AI Inspection: Computer Vision For Visual Inspection

Amruta Mohite[1], Atharva Kulkarni[2], Rutwik Chitnis[3], Swapnil Mane[4], Shubham Asabe[5]
[1, 2, 3, 4] Dept of Mechanical Engineering
[5]Dept of Computer Engineering
[1, 2, 3, 4] Pimpri Chinchwad College of Engineering and Research, Ravet
[5]Indira college of engineering and management

Abstract- *This review paper explains about computer based visual inspection, comparison between human and computer vision system, its development , improvements and applications.*

I. INTRODUCTION

Artificial Intelligence is a branch of computer science which deals with machine's capability to perform human like tasks. This has numerous trending applications; it is ruling in almost every domain: Engineering, science, education, medicine, business, accounting, finance, marketing, economics, stock market, and law. The intelligence of machines with machine learning capabilities has created their profound impact in these fields. In the field of engineering digital manufacturing and production are providing automation that is faster, cheaper and more superior.

A typical automotive industry consists of body shop, paint shop, chassis line and a final assembly line. In the body shop with the sheet metals the outer structure of the vehicle is formed, by the help of robots for spot welding, and material handling, and in addition the robots are also used to apply adhesives and sealer during the assembly. However, after each and every steps quality check is must; with the help of Artificial Intelligence an efficient, accurate and quick fault detection is possible. Quality control strategies are classified as destructive and non-destructive testing.

Destructive testing is done by forcing the material to fail under various conditions while, non-destructive testing examines the component without damaging it.

Non-Destructive Testing types
Visual-based approaches
Dye penetrant inspection
Radiography
Eddy current approach
Ultrasonic testing
Thermography
...

Non-destructive testing is mostly used in the industry, among them the visual-based approach for fault detection is one of the most common procedures.

II. DEEP LEARNING

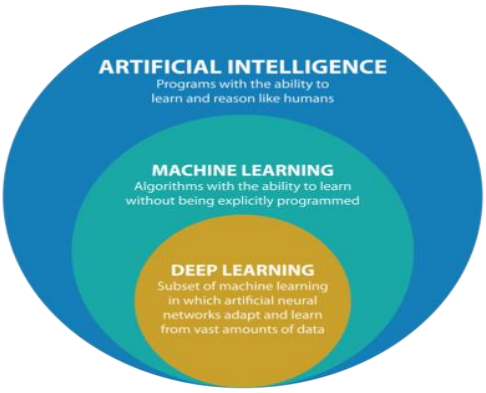

Fig.1. Deep learning

Deep learning is part of machine learning methods which is based on artificial neural networks with representation learning. Deep learning can be supervised, semi-supervised or unsupervised. This branch is developing and will be very valuable for future developments.

III. CONCEPT OF VISUAL INSPECTION

Visual quality inspection is used for the defect and mismatch assessment. It can be applied in industries like manufacturing, airport baggage screening, food factories, medicine, etc.

About its working,

Recent advancement in technology has made it possible to use advanced deep learning concept for visual inspection in computer vision.

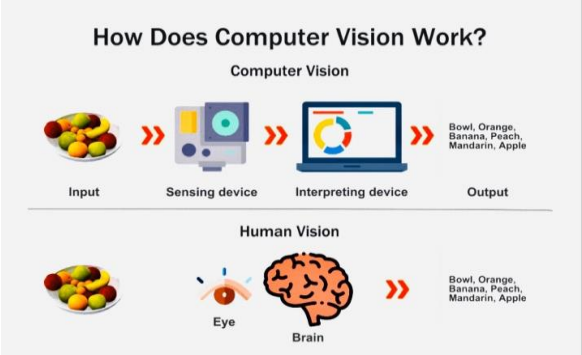

Fig.2.Computer VS Human vision

Images captured by the camera or processed by a neural network, which is trained to detect and localise the defect. Once the visual inspection system is confident about type of problem and its location, it follows the pre-set instructions like sending a notification or executing other operations.

Further to illustrate the process; while producing juice bottles even during production bottles can get damaged which can lead to additional cost, problems while transportation which ultimately causes trouble for the company. Visual inspection system based on the computer vision model detects this mismatch and notifies us in real time so that the defective piece can be excluded before they reach the final packaging stage.

