



**BUSITEMA
UNIVERSITY**
Pursuing Excellence

P.O. Box 236, Tororo, Uganda
Gen: +256 - 45 444 8838
Fax: +256 - 45 4436517
Email: info@adm.busitema.ac.ug
www.busitema.ac.ug

FACULTY OF ENGINEERING

FACULTY OF ENGINEERING

DEPARTMENT OF COMPUTER ENGINEERING AND INFORMATICS

FINAL YEAR PROJECT REPORT

AN AUDIO-ENABLED SMART WHEELCHAIR

BY

SSEMAMBO CHRISTOPHER

REG NO: BU/UG/2019/0118

Tel: 0700997993/0788886684

Email: semachris6@gmail.com

SUPERVISOR: MR. ALUNYU ANDREW EGWAR

**A FINAL YEAR PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF
COMPUTER ENGINEERING IN PARTIAL FULFILLMENT FOR THE AWARD OF A
BACHELOR OF SCIENCE IN COMPUTER ENGINEERING OF BUSITEMA
UNIVERSITY**

September, 2023

DECLARATION

I SSEMAMBO CHRISTOPHER, hereby declare that this report, written in partial fulfilment of the requirement of the award of a Bachelor of Science in Computer Engineering degree at Busitema University, is my very own authentic work and the content of this document has never been submitted before to the Department of Computer Engineering and Informatics of Busitema University and any another institution of high education.

Signature 

SSEMAMBO CHRISTOPHER

Date 27.09.2023

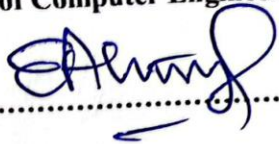
APPROVAL

This is to certify that the project entitled "AN AUDIO-ENABLED SMART WHEELCHAIR" has been produced under my supervision.

SUPERVISOR

NAME: Mr. Alunyu Andrew Egwar

Department of Computer Engineering and Informatics

Signature: 

Date: 06/10/2023

DEDICATION

I dedicate this report to God Almighty my creator, my strong pillar, my source of inspiration, wisdom, knowledge and understanding. He has been the source of my strength throughout this project and on His wings only have I soared.

I also dedicate this report to my family that has encouraged me all the way and whose encouragement has made sure that I give it all it takes to finish that which I have started.

God bless you.

ACKNOWLEDGEMENT

I convey my sincere gratitude to my Supervisor, Mr. Alunyu Andrew Egwar and the Department of Computer Engineering and Informatics for the guidance and insight into concepts of research and project management as well as technical knowledge applicable to the design of the system.

I am thankful to all my friends Ahimbisibwe Patricia (Course coordinator), and Faruk Toah who have been always helping and encouraging me throughout this project. I have no valuable words to express my thanks, but my heart is still full of the favors received from every person.

ABSTRACT

Wheelchairs are crucial for people with physical disabilities, but traditional manual handling can be challenging or impossible for those without hands or with age-related limitations. To address this, a voice-controlled wheelchair has been developed using Arduino and a voice recognition module. This system identifies spoken commands and matches them with actions predefined for the chair's motion. By converting voice commands into digital signals, the wheelchair responds accordingly. Through simple voice prompts, the wheelchair can navigate various directions effectively, enhancing mobility and comfort. This innovation empowers people who struggle with manually hand-controlling the wheelchair. However, current commands have been programmed in English. Future works should focus on customizing this innovation to respond to local languages such as Luganda, Swahili, and Luo, among others.

LIST OF ACRONYMY

AC: Alternating Current

ADC: Analog Digital Conversion

DC: Direct Current

LCD: liquid crystal display

RAM: Random Access Memory

ROM: Read Only Memory

CPU: Central Processing Unit

VRM: Voice Recognition Module

CMD: Command

WHO: World Health Organization

GSM: Global System for Mobile Communications

IDE: Integrated Development Environment

GPS: Global Positioning System

SMS: Short Message Service

Table of Contents

DECLARATION	Error! Bookmark not defined.
APPROVAL	Error! Bookmark not defined.
DEDICATION	iii
ACKNOWLEDGEMENT	iv
ABSTRACT	v
LIST OF ACRONYM	vi
CHAPTER ONE: INTRODUCTION	1
1.1 BACKGROUND	1
1.2 PROBLEM STATEMENT	4
1.3 OBJECTIVES	5
1.3.1 Main Objective:	5
1.3.2 Specific Objectives:	5
1.4 Significance of study	5
1.5 SCOPE	6
1.5.1 Technical Scope	6
1.5.2 Geographical Scope	6
1.5.3 Time scope	6
CHAPTER TWO: LITERATURE REVIEW	7
2.1 Main Concepts of the Project	7
2.1.1 Automated System	7
2.1.2 Microcontroller Technology	7

