



Interactive Light System Design Based On Simple Gesture Recognition 基于动作识别的灯光交互娱乐装置设计

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Special Thanks To Yi Xiao 肖懿 (技术指导)

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Design Backgrounds

A

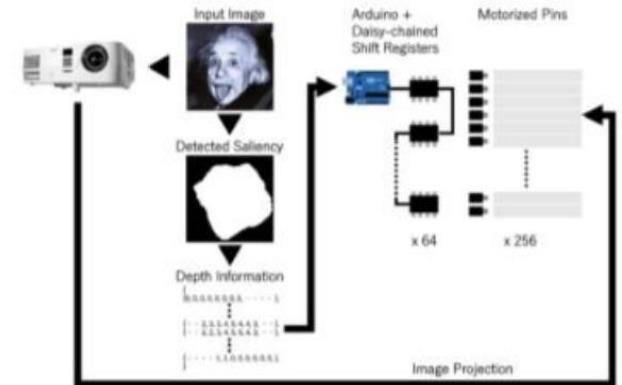
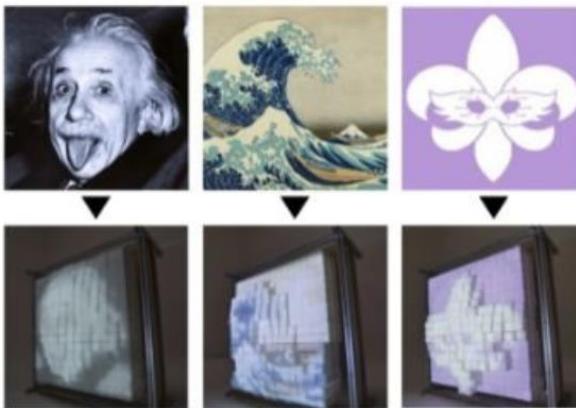
设计背景/文化

Culture

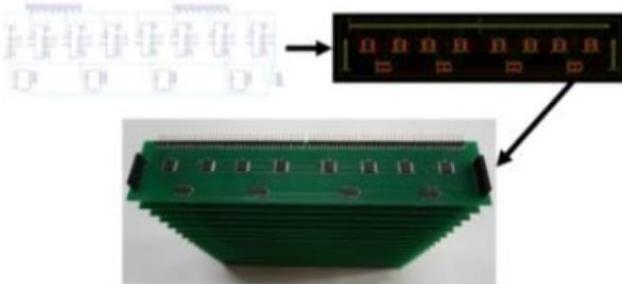
Related Works



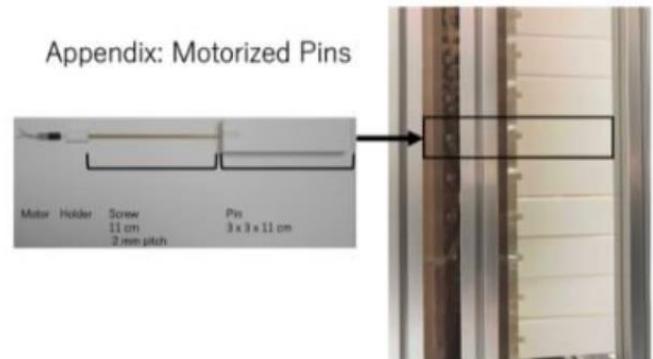
- Wooden Mirror [Rozin 1999]



Appendix: Control Circuits



Appendix: Motorized Pins



- Riku Arakawa et.al BulkScreen: Saliency-Based Automatic Shape Representation of Digital Images with a Vertical Pin-Array Screen ACM TEI 2020 Work-in-Process

Related Works

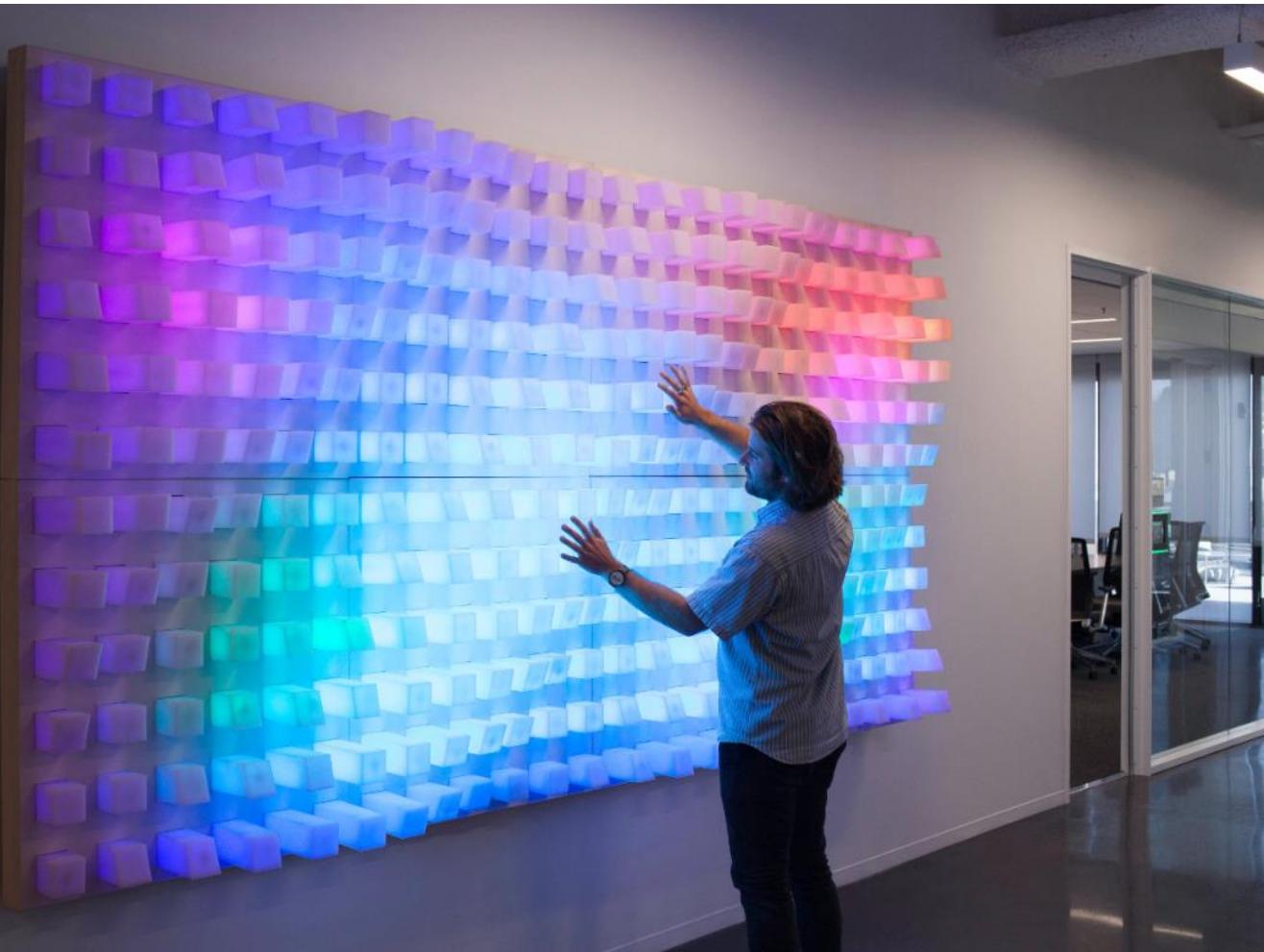


● Echo [BREAKFAST 2018]



● One Hundred and Eight [Nils 2010]

Related Works

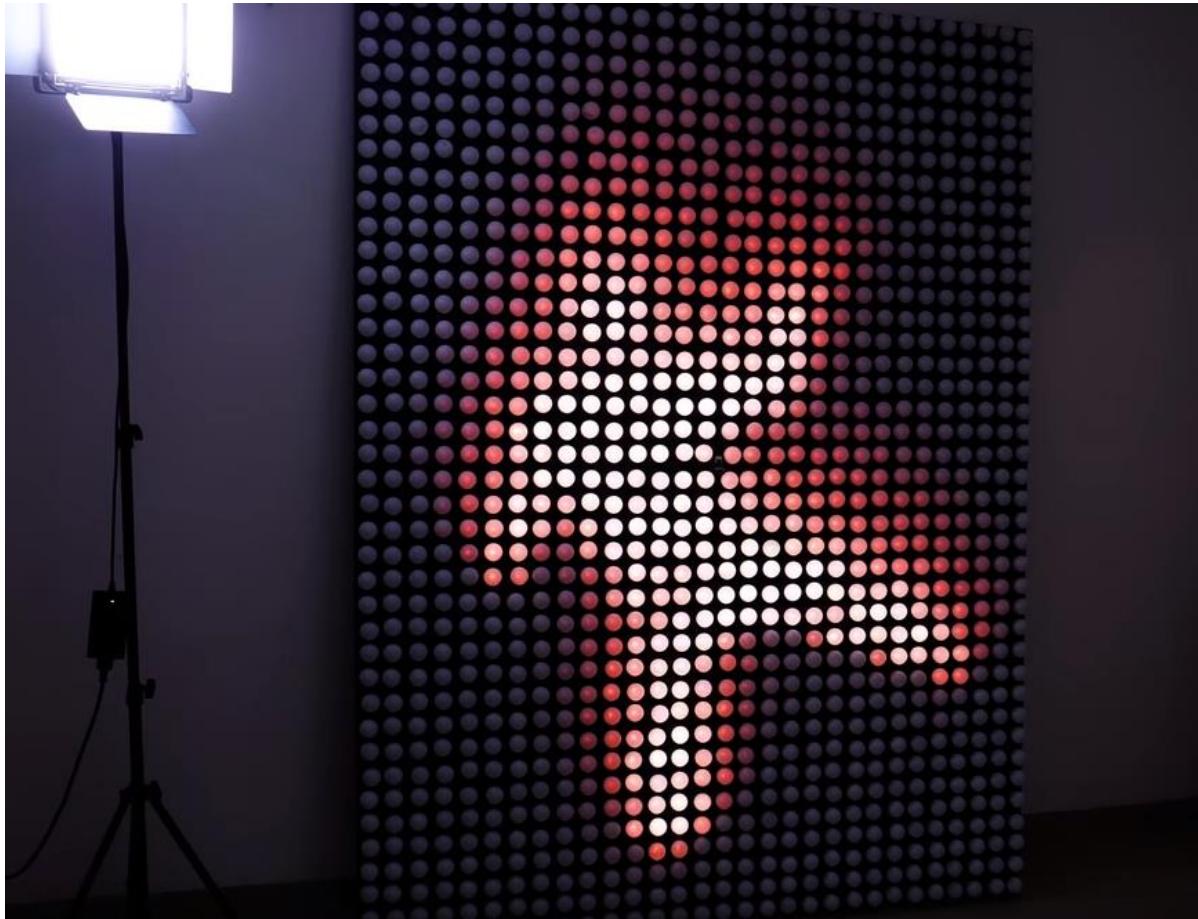


● Moment [Brannon 2015]

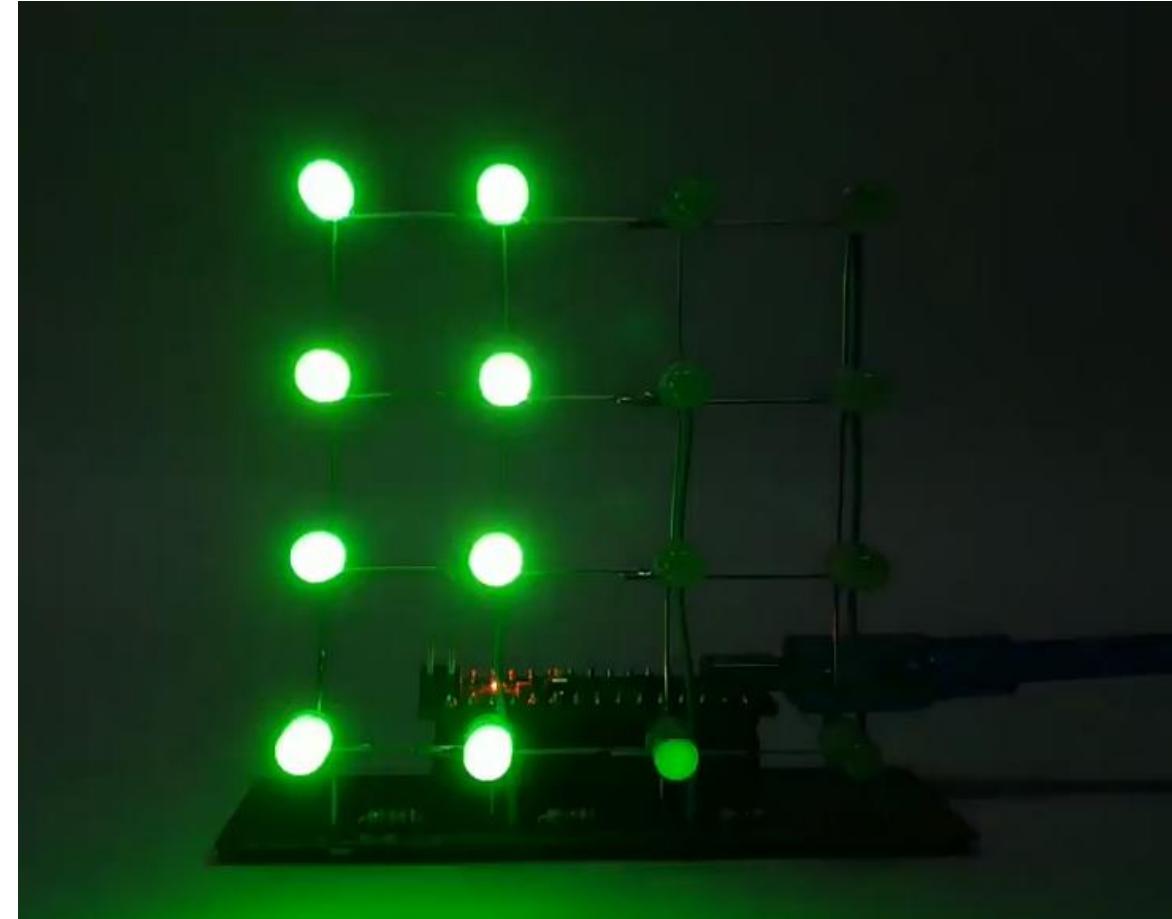


● LED INTERACTIVE WALL [Chris 2019]

