Optimization for Detecting Pipeline Defects Using Image Processing Techniques

B.Suresh Kumar[1], S.Balakrishnan[2], S.Arun Nehru[3]
[1, 2, 3] Department of Electronics and Communication Engineering
[1, 2, 3] Assistant Professor, The Kavery Engineering College,Mecheri,Tamilnadu, India

Abstract- *Pipelines are the safest and most economical way to transport the gas and condensations over long distances. Classifying the different defects types like hole, crack, welding joints using Image processing and optimization techniques and identifying the welding defects is possible through image segmentation operation one of the methods image segmentation is thresholding. The main feature of the method setting a threshold value, the values higher than the threshold limit are considered as an object and the lower values are considered as another object. The key point in this method is to determine the threshold limit. In the method multilevel threshold limit can also be used which is used for optimized images. In previous method number of defects only identified in the pipelines for that to implement the neural network classification algorithm (MLP) which is used to identifying the accurate defects and seniority level in the pipelines. After identification of accurate defects and seniority level the information will be send to the required users by using GSM module.*

Keywords- Multilayer perceptron Neural network (MLP), Global System for Mobile (GSM).

I. INTRODUCTION

Today, digital image processing is an important solution to detect and reconstruct of defects in pipeline application .In the optimization technique for identifying the properties of material without making any damage .In the field of optimization technique the most important stage concerns the detecting defects in pipeline .when dealing with this it could be very hazardous. For, example with gas and oil pipeline etc…,In the image processing technique some of the steps are included that the gray scale conversion, histogram equalization wiener filter ,thresholding and neural network classification .image processing, feature extraction and pattern recognition. Feature extraction is the operation to extract various image features for classification or interpretation of meaningful objects from images and is considered as one of the most important parts. It can be defined as a function of one or more measurements, each of which specify some quantifiable property of an object, and are computed such that it quantifies some significant characteristics of the object.

II. IMAGE PROCESSING

Image processing is a method to convert an image into digital form and perform some operations on it, in order to get an enhanced image or to extract some useful information from it.

Image processing systems are becoming popular due to easy availability of powerful personal computer, large size memory devices, graphics software etc.

Image processing basically includes the following three steps:

- Importing the image with optical scanner or by digital photography.
- Analyzing and manipulating the image which includes data compression and image enhancement and spotting patterns that are not to human eyes like satellite photographs.
- Output is the last stage in which result can be altered image or report that is based on image analysis.

Applications of Image processing

- Remote sensing
- Medical imaging
- Forensic Studies Textiles
- Material science
- Military
- Film industry
- Document Processing

The common steps in image processing are image storing, scanning, enhancing and interpretation. The following Figure 1.1 shows image processing.

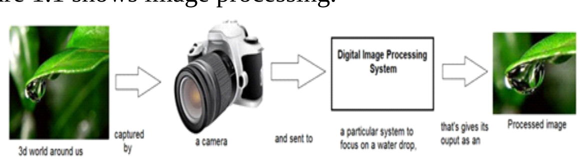


Figure 1.1 Image Processing

In the above Figure, an image has been captured by a camera and has been sent to a digital system to remove all the other details, and just focus on the water drop by zooming it in such a way that the quality of the image remains the same.

Purpose of Image processing:

The purpose of Image processing has 5 types,

- Visualization - Observe the objects that are not visible.
- Image sharpening and restoration - To create a better image.
- Image retrieval - Seek for the image of interest.
- Measurement of pattern – Measures various objects in an image.
- Image Recognition – Distinguish the objects in an image.

III. EXISTING SYSTEM

Radiographicfilmsareusedasatoolforidentifyingwelding defectsofgaspipelines.The studyofwelding in oil and gaspipelineshasalwaysbeenoneofthemostimportantfieldsofND T.Nowadaysinmanycountries,expertinterpretersareemployedto interpretradiographicfilmsoNDT.Theaimofthisstudyistopresent amethodthatcanbe usedtointerprettheradiographicfilmsquicklyandidentifytheweld ingdefectsinthesefilmsusing parallelalgorithms.Identifyingweldingdefectsispossiblethrough image segmentationoperation. One of themethodsofimagesegmentationisregiongrowing.Themainfeat ureofthismethodisitsgoodperformanceonfilmssuch asradiographicimages,whichenjoy lessvariety.

Features Extraction:

In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.When the input data to an algorithm is too large to be processed and it is suspected to be redundant (e.g. the same measurement in both feet and meters, or the repetitiveness of images presented as pixels), then it can be transformed into a reduced set of features (also named a features vector). This process is called feature extraction. The extracted features are expected to contain the relevant information from the input data, so that the desired task can be performed by using this reduced representation instead of the complete initial data. Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over-fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy.

