Smart Glasses

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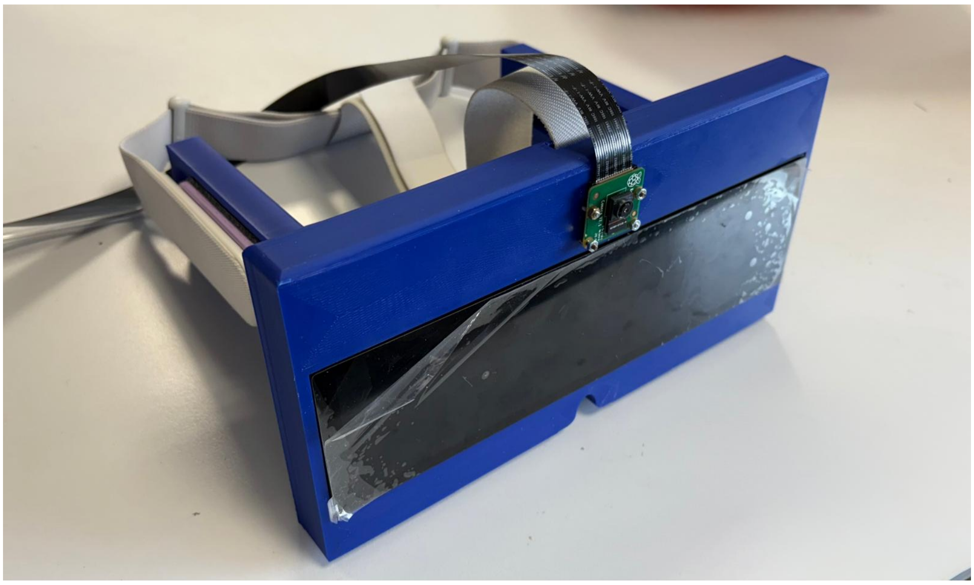
Master 2 : MSR 2025-2026



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1 Introduction

1.1 Project Context

With the rise of wearable technology, smart glasses are undergoing significant development. Companies such as Meta, with their Ray-Ban Meta glasses, are now offering devices capable of capturing images and video, interacting via voice commands, and accessing AI-based assistants.

At the same time, within the field of assistive technology, several research projects and commercial products aim to support visually impaired or blind individuals specifically through obstacle detection, scene description, and the reading of visual information. Furthermore, recent breakthroughs in artificial intelligence, particularly in natural language processing (NLP) and computer vision, are opening up new possibilities to enhance visual assistance tools.

1.2 Objectives

In this context, our project follows a similar path, but with a specific focus on social interaction and assistance. The objective is to design smart glasses capable of detecting both the emotions of the person facing the user and any obstacles within the environment.

However, to ensure reliable operation and straightforward interaction, these two features do not run simultaneously. The system is organized into different operating modes, accessible through an interface of physical buttons integrated into the glasses. This allows the user to switch between "obstacle detection" and "emotion detection" modes, depending on their immediate needs.

This approach simplifies data processing, improves the clarity of haptic feedback, and provides the user with greater control over the device's behavior.

2 Materials Used

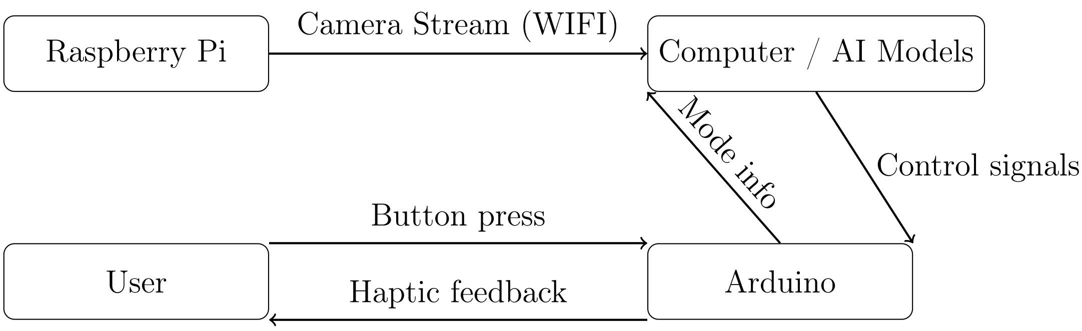
Component	**Number**	**Reference / Model**	**Description / Role**
Camera	1	Camera Raspberry module 2	Sony IMX219 8-megapixel sensor
Raspberry Pi	1	Raspberry Pi 3B+	Used to process image data and send it to the computer
Arduino	1	Arduino Uno	Used to control the haptic feedback system (ie pneumatic actuators...)
Differential Pressure sensor	2	DFRobot SEN0343	Used to detect pressure into balloons
Motor driver	3	L298N	Used to control 2 motors per driver
Valves	2	DFR0866	Used to switch between inflate and deflate

Component	Number	Reference / Model	Description / Role
Pumps	4	DFRobot 370 Mini Vacuum Pump	2 used to inflate and 2 to deflate balloons
Balloons	2	Standard party balloons	Used to do haptic feedback
Push buttons	2	Standard push buttons	Used to switch between modes
Computer	1	PC linux	Used to run the AI models for emotion and obstacle detection
Battery 12V	1	lead acid battery 12V	Used to power the pumps
Battery 5V and <2.5A	2	Standard Power bank 5V	Used to power the Raspberry Pi and Arduino

TABLE 1: Main hardware components used in the project

3 Implementation

3.1 Overall Architecture



3.2 Camera and Raspberry pi

Initially, we attempted to implement a stereo camera system using an Arducam module to obtain depth information directly from two synchronized camera feeds. However, the image quality was insufficient for reliable image processing, which led to poor performance in depth estimation. Moreover, the Raspberry Pi 4B frequently crashed when using the Arducam module, likely due to insufficient processing power and high resource demands of the stereo setup. This instability made the configuration unreliable for real-time operation.

As a result, we switched to using a single camera, combined with AI processing on the computer block to infer depth information from the captured images. This approach allowed us to maintain accurate obstacle and emotion detection while simplifying the hardware setup.

For transmitting the camera stream, we initially experimented with USB gadget mode on a Raspberry Pi 4B. However, this setup proved unstable and presented power supply challenges, as the USB port could not simultaneously provide enough power and transmit data reliably.

To overcome these issues, we opted for a Raspberry Pi 3B+ equipped with Wi-Fi for streaming the camera feed to the computer. Although this solution introduces a small amount of latency, it provides a stable and functional system for real-time image analysis.

All the configuration steps and installations required to use the Raspberry Pi 3B+ with Wi-Fi for the system are detailed in the file `procedure_camera.md`.

3.3 Pneumatic/haptic system

3.4 Computer and AI models

3.5 User Interface + CAD Design

4 Fonctionnalités

5 Objectifs initiaux et limites du projet

6 Pistes d'amélioration