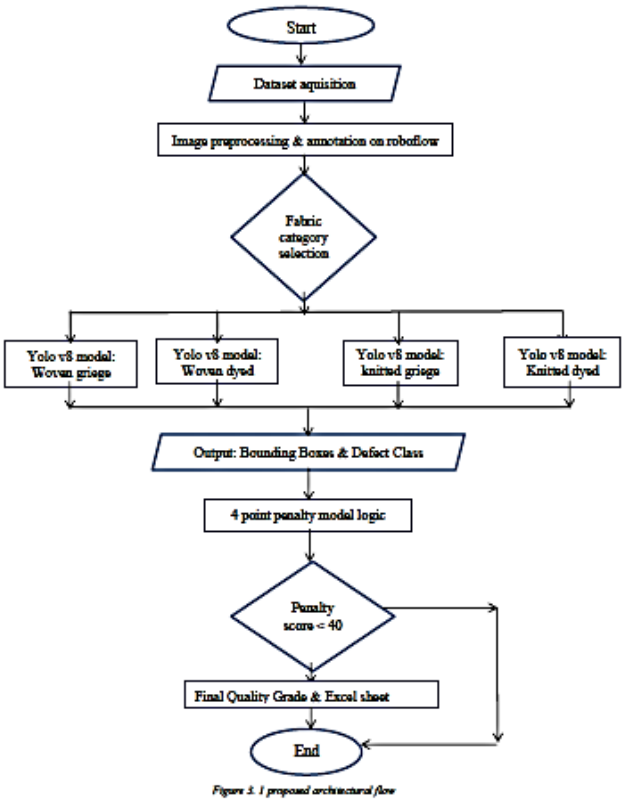
Final Year Design Project Showcase
Batch-2022
Year 2026

Department: Textile Engineering
Programme: Textile Engineering

1	**Project Title** INNOVATION OF AI IN THE FOUR-POINT SYSTEM IN FABRIC MANUFACTURING
2	**Project Idea** ✓ Develop an AI-based system ✓ Train & evaluate a YOLOv8 model using fabric defect images ✓ Apply the Four-Point Inspection System to assign penalty points and generate final fabric grades.
3	**Process** The proposed system follows a streamlined pipeline. It begins with the acquisition of images from the fabric web. These inputs are routed to a specialized YOLOv8 detection module depending on the fabric category. The AI extracts visual features, identifies localized defects, and outputs precise bounding box coordinates alongside confidence scores. These automated predictions are then mapped to the standard Four-Point System parameters to assign defect penalty points and determine the ultimate grade of the fabric roll (Fig 3.1).  *Figure 3. 1 proposed architectural flow* 49
4	**Outcome** **Proposed YOLOv8 Integration into 4 Point System Workflow**

The integration of the YOLOv8-based defect detection process with the traditional 4-point grading system as described is the most crucial aspect of this approach. By performing this integration, a full end-to-end automated system has been developed. The overall workflow of the system will operate as follows:

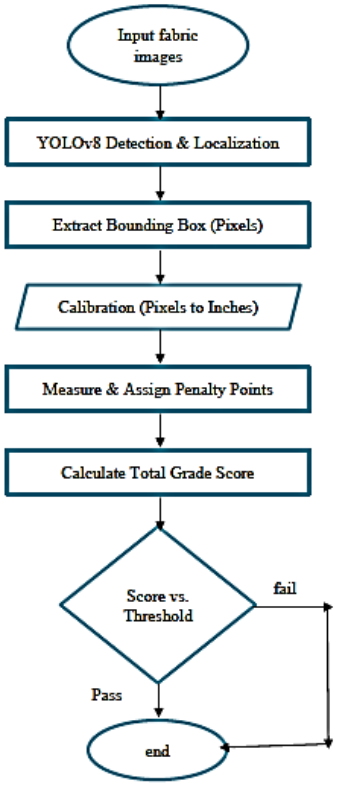


Figure 3. 5 *Proposed YOLOv8 Integration into 4 Point System Workflow*

The proposed system has demonstrated promising outcomes for fabric defect detection and the application of the Four-Point System. Nevertheless, there are certain aspects that could still be improved in future research.

First, the accuracy rate of the model can be increased by increasing the sample size. Given the limited time of the project, only a small range of defects has been chosen. The inclusion of new defect types is expected to increase the performance of the system.

Second, the current project has been developed as a software-based tool. Future research may involve hardware integration to achieve a real-time solution. This may involve the use of high-resolution cameras in industries, real-time calibration of cameras, conveyor inspection systems, and automated inspection systems for continual inspection of fabrics in an industrial environment.

Furthermore, the application of the Four-Point System in the present study was conducted on woven greige, woven dyed, knitted greige, and knitted dyed fabrics. The next scope for research would be printed fabrics where detecting defects is a more difficult task because of the complexity of prints in such fabrics. Various other defects which are specific to printed fabrics may be studied and classified, after which the Four-Point System can be implemented.

