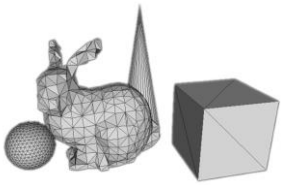

Introduction to Computer Graphics

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Contents(本节内容）

- What is CG (computer graphics)? 图形学是什么？
- Development History 历史发展
- Application areas 应用领域

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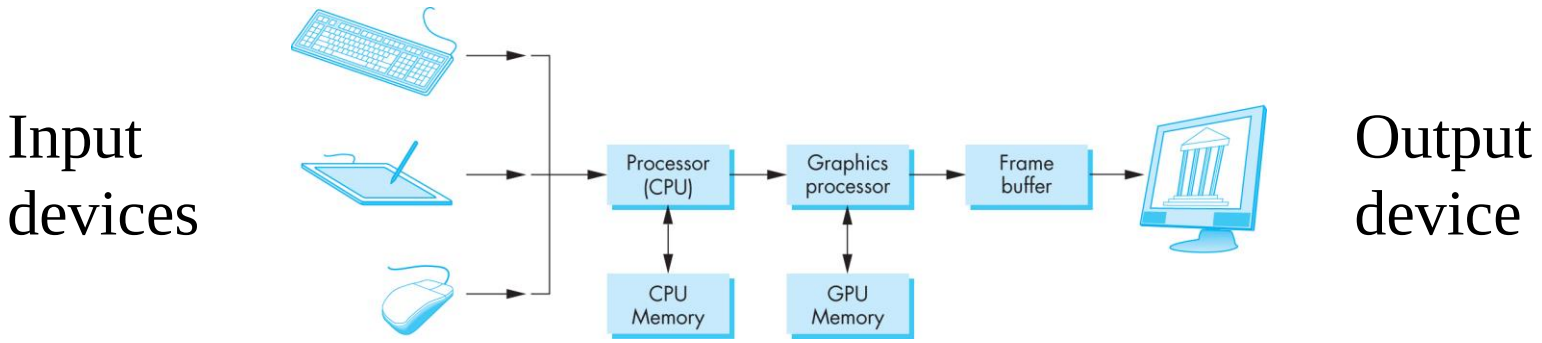
Computer Graphics

- *Computer graphics* deals with all aspects of creating images with a computer (研究利用计算机生成图像的方法)
  - Hardware 硬件
  - Software 软件
  - Applications 相关应用



Example

- How to create this image?

- What hardware/software did we need to produce it?

Preliminary Answer

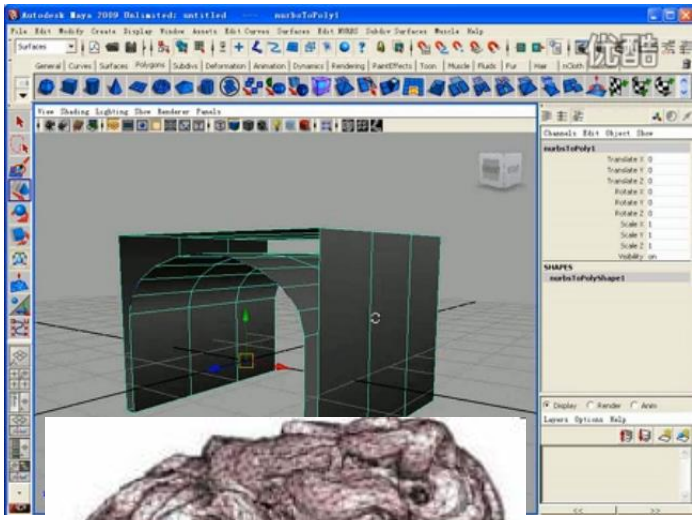
- **Application**: The object is an artist's rendition of the sun
- **Software**: Maya for modeling and rendering but Maya is built on top of OpenGL
- **Hardware**: PC with graphics card for modeling and rendering

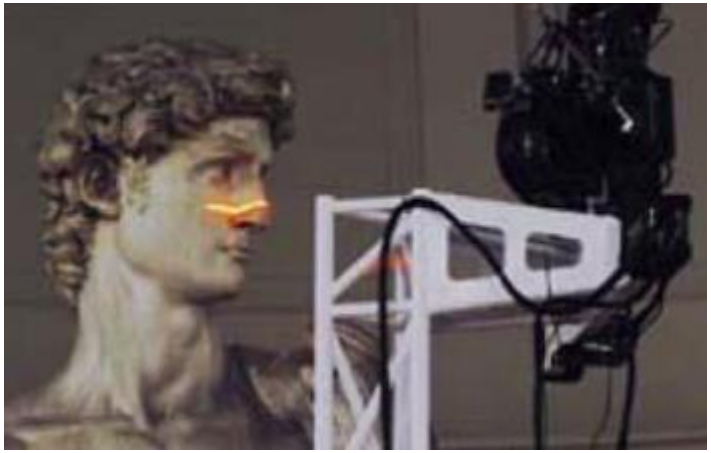
Main Research Contents (主要研究内容)

- Modeling （建模）
  - Create the 3D objects (draw what)
- Rendering (绘制、渲染）
  - How to draw a image
- Animation (动画）
  - How to generate the moving/deforming objects
  - How to draw the object's motion

Modeling (建模)

- Create the 3D geometry
  - Generate
  - Reconstruct





Rendering（绘制）

- Creating the image
  - As realistic as possible
  - As cartoonlike as possible
  - …

Animation（动画）

- Generating the image of moving objects
  - How to generate the moving/deforming objects
  - How to draw the object's motion
  - Obey the physics rules

顽皮跳跳灯(Luxo Jr), Pixar, 1986

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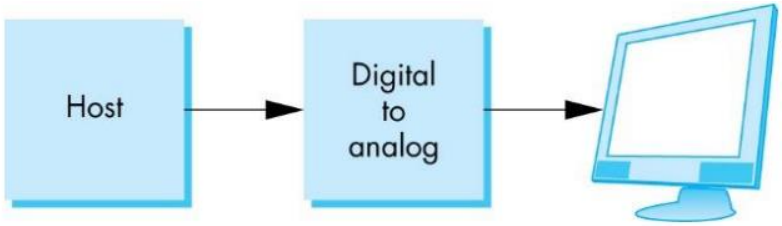
Computer Graphics: 1950-1960

- Computer graphics goes back to the earliest days of computing
  - Strip charts 条形图
  - Pen plotters 笔式绘图仪
  - Simple displays using A/D converters to go from computer to calligraphic CRT

