Optimizing the "Last-mile" of Quality Management in Precision Parts Manufacturing
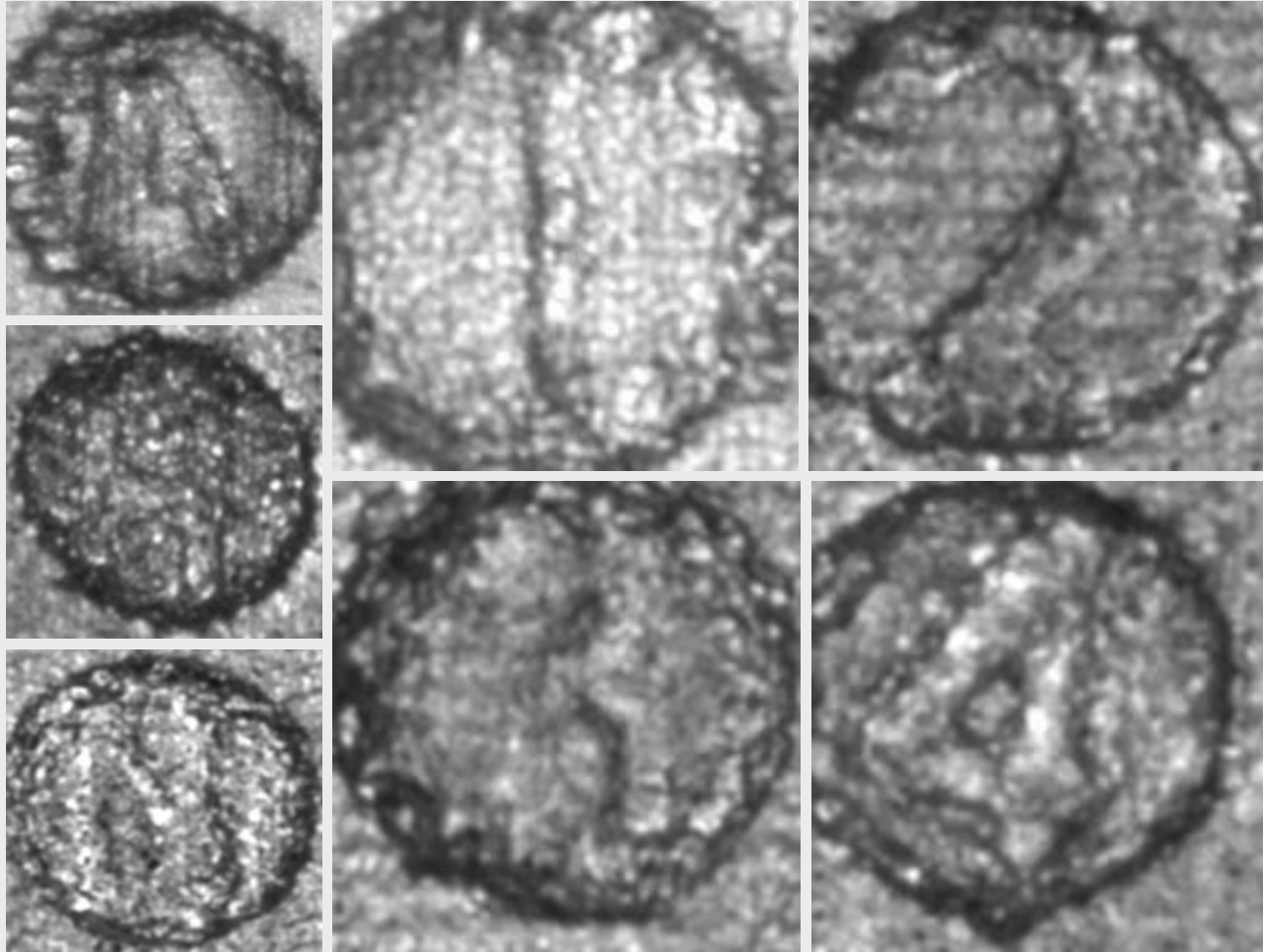
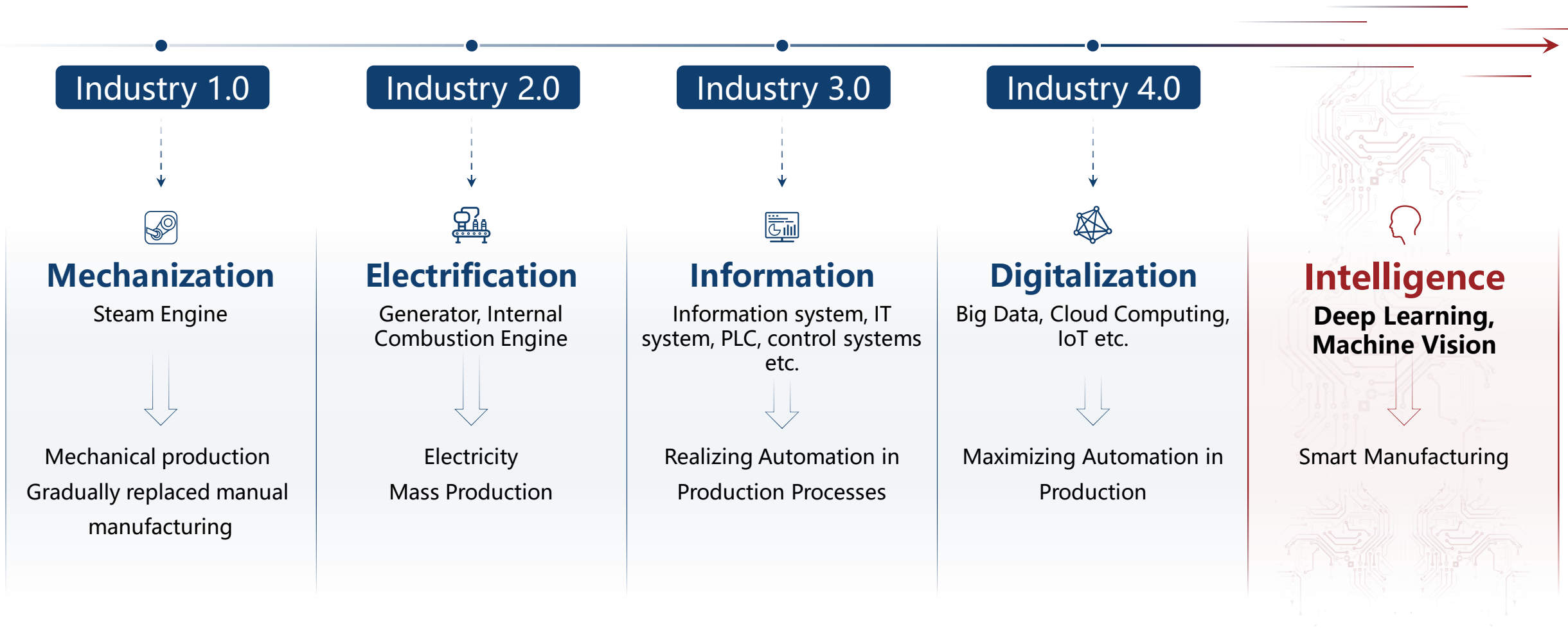Mercy Liu

