Project Proposal: 4D Reconstruction Methodologies

Executive Summary

Goalkeeper.com, part of a larger multinational technology group and soon finalizing a data/media partnership with a major global sports league, proposes a project for a student team. The project focuses on researching and designing an accurate, scalable, and future-proof technical approach for creating 4D reconstructions (3D + time) from multiple, non-time-synced video sources (like broadcast replays). The goal is less about delivering a finished product and more about investigating and validating the best methodologies for temporal synchronization, camera pose estimation, and 3D tracking, using football goal analysis as the initial test case. Students will gain deep experience in evaluating and applying advanced computer vision and ML techniques. A baseline environment and data will be provided. Work is remote/campus-based. Reflecting the direct relevance of this work to our upcoming league partnership, there's strong potential for paid positions (internship/full-time) for successful team members post-project.

Full Project Proposal

1. Project Title: Designing Methodologies for 4D Reconstruction from Unsynchronized Multi-Camera Video

2. Proposer Information / Company Background:

- **Proposer:** Proposed by **Brendan Roslund** on behalf of **Goalkeeper.com**
- Background: Goalkeeper.com, part of a multinational technology group, is a sports technology venture. We are finalizing a major sports league partnership requiring robust analysis of video footage. This project aims to establish the most accurate and future-proof technical foundation for these analyses, tackling challenges relevant to our partnership goals and offering students deep experience in applied research within sports tech.

3. Description of Work:

- **Problem:** Utilizing common, unsynchronized video sources for accurate 4D event reconstruction requires careful selection and integration of complex techniques. Identifying the optimal, scalable methods is crucial for future development.
- **Project Goal:** The primary goal is to research, design, and evaluate potential methodologies for creating accurate and scalable 4D reconstructions (3D structure + time) from multiple, non-time-synced video sources. The focus is on identifying future-proof techniques for temporal synchronization, camera pose

estimation, and 3D tracking. While implementing a prototype demonstrating the viability of the chosen approach is expected, the emphasis is on the thoroughness of the technical investigation and the architectural design rather than a fully polished product.

- **Initial Use Case & Tasks:** Use football goal analysis from broadcast replays as the testbed to:
  - Research and evaluate different methods for temporal synchronization.
  - Investigate and compare approaches for robust camera pose estimation (SfM) with potentially limited calibration data.
  - Assess techniques for accurate 3D object trajectory and articulated human pose estimation from multiple views.
  - Design a system architecture capable of integrating these components scalably.
  - Prototype key components of the chosen methodology.

4. Desired Skill Set

- Solid programming fundamentals (Python preferred).
- Strong analytical skills and interest in researching/comparing technical approaches.
- Interest in Computer Vision, ML, or related fields.
- Willingness to learn, experiment, and collaborate effectively.

5. Post-Project Opportunities (Internship/Employment Potential):

- **Yes.** This foundational research directly informs critical systems for our upcoming league partnership. There is strong potential and intention to offer paid positions (internship/full-time) to successful team members interested in implementing and scaling these architected solutions.

6. Location Where Work Should Be Performed & Resources:

- Work can be performed on campus or remotely.
- Regular virtual mentoring meetings will be held.
- A baseline technical environment and example video clips will be provided. Standard campus computing resources should suffice.

7. Non-Disclosure Agreement (NDA):

- NDA required.