Related Works

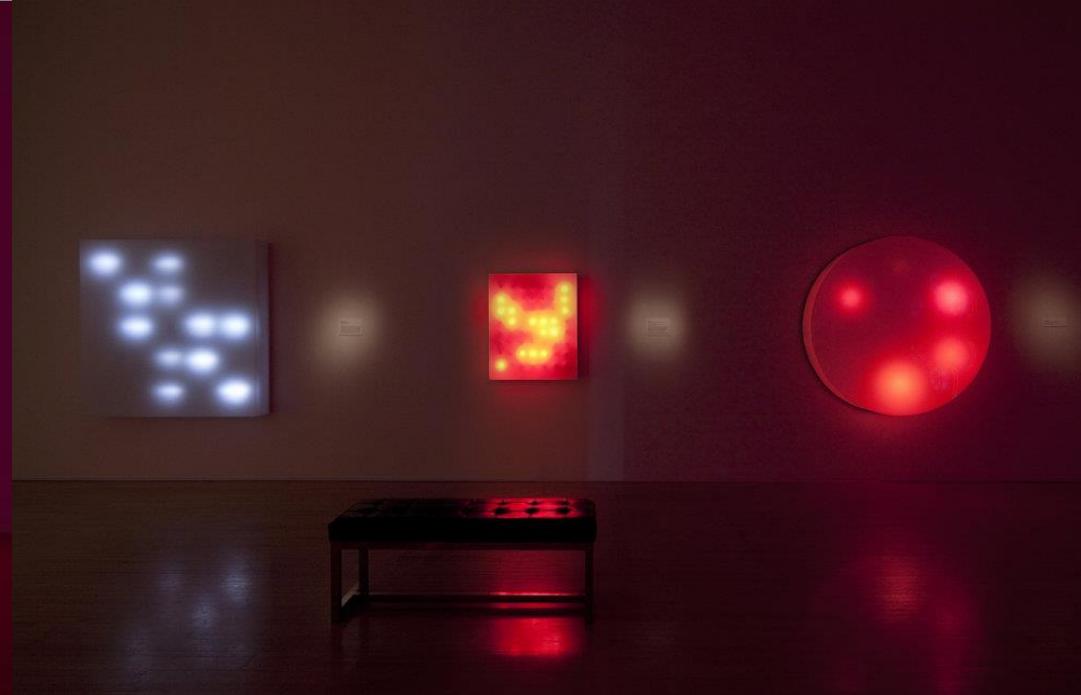


● LED Wall [bitluni's lab 2019]



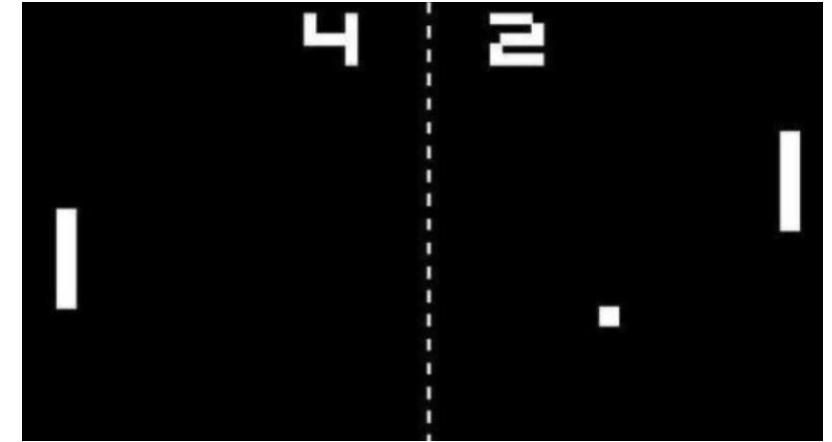
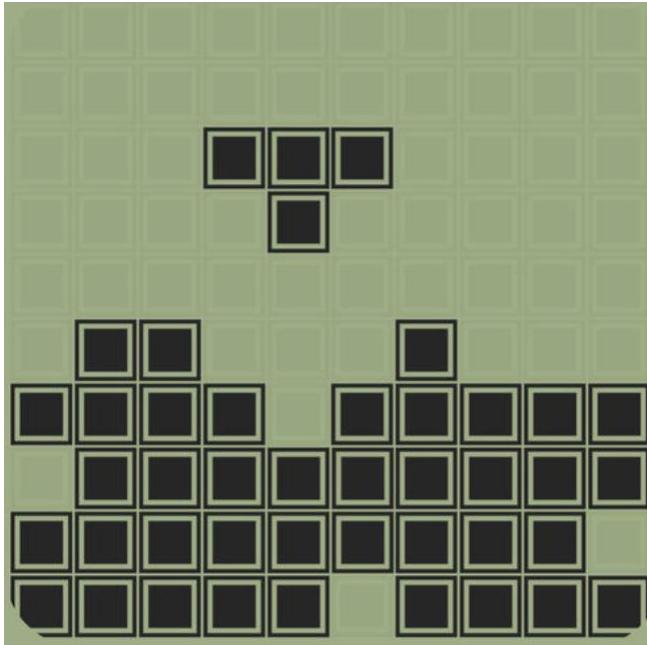
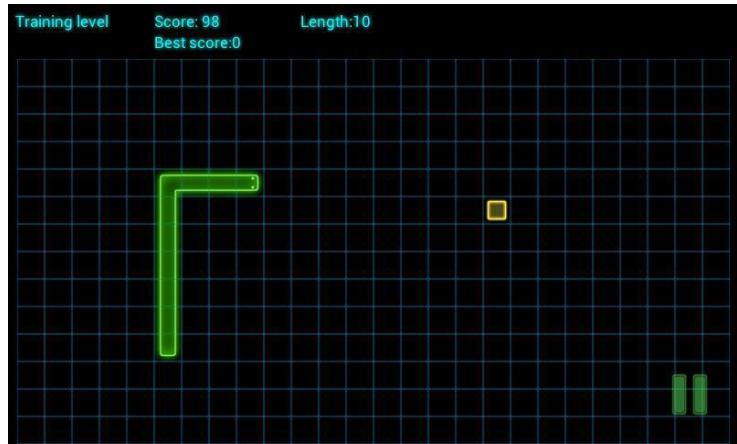
● Amazing LED Wall [ES Tech knowledge 2019]

LED Art



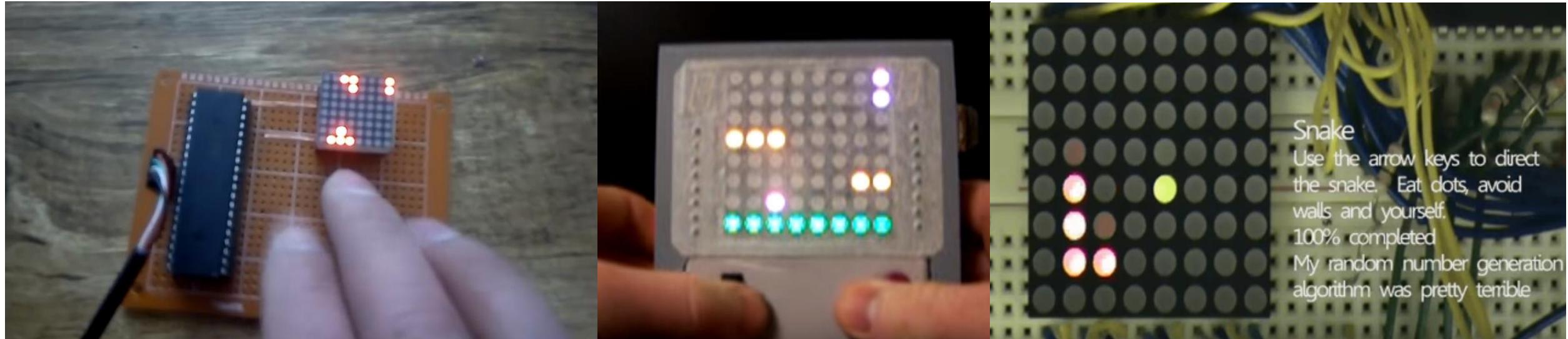
Leo Villareal以创作简洁而极具启发性的动态灯光作品而闻名。自2000年代开始，Villareal将LED及电脑编程引入创作中，利用灯光矩阵创造出无限变化并有着独特节奏韵律的画面，以其开放性和空灵感激发观者的视觉及心理感知。

Pixel Games



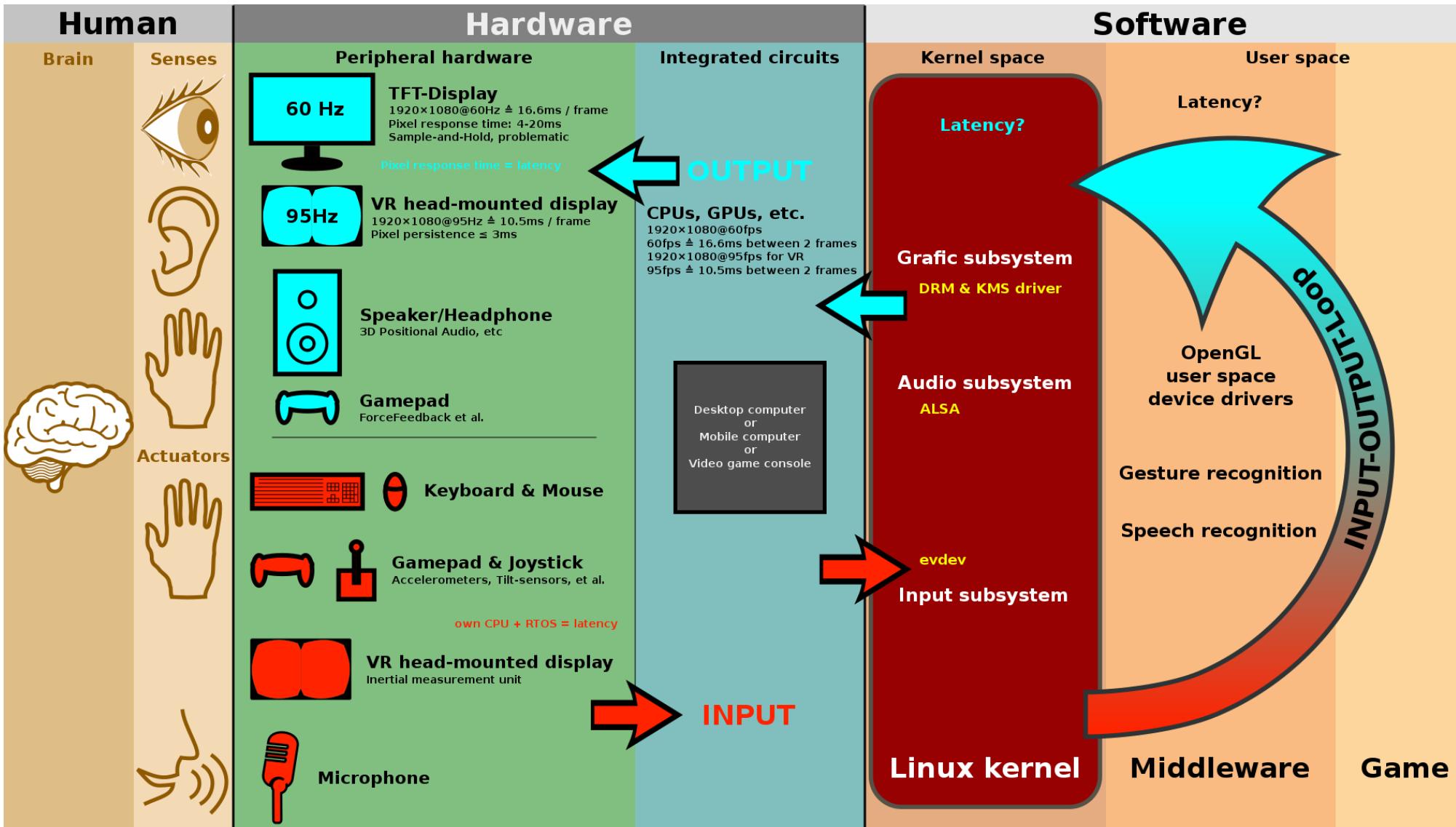
上个世纪60-80年代是现代电子游戏的黎明期，诞生了诸多利用简易像素就可以表示操控的游戏。

Pixel Games



这种像素游戏文化也催生出了诸多的利用基本9x9LED屏幕和单片机实现简易游戏操作的电子极客们。

HCI System



Design Backgrounds

A

设计背景/技术

Technology

Kinect

Developed by Microsoft, Kinect uses RGB-D camera to get the human positions accurately. It can do valley bone recognition, deep inspection, face recognition and voice recognition successfully.

Kinect由微软开发，利用深度摄像头捕获人体的位置数据。
它可以骨骼追踪，深度检测，人脸识别，语音识别。

Kinect V2

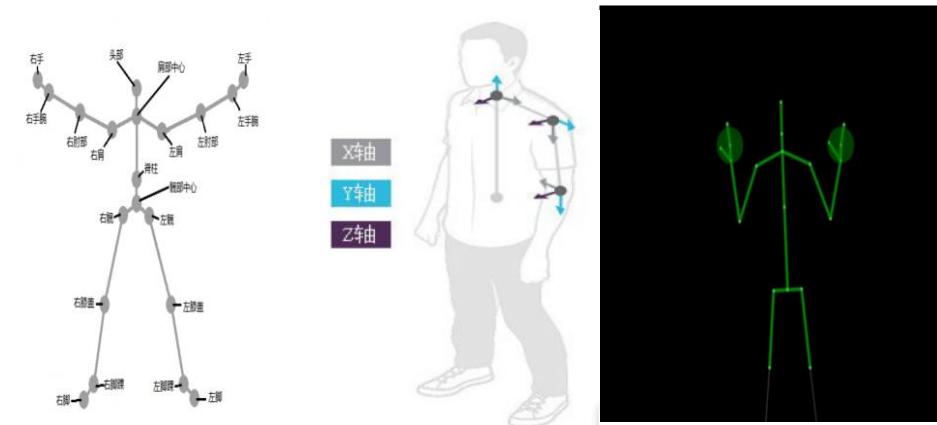
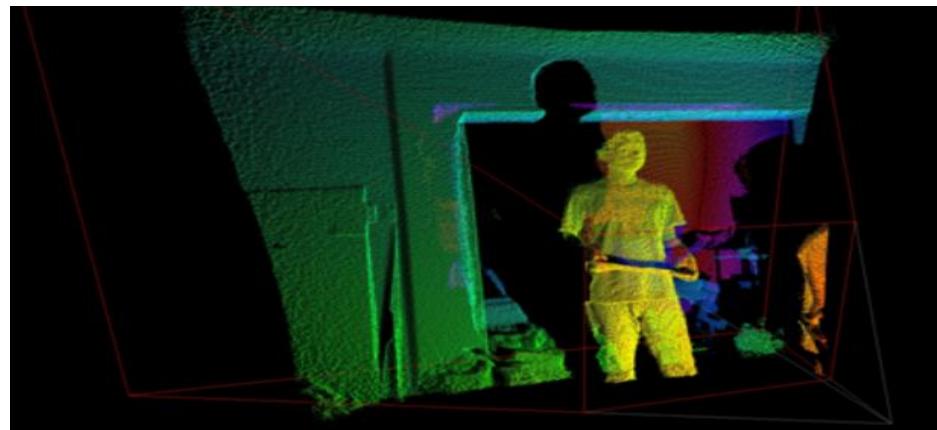
Color Resolution 颜色分辨率： 1920*1080

Depth Resolution 深度分辨率： 512*424

Max People 检测人数上限： 6

Joint Number 关节数： 25

Detection Distance 检测范围： 0.5—4.5m



Kinect

At the same time we should consider the accuracy and distance for Kinect V2.