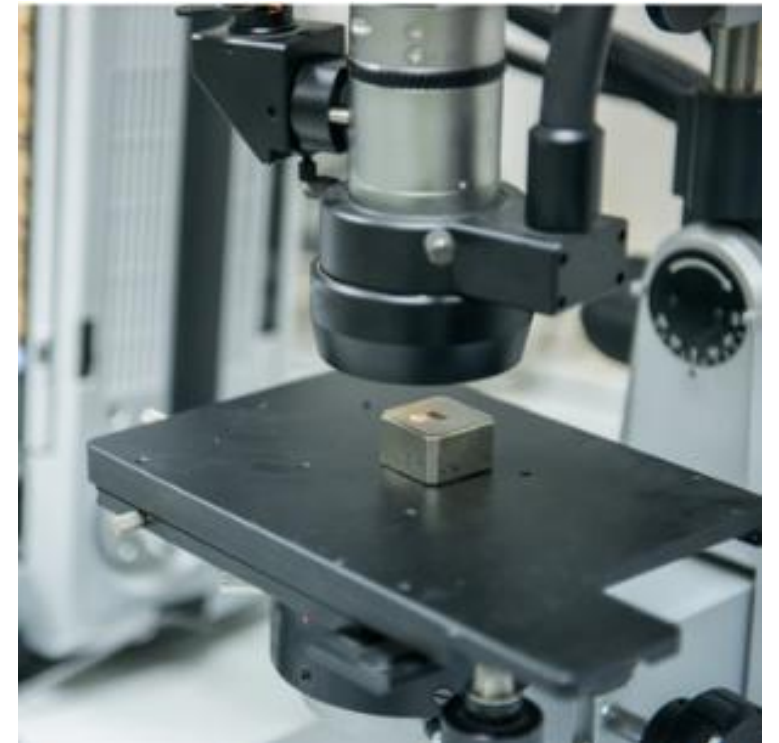SmartMore Corporation Limited

Can you read these characters?

