



# **Cloud based 3D Printing Service Platform for Personalized Manufacturing**

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# Outlines



**Background and Significance**

Architecture

Research on some key technologies

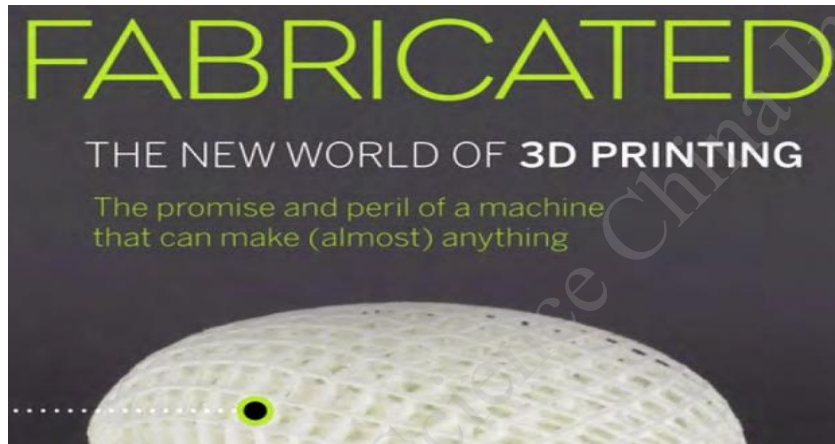
Conclusion



# Background and Significance

## CMfg + 3D printing: like ants with factories

- One future business model enabled by 3D printing and the new design technologies will be cloud manufacturing.
- Each manufacturing company, alone, by itself, may be small. However, like billions of cell phones or ants with factories, the combined whole will be greater than the sum of its parts.



\* Hod Lipson and Melba Kurman, Wiley, 2013



# Benefits of CMfg+3D printing

(1) Quick response to the individual user's personalized needs

- Can use for everyone online
- Can print things in anytime and anywhere
- Can be manufactured directly by consumers



# Benefits of CMfg+3D printing

## (2) Customized design and group innovation

- Design resources in cloud
- Design community
- Design collaboration
- Design crowdsourcing
- Flexibility in Design



# Benefits of CMfg+3D printing

## (3) Like ants with factories

- Customized production with low cost
  - Mass “ants factories” work together
    - Smart cloud factory
  - Super flexible production with cloud
    - Service and standardization
    - Service composition and collaboration
    - Online planning and scheduling

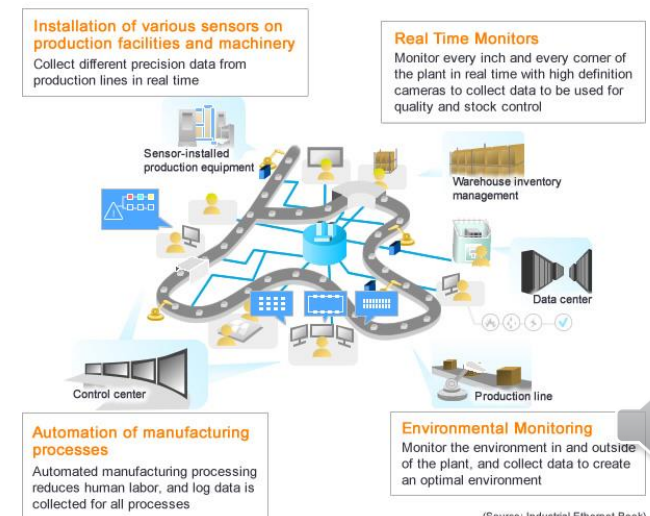


# Benefits of CMfg+3D printing

## (4) Knowledge & Big Data Support

- Mass knowledge management
- Manufacturing big data (manufacturing lifecycle data)
- Simulation and analyses in the cloud
- Prediction with data
- Evaluation with data
- Added value services