Fig.3. Bottle Inspection

Another illustration: This system is very helpful when it comes to safety of factory worker, it can be used to detect whether the person is wearing its safety measures like gloves, helmet, goggles, shoes. The neural network system is able to analyse this by monitoring cameras and then they notify about the violation.

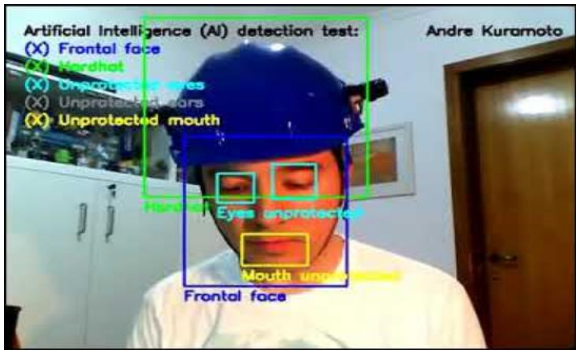

Fig.4. Worker defect detection

IV. TRAINING OF NEURAL NETWORK

A correctly trained neural network provides high inspection accuracy. The network can be trained with many images of different objects. The network of neural system depends on the task image specification object detection or semantic segmentation pending on how precisely we would like to detect defect. Define the task and train the network soas todetect any deviations from the standard appearance.

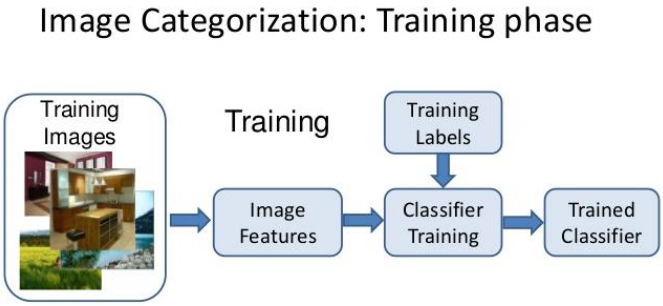

Fig.5.Image Categorization

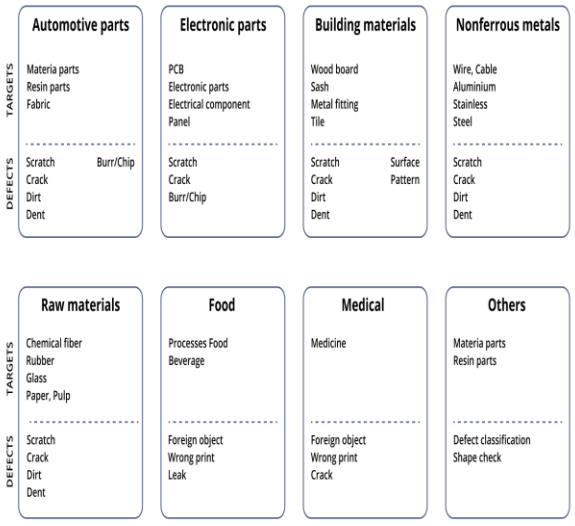

Fig.6.Target and defect categories for visual inspection.

V. IMPROVEMENTS

After deployment, deep learning model becomes more smarter through data accumulation.

VI. APPLICATIONS

- HEALTHCARE: Example; in Qinghai Railway Station in china has a system which can detect temperature of up to 200 persons per minute. And if this temperature is above 37.3 degrees, alert signal is passed.
- AIRLINE: A drone-based aircraft visual inspection system which enable faster quality inspection; hence the production time is also reduced.
- COMPUTER VISION FOR INTRUDER DETECTION: Through hyperspectral cameras it is possible to differentiate different type of materials, as every material makes different wavelength so the system measures these wavelengths to distinguish the materials. Like, these cameras as able to distinguish between a stone and fruit, a plastic and a metal, etc.
- COMPUTER VISION FOR METROLOGY: Assessment of geometric parts can be more quickly and precisely without any other instrument. Accuracy of dimensions can be tested that can affect reliability and functionality of any product.

VII. ADVANTAGES

- Consistent, accurate inspection, in contrast with human inspectors
- Faster inspection of mismatch with accurate location
- Time saving
- Reliable; The system is unbiased and programmable as required
- Machine Vision has a very high optical resolution
- No human intervention is required.
- Reduced number of defective pieces will lead to improvement in quality and customer experience.

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