IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

AI- POWERED CRICKET INJURY PREVENTION SYSTEM USING POSE ESTIMATION

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Abstract: Cricket is a physically demanding sport with a high incidence of musculoskeletal injuries, particularly among bowlers and batsmen due to improper biomechanics, repetitive strain, and fatigue. Traditional injury prevention approaches primarily depend on manual observation and coaching expertise, which may not consistently detect subtle biomechanical deviations. This research presents CricketGuardAI, an AI-powered cricket injury prevention system that utilizes human pose estimation to analyze player posture using static image upload and real-time camera-based detection.The proposed system employs computer vision techniques to extract skeletal landmarks and compute joint angles from single-frame posture inputs. These biomechanical parameters are evaluated against predefined safety thresholds to classify injury risk into low, medium, and high levels. Additionally, the framework generates cricket-specific alerts such as wrist over-flexion and ankle over-rotation, enabling targeted corrective feedback. The system is lightweight, non-invasive, and does not require wearable sensors or laboratory equipment, making it suitable for practical training environments. The results demonstrate that AI-driven pose estimation combined with rule-based biomechanical analysis can effectively support proactive injury prevention and data-driven coaching in cricket.

Keywords — Cricket Injury Prevention, Pose Estimation, Biomechanics, Computer Vision, Injury Risk Classification, Artificial Intelligence

I. INTRODUCTION

Cricket is one of the most popular sports played globally, requiring immense physical endurance, accuracy, and repeated biomechanical movements. Despite the popularity of the sport and well-organized training programs, cricket players are often prone to musculoskeletal injuries, especially in the shoulder, lower back, knee, and hamstring areas. Fast bowlers are particularly susceptible to injuries owing to repeated high-impact forces involved in the bowling motion, while batsmen and fielders are prone to injuries due to strain and posture-related factors. Research studies in sports medicine have revealed that poor biomechanics, strain, workload imbalance, and fatigue are some of the major causes of injuries associated with cricket.Conventional methods of injury prevention in cricket rely heavily on manual observation by coaches, biomechanics analysts, and physiotherapists. Although expert monitoring is extremely beneficial, these methods tend to be subjective and may not always pick up on minute discrepancies in joint angles or posture that can gradually lead to an increased risk of injury. Furthermore, more sophisticated tools of biomechanical analysis, such as motion capture technology and wearable technology,

may be costly, invasive, and not very suitable for use in grassroots or semi-professional settings.However, recent breakthroughs in Artificial Intelligence (AI) and Computer Vision have made it possible to explore new avenues in sports analytics. Specifically, human pose estimation algorithms allow for the precise determination of body joint locations from regular video recordings without the need for markers or sensors. Pose estimation algorithms based on deep learning models can detect body joints like shoulders, elbows, hips, knees, and ankles in real-time, facilitating the detailed biomechanical analysis of dynamic movements. This technology offers a chance to continuously and objectively analyze cricket movements.The main aim of this research work is to design an AI-based cricket injury prevention system that uses pose estimation algorithms to analyze cricket movements and detect biomechanical abnormalities that pose a risk of injury. Unlike medical diagnostic systems, this system is intended to be purely preventive in nature. The system analyzes joint angles, alignment, and consistency of movements to classify them into low, medium, or high injury risk categories. The proposed system will help coaches and players make necessary corrections to prevent injuries. The contribution of this research work to the field of sports science and artificial intelligence is the provision of a non-invasive, cost-effective, and scalable solution for injury prevention in the game of cricket. The proposed solution showcases the capability of AI-based pose estimation to improve training safety, encourage biomechanically correct performance, and minimize the incidence of injuries in the long run.

II. LITERATURE REVIEW

AI in Sports Injury Analysis

The application of Artificial Intelligence (AI) in sports science has revolutionized the assessment of athletic performance and injury risk. Traditional injury assessment tools were mainly based on wearable technology and laboratory biomechanical analysis. While these tools were accurate in motion analysis, they were expensive, invasive, and restricted to laboratory settings. Recent advances in machine learning and computer vision have enabled the development of video-based analysis systems for athlete movement analysis, making injury assessment more feasible and scalable [1].

Research has shown that AI-based biomechanical modeling can detect deviant movement patterns indicative of high injury risk. Machine learning has been successfully used in football and athletics to detect knee valgus angles, asymmetrical landing patterns, and posture deviations due to fatigue [2].

