Baidu Cloud Industry Quality Inspection Solution

Baidu Inc.
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2019.3.18
Highest Labor Cost in Complex Cosmetic Defect Inspections

<table>
<thead>
<tr>
<th>industry</th>
<th>daily output</th>
<th>current cycle time</th>
<th>labor amount</th>
<th>avg. labor cost</th>
<th>Monthly inspection labor cost</th>
<th>% of inspection labor #</th>
</tr>
</thead>
<tbody>
<tr>
<td>3C</td>
<td>2.3 million pcs</td>
<td>19 pcs/person/min</td>
<td>261</td>
<td>7800 RMB</td>
<td>2.03 million RMB</td>
<td>from 20% to 40% in past 3 yrs.</td>
</tr>
</tbody>
</table>

Previous machine vision automation solution still cannot solve this problem.

The complexity and variability of cosmetic defect.

The complexity and variability of products’ surface.

Limitations of traditional rule-based machine-vision algorithms.
# Unified Terminal-Cloud Quality Inspection Solution

## Baidu Industry Quality Inspection Platform (Public Cloud)

<table>
<thead>
<tr>
<th>Data Uploading</th>
<th>Image Annotation</th>
<th>Model Training</th>
<th>Model Testing</th>
<th>Model Downloading</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligent Annotation</td>
<td>Defection Synthesis</td>
<td>New Defection Discovery</td>
<td>Model Integration</td>
<td></td>
</tr>
</tbody>
</table>

## Terminal-Cloud Cooperative Control

- Terminal Registration & Configuration
- Heterogeneous Model Optimization
- Model Synchronization

## AI Model Training Closed Loop

- Data Uploading
- Image Annotation
- Model Training
- Model Testing
- Model Downloading

## Model Store

- Model Downloads
- Data Uploading

## BIE Runtime Package

- Device Admittance
- Data Communication

## Intelligent Quality Inspection Integrated Machine

- Multiple Computation Powers

## Industrial Personal Computer

## Quality Inspection Box (Embedded Terminal)

## Terminal Registration & Configuration

## Heterogeneous Model Optimization

## Model Synchronization

## New Defection Discovery

## Defection Synthesis

## Data Communication

## Application

- 3C

## Iron

Etc..
5 Key Features on Baidu Industry Quality Inspection

- Intelligent Data Annotation
- Defection Synthesis for New Product Line
- New Defect Discovery
- Heterogeneous Inference Engine
- Edge-Cloud Association

Over 80% Data Labeling Time Reduced
Fast Product Line Translation
Discovery Unclassified Defect
Best Performance-Cost Balance
Model and Data Cycle
Intelligent Data Annotation

Annotation : Slow (usually > 50s per object) → Potential Defect Suggestion ( > 80% precision )
Coarse (approximated polygon) → Automatically Segment Foreground (only 4 corners)
Intelligent Data Annotation - Interactive Segmentation

Interactive Segmentation: class-agnostic semantic segmentation with global context heatmap to acquire high accuracy

Deep Segmentation from Extreme Points
Heterogeneous Inference Engine

Anakin- Baidu Heterogeneous Inference Engine

1、Multiple Deep Learning Framework
2、Graph Merging and memory re-using
3、Address Pre-Mapping
4、Heterogeneous Assembly Optimized
Intelligent Defection Synthesis

**New Product Line Cold Start:** Transfer time-consuming labeled data collection (> 3 months) to 30 minutes

**Mono Defect-Free Sample**

**Mono Defect Sample**

**Poly Defect-Free Sample**

**Poly Defect Synthesised Sample**

**Encoding**

**Transformation**

**Decoding**

**Discriminative Network**
Intelligent Defection Synthesis

\[ x \xrightarrow{G} \hat{Y} \xrightarrow{F} \hat{x} \]

\[ y \xrightarrow{F} \hat{X} \xrightarrow{G} \hat{y} \]

\[ D_Y(G(x)) \]

\[ D_G(F(x)) \]

\[ \|F(G(x)) - x\|_1 \]

\[ \|G(F(y)) - y\|_1 \]
**New Defection Discovery**

**Maintenance**: Discovery un-classified defect for model optimization

**Novel Defect discovery**: discover un-predefined defect by modeling defect-free image

![Apple iWatch Charger](image1)

![Textured Anomaly Dataset](image2)
New Defection Discovery

Network:
- Reconstruction Network: Denoising/Variation AutoEncoder
- Discrimination Network: Detect Anomaly Samples

Loss Function:
- Encoding Loss: latent variable loss
- Content Loss: Ensure the reconstructed image
- Adversarial Loss: Ensure the authenticity of samples generated
Edge Cloud Synchronization

Baidu Intelligent Edge (BIE) Framework

1. Hardware and Framework Transparency
2. Edge-Cloud Association
3. AI on the Edge Device
4. Seamless Integration with Industrial Inspection
Baidu Cloud  ABC Integrated Industrial Inspection

High-Performance Industry Inspection Device

<table>
<thead>
<tr>
<th>Feature</th>
<th>Strictly Meet AQL and FP for super-star</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>Replace 100% labor + Computer Center + Quality Tracing Center</td>
</tr>
<tr>
<td>Customer</td>
<td>Digital Industrial Inspection for large company ( &gt; 200+, 1 million RMB per Machine)</td>
</tr>
</tbody>
</table>

High Performance-Cost Industry Inspection

<table>
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<tr>
<th>Feature</th>
<th>Basically Meet the AQL and FP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario</td>
<td>Replace the Entire- workers(Verification worker reserved), rapidly deployment</td>
</tr>
<tr>
<td>Customer</td>
<td>Rapid labor-saving for small incorporation with sailing and renting ( &gt; 2000, renting for 10,000 per month)</td>
</tr>
</tbody>
</table>
THANKS