IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.301
Volume 3, Issue 2, June 2023

Quality Control and Inspection of Antigen Testkit using Machine Learning

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Abstract: *The pandemic has led to major losses in industries due to limited manual labored various restrictions. Introducing machine learning can be proved to be very helpful to increase efficiency and reduce errors and control the quality of products being manufactured. Production lines have installed cameras that scan these products being manufactured and they are compared to the dataset. scanning products every second turns helpful for quality control. Algorithm and Artificial Intelligence Based production and quality control can also have future scopes in other industries as well.*

Keywords: Machine Learning- Quality Control- Image Scanning- Data Comparing- Future scope.

I. INTRODUCTION

One important factor to get grips with the spread of COVID-19 across the globe is testing. From wearing masks, maintaining social distancing, practicing hygiene, and avoiding large indoor gatherings. Self-tests/ Home test kits are sold over the counter (OTC) and allows users to test self- collected samples and interpret results. However, these home testing kits are manufactured manually every hour. Hence, using manual labor and checking for quality and errors in these kits is difficult especially in covid due to restrictions. Introducing, machine Learning and algorithm-based production can tackle the problems that arise due to manual labor and will be helpful to increase efficiency. The supply of high-quality defect-free products is an important success factor for the long-term competitiveness of manufacturing companies. Artificial Intelligence and Machine Learning are changing the technologies we use to run manufacturing and processing facilities in subtle and not so subtle ways.

With problems arising everyday in testing such as misinterpreted results, long working hours has become tiring for health care experts and professionals. The evolution from lab testing to home testing has certainly helped overcome all these problems. Home testing kits are a type of rapid antigen testing kits that are quick to manufacture and easy to use.

However, production of these kits by using manual labour leads to problems in production.

By incorporating machine learning, manufacturing companies will be able to leverage these developments to improve productivity, efficiency and revenue.

II. PROPOSED ALGORITHMS

A. YOLO

YOLO(You Only Look Once) is a method / way to do object detection. It is the algorithm behind how the code is going to detect objects in the image. It looks at the entire image only once and goes through the network once and detects objects. It is very fast. That's the reason it has got so popular.

B. HAAR-CASCADE

Haar Cascade classifiers are an effective way for object detection. Haar Cascade is a machine learning-based approach where a lot of positive and negative images are used to train the classifier.

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C. DECTRON

is a high-performance codebase for object detection, covering bounding box and object instance segmentation outputs. Detectron was built by Facebook AI Research (FAIR) to support rapid implementation and evaluation of novel computer vision research. It includes implementations for the following object detection algorithms: Mask R-CNN, Faster R- CNN,Fast R-CNN

III. SOFTWARE DEVLOPMENT

To develope a software for a project in a structured approach, the Software Development Process plays an important role. It is also refered as Software Development Life Cycle (SDLC). Typically, the Software development lifecycle covers the following stages

- Requirement analysis
- Planning
- Software design
- Software development
- Testing
- Deployment.

The below diagram will show the flow of implementation process.