同时需要考虑Kinect的测量范围以及测量精度与距离的影响变化。

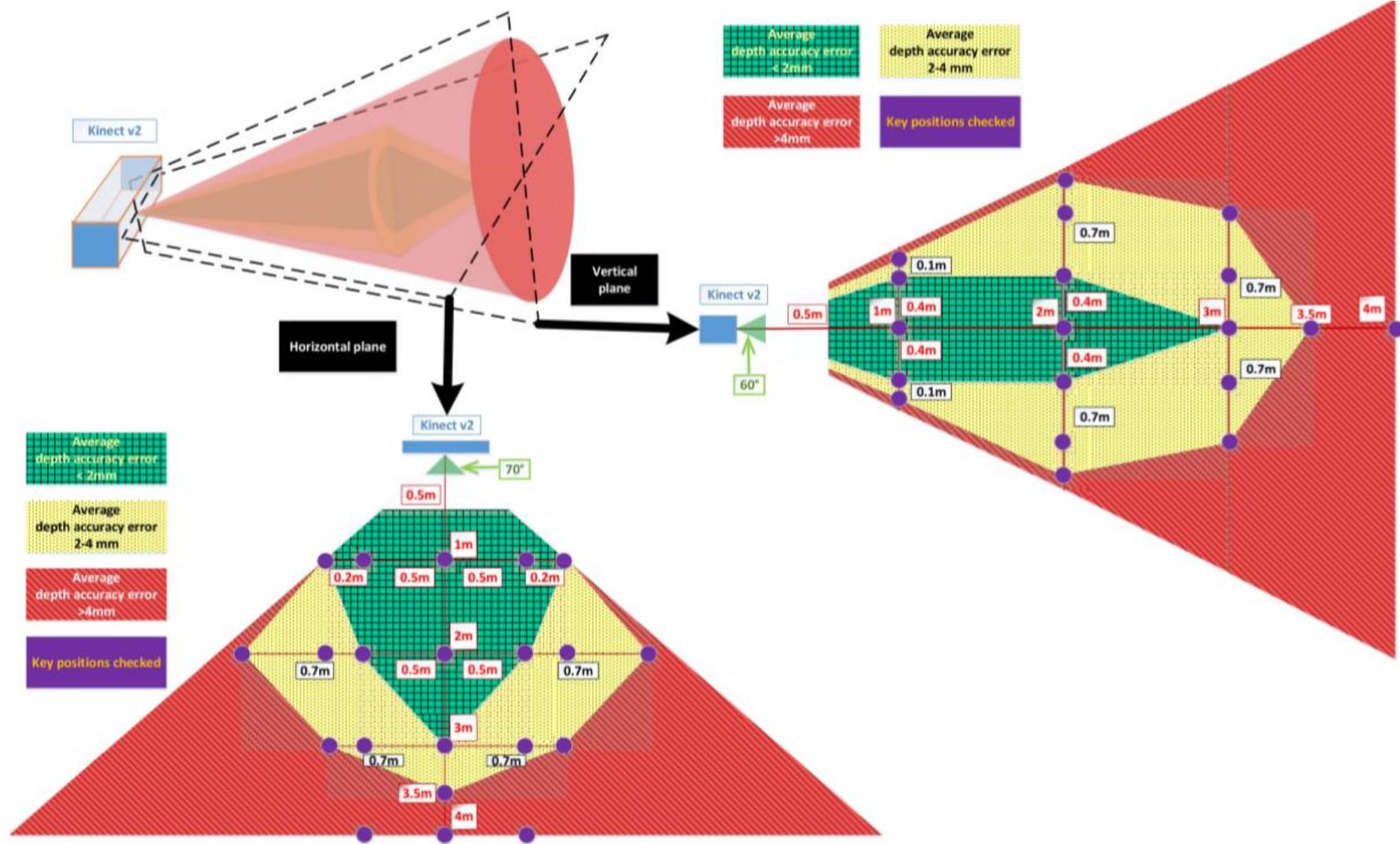
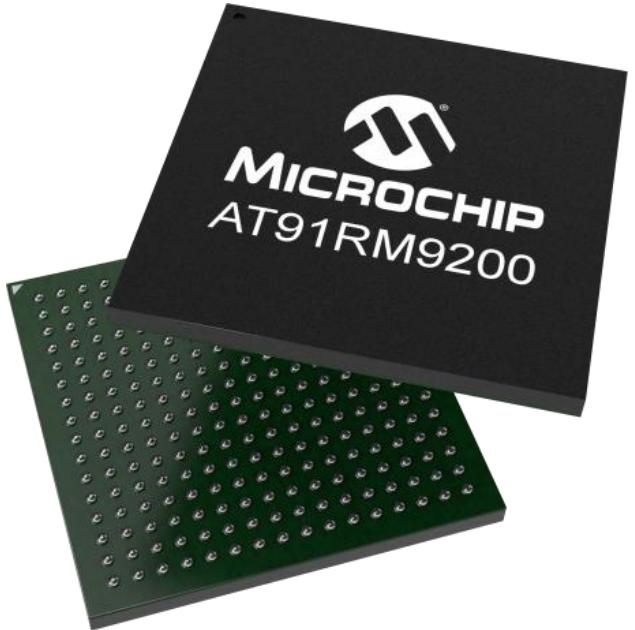


Fig. 6. Accuracy error distribution of Kinect for Windows v2.

[1] Yang L , et al. Evaluating and Improving the Depth Accuracy of Kinect for Windows v2[J]. IEEE Sensors Journal, 2015, 15(8):4275-4285.

[2] Zennaro S , et al. Performance evaluation of the 1st and 2nd generation Kinect for multimedia applications[C]// IEEE International Conference on Multimedia and Expo (ICME). IEEE, 2015.

Microprocessor



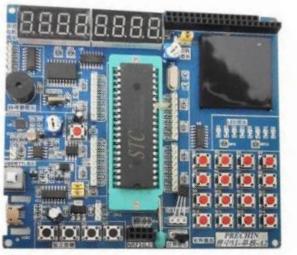
AT91RM9200

相比学生常用的Arduino和51 SCM, 选用了性能更强大稳定的 AT91RM9200微处理器, 优势如下。

1. 大规模成熟地工业控制应用
2. 开源资源丰富
3. 主频180MHz, 处理能力强
4. 实时操作系统支持

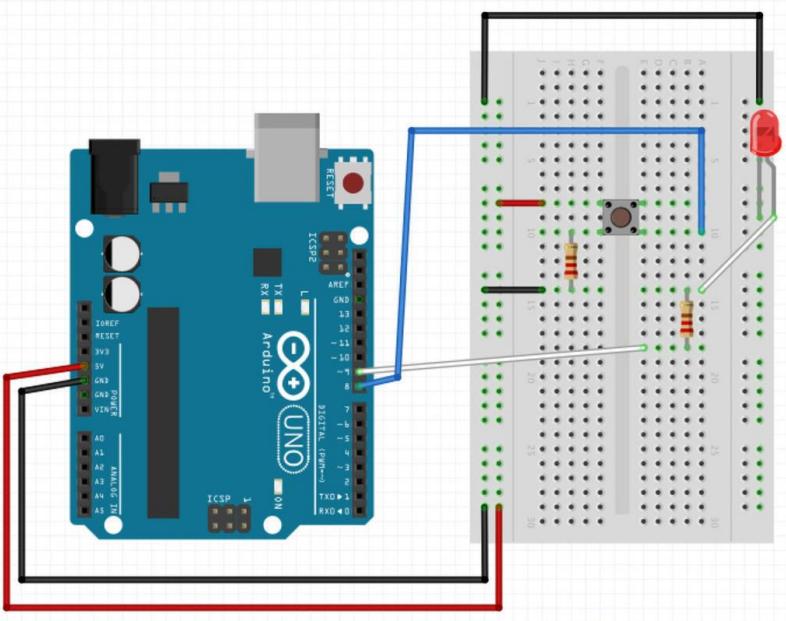


Arduino

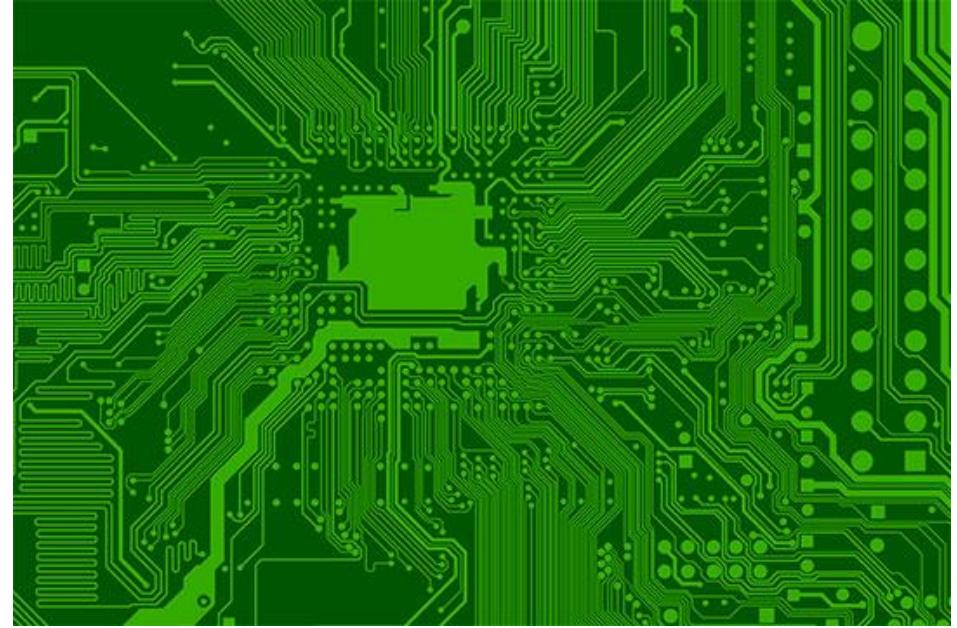


51 SCM

Printed Circuit Board



传统面包板布线



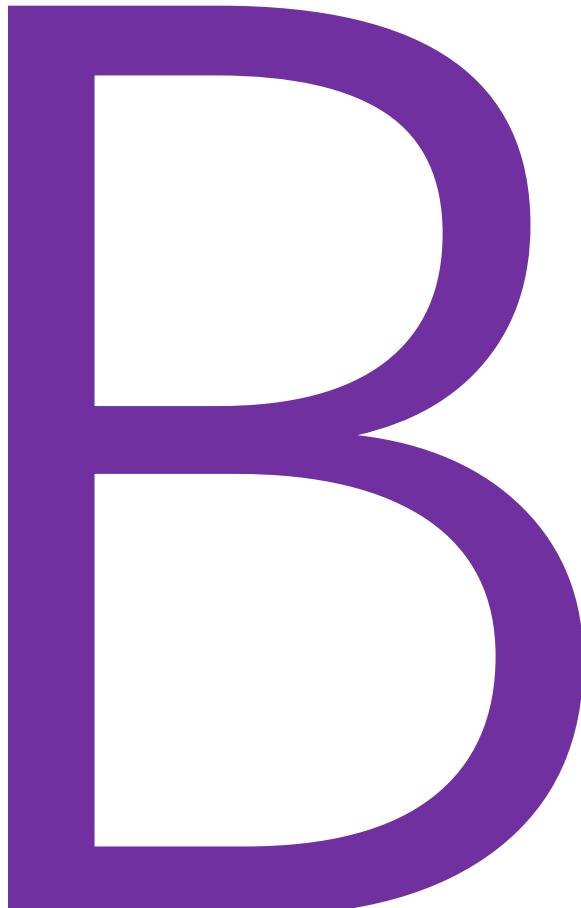
PCB印刷电路板

传统手工连线面包板在复杂度到达一定程度后信号质量和可连接信号线密度都存在明显瓶颈。故使用了多层的PCB布板技术, BGA技术, 结合高密度的模块化设计达到工业化水准。