- The best results are achieved when an expert constructs a set of application-dependent features, a process called feature engineering. Nevertheless, if no such expert knowledge is available, general dimensionality reduction techniques may help.

Image segmentation:

In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets ofpixels, also known as superpixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics.

The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as color, intensity, or texture. Adjacent regions are significantly different with respect to the same characteristic(s). When applied to a stack of images, typical in medical imaging, the resulting contours after image segmentation can be used to create 3D reconstructions with the help of interpolation algorithms like Marching cubes.

Thresholding;

The simplest method of image segmentation is called the thresholding method. This method is based on a clip-level (or a threshold value) to turn a gray-scale image into a binary image. There is also a balanced histogram thresholding.

The key of this method is to select the threshold value (or values when multiple-levels are selected). Several popular methods are used in industry including the maximum entropy method, Otsu's method (maximum variance), and k-means clusteringRecently, methods have been developed for thresholding computed tomography (CT) images. The key idea is that, unlike Otsu's method, the thresholds are derived from the radiographs instead of the (reconstructed) image.

New methods suggested the usage of multi-dimensional fuzzy rule-based non-linear thresholds. In these works decision over each pixel's membership to a segment is based on multi-dimensional rules derived from fuzzy logic and evolutionary algorithms based on image lighting environment and application.

Clustering:

Source image:

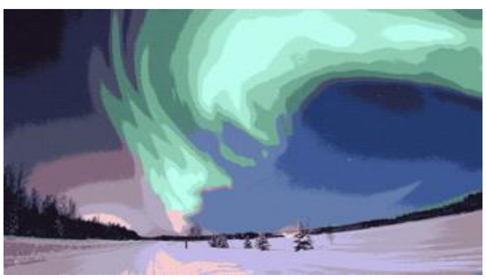


Image after running k-means with k = 16. Note that a common technique to improve performance for large images is to down sample the image, compute the clusters, and then reassign the values to the larger image if necessary.

The K-means algorithm is an iterative technique that is used to partition an image into K clusters. The basic algorithm is

- Pick K cluster centers, either randomly or based on some heuristic
- Assign each pixel in the image to the cluster that minimizes the distance between the pixel and the cluster center
- Re-compute the cluster centers by averaging all of the pixels in the cluster
- Repeat steps 2 and 3 until convergence is attained (i.e. no pixels change clusters)

In this case, distance is the squared or absolute difference between a pixel and a cluster center. The difference is typically based on pixel color, intensity, texture, and location, or a weighted combination of these factors. K can be selected manually, randomly, or by a heuristic. This algorithm is guaranteed to converge, but it may not return the optimal solution. The quality of the solution depends on the initial set of clusters and the value of K.

Histogram based methods:

Histogram-based methods are very efficient compared to other image segmentation methods because they typically require only one pass through the pixels. In this technique, a histogram is computed from all of the pixels in the image, and the peaks and valleys in the histogram are used to locate the clusters in the image.

One disadvantage of the histogram-seeking method is that it may be difficult to identify significant peaks and valleys in the image.

Detection of Welding Flaws with MLP Neural Network This paper has presented the performance of four popular pattern classification methods for welding flaws detection using data that were obtained. These methods including case based reasoning, MLP neural networks, MLP NN based attribute weighting, and combination of multiple classifiers have found successful applications in various problem domains. The results obtained in this study indicate that better performance in terms of higher accuracy rate and lower false positive rate can be achieved than that of the fuzzy clustering methods employed before. Nevertheless, the false negative rate is kind of high for most of the methods tested in this study. Physically, this high false negative rate means many flaws are not detected. In an application where flaws are detrimental or potentially fatal, such high false negative rate could be intolerable and costly.

Optimization algorithms

Each optimization algorithm is an adaptation of models from a variety of fields and they are set apart by their unique cost functions. The common trait of cost functions is to penalize change in pixel value as well as difference in pixel label when compared to labels of neighboring pixels.

IV. PIPELINE DEFECT PREDICTION

Image Acquisition

Image acquisition in image processing can be broadly defined as the action of retrieving an image from some source, usually a hardware-based source, so it can be passed through whatever processes need to occur afterward. Performing image acquisition in image processing is always the first step in the workflow sequence because, without an image, no processing is possible. The image that is acquired is completely unprocessed and is the result of whatever hardware was used to generate it, which can be very important in some fields to have a consistent baseline from which to work. One of the ultimate goals of this process is to have a source of input that operates within such controlled and measured guidelines that the same image can, if necessary, be nearly perfectly reproduced under the same conditions so anomalous factors are easier to locate and eliminate. In this module, we can upload or capture image from web camera about pipeline. Image can be any type and any size.

