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, I created a prototype application 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 \*\* production \*\*

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 techniques 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).

Synthetic fibres are

### Types of Defects

### Importance of Inspection

## Current Inspection Techniques

## 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 2: Results

# Chapter 4: Discussion

# Bibliography

Shaker, K., Umair, M., Ashraf, W. and Nawab, Y. (2016) Fabric manufacturing. Physical Sciences Reviews, Vol. 1 (Issue 7), pp. 20160024. <https://doi.org/10.1515/psr-2016-0024>

P. A. Smith B.Sc., Ph.D., F.T.I. (1969) YARN PRODUCTION AND PROPERTIES, Textile Progress, 1:2, 1-117, DOI: [10.1080/00405166908688985](https://doi.org/10.1080/00405166908688985)

# Appendix A Self-appraisal

# Appendix B External Materials

# Appendix D User Testing Consent Form

# Appendix F User Manual