2.1.3 Sensor Technology	7
2.1.4 Motor Technology	8
2.1.5 GSM Technology	8
2.1.6 GPS Technology.....	8
2.1.7 Voice Recognition Module (VRM).....	8
2.2 Wheelchair Navigation Technologies	9
2.2.1 Manual Wheelchair.....	9
2.2.2 Power Wheelchair.....	9
2.3 Existing Wheelchair Navigation Systems	10
2.3.1 Gesture Controlled Wheelchair	10
2.3.2 Touch Screen-Based Wheelchair System.....	10
2.3.3 Hand Propulsion Wheelchair	11
2.3.5 Summary of The Existing Systems.	12
2.4 Developed System.....	12
CHAPTER THREE: METHODOLOGY	13
3.1 Data Collection Methods.....	13
3.1.1 Document Review/ Literature Review	13
3.1.2 Interview	13
3.1.3 Observation.....	13
3.1.4 Internet.....	14
3.1.5 Consultation.....	14
3.2 Requirement gathering	14

3.3 System Design.....	14
3.3.1 Hardware tools/components.	14
3.3.2 Software Tools.....	15
3.3.3 System Block Diagram.....	15
3.4 System Implementation.....	16
3.4.1 Hardware Implementation	16
3.4.2 System Testing and Validation.....	16
3.4.3 Unit Testing	17
3.4.4 Integration Testing.....	17
3.4.5 System Testing	17
3.4.6 Validation	17
CHAPTER FOUR: SYSTEM DESIGN AND ANALYSIS.....	18
4.1 System Analysis	18
4.1.1 Functional Analysis.....	18
4.1.2 Requirement Analysis	18
4.2 System Design.....	20
4.2.2 logical design	20
4.2.1 The Physical Design	22
CHAPTER FIVE: IMPLEMENTATION AND TESTING	23
5.1 Introduction	23
5.2 Development platforms	23
5.2.1 Arduino.....	23

5.2.2 Proteus Design Suite.....	23
5.3 Code Designs.....	23
5.4 Testing.....	23
5.4.1 Unit Testing.....	24
5.4.2 Integration Testing.....	31
5.4.3 System Testing.....	32
5.4.4 System Verification.....	32
5.4.5 System Validation.....	33
5.5 System Operation.....	33
CHAPTER SIX: DISCUSSIONS AND RECOMMENDATIONS.....	35
6.1 Introduction.....	35
6.2 Summary of work done.....	35
6.3 Critical Analysis / Appraisal of the work.....	35
6.4 Recommendations.....	35
6.5 Conclusion.....	36
REFERENCES.....	37
APPENDICES.....	38
Appendix A. Circuit diagram.....	38
Appendix B. Project code.....	38

List of Figures

Figure 1: Showing the system block diagram	16
Figure 2: Showing the flowchart of the system.....	21
Figure 3: Showing the physical design.....	22
Figure 4: Showing the VRM training	24
Figure 5: Showing the GSM	28
Figure 6: Showing the emergency button	29
Figure 7: Showing the message received by the care giver.....	29
Figure 8: Showing the messages received	30
Figure 9: Showing the location of the wheelchair user	31
Figure 10 showing the circuit diagram.....	38

List of Tables

Table 1: Showing Summary of existing systems.	12
Table 2: Showing symbols used in a flowchart	20

