▶ Portfolio

▶ Video Presentation(selected)

Tracking Four-Rotor Aircraft (2017)

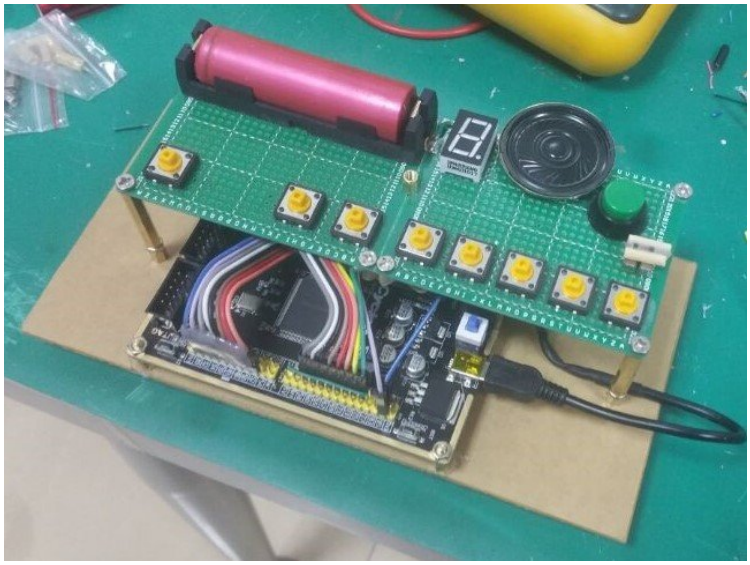
[Background]

• A design for a national competition. And this design won **the second prize on a national level**, and the first prize on a provincial level)

[Function]

• The aircraft can take off, hover and land automatically, and follow the remote control car automatically when flying (it can learn to follow **differently colored targets**).

[Realization]
- The flight control module adopts **APM Flight Controller** (Ardupilot Mega).
- The **OV7725 camera** is used to collect real-time visual data, whose rate is 25 FPS.
- For better control effectiveness, The **Dual-loop PID control algorithm** and the **color standard conversion** are applied in algorithms.

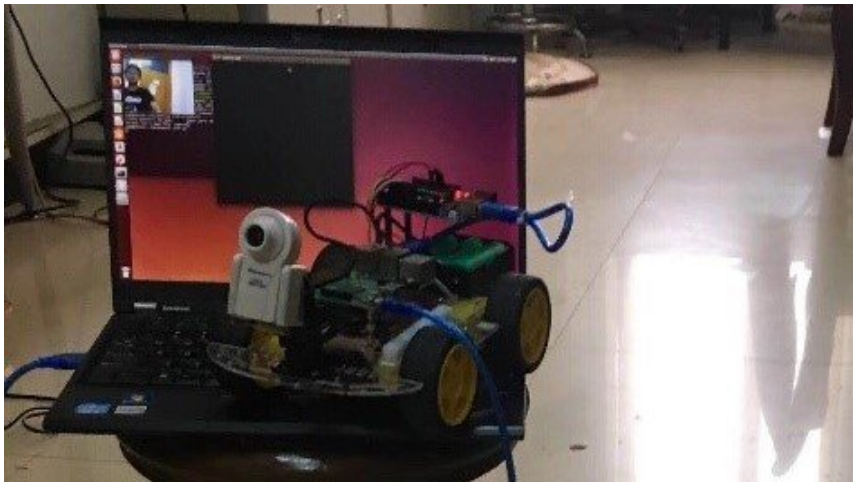


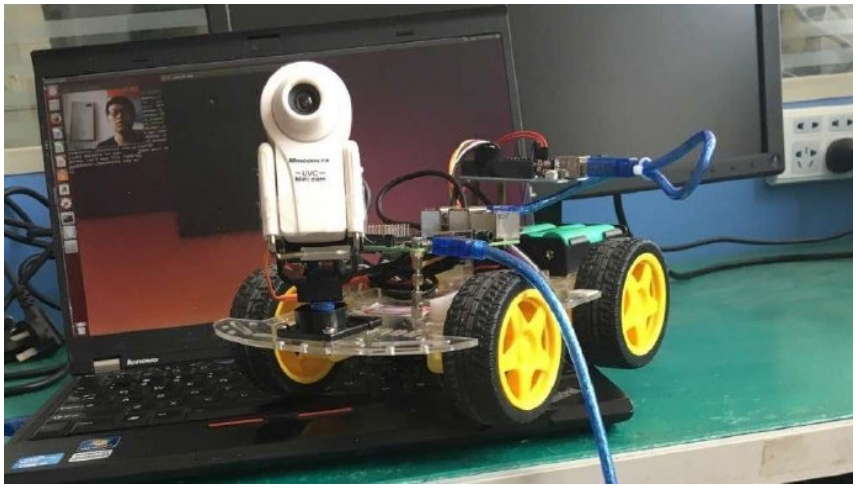
FPGA Electronic Piano (2018)

[Background]
- A self-designed work for learning

[Function]
- The design can emit the corresponding tone when any button is pressed. It can also play a pre-setted song (my school song).

