Generating Expertise-Specific Explanations in Cricket Pose Estimation

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1. Introduction

Background

- Use of AI-based pose estimation tools is increasing in sports like cricket
- Many explanation methods follow a one-size-fits-all approach
- This lack of personalization can reduce the usefulness of AI-generated feedback

Research Gap

- In cricket, explanation effectiveness depends on the user's expertise, yet current systems don't take them into account
- No current method tailors pose estimation explanations to different player expertise levels in cricket.

2a. Research Question

What are the best ways to generate explanations across different levels of cricket expertise?

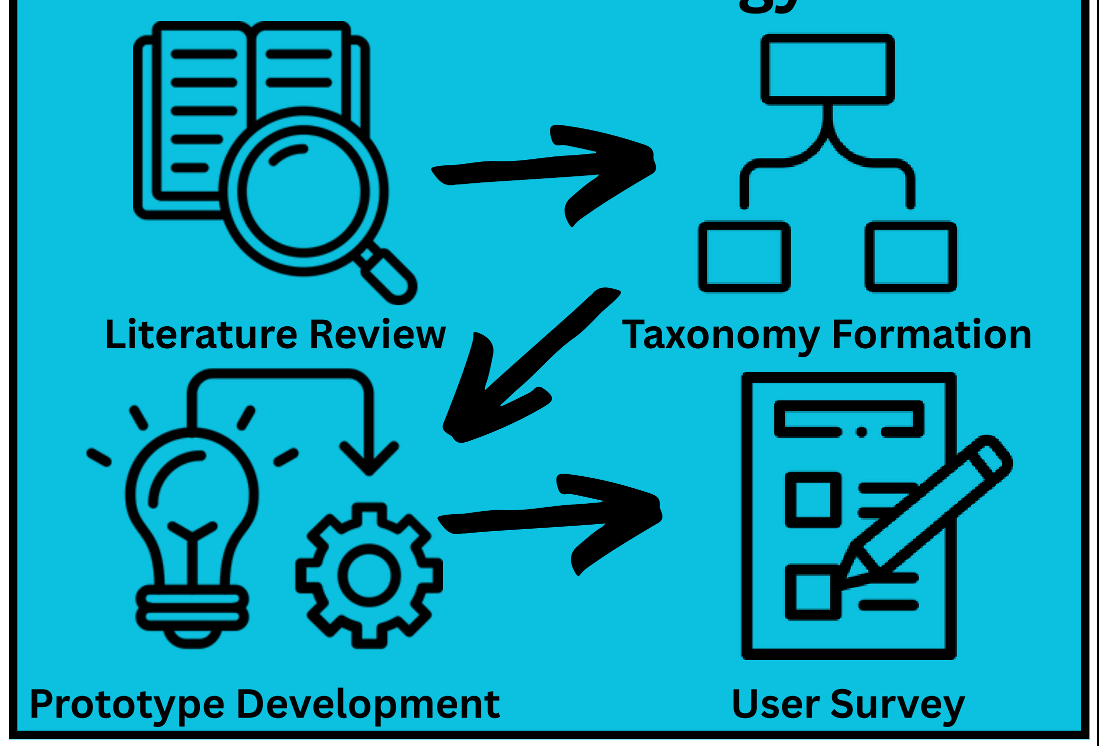
2b. Sub-Questions

How do the explanation needs differ between beginners, intermediate players, and advanced cricket experts?

What types of explanations are most effective for each level of expertise?

How can explanations be structured to provide actionable feedback tailored to different skill levels?

3. Methodology



4. Explanation Taxonomy

User Level	Explanation Details
Beginner	**Format:** Annotated Visuals, color-coded overlays **Content:** One key issue, no jargon **Model Exposure:** Hidden
Intermediate	**Format:** Comparative poses, annotated angles **Content:** Multiple focus points, light metrics **Model Exposure:** Moderate
Expert	**Format:** Dashboards, raw pose data **Content:** Full analysis, causal insights **Model Exposure:** High

