ISSN No:-2456-2165

Survey Paper on the Quality Control and Inspection of Antigen Test Kit

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Abstract:- The world has seen the spread of COVID-19 and its rapid increase in cases, which has led to major lifestyle and working changes. The pandemic has led to major losses in industries due to limited manual labour and 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. If the live images of products the are same after them comparing to the dataset, then they can be further packed for shipping or discarded. Compiling a code to run the production lines and scanning products every second turns helpful for quality control compared to manual as it is comparatively faster. 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 scopes.*

I. INTRODUCTION

One important factor to get grips with the spread of COVID-19 across the globe is testing. Fromwearing masks, maintaining social distancing, practicing hygiene, and avoiding large indoor gatherings. Self-tests/ Home test kits are sold overthe 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 labour 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 labour 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.

II. METHODOLOGY ADOPTED

The main modules of the system comprise of

Fig.1: Block Diagram of Methodology Adopted

A. Recognizing the Problem:

The problems refers to manual based quality control. After coming in contact with Mr. Prathmesh Ponkshe who is the head of Plant of that produces these covishelf testing kits explained us the different errorsthat occurred on these testing kits. These self test kits are produced in a lot, regularly inspecting these kits continuously could be difficult for workers. The solutions explained above proposed by different companies were either very expensive or had their own pros or cons. Development of a new affordable quality control solution based on computer vision wassalient.

B. Development:

- *Data Evolution*

The predominant step for computervision based quality control is to compile a code thatcan successfully scan these testing kits for errors in them. Using equipment's such as Raspberry Pi 4 and Open MV h7 camera for efficiently developing a code Python Open CV library and scanning testing kits for errors in them. Different experimentations based on different methods were tried and tested to examine these self testing kits.

- *Raspberry pi 4*

Raspberry pi 4 is the quick and easy way to install Raspberry Pi OS and other operating systems to a microSD card, ready to use with your Raspberry Pi.

Fig. 2: Raspberry pi 4

- *OpenMV h7*

The OpenMV Cam is a small, low power, microcontroller board which allows you to easilyimplement applications using machine vision in the real-world. You program the OpenMV Cam in high level Python scripts.

Fig. 3: OpenMV h7

The first method tried was the

- *Haar Cascade method:*

Beginning inspection with haar cascade method was important part of computer vision and image processing literature. Object detection is a computer technology related to computer image processing and deep learning. The issue that was found out after experimenting with this method was as these kits are produced in lots they have certain printing errors where the logo of the company could be misplaced/misspelled/missed. These kits are considered as negative i.e disapproved kits as they don't qualify after comparing with the dataset. Also these kits have certain problems like broken strips, cracks in kits etc. But the haar cascade classifier could not successfully detect these errors. It could compare the product live images with data set and pass on the positive one's correctly but also the negative one's as positive and hence, could give us an efficiency of 70% only. It was necessary to find out another method for proper detection.

The subsequent method for experimentation was

- YOLO V3 algorithm:

You Only Look Once is one fast real time object detection algorithm. Compiling a code for image scanning and matching using YOLO V3 did not work up to the mark as it was expected. The problem noticed on using YOLOV3 was that it could not scan these kits properly and efficiently. For instance, when 5 kits were inspected one behind each other, V3 inspected all these kits as one live image and compared that one live image to the dataset. It gave false results giving neither higher efficiency or effective detection.