Figure 2: Image of Big Data collection at a plant



# Outlines



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**Architecture**

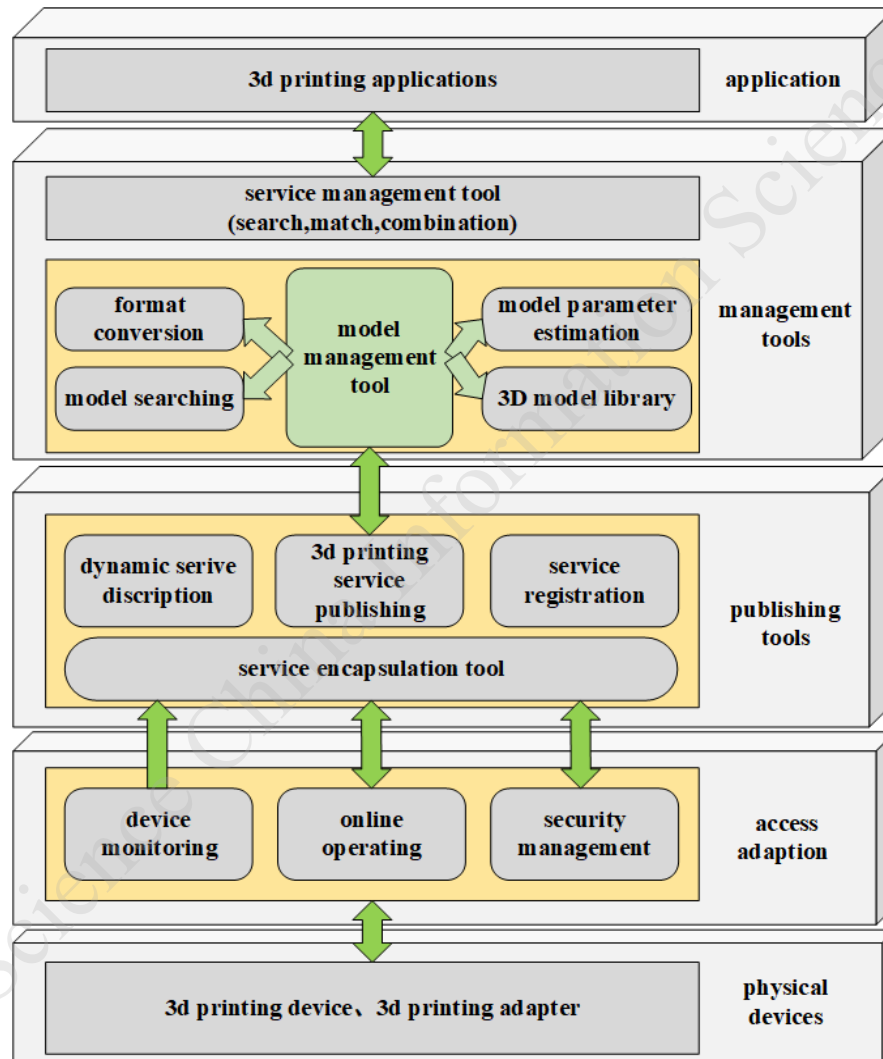
Research on some key technologies

Conclusion

