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# Inspection With Eye [IWE]

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**Abstract—The new solution reduces the inspection time by 85 percent and cut manufacturing defects by 8-10 percent. Using a high definition (HD) camera and cognitive capabilities from IBM Watson and the visual defect tracking system to visually track defects and provide possible remediation steps, the solution captures images of products as they move through the production and assembly lines, they can identify defects in products, including scratches or punctures or any abnormalities. The solution is designed to help manufacturers improve for product excellence, achieve never seen before specialization levels.**

## I. INTRODUCTION

The technology of Artificial Intelligence (AI) is suddenly changing production areas for manufacturing. Artificial Intelligence allows manufacturers to automatically revise and generate image recognition system programs, used for assembling parts and various inspections, to respond immediately to changes in part specifications or the manufacturing line. This greatly improves quality, cost, and delivery (QCD) as scratches, dirt, foreign matter, and other subtle faults—which had been inspected with the naked eye-can now be caught in the inspection. Even so, the manufacturing industry is changing, and image recognition systems are becoming a bottleneck. Systems are expected to respond flexibly and promptly to the changes in part specifications. If there is a change to the manufacturing line, the image recognition system needs to be rebuilt or reprogrammed.

This re-building or re-programming of the solution for each and every engineering changes of the product, makes the process tedious and hence creates dependencies on the manual inspection as the system loses accuracy. In order to overcome and provide a sustainable, continuously learning Visual Inspection system, the below solution 'IWE' – Inspection With Eye System is created. Below are different phases describing how Inspection With Eye (IWE) solution will enhance manufacturing process to produce goods with best quality.

### *A. The challenges of quality inspection*

Manufacturing operations strive to deliver very high quality during each stage of assembly or production process. These quality checks consists of visual confirmation to ensure if the parts are in correct locations, have right shape. Automating these kind of visual quality checks are very difficult as the volume of inspections, product variety, and the possibility that defects may be high. This is where AI enabled Inspection With Eye (IWE) system – delivers its highest value.

### *B. Learning from defect images that are 'OK' and 'NG'*

AI enabled Inspection With Eye (IWE) system takes the advantage of IBM Watson's experience in Deep Learning, IBM has developed algorithms for visual quality inspections. Images of normal and abnormal products from each stage of productions are submitted to the 'learning service' that builds the analytical model to observe OK vs NG characteristics of parts, components and products that meet quality specifications (OK) and those that does not as (NG). If there is a need to classify defects into different types to address causes and fix the quality issues, the IBM Watson can be trained to perform such tasks with a higher level of confidence.

### *C. Cognitive for improvement in defect recognition*

The models trained by AI enabled Inspection With Eye (IWE) using IBM Watson can be deployed on the pre-configured hardware of the factory, so that there can be a very less decision latency during production. The solution can continuously learn by the feedback from manual inspectors who review the automated classification and override them based on human judgment. The correct information along the image from the production floor is then included in the next training cycle for that analytical model, thereby improving its ability to discern in future.

**Reduce dependency on manual inspection**

The AI enabled Inspection With Eye (IWE) system delivers results with a very low escape rate to reduce the

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dependency on specialized labor and to improve throughput of quality.

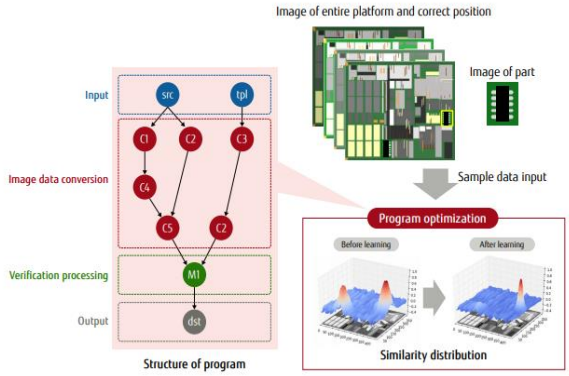


**Figure 1: High level approach to create training model**

### *D. The different phases of the INSPECTION WITH EYE (IWE)*

It enhance the model challenges of quality inspection in manufacturing, learning from defect images that are 'OK' and 'NG', cognitive for continuous improvement in defect recognition, reduce dependency on manual inspection.