[Realization]
- The design is implemented by using an **ALTERA FPGA** (CYCLONE IV EP4CE) and **Verilog HDL language**.
- Different tunes are produced by different PWM waves, and the pre-setted song is played by **FSM (finite state machine)**.





Raspberry Pi Monitoring Vehicle (2018)

[Background]
● A self-designed work for learning

[Function]
●The keyboard and the mouse can control the movement of vehicle and the orientation of camera respectively. The real-time images captured by the moving camera on the camera platform will be uploaded to the host computer through WLAN.

[Realization]
●The vehicle is based on **Raspberry Pie**, and another **Arduino Uno board** is used to control motor movement. The communication between them is based on Serial Communications.
● The code of client and server is written in **Python** and runs in **Linux** environment. The control code of the camera platform is implemented by **pygame module**.
● The information transmission adopts the socket protocol. The code of transmission is implemented by **cv module**, **Image module**, **StringIO module** and **socket module** of python.

Gesture Recognition Device (Based on capacitive sensor) (2018)

[Background]
- A design for a provincial competition

[Function]
- The device can recognize the gestures of the finger-guessing game and **learn to recognize special gestures**.

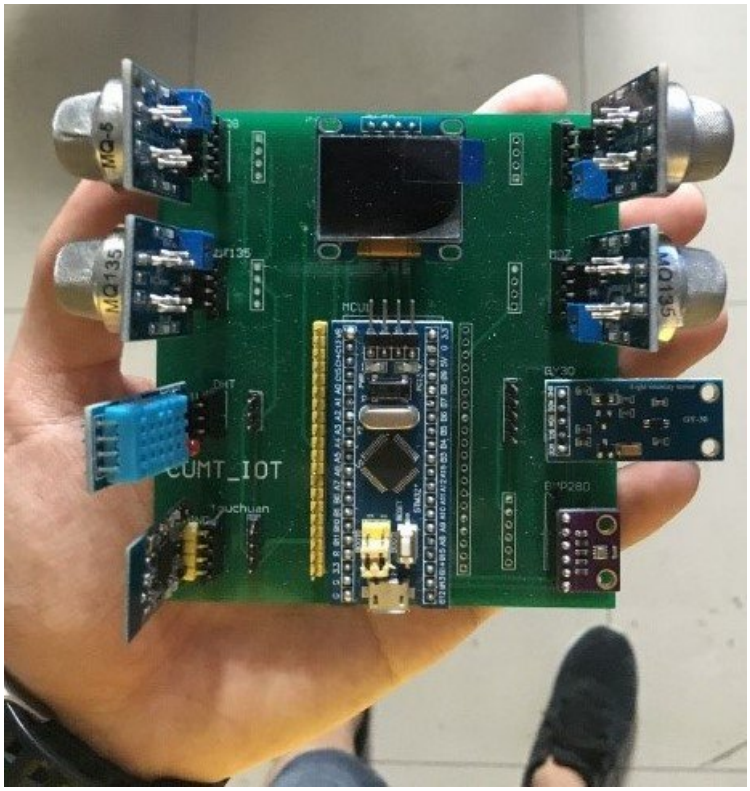
[Realization]
- Capacitance values of multiple locations are collected by two **3-Channel capacitance sensors**. The recognition function and learning function are realized by the **K-means clustering algorithm**.
- A human-computer interface of resistance screen is designed to realize real-time display.

Plate Ball Control Device (2018)

[Background]
- A design for a provincial competition

[Function]
- The tilt angle of the flat board is controlled by two digital servos, so that the rolling ball can be stabilized in the pre-setted position on the flat board.

[Realization]
- PID was adopted as a control strategy. Mechanical control was realized through two digital servos. The PID parameters of the **two degrees of freedom** are identical.
- The position of the rolling ball is obtained by **OV7725**.
- The controlling effect is attached to the stability of the structure.

