



# Real-time elderly fall detection

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## Objective

To train a binary classification model using deep learning that can detect falls in real-time with >95% accuracy.

## Background

According to the WHO, an estimated 37.3 million falls each year are severe enough to require medical attention, with 684,000 being fatal, making it the second leading cause of unintentional injury death, after road traffic injuries.

## Pre-Processing

1. Fourth order low pass infinite impulse response (IIR) Butterworth filter with a cut-off frequency of 5 Hz
2. Data augmentation using magnitude warping



## Data

Used the SisFall dataset, split as follows:

- 1798 files with 15 types of falls
- 2707 files with 19 types of Activities of Daily Living (ADL)

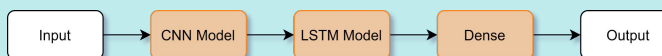
The SisFall dataset was the only one that had volunteers over 60, collecting from 23 young adults between 19-30 years and 15 elderly between 60-75 years. The data was collected using 2 accelerometers and 1 gyroscope at 200 Hz placed on the hip.

## Model/Algorithm

Binary classification using a combination of a Convolutional Neural Network (CNN) and Long Short Term Memory (LSTM) for time series prediction.

The data was split 80% training, and 20% testing with 15% of training data going to validation.

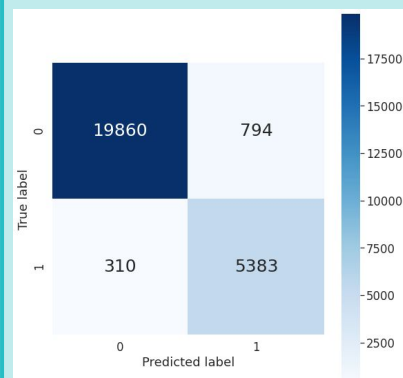
Also tried Support Vector Machine (SVM), as well as CNN and LSTM only models.



## Evaluation

The CNN-LSTM model performed the best out of the SVM, LSTM-only, and CNN-only models with over 95% accuracy.

Test Metrics (N=26,347)	%
Accuracy	95.81
Precision	87.15
Recall	94.55
F1 Score	90.07



## Reflection

The biggest hurdle I faced was the low computational power and memory of the Arduino. I managed to train a model with over 99.5% accuracy using an SVM on statistical extracted features across a time period, though the required computations were too much for the Arduino to handle in real time.

I am grateful for the support of Adan Rivas (my mentor) as well as AI4ALL staff and Changemakers.

## Next Steps

- Collect more data from the Arduino to be used for training
- Optimize model to decrease processing time and model size as well as increase accuracy