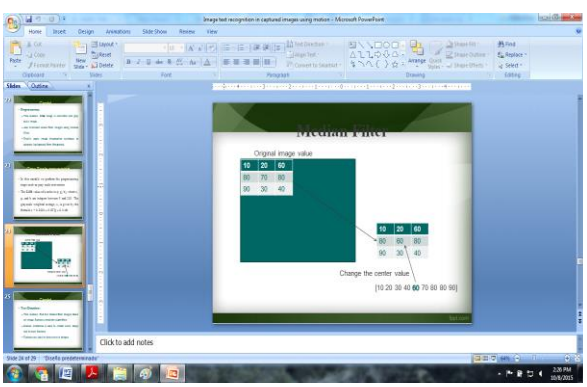
Preprocessing

In this module we convert the RGB image into gray scale images. The colors of leaves are always green shades and the variety of changes in atmosphere cause the color feature having low reliability. Therefore, to recognize various plants using their leaves, the obtained leaf image in RGB format will be converted to gray scale before pre-processing. The formula used for converting the RGB pixel value to its grey scale counterpart is given in Equation.

$$Gray = 0.2989 * R + 0.5870 * G + 0.1140 * B$$

where R, G, B correspond to the color of the pixel, respectively.

Then remove the noises from images by using filter techniques. The goal of the filter is to filter out noise that has corrupted image. It is based on a statistical approach. Typical filters are designed for a desired frequency response. Filtering is a nonlinear operation often used in image processing to reduce "salt and pepper" noise. A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges. And implement image binarization tasks. The median filter process as follows:



Document Image Binarization is performed in the preprocessing stage for document analysis and it aims to segment the foreground text from the document background. A fast and accurate document image binarization technique is important for the ensuing document image processing tasks.

Histogram Equalization

This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values.

Segmentation

Image segmentation is the process of dividing an image into multiple parts. This is typically used to identify objects or other relevant information in digital images. In this module, we can implement intermediate filter to filter the image values and show binary image for segmented pipeline.

Defect Prediction

In this module, we can predict the defects using neural network approach. It is a nondeterministic artificial intelligence model is proposed with the aim to increase the accuracy of prediction of occurrence of defection rate. This model is based on neural network technique. This kind of models outperforms deterministic models when it is high severity.

V. CONCLUSION

Defects are the main cause of deterioration of pipelines. Therefore, prediction of internal corrosion along the pipeline profile is a critical issue for the Oil&Gas sector, particularly for new frontiers of ultra-deep waters, where remote treatment is performed on floating processing units: in this case, also flowlines and risers are subjected to corrosion. A correct corrosion assessment impacts metallurgy (for instance, the choice between carbon steel, stainless steel or alloys) and therefore pipeline costs. A reliable prediction of pipeline sections more exposed to corrosion risk would help also the pipeline integrity management, reducing the economic impact. Furthermore, given the worldwide increasing number of old pipelines, this issue is particularly relevant also to avoid pipeline failures and to reduce environmental impact. In this paper, the prediction of internal corrosion along the pipeline profile is performed by a data-driven model, given the available measurements derived from two internal line inspections.

REFERENCES

[1] Ali Ebrahimi, Ali MohamadLatif and Kamal Mirzael (2015). Parallel techniques for detecting defects in Radiographic Evaluation of oil and gas pipelines using image processing. Indian Journal of Fundamental and Applied Life Science ISSN: 2231-6345.

[2] Basturk A and Gunay E (2009). Efficient edge detection in digital images using a cellular network optimized by differential evaluation algorithm. Expert systems with applications 36(2) 2645-2650.

[3] Batenburg KJ and Sijbers J (2009). Optimal threshold selection for tomogram segmentation by projection distance minimization. IEEE Transactions on Medical Imaging 28(5) 676-686.

[4] Billingsley FC (1970). Applications of digital image processing. Applied Optics 9(2) 289-299.

[5] Carraso M and Merry D (2011). Automatic multiple view inspection using geometrical tracking and feature analysis in aluminium wheels. Machine Vision and Applications 22 157-170.

[6] Dighe S (2012). Preprocessing, segmentation and matching of Dental Radiographs used in Dental Biometrics. International Journal of Science and Applied Information Technology 1(2) 52-56.

[7] Elizebeth B (2012). Semiautomatic Dental Recognition Using a Graph-Based segmentation Algorithm and Teeth Shapes Features. IEEE International Conference 348-353.

[8] Fan J, Yau DK, Elmagarmid AK and Aref WG (2001). Automatic image segmentation by integrating color-edge extraction and seeded region growing. IEEE Transactions on Image Processing 10 (10) 1454-1466

[9] Jagannathan S (1997). Automatic inspection of wave soldered ionts using neural networks. Journal of Manufacturing System 16(6) 389-398.

[10] Kim TH, Cho TH, Moon YS and Park SH (1999). Visual inspection system for the classification of solder joints. Pattern Recognition 32 565-575.