Design Process

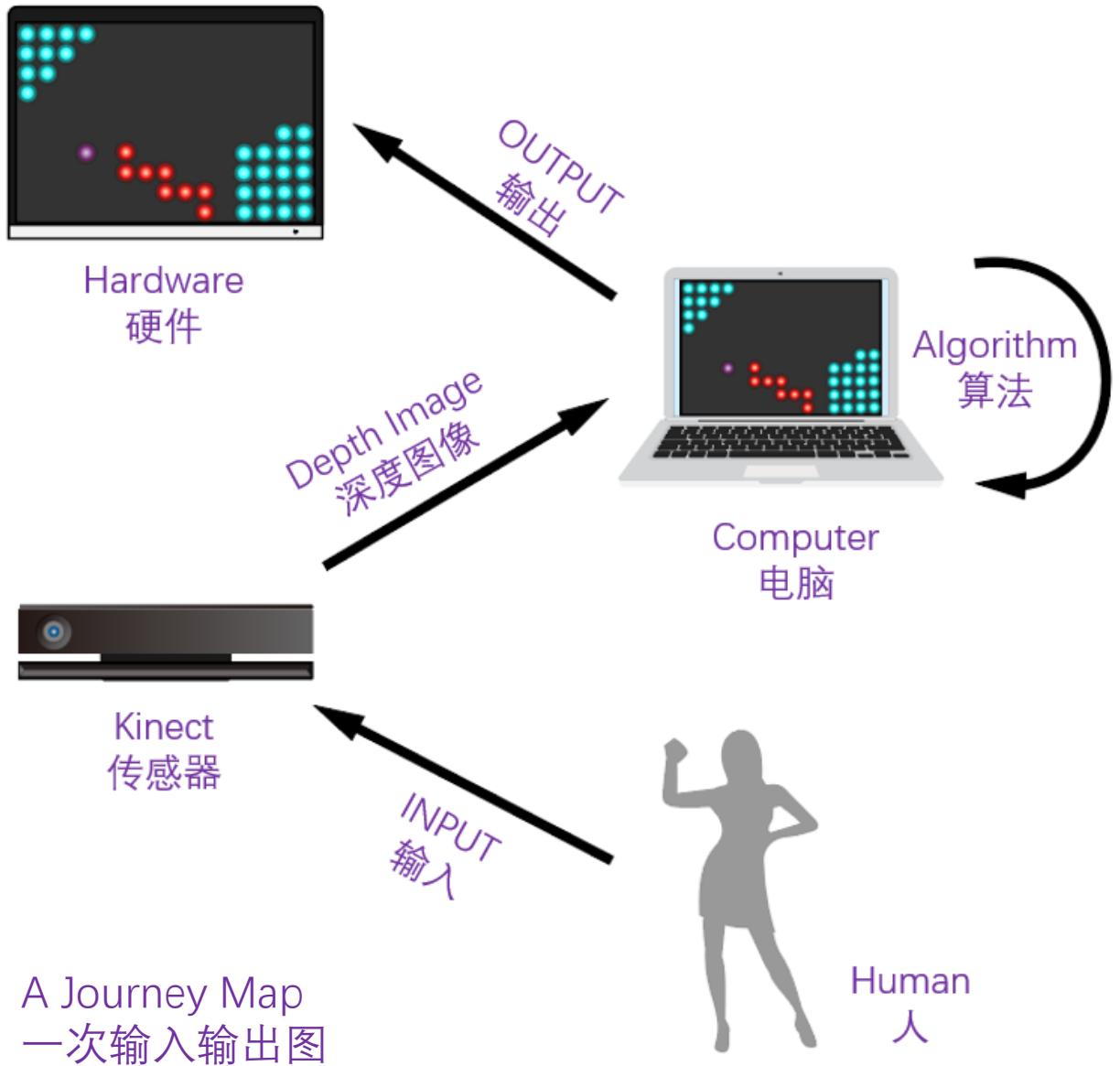
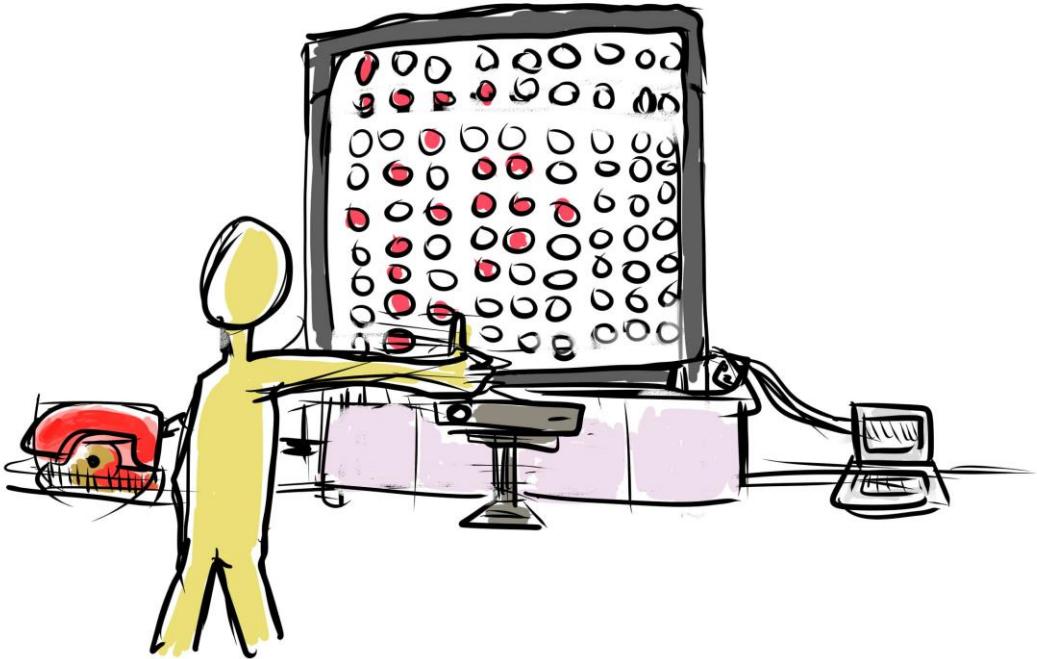
设计过程/方案

My Design

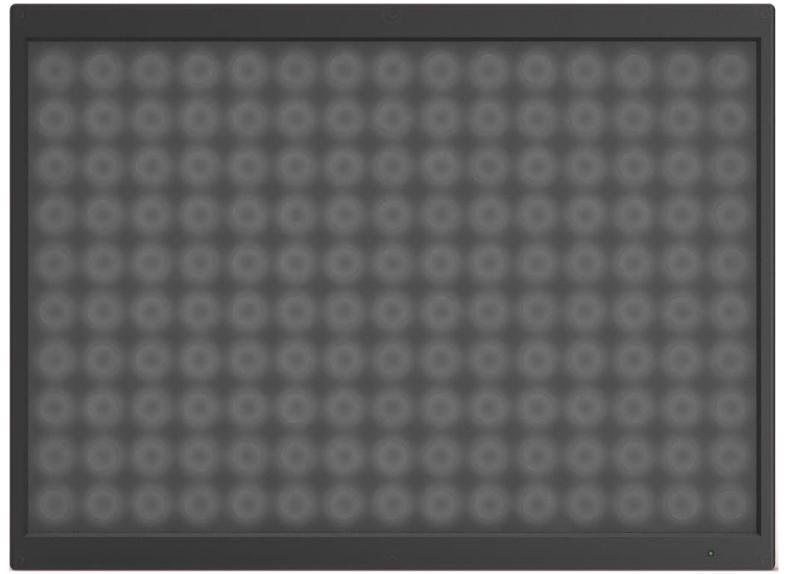
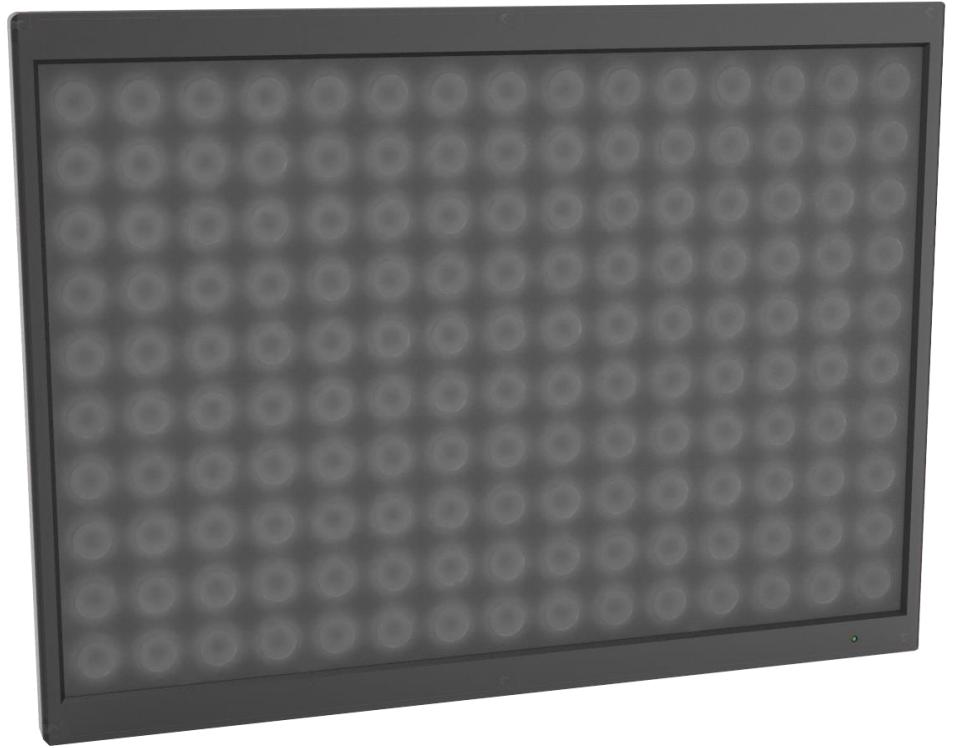


