

AI: A System Perspective

系统视角下的人工智能

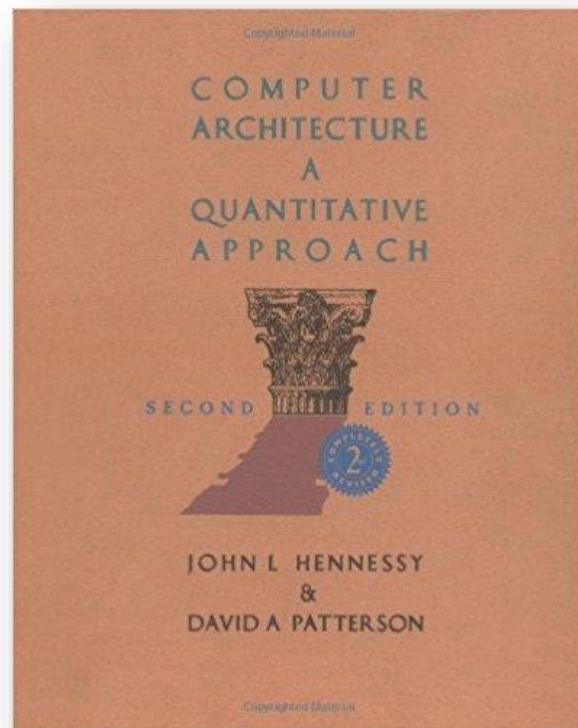
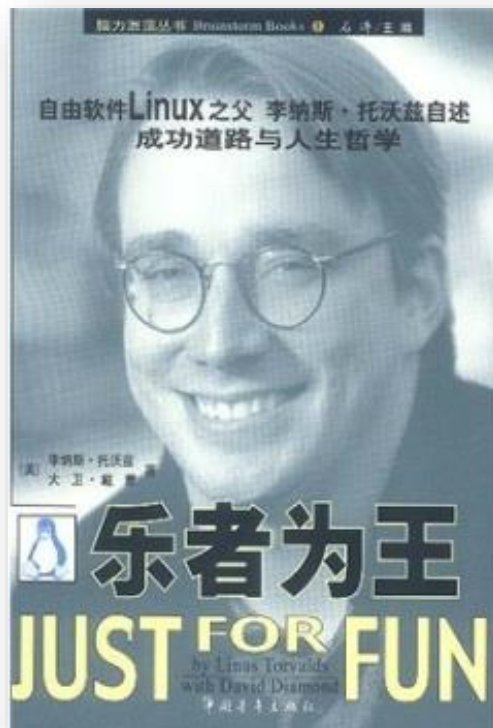
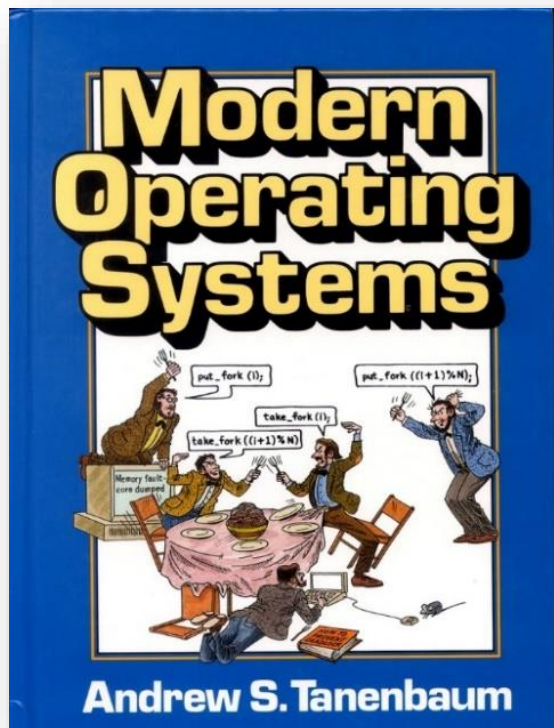
2018.12

Who is ThunderSoft?



Smart Device Platform Technology Provider

What do we read?



Who is ThunderSoft, really?



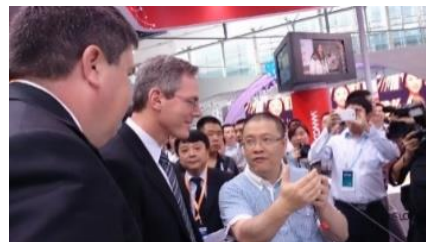
Company Profile

- Smart System Tech. Provider
- Founded in 2008
- IPO in 2015
- 3500+ Employees
- 90% Engineers
- Serves 1000+ Global Customers
- 20+ Cities Worldwide



Core Business

- **Smart Business Units**
 - Smart Mobile
 - Smart IoT
 - Smart Automotive
 - Smart Vision & AI
- **Full System Coverage**
 - Device – OS, Camera, Security, AI, Connectivity, Audio, Graphics...
 - Edge – Microservices, Docker...
 - Cloud – FOTA, MDM, MAM ...



Tech & Products

Vision Tuning, ISP, Camera Stack Customization, Algorithm, Depth Camera, Multi-camera, HDR ...

SoM TurboX 940 TurboX 625 TurboX 410 TurboX 9206 AI Kit IP Camera

AI Model Design, Algorithm Optimization, Data Training, Data Labeling, Benchmarking

Security TEE, Authentication, Encryption, System Hardening, FOTA, Device Management,



Global Presence

- **Business Cooperation**
- **Technology Collaboration**
- **Global Tech. Centers**
 U.S. • Japan • Korea • India • Malaysia • Finland • Bulgaria ...

Where are we from?