## II. EXISTING SYSTEM

Image recognition systems is used in manufacturing lines. Ultra-high definition cameras are used to perform automated assembly and inspections throughout the manufacturing process, from the start to finish. Taking visual inspections as an example, an image recognition system can identify defects from multiple images of the target as captured under various lighting patterns with an camera. This greatly improves QCD (quality, cost, delivery) which had been inspected with the naked eye can now be caught in a batch inspection.

### A. *Issues*

The manufacturing industry is dynamically changing, and image recognition systems are becoming a bottleneck. Systems are expected to respond flexibly and promptly to changes in manufacturing lines, and other needs. If there is a change to the manufacturing line, the image recognition system needs to be retrained or rebuilt.

These systems require constant maintenance; any changes to the manufacturing line or part specification means captured images might not be recognized accurately.

## III. PROPOSED SYSTEM

To loosen this bottleneck, many AI & IOT based companies like Microsoft, IBM, Fujitsu, PTC has been working on automating image recognition systems these last five years. If program generation and onsite adjustments could be automated, it would reduce the time spent on preparing equipment and switching part specifications, which in turn would accelerate turnaround time until safe operation for the manufacturing lines and eliminate the need for developers to stay at the production site. While image recognition systems are only automated in some automated assembly and inspections, this shift will in effect improve productivity and quality for the manufacturing line as a whole.

The new IWE Quality Defect Tracking solution reduced inspection time by 85 percent and cut manufacturing defects by 8-10 percent. Using an ultra-high definition (UHD) camera and cognitive capabilities from IBM cognitive vision and the Inspection With Eye (IWE) couples manufacturing with 'Naked Eye' to visually track defects and provide possible remediation steps, the solution captures images of products as they move through production and assembly, and together with human inspectors, can detect defects in products, including scratches or pinhole-size punctures. This solution, which continuously learns based on the human assessment of defect classifications in images, is designed to help manufacturers improve the product excellence and achieve never seen specialization levels.

## IV. PROBLEM STATEMENT

Manufacturing operations strive to deliver very high quality during each stage of the assembly process or production. Over three-fourth of the quality checks imply visual confirmation to ensure that the parts are in the correct positions and are gratuitous from any deformity such as pinholes, scratches, etc. These types of visual quality checks is difficult because of the amount of inspections, product variety.

Additionally, based on early testing of a production cycle that typically takes 9 days with 1 day required for needed visual inspection and no driven way of remediating the visual defects based on precedent learnings or issues.

### *A. Objective*

The visual inspection qualification, brings a new set of intelligent eyes to the manufacturing floor that have potential to support manufacturers to virtually eliminate product defects and increase revenue and build brand reputation.

Build a solution which is highly sustainable, continuously learning and cognitive. Solution should leverage advantage of Industry solutions which has experience in Deep Learning, like IBM who has developed algorithm for manufacturing customer to automate visual quality inspections. Images of normal and defected products from different stages of production can be submitted to the centralized 'learning service' that will build analytical models, components that meet quality specifications (OK)

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and those that don't (NG). If there is need to classify defects into different types to address potential root causes and fix the quality issues, the IBM Watson Insights can be trained to perform such tasks with a high level of confidence.

## V. BENEFITS

1) Fast learner- Quickly learns to differentiate the good from defected.
2) Quick study- Recognition is done in milliseconds.
3) Consistent- Ensures a reliable defect detection process.
4) Confident- Calculates the detection score; without guessing.
5) Attentive- Never distracted.
6) Never forgets- Continually improves the recognition algorithms based on the defects.
7) Centrally managed- Applied on the factory floor via edge devices.

## VI. METHODOLOGY

The camera captures images of product components as they move through the production and assembly, and feeds these to IBM Watson for analysis. By comparing them with the images it has already processed, IBM Watson can detect defects as minor as tiny scratches and punctures as small as pinholes.