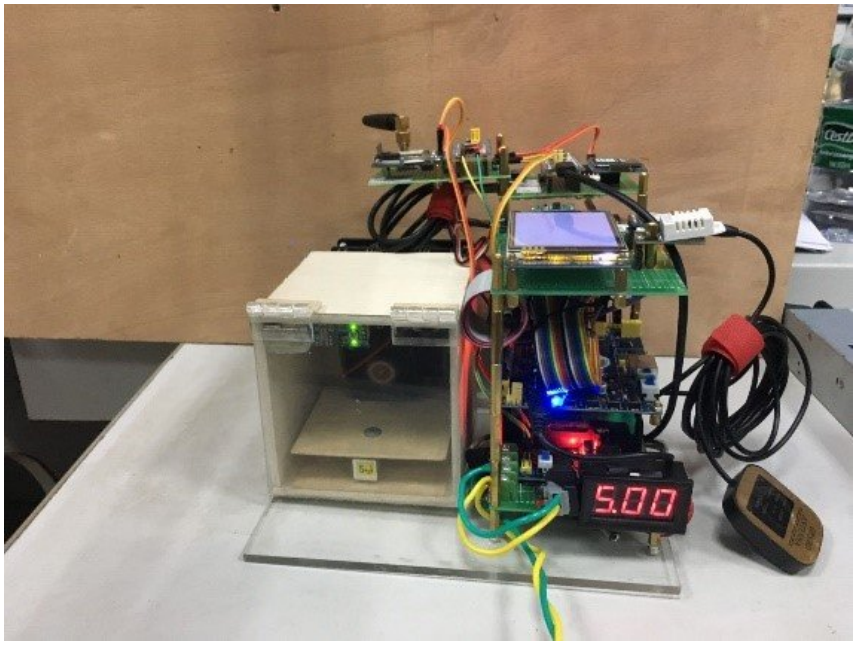


Multisensor Environmental Monitoring Device (2019)

[Background]
- A design for Innovative Training Program for College Students

[Function]
- Multiple sensors collect environmental data and upload them to the **Aliyun server**.