Big Picture

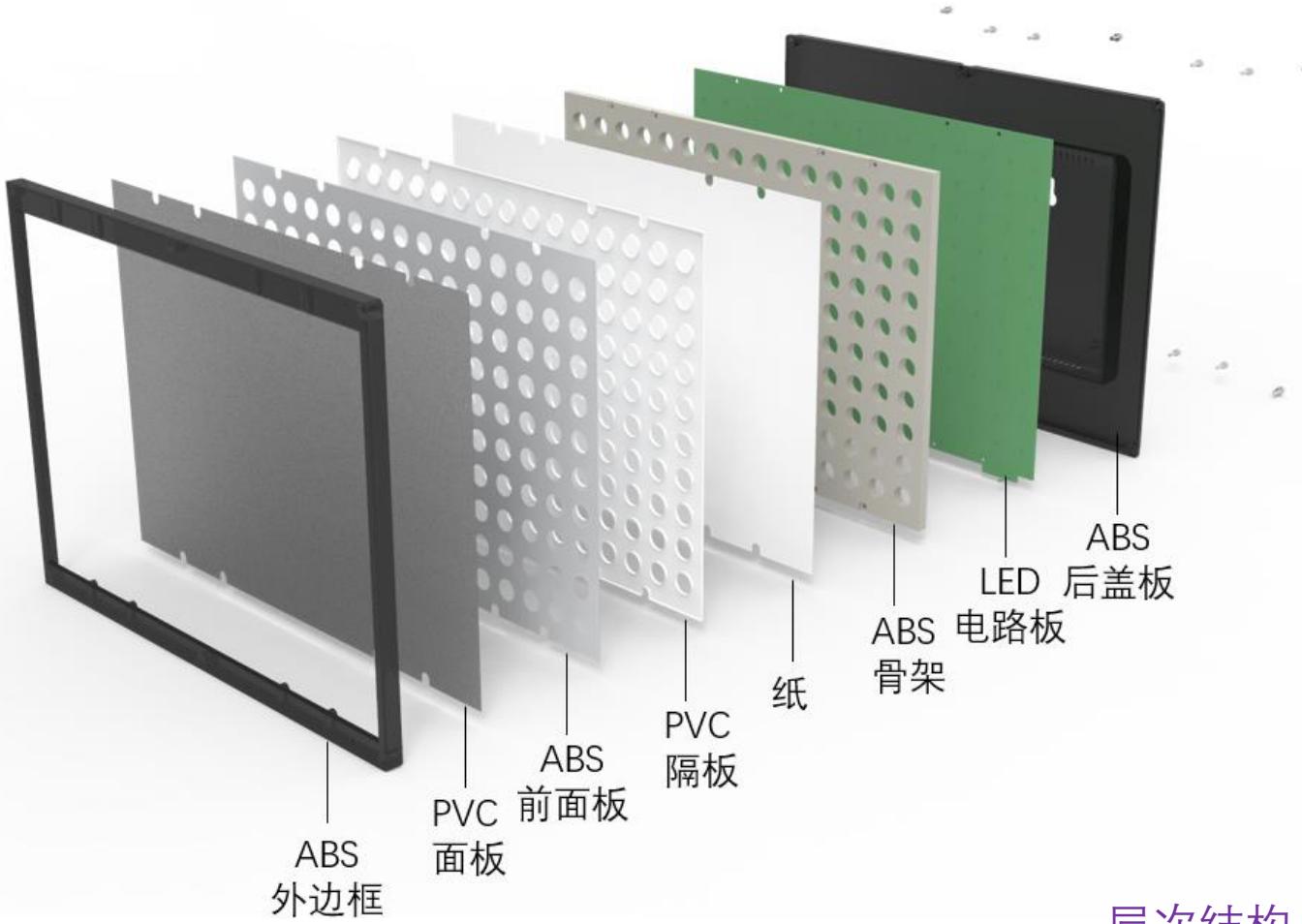
Sketch
概念草图



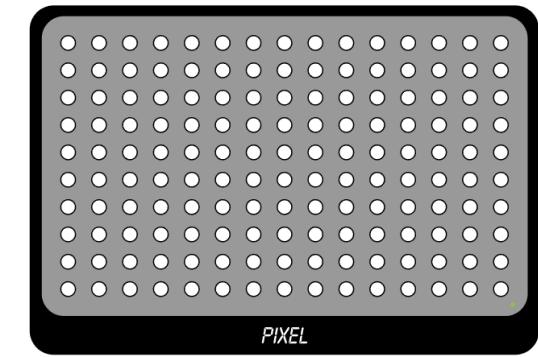
Hardware Model



Hardware Design



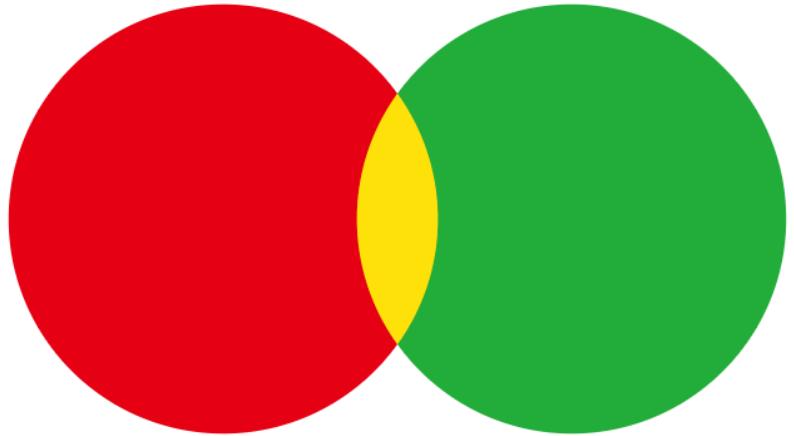
通过调整各板的间距和材料来实现透光的效果。



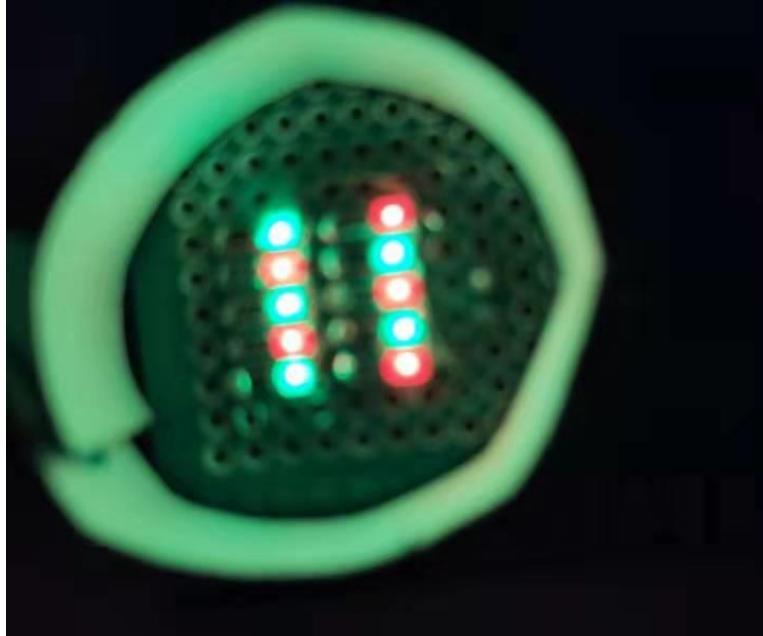
40
cm

60cm

Circuit LED Design



Red+Green=Yellow



实际的发光LED

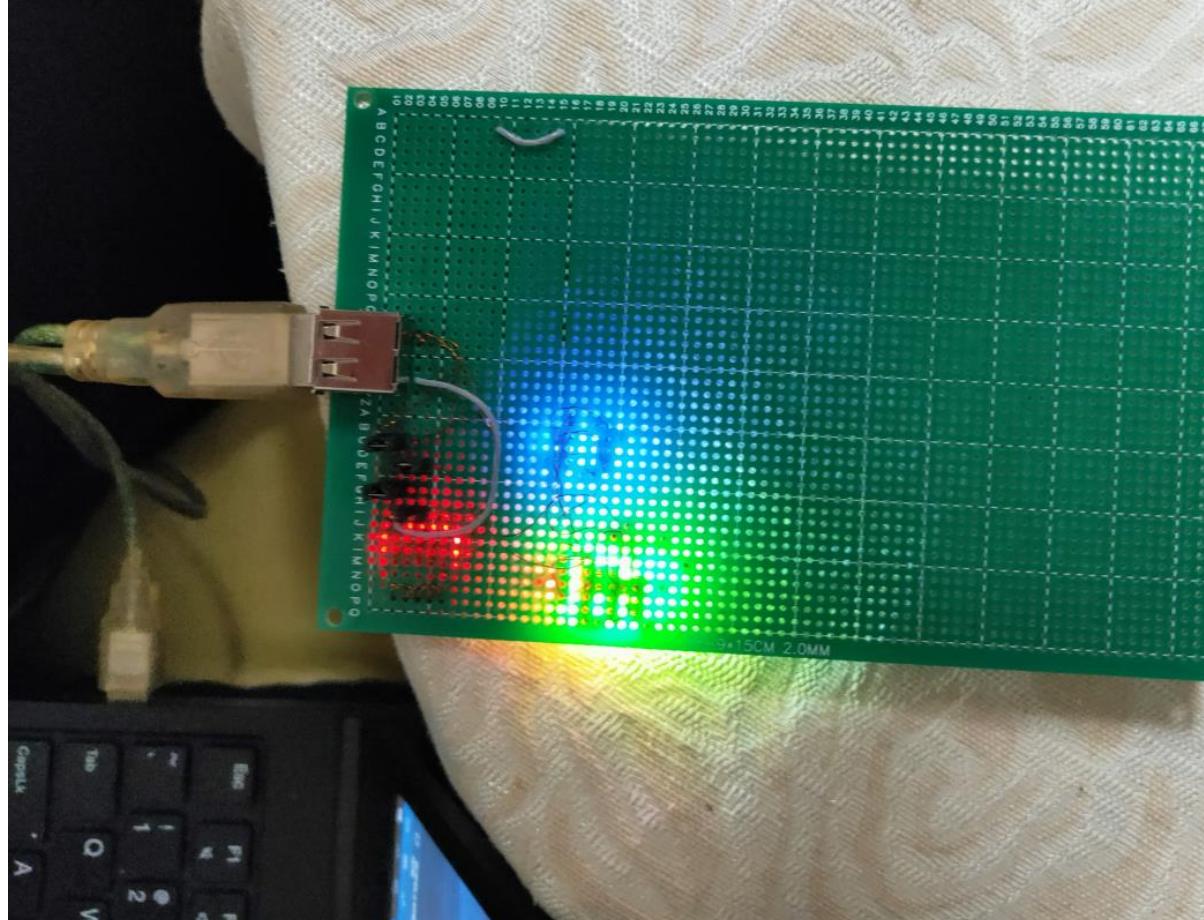


扩散后形成整体效果

考虑电路板功率限制，采用单色LED小灯泡并联，6个一组，再透过上方一定距离的聚光材质形成一个整体的发光效果。通过两种基本颜色的混色产生第三种颜色。6*15*10个LED被嵌在印刷电路板上。

