uOttawa
Faculté de génie
Faculty of Engineering

TEAM 3
GNG 1103 PROJECT

Deliverable D - Conceptual Design

Sum Ki Kelsie Ling

Roz Diella Tikum Ngo Sii

Thomas Harvey

Stephanie Chiamaka Obasi

10th October 2024

Abstract

In this deliverable, previously developed user and technical benchmarking and design criteria are analysed and evaluated to develop subsystems and their conceptual designs, which is then further discussed and defined to determine the final functional solution.

Table of Contents

1 Introduction

Based on the problem statement, the team defines boundaries for each individual subsystem and sketch, which are then evaluated against benchmarking and design criteria using a selection matrix. Based on these conceptual designs, three global concepts are created, combining the subsystem ideas. In the end, a final functional solution is refined for prototyping and development.

2 Defining the Subsystems

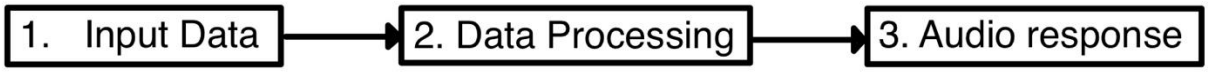
Following the identification of the user needs, four distinct subsystems were identified to achieve and meet the design criteria. There are two main systems, audio and visual, which each have an input in which data is collected, and an output in which the data is processed, and a desired result is produced.

For the data input, two hardware components are used: a camera in which visual data is collected, and a microphone where audio is received. For the output, again two hardware components are used: visual display and the speakers corresponding to the visual and audio systems respectively. Each hardware component matches up to a subsystem.

A basic prototype and the general concept of each subsystem are defined below.

a) <u>Audio</u>

- Directional/navigational assistance
- Object identification audio
- Environmental awareness (audio cues for approaching objects)



Input Data

Data is received inputted either through the camera (ex. approaching obstacles) or through the voice assistance (ex. activation of navigation software).

1. Data Processing

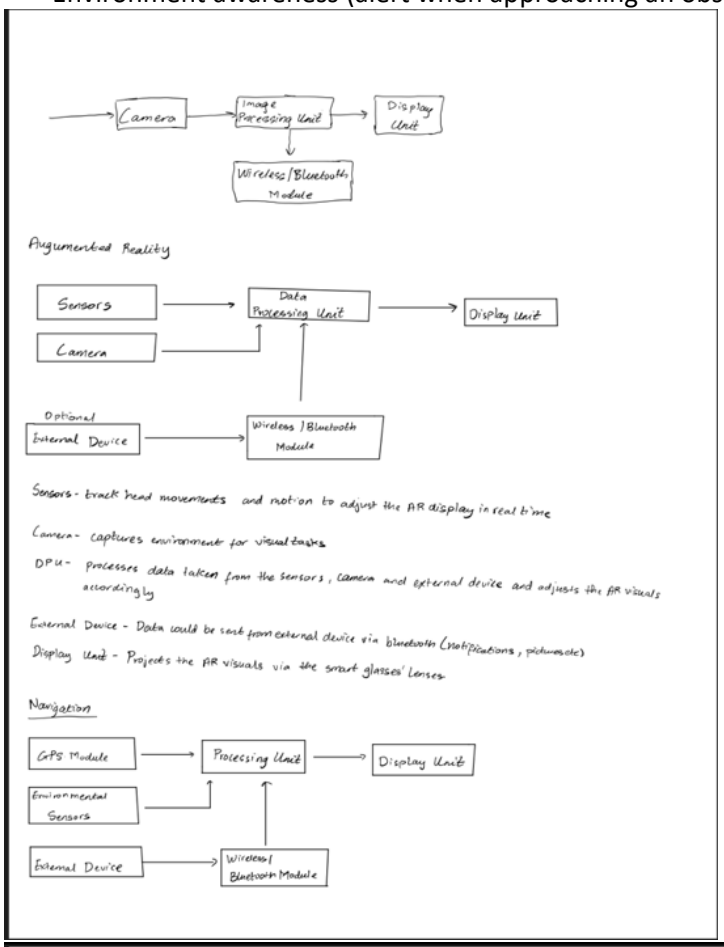
The data inputted is processed to determine what the desired audio response would be.