## VII. ARCHITECTURE

Inspection With Eye (IWE) comprises two main tools: images captured using the high definition cameras, and IBM Watson AI-powered capabilities. Images of normal and defected products are fed into IBM Watson's central learning service to teach it the difference between faulty and correctly functioning components. IBM Watson uses these data to build an analytics library of known defects that can identify quality issues and learn continuously from feedback. This technology can be used to spot the defects in live images from the assembly line.

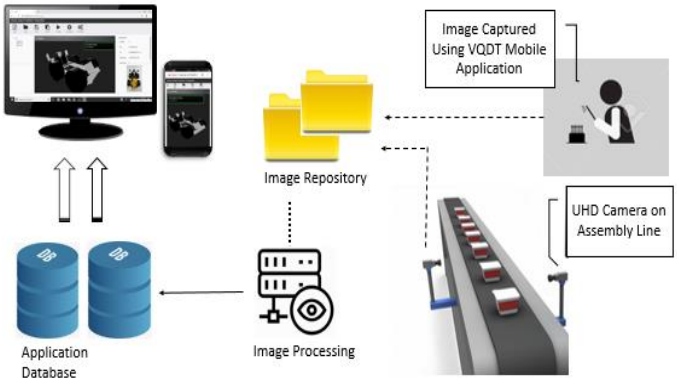


**Figure 2: Solution Architecture Of the Inspection With Eye (IWE)**

A camera captures images of product components as they move through production and assembly, and feeds these to IBM Watson for analysis. By comparing them with the images it has already processed, IBM can detect defects as minor as tiny scratches and punctures as small as pinholes. It also knows whether parts are in the correct location and are the right shape and colour.

IBM Watson's classification of quality issues is automatically been sent to the manual inspectors, who will perform a secondary check and override the solution's decision if need be.

## VIII. IMPLEMENTATION

1) Prepare Training Data to train the classifier.
2) Train the IBM Watsons Classifier.
3) Sort Images into positive / negative examples.
4) Call the API with captures from production.
5) Classify the pictures with good and bad. Identify defects and coordinates and capture parameters.
6) Report Visual defect with Images to Defect Tracking System and track visual parameter scores for the product against quality disposition in MES.
7) Generate Operator Alert for Visual Defect.
8) Deploy models to analyze the possible remediation based on root cause for previous issues and scores identical or closely matching.
9) Quality admin to classify and perform root cause for the issue using Inspection With Eye (IWE) Dashboard.
10) Wrong classification to be feedback into Classifier for learning and improvement.

## RESULTS

The below given images are IWE - Inspection With Eye screenshots.