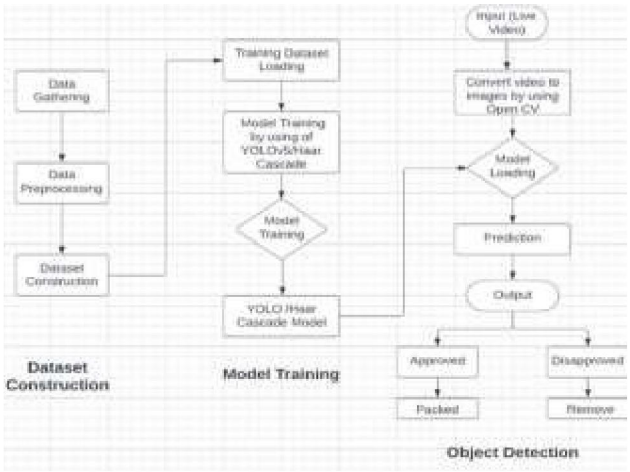

Fig. Implementation Module

Actual Results of implementation

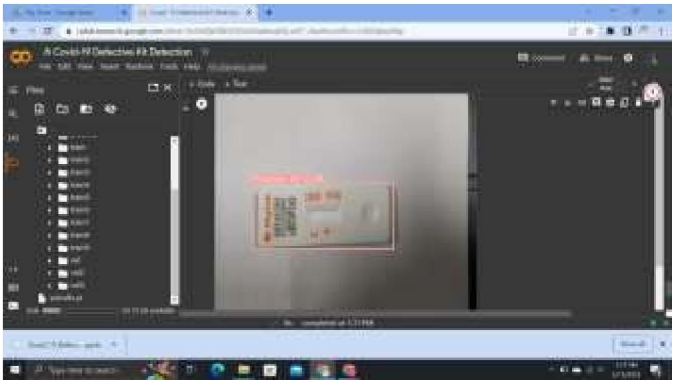

Fig. Positive Detected

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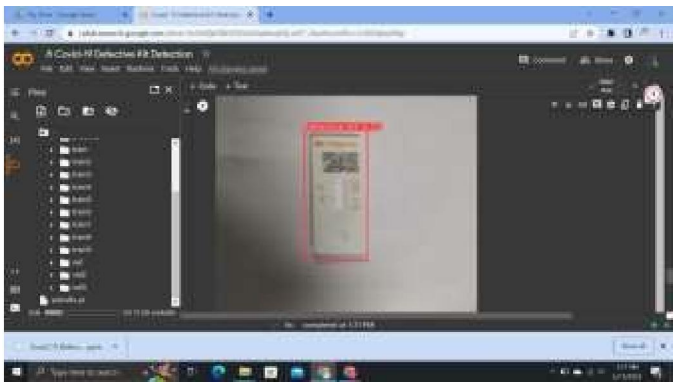

Fig. Defective Detected

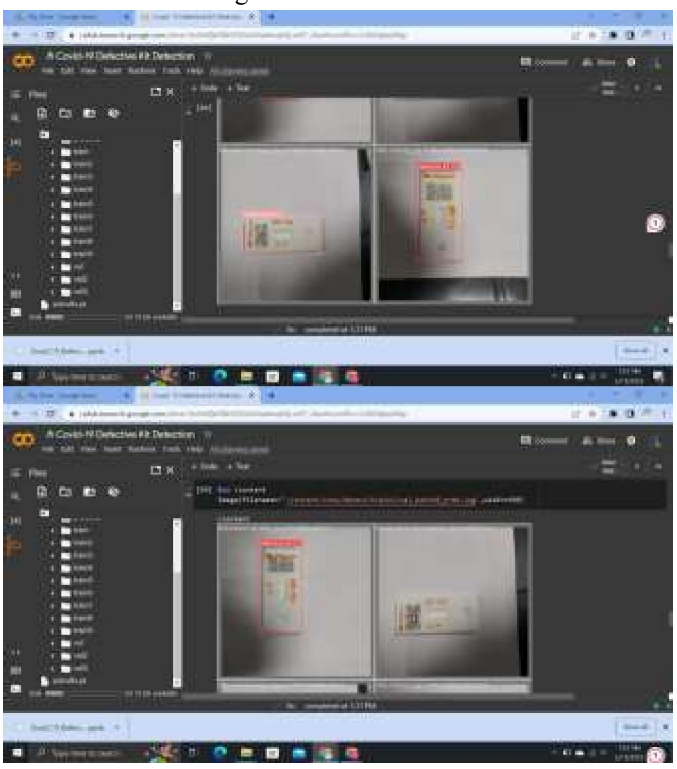

Fig. Detection in Colab

Above are the results generated using the Yolo v8 algorithm. For this, we have collected the different types of images having errors. Then using that image we created the dataset, after creating we trained the model and tested whether it is detecting the image or not. And we get the above results successfully.