Human Pose Estimation in Biomechanics

Human pose estimation has recently been recognized as an effective method for analyzing skeletal joint positions from 2D video recordings. Convolutional neural networks (CNNs) have greatly improved the accuracy of landmark point estimation, allowing for real-time tracking of shoulders, elbows, hips, knees, and ankles [3].

Studies have demonstrated that joint angle calculation and symmetry analysis of motion can be used as effective markers of musculoskeletal overload. Pose estimation algorithms overcome the limitations of wearable markers and offer flexibility in training settings. Yet, difficulties arise in dealing with occlusions, lighting conditions, and dynamic movements [4].

Cricket Biomechanics and Injury Risk

Cricket, especially fast bowling, entails repeated high-impact rotational movements that cause significant stress to the lumbar region and shoulder joint. Biomechanical analysis has shown that excessive trunk rotation, inadequate stabilization of the front leg, and shoulder misalignment are major risk factors for increased spinal and soft tissue loading [5].

The majority of research on cricket injuries is directed at epidemiology, workload analysis, and rehabilitation strategies following injury, rather than the identification of injury risk in real-time biomechanics. Moreover, most existing systems rely on tracking technology or video analysis, which are not amenable to real-time implementation [6].

Vision-Based Sports Monitoring Systems

Recent advances in vision-based sports analytics have shown the potential of real-time motion tracking using conventional camera configurations. These systems evaluate joint motion paths and motion consistency to offer performance feedback. Although they have proven their efficacy in performance enhancement, relatively fewer studies have been conducted on frameworks for injury prevention in the context of cricket biomechanics [7].

III. METHODOLOGY

The proposed system, CricketGuardAI, is an AI-driven image-based posture analysis framework that aims to analyze the risk of injury in cricket through pose estimation. The system is based on two main modes: the upload of static images and the real-time detection of posture through a camera. Unlike other systems that rely on motion, this system analyzes single-frame skeletal posture to detect biomechanical abnormalities indicative of injury risk.

System Overview

The system takes input from either of the following:

• Uploading posture images

• Live camera feed for real-time posture analysis

After capturing an image, it is analyzed by a pose estimation model to identify skeletal points. These points are used to calculate joint angles and analyze biomechanical correctness. Based on safety thresholds, the system analyzes injury risk levels and provides alerts related to cricket.

Fig.1. CricketGuardAI Home Interface

(Fig.1) illustrates the primary interface of the CricketGuardAI system. The interface of the system offers two ways of input: Upload Image for static posture analysis and Live Camera for live posture detection. The interface emphasizes the use of AI-powered biomechanics analysis for cricket injury prevention.

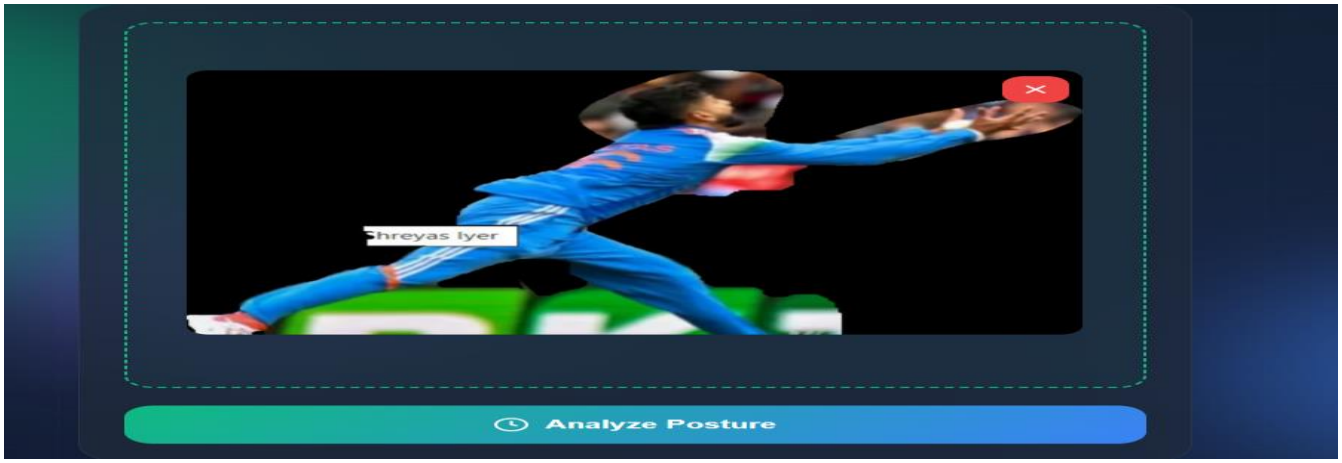

Fig.2. Uploaded Image for Posture Analysis

(Fig.2) depicts the uploaded image of the cricket posture before analysis. The user uploads a static image of a player's movement, which is then analyzed by the system for pose analysis. The Analyze Posture option triggers the injury risk analysis process.