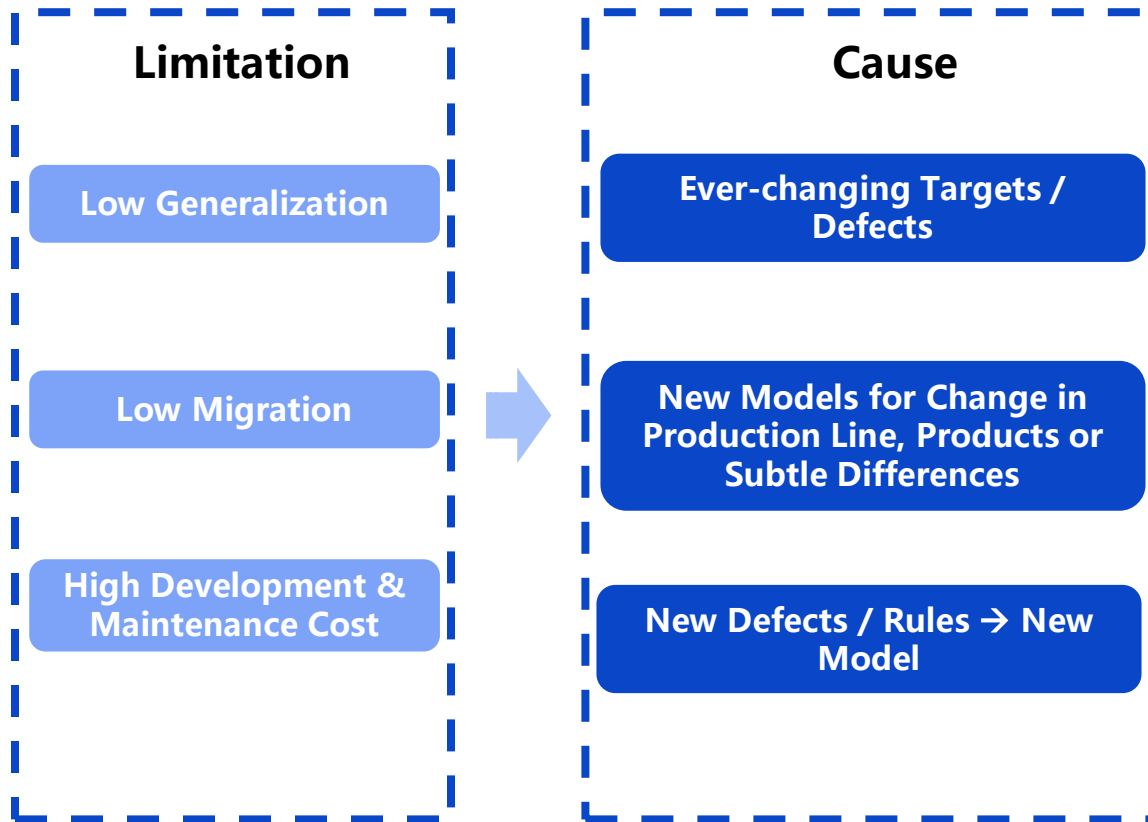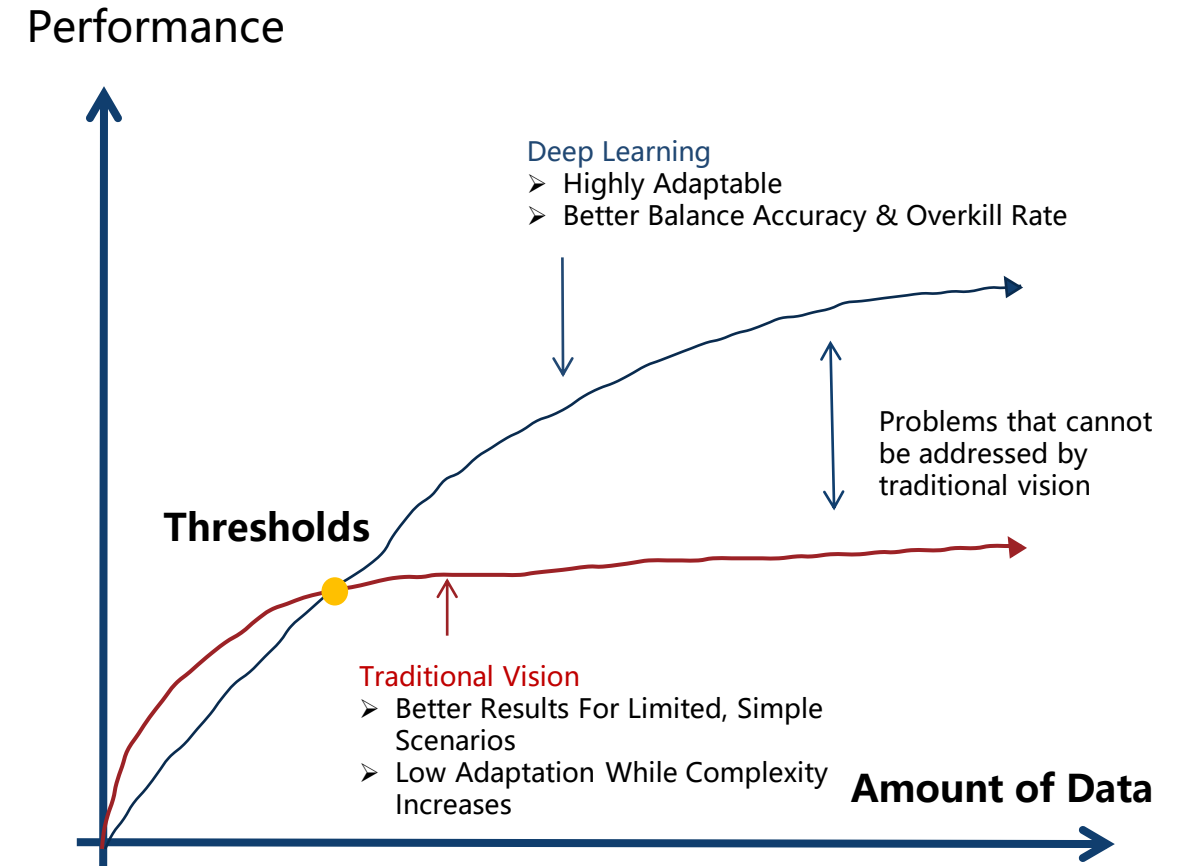# Embracing a New Era of Manufacturing Advancement

Industry 1.0

Industry 2.0

Industry 3.0

Industry 4.0

Mechanization
Steam Engine

Mechanical production
Gradually replaced manual manufacturing

Electrification
Generator, Internal Combustion Engine

Electricity
Mass Production

Information
Information system, IT system, PLC, control systems etc.

