arduino.org.cn](http://www.Arduino.org.cn)
- [www.Arduino.cn](http://www.Arduino.cn)
- [www.dfrobot.com.cn](http://www.dfrobot.com.cn)
- [www.lupaworld.com](http://www.lupaworld.com)

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## ➤ Products

### ➤ 淘宝

- Arduino , 29
- Beaglebone, 8
- Raspberry pi, 12

### ➤ 厂商

- 英蓓特 (Raspberry pi, Beaglebone, [www.embest-tech.cn](http://www.embest-tech.cn))
- 朗译电子科技 (Arduino, [www.langyidianzi.com](http://www.langyidianzi.com))
- .....



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## ➤ Products

### ➤ OSHW

- Seeedstudio (深圳矽递科技, [www.seeedstudio.com.cn](http://www.seeedstudio.com.cn))
- Banana pi (比派科技, [www.banana-pi.org.cn](http://www.banana-pi.org.cn))
- Kiwiboard ([www.kiwiboard.org](http://www.kiwiboard.org))
- Espduino (四博智联, [www.esp\\_iot.doit.am](http://www.esp_iot.doit.am))
- Microduino(美科科技, [www.microduino.cn](http://www.microduino.cn))



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中国单片机三十年  
China MCU 30 Years



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# Agenda

- OHS 2016
- OSHW
- OSHW Projects
- MCU·Application http://www.arduino.cn/
- OSHW in China
- Outlook



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# Outlook

- **Open from Core to Application**
- **Open Application Products in Market**
- **OSHW Community**



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# Thank you!



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