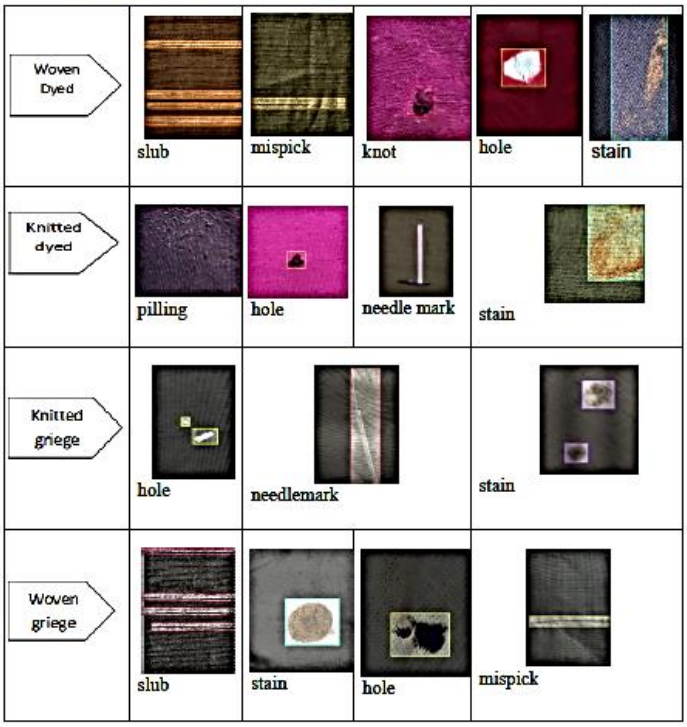
5

Evidence (Theoretical Basis)

The current task of textile industry has been the operational bottleneck of both large and small companies due to overdependence on Four Point Inspection System, a slow, laborious, inconsistency and repetitive manual task where human fatigue and subjective judgment led to inconsistent grading, high fabric wastage and business losses, and where optimum quality could not be assured and profitability be guaranteed. Therefore, this project implements an AI-assisted automatic fabric inspection system based on the latest YOLOv8 deep learning algorithm that

achieves the best speed accuracy ratio. And by the use of robust detection structure, including the enhanced model, it can distinguish very tiny defects such as incomplete yarn breaks, low contrast stains, misprint drops on different fabric types-grey fabric, plain printed fabric, woven fabric, knitted fabric-, on the fly, at any time, without interruption.

Table 3. 1 classification of annotated samples in roboflow



It automatically locate and categorize fabric defect images, no penalty points are individually assigned according to Four Point system, automated, certified human auditors use the system to achieve the same consistency, objectivity, on-line repetition in inspection. It will be just the first step forward to the with automation for the advanced concept of the smart manufacture with less waste, higher efficiency and secured quality fabric audits from source.

The latest system based on the YOLOv8 deep learning algorithm conceptions shown here is a valid intelligent tool for robotic fabric inspector implementation and we have a scientific evidence to show that machine detection can be integrated into robot automated quality grading towards a global standard achieved in real-time fabric inspecting process while saving time and assuring quality.

Our results also proved that the latest model was applied successfully at different stages of textile production with the best training accuracy obtained in Knitted Dyed class and the most accurate test in Woven Dyed class; 2nd edition of our original end-to-end tests by a process tailored from the actual long industrial length/fabric roll-quality inspection and backend calculation to build a global automated fabric inspection platform. Further conceptual validation work can be pursued in the direction of hardware engineering for real-time industrial environment with higher resolution sources; printed fabric PDF file recognizing.

Table 5. 5 comparative analysis of final and training and testing accu

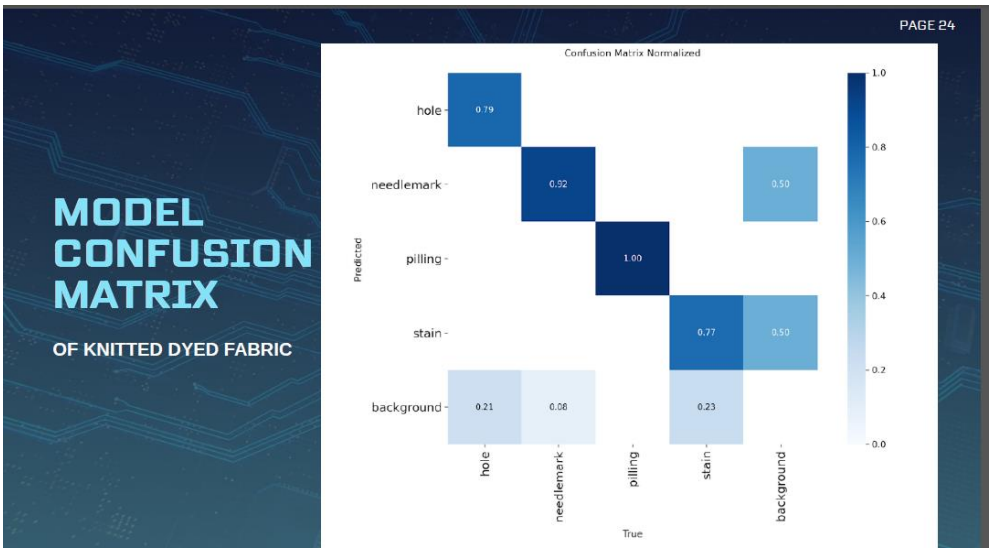
Fabric Category	State	Training Time (Hrs)	Training mAP50 (%)	Training F1-Score (%)	Test Accuracy (%)	Test Precision (%)
Knitted	Greige	0.215	73.2%	68.1%	69.30%	67.45%
Knitted	Dyed	0.308	84.5%	84.8%	71.83%	78.07%
Woven	Greige	0.358	71.2%	71.4%	70.05%	63.32%
Woven	Dyed	0.277	70.9%	68.7%	76.24%	86.34%

