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Computer Vision based Object Detection System for Statistical Process Control

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Abstract: In large scale manufacturing industries goods are produced through assembly line processing on which number of variety of processes are performed on the goods.

If any particular processes result in a poor-quality output the final product is affected even though other processes may have proper quality output.

The technique called Statistical Process Control (SPC) is employed where samples of process outputs at each stage is measured and sent to central controller which monitors all the processes. For implementing this process in real time computerized techniques based on computer vision and machine learning are used.

In proposed project a manufacturing industry provides about one meter of rubber sheet which is cut into parallelogram shape continuously. Hence manual measurement of size and shape becomes difficult. The proposed solution consists of cameras for capturing the video on assembly line where every process takes place and implementing machine learning and computer vision algorithms for real time measurement of size and size.

Keywords: Statistical Process Control, Computer Vision, Image Processing, Raspberry-Pi, Machine Learning, Open CV, Python, WAMP Server, conveyor belt

I. INTRODUCTION

In large manufacturing industries, large number of products are manufactured everyday. One of the important process in industries is sheet cutting. Sheet cutting is done using machinery but due to any sudden displacement or misalignment error is observed in dimensions of sheet. This error is not detected immediately as detection of error is not real-time. So, motivation behind this proposed project is to develop real-time and automated process to detect error in sheet cutting.

II. EXISTING SYSTEM

In the industries, in the existing system, for the sheet cutting process, the dimensions and size of the sheets are manually measured. The workers in the industry randomly pick up the sheets from the batch of sheets cut by the bias cutter. Based on these measured dimensions, at the end the report is generated for every batch of the sheets. Most of the times, the dimensions measured are not accurate as they are manually measured. This affects the overall products developed in the industry. Also, the manual calculation requires lot of time and energy and is not possible in real time.

III. PROPOSED SYSTEM

To avoid the drawbacks in the existing system, we have proposed a computer vision-based system which will help in the real time detection of the object, shape, size and dimensions of the sheets cut.

A. Methodology

In this proposed system, input to the system will be sheet cut on conveyor belt on assembly line. Then video is captured through camera, which will be fitted above assembly line.

After video is captured, frames will be separated. These frames will then be filtered. Then we will use algorithms to detect object. In proposed project, three algorithms will be used for detecting object shape, object size and object colour using computer vision and image processing algorithms. All this processed information is sent to server. At server, Statistical process control is used. A report is generated as output.

The report will have object Id and information related to whether that object is cut within predefined threshold values or not. This report is sent to supervisor or higher authorities and if a particular object is not in threshold value then it can be rejected by higher authorities.

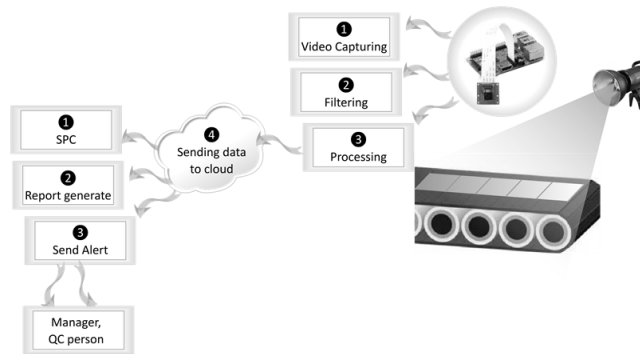


Fig. 1 Block diagram of the project

B. Image Processing

Computer vision is a technology that enables the computer to identify different objects in the environment. Its capability is to seek images as like human vision. Image processing is a method by which we can extract information from images by using different algorithms. There are many researchers who have worked on computer vision and image processing for detection of object's shape and size. System will be implemented using Open CV for doing all image processing, filtering, detection of shape, size and colour detection. Also, with Open CV will be able to use computer vision algorithms. Open CV is also used for mathematical calculation if needed.

- 1) *Detection of Object:* In proposed system will use image processing algorithms to detect object on assembly line.
- 2) *Detection of Shape:* In this system, after detecting the object, the system will detect shape of object
- 3) *Detection of Size:* The system will also detect the size of object. Its dimensions will be calculated.

