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# Automatic Distal Radius Fracture Detection and Classification Using Deep Convolutional Neural Network with Radiological Images

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# Faculty Disclosure Information

- No relevant disclosure

# Background

- Distal radius fractures (DRF) - most common orthopaedic injuries, in the elderly and pediatric populations.
- Accurate and timely diagnosis: critical to prevent functional impairment
- Manual interpretation of radiological images is time-consuming and subject to resource availability.
- An automated system can assist radiologists and orthopaedic surgeons by providing rapid, consistent, and reliable fracture detection and classification.
- Deep Convolutional Neural Networks (CNNS) have revolutionised medical image analysis by enabling machines to learn complex visual patterns.

# Objective

- To develop and validate a deep learning-based framework capable of automatically identifying the presence of distal radius fractures using radiological images.

- Successful implementation of this AI-based system could enhance diagnostic accuracy, reduce workload for healthcare providers, enable early treatment initiation, and potentially be integrated into emergency settings and telemedicine platforms for improved orthopaedic care.

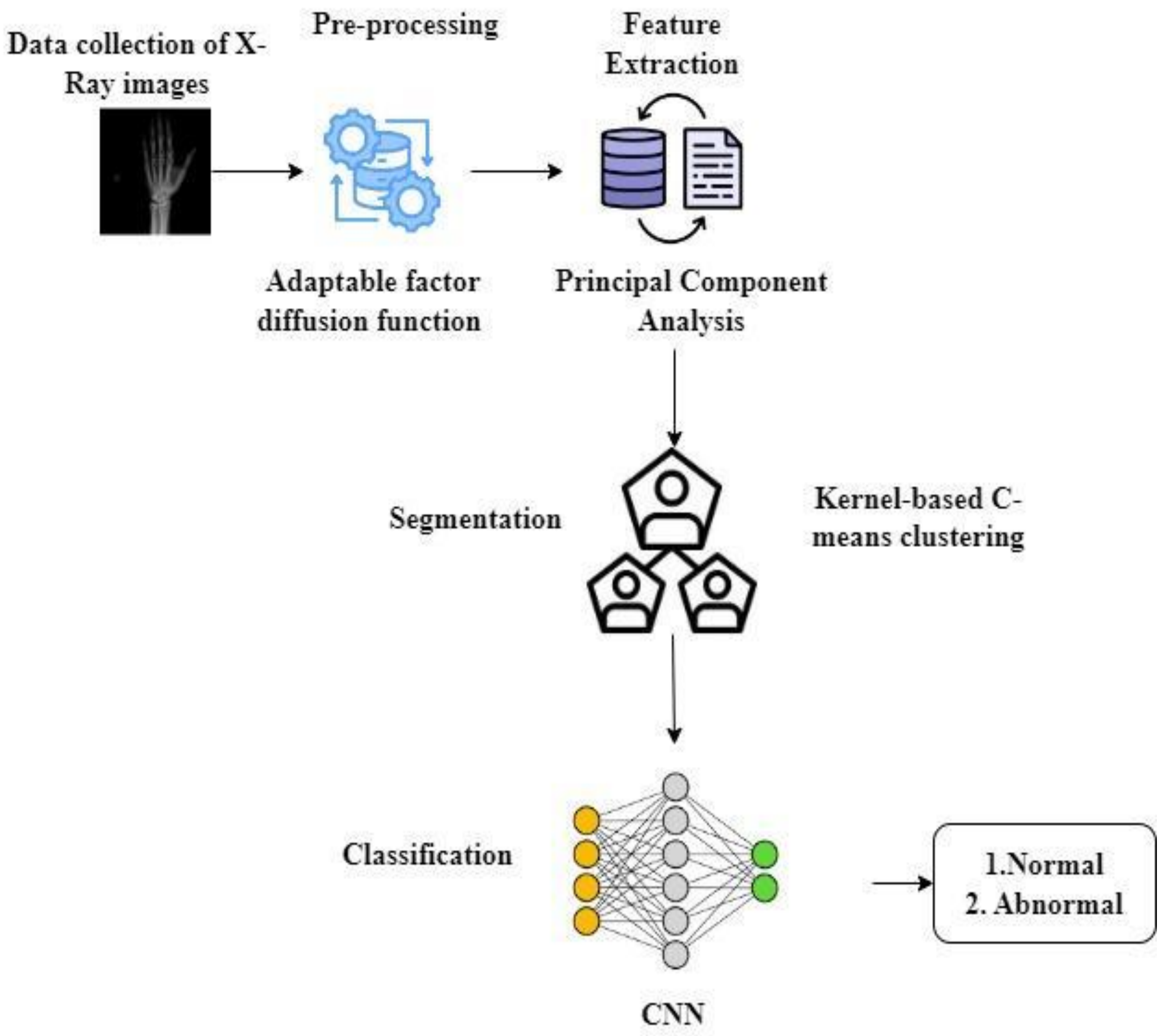
# Methods:

- **500 wrist radiographs**
- Preprocessing steps:
  - Global contrast normalisation
  - Noise reduction techniques applied.
- Dataset split: 80% training, 10% validation, 10% testing.
- **Data augmentation** performed (zooming, rotation).

# Methods – Training and Optimization

- Optimisers used: **SGD** and **ADAM**
- Learning Rate: 0.01
- Batch Size: 120
- Epochs: 100
- Loss Function: **Cross-Entropy Loss** with side-output loss fusion.
- Hyperparameter tuning to maximise accuracy and minimise overfitting.