III. LITERATURE REVIEW

- **Simon Fahle:** Artificial Intelligence and machine learning became increasingly more frequently applicable in factory operations. This paper represents a systematic review of today'sapplications of machine learning methods in factory environment. The utilisation of machine learning methods related to manufacturing processes, planning and control, predictive maintenance, quality control processes, control optimization, logistics, robotics and learning systems for shop floor employees are being analysed. Furthermore, these concepts will be analysed regarding the implemented machine learning for research gaps are identified.
- **Artificial intelligence and Machine learning applications in smart productions by Giuseppina pistecelli:** This paper explains that adaptation and innovation are extremely important in manufacturing industry. The development should lead to sustainable manufacturing using new technologies. The aim of present research was to analyse systematically the scientific literature relating to applications of artificial intelligence and machine learning are considered to be drivingforce of smart factory revolution.
- **Programming computer vision with Python by Jan Erik solem:** This book explains computer vision in brand terms on learning techniques used in robot navigation, medical image analysis and other computer vision applications. Work with image mappings and transforming. Organize images based on similarity of course and content access to popular open CV library through Python interface.
- **Hands on algorithm:** For computer covers grips with machine learning and artificial intelligence, algorithm and process images and videos. Perform mathematical, matrix and other type of image data operations, detect motion, extract foregrounds and track objects. Extract key points with a collection of feature defector algorithms. Develop cascade classifiers and use them and train and test classifiers employ tensor flow object detection to detect multiple objects.
- **Machine Learning applications in production lines by A. Ziquile Kang:** explains that a production line is a set of sequential operations established in a factory where materials are put through a refining process to produce an end product that is suitable for further. Monitoring production lines is essential to ensure that the targeted quality of production processes and products are achieved. With the increased digitalization, lots of data can now be generated in overall production process. Generated data setsare used by machine Learning techniques for analytics of production line to improve quality, evaluate risks and save cost.

IV. STEP TOWARDS MACHINE LEARNING

The COVID-19 pandemic has pushed us five years ahead at least in rise of technology, science. The pandemic created stressful conditions for manufacturers causing losses in production systems. As a result manufacturing companies arelooking for smarter ways to visually inspect the products also following the mandatory restrictions. Artificial intelligence and Machine learning are able to do high visual inspections forevaluating entire enterprises. Advancement in artificial intelligence helps providing framework for innovation and enhancements. This innovation removes complexity inherent in earlier generations of machine vision and ultimately lowers cost making it easier for companies to adopt. Testing and inspection in various stages of manufacturing are increasing frequently. Quality focused inspection offer manufacturers quality data collection solutions. Good accurate inspectiondata at multiple points in manufacturing enables operators and engineers to make further strategies. Increasing changes in technologies and manufacturing systems will further continue accelerating.

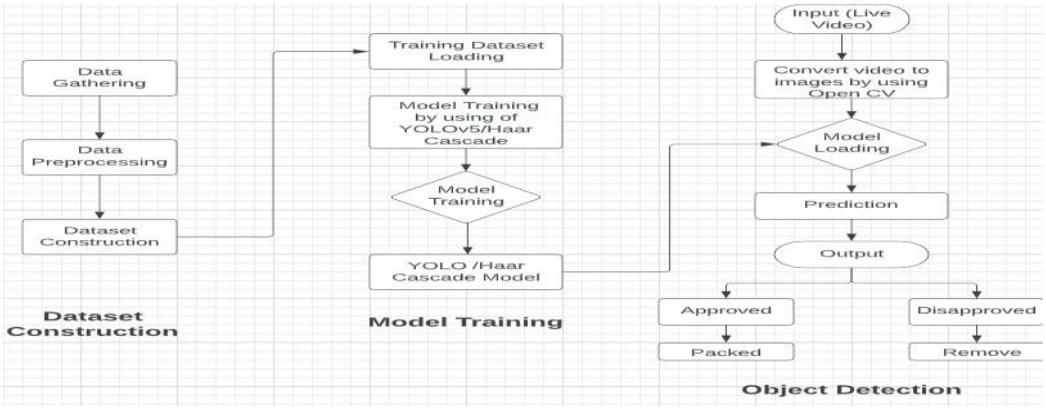


Fig. 4: System Architecture

A. INSIGHT

➢ *Device Assembly*

- These self testing kits are manufactured manually.
- The manual assembly lines consist of 20 workers per assembly line.
- First 6 workers take the lower part of the kits being produced and pass it on further.
- The next 6 workers put a paper strip on thetop of lower part and pass it to another 6 workers that put up the upper part of the kit.
- These kits are passed through rollers wherethey are being pressed and remaining 2 workers check the kit for errors and collectin the baskets.