[Realization]
- An STM32 is simply used to read multi-sensor values and A **ZigBee module** is used to upload the data to the host computer.
- The highlight of the project is the design of the **Printed Circuit Board**.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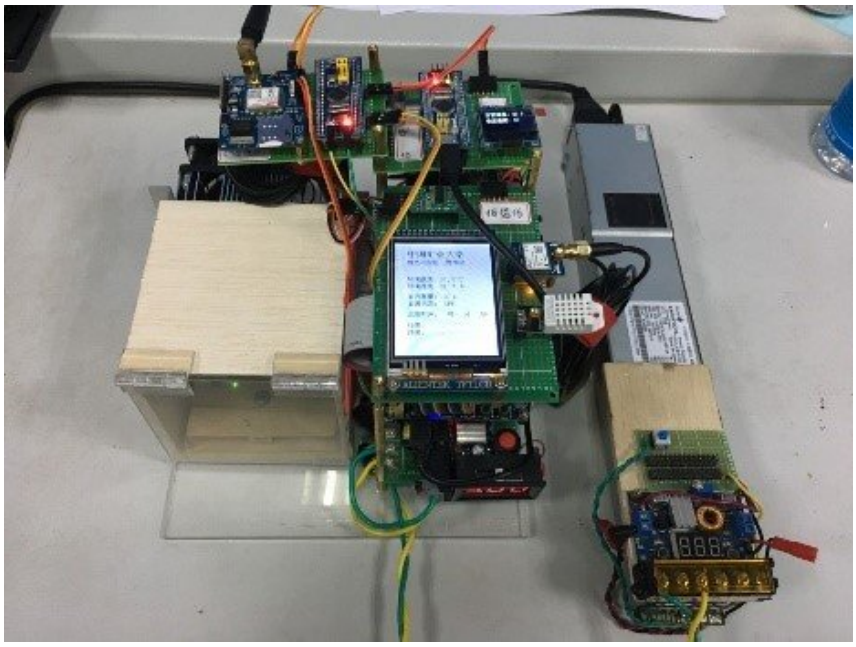
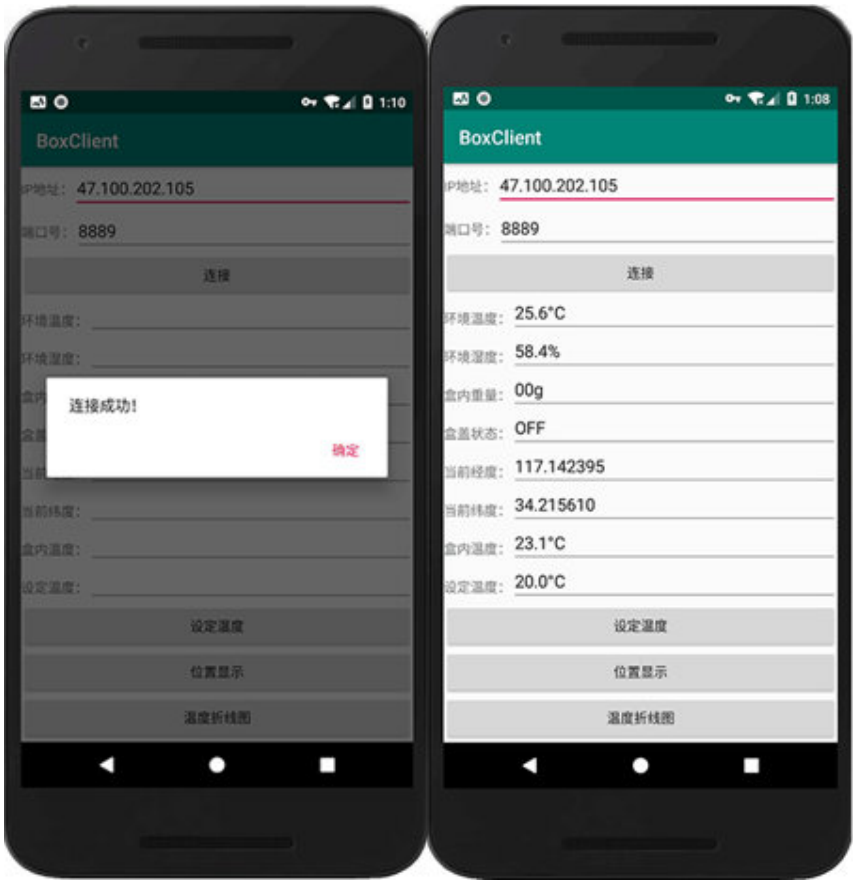
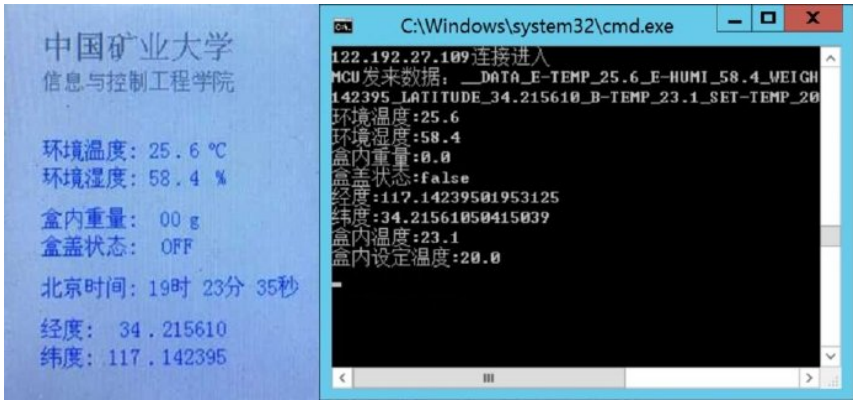
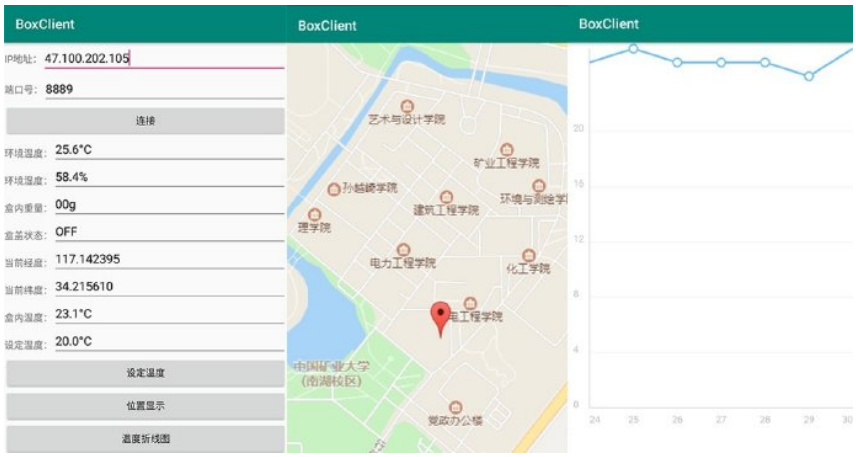



BoxClient
IP地址: 47.100.202.105
端口号: 8889
连接
环境温度:
环境湿度:
连接成功!
确定
当前纬度:
盒内温度:
设定温度:
设定温度
位置显示
温度折线图
BoxClient
IP地址: 47.100.202.105
端口号: 8889
连接
环境温度: 25.6°C
环境湿度: 58.4%
盒内重量: 00g
盒盖状态: OFF
当前经度: 117.142395
当前纬度: 34.215610
盒内温度: 23.1°C
设定温度: 20.0°C
设定温度
位置显示
温度折线图


中国矿业大学
信息与控制工程学院
环境温度: 25.6 ℃
环境湿度: 58.4 %
盒内重量: 00 g
盒盖状态: OFF
北京时间: 19时 23分 35秒
经度: 34.215610
纬度: 117.142395
C:\Windows\system32\cmd.exe
122.192.27.109连接进入
MCU发来数据: __DATA_E-TEMP_25.6_E-HUMI_58.4_WEIGH
142395_LATITUDE_34.215610_B-TEMP_23.1_SET-TEMP_20
环境温度:25.6
环境湿度:58.4
盒内重量:0.0
盒盖状态:false
经度:117.14239501953125
纬度:34.21561050415039
盒内温度:23.1
盒内设定温度:20.0