Smart System Service & Technology Provider



AI & Vision



TurboX Smart IoT



Smart Vehicle

Smart System



2008

founded



2009

Japan branch



2010

Qualcomm Smartbook

Investment from Qualcomm, ARM, Spreadtrum, NL



2011

Qualcomm Joint Lab

Spreadtrum Joint lab



2013

Intel/MS Joint Lab

Camera Turn-key



2014

JV with Intel

H5OS Security



2015

JV with ARM

IPO 300496



2016

JV with Qualcomm

Rightware Acquisition



2017

TurboX SoM & OS

MM Solution Acquisition



2018

Iot Scaling

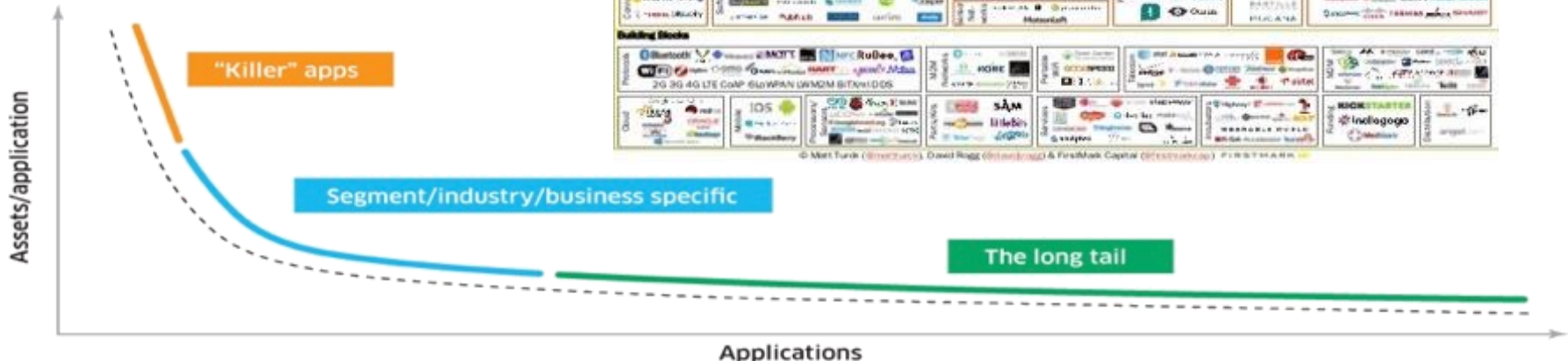
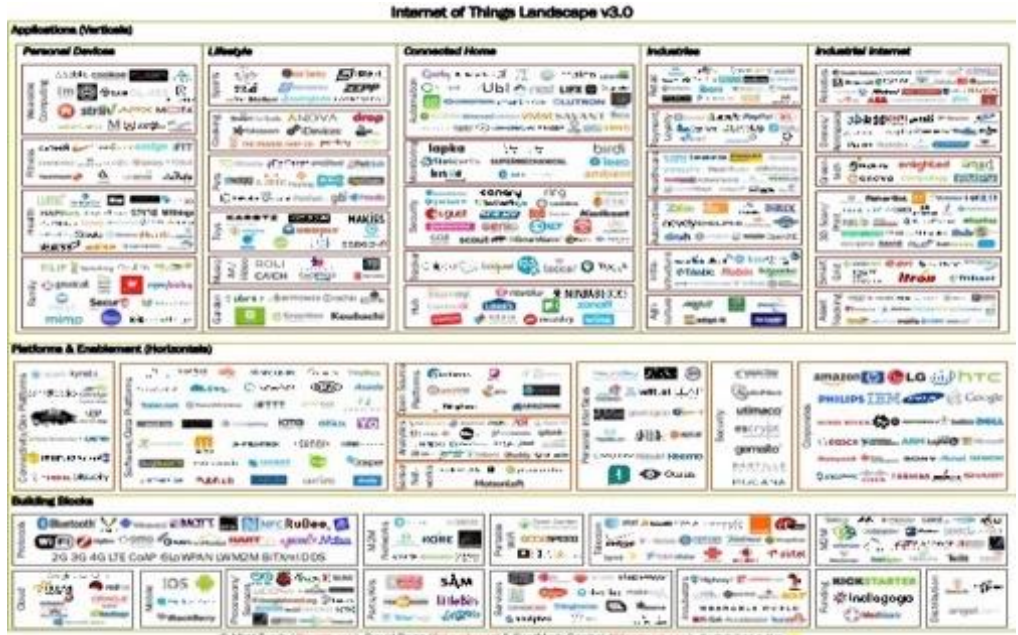
AI Dev Kit

India/Malaysia Branch



the Problem – the Messy World of IoT

- ❖ Thousands of thousands customers
- ❖ Quite Small volume
- ❖ Fragmented Requirements
- ❖ Large choices of IoT platforms
- ❖ Higher go to market pressure
- ❖ Many Tech. Challenges
- ❖ Immature Ecosystem



ThunderSoft IoT Modulization



TurboX 835



TurboX 845



TurboX 801



TurboX 821



TurboX 410



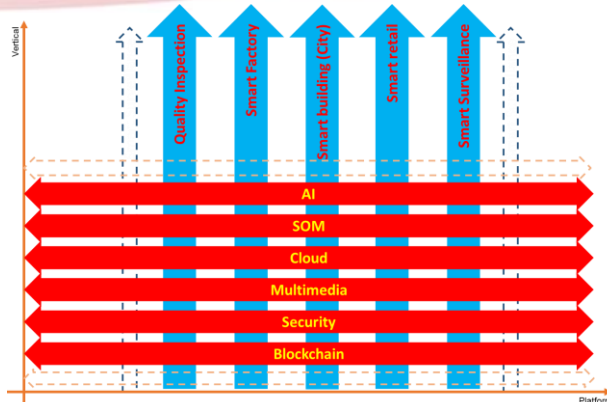
TurboX 625



TurboX 9206



TurboX 210



Tencent 腾讯



FLEXTRONICS



HISCENE
海思芯视科技



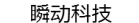
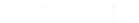
Polycom



