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FracXpert: Ensemble Machine Learning Approach for Localization and Classification of Bone Fractures in Cricket Athletes

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Abstract : In today's world of medical diagnosis and prediction, machine learning stands out as a strong tool, transforming old ways of caring for health. This study analyzes the use of machine learning in the specialized domain of sports medicine, with a focus on the timely and accurate detection of bone fractures in cricket athletes. Failure to identify bone fractures in real time can result in malunion or non-union conditions. To ensure proper treatment and enhance the bone healing process, accurately identifying fracture locations and types is necessary. When interpreting X-ray images, it relies on the expertise and experience of medical professionals in the identification process. Sometimes, radiographic images are of low quality, leading to potential issues. Therefore, it is necessary to have a proper approach to accurately localize and classify fractures in real time. The research has revealed that the optimal approach needs to address the stated problem and employ appropriate radiographic image processing techniques and object detection algorithms. These algorithms should effectively localize and accurately classify all types of fractures with high precision and in a timely manner. In order to overcome the challenges of misidentifying fractures, a distinct model for fracture localization and classification has been implemented. The research also incorporates radiographic image enhancement and preprocessing techniques to overcome the limitations posed by low-quality images. A classification ensemble model has been implemented using ResNet18 and VGG16. In parallel, a fracture segmentation model has been implemented using the enhanced U-Net architecture. Combining the results of these two implemented models, the FracXpert system can accurately localize exact fracture locations along with fracture types from the available 12 different types of fracture patterns, which include avulsion, comminuted, compressed, dislocation, greenstick, hairline, impacted, intraarticular, longitudinal, oblique, pathological, and spiral. This system will generate a confidence score level indicating the degree of confidence in the predicted result. Using ResNet18 and VGG16 architectures, the implemented fracture segmentation model, based on the U-Net architecture, achieved a high accuracy level of 99.94%, demonstrating its precision in identifying fracture locations. Simultaneously, the classification ensemble model achieved an accuracy of 81.0%, showcasing its ability to categorize various fracture patterns, which is instrumental in the fracture treatment process. In conclusion, FracXpert has become a promising ML application in sports medicine, demonstrating its potential to revolutionize fracture detection processes. By leveraging the power of ML algorithms, this study contributes to the advancement of diagnostic capabilities in cricket athlete healthcare, ensuring timely and accurate identification of bone fractures for the best treatment outcomes.

Keywords : multiclass classification, object detection, ResNet18, U-Net, VGG16
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