BoxClient
IP地址: 47.100.202.105
端口号: 8889
连接
环境温度: 25.6°C
环境湿度: 58.4%
盒内重量: 00g
盒盖状态: OFF
当前经度: 117.142395
当前纬度: 34.215610
盒内温度: 23.1°C
设定温度: 20.0°C
设定温度
位置显示
温度折线图
BoxClient
艺术与设计学院
矿业工程学院
建筑工程学院
电力工程学院
化工学院
中国矿业大学
(南湖校区)
党政办公楼
BoxClient

Smart Portable IoT Medicine Box (Device+Server+APP) (2019)

[Background]
- A horizontal research project
- Graduation Project(won the prize of **School's Excellent Graduation Design**, the proportion of which is **2%**)

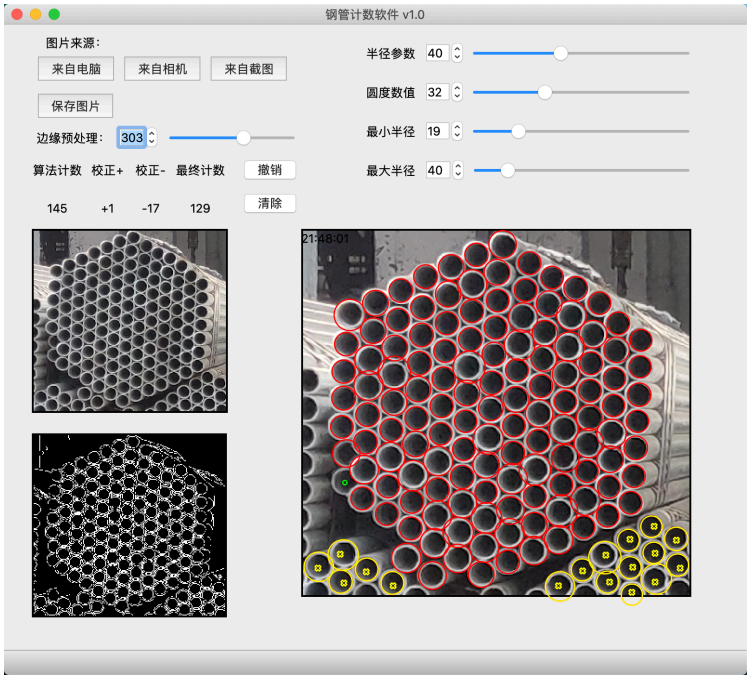
[Function]
- The design realizes:

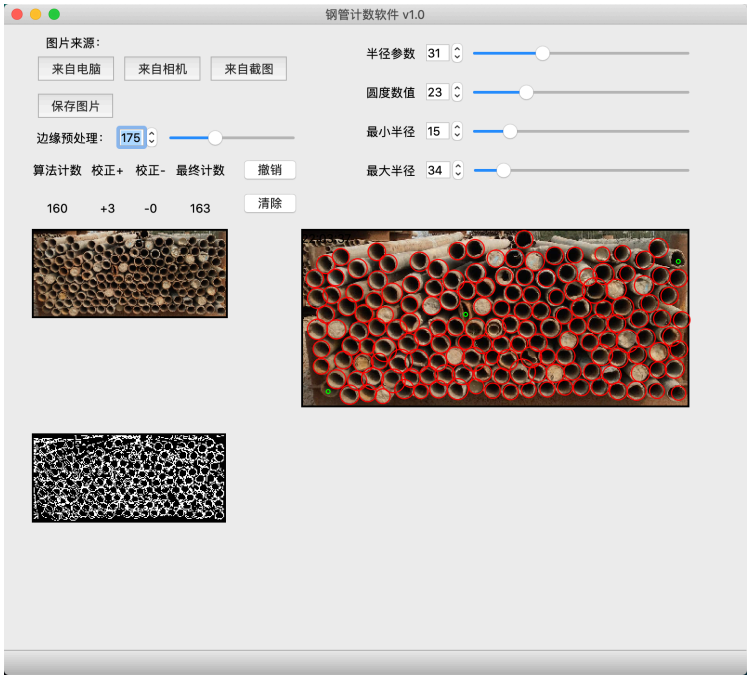
① the visual tracking of the GPS positioning of the box
② the curve display of real-time temperature
③ the display of the medicine status
④ the monitoring of the lid

- The hardware and software of the system are composed of four weakly-coupled subsystems：

① the incubator system
② the acquisition and communication system
③ the server and host computer system
④ the hardware power supply system

[Realization]
- On the platform of STM32 and with incremental PID arithmetic, adjustable constant temperature storage of medicines is realized. Then an incubator system is constructed.
- The server is deployed in **Windows Server 2012** and the host computer is based on **Android OS**. The related programs are written in **Java**.
- The acquisition and communication system adopts **multiple sensor modules** to collect the environment and state data of the box and upload them to the server through the **GPRS communication module**. Both acquisition and transmission delays are within 1 second.
- 18650 lithium batteries and switched-mode power supply are both applied in the hardware power supply system.