NIDEC MOTOR CORPORATION



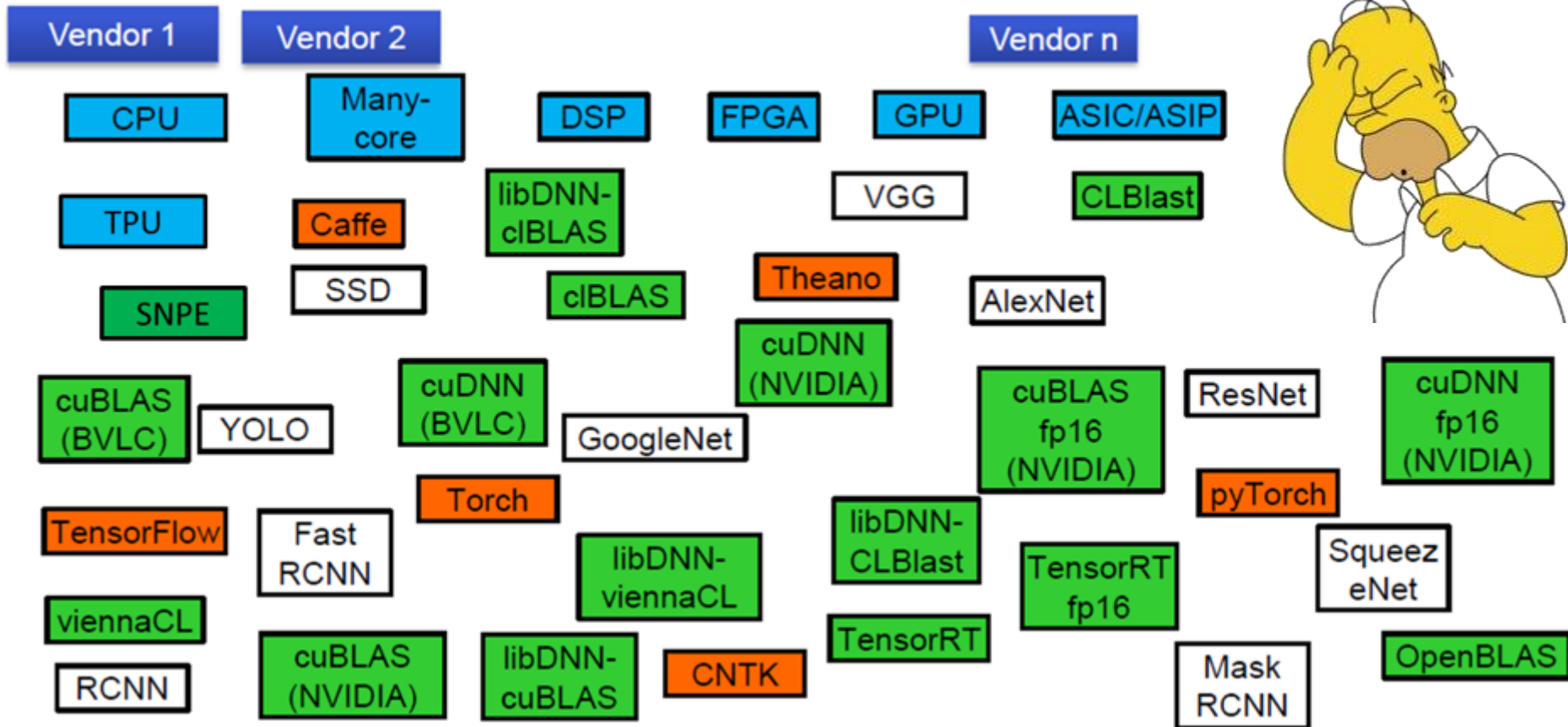
零零无限



HUAWEI



The Bigger Problem – the Messy World of AI



AI System

Smart Cloud

Smart App

Smart Framework

Smart Device

Smart Chip



ASA – AI System Alliance

Smart Cloud

Smart App

Smart Framework

Smart Device

Smart Chip



价值 (Gold)

激情 (Fire)

中庸 (Water)

系统 (Wood)

踏实 (Earth)

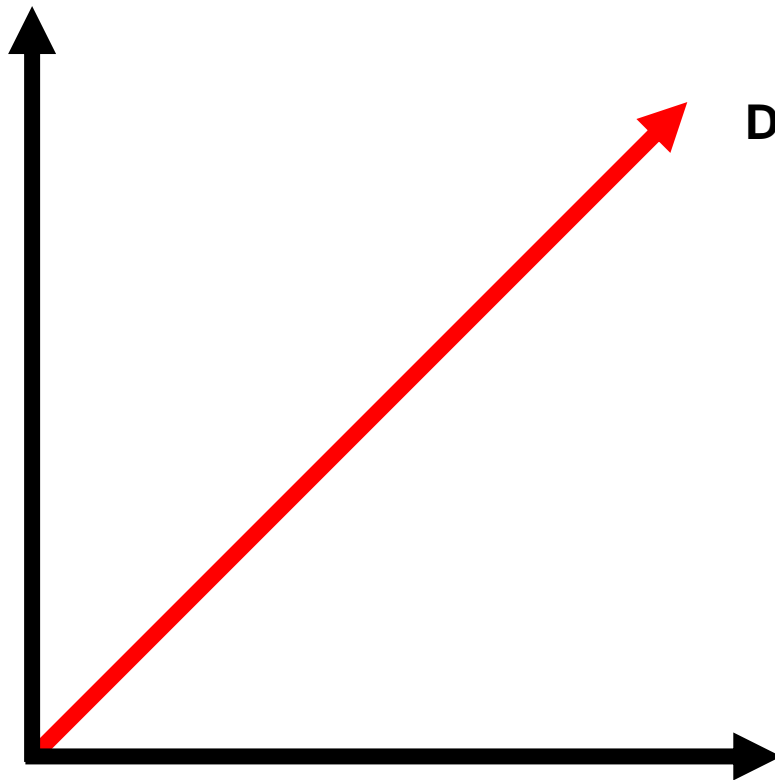
ASA Philosophy – 45度

应用
云端
过去
中国
效率
闭源



中庸

Doctrine of the Mean



技术
终端
未来
海外
安全
开源

Powerful On-Device AI Kit



Based on **Qualcomm 845 Platform** with On-device AI Engine

High performance on-device AI development platform

Rich on-device AI development, analysis, optimization and tuning tools.

Accelerate on-device AI application and ecosystem development



OS Support



Powerful On-device AI Performance



Full Camera Stack



Rich AI Tools



AI Turnkey Solutions



AI Algorithm Store



AI Services Service



DL Training Engine

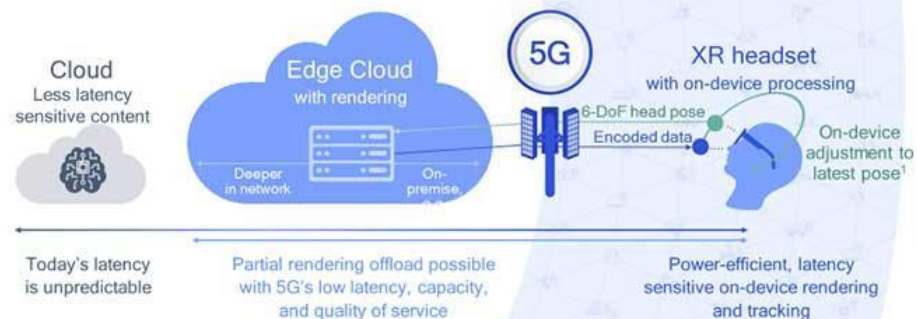
Why AI Kit?

- ❖ Cloud is not enough.
- ❖ AI is not enough.
- ❖ AI is difficult to develop and deploy.

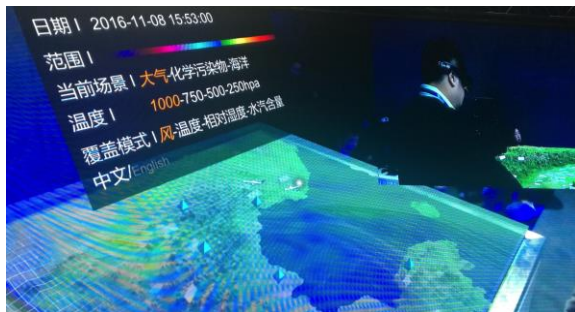
Cloud is Not Enough

- ❖ Computation Intensive
- ❖ Privacy Concern
- ❖ Realtime Response

Augment on-device processing for boundless photorealistic mobile XR



1. Asynchronous time warp reduces Motion to Photon (MTP) latency by using on-device processing based on the latest available pose. MTP (pose 20 ms generally exceeds 60ms) can't be processed on the device.



