Late Breaking Results on vS-Graphs: Integrating Visual SLAM and Situational Graphs for Multi-level Scene Understanding

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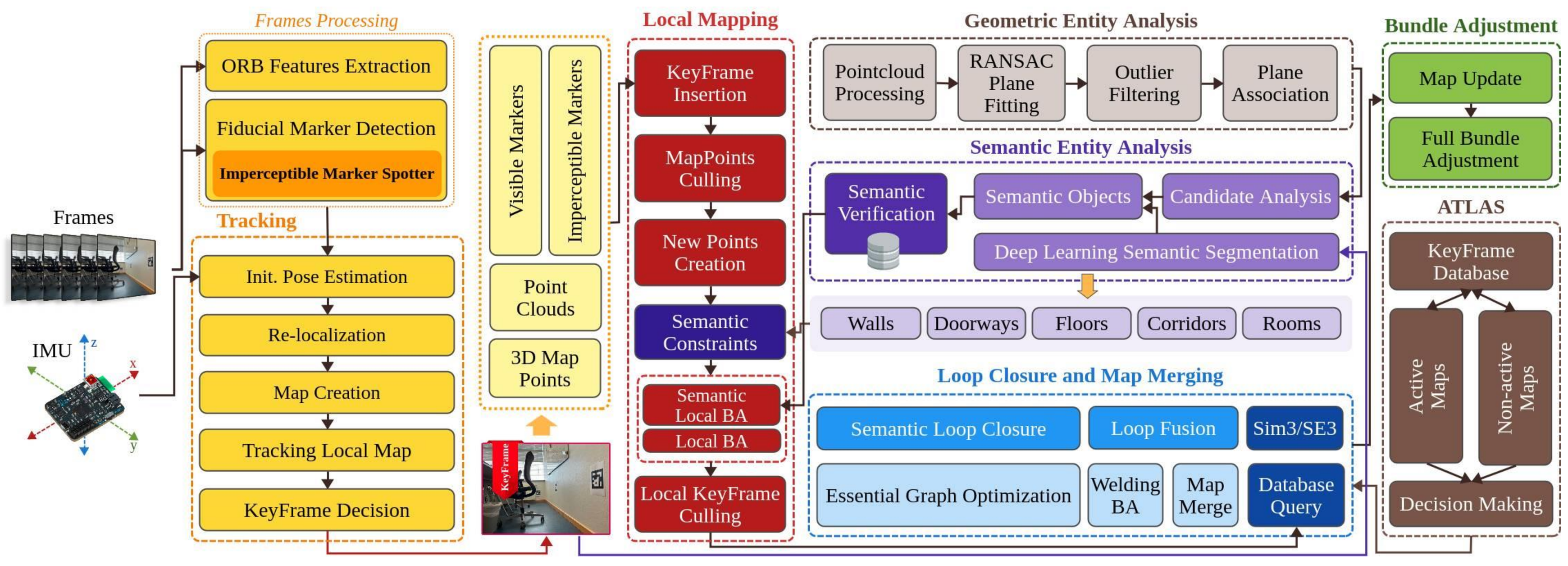

Introduction and Motivation

Providing high-level **Scene Understanding** using situational graphs [6] and building them from **visual data** enables reasoning about:

- **Geometry**, as in traditional SLAM solutions (*e.g.,* ORB-SLAM 3.0 [4]),
- **Semantics** from a Deep Neural Network (DNN) semantic segmentation module,
- **Knowledge augmentation** through labeling various structural-level objects using ArUco markers [1],
- And cheap and widely available **sensors**: robots, phones, VR/AR devices, etc.

Problem Statement and Solution

Incorporate different sources of **visual knowledge** (geometric, semantic, and marker-based) for mapping higher-level semantic entities, including **rooms** and **corridors** [3]. What we combine in a situational graph are:

- Geometric mapping (ORB-SLAM3 / Keypoints / Dense PointCloud)
- **Semantic mapping** using a DNN (pFCN)
- **Marker-based** information (the idea taken from our previous work in [3], which was based on UcoSLAM [2]).

For richer map building, we incorporate:

- More robust and precise **structural extraction** with geometric and semantic information, as an improvement over [5],
- Integration of **knowledge augmentation** through ARUCO markers,
- Integration in an **end-to-end framework**,
- **Real-time** performance of all the modules.