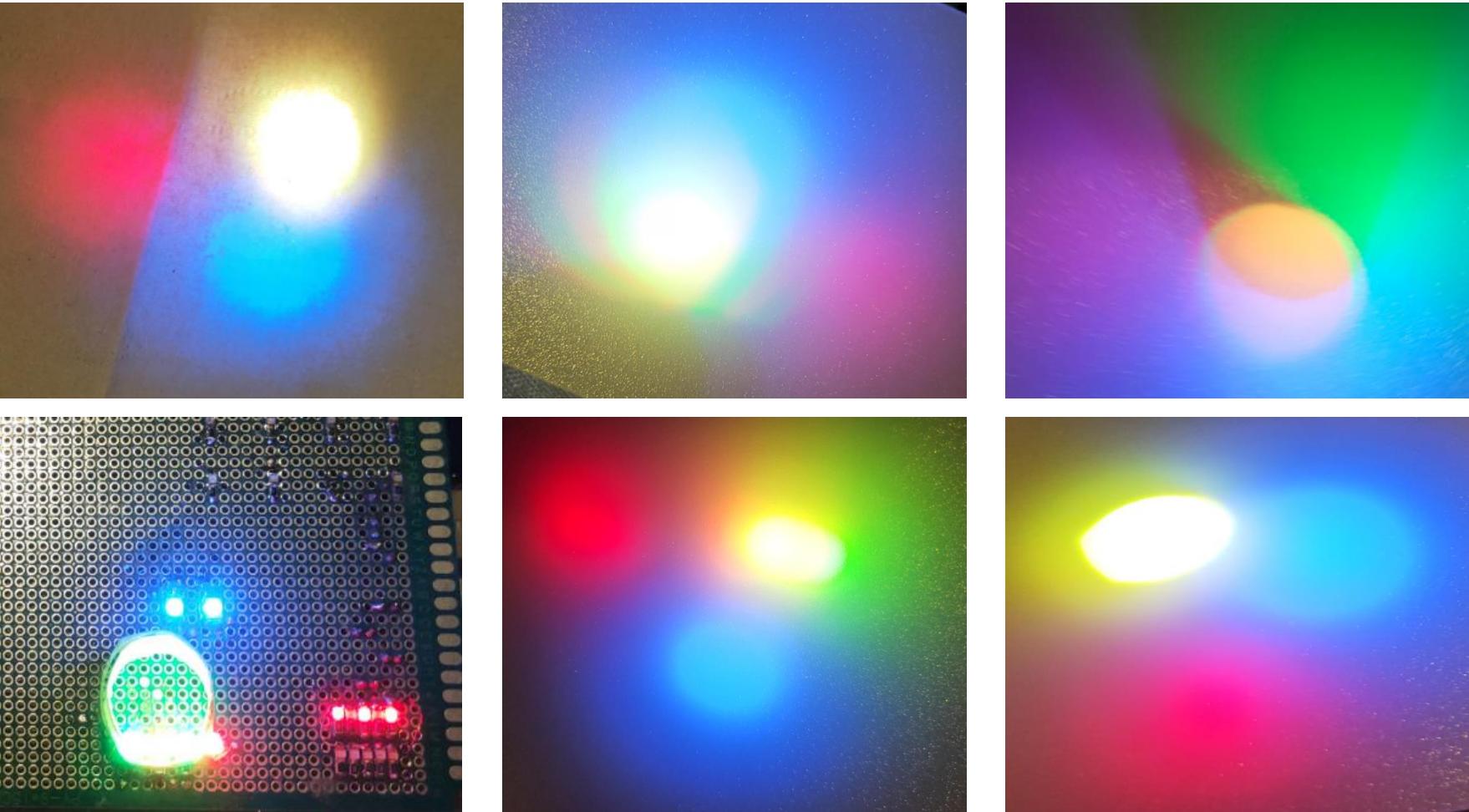
Material Selection

我们通过小的样板原型，对多种材质的散光效果进行了测试。包括：
不同厚度的普通玻璃，
聚碳酸酯，聚氯乙烯，
涤纶树脂，纸

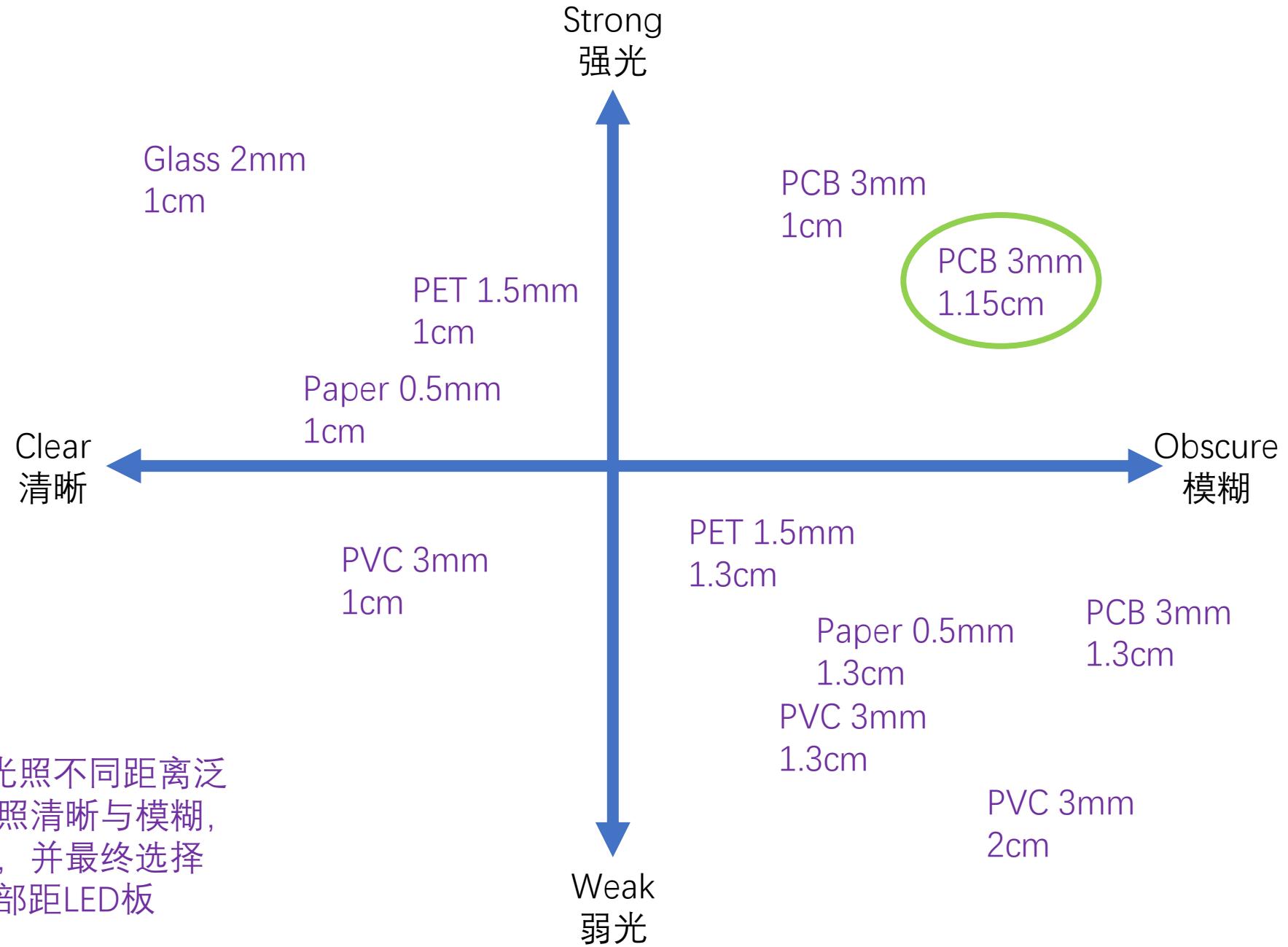


Material Selection

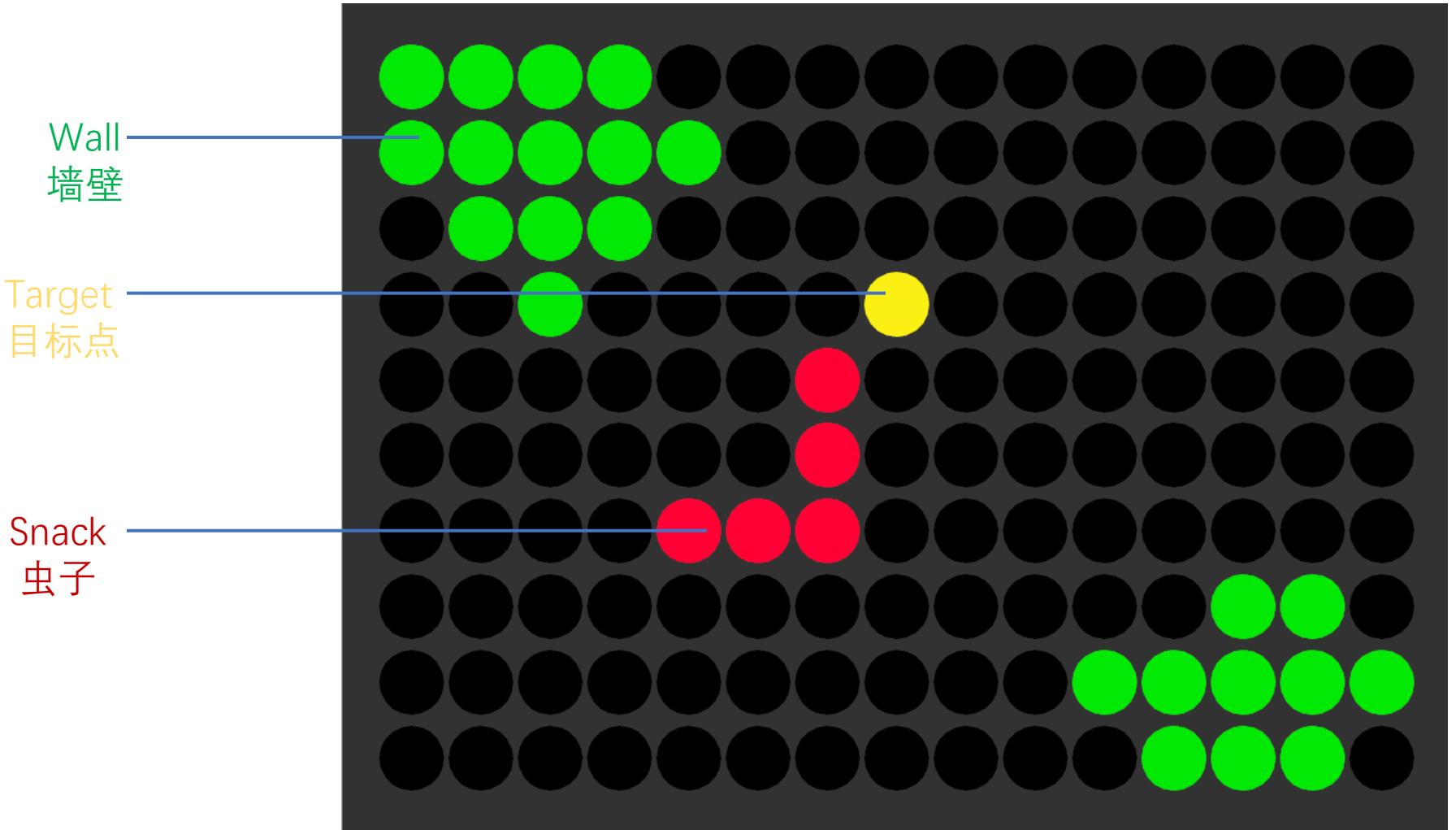
不同材质在不同距离会体现出不同程度的透光效果。



Material Selection

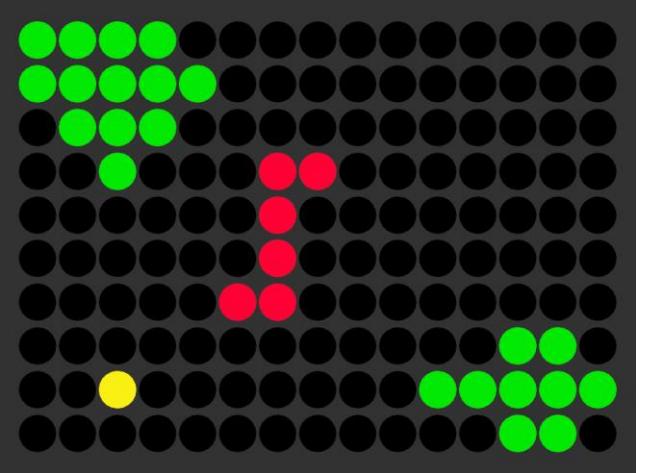
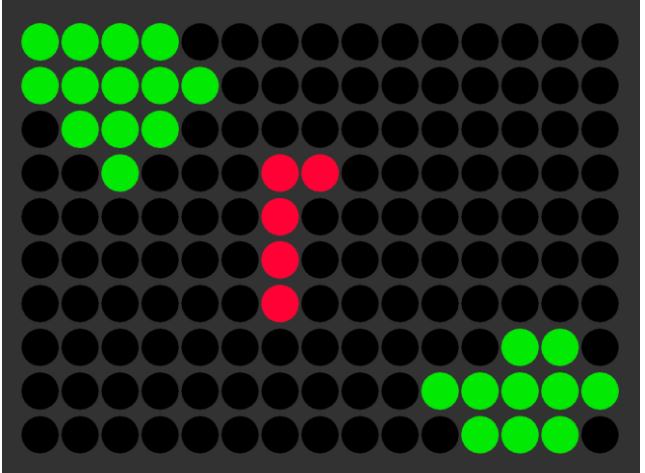
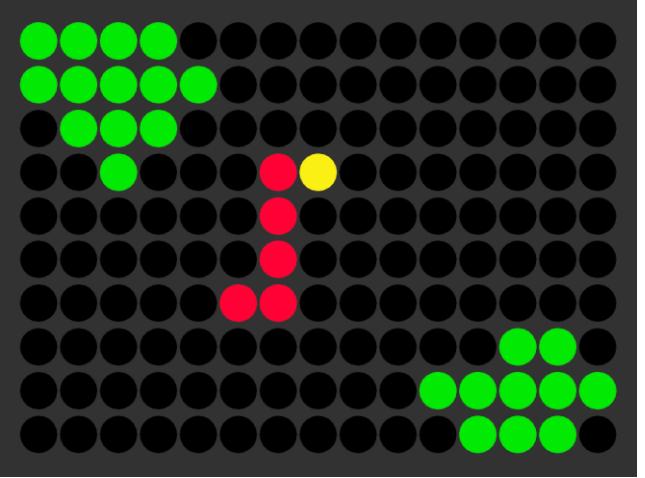
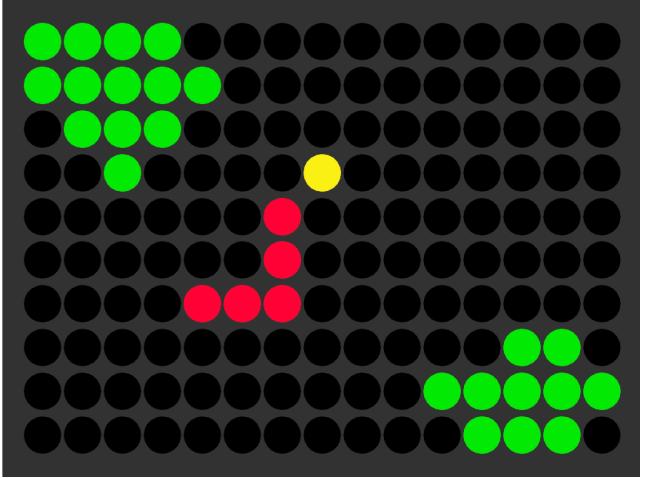


Game Design



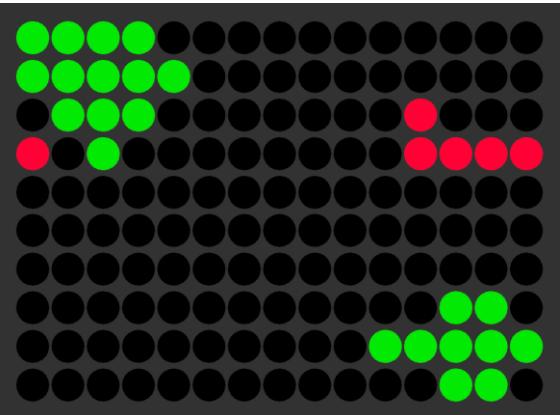
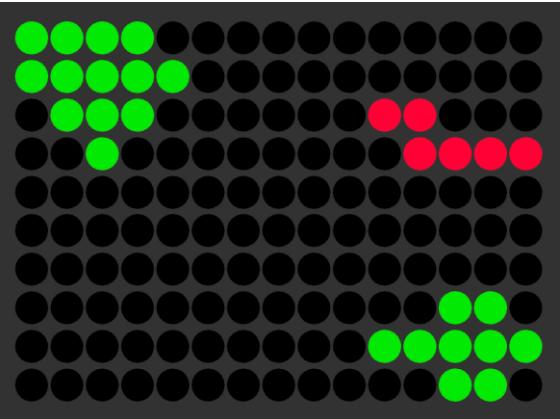
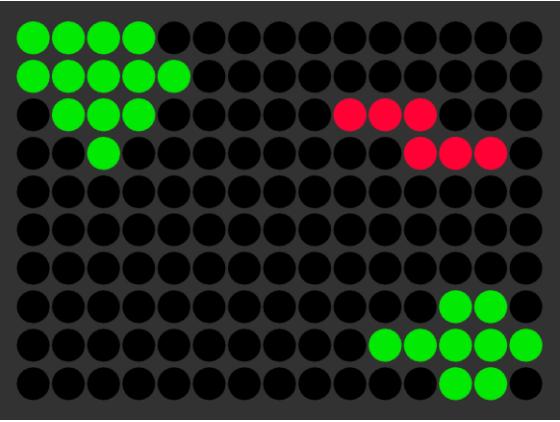
硬件上呈现的是一个简单的贪吃蛇游戏。

Game Design

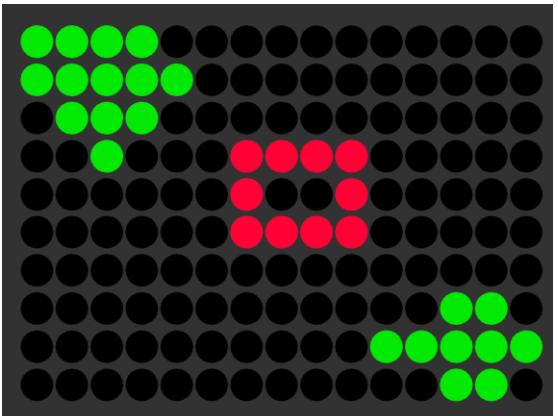
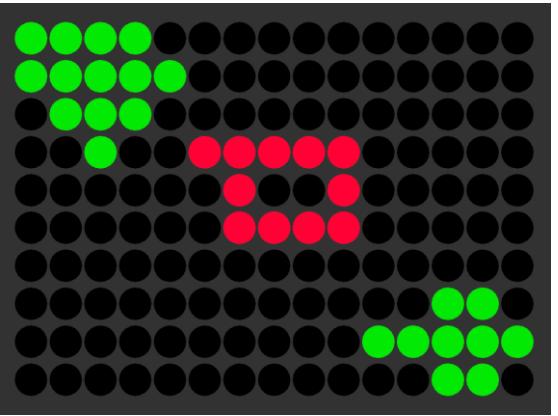
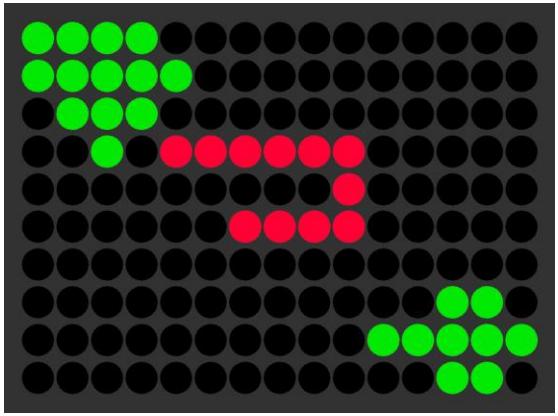


吃掉目标后虫子的尾部增长，同时随机产生新的目标点。

达到边界后虫子会穿过边界到达对岸。

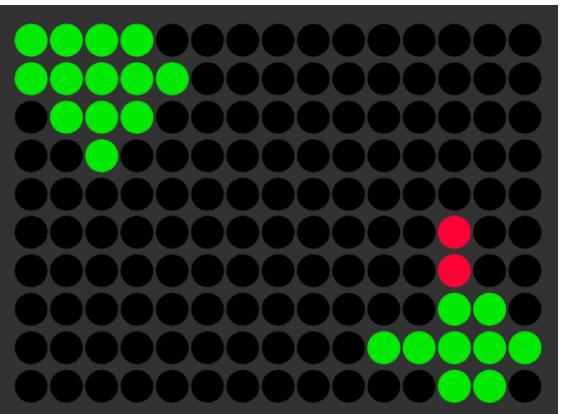
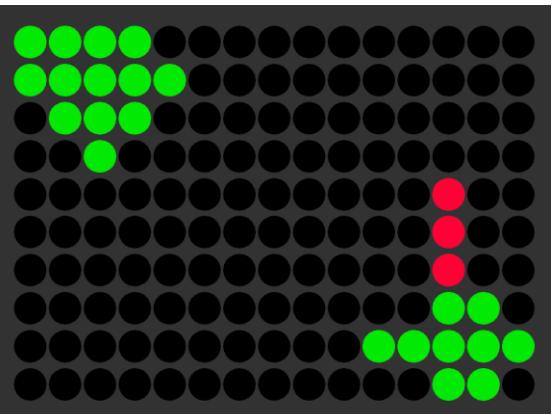
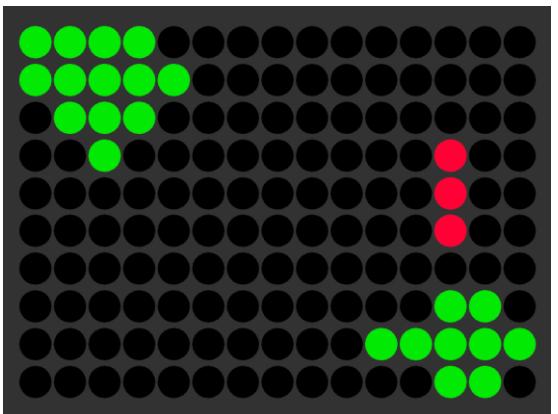


