**VIRTUAL WORLD NAVIGATION HAT – DEVELOPMENT OF SENSORY SUBSTITUTION DEVICE THROUGH POINT CLOUD PROJECTION WITH IOT SENSORS FOR THE VISUALLY IMPARED**

An Undergraduate Design Project Presented to

Faculty of the Computer Engineering Department

College of Technology

University of San Agustin

 In Partial Fulfillment of the

Requirements of the Course

CPE 413 – CpE Practice and Design I

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**General Objective:**

**Specific Objectives:**



**Significance of the Study**

**Conceptual Framework**

**Figure 1**

*IPO Model of the Controlled System*

**Theoretical Framework**

**Figure 2**

*IOT System Architecture of (the whole system)*

**Figure 3**

*Basic Architecture of and Embedded System (whole system)*

**Figure 4**

*Flow chart of the AI in the System (specify what’s the AI system used)*

**Figure 5**

*Process flow of the System (whole system)*

**Scope and Delimitations**

**REVIEW OF RELATED LITERATURE**

1. **Related Studies**

**Sensory Substitution and Assistive Technology**

Study-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------- **Studies on sensory substitution devices for the visually impaired (e.g., auditory or tactile feedback) to enhance environmental perception.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research on the Neuroscience of sensory substitution, specifically how the brain adapts to information presented through non-visual channels (like sound or touch).** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Work on assistive technology for blind individuals, including electronic navigation aids and their effectiveness in real-world environments.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Point Cloud Projection for Navigation** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research on point cloud data and its application in environmental modeling (e.g., creating 3D maps of environments).** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Use of 3D point cloud data in robotics and autonomous navigation to help with the precise location of objects in real-time.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Previous work on point cloud visualization technologies and haptic feedback systems for improving spatial awareness in visually impaired individuals.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**IoT Sensors in Assistive Devices** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research on IoT sensors and their integration with assistive technologies, including their role in providing real-time environmental data for blind users.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**The use of wearable IoT devices (such as smart glasses, smart hats, or vests) for real-time navigation and obstacle detection.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Investigations on sensor fusion (e.g., combining ultrasonic, infrared, and vision sensors) to improve the accuracy of navigation systems for the blind.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Haptic Feedback and Tactile Interfaces** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Studies on haptic feedback technology for navigation, including wearable devices that convert data into tactile sensations.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research on the integration of tactile feedback with auditory cues, allowing visually impaired users to navigate using both sensory modalities.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Development of wearable tactile systems (e.g., vests, gloves, or headgear) to assist in guiding users based on real-time environmental data.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Wearable Technology for the Visually Impaired** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research on the development of wearable devices such as glasses, hats, or vests that use various sensory inputs (like sound or touch) to help blind individuals navigate.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Work on the development of smart hats and headgear with built-in sensors for location tracking and environmental mapping.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Navigation Aids for the Visually Impaired** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Studies exploring the effectiveness of wearable navigation aids, including systems that combine environmental sensing, GPS, and real-time feedback.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Exploration of real-time object detection and collision avoidance systems for visually impaired individuals, using sensors such as ultrasonic, LiDAR, or radar.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Investigation of auditory navigation aids, such as real-time audio feedback systems that guide the user through audio cues about their environment.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**User Experience and Usability of Assistive Devices** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**User studies on the usability and accessibility of wearable technologies for the blind and visually impaired.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Research into the human factors in the design of assistive devices, focusing on comfort, ease of use, and learning curve.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**User-centered design principles and testing of tactile and auditory interfaces in sensory substitution devices.** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

1. **Review Literature**

**Sensory Substitution and Assistive Technology for the Visually Impaired**

Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Assistive Devices for Navigation** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Point Cloud Projection and 3D Mapping** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Point Cloud Technology in Environmental Mapping** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**3D Mapping for Navigation** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Internet of Things (IoT) Sensors in Assistive Technologies** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Role of IoT Sensors in Navigation** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**IoT Sensor Fusion** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Haptic Feedback and Tactile Interfaces for Visually Impaired Users** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Haptic Feedback for Navigation**

Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Wearable Tactile Interfaces** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Integration of Wearable Technologies for Visually Impaired Individuals** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Wearable Smart Devices**

Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**Human-Computer Interaction and User Experience** Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**User-Centered Design for Assistive Devices**

Study--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

**METHODS AND MATERIALS**

**A. METHODS**

**A.1 Research Design/ Methods**

*In paragraph form*

**B. MATERIALS**

**B.1 Materials and Processes**

*In paragraph form*

**B.2. Hardware Material Specifications**

*In paragraph form*

**B.3. Software Specification**

*In paragraph form*

**B.4. Library and Board Managers**

*In paragraph form*

**B.5. Other Materials / Equipment/ Devices**

*In paragraph form*

1. **PROTOTYPE BUILDING AND PROCEDURES**

**Figure 6**

*Engineering Design Process*

**C.1. Construct a Prototype**

*Explain here your Prototyping methods*

**Figure 7**

*Prototyping Method*

**C.1.A. Prototype Design**

**Figure 8**

*Front Design of (systems name)*

Front (AutoCAD or Sketch Up)

**Figure 9**

*Back Design of Systems name*

Back (AutoCAD or Sketch Up)

*Insert explanation about the prototype design*

**Figure 10**

*Hardware Design of (System)*

Front (AutoCAD or Sketch Up) Back (AutoCAD or Sketch Up)

*Insert explanation about the hardware design*

**Figure 11**

*Hardware Design of (System)*

Front (AutoCAD or Sketch Up) Back (AutoCAD or Sketch Up)

*Insert explanation about the hardware design*

**C.1.B. Frame**

*Insert here why you chose that type of framing.*

**Figure 12**

*Illustration of Frame for (System Name)*

Front (AutoCAD or Sketch Up) Back (AutoCAD or Sketch Up)

**C.1.C. Hat Design**

*Insert here why you chose that type and design of the Hat.*

**Figure 13**

*Illustration of Hat of the System*

Front (AutoCAD or Sketch Up) Back (AutoCAD or Sketch Up)