Embedded AI Conference

THUNDERWORLD 2018

嵌入式 AI 人工智能大会



主办方



合作伙伴



邀请函

2018.12.13 星期四
清华大学中央主楼
北京市海淀区 清华园路1号

THUNDERWORLD



“人工智能正在去中心化，云与边缘逐步分裂，针对AI的新的计算架构将会应运而生；近年来端的数据以几何级数增长，AI从云端迁移在许多应用场景下不可避免，端侧智能将崛起；未来十年端的数据的模式将是“基于存储的计算，存储与计算合二为一。”

邓锋

北极光创投创始人董事总经理

THUNDERWORLD



“5G和AI是未来十年的两大潮流，市场前景非常广阔。5G发展会使得通讯的速度更快，同时也会产生更多的数据；而数据是AI的基础，更多的数据将会使得AI更有效，两个技术的发展相辅相成。在这种潮流下，高通凭借全球领先的高通技术为业界提供更多的产品组合和解决方案，同时希望和合作伙伴联合推动这些技术向前发展。”

孙力

高通产品市场副总裁

THUNDERWORLD



“智能视觉是一个复杂的子系统，正在面临硬件碎片化、功耗、性能等诸多挑战。智能视觉目前正处在爆发的起点。在图形图像调优、操作系统、人工智能等方面拥有深厚技术积累的中科创达，将成为智能视觉的引领者。”

孙力

中科创达副总裁

THUNDERWORLD



“做操作系统实际上就是做平台，在丰富的应用场景中，垂直的90度不好，平行的0度也不好。我们的梦想以及做事的哲学就是——中庸的45度。”

邹鹏程

中科创达 CTO

THUNDERWORLD



“中国作为工业重型装备的制造和使用大国，目前对设备的维护措施仍是相对传统的。当下，我们更顺应人工智能浪潮，充分利用工业大数据，推动工业智造持续深化，加强技术对工业设备的状态预测的干预，不断优化运维决策，让人工智能落地到实业中。”

邓仰东

清华大学软件学院副教授

THUNDERWORLD



“未来云端联系将越来越紧密，并且随着5G时代的到来，云端训练模型还会与终端进行频繁迭代与交互，这将加速终端设备的智能化。”

陈天石

寒武纪科技创始人兼CEO

THUNDERWORLD



“每个家庭的房间构造以及物品堆放的方式不同，会造成扫地机器人无法做出恰当反馈。而恰恰就是人工智能能够帮助扫地机器人变得更加智能，让扫地机器人对环境理解更加深入。”

吴震

石头科技联合创始人兼CTO

THUNDERWORLD



“未来基于AI的各类应用将会进入大前端时代。大前端时代需要强大的API能力支撑，通过API中台给前端提供标准化能力，同时在后端集成所有的数据、功能和服务。”

邹达

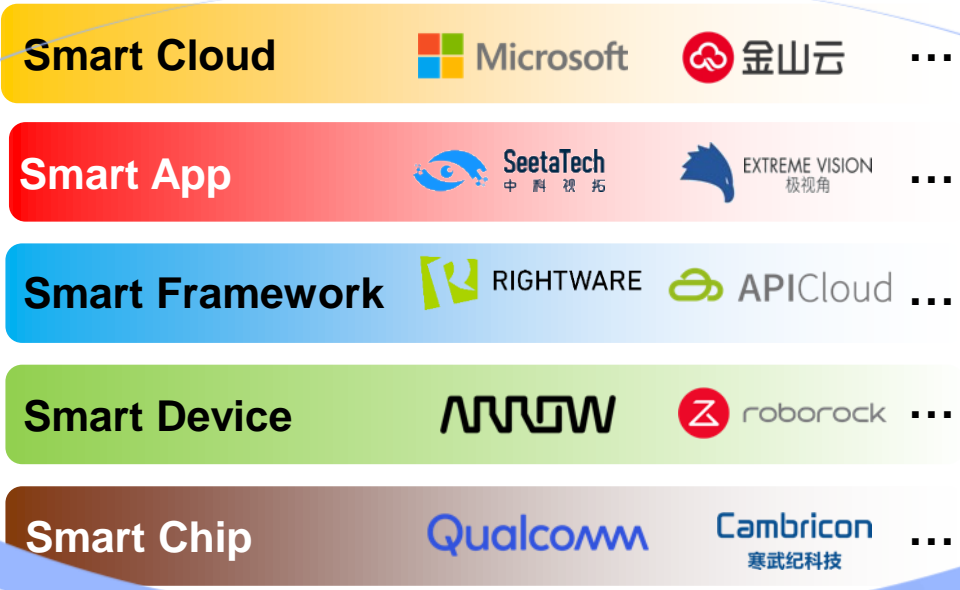
APICloud CTO

Smart Ecosystem

ASA - AI System Alliance



Smart Money



清华大学
Tsinghua University

Smart People



Smart System

AI is Not Enough

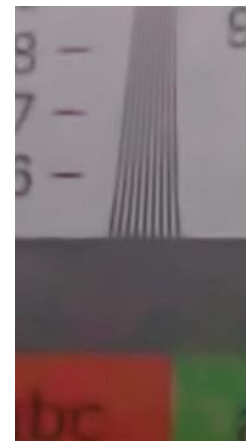
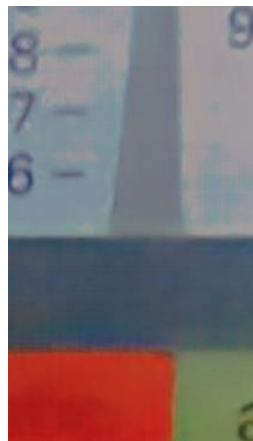
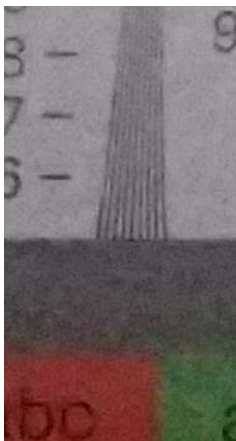
Normal ISP only