    画线CRT显示器（矢量CRT显示器）

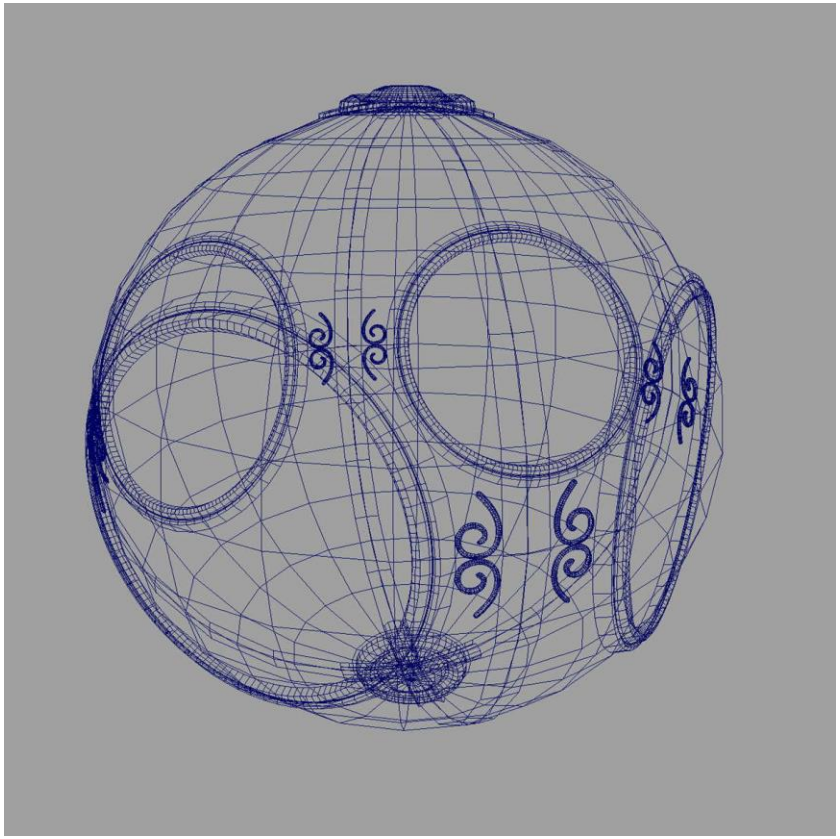


- Cost of refresh for CRT too high
  - Computers slow, expensive, unreliable

Pen plotters 笔式绘图仪

Computer Graphics: 1960-1970

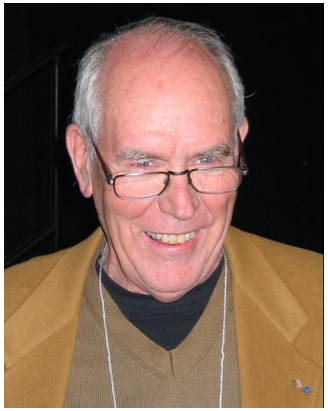
- *Wireframe* graphics
  - Draw only lines
- Sketchpad
- Display Processors



wireframe representation
of sun object

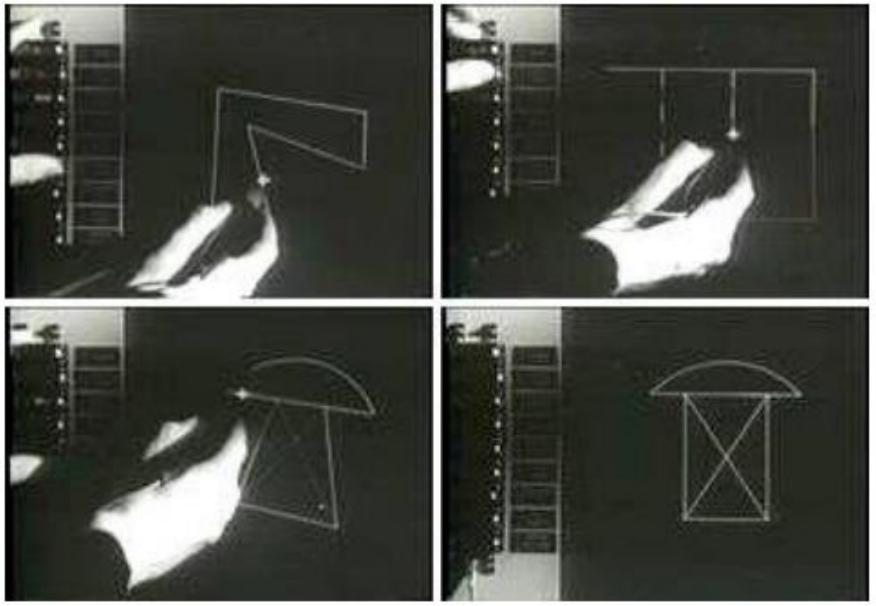
Sketchpad

- ***Ivan Sutherland***'s PhD thesis at MIT
  - Recognized the potential of man-machine interaction
  - Loop
    - Display something
    - User moves light pen
    - Computer generates new display



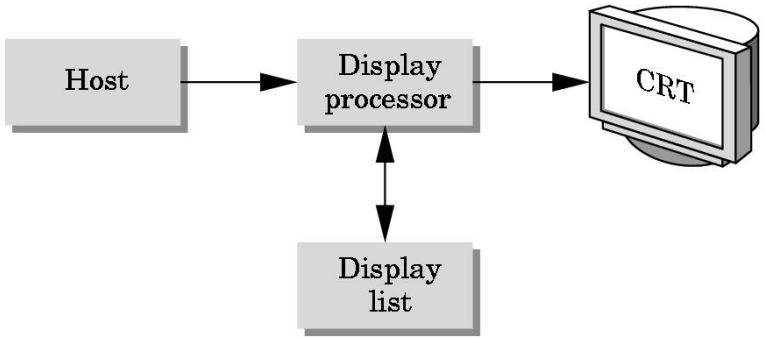
  - Sutherland also created many of the now common algorithms for computer graphics

Sketchpad



Display Processor

- Rather than have the host computer try to refresh display use a special purpose computer called a *display processor* (DPU)