Realizing Automation in Production Processes

Digitalization
Big Data, Cloud Computing, IoT etc.

Maximizing Automation in Production

Intelligence
Deep Learning, Machine Vision

Smart Manufacturing

Traditional Machine Vision vs. Deep Learning

Limitations of Traditional Machine Vision

Limitation

- Low Generalization
- Low Migration
- High Development & Maintenance Cost

Cause

- Ever-changing Targets / Defects
- New Models for Change in Production Line, Products or Subtle Differences
- New Defects / Rules → New Model

Advantages of Deep Learning

Performance

Deep Learning
➤ Highly Adaptable
➤ Better Balance Accuracy & Overkill Rate

Problems that cannot be addressed by traditional vision

Thresholds

Traditional Vision
➤ Better Results For Limited, Simple Scenarios
➤ Low Adaptation While Complexity Increases

Amount of Data
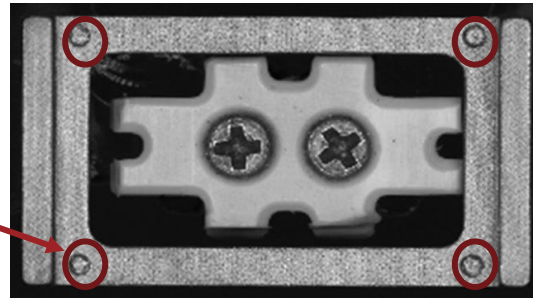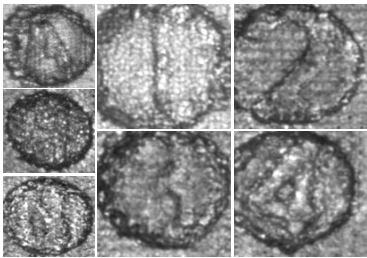
A smart phone contains **more than 100** high-precision parts

SmartMore

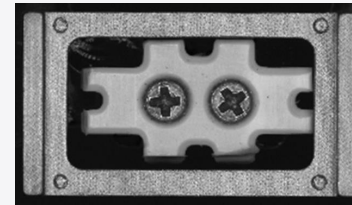# Smart Phone Vibration Motor OCR Detection

Requirement

- Recognize workstation identification character, corresponding device number and date of production
- Detection rate higher than 99% with less than 10% overkill

Description

Challenge

- **Small Item of Inspection**: Various character forms, imaging issues such as reflection and bad engraving, hard for manual inspection
- **Blurry Engraving**: Difficult to see characters on surface under common situations
- **Missing Characters**: Need to recognize partial characters
- Tiny characters: Size of character is only $0.1mm^2$

Solution

SMore OCR Algorithm allowed recognition of partial character features, exclude products with blurry characters
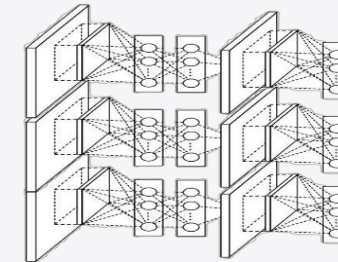
Data pre-processing | Detection of ROI | Segmentation