Game Design

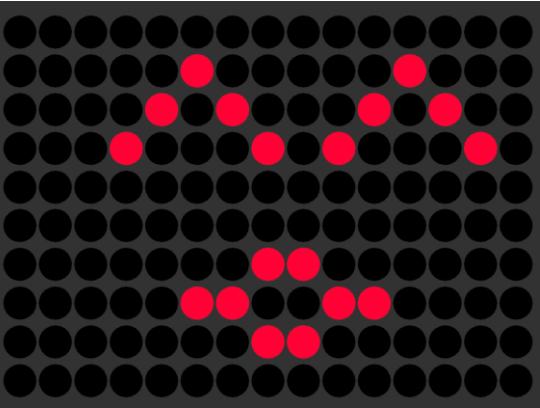
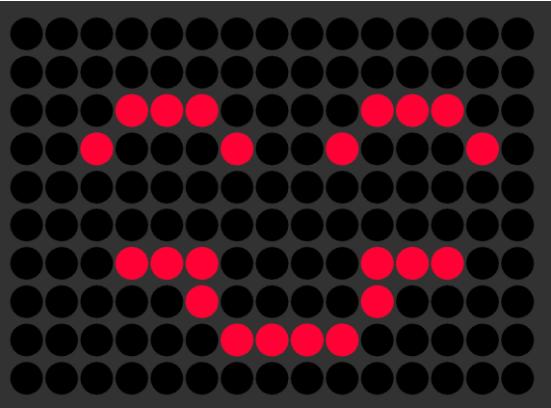
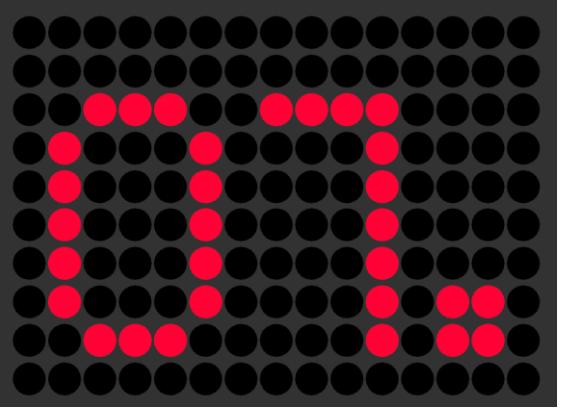
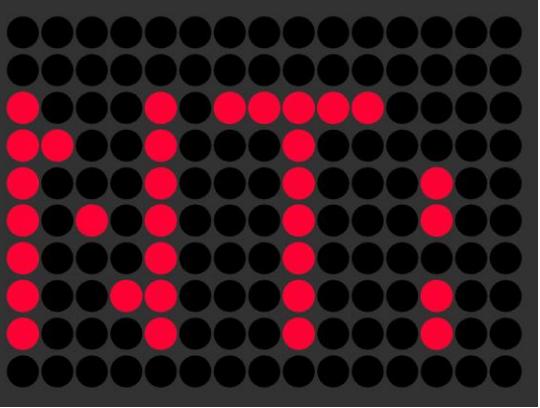
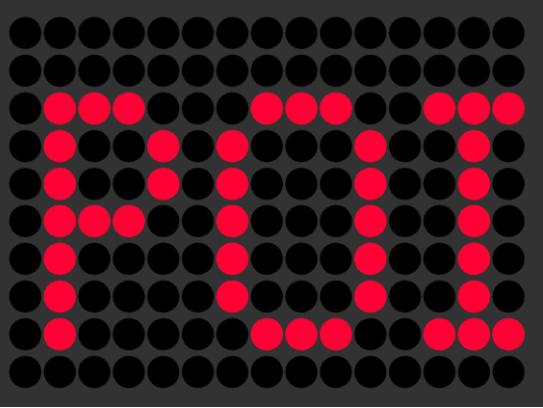
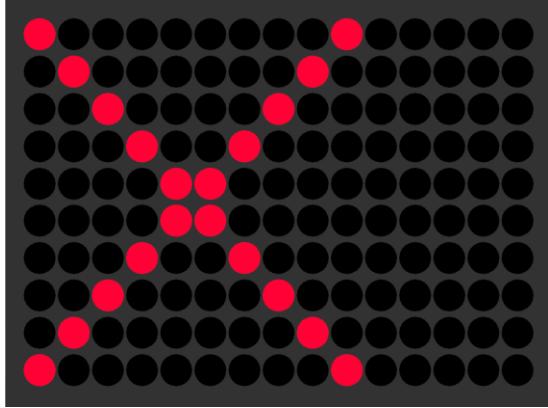


当虫子吃到自己身体的时候，
游戏结束。

当虫子身体撞击到墙壁的时
候，游戏结束。



Game Design



可以以滚动文字的形式传递出分数等必要信息，也可以展示出一些动态图像。

Software Design

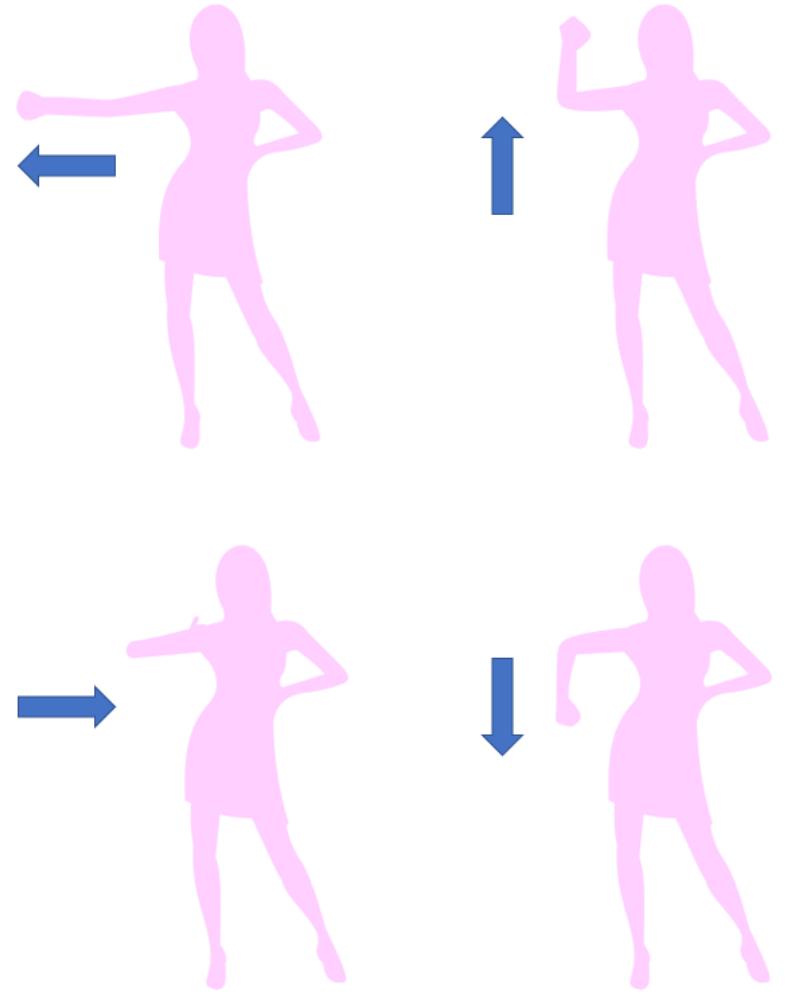
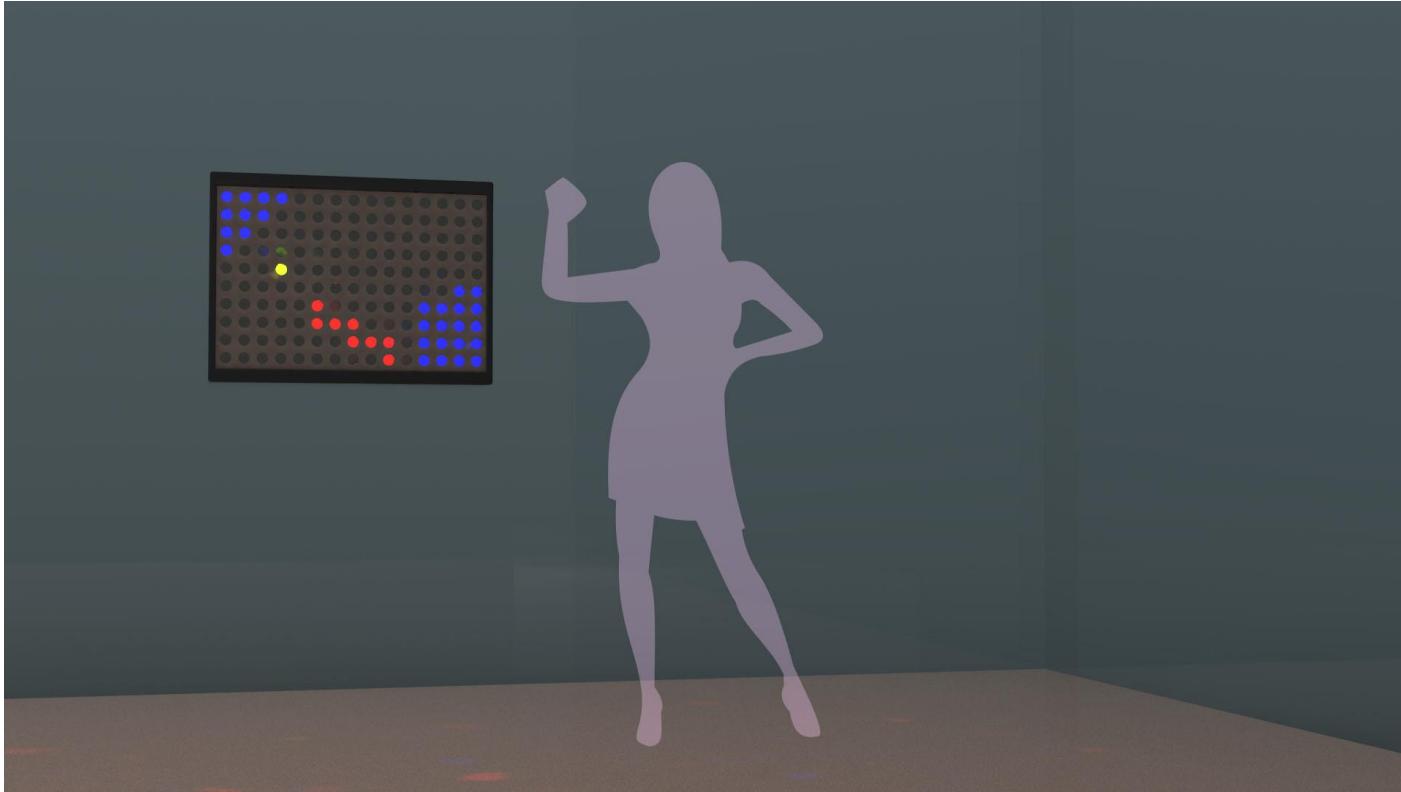


The screenshot shows a Microsoft Visual Studio interface with the following components:

- Left Panel:** Shows the code editor with `ofApp.cpp` open, displaying C++ code for a game loop. The code handles button inputs (0-2) and mouse events (x, y coordinates). It uses a 15x15 grid of circles, where each circle's color (BLACK, RED, GREEN, or YELLOW) corresponds to its current state or a specific event like a mouse click.
- Middle Panel:** A preview window displays a 15x15 grid of circles. The grid contains several green circles, one yellow circle, and two red circles. The background is black.
- Right Panel:** The Solution Explorer shows the project structure for "解决方案 1" (Solution 1) with files like `circle.h`, `circle.cpp`, `main.cpp`, and `ofApp.h`. The Properties window is also visible.
- Bottom Panel:** The Task List shows the command used to run the application: `.\D:\Study\UNI\FINAL\1\bin\1_debug.exe`.

在C++上利用Openframeworks创意编程框架编写电脑的模拟输出，同时实时处理Kinect端口检测到的数据，并且和硬件单片机通过UDP协议串口通信控制装置发光。