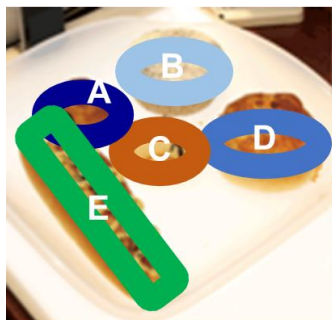
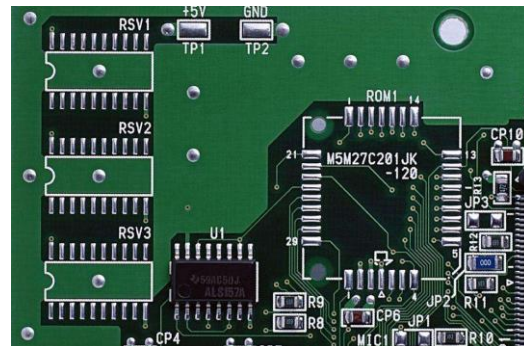
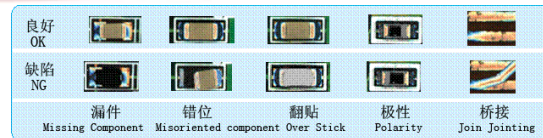
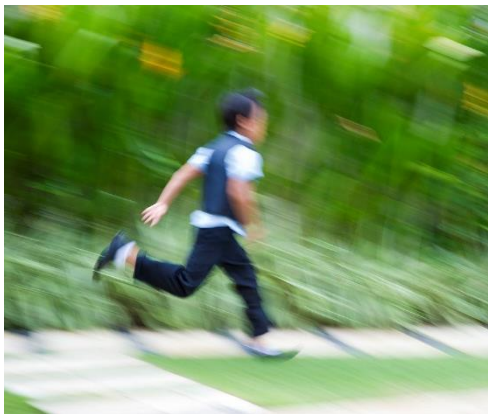
SeenIntheDark only



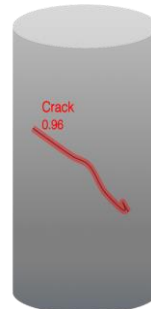
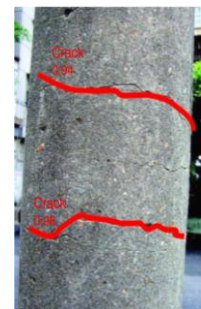
Denosing + Normal ISP



AI is Not Enough



项目	食物类别	数量	单价 (元)	小计 (元)
A	菠萝小饼	1	6.50	6.50
B	雪饼奶油包	1	14.00	14.00
C	海苔面包	1	4.00	4.00
D	饼干包	1	7.00	7.00
E	热饮	1	16.00	16.00
总计			47.50元	



AI is Only 10% of the Solution

OVERVIEW

AI Worker for Quality Assurance

A 3D intelligent vision for manufacturing and logistics, which combines 3D vision and deep learning for improving accuracy and quality of products

HIGHLIGHTS

- Depth camera + 3D model to capture the 3D image of many goods
- Machine learning for quality assurance, reliable and fast, improve productivity and efficiency
- Inspect shape, color, configuration, quality and other physical attributes. Or scan objects in full-color 3D to identify products for sorting and packing, validate labeling or locate defects
- Aquifi 3D Depth Camera Solution Embedded(O)

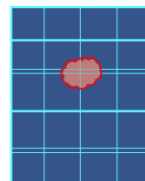
Improved validation efficiency, product quality and competence
Got much more structured data for defect big data analysis

Defect Detection Accuracy: >99%
Defect Classification Accuracy: >95%



Defect Classification

Classify the Defects



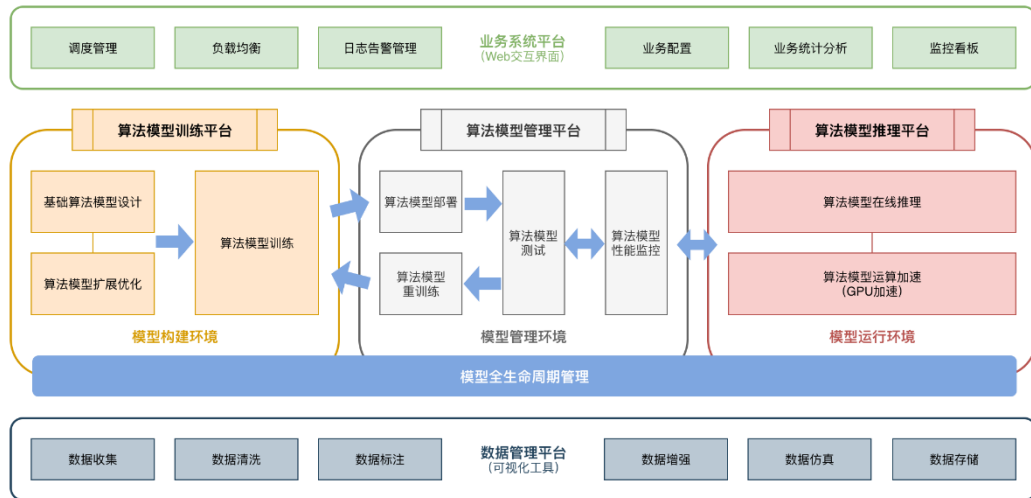
Defect Detection & Segmentation

Locate the Defect and Segment it in Pixel Level



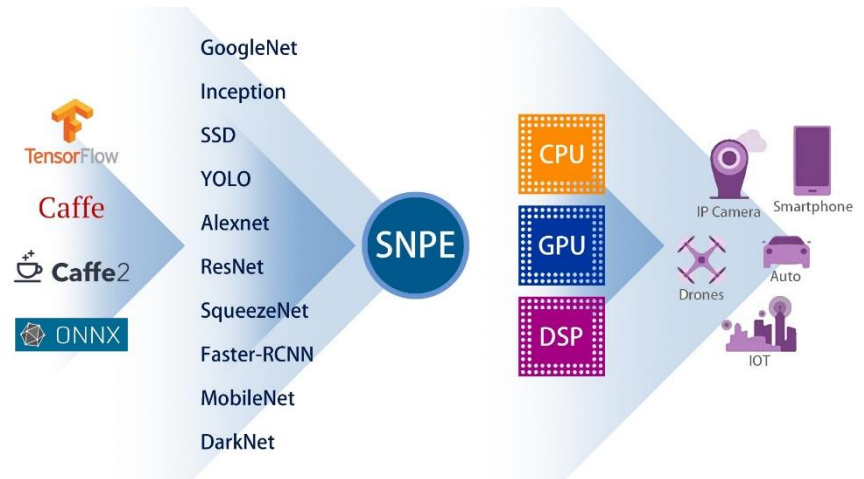
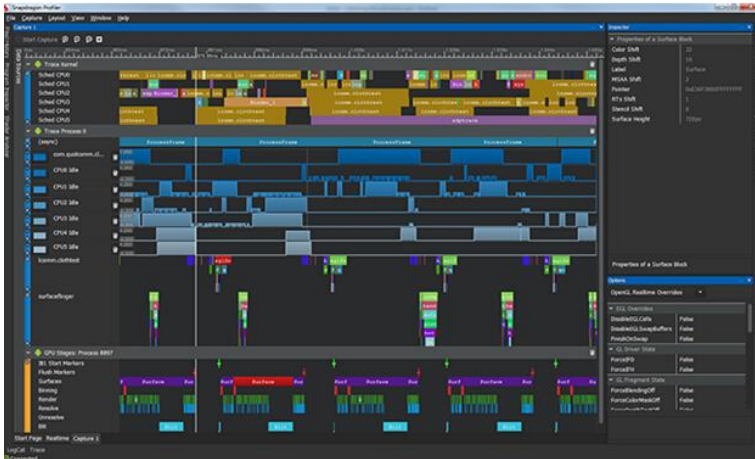
Anomaly Defect Detection

