



**INFORMATICS
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INFORMATICS INSTITUTE OF TECHNOLOGY

In Collaboration with

UNIVERSITY OF WESTMINSTER

**ATP ACEGUARD - PREDICTIVE ANALYSIS OF TENNIS SHOT
TECHNIQUES AND ASSOCIATED INJURY RISKS USING
HYBRID CNN-GRU-ATTENTION MODELS**

A Project Proposal by

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ABSTRACT

As one of the most common sports, tennis also has a high rate of injury-especially among beginners and previously injured players. General issues such as a torn rotator cuff, tennis elbow, and pain in the lower back are due to improper techniques and a lack of professional teaching. Although most research focuses on stroke classification and injury analysis, few models provide real-time personalized feedback for injury prevention. This project is for the development of a real-time personalized feedback system of tennis player stroke mechanics.

The current work has been carried out on real-time injury prevention by proposing a hybrid CNN-GRU model. In this hybrid model, the spatial feature extraction capability of CNN is combined with that of the GRU network for modeling temporal sequences. Biomechanics are caught in both 2D and 3D environments through the technologies available for pose estimation like OpenPose and MediaPipe. The system personalizes feedback based on mapping of this player-specific data, including age, injury history, and fitness levels, hence making changes in their techniques while reducing the chance of injury at play.

Performance testing was performed using accuracy, precision, recall, F1 score, and mean squared error. These demonstrate a high predictive accuracy of substantial reliability, good precision and recall would serve best for real-time assessment of injury risks. Further work will include the extension of this model to other sports and injury prevention scenarios.

Computing methodologies -> Machine Learning -> Neural Network -> Convolutional Neural Networks

Applied computing -> Life and Medical sciences -> Health informatics -> Injury prediction

Human-centered computing -> Ubiquitous and mobile computing -> Sports informatics

Keywords: *Tennis Injury Prediction, CNN-LSTM, CNN-GRU, Deep Learning, Pose Estimation, Real-time Feedback, Convolutional Neural Networks, Long Short-Term Memory Networks, Sports Biomechanics, Musculoskeletal Injury Prevention, Attention Mechanisms*