Control Design



经过讨论Kinect在2米范围内只能识别到人体上半身，故考虑通过人体手臂的方向来控制虫子的移动方向。

Design Process

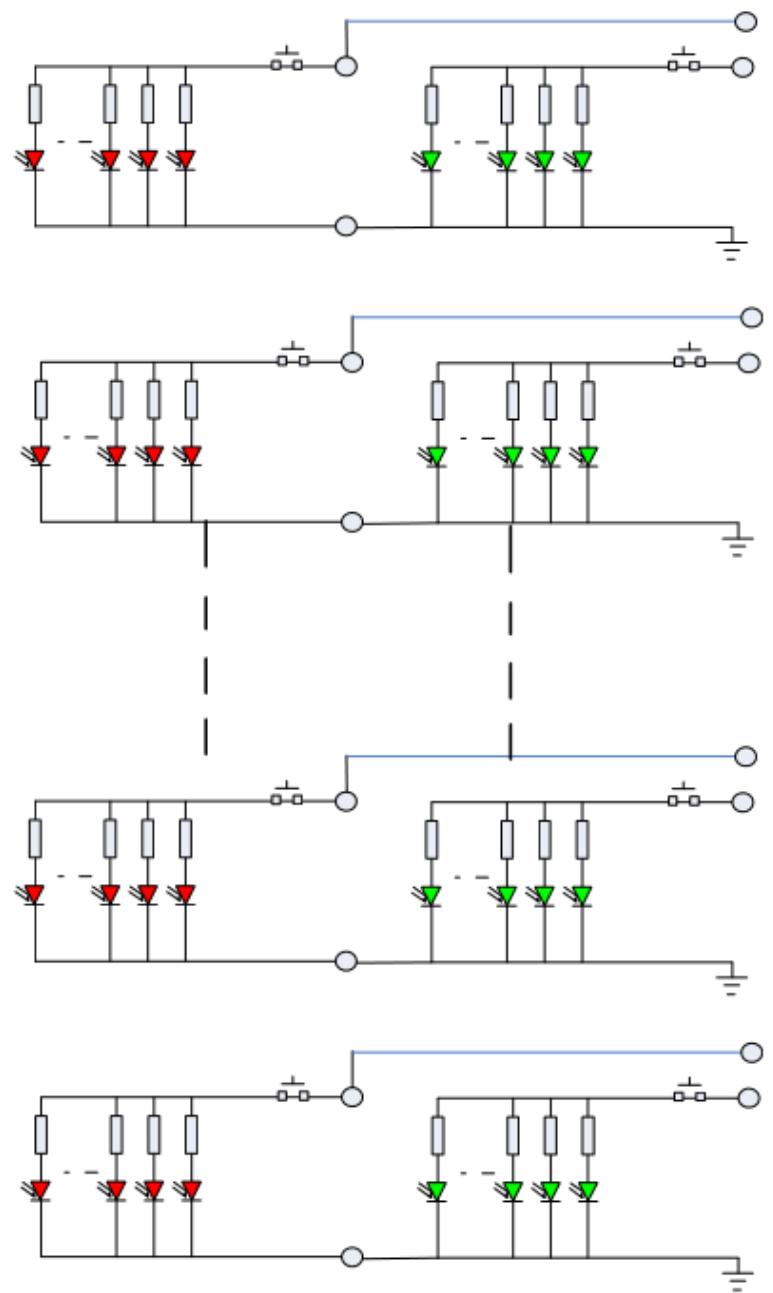
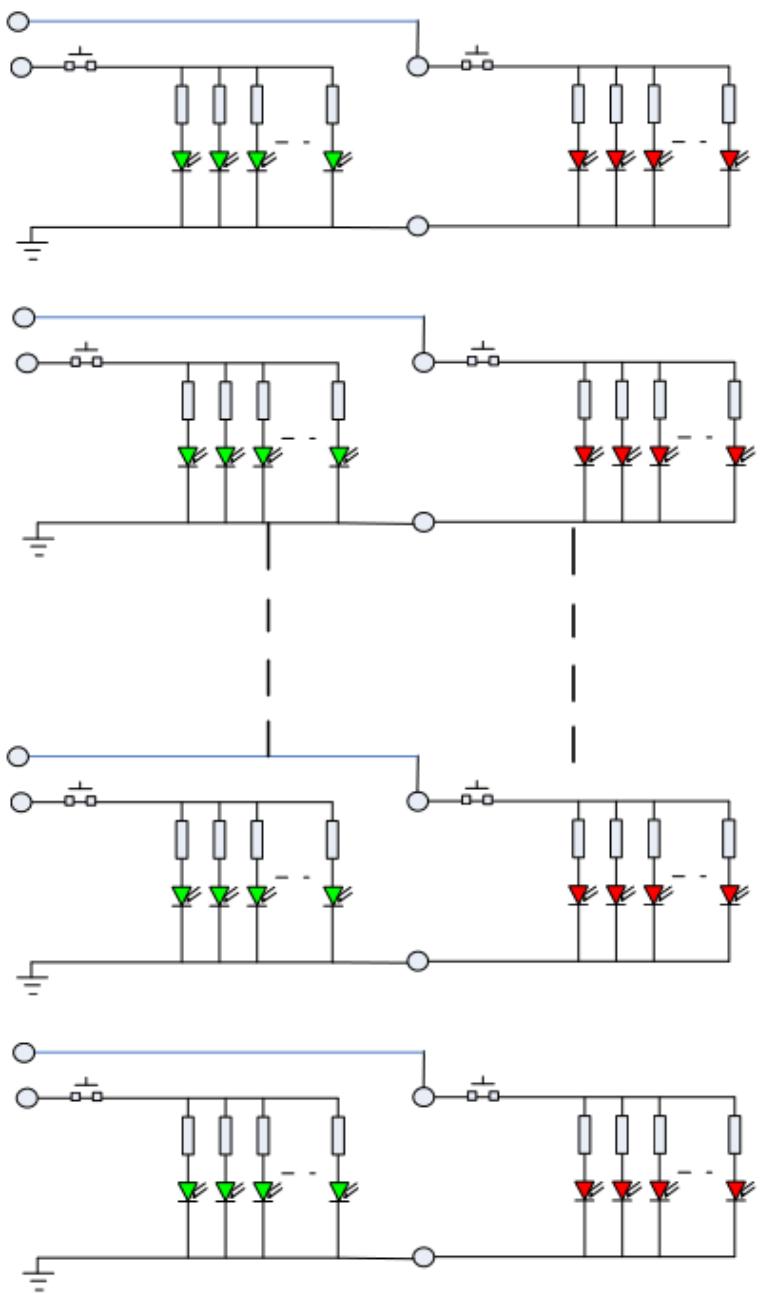
设计过程/文件

Documents

B

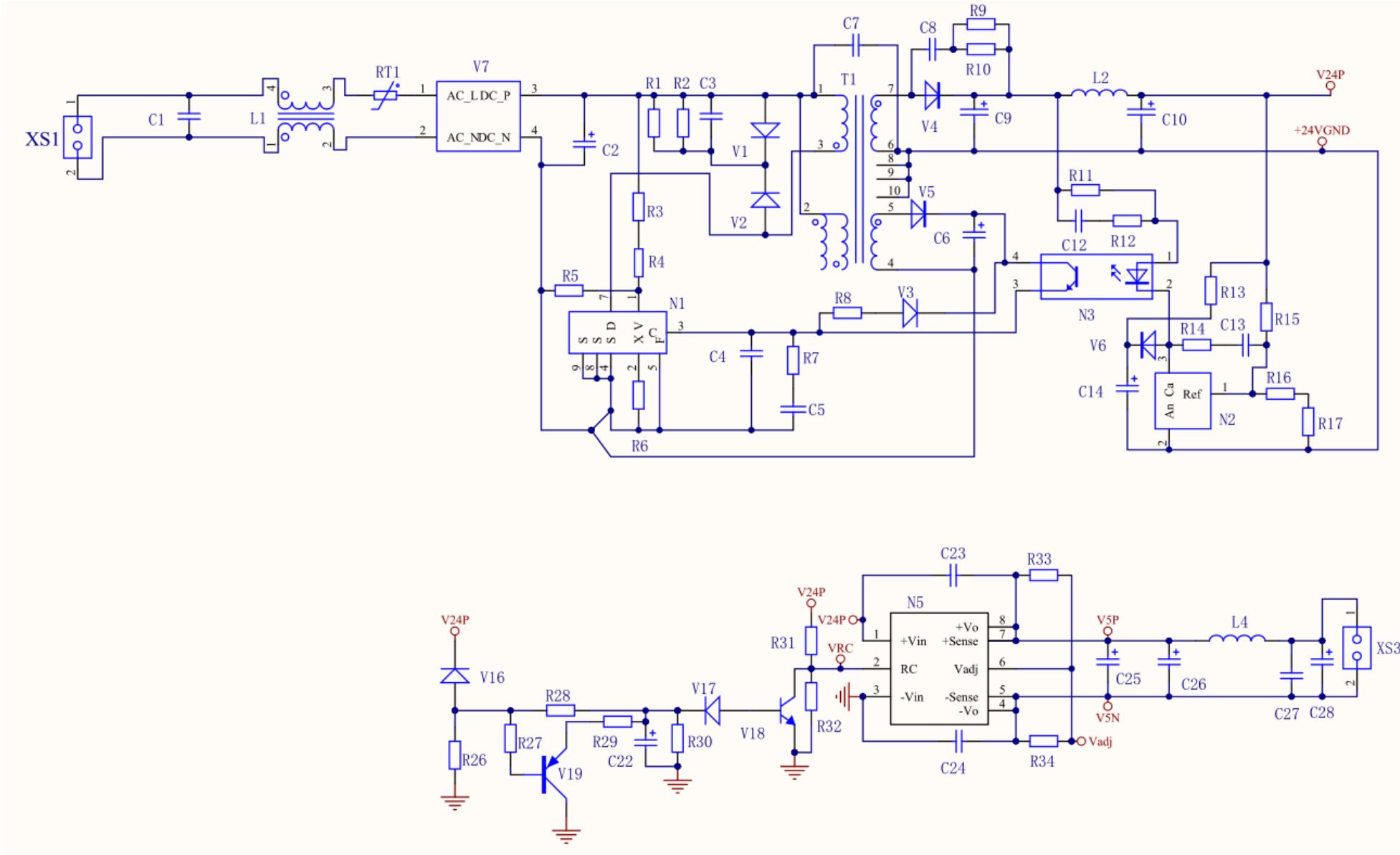
Documents

The Design of LED Circuit
LED电路设计图

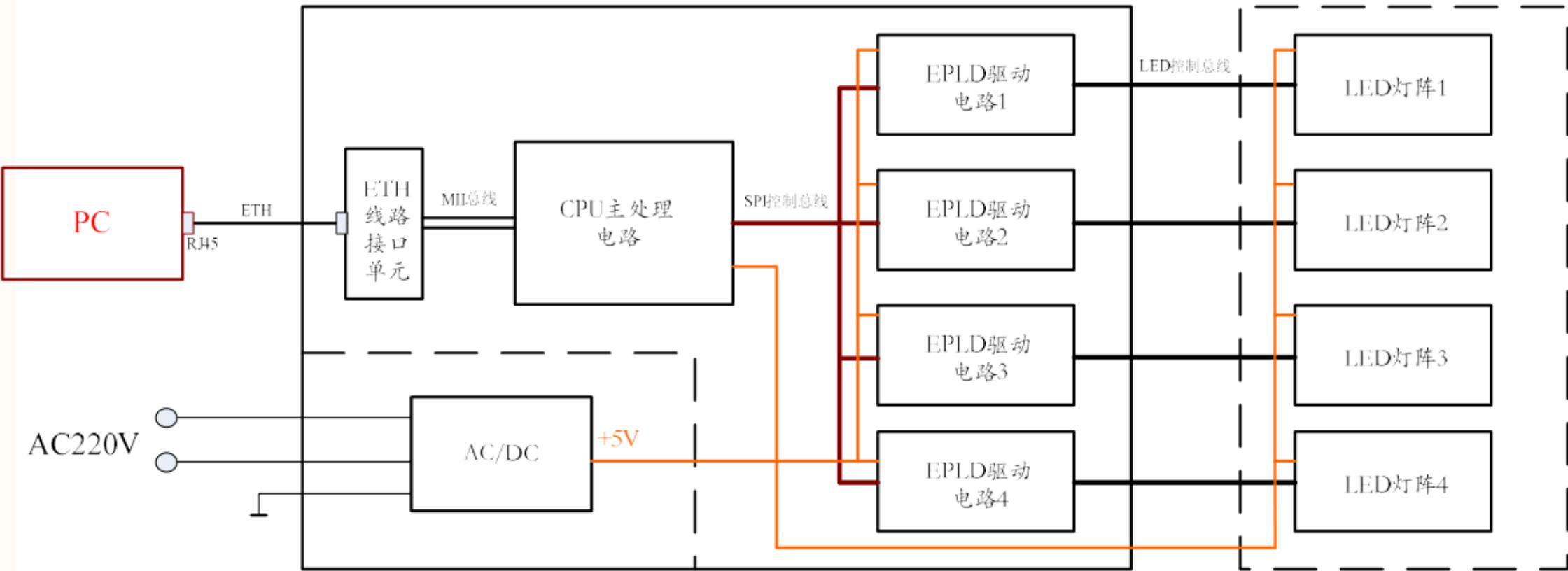


Documents

Power Circuit
电源电路图



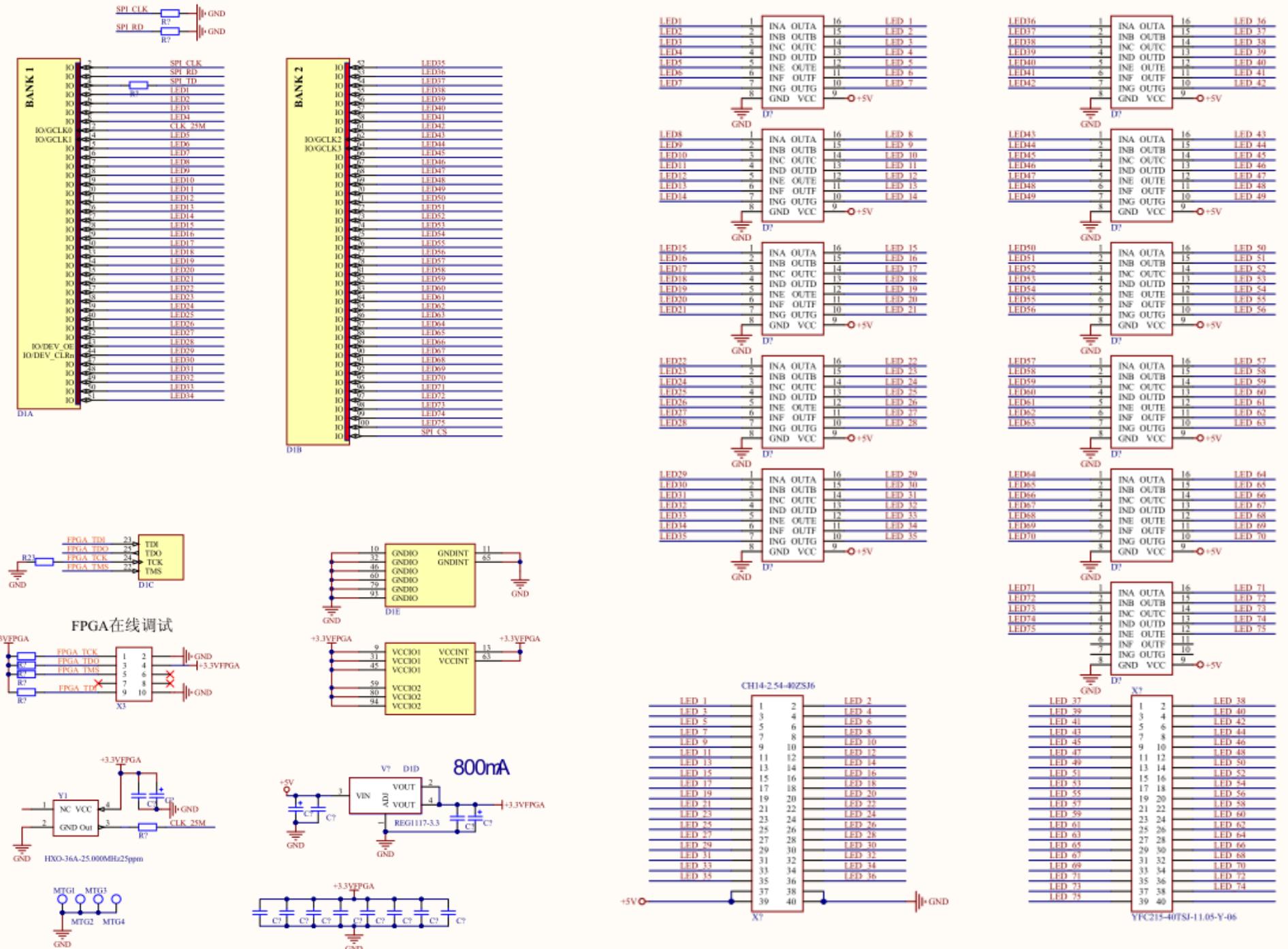
Documents



Big Picture of Hardware System
系统原理框架图

Documents

Main Processing Drive Circuit Diagram 主处理驱动电路图





Thank You!

Xuedan Zou 邹雪丹

Advisor: Ming Zhong 钟鸣

Special Thanks To Yi Xiao 肖懿 (技术指导)