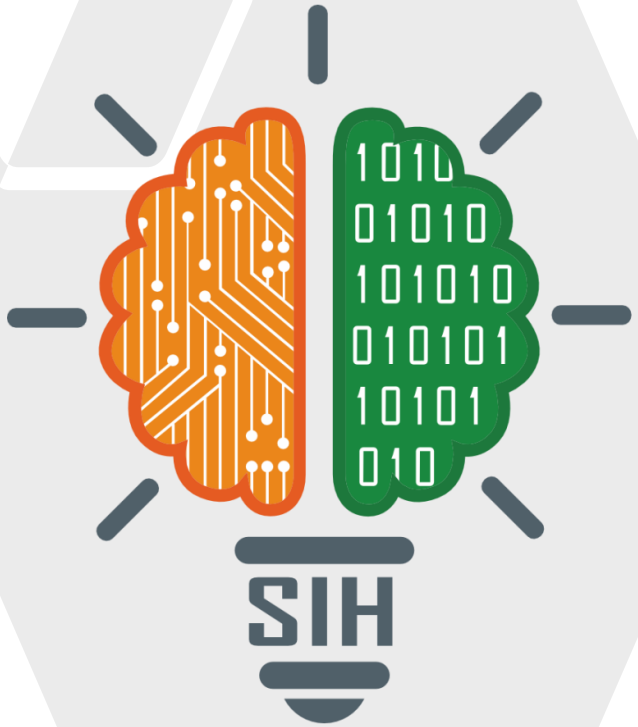
# SMART INDIA HACKATHON 2025

## HASTALAYA

- **Problem Statement ID– 25157**
- **Problem Statement Title- Identify the mudras in Bharatiya natya forms**
- **Theme- Smart Education**
- **PS Category- Software**
- **Team ID- 109722**
- **Team Name - Luminiferous**



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# HASTALAYA

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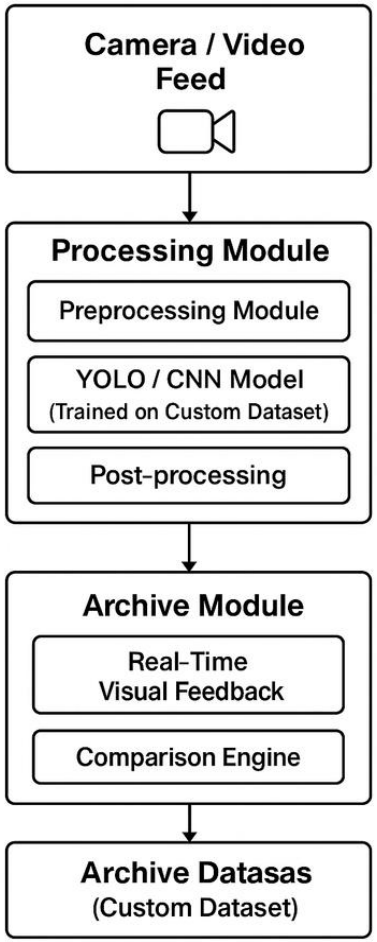


## Proposed Solution-

**A deep learning–based virtual guide that uses computer vision to recognize and evaluate Bharatanatyam mudras in real time, providing instant visual to help students improve accuracy and preserve traditional techniques.**

### How It Addresses the Problem:

- **Instant Feedback**: Real-time visual detection for self-correction without a live guru.
- **Mudra Recognition:** Identifies 50+ foundational mudras with high precision, including subtle variations.
- **Digital Preservation:** Archives and preserves traditional mudras for future generations.

### Innovation & Uniqueness:

- **Real-Time Recognition:** Interactive learning through immediate real-time visual.
- **Custom Dataset:** Proprietary mudra dataset ensuring accuracy and reliability.
- **End-to-End Workflow:** Efficient CV pipeline built using Roboflow for seamless implementation.