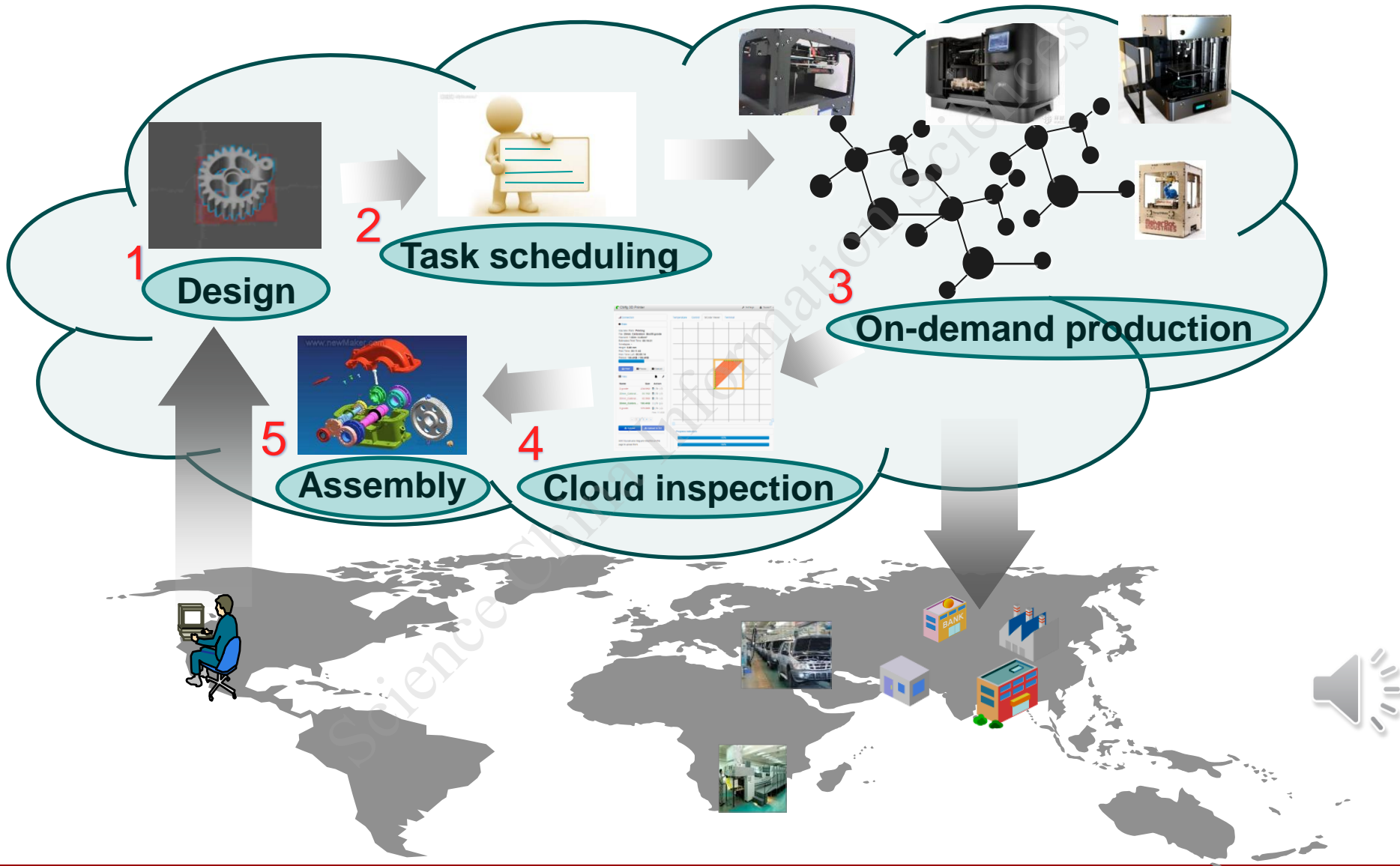




# Architecture



# 3D printing whole life-cycle activities in a cloud environment



# Outlines



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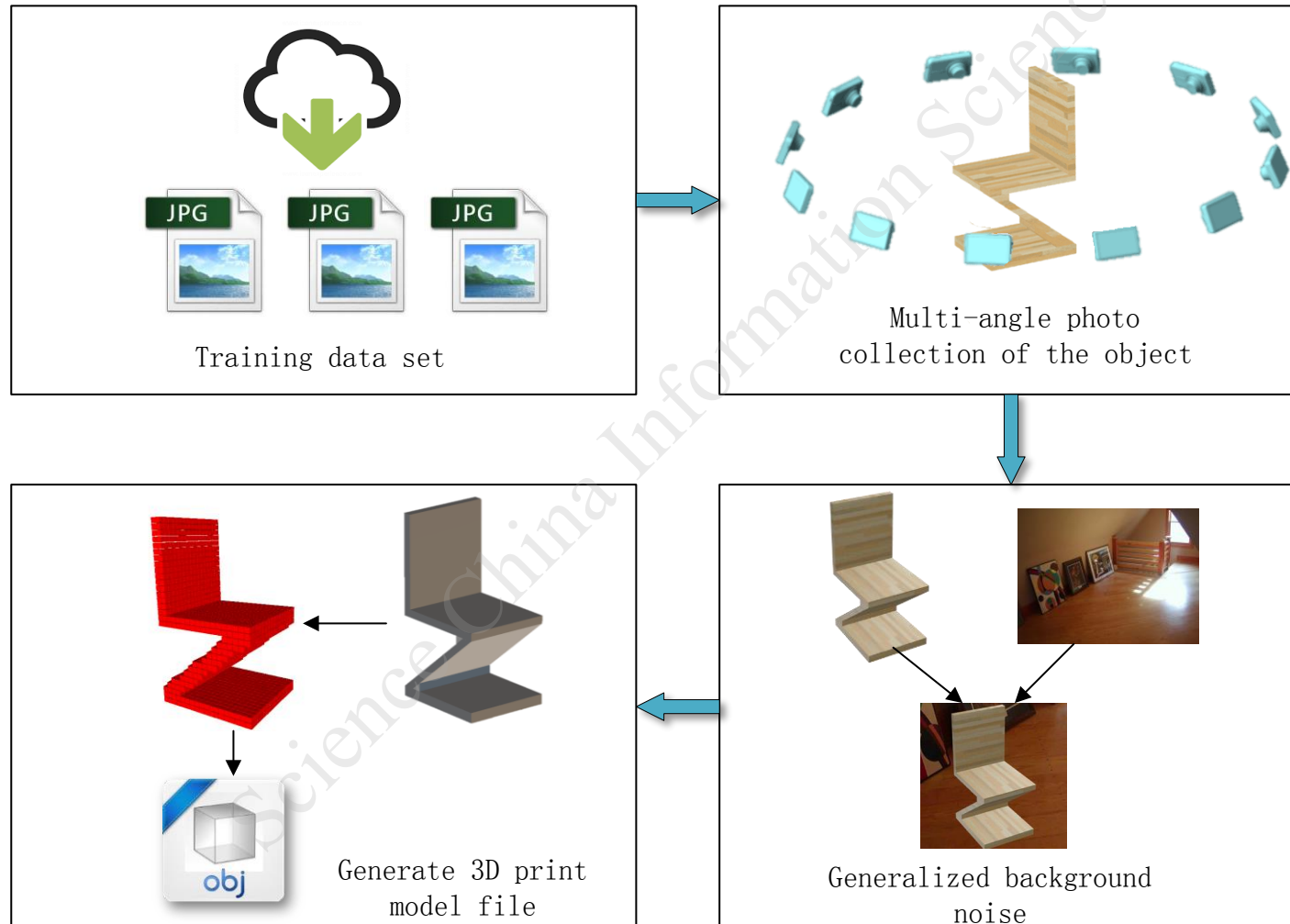
Conclusion