99.5%
Recognition Rate
Higher Than Manual Inspection

70%
Labor cost reduced
Close to 100% Automated Inspection

0.1s
Processing Time

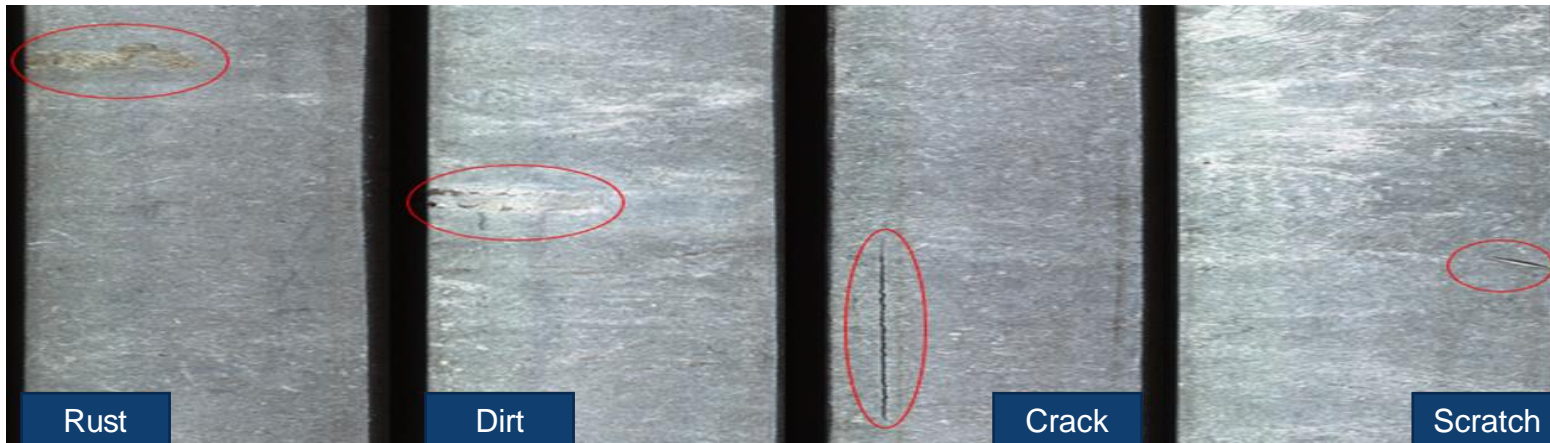**7%**
Overkill Rate

SmartMore

Automobile Bearing Surface Defect Inspection

📚 Requirement

- Detect OK/NG items and **identify major defect types**, such as oxidation, dirt, cracks etc

- CT = **1s/piece**

- Detection rate higher than **97%**

❓ Challenge

- Precision at **4 pixel**, 10x higher than common components

- Various types of defects (**20+ defect types**) and distribution

- Detailed classification and detailed labelling of defects

Rust	Dirt	Crack	Scratch

¥ Benefit

99%	**0.5s**
Detection Rate	CT per unit
98.5%	**80,000**
Accuracy	Units/line/day
3%	**80%**
Overkill	Labor cost reduction

SmartMore

New-generation Smart Manufacturing Infrastructure

| APPs | → | Sorting | Data analysis | Positioning | Quality inspection | OCR | Measurement | ...... |

100+ AI Apps hot plug

| Algorithm | → | **SMore ViMo – Super Brain of Smart Manufacturing** |

Hardware combinations and autonomous adaption

| Hardware | → | SMore ViScanner | SMore ViAir | SMore ViNeo | SMore Machine |
| | | Camera | PLC | Robotic arm | Robot | AOI | Light source | ...... |

With a variety of high-precision **built-in computer vision algorithms** tailored for the industrial field, including **character detection and recognition, defect detection, target classification, etc.**

More than 50 types of algorithm combinations, flexibly supporting a variety of complex requirements of industrial visual inspection

Quickly Build a Cross-industry Smart Manufacturing Ecology

Built-in Algoritms for the Industrial Field
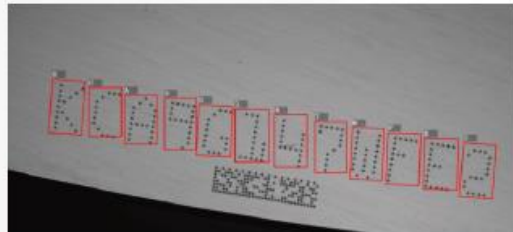
OCR for single character »» Fine-grained recognition of single characters

The system supports labeling and recognition of single characters, and the recognition of characters on multiple material backgrounds such as steel stamp, laser engraving, printing, and textile, breaking the technical limitations of traditional methods and solving complex character recognition problems such as low contrast and large character recognition.

OCR for character string »» Batch reading of character strings

It can quickly label and recognize character strings, and supports recognition of characters on multiple material backgrounds such as steel stamp, laser engraving, printing, and textile, solving complex string recognition problems such as recognition of characters on curve surfaces, multi-size characters, and numerous characters.
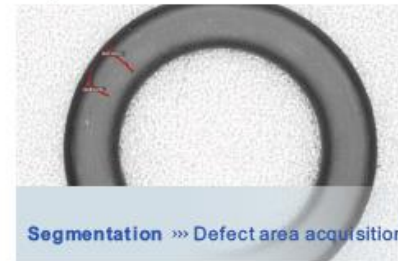
Locating »» Precise locating and counting

It supports location labeling of the inspected objects. For the inspected objects with angular deviation and whose direction needs to be determined, rotational locating and position correction can be performed to accurately locate the inspected objects.

Detection »» Classification, recognition and counting

It can perform coarse-grained recognition and classification of targets in inspected materials, and is suitable for multi-target detection, small target detection, counting, etc., such as pill counting, 3C device inspection and other scenarios.
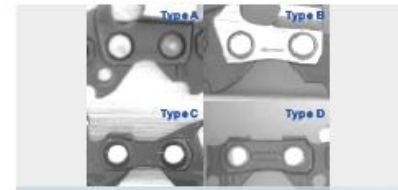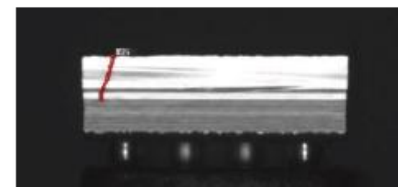
Classification »» Multi-type and multi-scenario classification

It supports classification and judgment of inspected materials, such as the OK/NG classification and judgment of materials, as well as the inspection of object colors, food material types, and 3C device sub-categories.