Identify Unknown Defect Classes



AI is Difficult to Develop and Deploy

- ❖ Chip: CPU, GPU, DSP, ASIC, ...
- ❖ Framework: TensorFlow, Caffe, MACE, HIAI, OpenVINO, ...
- ❖ Performance: Speed, Power, Memory, Scheduling
- ❖ Programming Tools for non-data scientist and non-programmer



Solution: TurboX AI Kit

- ❖ **Premium Platform:** Qualcomm 845 is used in most of the flagship smartphones and many IoT devices, it provides superb performance and power control.
- ❖ **High Performance:** can do Face Recognition at 20+ fps. The on-device AI capabilities through the integrated system containing CPU, GPU, DSP, NPU, etc.
- ❖ **Mature Ecosystem:** provide many pre-certified hardware and software modules, including camera, audio, sensors, LiDAR, display, etc.
- ❖ **Small Form Factor:** the AI module is of size of just a matches box. yet it's quite integrated with many built-in hardware features like GPU, DSP, Wifi, GPS, microphone, speaker, camera, bluetooth, codec, etc.
- ❖ **Multi OS Support:** AI Kit supports Android, Linux, HTML5 OS and Windows.
- ❖ **Full SDK Support:** provide built-in software SDK such as UI, AI, Camera, Audio, Security, Connectivity and Cloud access etc.
- ❖ **Easy Development:** AI Kit is not only designed for experienced AI developers, but also targets the user with zero programming experience, who can use AI Kit to develop AI apps with just a few clicks.
- ❖ **Rich AI Modules:** provides built-in AI algorithms to be used in building applications, such as Face Recognition, Face Detection, Object Recognition, Voice Recognition, Gesture Recognition, Pet Recognition, etc.
- ❖ **Quick Deployment:** AI Kit is made with product quality and rich interfaces to extends its functionality, and because of this, it can be deployed into various areas quick and sound.
- ❖ **Well Supported:** different levels of support are available for algorithm developers, application developers, students, OEM, ODM, industrial companies. Related development assets are all available such as documents, tools, test cases, SDK, application samples, tutorial and workshops.

Face SDK

❖ Key Features

- ▶ Safe smart face detection, face recognition
- ▶ gender, age, emotion detection
- ▶ Live detection
- ▶ Full angle face detection
- ▶ Face key point location
- ▶ Infrared face image
- ▶ High precision face comparison
- ▶ Dynamic face recognition
- ▶ Big scale face search
- ▶ Face characteristic analytics
- ▶ Recognition Model

Detection range	-45°~+45°, yaw(horizontal)
Detection range	360° face rotation(roll)
Minimum Face size	80*80 pixel
1:1 Recognition Accuracy	> 99%
1:N Recognition Accuracy	> 93%
Face feature point	81 feature points
Platform	Android, Linux, Windows

Face entrance

Solution strength :

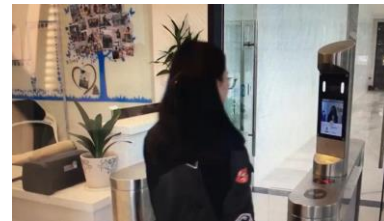
- Non-force, finish in nature
- Non-interact, no need for interaction with device

Scenario :

- Office building, residential area
- Self-service login in bank
- Company attendance, meeting attendance

System design :

- Establish face library
- Blacklist alarm, whitelist allowance

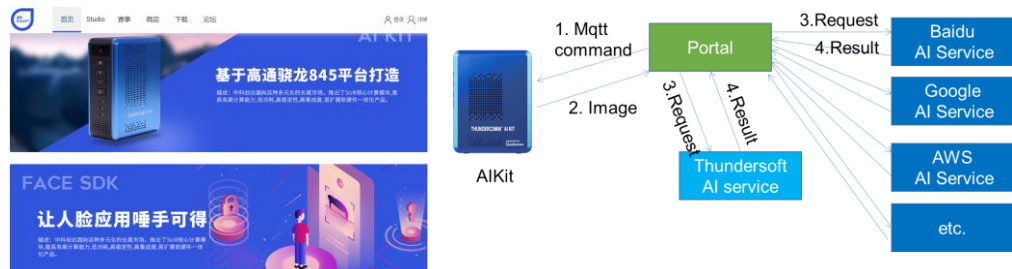


Value Proposition

- AI Hub Connecting AI Consumers and Suppliers

AI Studio

- Connect your AIKit with the ThunderAI studio, by input correct token.
- Drag and drop the modules you wish to use.
- Connect the modules
- If you want to use Logic module, double click it and edit.



The screenshot shows the ThunderAI Studio interface. On the left, there is a sidebar with sections for Input, Process, Logic, and Output. The main area displays a pipeline editor with a flowchart of modules: AIKit (blue) connects to 人脸识别 (Face Recognition, green), which connects to Logic Config (orange), which then branches to Sound (purple) and Flash (purple). Another path goes from AIKit to 通用物体识别 (General Object Recognition, green), which connects to 主体识别 (Subject Recognition, green), which connects to Logic Config (orange), which then branches to Save (purple) and another Logic Config (orange). The console on the right shows a video feed and a JSON output:

```

{
  "info": "don't have face or error"
}
{
  "result": [
    {
      "score": 0.865696,
      "root": "建筑-层家室内",
      "keyword": "吊顶"
    },
    {
      "baike_info": {
        "baike_url": "http://baike.baidu.com/..."
      }
    }
  ]
}