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# TECHNICAL APPROACH

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## Technologies Used

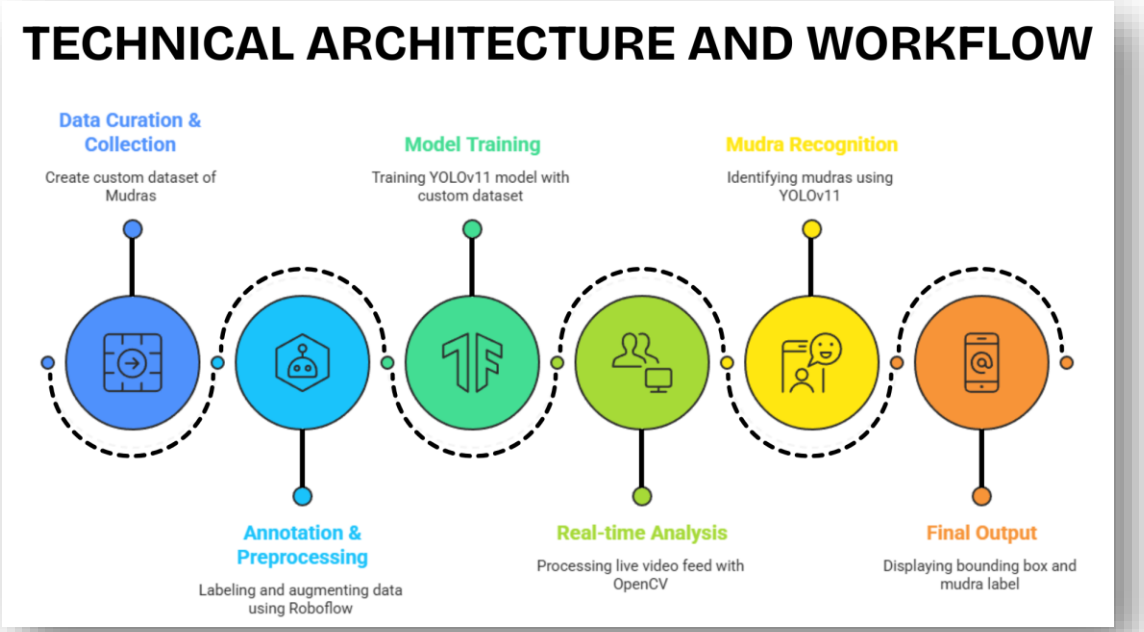
•**End-to-End Platform: Roboflow** - Manages our **custom dataset** and entire training pipeline, from annotation to export.

•**Core Model: YOLOv11** - Provides **superior speed and accuracy** for real-time mudra classification in video.

•**Feature Extraction:** OpenCV Integrated for **precise hand and joint tracking**, necessary to distinguish subtle mudra differences.

•**Deep Learning Framework: TensorFlow** - Utilized for advanced **Transfer Learning and fine-tuning**, maximizing the model's performance.

•**Programming & Interface: Python**- The essential language for system development, integration, and deployment.



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# FEASIBILITY AND VIABILITY

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## Analysis of the Feasibility of the Idea:

**Technical**: YOLOv11 with custom keypoint detection identifies Bharatanatyam mudras, detecting both hands under varied conditions.

**Financial:** Open-source frameworks (YOLOv11, TensorFlow, OpenCV) keep it low-cost and feasible.

**Market:** Growing interest in AI performing arts tools drives adoption among dance schools, e-learning platforms, and cultural institutions.

**Operational:** Runs on standard laptops and smartphones with no expensive hardware, enabling easy deployment.

## Potential Challenges and Risks:

**Technical:** Fast or overlapping hand movements and varied lighting, attire, or camera angles may reduce accuracy.

**Financial:** Creating and annotating a large, high-quality dataset requires time and moderate storage.

**Market:** Traditional art institutions may initially hesitate to adopt AI-based learning.

**Operational:** Limited Bharatanatyam/open dance datasets could delay training.

## Strategies for Overcoming These Challenges:

**Methods:** Build a 50+ mudra dataset with diverse dancers, angles, and lighting.

**Principles:** Apply augmentation, smoothing, and brightness normalization.

**Strategies:** Collaborate with dance academies for authentic data and validation.

**Algorithms:** Optimize YOLOv11 with TensorFlow Lite/ONNX for real-time edge performance.

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# IMPACT AND BENEFITS

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## Enhanced Learning & Practice

**(For Students)**

**Quantitative Correction:**
Delivers objective, **real-time feedback** on joint angles and **Bharatanatyam mudra** spatial positioning.

**Autonomous Learning:**
Provides an **AI-driven, 24/7 personalized practice loop**, eliminating dependency on scheduled instruction.

## Cultural Preservation & Scalability

**(National Impact)**

**Digital Archival:**
Establishes a **quantifiable digital repository** for **Bharatanatyam mudras** and scholarly research.

**Modular Scalability:**
**Low-cost adaptation** to other classical dance forms (e.g., Odissi, Kuchipudi).

## Standardization & Pedagogy

**(For Teachers & Institutes)**

**Objective Grading Metric:**
Offers a **non-subjective, data-backed** tool for student grading and progression analysis.

**Global Pedagogy:**
Enables **geo-agnostic remote tutoring**, drastically expanding enrollment and **global outreach**.

**Ergonomic Safety:**
AI detects patterns that lead to **musculoskeletal strain**, promoting dancer longevity.

# RESEARCH AND REFERENCES



https://docs.ultralytics.com/models/yolo11

https://opencv.org/

https://www.natyasutraonline.com/picture-gallery/asamyuta-hasta-bharatanatyam

**https://youtu.be/jWVDJ59MPpQ**

## Sample Images Of Working Model