6	**Competitive Advantage or Unique Selling Proposition** (Cost Reduction, Process improvement, Attainment of any SDG (Sustainable Development Goal), increase of market share or capturing new market or having superior performance over a competitor. In summary, any striking aspect of the project that compels the industry to invest in FYP or purchase it. Some detailed description is required in terms of how, why when what. You can select one or more from the following dropdown and delete the rest of them). Please keep relevant options, delete the rest of them, and correct the sequence
a	**Attainment of any SDG** (e.g. How it is achieved and why it is necessary for the region) **SDG 8 – DECENT WORK AND ECONOMIC GROWTH :** The project is imported to SDG 8 via the installation of AI-based inspection system which gives more accurate results, prevents less fatigue of humans and reduces the manual work which is both heavy and time-taking. Not least, this leads to safer conditions for work and supports efficiency and loss minimizing economic growth not only of the textile producing industry but of the entire economy. **SDG 9 – INDUSTRY, INNOVATION AND INFRASTRUCTURE** This project is related to SDG 9 by demonstrating a new, innovative and creative approach for the monitoring of textile quality utilizing YOLOv8 and machine vision. It is indeed the automation and instructional methodologies that manual inspection has graduated from, that have strengthened industrial base and reliability and technological enhancement in textile manufacturing. **SDG 12 – RESPONSIBLE CONSUMPTION AND PRODUCTION** It will provide benefits to SDG 12 in terms of lower fabric wastage, avoidance of processing, and improving resource efficiency. The automatic and early precise recognition of defects plays a more and more important role in order to conserve material, energy and chemicals efficiently and to keep the produced products environmentally benign and sustainable.
b	**Any Environmental Aspect** (e.g. carbon reduction, energy-efficient, etc.) This project outcomes, lower fabric wastage, avoidance of processing, and improving resource efficiency. The automatic and early precise recognition of defects plays a more and more important role in order to conserve material, energy and chemicals efficiently and to keep the produced products environmentally benign and sustainable.
c	**Cost Reduction of Existing Product** It is indeed the automation and instructional methodologies that manual inspection has graduated from, that have strengthened industrial base and reliability and technological enhancement in textile manufacturing.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** (e.g. What is the issue is current process and what improvement you suggests) Our results also proved that the latest model was applied successfully at different stages of textile production with the best training accuracy obtained in Knitted Dyed class and the most accurate test in Woven Dyed class; 2nd edition of our original end-to-end tests by a

	process tailored from the actual long industrial length/fabric roll-quality inspection and backend calculation to build a global automated fabric inspection platform. Further conceptual validation work can be pursued in the direction of hardware engineering for real-time industrial environment with higher resolution sources; printed fabric PDF file recognizing.	
7	**Target Market** (Industries, Groups, Individuals, Families, Students, etc) Please provide some detail about the end-user of the product, process, or service Textile Fabric, Garment and Apparel Industry	
8	**Team Members** (Names along with email address)	Afeefa Batool , TS-22011 , afeefabatoolts@gmail.com Aiza Javed TS-22001, aiza.javed0907@gmail.com Syeda Neha Ahmed TS-22004, nehaahmed.nh@gmail.com Wadia Mushtaq TS-22013, Wadiamushtaq2004@gmail.com
10	**Supervisor Name** (along with email address)	Main Supervisor : Engr. Dr. Muhammad Amir Quresh, Associate Professor , Textile Engineering , qureshi@neduet.edu.pk , +923363685329. Co Supervisor: Engr. Dr. Rizwan Aslam Butt, Associate Professor, Telecommunication Engineering
11	**Video (If any)**	NA

Pictures (to be pasted below)

MODEL PERFORMANCE COMPARISON
PAGE 23
Knitted greige
mAP50
hole needlemark stain
Knitted dyed
mAP50
hole needlemark pilling stain
Woven Greige
mAP50
hole mispick slub stain
Woven Dyed
mAP50
hole knot mispick slub stain


PAGE 24
MODEL CONFUSION MATRIX
OF KNITTED DYED FABRIC
Confusion Matrix Normalized
hole
needlemark
pilling
stain
background
0.79
0.92
1.00
0.77
0.50
0.50
0.21
0.08
0.23
Predicted
True
hole
needlemark
pilling
stain
background
1.0
0.8
0.6
0.4
0.2
0.0