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Ensuring Scalability, Governance & Innovation

Parts Inspection using Computer Vision & AI by Comparing 3D Images with Actual Part Image

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Approach 1
Mobile App-Based Part Inspection

Mobile App-Based Part Inspection

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Why This Matters:

- **Reduces downtime** by detecting defects early.
- **Improves quality** and ensures **consistency** with CAD specifications.
- **Empowers** on-site teams to make **quick decisions** without specialized equipment.

Problem Statement

- MSIL needs a quick, on-the-spot way to compare **actual parts** against **3D CAD models** or reference images.
- Manual inspection can be error-prone and time-consuming.

Proposed Solution
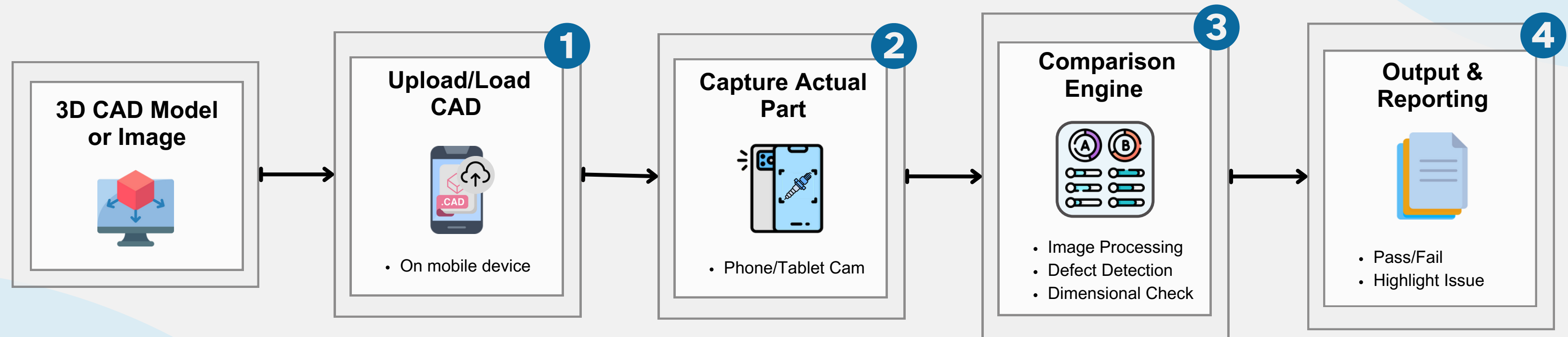
A **mobile application** that:

- **Loads** a 3D CAD model or reference JPG/PNG.
- **Captures** an image of the produced part using the device camera.
- **Analyzes** deviations, defects, or missing features in real time.

Target Users

Shop-floor operators, quality inspectors, and production managers who need **immediate feedback** on part quality.

How the Mobile App Works

3D CAD Model or Image

Upload/Load CAD — **1**
- On mobile device

Capture Actual Part — **2**
- Phone/Tablet Cam

Comparison Engine — **3**
- Image Processing
- Defect Detection
- Dimensional Check

Output & Reporting — **4**
- Pass/Fail
- Highlight Issue

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1 CAD/Image Input:
- The user can load the 3D model or a reference image into the app.

2 Camera Integration
- The app uses the device's camera to capture the **actual product**.

3 Comparison Algorithm
- **Feature detection** and **image alignment**.
- **Deviation mapping** to highlight any differences.

4 Reporting & Feedback
- Displays **results** (e.g., pass/fail or defect locations).
- Optionally **stores data** in a central server for further analysis.

Pros & Cons + Final Thoughts

Pros

Cons

- **Immediate Feedback:** Operators get **real-time** results on the shop floor.
- **Low Infrastructure Cost:** Only a **mobile device** is needed, no expensive scanning equipment.
- **User-Friendly:** Minimal training required, familiar **smartphone interface**.
- **Scalable & Portable:** Easily deploy to **multiple facilities** or lines.

- **Lighting & Environment:** Inconsistent lighting or background can affect accuracy.
- **Limited 3D Depth Analysis:** 2D images may not capture **complex 3D** defects.
- **Device Constraints:** Performance depends on **mobile hardware**, high-end devices may be required for **complex algorithms**.
- **Accuracy Threshold:** May need **calibration** or **additional references** for precise dimensional checks.

Summary

- A **Mobile App-Based Comparison** system is an **accessible** and **cost-effective** approach to quality control.
- It is best suited for **quick checks** and **simple geometry** comparisons.
- For **highly complex parts** or **stringent tolerances**, consider **3D scanning** or more advanced inspection solutions.
- This solution can be **integrated** with other quality processes, offering a **first line of defense** against defects.