```

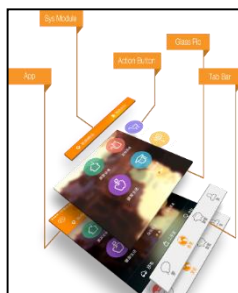
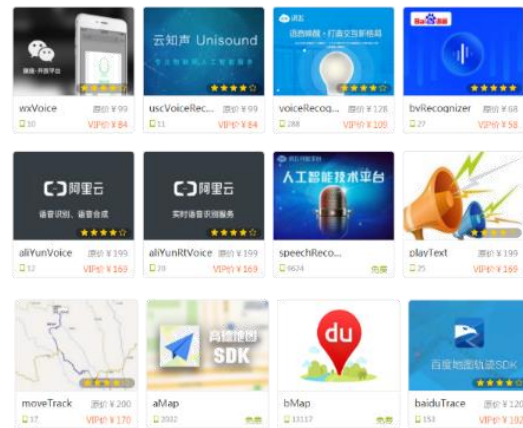
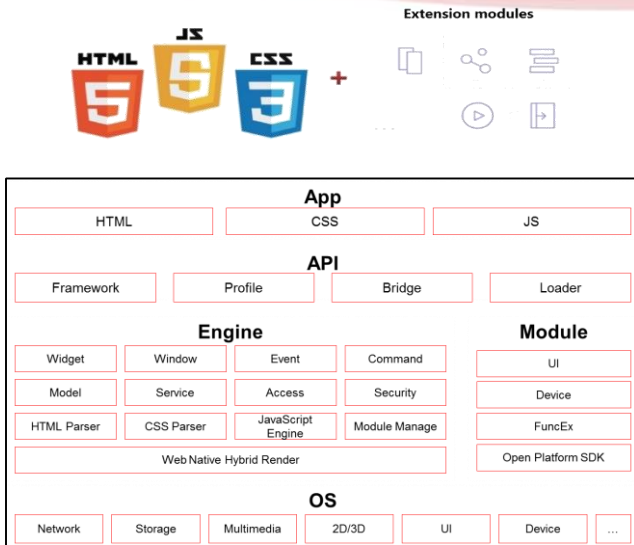
IoT/AI App Engine

❖ Differentiations

- ▶ open standards
- ▶ cross-platform
- ▶ extensive ecology
- ▶ cloud-client integration
- ▶ autonomous control

❖ Features

- ▶ Key Language: JS
- ▶ efficient rendering engine
- ▶ rich APIs
- ▶ module ecosystem
- ▶ app/module superstore



300+ Software Modules

Platform

- + App Creation
- + App Configuration
- + Code Mgr
- + License Mgr
- + Modules Mgr
- + Dev & Debug
- + Cloud compile
- + Encryption
- + Version Mgr
- + Cloud repairment
- +

App Mgr

- + App lifecycle
- + App communication
- + sandbox
- + Network communication
- + Data storage
- + Media player
- + Pic processing
- + Event & gesture
- + Data cache
- + Custom module
- +

UI layout

- + Layout framework
- + Window system
- + Windows Mgr
- + Windows lifecycle
- + Animation effect
- + frontend FW
- + UI interface
- + Display fit
- + UI modules
- + hybrid layout
- +

Device

- + Network
- + Sensor
- + Touch ID
- + Bluetooth
- + Wi-Fi
- + Audio
- + Camera
- + Contact
- + Location
- + Map
- +

AI

- + Face Recognition
- + Gender Detection
- * Emotion Detection
- + OCR
- + Object Detection
- + People Counting
- + Food Detection
- + **Voice recognition**
- + Pic recognition
- + Voice Command
- +

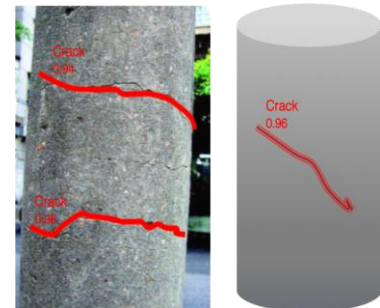
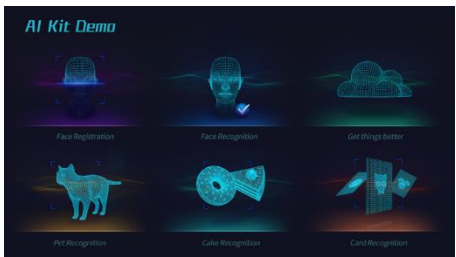
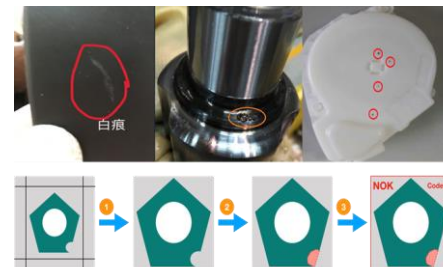
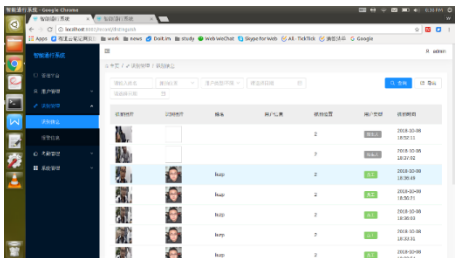
Open Service

- + Data cloud
- + Message push
- + Statistics
- + IM
- + Advertisement
- + Customer service
- + Sharing
- + Payment
- + Short message
- +

What can you do with the AI Kit?



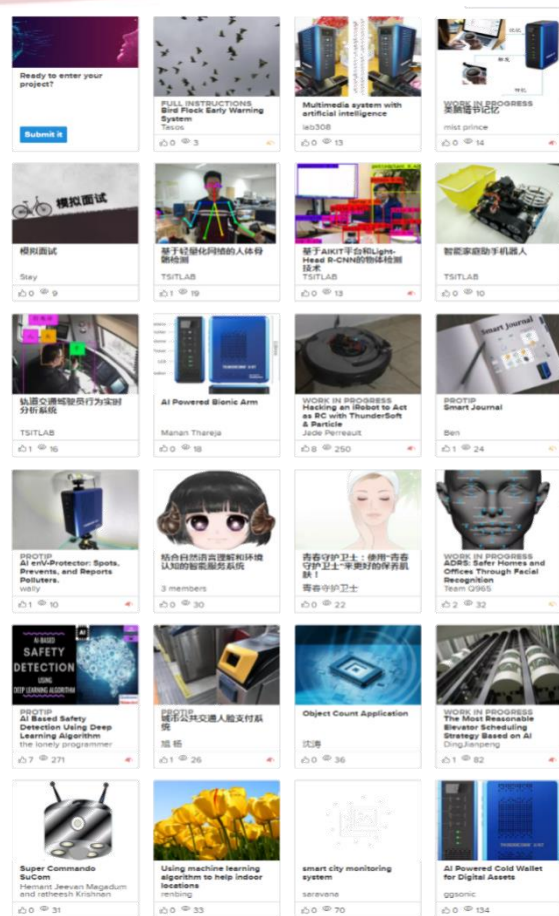
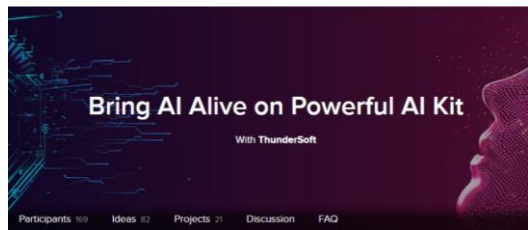
结果: 132410



