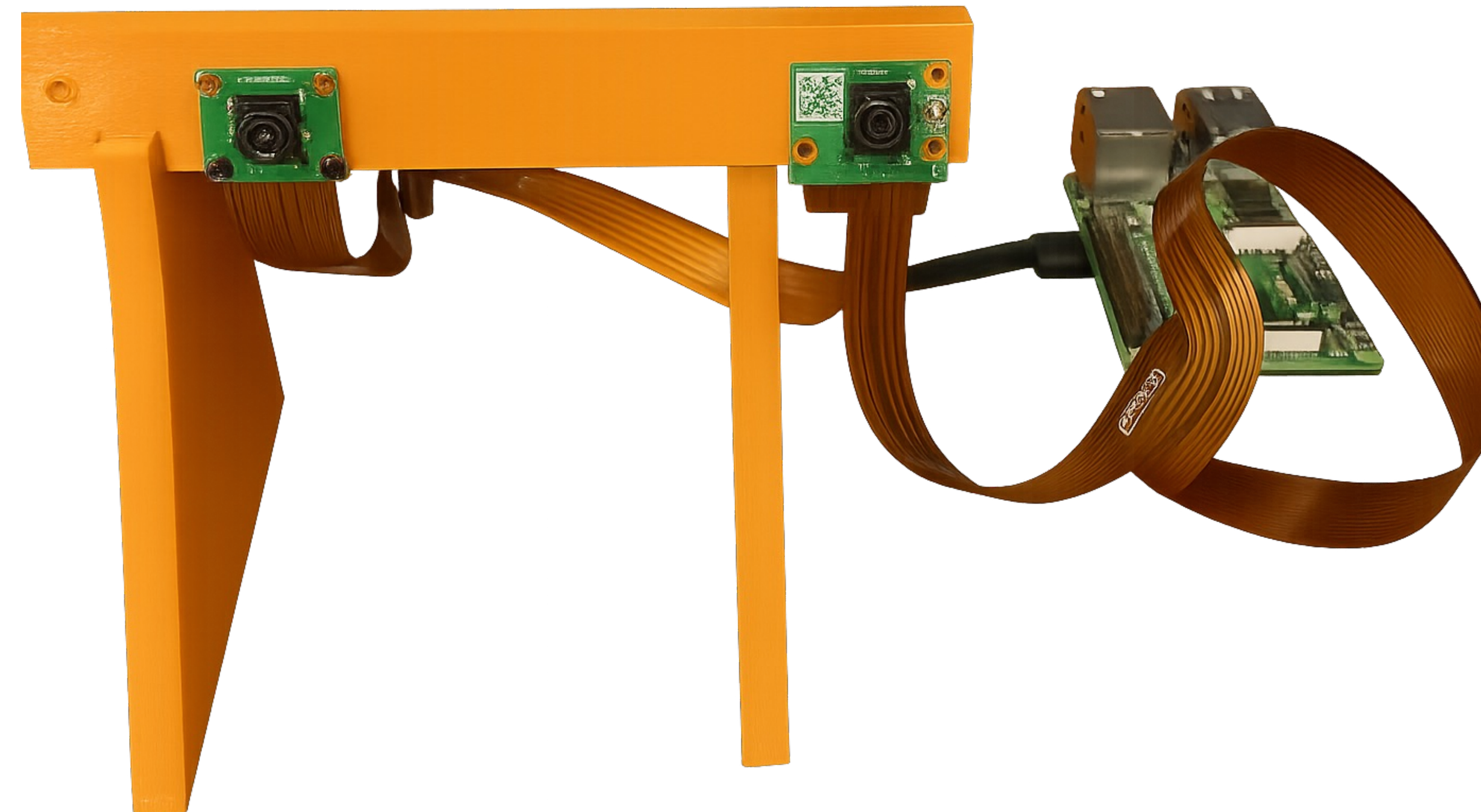


Background & Motivation

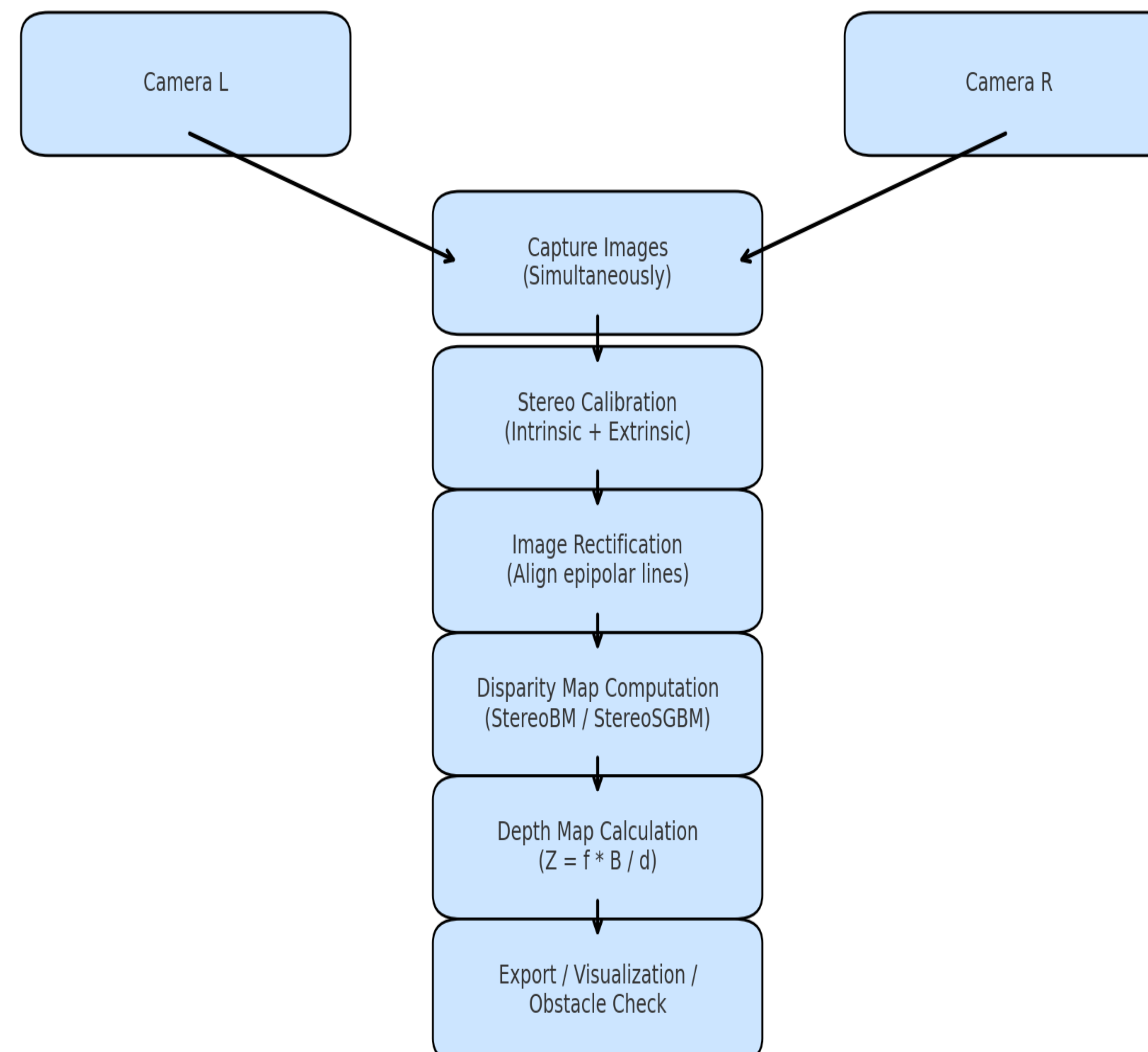
- Navigating Carroll College's campus in Montana during winter is often hindered by icy and snow-covered pathways. Snow removal is necessary but highly labor-intensive, especially during frequent and heavy snowfall.
- To address this challenge, robotic automation presents a promising solution—reducing the physical burden on human workers and ensuring timely maintenance. However, snow presents unique visual challenges due to its reflective, low texture, and often uniform appearance, making accurate environmental perception difficult.
- This project explores stereo vision-based depth estimation as a core component of an autonomous snow-shoveling system, offering a cost-effective alternative to LiDAR for obstacle detection and terrain mapping.

Goal

Building depth estimation algorithm using two parallel cameras for full autonomous snow shoveling robot



Flowchart



<https://opencv.org/media-kit/>

Technical Concepts

- **Baseline (B):** Distance between the two cameras
- **Focal Length (f):** Obtained via calibration
- **Disparity (d):** Pixel difference between the same object point in left and right images
- **Depth (z):** Calculation using $z = f * B / d$ for each

Hardware Setup

- Two identical Raspberry Pi Cameras: Mounted in parallel on a fixed baseline, the distance between cameras is known
- Embedded System: Raspberry Pi 5 running on Linux so computational work can be done
- Mounting Rig: Ensures rigid alignment between two cameras

<https://chatgpt.com/>