Unsupervised learning »» Defect analysis

It supports business scenarios where there is little or no data of defective samples, and enables recognition of defective samples through the learning of qualified sample data.

Segmentation »» Defect area acquisition

It supports pixel-level inspection and edge recognition, such as the recognition of cracked area on silicon wafers and the bruise area on bearings.

Scratch segmentation »» Scratch size

Its algorithms tailored for scratch detection can be refined to 4 pixels in scenarios such as the detection and recognition of scratches on battery polar plates and vehicle appearance.

Stain segmentation »» Stain size

Its algorithm tailored for stain feature detection ensures optimal detection of stains that are difficult to distinguish from the background, such as water stains and glue residues.
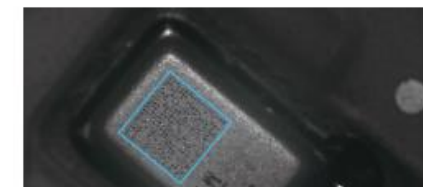
Deep learning-based code reading »» Barcode and QR code

Its code reading algorithms, strengthened through deep learning, can improve recognition of deformed, blurred, distorted codes, so as to improve the recognition rate and meet the needs of code scanning in complex scenarios.

Traditional Machine Vision Approach

2 Days · Operator
- Data Collection
- Data Cleansing
- Data Labelling

2 Days · Algorithm Engineer
- Model Training
- Model Testing

7-14 Days · Software Engineer
- SDK
- Model Release

Adoption

Fine-tuning
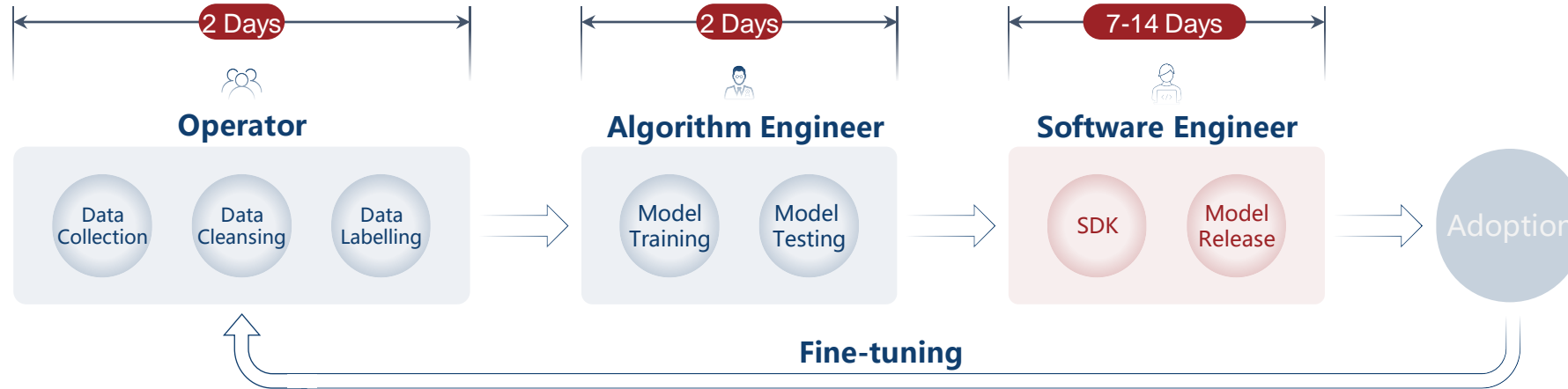
Long Cycle

Advanced Skills Requirement

High Maintenance Cost

Single Application

SmartMore Solution

1 Day · Operator
- Data Collection
- Data Cleansing

0.5 Day · SMore Industrial Vision Platform
- Automated Labelling
- Manual Modification
- Model Training
- Model Testing
- Model Release