# Key-technology

## 1. 3D model generation base on deep learning

### 3D model generation process



# Key-technology

## 1. 3D model generation base on deep learning

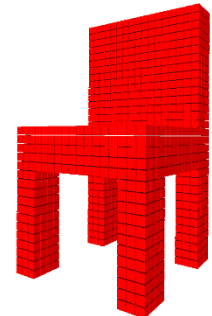
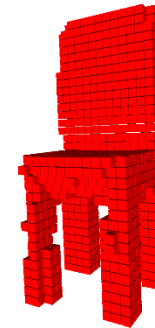
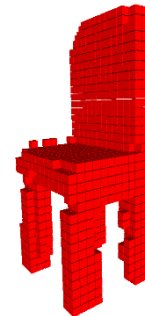
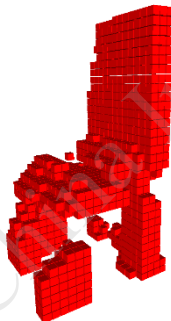
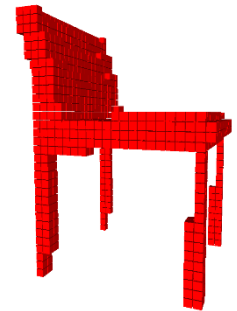
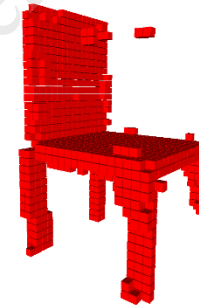
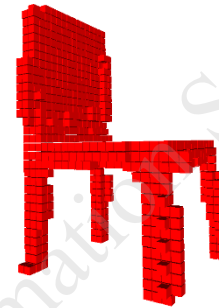
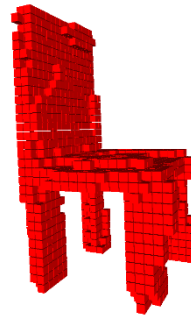
10<sup>th</sup> epoch

