Fabric Defect Detection using Computer Vision

# Summary

This report aims to how computer vision could be used to find defect in narrow fabric. Utilising the open source technologies, OpenCV and TensorFlow to create 3 different inspection techniques and Qt to build a fabric inspection GUI.

\*\*\* pre-processing maybe \*\*\*

The three inspection techniques were all created in python using OpenCV. The first used created and examined histograms generated form the pixel values of the images. The second utilised image morphology and contour finding to look for large objects present in the image. The last method leveraged TensorFlow to build a CNN (Convolutional Neural Network) that was trained on pre labelled defect data obtained from the aitex fabric image database.

A prototype graphical application was then created using the second and third inspection techniques and the report discusses how this would be implemented in a full inspection system. Finally, the report compares the inspection techniques created to human inspection, the current method most companies use. \*\* explain findings \*\*

The report concluded \*\* conclusion \*\*

# Acknowledgements

I would like to thank my assessor \*\*name\*\* and both of my supervisors Amy Lowe and David Head who provided indispensable guidance throughout the project.

I would also like to thank my friends who provided much needed data around human inspection.

Finally I would like dedicate this report to my late father Charles, who inspired the idea for the project. \*\* add more about dad \*\*

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# Chapter 1: Introduction and Background Research

## Introduction

The purpose of this project was to explore how computer vision could be used in fabric defect detection and what advantages it could offer over traditional methods.

This project and report will investigate the effectiveness of different computer vision techniques at locating defects in images of fabrics. To carry out this investigation three different inspection techniques were created, the first two using OpenCV and the last using TensorFlow.

Lastly, a prototype application was created that would be used to automatically inspect a user supplied images using the most effective inspection methods found in the initial stages of the project.

## Fabric

Most fabric / textile is produced through one of a number of processes weaving, knitting, felting, bonding or turfing. Out of these the most common are weaving and knitting which produces most conventional fabrics. Both involve very similar steps, first fibres (synthetic or natural) are spun into yarn which is then converted into fabric using either weaving or knitting (Shaker,2016).

As these two production methods are the most widespread the projects definition of a fabric or textile was limited to those produced by either of these two methods. To understand the problem, it was important to have a surface level understand of how these production technique’s function.

### Spinning

First fibres are harvested naturally for example flax or are produced synthetically such as polyester. These are then aligned and collected into yarn through the process of spinning, this process varies for natural and synthetic material. Natural fibres can be spun in many ways, but all involve them being twisted, this binds them together to form yarn (Smith, 1969, p. 1).

Synthetic fibres are spun differently, here liquid polymer is extruded though many, densely packed small holes. A cool “quench air” is passed over them to solidify the liquid polymer into long continuous fibres. Variations in the air passed over them also causes fibres to bunch in certain areas binging them together into yarn (Denn, 1983, pp. 179-180).

### Weaving and Knitting

After yarn is created, weaving and knitting are two processes that can be used to convert this yarn into fabric. Weaving is the process of interlacing yarn perpendicularly to each other. The patterns this is done in determine the properties and appearance of the textile (Adanur, 2020, p. 1).

Knitting is the second most prevalent for of textile manufacturing. It is achieved by vertically intermeshing loops of yarn (Ray, 2012, p.2). Similarly, to weaving the way in which the loops mesh decides the properties and appearance of the final textile. While they processes differ Both methods aim to produce an ordered and reoccurring structure of yarn.

### Dyeing

Once these textiles are produced most if not all go through some level of processing. This may include dyeing a form of post processing that colours the fabric with a dye or pigment. There are many ways to dye a fabric but the common is the batch dyeing processes. The batch dyeing processes involves a textile being submerged in a large quantity of dye for an extended period, this allows the dye to transfer into the textile (Perkins, 1991, p. 23).

Many other finishing processes can also be applied such as coatings, but these are less prone to producing visible defects and so do merit discussion.

### Types of Defects

Now the project has a baseline understanding of how fabric is created we can assess what defects are produced during all phases of its creation.

### Importance of Inspection

## Current Inspection Techniques

## aitex fabric image database

## OpenCV

### Morphology

### Contour Finding

### Example of Object Detection Using OpenCV

## TensorFlow

### CNN

### Binary Classification using CNN’s

## Background research summary

# Chapter 2: Methods

## Initial Project Decisions

\*\* talk about the scale of the project, decision to just do detection rather than classification. Limited size of data, decision to use that specific data set as opposed to <https://www.kaggle.com/datasets/belkhirnacim/textiledefectdetection> and others, why develop the openCv techniques as well \*\*

## Sprint 1: Data Preparation and Analysis

### Goals

### implementation

#### Acquiring and Preparing the Dataset

\*\*tiling , edge finding\*\*

#### Image Analysis

### Sprint Review

## Sprint 2: OpenCV Contour Finding

### Goals

### Implementation

#### Image Morphology

### Sprint Review

## Sprint 3: TensorFlow

### Goals

### Implementation

#### CNN

### Sprint Review

## Sprint 4: Gui

### Goals

### Implementation

### Sprint Review

# Chapter 3: Results

# Chapter 4: Discussion

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# Appendix A Self-appraisal

# Appendix B External Materials

# Appendix D User Testing Consent Form

# Appendix F User Manual