Deployment For Running

Fine-tuning
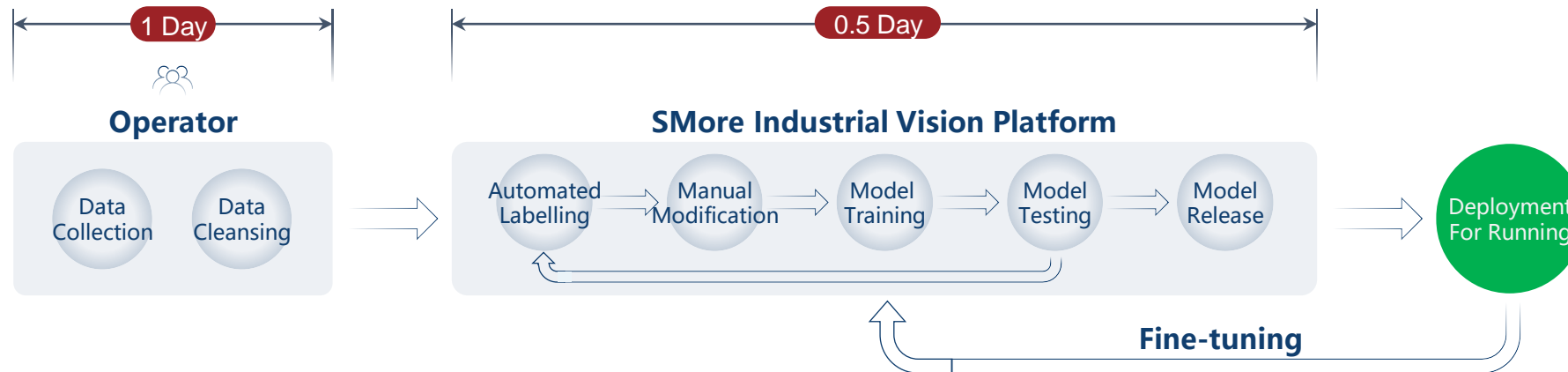
Shorter Cycle

Low Entry Barrier, Easy Operation

Easy Maintenance

High Precision & Detection Rate

Across Products, Applications & Industries

| Inbound Logistics | Material Inspection | Production | Quality Assurance | Outbound Logistics |
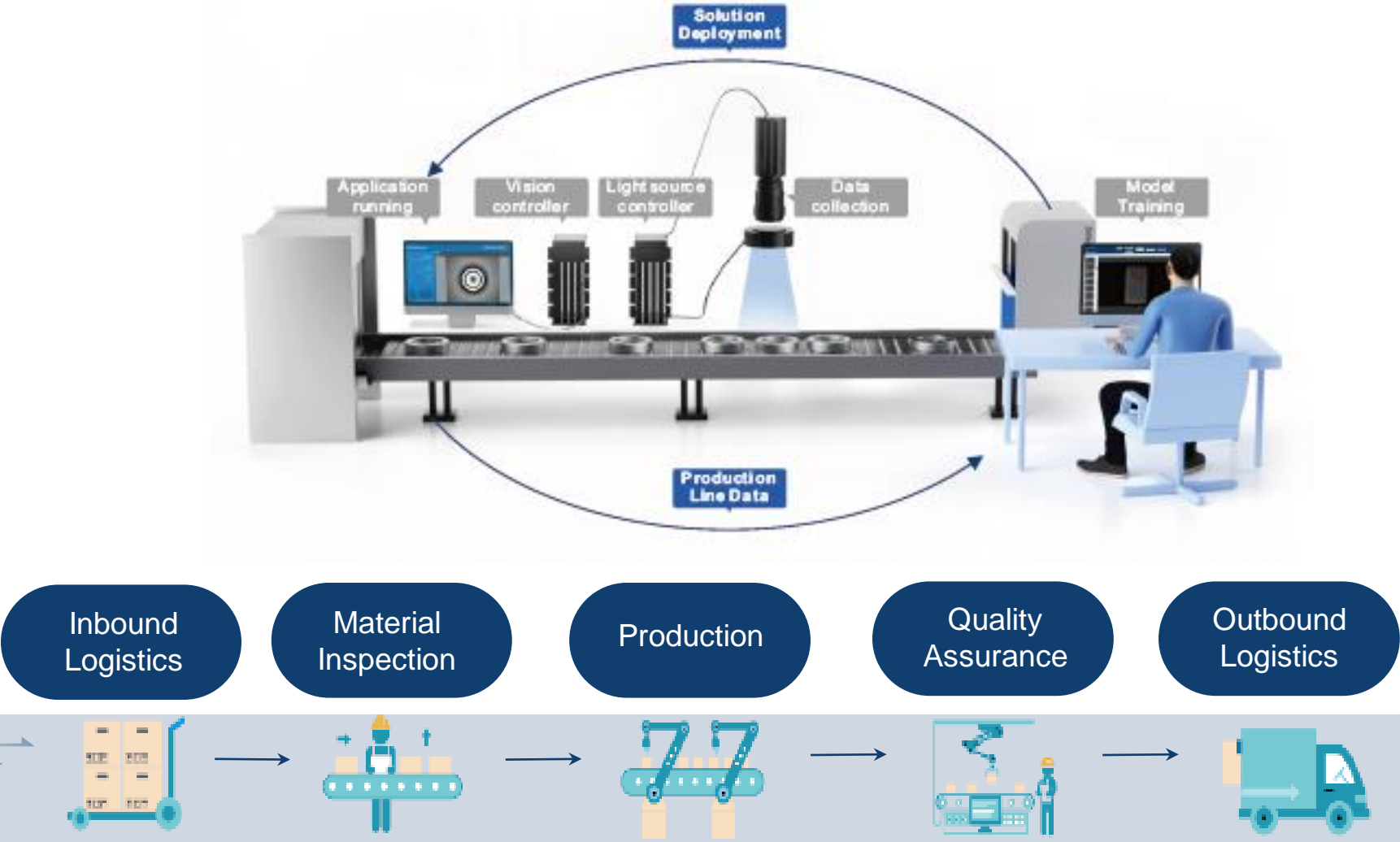
Top 500 auto parts manufacturer in the world

