RoboFlow Model Training Requirements

Executive Summary

For production-ready basketball shooting form analysis, we need **1,000-1,500 high-quality annotated images**.

Images Needed for Basketball Shooting Form Analysis

For 3 Custom Models:

1. Basketball Shooting Form Keypoint Detector (18 keypoints)

Purpose: Detect body pose keypoints for biomechanical analysis

Training Level	Images Required	Expected Accuracy	Notes
Minimum Viable (MVP)	500 images	85-88%	Basic functionality
Production Ready	1,000-1,500 images	90-95%	**Recommended**
Optimal Perform-ance	2,000+ images	95%+	Elite accuracy

Keypoints to detect:
- 0: Neck, 1: Mid-hip, 2-7: Shoulders/Elbows/Wrists
- 8-13: Hips/Knees/Ankles, 14-17: Eyes/Ears

Diversity requirements:
- Various shooting phases (preparation, release, follow-through)
- Different camera angles (front, side, 45°)
- Indoor/outdoor lighting conditions
- Multiple body types and heights
- Both male and female players

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2. Shooting Form Quality Classifier (5 categories)

Purpose: Classify shooting form quality automatically

Training Level	Images Required	Per Category	Expected Accuracy
Minimum Viable	300 images	60 per category	80-85%
Production Ready	500-1,000 images	100-200 per category	88-93%
Optimal	1,500+ images	300+ per category	95%+

Categories:
1. **Excellent** - Elite form (Stephen Curry, Ray Allen level)
2. **Good** - Solid fundamentals, minor issues
3. **Average** - Mixed fundamentals
4. **Needs Work** - Several form issues
5. **Poor** - Major form problems

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3. Ball Flight Trajectory & Arc Analyzer

Purpose: Track ball trajectory and shooting arc

Training Level	Images Required	Expected Accuracy
Minimum Viable	300 images	85%
Production Ready	500-800 images	90-95%
Optimal	1,000+ images	95%+

Requirements:
- Clear ball visibility throughout flight
- Multiple arc heights (flat, medium, high)
- Various distances (free throw, mid-range, 3-point)

Total Images Needed

Summary Table

Level	Total Images	Time to Collect	Expected Accuracy	Recommendation
MVP (Minimum)	1,000-1,500	3-5 days	85-90%	✅ **Start here**
Production Ready	2,000-3,000	7-10 days	90-95%	🎯 Target
Optimal	3,000-5,000	14-21 days	95%+	🏆 Long-term goal

Current Status

Collection Progress

- ✅ **Collected:** 25 images (pending user approval)
- 🎯 **Target:** 1,000-1,500 images for MVP
- 📊 **Need:** 975-1,475 more images
- ⏱️ **Timeline:** 5-7 days with multi-source collection

Collection Sources

1. **YouTube Videos** (300-500 images) - Tutorial extraction
2. **Pixabay API** (100-200 images) - Free stock photos
3. **Pexels API** (100-200 images) - High-quality photography
4. **Unsplash API** (100-200 images) - Professional shots
5. **Web Scraping** (100-200 images) - Basketball training sites

Expected yield after Vision AI filtering: 700-1,000 approved images

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Image Quality Requirements

Must-Have Criteria

✅ **Basketball visible** in frame
✅ **Full body visible** (head to feet)
✅ **Clear shooting form** (not blurred)
✅ **Good lighting** (not too dark/bright)
✅ **Single player focus** (for keypoint detection)
✅ **High resolution** (minimum 800x600px)

Bonus Criteria

⭐ **Multiple shooting phases** in sequence
⭐ **Side/45° angle** (best for form analysis)
⭐ **Professional photography** (sharp focus)
⭐ **Diverse player types** (height, gender, skill level)
⭐ **Court background** (contextual realism)

Annotation Requirements

For Keypoint Detection Model

- Annotate all 18 keypoints per image
- Use RoboFlow's skeleton annotation tool
- **Estimated time:** 2-3 minutes per image
- **Total annotation time:** 33-75 hours for 1,000-1,500 images

For Quality Classifier Model

- Label each image with quality category (Excellent/Good/Average/Needs Work/Poor)
- **Estimated time:** 30 seconds per image
- **Total annotation time:** 8-12 hours for 1,000-1,500 images

For Trajectory Model

- Draw bounding boxes around ball in flight
- Track ball across multiple frames (for videos)
- **Estimated time:** 1-2 minutes per image
- **Total annotation time:** 17-50 hours for 1,000-1,500 images

Total annotation effort: 58-137 hours for all 3 models

Recommended Strategy

Phase 1: MVP Collection (Week 1)

✅ **Goal:** 1,000-1,500 images
✅ **Focus:** Keypoint detection model (highest priority)
✅ **Sources:** All 5 sources with Vision AI pre-filtering
✅ **User approval:** Batch review (50-100 images at a time)

Phase 2: Annotation (Week 2-3)

✅ **Annotate keypoints** for 1,000-1,500 approved images
✅ **Train initial model** in RoboFlow
✅ **Test accuracy** on validation set

Phase 3: Iteration (Week 4+)

✅ **Collect more images** for weak categories
✅ **Add quality classification** labels

✅ **Train classifier model**
✅ **Integrate trajectory tracking**

Success Metrics

Keypoint Detection

- **Accuracy:** 90%+ keypoint detection rate
- **Speed:** <500ms inference time per image
- **Robustness:** Works in various lighting/angles

Quality Classifier

- **Accuracy:** 88%+ classification accuracy
- **Consistency:** <5% false positive rate for “Excellent”

Trajectory Analyzer

- **Accuracy:** 90%+ ball tracking accuracy
- **Arc calculation:** ±3° error margin

Next Steps

1. ✅ **Execute multi-source collection** (automated)
2. ✅ **Run Vision AI pre-filtering** (automated)
3. 🔄 **User approval** (manual, 2-4 hours)
4. 🔄 **Upload to RoboFlow** (semi-automated)
5. 🔄 **Annotate keypoints** (manual, 33-75 hours)
6. 🔄 **Train models** (automated)
7. 🔄 **Validate accuracy** (semi-automated)

References

- **RoboFlow Documentation:** https://docs.roboflow.com/
- **Pose Estimation Best Practices:** https://blog.roboflow.com/pose-estimation/
- **Dataset Size Recommendations:** https://blog.roboflow.com/how-much-data-do-i-need/

Last Updated: December 13, 2025
Status: Ready for multi-source collection