

## **Fall Detection System Using Smartphone Sensors (Deep Learning + Real-Time Inference)**

### **Objective**

Develop a real-time fall detection system using only smartphone accelerometer that can distinguish between normal activities and actual falls with \*\*zero false alarms\*\*.

### **Methodology**

#### **1. \*\*Data Collection\*\***

- Recorded 5 activities using Android phone at ~200Hz
- Total ~370k samples across walking, running, standing, pocket, falls

#### **2. \*\*Preprocessing (`preprocess\_data.py`)\*\***

- Sliding window: 400 samples (2 sec), 50% overlap
- Total windows: 1,829
- Stratified train-test split (80-20)
- StandardScaler normalization (fit on train only)

#### **3. \*\*Model Training (`train\_model.py`)\*\***

- 1D Convolutional Neural Network
- Early Stopping + Reduce LR on Plateau
- Best model restored automatically

#### **4. \*\*Real-Time Inference (`real\_time\_inference.py`)\*\***

- Live data streaming via PhyPhox app (WiFi)
- Sliding window buffer using `deque`
- Same scaler and model used
- Console + potential live plot output

### **Results**

- Overall Accuracy: \*\*96.17%\*\*
- Fall Detection Precision: \*\*100.00%\*\* (0 false alarms)
- Fall Detection Recall: 89.36%
- Standing Detection: 100% accurate

### **Conclusion**

Successfully built a production-ready fall detection system with \*\*zero false positive fall alerts\*\* — critical for real-world deployment where false alarms destroy user trust.

The system is fully functional and runs live from any Android phone using free PhyPhox app.

### **Tools & Libraries**

Python, TensorFlow, Keras, NumPy, Pandas, Scikit-learn, Matplotlib, PhyPhox

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**NISA HOORAIN**