

**BUSITEMA
UNIVERSITY**
Pursuing Excellence

**FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF COMPUTER ENGINEERING AND INFORMATICS
FINAL YEAR PROJECT REPORT**

**DESIGN AND IMPLEMENTATION OF A WEARABLE DEVICE FOR EARLY
DETECTION, MONITORING, AND ALERTING OF ASTHMA ATTACKS**

BY

NAME	REGISTRATION NUMBER
NAJJUKIRANGA LIZ NDAGAANO	BU/UG/2021/3417
ZZALWANGO JOANITAR	BU/UP/2021/1320

SUPERVISOR: PROF. OCEN GILBERT

**This Final Year Project Report is submitted to the Department of Computer Engineering
and Informatics in partial fulfillment of the requirement for the award of a Bachelor's
Degree in Computer Engineering of Busitema University**

May, 2025

DECLARATION

We, NALLUKIRANGA..LIZ..MAGANDA.. and ZALWANGO..JANITA.......do hereby declare that this project report was done by us and has never been submitted to any Academic Institution of Higher Learning for an academic award.

Signature: .....

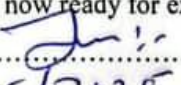
Date: 26th May, 2025.....

Signature: .....

Date: 26th May, 2025.....

APPROVAL

The final year report under the title “Design and Implementation of a Wearable Device for Early Detection, Monitoring, and Alerting of Asthma Attacks.” has been done under my guidance and is now ready for examination.

Signature 

Date ..26/05/2025.....

PROF. OCEN GILBERT

Department of computer engineering and Informatics

DEDICATION

WE dedicate this report to our lovely parents, classmates and our excellent supervisor **Prof. Ocen Gilbert**. We are very grateful for the support and endeavors done for us throughout our entire academic journey.

ACKNOWLEDGEMENT

We extend our sincere gratitude to the Almighty God for granting me the strength, wisdom, resilience, protection and provision throughout this project.

We are deeply thankful to our Supervisor, **Prof. Ocen Gilbert** for his dedicated support, advice and constant encouragement throughout the entire project. Our appreciation also goes to the entire Department of Computer Engineering and Informatics for the guidance as well as the technical knowledge applicable to the research and design of the system.

We are also grateful to Mr. Ojok Rogers, Dr. Mirondo Godfrey and all our classmates who have encouraged and supported us throughout this entire project.

LIST OF FIGURES

Figure 1: Showing Adruino Nano.....	14
Figure 2: Showing a led	15
Figure 3: Showing a buzzer	15
Figure 4: Showing pulse oximeter	15
Figure 5:Showing temperature sensor	15
Figure 6: Showing DHT11	16
Figure 7: Showing connecting wires.....	16
Figure 8: Showing a perforated board.....	16
Figure 9: Showing resistors	16
Figure 10: Showing system block diagram.....	18
Figure 11: Showing system flowchart	19
Figure 12:Showing physical design of the project.....	20
Figure 13: Showing Adruino display dimension	23
Figure 14:Showing Dashboard log In	26
Figure 15:Showing Vital signs displayed on Dashboard	27
Figure 16:Showing results on OLED screen.....	28
Figure 17:Showing dashboard with pulse trend graph.....	29
Figure 18:Showing vital signs on dashboard and SPO2 trend graph.....	30
Figure 19:Showing vital signs on dashboard and humidity trend.....	31
Figure 20:Showing recorded data for the parameters.	32

LIST OF TABLES

Table 1: Showing advantages and disadvantages of systems	8
Table 2: Showing the existing systems and the proposed system parameters.	10
Table 3: Showing average temperature, heart rate and SpO2 values.....	31

LIST OF ACRONYMS

API	Application Programming Interface
BPM	Beats Per minute
CSCS	Control System Computer Science
DHT11	Digital Temperature and Humidity Sensor
GPRS	General Packet Radio Service
GPS	Global Positioning System
IDE	Integrated Development Environment
LCD	Liquid Crystal Display
LED	Light Emitting Diode
MAX30102	Integrated pulse oximeter and heart rate monitor sensor
NCD	Non-communicable disease
NHS	National Health Service
PEFR	Peak Expiratory Flow Rate
SMS	Short Message Service
SpO2	Oxygen Saturation
UGX	Ugandan Shilling

TABLE OF CONTENT

Table of Contents

DECLARATION	Error! Bookmark not defined.
APPROVAL	ii
DEDICATION	iii
ACKNOWLEDGEMENT	iv
LIST OF FIGURES	v
LIST OF TABLES	vi
LIST OF ACRONYMS	vii
ABSTRACT	xi
CHAPTER ONE: INTRODUCTION	1
1.0 Introduction	1
1.1Background	1
1.2 Problem Statement	2
1.3 Objective	2
1.3.1 Main Objective:	2
1.3.2 Specific objectives	2
1.4 Justification	3
1.5 Significance	3
1.6 Scope.	4
1.6.1 Technical Scope	4
1.6.2 Geographical scope	4
1.6.3 Time scope	4
CHAPTER TWO: LITERATURE REVIEW	5
2.1 Introduction	5
2.2 Existing Systems	5
2.2.1 IoT-Based Cloud Smart Monitoring for Asthma Patients	5
2.2.2. Asthmate	5
2.2.3. Asthma Tracker App	5
2.2.4. Identi-Wheez	6
2.2.5. Asthma Severity Monitoring	6
2.2.6 Existing systems table.	6