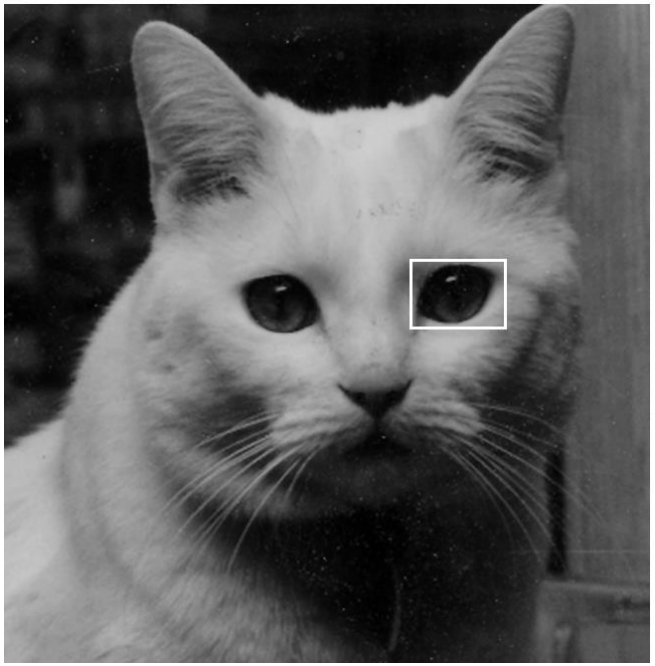
- Graphics stored in display list (display file) on display processor
- Host *compiles* display list and sends to DPU

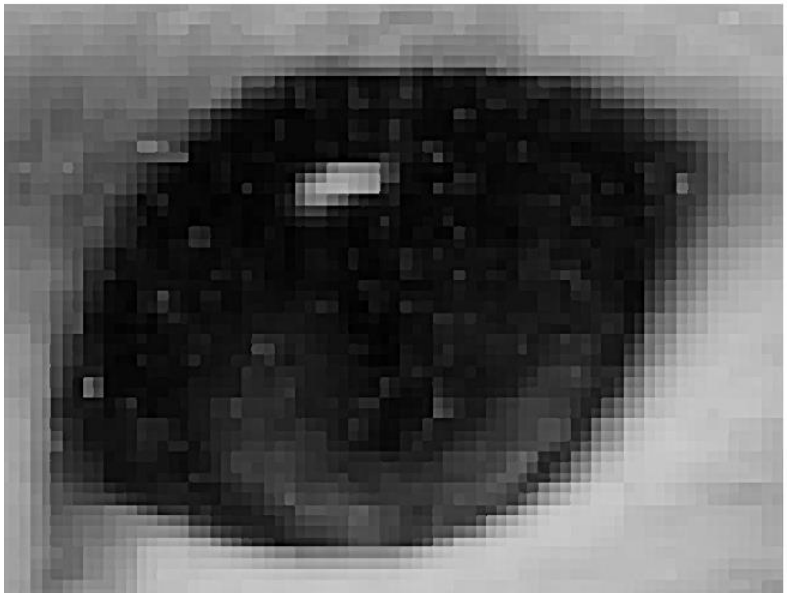
Computer Graphics: 1970-1980

- Raster Graphics 光栅图形学
  - Compare with vectorised graphics
- Beginning of graphics standards
  - GKS: European effort
    - Becomes ISO 2D standard
  - Core: North American effort
    - 3D but fails to become ISO standard
- Workstations and PCs

Raster Graphics

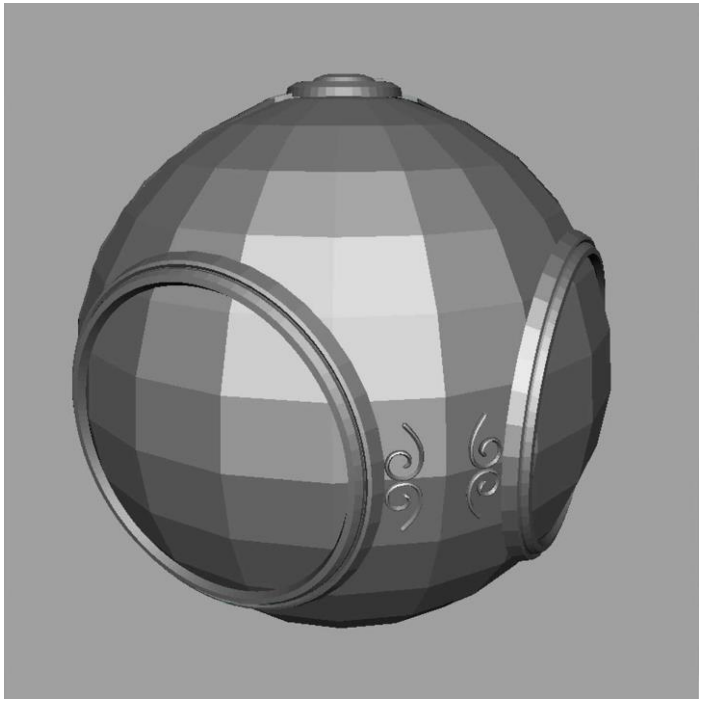
- Image produced as an array (the *raster*) of picture elements (*pixels*) in the *frame buffer*