100<sup>th</sup> epoch

750<sup>th</sup> epoch

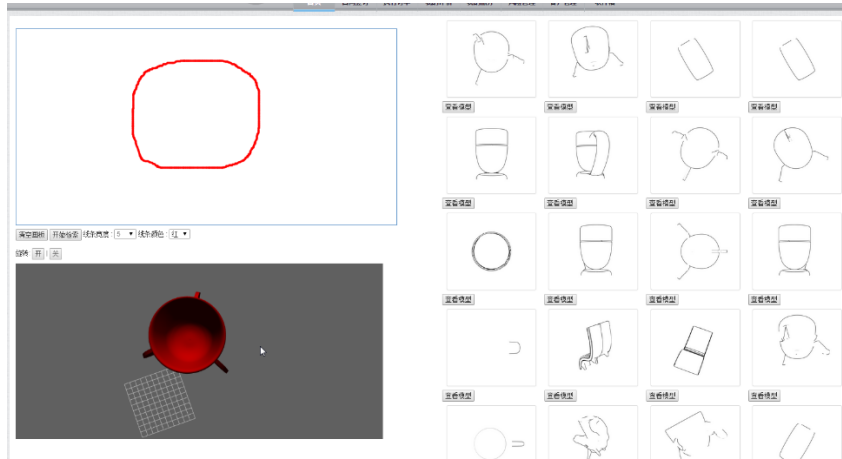
1495<sup>th</sup> epoch

Ground Truth

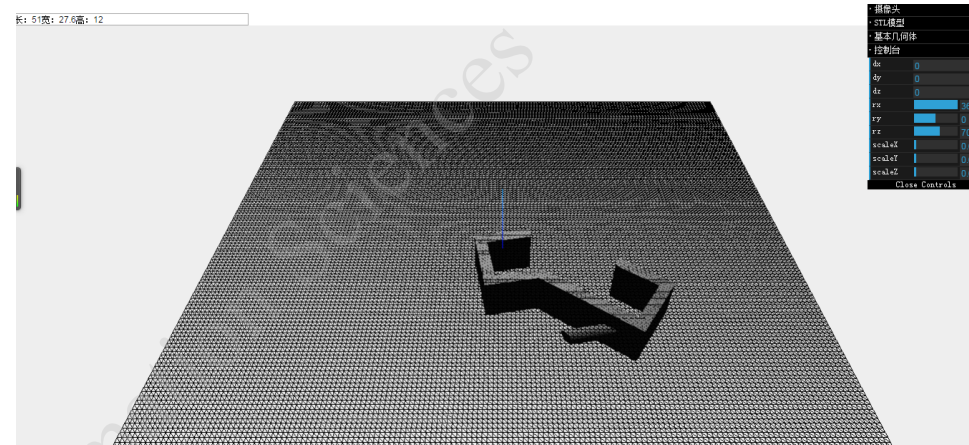


Effect of different training times base on  
Generative Adversarial Nets

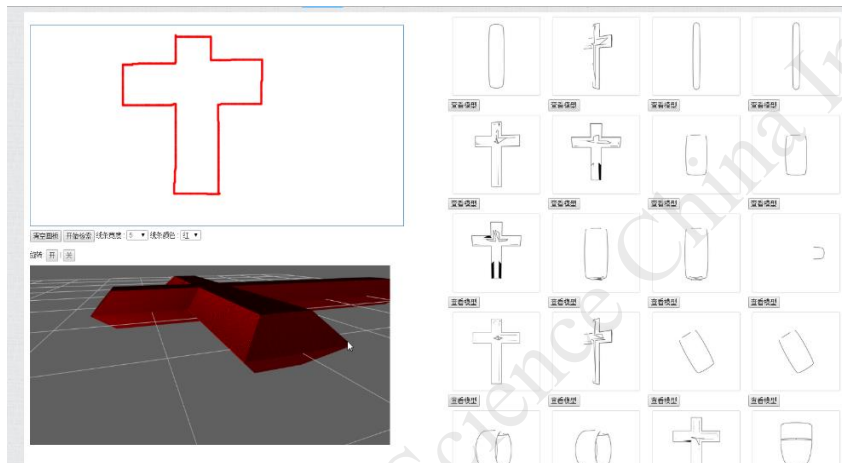
## 2. Sketch retrieval



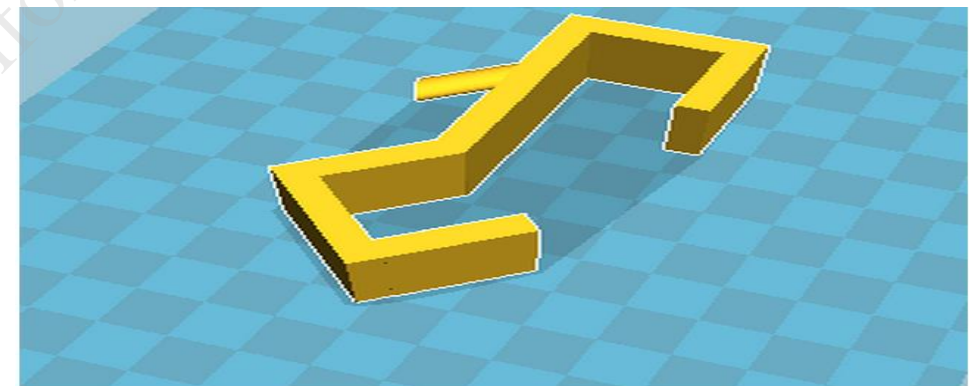
Sketch searching -- circle



Model editing



Sketch searching -- cross



模型材质: 模型介绍: 模型介绍				
模型名称:	单击执行操作:	单击执行操作:	单击执行操作:	模型尺寸信息 (单位: 毫米):
hair_dryer_hook.stl	下载模型	打印模型	编辑模型	File Types: ascii The number of triangles mesh in the STL file = 11673 X: 84.9218 Y: 46.027 Z: 20
				设置模型尺寸 (单位: 毫米):
				设置模型尺寸