5. Prototypes

Figure 1: Beginner - 1 Focus Point

Figure 2 : Intermediate - 5 Focus Point

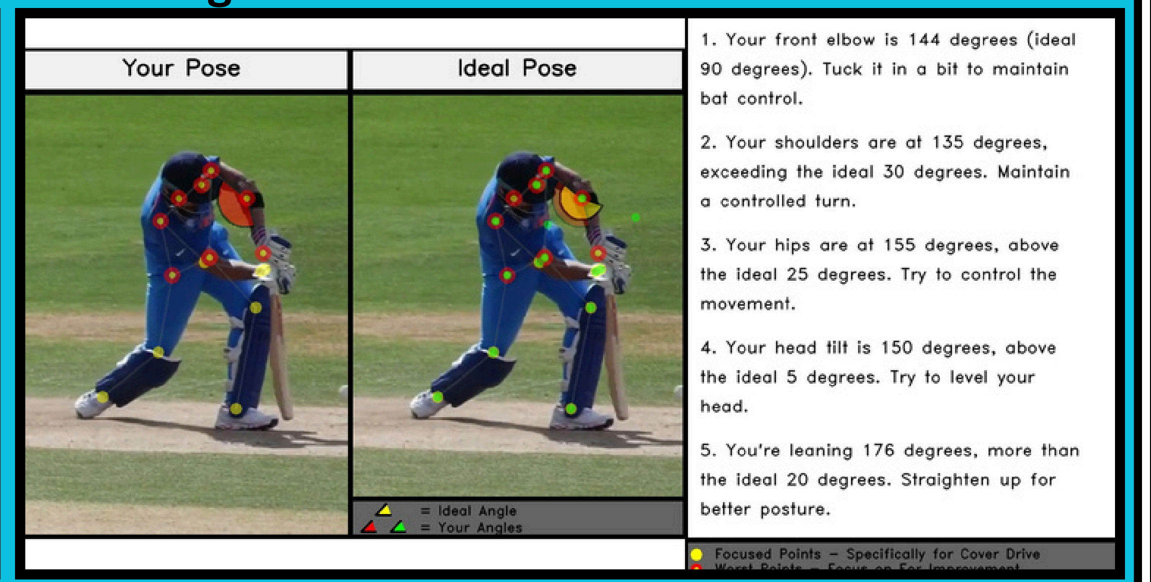
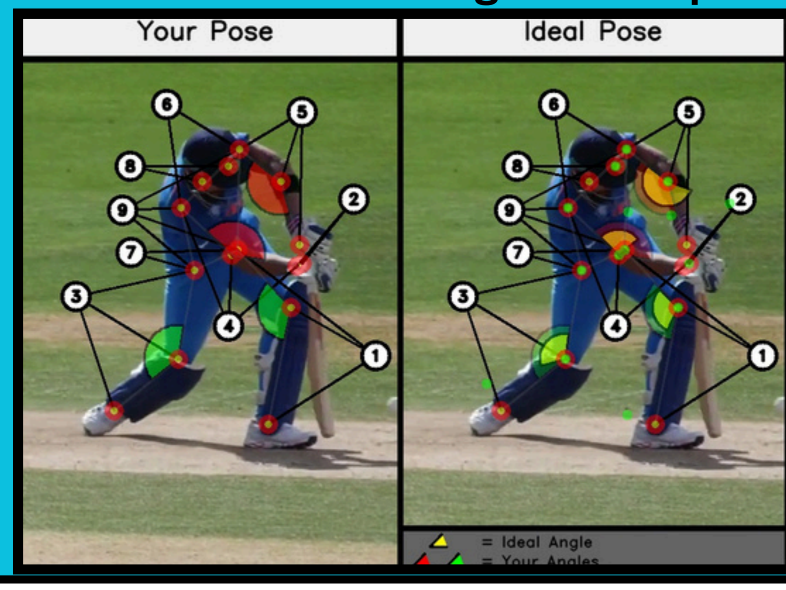