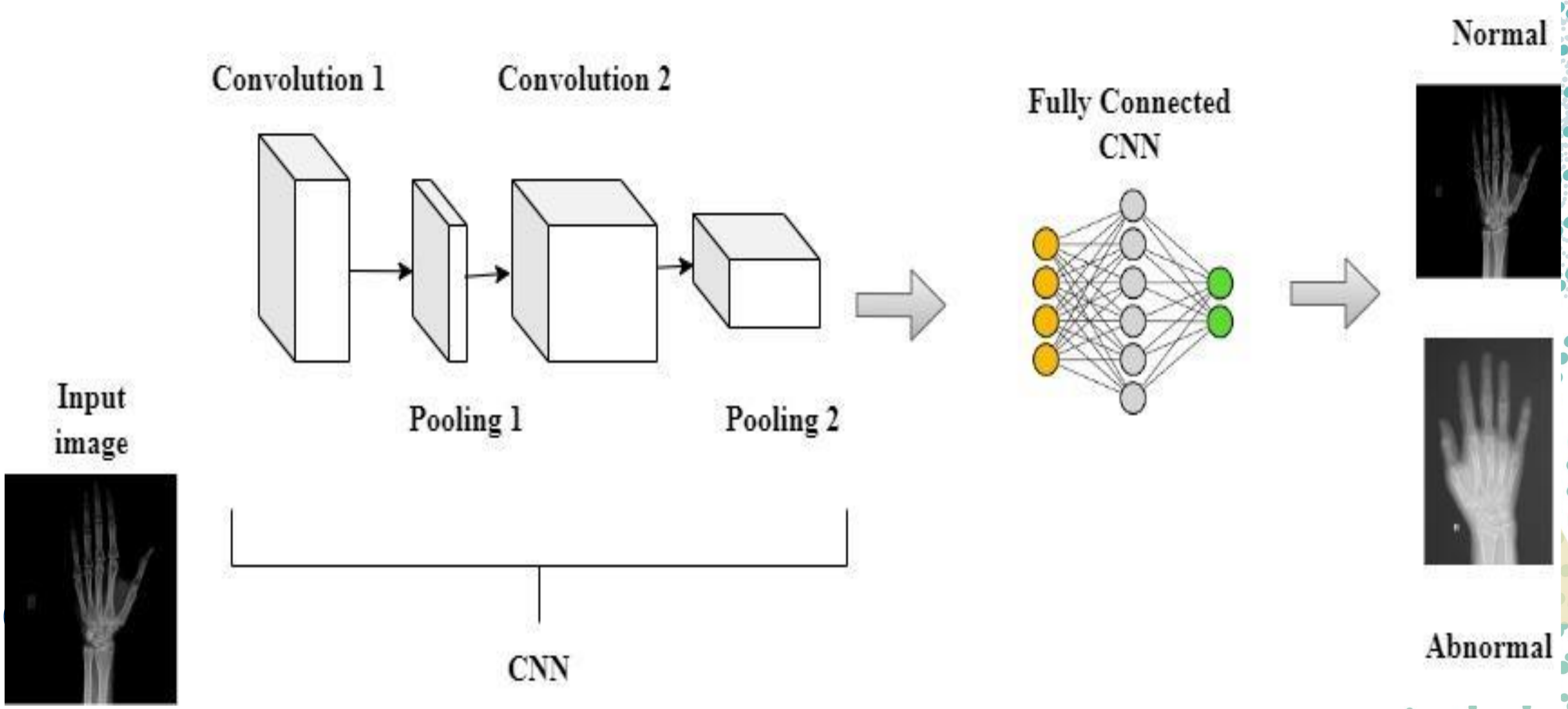
# Process


Data collection of X-Ray images
Pre-processing
Feature Extraction
Adaptable factor diffusion function
Principal Component Analysis
Segmentation
Kernel-based C-means clustering
Classification
CNN
1.Normal
2. Abnormal

# Process

- Data: training set, validation set, and test set of data.
- A Convoluted Neural Network model will be introduced to the test set following a training phase of several iterations.
- The collection of X-ray images will be followed by noise reduction with an adaptable factor diffusion function.
- The extraction of features will be achieved by Principal Component Analysis (PCA), followed by kernel-based c-means clustering for segmenting the wanted section of images.
- The final stage is the classification of a normal or fractured image by CNN.

# Classification by CNN



# Results – Performance Metrics

- **Classification Accuracy**: 99.3%
- **Sensitivity**: 96.5%
- **Specificity**: 97.8%
- **F1 Score**: 95.6%
- **Error Rate**: Reduced by 11.2% compared to traditional models.

# Results – Comparative Analysis

- Benchmarked against:
  - Wrist Fracture Detection-Combo (WFD-C)
  - Deep Supervised Learning (DSL)
  - DCNN-LSTM frameworks

- DCNN-DRFCM **outperformed** across all metrics.
- Achieved **high sensitivity** without compromising specificity.

# Take Home!

- The model remained highly accurate even with **500 diverse images**.
- **Schmid filter-based texture enhancement** improved fracture detection.
- Effective in differentiating fracture vs non-fracture across varied wrist anatomies.
- Limitation: Focused only on the distal radius; Data set was small, further validation is needed

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