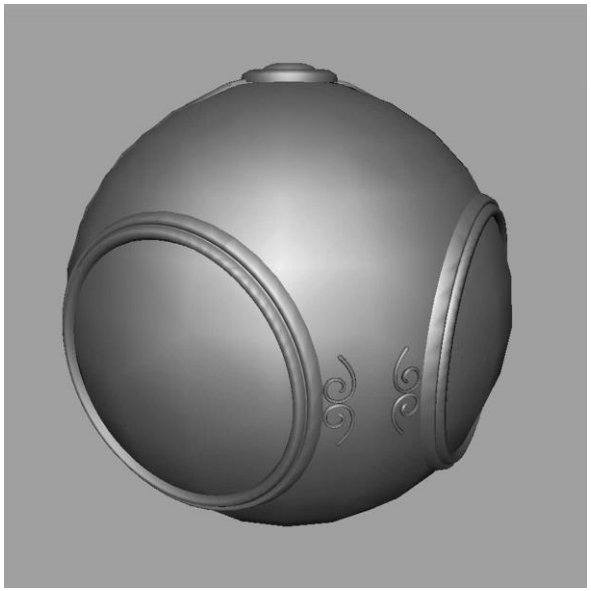
Raster Graphics

- Allows us to go from lines and wire frame images to filled polygons



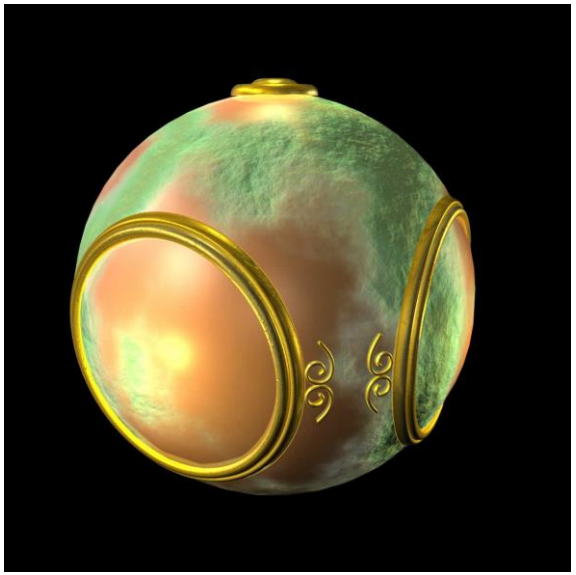
Computer Graphics: 1980-1990

Realism comes to computer graphics



smooth shading

environment mapping



bump mapping

Computer Graphics: 1980-1990

- Special purpose hardware
  - Silicon Graphics（Silicon Graphics, Inc. SGI）geometry engine
    - VLSI implementation of graphics pipeline
- Industry-based standards
  - PHIGS
  - RenderMan (皮克斯公司)
- Networked graphics: X Window System
- Human-Computer Interface (HCI)

Computer Graphics: 1990-2000

- OpenGL API
- Completely computer-generated feature-length movies (Toy Story) are successful
- New hardware capabilities
  - Texture mapping
  - Blending
  - Accumulation, stencil buffers

Computer Graphics: 2000-

- Photorealism
- Graphics cards for PCs dominate market
  - Nvidia, ATI
- Game boxes and game players determine direction of market
- Computer graphics routine in movie industry: Maya, Lightwave
- Programmable pipelines
- GPGPU

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Applications

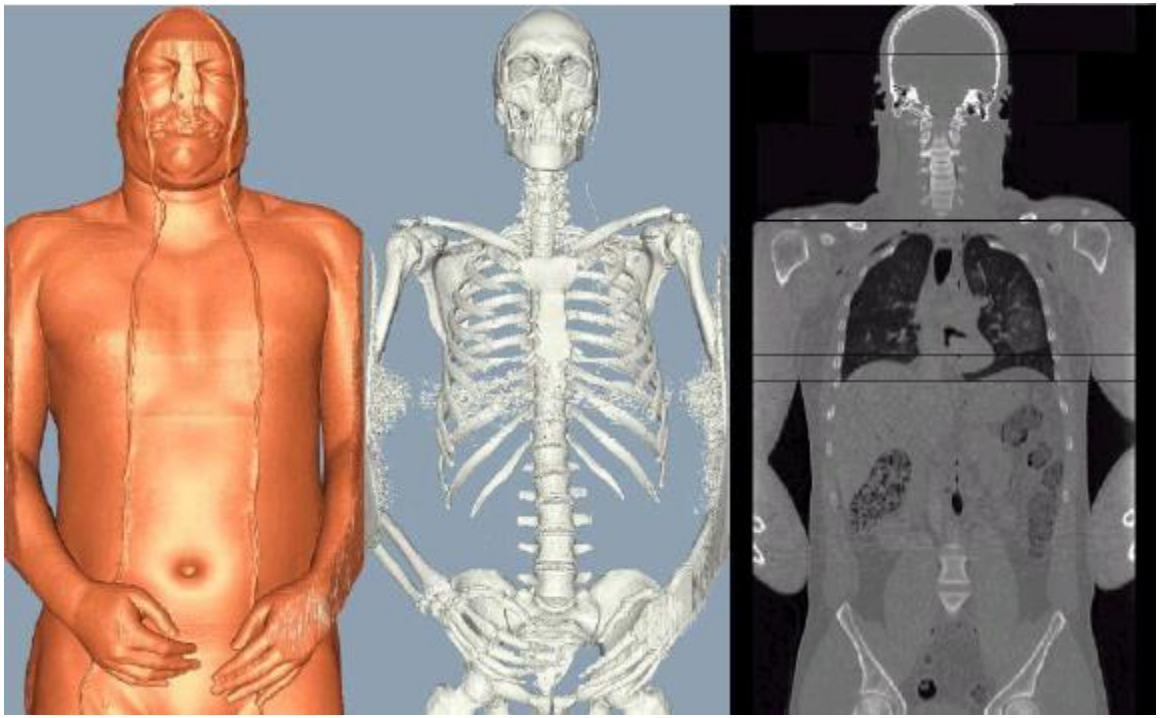
- Visualization of Information (信息可视化）
- Design（设计）
- Simulation and Animation（模拟与动画）
- User Interface (用户界面）

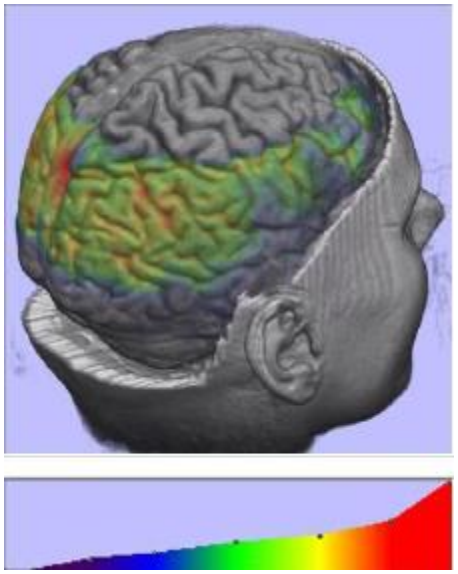
Digital Earth and Digital Urban (数字地球与数字城市）

- Google earth
- Bing maps (previously Microsoft Virtual Earth)

