FUZZY LOGIC MODEL FOR MONITORING LIVESTOCK FARMING

BY

NWALA, BLESSING UCHECHI
(B.Eng. KNUST)
G2018/MSC/COMP/FT/006

DEPARTMENT OF COMPUTER SCIENCE,
FACULTY OF SCIENCE
SCHOOL OF GRADUATE STUDIES
UNIVERSITY OF PORT HARCOURT
RIVERS STATE, NIGERIA

SUPERVISOR: Prof. (Mrs.) L.N Onyejegbu

MARCH, 2022

FUZZY LOGIC MODEL FOR MONITORING LIVESTOCK FARMING

BY

NWALA, BLESSING UCHECHI

(B.Eng. KNUST)

G2018/MSC/COMP/FT/006

A Thesis submitted to the School of Graduate Studies in partial fulfilment of the requirements for the award of degree of Master of Science (MSC) in Computer Science Faculty of Science, University of Port Harcourt.

Name of Supervisor:

Prof. L.N Onyejegbu

MARCH, 2022

DECLARATION

I, NWALA, BLESSING UCHECHI with Registration Number G2018/MSC/COMP/FT/006 declare that the work in this Thesis on FUZZY LOGIC MODEL FOR MONITORING LIVESTOCK FARMING was carried out by me; that it is my original work and that it has not been submitted wholly or in part for the award of a Degree in any Institution.

Nwala, Blessing Uchechi Signature/Date: …….

Confirmation by Supervisor

Prof. L.N Onyejegbu Signature/Date: ……..

CERTIFICATION

UNIVERSITY OF PORT HARCOURT,

SCHOOL OF GRADUATE STUDIES

FUZZY LOGIC MODEL FOR MONITORING LIVESTOCK FARMING

BY

NWALA, BLESSING UCHECHI

The Board of Examiners certifies that this Thesis is accepted in partial fulfillment of the requirements for the award of the degree of Master of Science (M.sc) in Computer science.

DESIGNATION	NAME	SIGNATURE	DATE
Supervisor (I)	PROF.L.N ONYEJEGBU	……	…….....
Chairman, Departmental Graduate Studies Committee	PROF. P. O. ASAGBA	……	……
Head of Department	DR. F. E. ONUODU	……	…….....
Dean, Faculty of Science	PROF. E. B. ESSIEN	……	…….....
External Examiner	PROF. A.A IMIANVAN	……	…….....
Dean, School of Graduate Studies/Chairman, Board of Examiners	PROF. B. F. NWINEE	……	…….....

DEDICATION

This research work is dedicated to the highest God who is the creator of all things.

ACKNOWLEDGEMENTS

I acknowledge the efforts and guidance of my supervisor, Prof. (Mrs.) L.N Onyejegbu without your thorough supervision, this work would not have been completed. To the staffs of Computer Science Department, I want to say a big thank you. I want also acknowledge my HOD, Dr. F.E. Onuodu, Head of Computer Science Department, University of Port Harcourt for his support and advices during this period he is like a father to us all, and ever ready to assist in any way he can. I am also grateful to the faculty and post graduate school staff for their support, without your support we won't be where we are today.

To my wonderful parents, Engr. Nwala Livinus and Dr. (Mrs.) Patricia Nwala, I thank you for your unconditional love and support, especially during the period of this research work. Finally, let me respectively appreciate the support of my siblings and friends who also supported me during the period of this research work. Nwala Prosper, Nwala Albright, Nwala Onyinyechi, Eleeh Cynthia, Ifiok Umoh and Umejuru Daniel. Once again, thank you and God bless you all.

