BUSITEMA UNIVERSITY
Pursuing Excellence

FACULTY OF ENGINEERING

DEPARTMENT OF TEXTILE AND GINNING ENGINEERING

FINAL YEAR PROJECT

OPTIMIZATION OF ELECTRICITY CONSUMPTION FOR A CHAIN OF RING FRAME MACHINES USING GENETIC ALGORITHM

BY

ECHODU JOREM

BU/UG/2016/20

SUPERVISOR'S

Dr. NIBIKORA ILDEPHONSE

Mr. KASEDDE ALLAN

Final year project report submitted to the department of Textile and Ginning Engineering in partial fulfilment for the award of a Bachelor of Science in Textile Engineering.

DECEMBER 2020

ABSTRACT

The textile industry has relatively high energy consumption compared to other small and medium industries. Energy is one of the main cost factors in the textile industry and accounts for 15% to 20% over the production cost and it stands next to raw material cost. The increase in energy consumption is attributed to inadequate maintenance of the ring frame machines, lighting system and mechanical ventilation.

Intelligent Analysis Systems (IAS) are gaining recognition in developing countries, Uganda inclusive. This proposal describes the use of genetic algorithm to optimize the electricity consumption from a chain of ring frame machines.

Keywords: Energy consumption, optimization, genetic algorithm.

DECLARATION

I ECHODU JOREM Reg. No BU/UG/2016/20 hereby declare that this project is my original work and that the information contained in this project is out of my hard work and research, except where explicit citation have been made and it has not been presented to any Institution of higher learning for any academic award.

14/12/2020

Signature Date

APPROVAL

This is to certify that the project under the title "Optimization of electricity consumption for a chain of ring frame machines using genetic algorithm" proposed under my supervision and is now ready for examination.

Supervisors:

Name: Dr. NIBIKORA Ildephonse

Signature: _____

Date: _____

Name: Mr. KASEDDE Allan

Signature: _____

Date: _____

DEDICATION

I dedicate this project research to my parents: Ms. Akwii Deborah and Mr. Omumwa Michael for their hard work, great love, moral and unconditional support to make me a successful person through attaining better education.

I also dedicate it to my siblings and well-wishers for their support morally and socially.

ACKNOWLEDGEMENT

I would love to extend my gratitude to a number of persons with whose efforts have managed to progress and put a landmark in my education.

First and foremost, I would like to thank the almighty God for giving me the strength to carry on with my final year project research.

Sincere thanks go out to Busitema University, department of Ginning and Textile Engineering and most importantly my supervisors Dr. NIBIKORA Ildephonse and Mr. KASEDDE Allan for the great work done (guidance and consultations).

I also acknowledge the love and care of my family and loved ones, for all the financial, moral, spiritual, and physical support.

Lastly, to all my course mates, thank you for the team cooperation.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF EQUATIONS

LIST OF ACRONYMS / ABBREVIATIONS

GA..... Genetic Algorithm

AI..... Artificial intelligence

MAPE.....Mean Absolute Percentage Error

ISO..... International Standard Organizations

CBA..... Cost Benefit Analysis

HVAC..... Heating, Ventilation and Air Conditioning

EJ..... Exa- Joules

UNIDO..... United Nations Industrial Development Organization

SEC..... Specific Energy Consumption

PID..... Proportional Integral and Derivative

CHAPTER ONE

1.1 INTRODUCTION

This chapter consists of the background of the study, problem statement, objectives of the study, justification, significance, scope and the limitations.

1.2 BACKGROUND OF THE STUDY

Energy plays an important role in industrial development and economic growth rate of country. The energy share of the global economy accounts 8.2% of the GDP.

Out of the total global available energy, consumption of energy by the industrial sector is 51%, household sector is 18% and commercial sector is 20%(British thermal unit, 2011). The consumption of energy is increasing at a fast pace while available resources remain limited. The global need for energy is increasing on an average by about 2.4% every year. (Mouzon, Yildirim, & Twomey, 2007).

Textile industries manufacturers face a competitive environment. This has compelled manufacturers to reduce production costs without affecting the production and quality of product. Due to spike in energy prices, this has led to an increase in the manufacturing cost as well as decrease in the quality of the product produced.(Li, Xing, Wu, Wang, & Luo, 2016)

Textile industry is the third largest energy consuming industry after chemical and engineering sector, due to modernized machines and continuous usage of the equipment in inefficient operating parameters.(Bruce, 2013). Energy is one of the main cost factors in the textile industry and accounts for 15% to 20% over the production cost and it stands next to raw material cost.(Patil, Patil, & Fulare, 2018).