Google Earth: 3D Urban

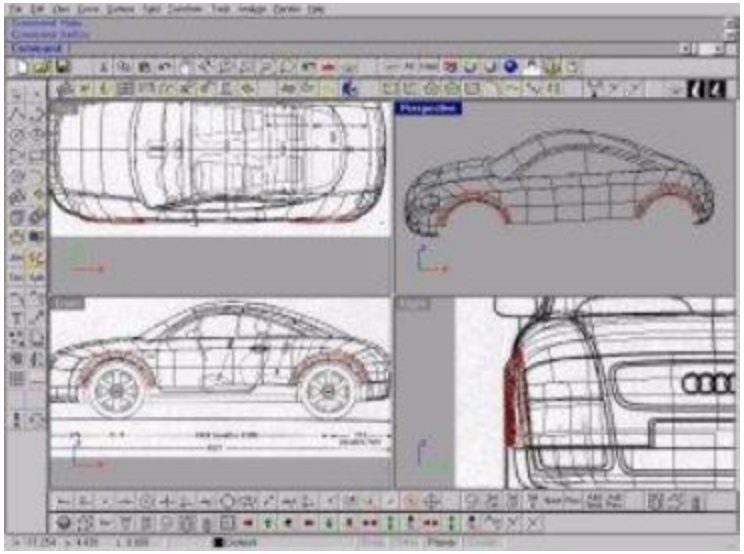
Medical Image (医疗图像）

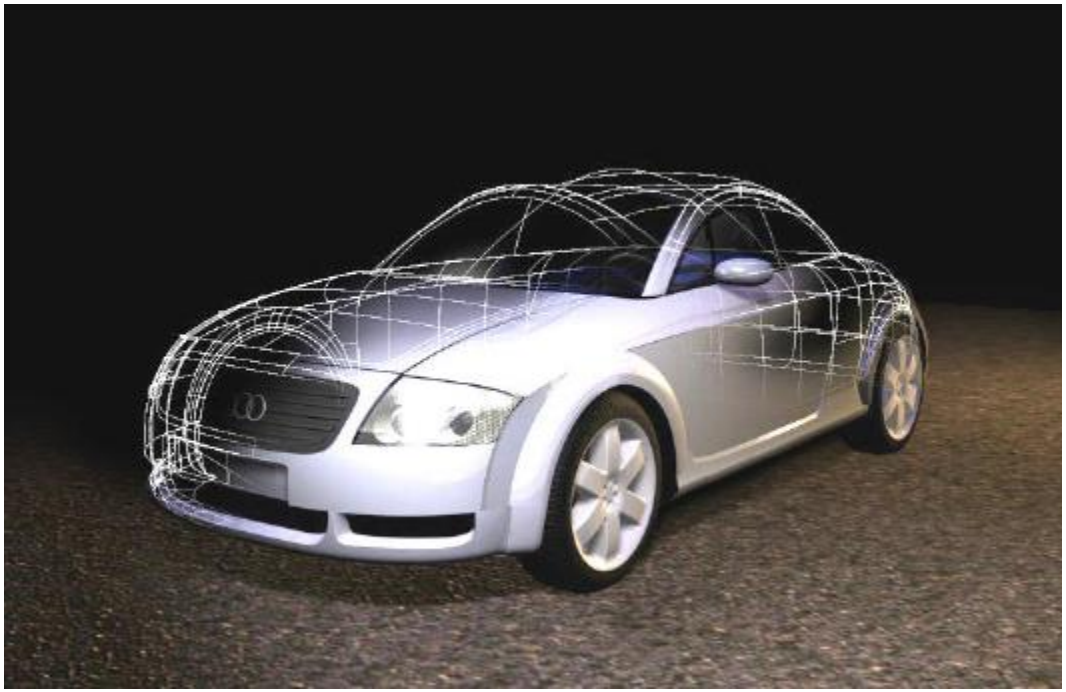




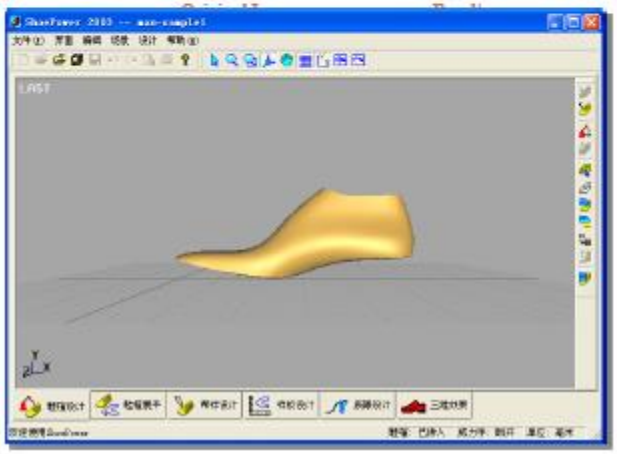
Visualization of Big Data

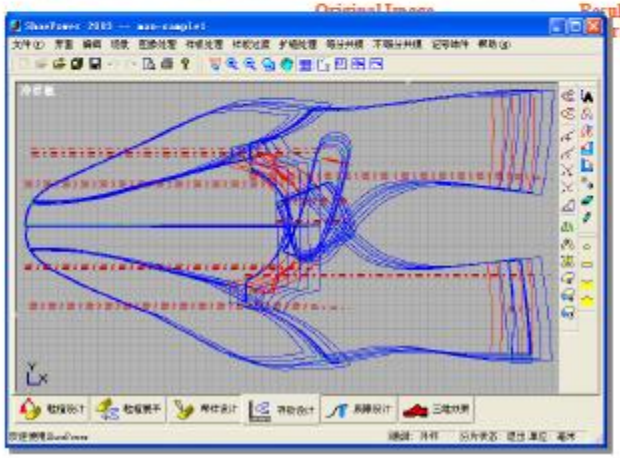
Design of Cars





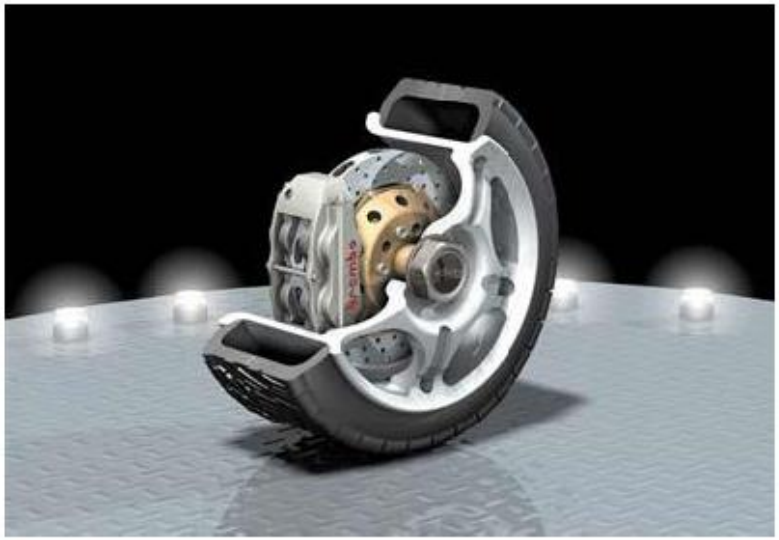
Virtual Design





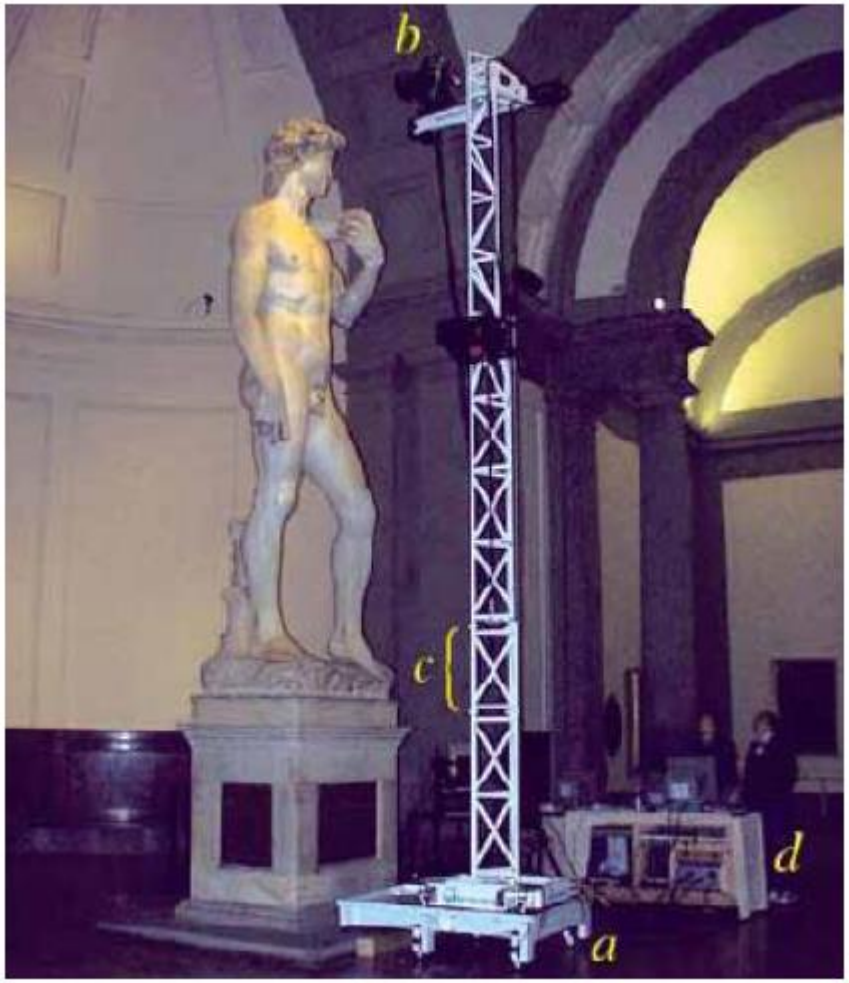
Virtual Try-on

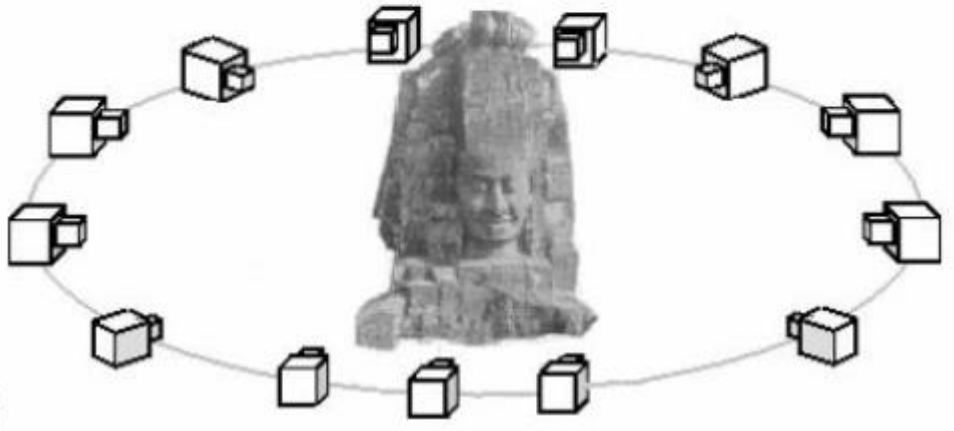
