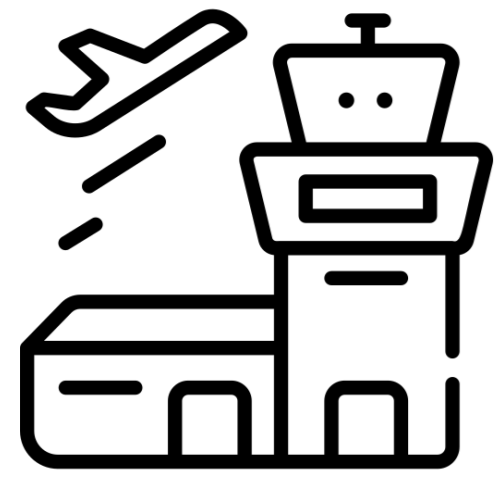# 3DMovieMap: An Interactive Route Viewer for Multi-Level Buildings

Seita Kayukawa[1,2]   Keita Higuchi[3]   Shigeo Morishima[1]   Ken Sakurada[4]
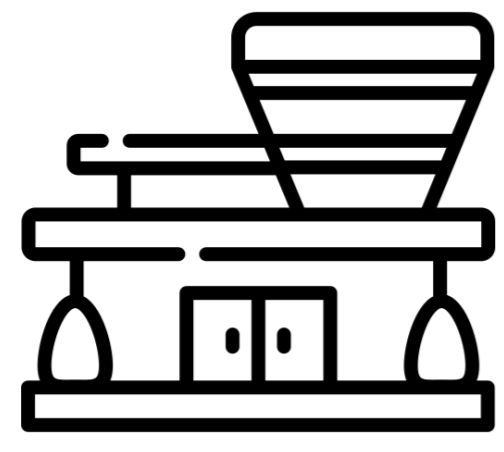
1 Waseda University   2 Miraikan - The National Museum of Emerging Science and Innovation   3 Preferred Networks   4 National Institute of Advanced Industrial Science and Technology (AIST)

Introduction

Multi-level Buildings

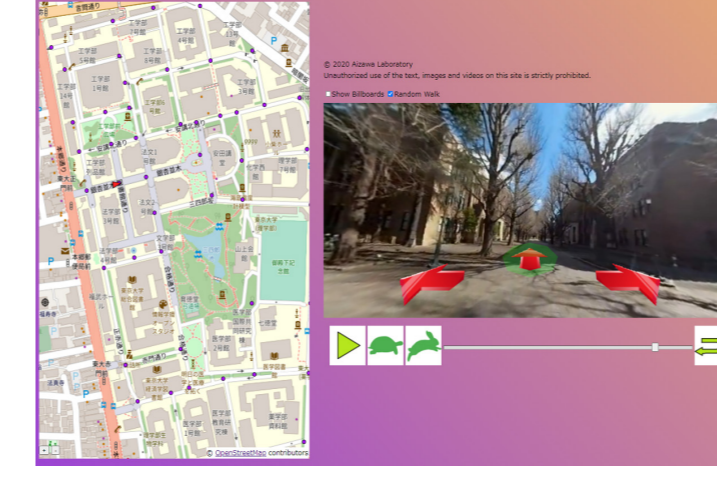Airport   Science Museum   University

- **Large and complex** structures
- Visitors often have **problems finding their way** around public buildings

Related Work

MovieMap Systems

[1. Lippman, 1980]   [2. Sugimoto et al., 2010]