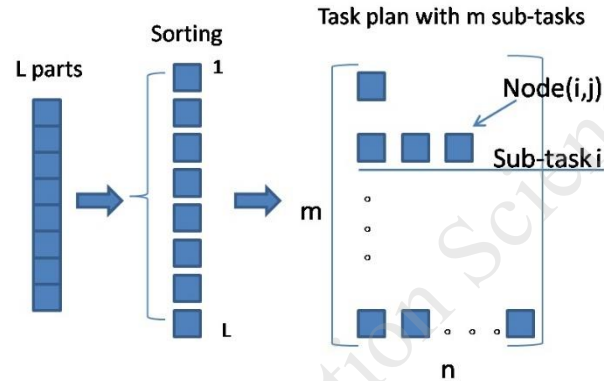


Rendering and molding



## 3. Printing task scheduling

Task planning strategy



$$\begin{aligned}
 \text{Obj.} \quad & \min \sum_{i=1}^m \left( \sum_{j=1}^n t_{ij} - t_{\max} \right)^2 \\
 \text{Const.} \quad & \sum_{j=1}^{L_i} t_{ij} \leq t_{\max} \\
 & P_{i1} = P_{i2} = \dots = P_{iL_i} \in P \\
 & M_{i1} = M_{i2} = \dots = M_{iL_i} \in M
 \end{aligned}$$

Dimension	3D printer $P_i$	3D printing task $M_k$
Size	The width and depth of the prototyping platform	The base area of 3D model, include width and depth
Height	The height of the prototyping space: the maximum height that this 3D printer can print	The height of the 3D model
Color	The color of consumable	The color of the 3D model
Precision	Different types of 3D printers have different precision definition FDM: the diameter of extruder SLA: the diameter of laser nozzle DLP: the pixel size of projector	The acceptable minimum accuracy of the 3D model
Storey	The minimum storey of the 3D printer	The maximum storey of the 3D model
Material	The type of print consumables, include: {ABS, PLA, TPU, UVCR, FUVCR}	Material requirement for the 3D model: {flexible, inflexible}

Task matching elements





## 4. Equipment map and On-demand pricing

首页 模型资源库 设备资源库 在线定制 在线设计 搜索 admin

新发布的设备



2015-10-28-080451dummy8

test

耗材: PLA/ABS  
耗材颜色: 红色黄色白色  
地理位置: 中国 北京 海淀区  
类型: FDM  
设备状态: 11分钟前 1 views


test6

耗材: PLA  
耗材颜色: 白色  
地理位置: 中国 北京 海淀区  
类型: FDM  
设备状态: offline 31分钟前 0 views

2015-10-28-080451dummy9

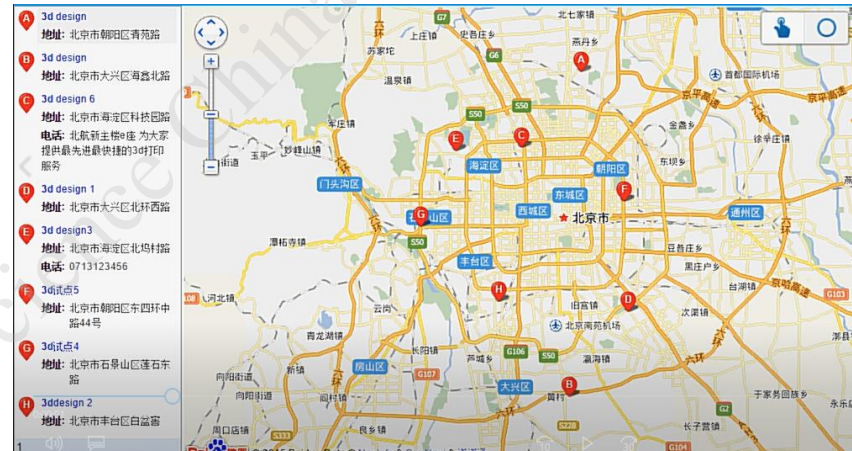
耗材: ABS  
耗材颜色: 红色  
地理位置: 中国 北京 海淀区  
类型: FDM  
设备状态: offline 31分钟前 0 views

The status of print tasks



名称	综合评分	距离	待打印数量	地址	成本估算
3d design 6	★★★★☆	1.93千米	5	北京市海淀区科技园路	525元
3ddesign 2	★★★★☆	16.7千米	3	北京市丰台区白盆窑	533元
3d design3	★★★★☆	8.696千米	5	北京市海淀区北坞村路	529元
3d试点4	★★★★☆	14.795千米	4	北京市石景山区莲石东路	532元
3d试点5	★★★★☆	11.952千米	3	北京市朝阳区东四环中路44号	530元
3d design 1	★★★★☆	20.922千米	4	北京市大兴区北环西路	534元

