BUSITEMA UNIVERSITY

FACULTY OF ENGINEERING

DEPARTMENT OF POLYMER, TEXTILE AND INDUSTRIAL ENGINEERING (PTI)

FINAL YEAR PROJECT REPORT

COMBINING NEURAL FUZZY INFERENCE SYSTEM AND MACHINE LEARNING ALGORITHMS TO IMPROVE FABRIC PREDICTION MODELS USING TECHNICAL PARAMETERS

By

KISHAIJA ERIC

This Report is submitted to the Faculty of Engineering in Partial Fulfillment of the Requirement for the Award of the Degree of Bachelor of

Polymer, Textile and Industrial Engineering (PTI) of Busitema University

June 2024

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BU/UG/2020/2433

SUPERVISORS

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June 2024

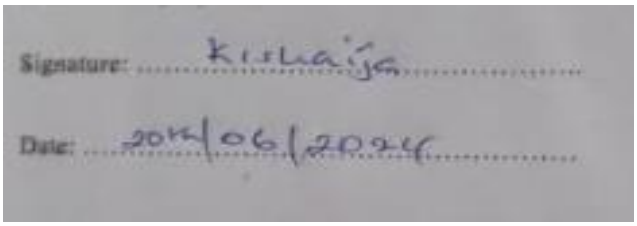
ABSTRACT

The textile industry plays a critical role in daily life, but faces challenges such as high levels of waste and environmental impact. This study explores the integration of Artificial Intelligence (AI) and machine learning techniques to address these issues, focusing on predictive modeling of fabric properties. Specifically, the study develops and validates an Adaptive Neuro-Fuzzy Inference System (ANFIS) model using real and synthetic data generated by Conditional Generative Adversarial Networks (CTGAN). CTGAN augments the dataset while preserving privacy, and the Discrete Wavelet Transform (DWT) aids in outlier detection to ensure data integrity. The research demonstrates the efficacy of AI-driven approaches in improving fabric property prediction accuracy, reducing waste, and enhancing production efficiency. The findings encourage broader adoption of AI technologies in the textile industry for sustainable and efficient manufacturing processes.

Keywords: Textile industry, Artificial Intelligence, ANFIS, CTGAN, predictive modeling, waste management

DECLARATION

I **Kishaija Eric**, Registration Number **BU/UG/2020/2433**, declare that this final year research report is my original work and that it has never been submitted to any university or any other institution of learning for academic or any other reasons. I am therefore glad to present it to the board of Busitema university examiners for examination purposes.



DEDICATION

I dedicate this proposal to my dearest parents, Mr. Marura John and Mrs. Nyiramaana Clementine. I too dedicate this work to the most influential person in pursuing this research, Mrs. Natasha Jaques, Programming Engineer at Google her work in AI research related programming has drawn a zeal in this field.

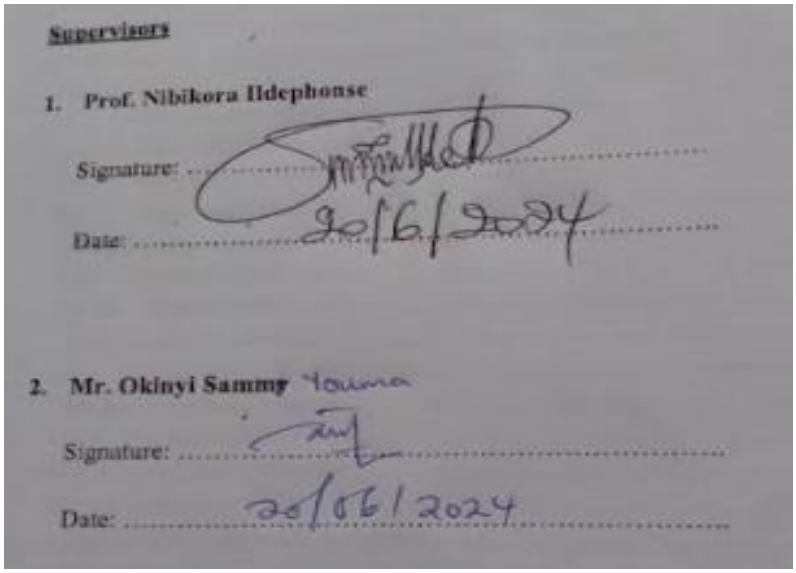
ACKNOWLEDGEMENT

Sincere appreciations go to the influential person in pursuing research in machine learning and artificial Intelligence, Mrs. Natasha Jaques. Her work moved me into horizons that my heart yarned for and I earned a lot from her work. I also send my appreciations to my research supervisors, Dr. Nibikora Ildephonse, his recommendations especially during crucial decisions making is algorithm choices made it a success, Dr. Godliver Owomugisha her work in python projects helped me have hope at the very beginning of the project, and Mr. Okinyi Sammy who tirelessly looked up for my resources and tutorials to help me out. Their comments, correction, recommendations and guidance made this work smooth and the best reflection in it is from their cooperation.

APPROVAL

This is to approve that this research report has been fully and consistently worked on and submitted to the Department of Polymer, Textile and Industrial Engineering under the supervision of the assigned supervisors.

Supervisors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ABBREVIATIONS AND ACRONYMS

- · **AI** - Artificial Intelligence
- · **ANFIS** - Adaptive Neuro-Fuzzy Inference System
- · **CTGAN** - Conditional Generative Adversarial Network
- · **DWT** - Discrete Wavelet Transform
- · **GAN** - Generative Adversarial Network

CHAPTER ONE: INTRODUCTION

1.1. Background of the study

The textile industry, a cornerstone of modern living, plays a pivotal role in daily life, as clothing is an essential human need (Sikka, Sarkar, & Garg, 2022). From casual wear to specialized garments for business, parties, and presentations, textiles contribute significantly to societal norms and personal identity. However, this vital industry faces numerous challenges, particularly concerning waste management and environmental sustainability. The growing volume of textile waste is a pressing issue, with pre-consumer and post-consumer waste contributing significantly to environmental degradation.

Globally, textile waste statistics are alarming. Production wastes can reach up to 35% before products even reach consumers, and pre-consumer waste also accounts for approximately 35% (Ahmad, Miskon, Alabdan, & Tlili, 2020). Post-consumer textile waste is staggering, with the United States producing 10.5 million tons annually, the United Kingdom generating 350,000 tons, and Turkey contributing 28,700 tons. Despite the pressing need for effective waste management, only 15% to 20% of textile wastes are recycled, a stark contrast to higher recycling rates in other industries, such as steel (80%), paper (65%), and plastic (30%), (Rapsikevičienė, Gurauskienė, & Jučienė, 2019).

To address these challenges, various waste management strategies have been explored, including preventive measures, reuse, recycling, energy recovery, and disposal. Preventive strategies are the most preferred due to their potential to reduce waste generation at the source. However, the adoption of preventive approaches is hampered by limited technological advancements and high implementation costs. The industry urgently needs innovative solutions to optimize production processes and minimize waste.

One promising solution lies in the integration of Artificial Intelligence (AI) and predictive modeling into textile manufacturing. AI has demonstrated significant potential in various fields, offering hope for addressing long-standing challenges in textile engineering (Wojnowska-Baryła, Bernat, & Zaborowska, 2022). Predictive tools can help industries foresee potential waste generation and take proactive

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