About SmartMore

SmartMore

Our Footprints

- Set up R&D and business centers in Hangzhou, Chongqing, and Singapore.
- **Completed the Series B financing with a total amount of over USD 200 million and became a "unicorn" company in smart manufacturing and digital innovation.**
- **Worked with 100+ industry leading enterprises; Helped a Fortune 500 auto parts manufacturer build its first production line with unmanned quality inspection; Launched the first full-stack "smart digital factory" for a global leader in optics.**
- Signed contract on the SmartMore Beijing Smart R&D Center at the opening ceremony of the Beijing-Hong Kong Economic Cooperation Symposium.
- The SmartMore Smart Manufacturing Lab was officially put into use, and over 60 integrated standard devices for smart manufacturing were developed and mass-produced.
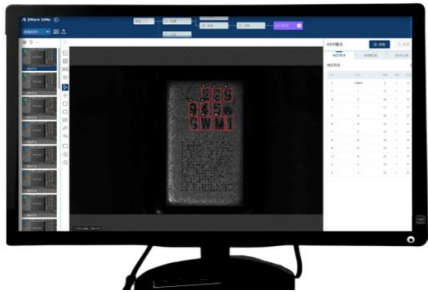
2021

- Set up R&D and business centers in Shanghai, Suzhou, and Tokyo.
- **Completed Series A financing and became a "quasi-unicorn" company.**
- Reached a strategic cooperation agreement with the Government of Xuhui District, Shanghai to facilitate the construction of national artificial intelligence development highland.
- **Delivered self-developed smart industrial platform SMore ViMo for commercial use and helped complete the smart transformation of nearly 100 production lines.**
- A full series of smart manufacturing products with SMore ViMo as the core debuted in the National Mass Innovation and Entrepreneurship Week.
- Named on over 50 major awards lists, including the "Most Influential Enterprises" Award.

2020

- SmartMore was established.
- **Set up R&D and business centers in Hong Kong and Shenzhen.**
- **Accomplished the angel investment**
- Completed the first commercial project for smart inspection of semiconductor wafers.

2019.12

Beijing 北京
Tokyo 东京
Chongqing 重庆
Shanghai 上海
Hangzhou 杭州
Suzhou 苏州
Shenzhen 深圳
HongKong 香港
Singapore 新加坡

18

SmartMore

Build Smart Manufacturing Product & Service Framework

SMore Industrial Vision Platform

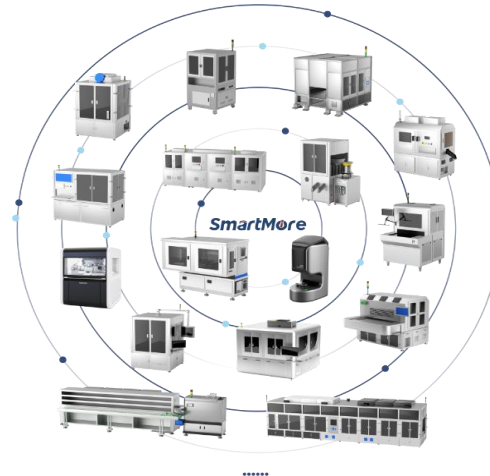
Smart Labelling · Model Training · Solution Configuration · Solution Publish

Smart Sensor Series
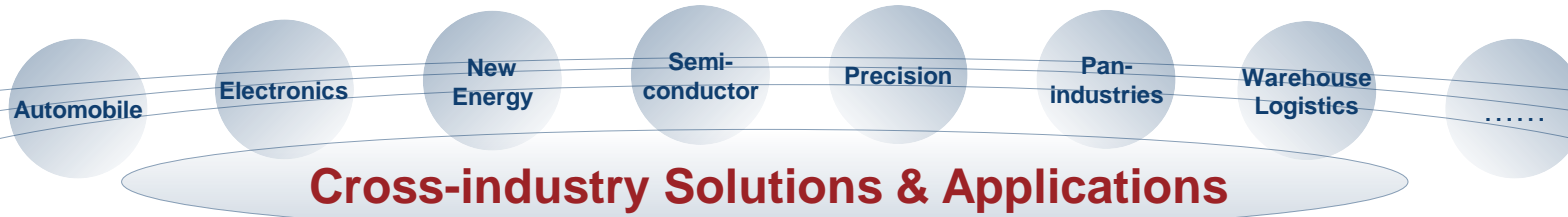

60+ Integrated Machines

Digital Platforms

Smart Production Line

Automobile · Electronics · New Energy · Semi-conductor · Precision · Pan-industries · Warehouse Logistics · ......

Cross-industry Solutions & Applications

Achieve High-quality, High-precision Flexible Manufacturing

Flexibility

Optimization

Precision

Pixel-level visual inspection with advanced machine vision algorithms for optimal quality

Strong algorithm foundation with multiple combinations to cover **diverse inspection requirement, product types, and industries**

- Automated quality inspection with comprehensive statistics and of product defects for output analysis, cause tracking and process improvement

- Increased inspection **efficiency** and **consistency**.

Meet us at Hall 6, Booth M14

SmartMore

MERCY LIU 劉夢溪

Head of Global Industrial Business
商務拓展負責人

SMARTMORE CORPORATION LIMITED

Unit 307-312, 3/F
Wireless Centre (Building 3E)
No.3 Science Park East Avenue
Hong Kong Science Park
N.T., HK

香港新界沙田區科學園科技大道東3號
3E大樓3樓307-312室

T +852 51698934   F +852 31110665
E mercy.liu@smartmore.com
W smartmore.com