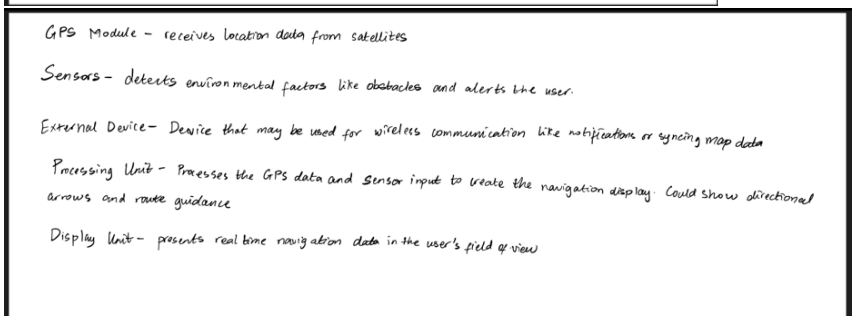
2. Audio Response

Audio is produced through the speaker to alert and direct the user (ex. a noise alerting user of the approaching object, or navigation assistance alerting t ed.

b) **<u>Visual Display</u>**

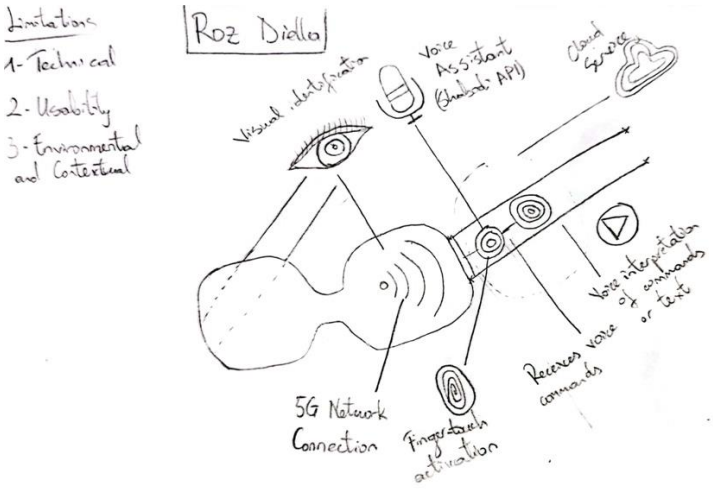
- Visual display of directions
- Environment awareness (alert when approaching an obstacle)





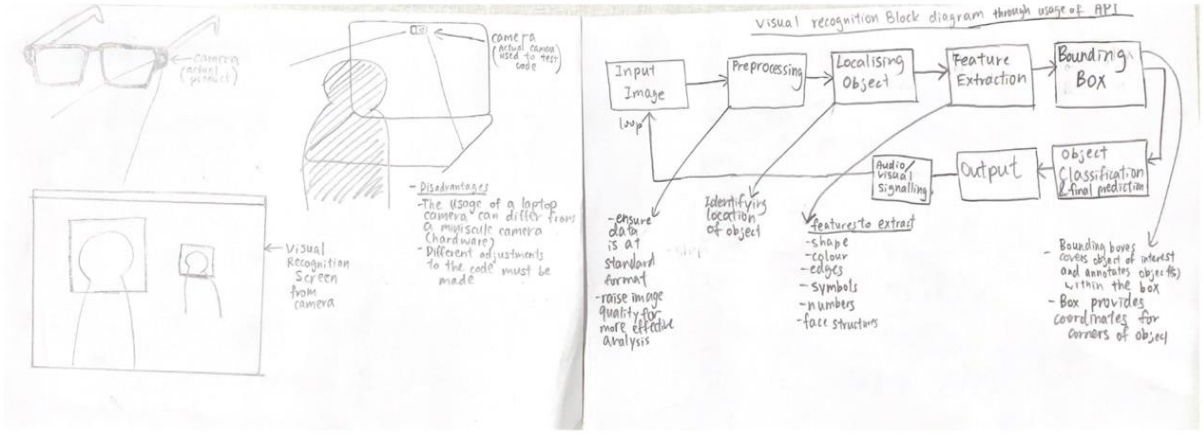
c) **<u>Voice Assistance</u>**

- Activation of APIs via voice
- Functionality and command within each API



d) **Visual Recognition**

- Object identification
- Face recognition
- Currency recognition



3 Identification of Global Concepts

Three different global systems were identified by using the subsystems found. These global concepts make use of different APIs and perform different functions.

