AUTOMATIC FABRIC INSPECTION USING DIGITAL IMAGE PROCESSING AND NEURALNETWORK

by
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- Textile testing -
Digital image processing

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CERTIFICATE

This is to certify that the thesis entitled **"AUTOMATIC FABRIC INSPECTION USING DIGITAL IMAGE PROCESSING AND NEURALNETWORK"** being submitted by **Mr. M.P.Mani** to the **Department of Textile Technology, Indian Institute of Technology, Delhi** for the award of the **Doctor of Philosophy** is a record of the bonafide research work carried out by him. He has worked under my guidance and supervison, and has fulfilled the requirements for the submission of this thesis, which to our knowledge has reached the requisite standard.

The results contained herein have not been submitted in part or full to any other university or institution for award of any degree or diploma.

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(M.P.Mani)

ABSTRACT

Conventional method of fabric inspection by visual examination has failed to produce completely flawless fabrics. This Research work proposes economic way of design and development of a system for automatic inspection of fabric defects by using digital image processing techniques along with development of an expert system embedded with artificial neural network for process control in weaving mills. The work comprises fabrication of an inspection machine equipped with all accessories such as scientific illumination system, robotic marking system and specialized image acquisition system.

Fabrication of the system involves modern industrial cameras (Dalsa CCD Camera Line Scan model CL-C3 with 2048 Horizontal resolution and 1 Vertical resolution having sensors of 14 x 14 μ pitch size) to sense the flaws of fabric to an extent of 300μ with suitable set of specially made rollers to pass the wrinkle free fabric in the midst of lighting using speed adjustable DC motor. Though the machine run speed set at 70 metres / min, speed can be varied from very low upto 128.7 metres / min. This is supported by the use of modern techniques of light set up with special circuit and electronic ballasts to provide adequate constant DC lighting from bottom to the high speed moving fabric. Elliptical reflectors designed in the lighting system focus light on a small required width of area so as to inspect the defect portions efficiently with high accuracy at low response time.

The machine frames containing special adjustable camera stand and special rollers weigh approximately 600 Kgs. Adjustable camera stand offers choice of adjustment of working

distance and selection of number of cameras to suit to the width of the fabric. The machine occupies a limited floor pace of about 217 Cm width, 360 cm length and 200 cm height.

Numbers of faults are being introduced in the fabric when yarns were put to use in weaving machine to manufacture fabric due to the inherent defects in the yarn, bad preparation of warp and weft, improper machine condition, bad working practices, ill-maintained ambient condition in the department and so on. Thus wide varieties of sources are responsible for fabric defects. To have an improved product, these factors must be identified, measured, specified through suitable inspection procedures.

To begin with this research work, an extensive industrial survey was conducted selecting certain weaving, composite and garment making units in order to have reliable, adequate, and accurate information pertaining to fabric inspection. Thus a comprehensive database of fabric defects and their possible causes and all necessary information have been gathered from all available sources to form an expert system.

Through the use of image subtractive technique, images of fabric defects were identified and stored. Wavelet was selected as an effective image compression technique in terms of space, time and execution speed, among three fast image compression techniques and two statistical approaches to incorporate in the main program for automatic fabric inspection.

Wavelet combined Probabilistic Neural Network was selected based on accuracy of results, among the five various neural network techniques namely Linear, Back Propagation, Radial Basis Function, Kohonen and Probabilistic Neural Networks.

To provide effective feedback information or a report useful to the weaving and its preparatory departments for early necessary action on the error making looms / operators, a knowledge-based real time expert system was developed using the knowledge and abilities of experts and all available literature in the field. The expert system was embedded with artificial neural network for faster processing of lot many nonmathematical relationships.

Special software developed for the purpose of "on line inspection" is written using Vasual Basic for the front end and Visual C++ for all camera control, image acquisition and image analysis purposes. The highly effective Wavelet image compression technique accompanying with simple but perfect classifier Probabilistic Neural Network produces the defect results for considerably very high no .of 33 fabric defects "on line" accurately at a in-significant time period. Image Microsoft Access carries the real time Expert System provides all required data to prepare a perfect inspection report for fabric grading and as feed back to the back process machinery.

While the run time length measurement device is useful for counting the fabric length from start to end and the Robotic fabric defect marker developed for the purpose to stamp the appropriate colour mark near selvedge by a robotic arm, activated by a relay, once the scanning camera observes a defect on the running fabric.

The system was developed in such a way that after running the full length of the fabric, a report was generated with all requisite details of fabric defects such as nomenclature, description, possible causes, possibilities of mending the defect / remedial measures, person responsible for the defect and number of defects per 100 sq. mts of fabric and number of defect points per 100 sq. mts as per 4 point system.

This information could be used by the grey cloth manufacturing and exporting units for decision making regarding proper quality control operations or decision on export fabric quality. Garment units could use this information whether to accept the lot or not. Though the initial investments lie on the higher side (around Rs. 25 lakhs), the advantages are manifold. With increased production and reduced personnel requirement, it proves to be profitable in long run. Inherent advantage of having an assured fabric quality remains the backbone of the system.

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