TABLE OF CONTENTS

Cover Page i

Title Page ii

Declaration iii

Certification iv

Dedication v

Acknowledgement vi

Abstract vii

Table of Contents viii List of Tables ix

List of Figures x

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study 1

1.2 Statement of the Problem 2

1.3 Aim and Objectives of the Study 3

1.4 Significance of the Study 4

1.5 Scope of the Study 4

1.6 Motivation of the Study 4 1.7 Definition of Terms 5

CHAPTER TWO: LITERATURE REVIEW

2.1 Concept of smart agriculture 6

2.1.1 Livestock farming 8

2.2 Deep learning as a tool for improved livestock farming 10

2.3 The Internet-of-Things as a tool for smart livestock farming 14
2.3.1 Application areas of IoT 15
2.3.2 Major IoT challenges 18
2.4 Fuzzy Logic as a tool for improving smart livestock farming 19
2.4.1 Fuzzy Sets and Systems 25
2.4.2 Analysis of Fuzzy Logic Algorithm 26
2.5 Review of Related Literature 29
2.6 Direction of the Study 54
CHAPTER THREE: MATERIALS AND METHODS
3.1 Analysis of the Existing System 55
3.1.1 Detailed Analysis of the Existing System 57
3.1.2 Dataflow Diagram of the Existing System 62
3.1.3 Decision Tree Algorithm of the Existing System 64
3.1.4 Advantages of the Existing System 65
3.1.5 Disadvantages of the Existing System 65
3.2 Design of the Proposed System 65
3.2.1 Detailed Analysis of the Proposed System 67
3.2.2 Dataflow Diagram of the Proposed System 75
3.2.3 Mathematical Model of the Proposed System 77
3.2.4 Algorithm of the Proposed System 78
3.2.5 Methodology 79
3.2.6 Frontend Interface Design 80
3.2.7 Steps for the Proposed System 81
3.2.8 Unified Modelling Language of the Proposed System 83
3.3 Datasets 84
3.4 Choice and Justification of Programming 87 3.5 Advantages of the Proposed System 87

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 System Requirements 88

4.2 Outputs and Discussion 88

4.2.1 Performance evaluation of the Existing and Proposed Systems 95

4.3 Discussion of Results 99

CHAPTER FIVE: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary 101

5.2 Conclusion 101

5.3 Recommendations 102

5.4 Contributions to Knowledge 102

5.5 Limitations to the Study 102

5.6 Future Work 102

References 103

Appendix A: Source Codes 106

Appendix B: Sample Outputs 152 Appendix C: Datasets 158

List of Tables

2.1 Further illustration of Fuzzy Logic 20

2.2 Fuzzy Logic Algorithm 28

2.3 Summary of Related Work 37

4.1 Detected Monitoring Possibility 95

4.2 Confusion Matrix Table 95

4.3 Performance Evaluation Matrix for Existing System 96

4.4 Detected Monitoring for Proposed System 96

4.5 Confusion Matrix Table 96

4.6 Performance Evaluation Matrix for Proposed System 97

List of Figures

2.1 A Typical Smart Agriculture Model 7
2.2 Images of Livestock Farming 9
2.3 Deep Learning 11
2.4 Illustration of Fuzzy Logic 20
3.1 Existing System Architecture 56
3.2 End-User Component of the Existing System 57
3.3 Knowledge-base Component of the Existing System 58
3.4 Inference Engine Component of the Existing System 59
3.5 User Interface Component of the Existing System 60

3.6	Farm Monitoring Component of the Existing System	61
3.7	Dataflow Diagram of the Existing System	63
3.8	Proposed System Architecture	66
3.9	End-user component of the Proposed System	67
3.10	Knowledge-base Component of the Proposed System	68
3.11	Inference Engine component of the Proposed System	69
3.12	User Inference Component of the Proposed System	70
3.13	Farm Monitoring Component of the Proposed System	71
3.14	Visualize Monitoring Component of the Proposed System	72
3.16	Rule-base Component of the Proposed System	74
3.17	Dataflow Diagram of the Proposed System	76
3.18	Frontend Interface Design of the Proposed System	80
3.19	Use-Case Activity Diagram of the Proposed System	82
3.20	UML Diagram of the Proposed System	83
3.21	Training Set	85
3.22	Test-Set	86
4.1	Netbeans IDE for Python	89
4.2	Welcome Page	90
4.3	Registration Page for New User	91
4.4	Login Page for registered users	92
4.5	Test-Set Input Page	93
4.6	Livestock and Visualization	94
4.7	ROC Curve	98

Abstract

Livestock farming comes with challenges such as exploitation by farmers, issues of expansion, economic volatility, input volatility, consumer retailer perception, poor animal health care and so on. The study intends to specifically focus on exploitation of livestock farming by farmers. This specific issue is associated with the concept of factory farming. Factory farming is the main cause of animal suffering and abuse. These silent victims have been converted into machines that generate meat, milk, and eggs. These animals are sentient beings with a desire to live, but are cruelly treated by the farmers that are supposed to manage them. In this work, an improved fuzzy-based model for monitoring livestock farming was developed. The study adopted Waterfall model

as methodology and implementation was achieved with Python Programming Language and MySQL as backend. The existing system adopted calibrated and uncalibrated measurement method and obtained an accuracy value of 59%, while the proposed system adopted confusion matrix as an evaluation technique and also obtained a ROC curve with accuracy value of 89%. The study will be beneficial to stakeholders in the Agricultural Sector and other researchers with keen interest in the study area.