Fig. Landing Page(User Interface)

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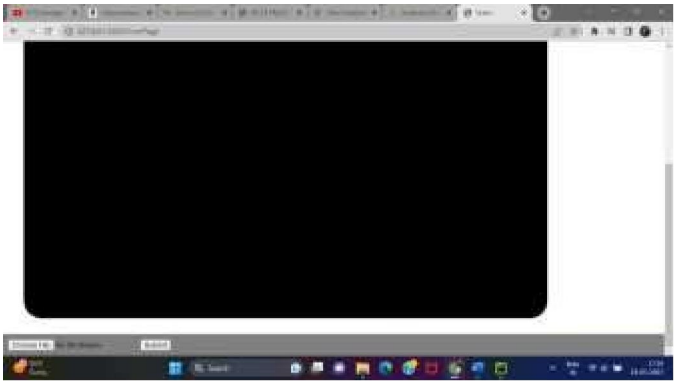

Fig. Video Upload Page

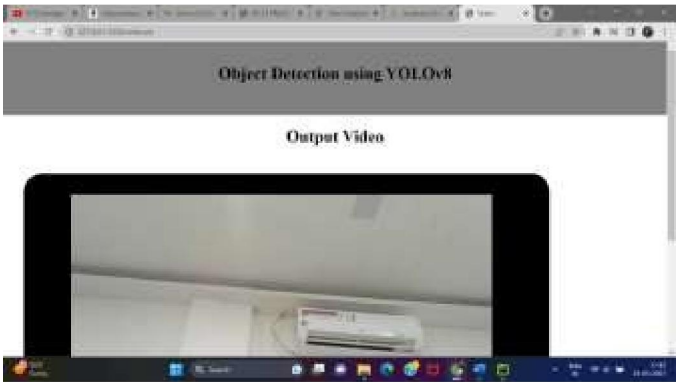

Fig. Web Cam Page

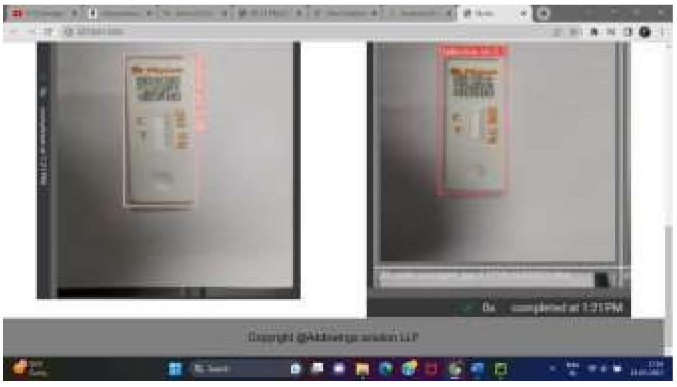

Fig. Sample Results

Above are the results of the application created in HTML, CSS, and Flask. The UI is created with the help of HTML, CSS. And for the backend part, we have used the flask. In the UI part, we have added two navigation menus one for the video and the other for the webcam, in a video you can upload the video which you want to detect, and in the webcam, your webcam will get start and you can detect the errors using the webcam. On the home page, we have simply added the images of the output so that you can get a clear idea about how the output should look like

Test Cases

TC ID	Description	Expected Output	Actual O/P
1	Upload the video	Video upload should upload successfully.	Kit detected successfully
2	Webcam working	Should detect the errors using a live webcam	Detecting errors successfully
3	Upload the image	An image should not be supported	Image not detecting

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IV. CONCLUSION

various algorithms were experimented to implement Computer Vision based quality control. The Aim of this work is to focus on scanning maximum number of testing kits produced every hour and matching it with dataset to find out what type of error has been frequently observed. The purpose behind switching to computer based quality is to reduce the problems that arise due to manual quality control and thus, also increasing efficiency of the production industry. Overall, computer vision based quality control has been successfully implemented using reliable methods.

V. FUTURE SCOPE

- The emerging technologies that characterize Industry 4.0 from connectivity to advanced analytics, robotics and automation has the potential to revolutionize every element of manufacturing labs within next 5 to 10 years.
- Digitalization and Automation will ensure better quality and compliance by reducing manual errors and variability, as well as allowing faster and effective solution to problems.
- Prevention of major compliance issues can itself be worth millions in cost saving.

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