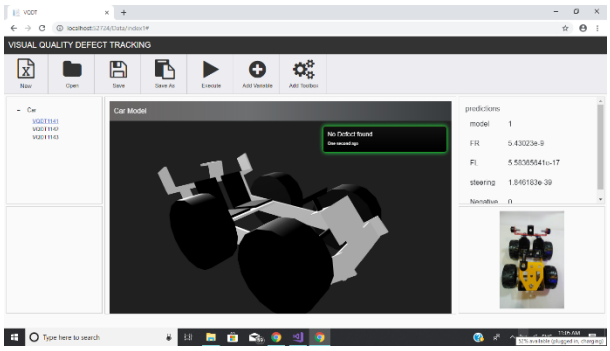


**Figure 3: Precision Score of a correct model**

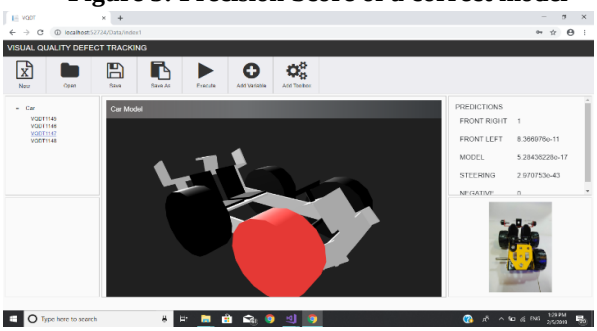


**Figure 4: Precision Score of a model with a defect**

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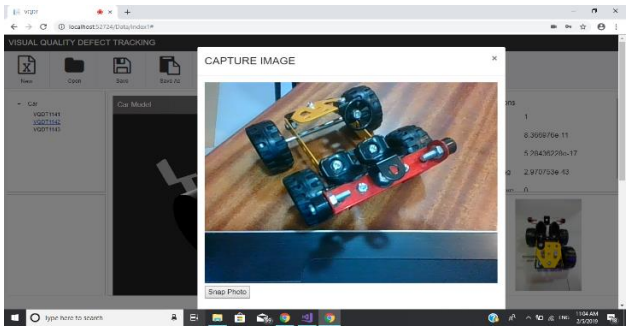


**Figure 5: Camera screen to capture the image**

## IX. CONCLUSION

Manufacturing of devices require the highest level of inspection for quality during every stage of production. Most of these quality checks involve the visual confirmation, which helps to ensure that all the parts are in the correct location, if they have the right shape and are free from scratches, holes. Automating these visual quality checks is very difficult due to the high volume and variety of products, as well as the fact that defects can be any size. By bringing IWE system to the factory floor, this can help to deliver new levels of efficiency, flexibility and product excellence in manufacturing can become an everyday reality.

## REFERENCES

[1 ]DamhujiRifai, Ahmed N. Abdalla, "*Subsurface Defects Evaluation using Eddy Current Testing*", Indian Journal of Science and Technology Vol 9(9), March 2016

[2] Moe Win, A. R. Bushroa, M. A. Hassan,N. M. Hilman, and Ari Ide Ektessabi. "*A Contrast Adjustment Thresholding Method for Surface Defect Detection Based on Mesoscopy*", IEEE Transactions on Industrial Informatics, 2015 June.

[3] L.Vieira et al. "*Scratch testing for micro- and nanoscale evaluation of tribocharging in DLC fi lms containing silver nanoparticles using AFM and KPFM techniques*", Surf. Coat. Technol., vol. 260, pp. 205–213, 2014.

[4] C.Meola and G. M. Carlomagno. "*Infrared thermography to evaluate impact damage in glass/epoxy with manufacturing defects*", Int. J. Impact Eng, vol. 67, pp. 1–11, 2014.

[5] XiaolongBai, Yuming Fang, Weisi Lin, Senior Member, IEEE, Lipo Wang, Senior Member, IEEE, and Bing-FengJu. "*Saliency-Based Defect Detection in Industrial Images by Using Phase Spectrum*", IEEE Transactions on Industrial Informatics, November 2014., vol. 10, no. 4.

[6] R.Ebner, B.kubicek and ujvari. "*Non-destructive techniques for quality control of PV modules: Infrared thermography, electro-and photoluminescence imaging*", inProc. 39th Annu. Conf. IEEE Ind.2013, pp. 8104–8109.

[7] Tung-Yen Li, Jang Zern, RongSeng Chang, Li Wei Ho. "*Pretest Gap Mura on TFT LCDs Using the Optical Interference Pattern Sensing Method and Neural Network Classification*", IEEE Transactions on Industrial Electronics, September 2013. vol. 60, no. 9.

[8] H. Koyama, F. Oohira, M. Hosogi, G. Hashiguchi, and T. Hamada. "*Multiprobe SPM system using optical interference patterns*", IEEE J. Sel.Topics Quantum Electron., Mar./Apr. 2007. vol. 13, no. 2, pp. 415–422

[9] Y.Zhang and J. Zhang, "*A fuzzy neural network approach for quantitative evaluation of mura in TFT LCD*", inProc. Int. Conf. Neural Netw. Brain, 2005, pp. 424–427.

[10] L.F.Chen and M. H. Chen. "*A neural-network approach for defect recognition in TFT-LCD photolithography process*", IEEE Trans.Electron. Packag. Manuf., 1–8, Jan. 2009. vol. 32, no. 1.



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