3.1 Global Concept 1

A system that focuses on street navigation and warns of danger. This includes an API that recognizes text and images and presents them via voice assistance from a speaker next to the ear on the glasses, such as detecting text and colors road signs and reading them aloud, which are immediate responses made possible by Shabodi API. However, the main hazard on the streets is getting into car accidents or collisions with other individuals in a crowd, so there could be a feature that detects objects quickly approaching the camera and emits a shrill warning via audio or red flashing lights in peripheral to prevent accidents.

3.2 Global Concept 2

The Augmented Reality (AR) systems allow hands free interactions for navigation and notifications. This API helps display real time directions on the smart glasses lenses and enhances the user's experience by immersion. However, it could also pose a distraction risk which could lead to safety risks in busy environments.

3.3 Global Concept 3

Design of smart glasses to integrate voice assistant and the corresponding API, factors like User interaction and technical integration. The API should be able to control basic functions of the glasses. Process voice-activated commands and produce a voice-given response. These tasks should enhance the hands-free, heads-up, and situational awareness benefits of smart glasses.

- Real-time information and assistance (GPS, weather updates, time and date updates).
- Hands-free messaging and calling (with reference words, like "Send a message to David, I'll be there in 10".
- Media control and playback, contextual adaptation (location-based triggers should enable insights or help).
- Noise adaptations, due to environmental conditions.
- Error detection and handling
- Cloud storage and service.

Devices such as MAD Gaze glasses offer a Software Development Kit (SDK) for developers, facilitating the integration of advanced video-streaming features and voice commands. Similarly, Google Glass has built-in APIs for live video streaming and voice-based command recognition, useful for troubleshooting and remote assistance applications [1] [2]

3.4 Selection Matrix

Contrasting and comparing each of the 3 global concepts against the design criteria was facilitated visually using a selection matrix. Ideal/best options for each criterion was highlighted in green with the worst in red, while the medium cases are shown in orange.

	Global concept 1	*Global concept 2*	*Global concept 3*
Usage of video	*High*	*High*	*Medium*
Usage of audio	*High*	*High*	*High*
Distance detection	*High*	*Medium*	*Medium*
Assistance in daily tasks	*Low*	*Low*	*High*
Navigation	*High*	*High*	*Medium*
Safety	*High*	*Medium*	*Low*
Expandable/adaptable	*High*	*Low*	*High*
Costs	*Low Cost*	*High*	*Medium*
Quantity of API usage	*Medium*	*Low*	*High*

Table 1: Selection Matrix

4 Final Idea and Recommendations

According to the selection matrix, global concept 1 is the best option and is chosen for further development. It is the optimal choice because it is being ranked high in most aspects, such as usage of video, audio, distance detection etc.

However, the global concept is low in the assistance in daily tasks, therefore potentially incorporating hands-free messaging and calling, weather report (from global concept 3) and currency recognition could substantially increase aid. It should be noted that any visual or audio notifications should be reduced as much as possible to reduce distractions, sacrificing safety for the customer, which contributed to the low safety aspect of global concept 2 and 3 in the selection matrix. Furthermore, it is important to keep in mind the flexibility and the expandability of the software, as the aim of the project is to create a software for Shabodi for further development and not a smart glasses product, which is one of the drawbacks of the other 2 global concepts.

5 References

1. "Smart Glass for Visually Impaired Person." *Intelligent Systems, Business, and Innovation Research*, edited by Rim El Khoury and Nohade Nasrallah, vol. 489, Springer, 2024, pp. 1–22, https://doi.org/10.1007/978-3-031-36895-0_52.
2. MAD Gaze. "MAD Gaze Smart Glasses and SDK." *MAD Gaze: Smart Eyewear for Consumers and Developers*, 2023, www.madgaze.com/sdk. Accessed 13 Oct. 2024.
3. Shunaran, Anas, et al. "Design of Visually Impaired Glass Using ARM Processors." *International Journal of MC Square Scientific Research*, vol. 9, no. 3, 2017, pp. 55–60. ResearchGate, https://www.researchgate.net/publication/321489654.