Ahmedabad University

Assessment of Athletic Readiness Using CMJ Videos

CSE 641 — Computer Vision

HyperVisionAI

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Problem Statement

- **Athletic readiness** is crucial for optimizing performance and preventing injuries in collegiate basketball.
- **Countermovement Jumps (CMJs)** are commonly used to assess fatigue and performance levels.
- The objective is to **analyze CMJ videos** and extract key performance indicators.
- Identify the correlation between extracted features and **athlete readiness** and to develop a **predictive model** to assess readiness.
- This innovation enables:
  - Real-time fatigue assessment
  - Data-driven readiness predictions
  - Actionable insights for coaches to tailor training programs

Literature Survey

Author(s) & Year	Title	Objective	Key Findings
Sharma et al., 2024 [1]	A Computer Vision Framework on Biomechanical Analysis of Jump Landings	Predict athletic readiness using CMJ biomechanics	High RSI correlation (r=0.94), XGBoost achieves R^2 of 0.892
McMahon et al., 2018 [2]	Key Phases of the CMJ Force-Time Curve	Understanding power output in CMJ	Identified critical force-time phases for optimal jump performance
Laffaye & Wagner, 2013 [3]	Eccentric Rate of Force Development in Jumping	Analyze eccentric phase duration	Eccentric RFD strongly correlates with jump height
Pérez-Castilla et al., 2018 [4]	Measuring Force-Velocity-Power in CMJ	Assess max velocity during CMJ	Validated a simple method to measure FVP profiles
Strength & Conditioning Journal, 2018 [5]	Symmetry Indices for Joints in CMJ	Evaluate symmetry in CMJ for performance	Key metrics for performance profiling, injury risk, and fatigue monitoring

Dataset Discussion

Watch the Dataset Video

Click here to watch the video

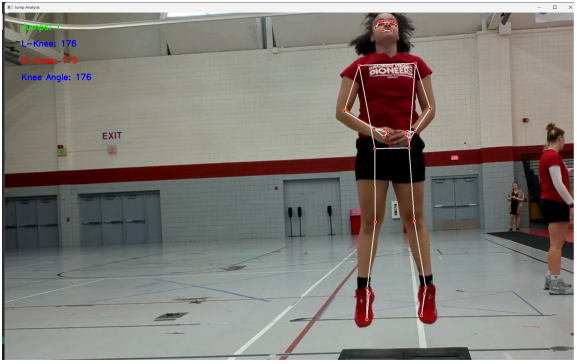
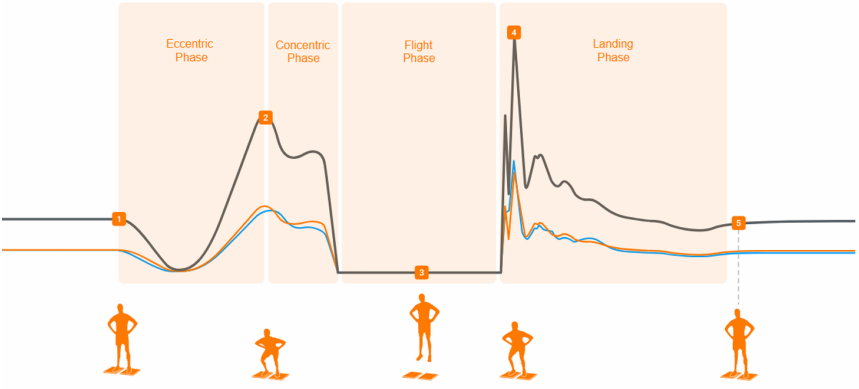


Figure: MediaPipe Pose Estimation for Biomechanical Analysis

Dataset Discussion



[6]

Figure: Phases Of Countermovement Jumps

Approach

Metric	**Methodology**
Power Output	Measures how much power is generated during the jump
Eccentric Phase Duration	Measure time taken from the start of the downward motion until the knees reach their lowest position (maximum knee flexion)
Concentric Phase Duration	Measure time taken from the lowest knee position to the moment the feet leave the ground.
Maximum Velocity During Jump	Track center of mass and calculate peak velocity during jump
Symmetry Indices for Joints	Compare left/right joint angles at key frames for asymmetry analysis

Table: New CMJ Metrics and Their Methodology

Experimental Results

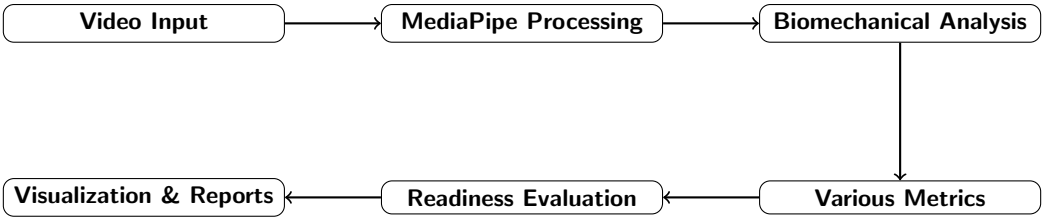
Experiment 1

Metric	Measured Value
Jump Height (m)	0.302
Power Output (W)	26.48
Flight Time (s)	7.833
Eccentric Duration (s)	0.221
Concentric Duration (s)	0.04
Max Velocity (m/s)	1.398
Symmetry Index	0.288

Experiment 2

Metric	Measured Value
Jump Height (m)	0.281
Power Output (W)	20.35
Flight Time (s)	9.467
Eccentric Duration (s)	0.03
Concentric Duration (s)	0.286
Max Velocity (m/s)	1.52
Symmetry Index	0.288

Proposed Workflow



Future Work

- **Collect more data for better accuracy:** Gather more videos from basketball players to improve how well the model works for different movements.
- **Train models on new metrics for enhanced readiness evaluation:** Develop and integrate additional biomechanical and physiological indicators (e.g., fatigue detection) to provide a more comprehensive readiness assessment.
- **Finds New Metrics:** Look for new movement patterns and body mechanics that can help understand efficiency and injury risks better.

References

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