PipeCount GUI (2020)

[Background]

- A horizontal research project of internship
- The code is open-sourced on [Gitee]

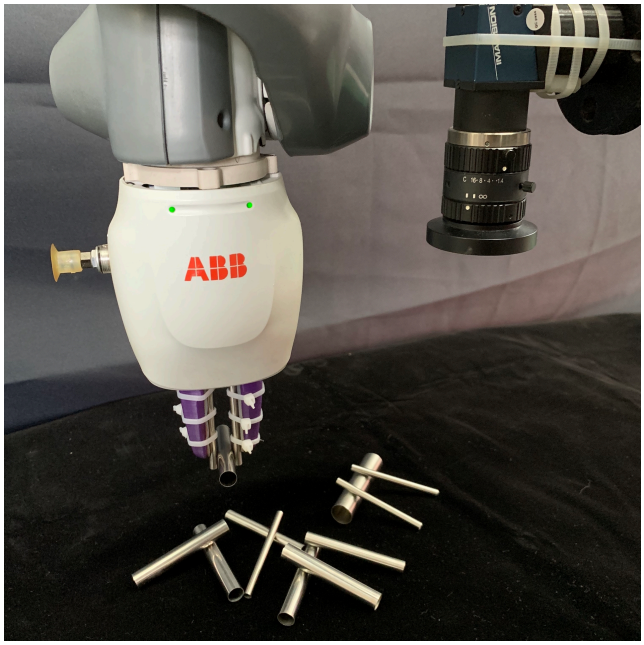
[Function]

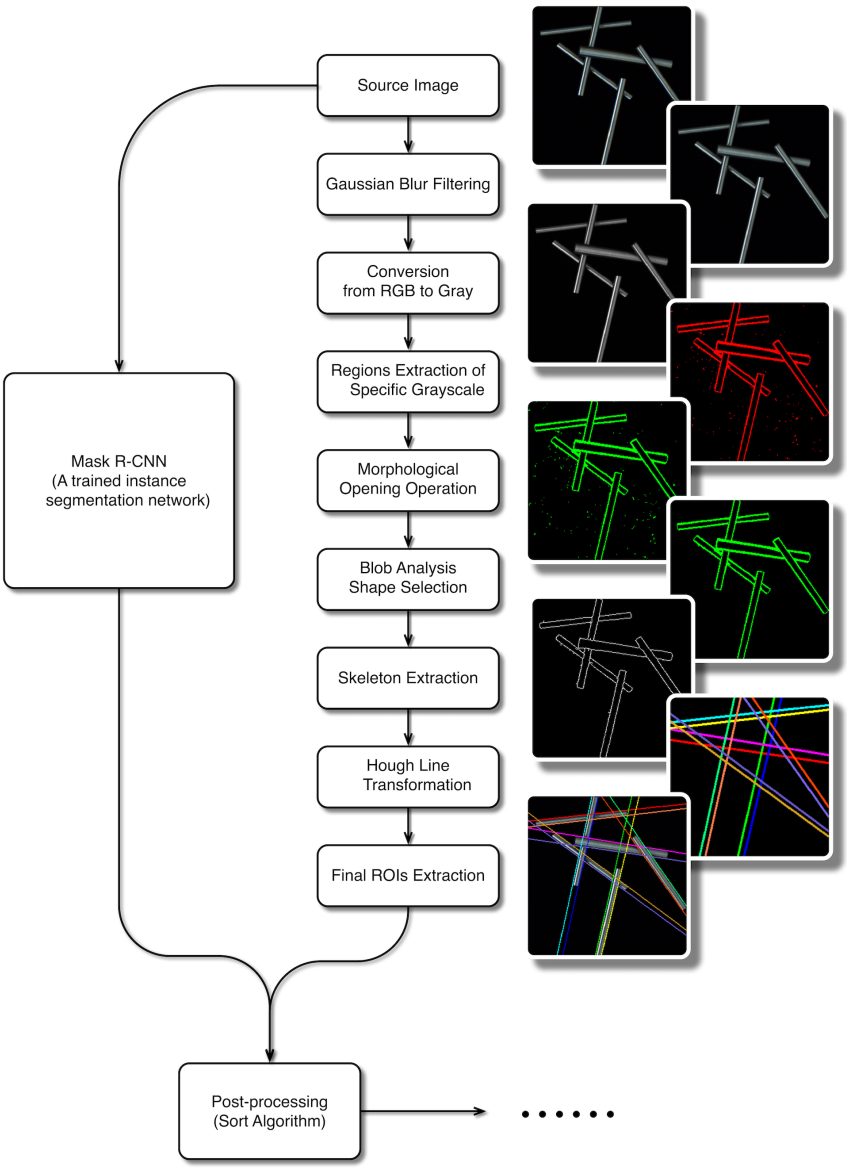
- In this project, a GUI was designed to assist workers to count the number of steel pipes and get rid of heavy visual fatigue in factories.
- A login system is designed for users.
- The picture can choose from your computer files, from an independent camera, or even screenshots. What's more, the final marked picture can be saved.

