

CASE STUDY

AUTOMATED SURFACE INSPECTION OF LPG CYLINDERS TO IDENTIFY DENTS USING 2D CAMERA AND LASER GRIDS (AI VISION SYSTEM)



CLIENT/INDUSTRY BACKGROUND

Our client is a Fortune 500 Company and is a major player in the Refining and Marketing of petroleum products in India. The Company today is a fully integrated entity after the incorporation of upstream subsidiary

Bharat Petro Resources Limited. The Company today offers fully integrated operations with the incorporation of upstream subsidiary Bharat Petro Resources Ltd. in 2005.

CLIENT'S PROBLEMS

- Defects like dents bend, cuts, dig, etc were not being identified during the inspection process due to the limited visibility i.e. only one side of the cylinder could be seen by operators
- False acceptance and false rejection cause the prolong in production time and hence TTM (To the Market) time
- Operators manually take cylinders off the conveyor as soon as they see a defect as there is no automated rejection mechanism

PROBLEM IMPLICATIONS

- Preventing defective cylinders from reaching the customer is the client's major concern. Improper inspection may result in sending defective cylinders to the customers
- Improper inspection may result in sending defective cylinders to gas filling stations as they may store less amount of gas or no gas at all because of the defects
- Supplying defective cylinders in the market would hamper the image and profitability


CLIENT REQUIREMENTS

- To automate the 360-degree surface inspection of the cylinders with high accuracy and precision with the help of a vision system
- Deploy an automated rejection mechanism in the same line to reject and collect all the defective cylinders in one place
- To reduce the current inspection cycle time 10 seconds to 1.5 seconds in order to increase production volume
- Two different variants need to be inspected i.e. domestic and commercial cylinders

CURRENT PROCESS

- The inspection process was being carried out manually. The operator standing at one side of the conveyor was able to see only one side of the cylinder and missed out on the other side causing defective cylinders to pass.
- They are manually picking and placing the defective cylinder from the conveyor to the rejection area.

BUSINESS IMPACT

- High investments in deploying operators just to trigger rejection mechanism
 - High Material handling cost
 - Decrease in profitability due to prolonged TTM (Time To Market)
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SOLUTION USING MACHINE VISION AND AI

AI and machine vision-based technologies will be used to automate the inspection process. With the help of 4I methodology which is Install, Instruct, Inspect and Improve the desired outputs were achieved -

Install:

A setup of 6 cameras (to capture 360 degrees) and appropriate lighting were set up to best capture the surface defects of the cylinders.



Instruct:

A solution is developed using the acquired images of all types of defects. Each type of defect is trained, with the help of a different set of images.





IMAGE ACQUISITION OF DENTED CYLINDERS

Inspect:

An **AI-based Anomaly Detection Module** will be used to correctly identify the defects on the cylinder's body.

Improve:

Deep Learning (DL) programs are created to train the machine vision system to understand the various defects. The results will be reflected on the UI in real-time.

CHALLENGES FACED DURING SOLUTION DEVELOPMENT

The distance between the camera and computing device was longer than 600 meters. This caused latency in image acquisition. Because of the long GigE cable, data transfer took a delay of 1-2 seconds.

HOW THE ABOVE CHALLENGE WAS DEALT WITH

Six 'Media Converters' were used to increase the speed of data transfer of all 6 cameras through the GigE interface. The latency was reduced and image acquisition with image transfer took place in real-time.



CONCLUSION

With the deployed machine vision solution, the following were observed -

1. The accuracy of defect identification is 100% and therefore false acceptance is completely reduced.
2. The average inspection time is reduced from 10 seconds to 1.5 seconds increasing the profitability too
3. Human intervention is completely removed and hence saved the labor costs



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Qualitas Technologies Pvt Ltd
53 Kempegowda Double Road,
BEML Layout 5th Stage, Raja
Rajeshwari Nagar Bangalore
560098, INDIA
Email: info@qualitastech.com