CHAPTER ONE: INTRODUCTION

1.1 BACKGROUND

Disability is a natural aspect of the human experience that arises from a complex interplay of health conditions and impairments, such as spinal cord injury, blindness, or dementia, with various contextual factors, such as societal attitudes, access to infrastructure, age, gender, and discriminatory policies. These factors create varying levels of disability, which can affect an individual's physical, mental, and social functioning, resulting in significant limitations in their daily lives. As such, disability should be understood and addressed within the broader social and environmental context in which it occurs.[1]

As of 2021, approximately 1.3 billion people – about 16% of the global population – have a disability. This number has increased substantially during the past decade due to different demographic and epidemiological changes such as population rising and the increase in the number of people with noncommunicable diseases, living longer and ageing with limitations in functioning.[2]. Trends influence patterns of disability in a particular country in health conditions and trends in the environment. The other factors include road traffic crashes, natural disasters, conflict, diet, and substance abuse.

In Uganda, according to the 2014 National Housing and Population Census¹, 12.5% of the population have at least one disability, which is expected to increase due to ageing and chronic illness. Disability is, therefore, a significant source of vulnerability. For the population of Children with Disabilities (CWD), data remains scarce. An analysis on the situation of the rights of children with disabilities in Uganda estimates that 13% or approximately 2.5 million children live with some form of disability. The report points to significant gaps in the disaggregation of data by gender and types of disabilities and the overall inexistence of accurate national data.[3]

The National Household Survey 2005/2006 estimated that 7% of Uganda's population had a disability. Physical impairments account for the highest form of disability (34%), followed by visual impairments (22%) and hearing difficulties (15%). Other impairments include mental, speech and learning disabilities.

REFERENCES

- [1] World Health Organisation, “WHO Policy on Disability,” WHO Policy Disabil., pp. 1–16, 2021, [Online]. Available: <https://www.who.int/publications/i/item/9789240020627>
- [2] E. Guanabara, K. Ltda, E. Guanabara, and K. Ltda, Title :Covariance structure analysis of health-related indices in the elderly at home, focusing on subjective health.
- [3] Unicef, “Investing in Social Protection in Uganda : The case for the expansion of the Senior Citizens ’ Grant Older persons,” no. 3, pp. 1–4, 2017, [Online]. Available: [https://www.unicef.org/uganda/media/1736/file/The case for the Disability Grant.pdf](https://www.unicef.org/uganda/media/1736/file/The%20case%20for%20the%20Disability%20Grant.pdf)
- [4] WHO, “Er Health for All Better People Health With for Disability All People With Disability,” World Heal. Organ., pp. 1–32, 2015.
- [5] A. H. Eide and B. Ingstad, Disability and Poverty: A Global Challenge. 2011. doi: 10.51952/9781847428868.int001.
- [6] N. Voorneveld and I. Design, “An Assessment of Wheelchair Provision in the Majority World With a Focus on Uganda through Fieldwork by Neil Voorneveld A thesis submitted to the Faculty of Graduate and Postdoctoral A ff airs in partial ful fi llment of the requirements for the degree of,” 2015.
- [7] M. F. Schuntermann, “The International Classification of Impairments, Disabilities and Handicaps (ICIDH) - Results and problems,” Int. J. Rehabil. Res., vol. 19, no. 1, pp. 1–11, 1996, doi: 10.1097/00004356-199603000-00001.
- [8] M. Boninger, “The Power Wheelchair: What the SCI Consumer Needs to Know,” SCI Model Syst., 2011.
- [9] P. W. Components, “Spinal Cord Injury Model System Consumer Information The Power Wheelchair What the SCI Consumer Needs to Know,” 2011, [Online]. Available: <http://www.msktc.org/>
- [10] F. John, J. Shaju, M. K. Mathai, and M. Seby, “Gesture Controlled Wheelchair,” vol. 4, no. 3, pp. 1–5, 2019.
- [11] V. G. Posugade, K. K. Shedge, and C. S. Tikhe, “Touch-Screen Based Wheelchair System,” Int. J. Eng. Res. Appl., vol. 2, no. 2, pp. 1245–1248, 2012, [Online]. Available: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.416.8506&rep=rep1&type=pdf>
- [12] B. S. Romero, B. D. Bayes, T. Island, P. E. A. Marmor, and A. E. Camby, “United States Patent (19) U . S . Patent,” no. 19, 1989.