- To avoid some errors of machine vision in complex cases, the final count can be manually corrected.

[Realization]

- The counting principle is based on **Hough Transform**.
- Combined with **Qt** and **OpenCV**, this software was designed in MacOS environment.




Source Image
Gaussian Blur Filtering
Conversion from RGB to Gray
Regions Extraction of Specific Grayscale
Morphological Opening Operation
Blob Analysis Shape Selection
Skeleton Extraction
Hough Line Transformation
Final ROIs Extraction
Mask R-CNN (A trained instance segmentation network)
Post-processing (Sort Algorithm)

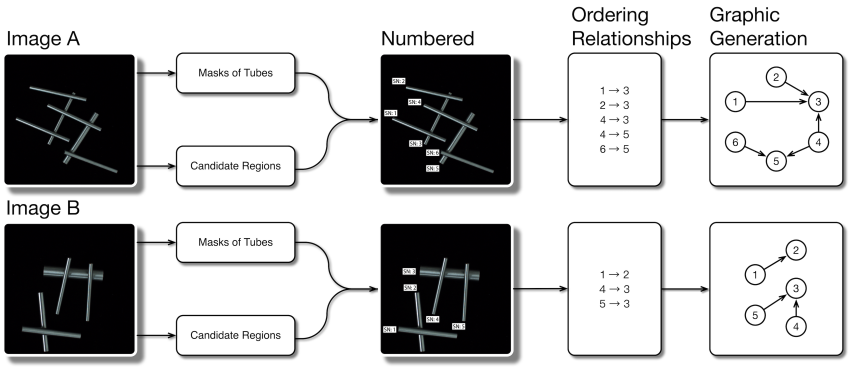
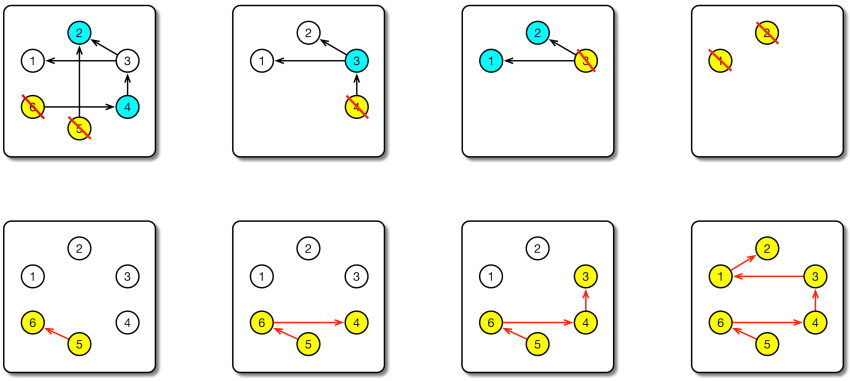


Image A
Masks of Tubes
Candidate Regions
Numbered
Ordering Relationships
1 → 3
2 → 3
4 → 3
4 → 5
6 → 5
Graphic Generation
Image B
Masks of Tubes
Candidate Regions
1 → 2
4 → 3
5 → 3



Pick-up Sticks Fetching Strategy Generation System (2020)

[Background]
• A research project of internship
• An SCI paper is under revision

[Function]
• In this study, we proposed a method to solve the problem mentioned below with the lowest relative cost. A common scenario in the actual industrial production environment (assembly line or construction site) is as follows: while confronting several workpieces in a crowd, it is general for humans to generate a **fetching strategy** unconsciously which signifies people know the placing ordering of workpieces. But it is difficult for robots to do so and this problem referred to as **crowd occlusion**.