CAD/CAM



Computer Arts

Digital Heritage





Virtual Reality

Virtual Reality

Augmented Reality

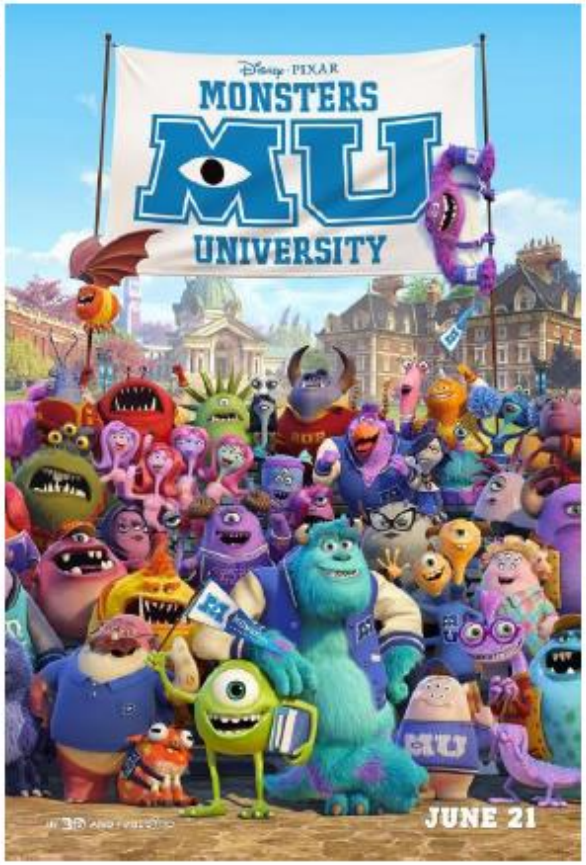
- Microsoft's HoloLens

Computer Games

Animation


PIXAR
PRESENTS
Geri's game


DREAMWORKS
PRESENTS
THE CROODS
MARCH 22 IN 3D


Disney PIXAR
MONSTERS
MU
UNIVERSITY
JUNE 21

Movies

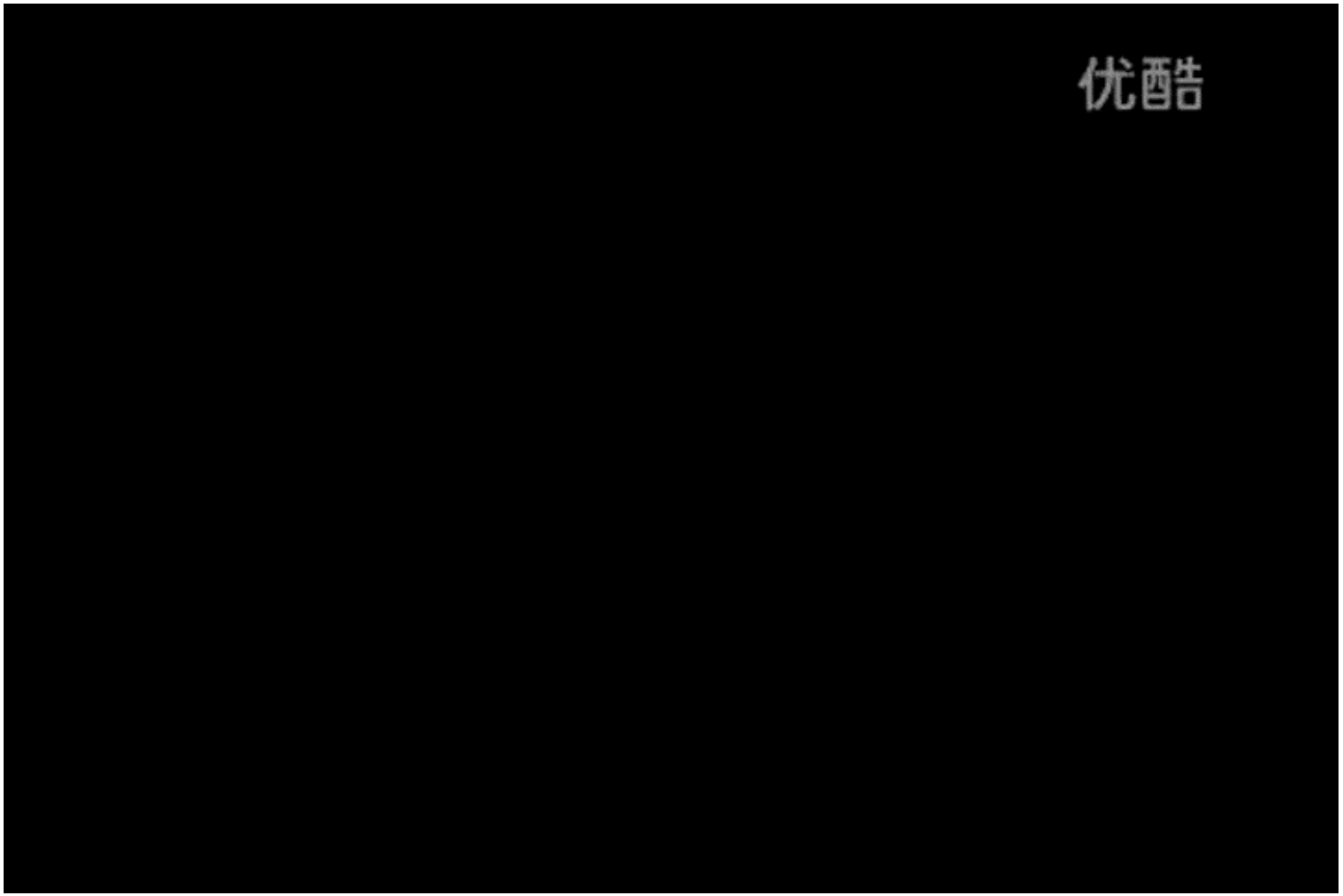

FROM THE DIRECTOR OF TERMINATOR 2 AND TITANIC