- Provide users with **visual cues** by **synthesizing navigation movies** based on **their inputs of routes**.
- These systems **map movie sequences on a 2D map** and **estimate the positions of intersections** where switch movie sequences.
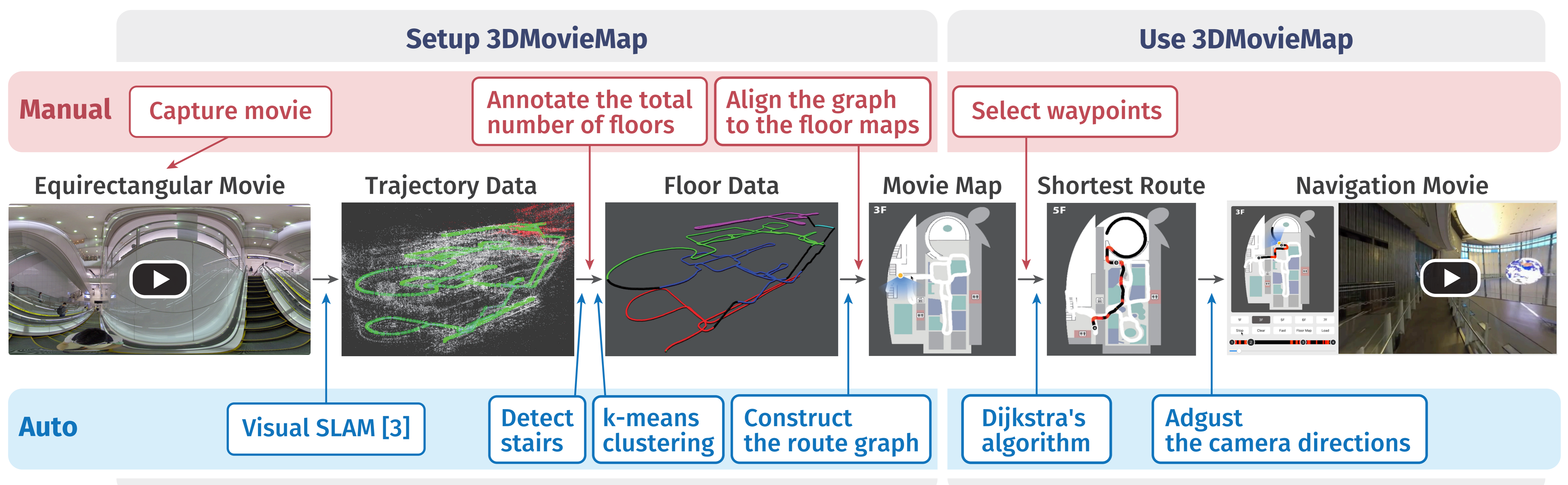
Limitation

If a system maps movie sequences **captured in a multi-level building**, the system can **not detect intersections** properly and **fail to connect movie sequences**.
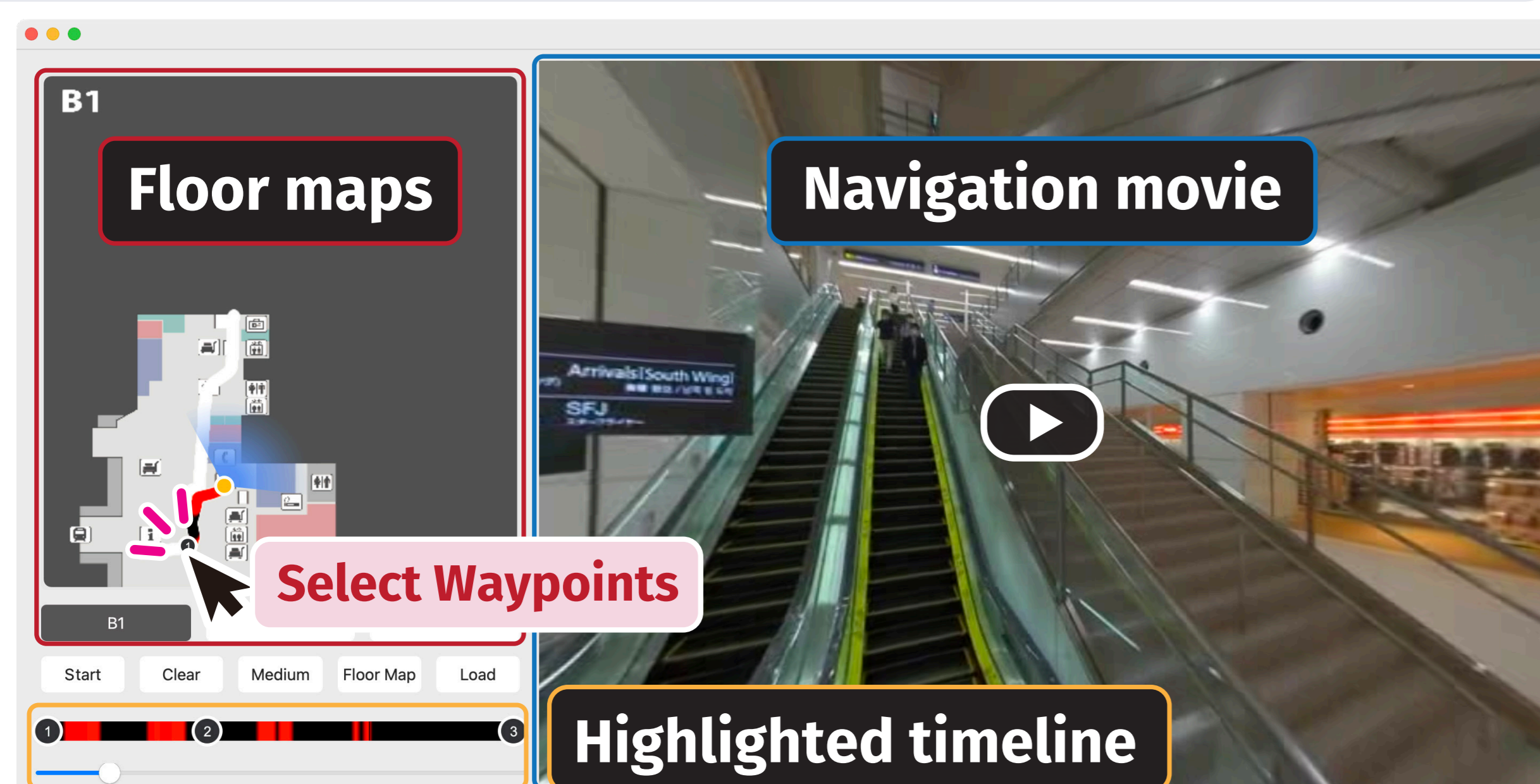
Our Approach