Bring AI Alive Contest

- ❖ 3 Months
- ❖ 172 Participants
- ❖ 25 Countries
- ❖ 110 Ideas
- ❖ 25 Projects

- **Smart Gate**
 - 智能门禁
 - 亮点：对进入人员的停留时间进行监控和管理
 - 使用的AI Kit功能：camera, 人脸识别
- **Smart Home Security Assistant**
 - 家用智能安防
 - 亮点：与智能门锁联动
 - 使用的AI Kit功能：camera, 人脸识别, 宠物识别, 麦克风, OpenCV
- **Dash Assistant**
 - 行车安全监控
 - 亮点：和ODB联动, 路况识别算法
 - 使用的AI Kit功能：camera, AI,
- **Console Grade Gaming platform**
 - 游戏盒子
 - 亮点：游戏机! AR游戏, 手势识别 ...
 - 使用的AI Kit功能：camera, AI, Graphics能力
- **Assistant Robot for the Elderly**
 - 老人看护机器人
 - 亮点：根据老人表情推荐一些活动。实时处理。
 - 使用的AI Kit功能：camera, AI, 表情识别
- **Clean Water AI**
 - 水质检测
 - 亮点：用AI检测水质（通过分析水体里面的细菌情况），接入电子显微镜
 - 使用的AI Kit功能：AI处理能力
- **Second Guardian**
 - 儿童看护
 - 亮点：根据表情进行主动交互, 隐私保护, 实时处理。
- **Artificial intelligence system to control car traffic**
 - 交通监控
 - 亮点：交通管理相关传感器：Donkey Car Kit , PIR Motion Sensor MQ2, Gas sensor, SRF05 Ultrasonic Sensor



轨道交通驾驶员行为实时分析系统

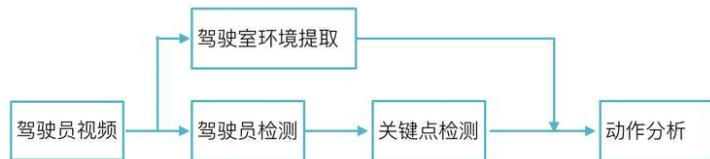
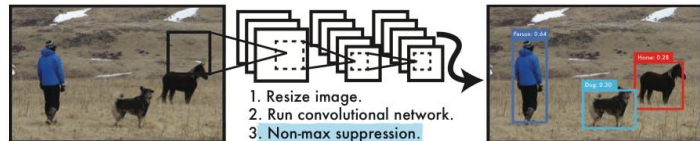
❖ 作者: 胡志坤, zhangende, 刘尧, Wei Zongzheng (清华大学)

❖ 目标

- ▶ 在轨道交通运行的过程中, 列车驾驶员操作动作的规范性对驾驶安全至关重要, 目前列车驾驶室装备6A系统, 能够视频记录驾驶室情况, 但是无法达到实时分析的要求。我们使用AIKIT平台, 对6A系统拍摄的驾驶员动作进行实时分析, 算法基于深度学习技术, 定位驾驶员身体关键部位, 结合驾驶室环境, 确定动作类别及是否按照规范及时完成相关操作。

❖ 方案

- ▶ 驾驶员行为识别: 通过检测驾驶员身体及关键部位(头, 手)的位置, 结合驾驶室环境, 进而分析司机动作类型;
 - 首先对司机进行检测, 由于我们在特定环境下做人体检测并要求实时性, 使用yolo检测网络
 - 检测到驾驶员位置之后, 仍然使用回归模型, 进一步对驾驶员的头, 手等关键部位进行定位, 在得知关键部位的坐标后, 根据特定的驾驶室环境, 进行动作分析, 在驾驶室中, 电话、操作台等位置固定, 通过设定动作的规则, 分析驾驶员动作类型。
- ▶ 受电弓接触点监控: 分析受电弓部位的监控视频, 定位受电弓与电网, 检测受电弓与电线接触点位置



面试助手

- ❖ 作者: Stay (韩飞定), 深圳
- ❖ 目标
 - ▶ 目前企业在招聘上需要花费大量的人力财力, 可以直接让应聘者跟AI对话交流, 通过AI技术协助面试官了解&筛选应聘者, 提高筛选效率, 也能帮助应聘者了解到自己的面试技巧有哪些不足的地方
- ❖ 方案
 - ▶ 通过AI分析视频和语音, 检测应聘者的面部表情和对话方式, 指出应聘者的优缺点并及时反馈给他们
 - ▶ 通过AI Kit的内置camera采集人脸信息, AI人脸识别算法检测应聘者表情, 分析应聘者心态
 - ▶ 用AI kit内置的mic采集面试者语, 通过语音识别算法检测应聘者语言表达, 分析应聘者性格特点
 - ▶ 通过语音识别算法检测应聘者答题内容, 分析答案的准确度
 - ▶ 综合上述分析结果, 给应聘者的面试过程评分



结合自然语言理解和环境认知的智能服务系统

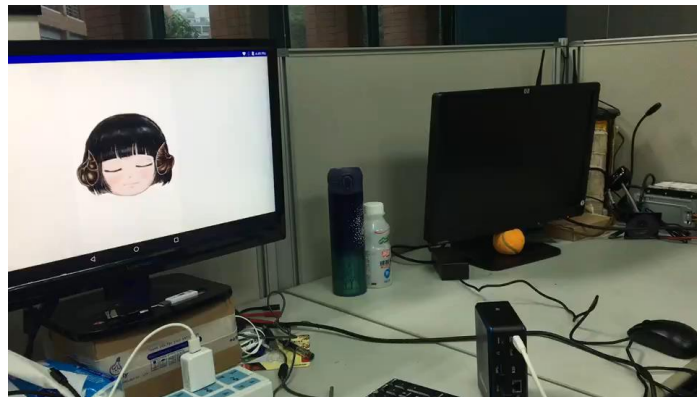
❖ 作者：毕盛教授团队，华南理工大学

❖ 目标

智能机器人真正走进家庭，真正为人们的生活提供服务需要机器人不仅能够听懂人们的讲话，还要具有对周围环境的认知能力，并把语音理解与环境认知结合起来。本项目旨在初步**探索语音识别与物体检测两者之间的匹配过程**，实现一个样例来提供简易的智能服务。

❖ 方案

- 1、APP可以识别到语音并进行语义分词。
- 2、APP可以检测到相机图像中的多个物体，并确定各个物体的位置信息。
- 3、APP可以简单理解语义信息并将语音识别的结果与物体检测的结果对应起来。
- 4、APP可以进行语音合成，将服务结果通过语音播放。



Conclusion / Thoughts

- ❖ AI should be delivered as a System Service.
- ❖ Non-data-scientist and non-programmer should be able to “develop” AI.
- ❖ AI Developers are keen to work on AI ideas.
- ❖ Need to work together to make it happen.
- ❖ Try AI Kit & building something cool together!



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THANKS!



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