JAMES CAMERON'S
AVATAR
EXPERIENCE IT IN IMAX 3D


奇幻 因相信而真實
李安 首部3D鉅作
少年PI的奇幻漂流
LIFE of PI
11.21(三) 見證不凡

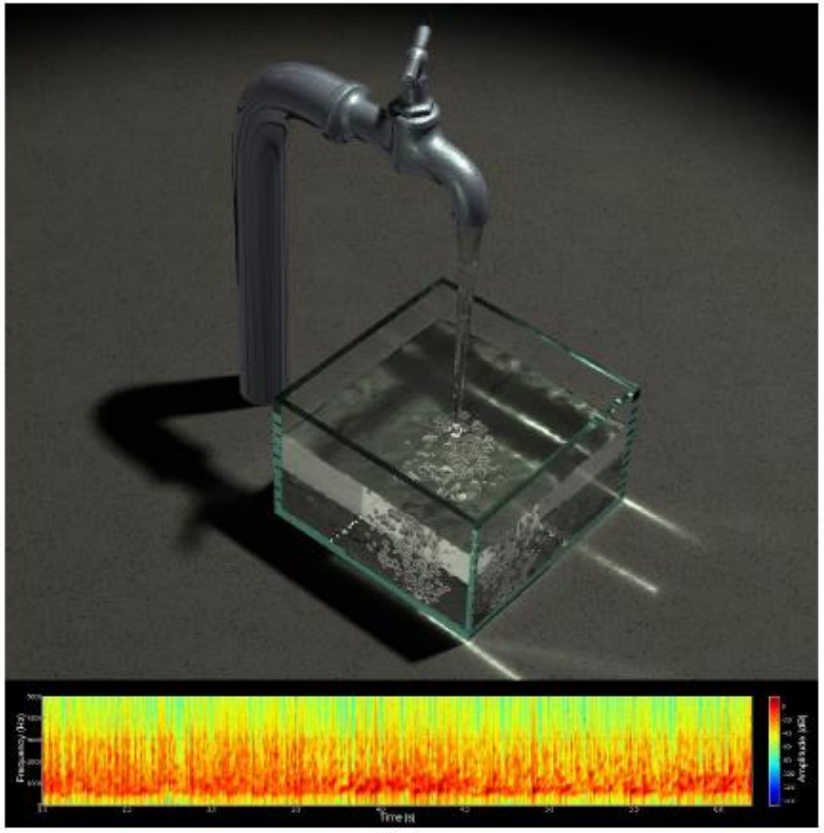

PACIFIC RIM
TO FIGHT MONSTERS WE CREATED MONSTERS
ON JULY 12 GO BIG OR GO EXTINCT
IMAX 3D

Visual Effects: Life of Pi

Visual Effects: The Adventures of Tintin



Simulation

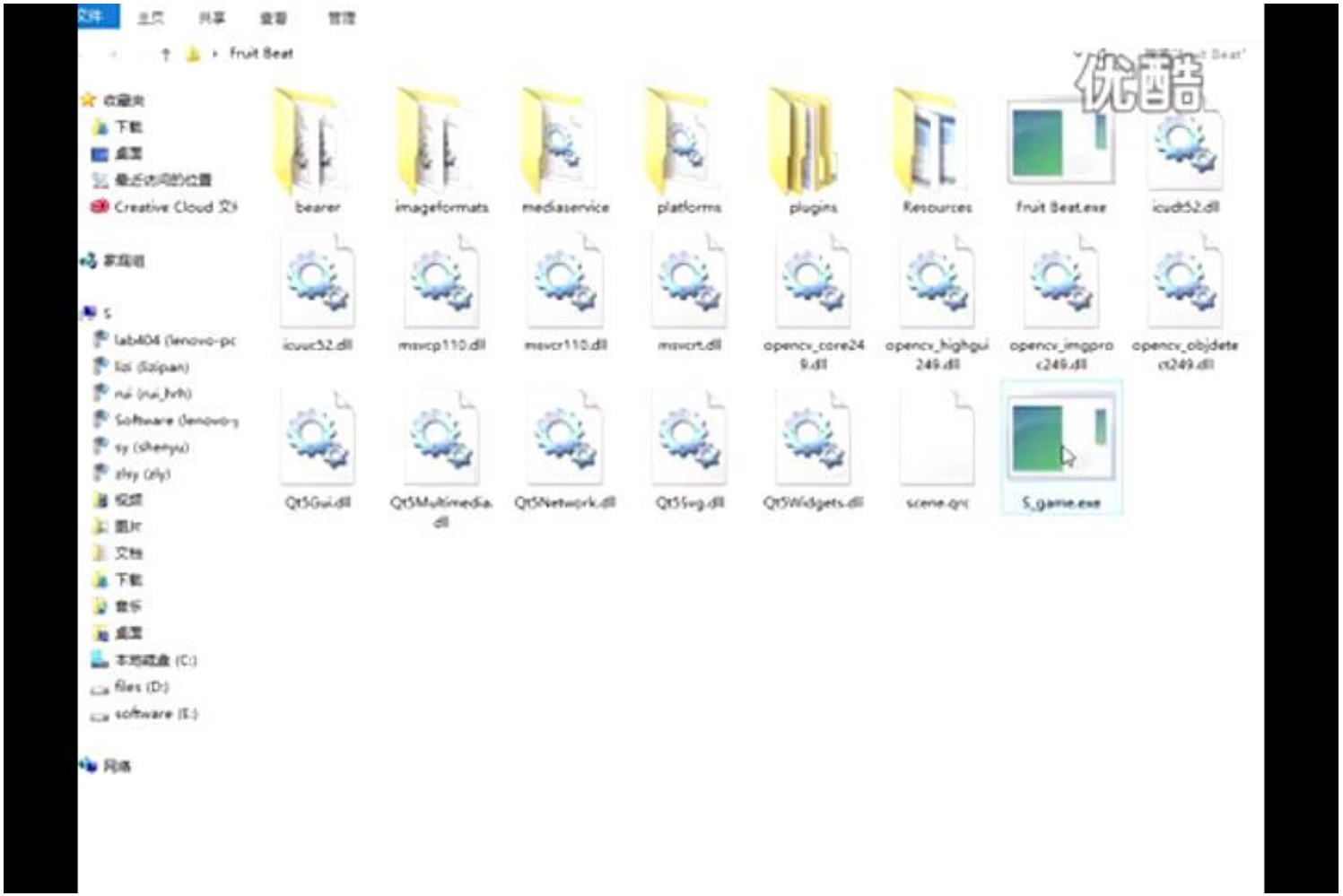


User Interface