• We wish robots are skilled to achieve the following purposes:
① To remove the objects above for a better global view or better force bearing points for grasping other objects underneath
② To guarantee the safety of objects by preventing collisions and falls during executing grasp actions
③ To make the cluttering stack stable as much as possible during grasping so that replanning the strategy is unnecessary

• We argue that there are three typical characters make the metal tube a kind of workpieces difficult to detect:
① Poorly textured
→ has insufficient local features to apply conventional feature matching methods
② A totally centrally symmetrical object
→ scarcely possible to apply general PnP algorithms to get its 6D pose
③ Reflection and highlight on surface
→ difficult to detect its contour

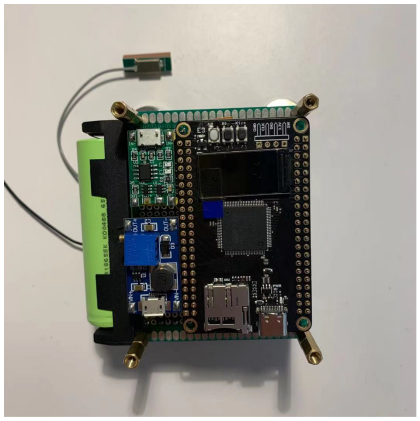
[Realization]
• Firstly, we trained the **Mask R-CNN** with a dataset that contains hundreds of manual labeled images of workpieces of different specifications standards.
• We utilized this neural network to get the precise counting of workpieces and get each precise location respectively from each image shot by a **monocular RGB camera**.
• Then designed a compounding method**(OpenCV+Halcon)** to extract occlusion regions, which will later be used for giving the stacking position ordering of workpieces with a local sort method. As the ordering relationships are given, we can generate a fetching strategy through the global sort algorithm**(Topological**

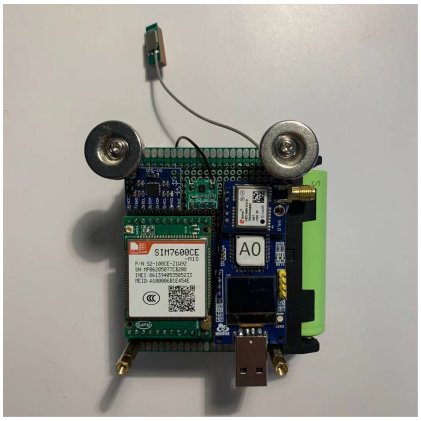
Sort Algorithm).
• Finally, we made a **GUI(Qt)** for our system. And demonstrated our method on **ABB YuMi robot** and complete a series of tasks.

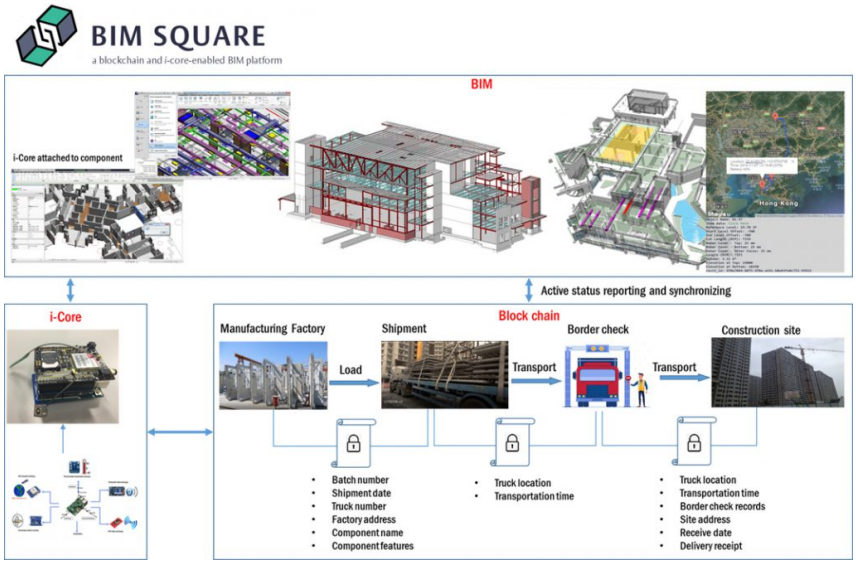
Coupler Inspector (2021)

[Background]
• A Project for **New World Development Company**
• Event related: [柏傲莊III兩幢樓宇須拆卸重建 據報涉錯用強度較低混凝土]

[Function]
• The device can receive the data from the Android APP through **Bluetooth** , and then detect the depth of the coupler.
• After detection, the data of the coupler will be displayed on the **E-paper**. What's more, a **QR-Code** will generate by the MCU and displayed on the E-paper.
• The device can be **charged wireless**.
• Combined with a server, the inspection form can be generated automatically.







New i-Core (2021)

[Background]

- Funded by **ITF 2020**(Hong Kong Innovation and Technology Fund) (ITP/029/20LP) (details)
- About our project (BIM and Blockchain for Construction)
- i-Core: Giving Construction A Heart (Press: HKU-UVISION)

[Function]

- The data combined with **IMU**, **GPS**,**UWB** and other sensors will be upload to the universal platform which implied **BIM**, **Blockchain** and other technologies, aiming to better manage the building flow and supply chain.

[Realization]

- The prototype is still under developing.
- The final product will be more compact and applied **Low-Power** Technology, **MQTT** protocol and so on.