**Virtual World Navigation Hat – Development of Visual Sensory Substitution Device  
through Point Cloud Projection and IoT services for the Visually Impaired**

An Undergraduate Design Project Presented to Faculty of the  
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**TABLE OF CONTENTS**

[**LIST OF TABLES** 3](#_Toc209388235)

[**LIST OF FIGURES** 4](#_Toc209388236)

[**INTRODUCTION** 5](#_Toc209388237)

[**Background of the Study** 5](#_Toc209388238)

[**Rationale** 5](#_Toc209388239)

[**Objectives of the Study** 5](#_Toc209388240)

[**General Objectives** 5](#_Toc209388241)

[**REFERENCES** 5](#_Toc209388242)

# **LIST OF TABLES**

# **LIST OF FIGURES**

# **INTRODUCTION**

## **Background of the Study**

Visual impairment affects a significant portion of the global population, with varying degrees of severity that impact daily life, mobility, and social integration. According to the World Health Organization (WHO), approximately 2.2 billion people worldwide experience near or distance vision impairment, of which at least 1 billion cases could have been prevented or remain unaddressed (W.H.O., 2023). Among these, 43.3 million individuals are fully blind (visual acuity worse than 3/60 in the better eye), while 295 million suffer from moderate to severe visual impairment (visual acuity between 3/60 and 6/18) (Lijuan Que, 2025). Common types include refractive errors such as near-sightedness (myopia) and far-sightedness (hyperopia), which account for a large share of impairments, alongside conditions like cataracts, glaucoma, and age-related macular degeneration (AMD), with AMD alone affecting 8.06 million people globally in 2021 (Yon, 2025). In the Philippines, an estimated 2.17 million people live with visual impairment, including approximately 592,000 who are fully blind and over 2.1 million with low vision or moderate impairments (Cubillan, 2025). Refractive errors and cataracts are predominant, with blindness rates at about 0.89% and moderate to severe visual impairment (MSVI) at 4.71% (Norton, 2024). In Iloilo, part of Western Visayas, regional surveys indicate a blindness prevalence of around 2.6-3.0% in adults aged 50 and older, primarily due to avoidable causes like cataracts, aligning with national trends but with limited city-specific data (Cristina Eusebio, 2007).

Visual sensory substitution devices (SSDs) convert visual information into alternative sensory modalities, such as auditory or haptic feedback, to assist the visually impaired in perceiving their environment (Otilia Zvorișteanu, 2021). These devices could significantly enhance independence by enabling obstacle detection, navigation, and object recognition, particularly for the fully blind who rely on traditional aids like white canes or guide dogs. However, SSDs are not widely adopted globally due to challenges such as cognitive overload from processing substituted sensory data, extensive training requirements for intuitiveness, ergonomic discomfort in wearables, and processing constraints of non-visual senses like hearing or touch, which have lower bandwidth than vision (Hoffmann, Spagnol, Kristjánsson, & Unnthorsson, 2018). Our study attempts to address these through three major solutions: creating virtual worlds for tracking physical and digital environments, emulating human visual processing techniques to reduce overload, and implementing a modular IoT-connected system for customization. The final objective is to advance SSDs and test their potential for societal-wide implementation, overcoming barriers to real-world use.

## **Rationale**

## **Objectives of the Study**

### **General Objectives**

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