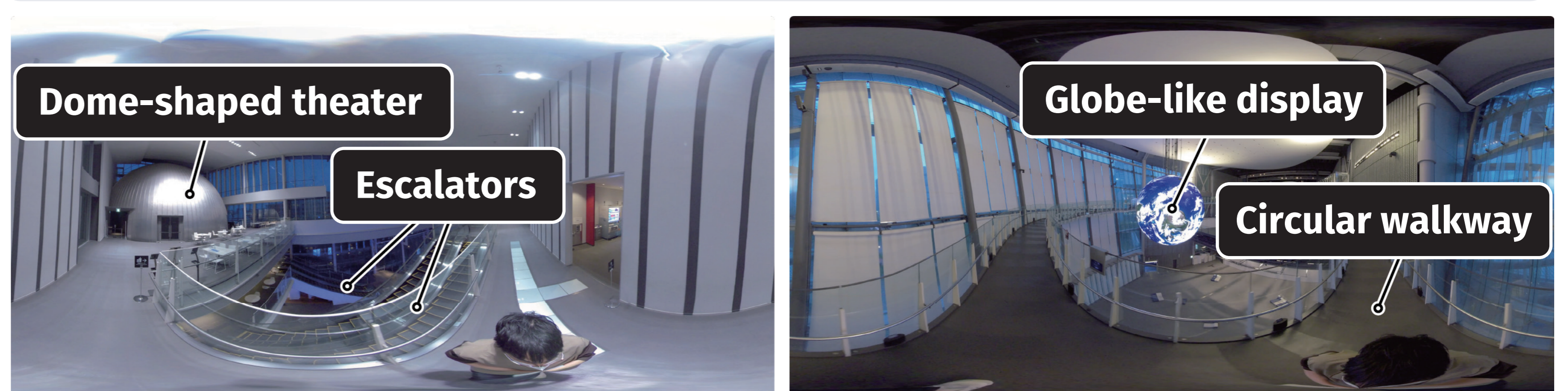**Goal: To extend MovieMap systems** to generate navigation movies **for multi-level buildings**.

Key Idea: To identify the floor on which each movie sequence was captured **based on the results of visual-SLAM**

Setup 3DMovieMap

Manual
- Capture movie
- Annotate the total number of floors
- Align the graph to the floor maps

Equirectangular Movie → Trajectory Data → Floor Data → Movie Map

Auto
- Visual SLAM [3]
- Detect stairs
- k-means clustering
- Construct the route graph

Use 3DMovieMap

Manual
- Select waypoints

Shortest Route → Navigation Movie

Auto
- Dijkstra's algorithm
- Adgust the camera directions

Interface

- B1
- **Floor maps**
- **Navigation movie**
- **Select Waypoints**
- Start   Clear   Medium   Floor Map   Load
- **Highlighted timeline**

Equirectangular Movie Dataset

- Dome-shaped theater
- Escalators
- Globe-like display
- Circular walkway

- **Open dataset** of **8K equirectangular movies** captured in the science museum
- The science museum has **distinctive architecture and exhibitions**

Preliminary Study

We asked two participants (a user and a staff of the science museum) to use our system and collected their feedback about our system.

Feedback and Suggestions

- 3DMovieMap allowed users to **easily learn their path** and the **quality of turning views was enough to grasp the path**.
- The system could provide users with a **path that walks that the building manager would like visitors to walk through**.

References: [1] Lippman, "Movie-Maps: An Application of the Optical Videodisc to Computer Graphics" (SIGGRAPH 1980)
[2] Sugimoto et al., "Building Movie Map - A Tool for Exploring Areas in a City - and Its Evaluations" (ACMMM 2020)
[3] Sumikura et al., "OpenVSLAM: A Versatile Visual SLAM Framework" (ACMMM 2019)

Equirectangular Movie Dataset