Comparative Analysis of various Visual SLAM methods for Different Environments

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*Index Terms*—SLAMs, localization and mapping, indoor navigation, outdoor navigation.

# INTRODUCTION

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imultaneous Localization and Mapping (SLAM) is a critical technology in robotics and computer vision, enabling autonomous systems to navigate and map their surroundings using sensory inputs. Visual SLAM (vSLAM), which utilizes visual data from cameras, has gained significant attention due to its ability to provide rich environmental information. This paper presents a comparative analysis of various visual SLAM methods, specifically ORB-SLAM, ORB-SLAM2, ORB-SLAM3, MonoSLAM, LSD-SLAM, and DyanaSLAM, focusing on their performance across different environments in terms of accuracy, speed, and cost-effectiveness.

Each vSLAM algorithm brings unique strengths and is designed with specific applications in mind. For instance, feature-based methods like ORB-SLAM and its variants (ORB-SLAM2 and ORB-SLAM3) rely on the detection and matching of visual features, making them robust in diverse environments. MonoSLAM, one of the pioneering SLAM methods, focuses on real-time monocular camera input, whereas LSD-SLAM uses semi-dense approaches for a balance between accuracy and computational load. DyanaSLAM introduces dynamic elements into the mix, addressing challenges posed by moving objects in the environment.

The effectiveness of these vSLAM algorithms is influenced by various environmental factors, such as lighting conditions, texture presence, dynamic elements, and the scale of the environment. Urban settings, indoor environments, and natural outdoor areas each pose unique challenges that impact the performance of these algorithms. Urban environments might present dynamic objects and repetitive patterns, indoor settings can involve cluttered and texture less surfaces, and natural outdoor environments often bring variations in illumination and seasonal changes.

This review paper systematically examines the performance of the aforementioned vSLAM methods across a diverse set of environments. By analysing metrics such as accuracy, computational efficiency, and robustness, we aim to provide insights into the suitability of different vSLAM techniques for specific applications. Our goal is to highlight the strengths and limitations of each method, providing a comprehensive understanding of their capabilities in real-world scenarios.

# FORMULATION

# System Setup

# Visual SLAM PARADIGAM

# Test and comparison for Different algorithms

# RESULTS

# Conclusion

# REFERENCES