Camera_

Hardware Selection

Objective : To capture reliable images inside a refrigerator container.

Caméra

The selected camera should feature a native CSI connector for direct integration with the Raspberry Pi, a fixed lens with adjustable focus optimized for the average distance inside the container, and low noise performance in low-light conditions to ensure high-quality, reliable images within the refrigerator environment.

Recommended parts :

- Official IMX219 Camera Module (8 MP) :
  An economical, fully supported by the Raspberry Pi, ideal for lightweight embedded applications.
- IMX477 High Quality (HQ) Camera Module :
  A compact yet more powerful option, offering higher image quality and better performance in low-light conditions.

Integrated lighting

A small diffused white LED, powered through a GPIO pin with a resistor and activated by a script before capture, ensures clear images even in the darkness of the refrigerator, while avoiding glare or harsh shadows through the use of a plastic diffuser.

Recommended parts :

- Kingbright WP710A10WDT or any 5 mm diffused white LED (150 Ω resistor)
- Waveshare Camera LED Ring Light for Raspberry Pi

Connectique

15-pin CSI ribbon cable, with a maximum length of 10–15 cm to avoid signal interference.

Software Architecture

Objective : Develop a robust, simple, and lightweight embedded AI solution.

- *Camera capture and driver :* libcamera + Picamera2. Modern stack officially maintained by the Raspberry Pi Foundation.

- *Image processing :* OpenCV . Used for image cropping, resizing, and preprocessing before inference.

Recommended Camera Parameters

Parameter	Recommended Value	Justification
Resolution	640×480 or 800×600	*Sufficient for food classification while reducing computation time*.
Format	JPEG	*Good balance between image quality and file size.*
Capture frequency	1 photo every 10–30 minutes or triggered when the container is opened	*Optimizes energy and resource usage.*
Exposure	Automatic at startup, then fixed	*Ensures consistent image brightness across captures.*
White balance	Fixed based on LED lighting	*Maintains stable color tones.*
Focus	Manually adjusted fixed lens	*Guarantees sharp images at a defined distance inside the container.*