➢ *Production of Home Testing Kits*

- Every hour about 5000 kits are manufactured I.e. 83 kits are manufacturedper minute.
- 26 lakh kits are manufactured on daily basis.
- There are total 70 Assembly lines running and 6500 working people (2 shifts per day).
- Every individual inspects 5 kits per second for quality control.

➢ *Problems arising due to manual qualitycontrol*

- Manpower is the total supply of workers available for production of kits.
- Plenty of kits are manufactured every hour hence, workers can be extremely physically and mentally due to longer working hours.
- If workers are not skilled or properly trained they might not properly inspect these kits for defects in them.
- Testing these workers can also be long for Covid-19.

B. Error

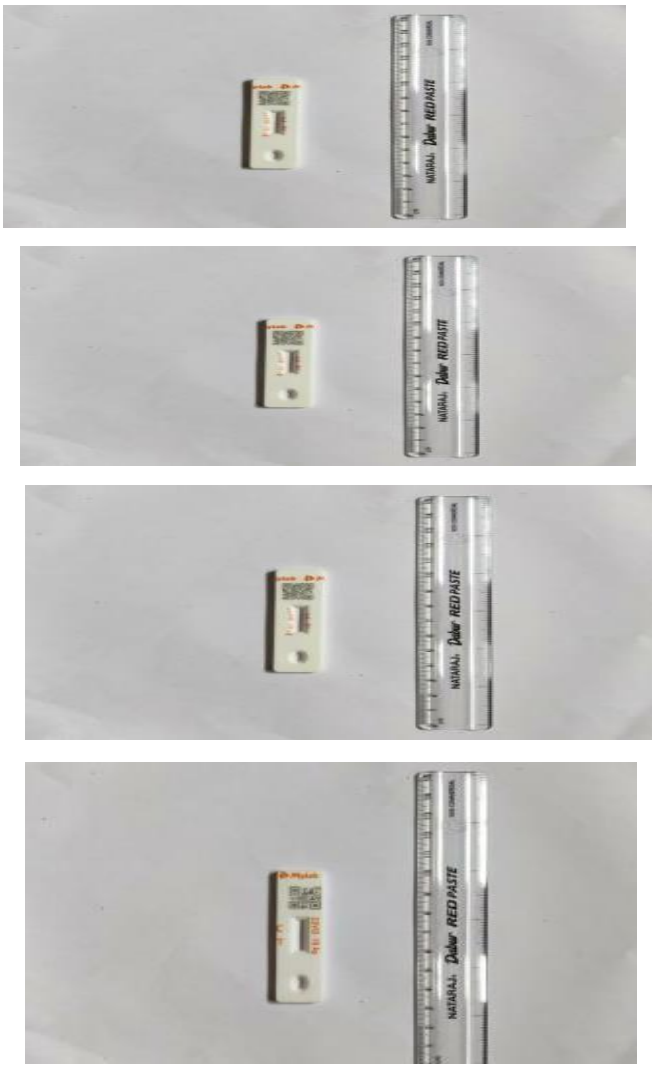
There are different types of errors in production in home testing kits that need to inspected properly.

V. TYPES OF ERRORS

A. QR CODE IS NOT PRINTED PROPERLY

ISSN No:-2456-2165

B. PRINTING MISTAKES



VI. OBJECTIVES

- The most important objective for adopting computer based quality control is to reduceerrors in production.
- The subsequent objective of this work is tolessen the cost of production.
- It should also be highly efficient and help increasing the rate of production.
- Introducing Python, Machine learning and artificial intelligence to manufacturing systems for quality control and also operating quality management process and key quality management activities.
- Quality and productivity of the testing kits can be influenced by appending programming processes. Hence, explaining how these processing factors influence production.

VII. CONCLUSION

In this Project, various algorithms were experimented to implement Computer Vision based quality control. The Aim of this work is to focus onscanning 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.

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