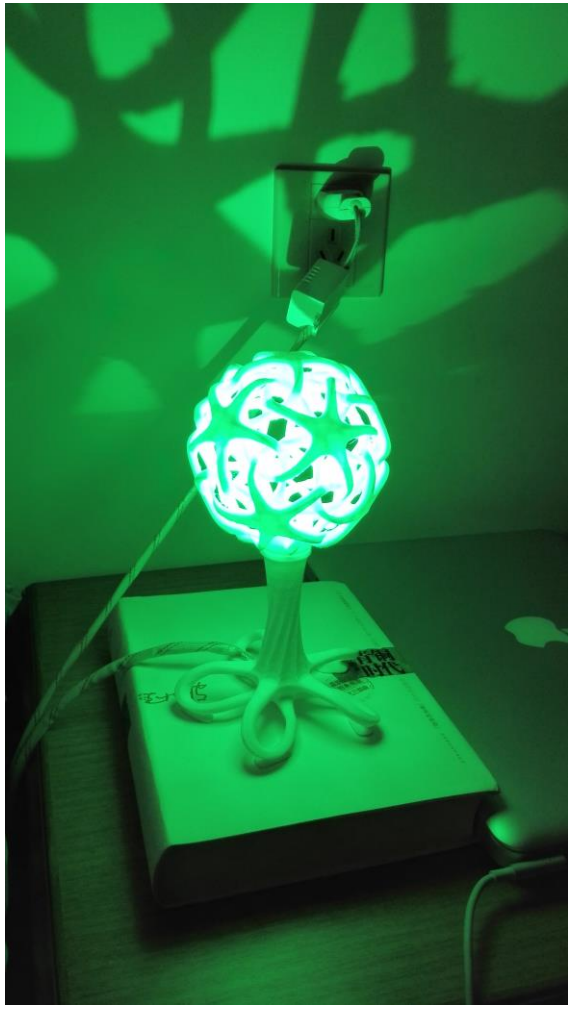
User Interface

- Kinect

Fruit Cut


Fruit Beat
bearer
imageformats
mediaservice
platforms
plugins
Resources
fruit Beat.exe
icudt52.dll
icuuc52.dll
msvcp110.dll
msvcr110.dll
msvcrt.dll
opencv_core249.dll
opencv_highgui249.dll
opencv_imgproc249.dll
opencv_objdetect249.dll
Qt5Gui.dll
Qt5Multimedia.dll
Qt5Network.dll
Qt5Svg.dll
Qt5Widgets.dll
scene.qrc
S_game.exe

3D Printing



3D Printing