Additional Notes for the Client

- **Integration Options:** Can integrate with existing **ERP/MES systems** for automated record-keeping.
- **Customization:** The algorithm can be **tailored** to specific part features or tolerances.
- **Future Upgrades:** Potential to add **AR overlays** or **machine learning** for more sophisticated defect detection.

Approach 2

AI-Powered Industrial Camera Quality Control

AI-Powered Industrial Camera Quality Control

Problem Statement:

- Ensuring manufactured parts match their 3D CAD designs is critical.
- Manual inspections are often slow and prone to human error.

Proposed Solution

- Deploy high-resolution industrial cameras at key quality checkpoints.
- Automatically capture images of produced parts and compare them with the CAD model.
- Operate in a fully automated quality control environment with minimal human intervention.
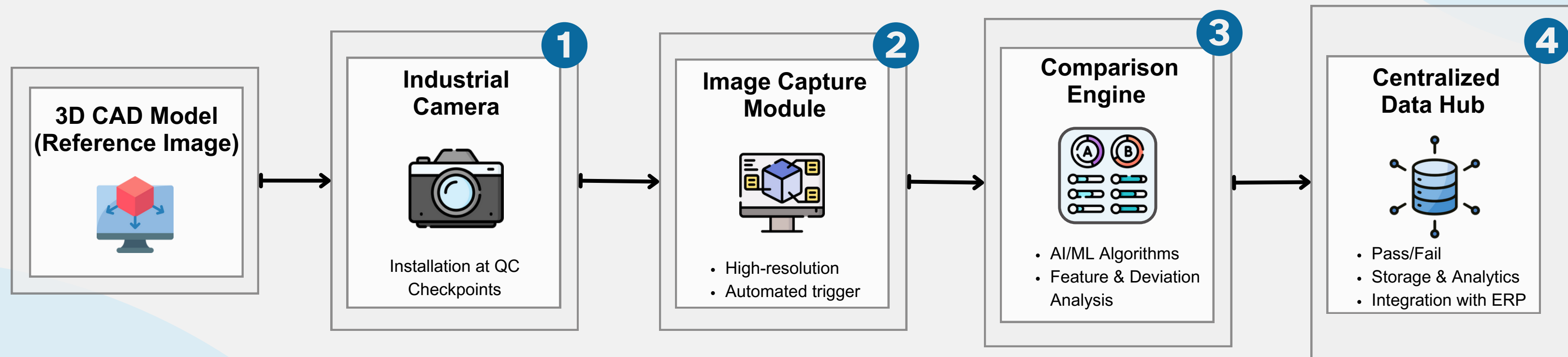
Benefits

- **Streamlined inspections** with automated detection of deviations.
- **Consistent and repeatable** quality checks across production lines.
- Reduced human error and increased **production throughput.**

Target Users

Manufacturing plants seeking improved **automation**, **consistency**, and **efficiency** in quality control.

AI-Powered Industrial Camera Quality Control

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3D CAD Model (Reference Image)

1 Industrial Camera

Installation at QC Checkpoints

2 Image Capture Module

- High-resolution
- Automated trigger

3 Comparison Engine

- AI/ML Algorithms
- Feature & Deviation Analysis

4 Centralized Data Hub

- Pass/Fail
- Storage & Analytics
- Integration with ERP

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1 Industrial Cameras
- Capture high-quality images at designated checkpoints.

2 Image Capture Module
- Ensures images are taken at the right moment with consistent settings.

3 Comparison Engine
- Uses AI/ML algorithms to align images with the CAD model, detecting defects.

4 Data Hub
- Aggregates inspection data, providing analytics and integration with existing systems.

Pros & Cons + Final Thoughts

Pros

- **High Accuracy:** Industrial cameras provide high-resolution images for detailed analysis.
- **Automation:** Fully automated process minimizes human intervention.
- **Consistency:** Standardized inspections lead to repeatable and reliable quality control.
- **Scalability:** Easily integrated across multiple production lines.

Cons

- **Initial Setup Costs:** Industrial cameras and installation can be costly.
- **Maintenance:** Requires periodic calibration and maintenance of cameras.
- **Integration Complexity:** May require integration with existing manufacturing systems.
- **Environment Sensitivity:** Variations in lighting or environmental factors can affect image quality if not properly controlled.

Summary

- The AI-Powered Industrial Camera Setup is ideal for high-volume, automated quality control.
- It delivers high accuracy and consistency, making it suitable for complex manufacturing environments.
- While upfront investment and integration may be challenging, long-term benefits include reduced errors and improved production efficiency.