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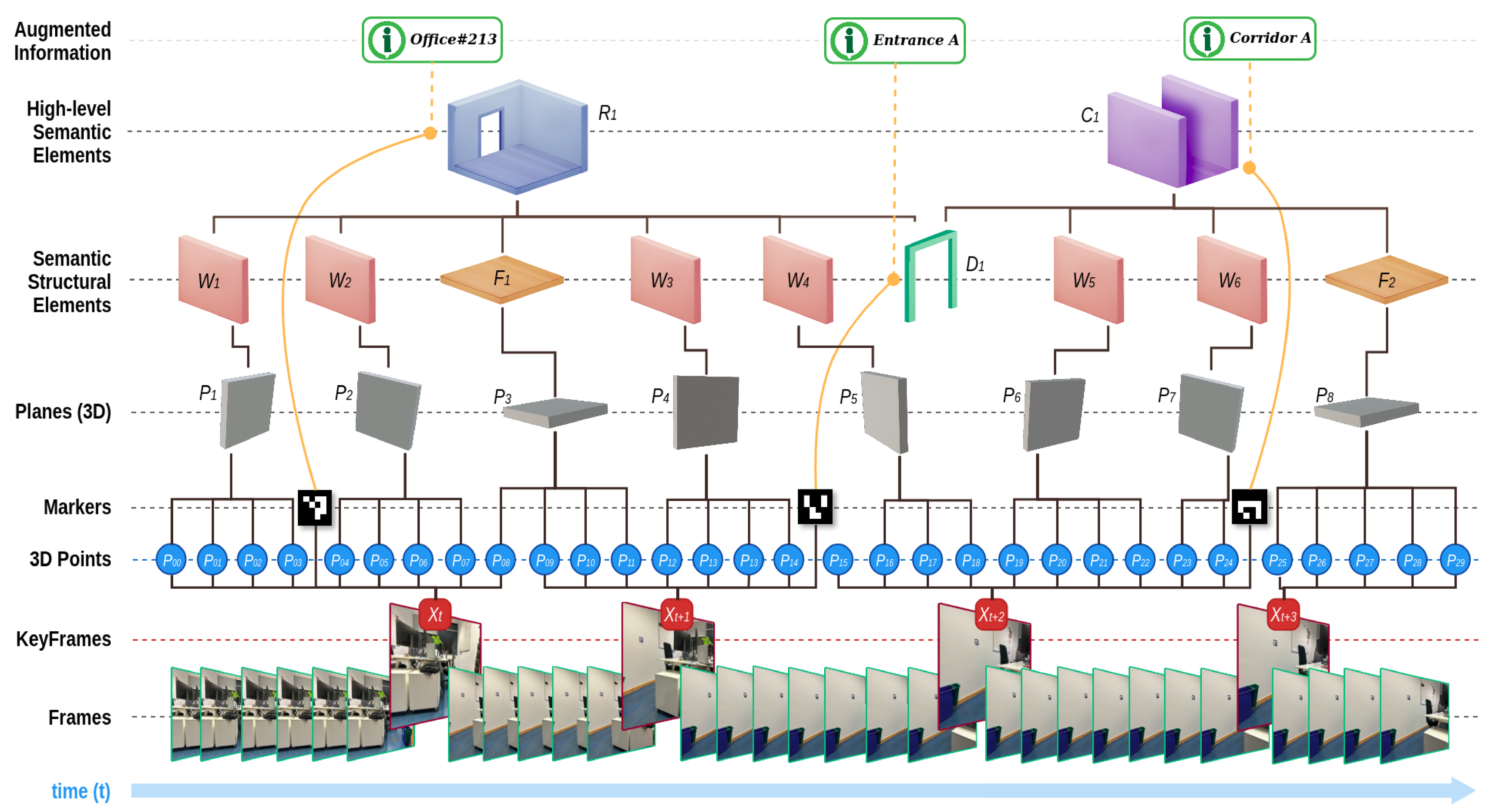
The base idea [5]

Our IROS'23 Paper [3]



Architecture Design

Baseline: ORB-SLAM 3.0.

New threads added to the baseline:

- Geometric Entity Analysis: plane based RANSAC
- Semantic Entity Analysis: semantic object detection and matching, respectively.

Processes:

1. **PointClouds** obtained from RGB-D / Mono-SLAM are passed to Geometric Analysis to fetch all the 3D planes and their equations without knowing their type,
2. In Semantic Analysis, the portion of the **point clouds** related to walls and grounds are matched with the previously detected planes to add semantic information to them. Detection of walls and corridors are done based on the geometrical layouts of structural-level entities.

References

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