C. Statistical Process Control

- 1) *Report Generation:* After processing the image, system will send this data to server, then use statistical process control and check each object are within predefined threshold values or not. Then report is generated and sent to higher authorities like supervisor.
- 2) *Alert Generation:* After generating report, if in a batch of objects there are more number of detected objects then the system will send alerts to supervisor of industry.

IV. WORKFLOW

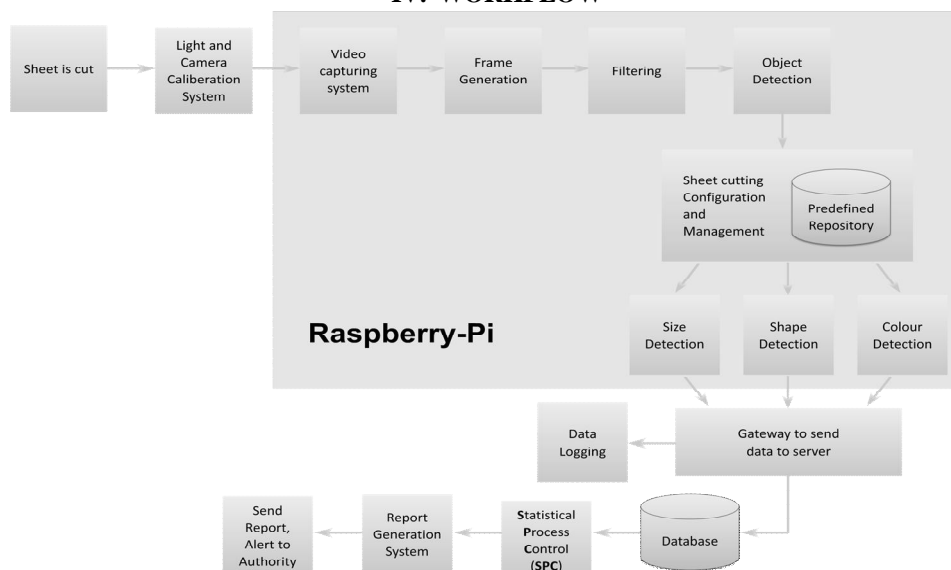


Fig. 2 Working of the project

In sheet cutting process, the sheet is passed on the conveyer belt. A biased cutter is fitted at the starting of the conveyer. After the sheet is cut by the biased cutter, it passes forward on the conveyer belt. A Camera calibration system is mounted above the conveyer belt having proper arrangement of the light so as to capture the proper video of the cut sheet. In the Camera calibration system, the camera is attached to Raspberry-Pi. When the sheet passes from under the camera system, the dimensions, size and shape of the sheet are recorded through the real time video recording. This video is processed in real time, in the Raspberry-pi only to separate the frames of the video. Then, these individual frames are filtered and processed for the noise removal and filtering. Then in the individual frame, the object is detected i.e. the sheet is distinguished from the background. After the object is detected, its dimensions are calculated. Also, its shape is also determined. All these values of shape and dimensions of the sheet are sent to the server. At the server, these values are compared with the already decided threshold values. If the dimensions are out of the tolerance values, then the notifications are sent to the higher authorities. Also, at the server, the statistical process control takes place where the chart is plot and report is generated for the various batches of the sheets. This report is sent to the supervisor and manager.

V. APPLICATIONS

- A. *In sheet cutting industries*
- B. *For rubber cutting industries*
- C. *Packing material industries*
- D. *Metal cutting*
- E. *Fabric Industries*
- F. *Paper Industries*

VI. CONCLUSIONS

Thus, this real time, automated system for shape and size detection of object has reduced the human efforts drastically. Since the human intervention is reduced, the errors in measuring the size of the sheet is also reduced. Also, as soon as the error is detected in the shape and size of the sheet, immediately an alert message is sent to the concerned persons. So, they can take the necessary action as early as possible. This has reduced the repetition of error on further sheet and hence reduced the scrap / wastage of the material and increased the profit for the company.

In the future scope, the system would be extended to make it work on Distributed System instead of working on standalone system. Also, a facility can be included in the system to stop the Conveyor belt automatically using Relay, if certain number of errors are detected in the measurement.

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