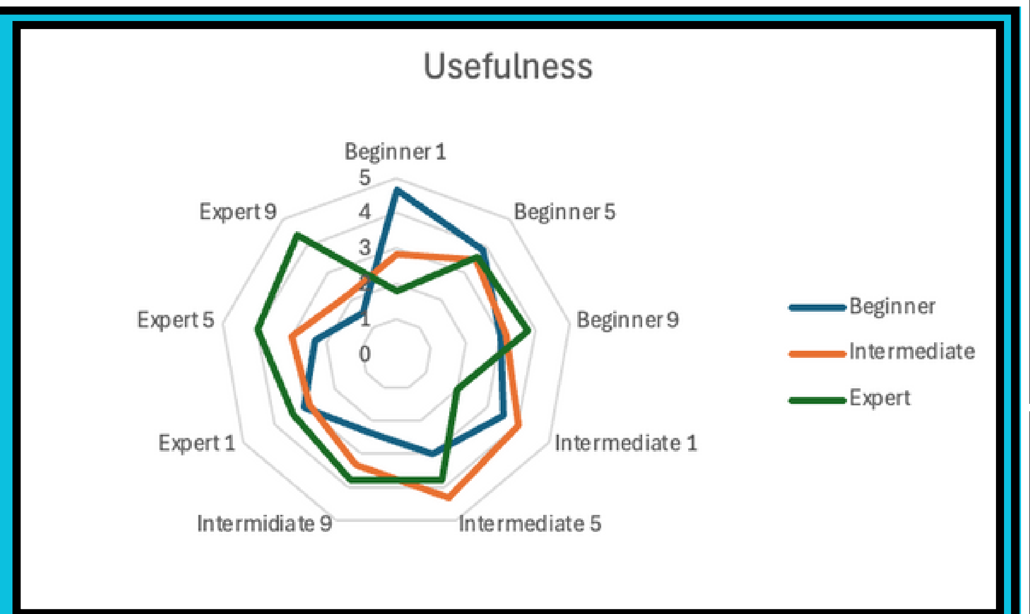
Figure 3 : Expert - 10 Focus Point



Joint	Your Angle	Ideal Angle	Deviation	SHAP (%)	Suggestion
Spine Forward Lean	176	20	155.85	9	Reduce your forward lean to maintain posture and balance.
Head Tilt	150	5	144.86	−6	Level your head to stabilize your gaze and body alignment.
Hip Rotation	155	25	129.8	18	Ease your hip turn to keep your body aligned and avoid losing power.
Shoulder Rotation	135	30	105.0	−20	Limit your shoulder rotation to maintain balance and avoid over−rotation.
Front Elbow Angle	144	90	54.14	35	Tuck your front elbow in slightly to keep the bat face square and reduce swing variance.
Back Elbow Angle	147	100	46.56	5	Straighten your back elbow slightly to optimize your swing arc and power transfer.
Back Knee Angle	139	160	−20.99	−12	Engage your back knee more by bending slightly to maintain a strong base at impact.
Bat Angle	27	45	−18.43	22	Raise your bat angle to meet the ball on the sweet spot and prevent ground−hits.
Front Knee Angle	126	140	−13.88	27	Bend your front knee deeper to lower your center of gravity and stabilize your stance.

6. Small-Scale Survey Setup

- 17 participants - 6 Beginner - 6 Intermediate - 5 Expert
- 9 Prototypes (3 of each expertise level)
- 7 Likert Scale Questions (Inspired by Explanation Satisfaction Scale)
  - ESS is a Validated questionairre specifically for user satisfaction with AI explanations [1]



7. Results + Evaluation I

- **Beginner users** favoured strongly visual explanations, rating them higher in usefulness and ease of understanding
- **Intermediate users** benefited from hybrid explanations (textual + visual). They found explanations with joint angles more useful, without becoming overwhelmed.
- **Expert users** Clearly preferred explanations involving detailed technical content such as SHAP-based feedback. They rated these prototypes as highly useful, easy to understand, and appropriately matched to their expertise.

8. Evaluation II

- Two statistical tests were done to confirm that preference differences were signifigant enough
- **Kruskal-Wallis Test**
  - Non-parametric test, used to check whether there are statistically significant differences in how these groups rated the explanation prototypes
  - The test revealed statistically significant group differences across nearly all evaluation dimensions (highlighted in green).

Kruskal-Wallis Test p-values	Usefulness	Ease of Use	Trust	Appropriate Skill Level	Visual Elements Help	Too many Elements	Too many points
Beginner 5	0.686	0.017	0.065	0.109	0.206	0.025	0.076
Expert 9	0.003	0.005	0.016	0.004	0.026	0.004	0.005
Intermediate 5	0.047	0.057	0.046	0.024	0.077	0.004	0.009
Intermediate 9	0.066	0.039	0.114	0.013	0.133	0.041	0.003
Expert 1	0.633	0.014	0.171	0.64	0.307	0.011	0.002
Beginner 9	0.284	0.006	0.767	0.375	0.793	0.025	0.024
Beginner 1	0.004	0.139	0.017	0.003	0.141	0.4	0.4
Expert 5	0.018	0.01	0.02	0.021	0.04	0.016	0.014
Intermediate 1	0.005	0.019	0.005	0.005	0.258	0.225	0.011

Table 1 : Kruskal-Wallis Test p-values

- **Dunn's Test**
  - Used after Kruskal-Wallis finds significant differences, to identify which group pairings differ
  - **Beginner vs Intermediate** - Differences were less pronounced. Suggests some shared preferences, particularly toward visual or hybrid feedback that maintains simplicity.
  - **Intermediate vs Expert** - Moderate differences were found, especially for technical clarity and trustworthiness.
  - **Expert vs Beginner** - The most significant differences.

9. Conclusion

- Explanation needs vary by expertise, and beginners, intermediates, and experts, each benefit from tailored explanations.
- The explanation taxonomy proved to be effective
- User study confirms significant difference in preference
- These findings validate the need for expertise-sensitive explanations in sports AI feedback systems.
- Furthermore they support that existing literature can be used in the domain of cricket.

10. Future Improvements

- Expand participant pool
  - Greater statistical power and generalizability of results
- Automatically determine expertise level of users, as they are currently self reported
- Implement real-time feedback, giving the user feedback on their current form
- Include a wider range of cricket techniques
- Investigate effectiveness of other XAI methods

Project Supervisors :

Danning Zhang and Ujwal Gadiraju

[1] Robert R. Hoffman, Shane T. Mueller, Gary Klein, and Jordan Litman. Measures for explainable ai: Explanation goodness, user satisfaction, mental models, curiosity, trust, and human-ai performance. Frontiers in Computer Science, Volume 5 - 2023, 2023. ISSN 2624-9898. doi: 10.3389/fcomp.2023. 1096257. URL https://www.frontiersin.org/journals/computer-science/articles/10. 3389/fcomp.2023.1096257.