On-demand pricing of print tasks



3d design  
地址: 北京市朝阳区清苑路

3d design  
地址: 北京市大兴区海鑫北路

3d design 6  
地址: 北京市海淀区科技园路  
电话: 北航新主楼9座 为大家提供最先最快最便捷的3D打印服务

3d design 1  
地址: 北京市大兴区北环西路

3d design3  
地址: 北京市海淀区北坞村路  
电话: 0713123456

3d试点5  
地址: 北京市朝阳区东四环中路44号

3d试点4  
地址: 北京市石景山区莲石东路

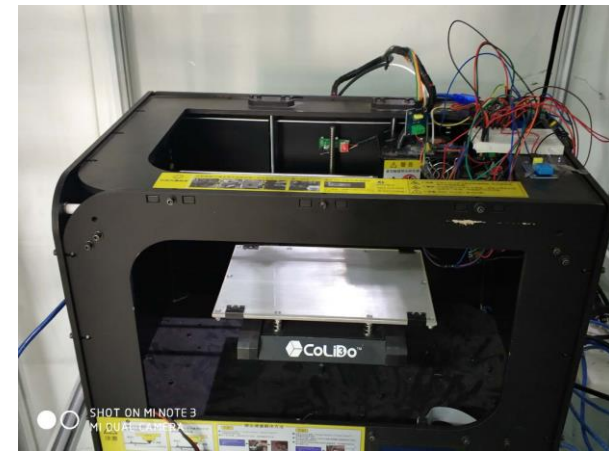
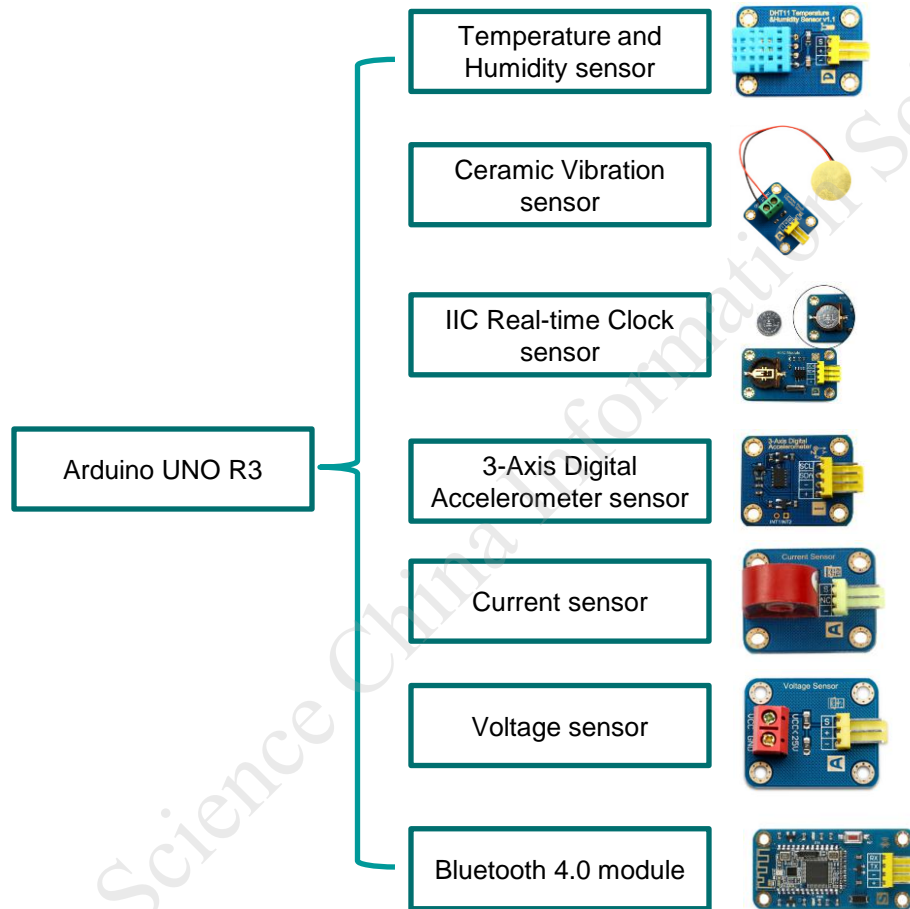
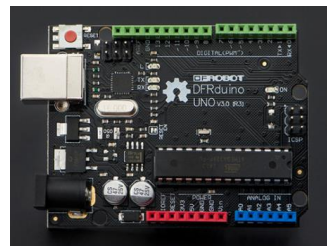
3ddesign 2  
地址: 北京市丰台区白盆窑