In a spinning industry, energy is consumed mainly in the form of electricity. At each stage of spinning such as blow room, carding, ring frame the energy is consumed in some manner. Beside this some electricity is also consumed in lighting, compressors and humidification systems. Also, to increase the production and to reduce the labor cost different automations have been done in a ring spinning industry, leading to increase in the energy consumption.(El, Hosny, & Mohamed, 2012).

Electric energy is one of the most commonly used energy types in the textile and clothing plants, used to supply energy for textile machinery, heating and cooling control systems, lighting, and

REFERENCES

1. Ali Hasanbeigi, 2010 ''Energy-Efficiency Improvement Opportunities for the Textile Industry'' A Guide book under China Energy Group, Energy Analysis Department, Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory, September 2010.
2. Nassif, N. Modeling and optimization of hvac systems using artificial neural network and genetic algorithm. Build. Simul. **2014**, 7, 237–245.
3. Ali H. and, Lynn P., 2010,''Industrial Energy Audit Guidebook: Guidelines for Conducting an Energy Audit in Industrial Facilities'' October 2010
4. Mccollum, D.; Gomez, L.; Riahi, E.K.; Parkinson, S. A Guide to SDG Interactions: From Science to Implementation. 2017. Available online: http://www.icsu.org/publications/a-guide-to sdg-interactionsfrom-science-to-implementation (accessed on 1 April 2019).
5. Koch E, Koplan E; "An Investigation on Energy Consumption in Yarn Production with Special Reference to Ring Spinning"; *Fibers & Textiles in Eastern Europe;* Vol. 15; October / December 2007; 63
6. Chandran RK, Muthu Kumaraswamy P; "SITRA Energy Audit – Implementation Strategy in Textile Mills"; *The South India Textile Research Association, Coimbatore; 43rd. Joint Technological Conference;* March 2002.
7. Navale, R.L.; Nelson, R.M. Use of genetic algorithms to develop an adaptive fuzzy logic controller for a cooling coil. Energy Build. **2010**, 42, 708–716
8. Nagy, Z.; Yong, F.Y.; Frei, M.; Schlueter, A. Occupant centered lighting control for comfort and energy efficient building operation. Energy Build. **2015**, 94, 100–108.
9. Conde-Gutiérrez, R.A., et al., *Optimal multivariable conditions in the operation of an absorption heat transformer with energy recycling solved by the genetic algorithm in artificial neural network inverse.* Applied Soft Computing Journal, 2018. **72**: p. 218-234.
10. "IEA - International Energy Agency - affordable clean energy for all | iea.org." [Online]. Available: http://www.iea.org/. [Accessed: 20-Feb-2014].
11. D. E. Goldberg, 'Genetic Algorithm in Search, Optimization and Machine Learning', New York: Addison –Wesley (1989)

12. Ahmadi, P.; Dincer, I.; Rosen, M.A. Thermodynamic modelling and multi-objective evolutionary-based optimization of a new multigeneration energy system. Energ. Convers. Manag. 2013, 76, 282–300.
13. Wu, Z.; Xu, J. Predicting and optimization of energy consumption using system dynamics-fuzzy multiple objective programming in world heritage areas. Energy 2013, 49, 19–31.
14. Greening, L.A., Roop, J.M., 2007. Modeling of industrial energy consumption: An introduction and context. Energy Economics 29 (2007) 599–608.
15. [Lin, 2012] M.-H. Lin, J.-F. Tsai, and C.-S. Yu, "A review of deterministic optimization methods in engineering and management," Mathematical Problems in Engineering, 2012.
16. "IEEE Recommended Practice for Energy Management in Industrial and Commercial Facilities", Recognized as an American National Standard (ANSI) IEEE Standard, pp. 739, 1995.
17. A. Thumann, and W. J. Yonger, "Hand Book of Energy Audits", 7 th ed, Lilburn: Fairmont Press Inc.; 2007.
18. P. Z. Yaacoh, and A. A. Mohd. Zin, "Electrical energy management in small and medium size industries", IEEE TENCON, Beijing, 1993.
19. Cataldo, A., M. Taisch, and B. Stahl. 2013. "Modelling, Simulation and Evaluation of Energy
20. Consumptions for a Manufacturing Production Line." In Proceedings IECON 2013 - 39th annual conference of the IEEE Industrial Electronics Society, Vienna, 7537–7542. Piscataway, NJ: IEEE.
21. Brattle Group, 2010. Transmission Planning and Cost Benefit Analysis. Presented at: EUCI Web Conference, by Johannes Pfeifenberger & Delphine Hou, September 22, 2010.