2.3 The Developed System	9
CHAPTER THREE: METHODOLOGY.....	11
3.0 Introduction.....	11
3.1 Requirements gathering	11
3.2 Data Collection Methods	11
3.2.1 Literature Review	11
3.2.2 Interviews.....	11
3.3 Requirement Analysis.....	13
3.3.1 Functional requirements (<i>What the system should do</i>)	13
3.3.2 Non-functional requirements (System performance and quality attributes)	14
3.4 System Design.....	14
3.4.1 Hardware tools	14
3.4.2 Software Tools.....	16
3.4.3 System Block Diagram.....	17
3.4.4 Logical design	18
3.4.5 Physical design	20
CHAPTER FOUR: IMPLEMENTATION AND TESTING	21
4.1 System Analysis	21
4.1.1 Requirement Analysis	21
4.1.2 Stakeholder Analysis	21
4.2 System Design	21
4.3 System Implementation	22
4.3.1 Hardware implementation	22
4.3.2 Software Implementation	23
4.4 Development platforms	23
4.4.1 Arduino	23
4.4.2 Code Designs.....	24
4.5 Testing and validation	24
4.5.1 Unit testing.....	24
4.5.2 Integration testing.....	24
4.5.3 System testing.....	24
4.6 System Verification.....	24
4.7 Validation.....	25

CHAPTER FIVE PROJECT RESULTS.....	26
5.1 Result analysis	26
5.2 Testing results.....	28
CHAPTER SIX: RECOMMENDATION AND CONCLUSION.....	33
6.1 Introduction.....	33
6.2 Summary Critical Analysis of work done.....	33
6.3 Challenges faced.....	34
6.4 Recommendations	34
6.5 Conclusion	35
REFERENCES.....	36
APPENDICES.....	38
Appendix A: The code designs	38
Appendix B: Circuit and schematic diagrams	41
Appendix C: Developed system	42

ABSTRACT

Asthma remains a major global health concern, particularly in low-income regions where access to timely monitoring and management tools is limited. This project presents the design and development of an intelligent IoT-based wearable device aimed at the early detection, real-time monitoring, and alerting of asthma attacks. The system continuously tracks vital health parameters including heart rate, oxygen saturation (SpO₂), and body temperature, along with environmental factors such as humidity and ambient temperature, which are known asthma triggers. Using a combination of sensors integrated with an Arduino Uno microcontroller, the device processes sensor data to detect abnormal conditions and immediately notifies users and caregivers through local alerts (buzzer and LED) and remote SMS communication via a SMS API module. Additionally, a Cloud computing is incorporated to log health data for future medical analysis. The integration of IoT technology ensures seamless data transmission and enhances the ability to respond quickly to asthma risks. The system was evaluated through unit, integration, and system testing, confirming its effectiveness in providing real-time health monitoring, early detection of asthma symptoms, and timely emergency alerts, thus improving overall asthma management and patient outcomes

REFERENCES

- [1] “Asthma attack - Symptoms and causes - Mayo Clinic.” [Online]. Available: <https://www.mayoclinic.org/diseases-conditions/asthma-attack/symptoms-causes/syc-20354268>
- [2] S. G, V. K, R. S, J. A, and S. M, “An Advanced Air Quality Monitoring and Health Care for Asthma,” *Int. J. Res. Appl. Sci. Eng. Technol.*, vol. 12, no. 5, pp. 5513–5517, 2024, doi: 10.22214/ijraset.2024.62880.
- [3] T. Stockdale, “Asthma,” 2020. doi: 10.1177/026010600301700111.
- [4] B. W. Morgan *et al.*, “Asthma and Allergic Disorders in Uganda: A Population-Based Study Across Urban and Rural Settings,” 2018. doi: 10.1016/j.jaip.2017.11.032.
- [5] NHS, “Asthma - Causes - NHS,” 2021. [Online]. Available: <https://www.nhs.uk/conditions/asthma/causes/>
- [6] “Natural Asthma Remedies_ Nutrition, Garlic, Yoga, and More.”
- [7] P. García-Rivada, P. Fraga-Lamas, and T. M. Fernández-Caramés, “An Intelligent IoT Wearable for Monitoring and Preventing Asthma Attacks,” pp. 263–268, 2023, doi: 10.17979/spudc.000024.40.
- [8] T. G. Al-jaf and E. H. Al-hemiary, “Internet of Things Based Cloud Smart Monitoring for Asthma Patient,” no. April, 2020, doi: 10.25212/lfu.qzj.2.2.36.
- [9] A. Vasilateanu and A. Buga, “AsthMate - Supporting patient empowerment through location-based smartphone applications,” *Proc. - 2015 20th Int. Conf. Control Syst. Comput. Sci. CSCS 2015*, no. May 2015, pp. 411–417, 2015, doi: 10.1109/CSCS.2015.61.
- [10] S. R. Anan, M. A. Hossain, M. Z. Milky, M. M. Khan, M. Masud, and S. Aljahdali, “Research and Development of an IoT-Based Remote Asthma Patient Monitoring System,” 2021. doi: 10.1155/2021/2192913.
- [11] J. T. Oduor, “A Model for home-based remote monitoring of asthmatic patients,” 2017.
- [12] “Temperature, humidity and your asthma.”
- [13] J. Hopkins, “Vital Signs (Body Temperature, Pulse Rate, Respiration Rate, Blood Pressure) | Johns Hopkins Medicine,” 2020. [Online]. Available: <https://www.hopkinsmedicine.org/health/conditions-and-diseases/vital-signs-body-temperature-pulse-rate-respiration-rate-blood-pressure>

[14] M. Griffin, “Vital signs,” 2021. doi: 10.1300/J510v08n01_07.