Resource distribution of 3D printers





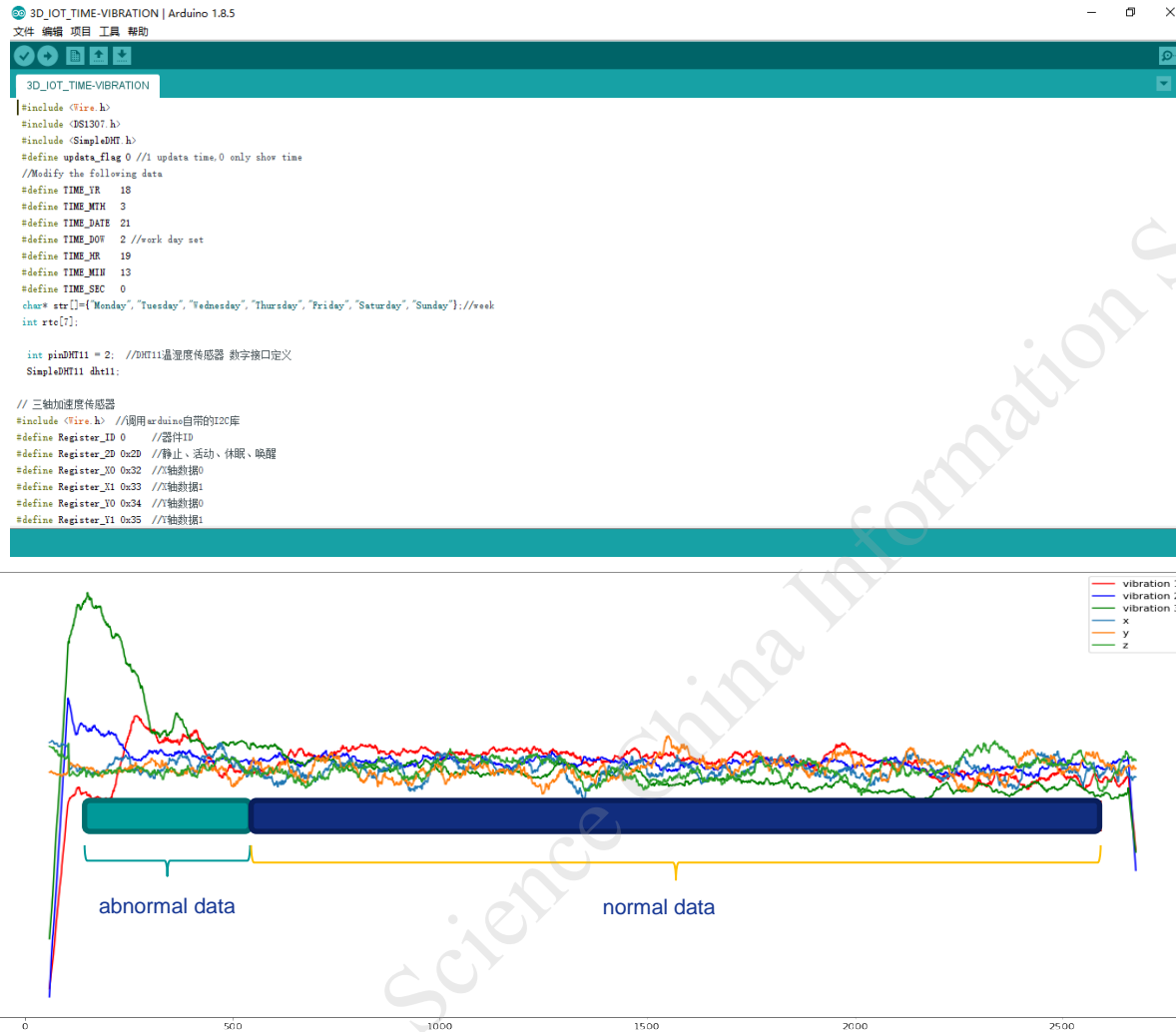
## 5. Monitor equipment health status



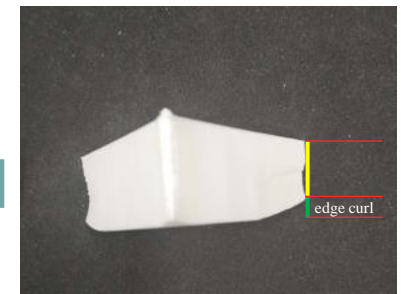
Data acquisition system based on Arduino



## 5. Monitor equipment health status



Data acquisition system  
code snippet



equipment health status analysis base on python

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➤ Our research is based on platform building and key technologies. Through the effective integration and management of this related software and hardware in the 3D printing service platform, these works **effectively improves the utilization rate of platform resources and shortens the production cycle of 3D printing products.**