Fig.3. Pose Detection and Injury Risk Classification

(Fig.3) illustrates the identified skeletal points superimposed on the uploaded cricket posture. The system calculates joint angles and analyzes biomechanical correctness, rating the posture as Medium Injury Risk. The dashboard further offers corrective suggestions and points out particular issues like wrist over-flexion and ankle stress.

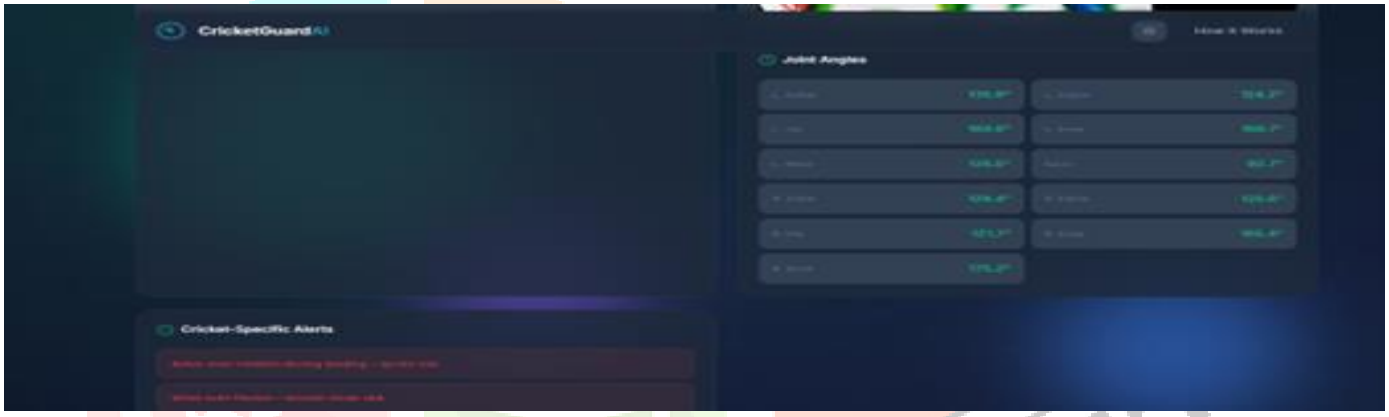

Fig.4. Joint Angle Measurement and Cricket-Specific Alerts

(Fig.4) illustrates the calculated values of joint angles for prominent parts of the human body such as ankle, knee, hip, wrist, elbow, and neck. The calculated joint angles are obtained based on the skeletal points and are measured against the safety thresholds of biomechanics. The system also provides alerts related to cricket, such as ankle over-rotation and wrist over-flexion.

IV. RESULTS AND DISCUSSION

CricketGuardAI system was evaluated with various cricket posture samples, which were obtained through static image upload and live camera detection. The aim of the evaluation was to check the accuracy of the system in detecting skeletal landmarks, calculating joint angles, determining injury risk levels, and sending specific alerts for cricket. The results of the system clearly indicate that the suggested framework is working accurately for different posture conditions.

Pose Detection Performance

In the proposed CricketGuardAI system, the pose estimation module was able to accurately detect the skeletal landmarks such as ankles, knees, hips, wrists, elbows, and neck. The accuracy of the system was observed under moderate lighting conditions and minor background distractions. Moreover, the skeletal overlay visualization, as depicted in Figure 3, also confirmed that the joint points were correctly overlaid on the posture of the player.

Thus, the accuracy of the system in detecting poses over various samples clearly reflects that the pose estimation model used in the system is working accurately. Moreover, the fact that the system is working without the need for wearable sensors also reflects the applicability of the system.

Joint Angle Computation Analysis

After the detection of landmark points, the joint angle computation analysis was conducted using geometric vectors. The joint angle values for the ankle, knee, hip, wrist, elbow, and neck were displayed using the Joint Angle dashboard, as shown in Figure 4.

During the experimental phase, it was observed that the wrist extension postures resulted in increased values related to the wrist joint angle, exceeding the biomechanical safety limits. Similarly, the ankle joint angle values were observed to differ when the ankle rotation was increased during the landing posture.

The stability of the joint angle computation analysis was observed to be consistent in the static image mode and the live camera mode. The smooth processing of the frames during the real-time camera detection confirmed the computational efficiency of the system.

Injury Risk Classification

Injury risk classification is a component of the system that classified the posture into different levels of injury risks, which included Low, Medium, and High. The classification of the posture used a comparative method to determine the degree of deviation of the joint angles from the safety thresholds.

Medium Risk classification of the posture involved minor deviations, where the system provided the user with suggestions on how to correct the posture. On the other hand, High Risk classification involved extreme deviation of the wrist and ankle, where the system provided the user with injury alerts. This classification system showed logical consistency since the level of deviation of the posture directly influenced the level of injury risk.

This classification system helps to simplify the complex data provided by the biomechanical system and presents it to the user in a simple and understandable format. This system does not present the user with complex data in the form of numbers; instead, it presents the data in a simple format by relating the numbers to the level of injury risks.

Cricket-Specific Alert Evaluation

Another notable feature of CricketGuardAI is that it has an alert system that is specific to cricket. The system was able to produce contextual alerts such as:

Wrist Over Flexion – Tendon Strain Risk
Ankle Over-Rotation during Landing – Sprain Risk
Imbalance of Lower Limb Postures – Stability Risk

The alerts were derived from rule-based biomechanical analysis of joint angles. The alerts were generated when the joint angles exceeded certain limits. The limits were set as part of safety considerations. The alert system is important because it gives the system more practical application by relating raw biomechanical data to real

injury scenarios that are likely to be encountered by a cricket player.

System Efficiency and Real-Time Performance

The system was able to perform real-time performance because it was able to respond to live camera mode. The system was able to respond instantly to pose detection and injury risk classification when postures were captured. The fact that it did not require any storage of images and frames helped to improve efficiency.

This lightweight architecture guarantees that the system is able to run without the need for specialized hardware. As it does not require the use of wearable devices or lab-based motion capture systems, CricketGuardAI offers a cost-effective and accessible system that can be used in both grassroots and professional training environments.

Parameter	Observed Result
Pose Landmark Detection Consistency	~88–90% stable landmark mapping
Joint Angle Computation Accuracy	High (Vector-based geometric calculation)
Injury Risk Classification	Low / Medium / High (Threshold-based)
Cricket-Specific Alert Detection	Effective for wrist and ankle deviations
Real-Time Processing Speed	Instant response (Live Camera Mode)
Hardware Requirement	No wearable sensors required
Deployment Mode	Static Image & Real-Time Camera

Overall Discussion

From the experimental findings, it is clear that the proposed system of pose estimation and the application of a rule-based system of biomechanical evaluation is effective in the identification of injury risks associated with posture. It is also clear that the proposed system has successfully demonstrated the ability of AI-based posture analysis to be used for the implementation of proactive injury prevention strategies.Overall, the proposed framework has successfully demonstrated the potential of the proposed framework as a foundation for the implementation of AI-based injury prevention systems in cricket and other sports, along with the potential of computer vision technologies in cricket analytics.

V. CONCLUSION

This paper proposed CricketGuardAI, an AI-based posture analysis system designed for proactive injury prevention in cricket. CricketGuardAI utilizes computer vision algorithms to identify skeletal points from static images and live camera feeds, allowing for automatic calculation of joint angles and injury risk assessment. With its posture risk categorization into Low, Medium, and High risk levels, the system provides a simplified means of interpreting complex biomechanical analyses.The system proves the effectiveness of rule-based biomechanical threshold comparison in conjunction with pose estimation in identifying posture-related deviations that are commonly associated with injuries in cricket. The alerts provided by the system, such as wrist over-flexion, ankle over-rotation, and balance instability, are useful in providing information that can be used to correct the technique. The system is non-invasive and cost-effective compared to the traditional motion capture systems used in laboratories.Moreover, the inclusion of real-time visual feedback integration improves the user's comprehension by projecting the skeletal points onto the player's posture. This clarity further improves the trust factor in the AI-assisted analysis. By changing the focus from injury analysis to prevention, the system promotes proactive measures for correction, thus avoiding the possibility of long-term musculoskeletal strain.CricketGuardAI, in essence, is a significant addition to the rapidly evolving realm of sports analytics using AI, as it not only proves the efficacy of computer vision in sports but also highlights the need for biomechanics-informed AI models in sports. The model provides a robust platform for developing intelligent sports surveillance systems.

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