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Improving the activity recognition using GMAF and transfer learning in post-stroke rehabilitation assessment

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Outline:

- Sensor based post stroke rehabilitation
- Dataset presentation
- Segmentation of the data
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- The 3D classification models
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- Performance of the 3D VGG_16 model
- Contribution
- Acknowledgement

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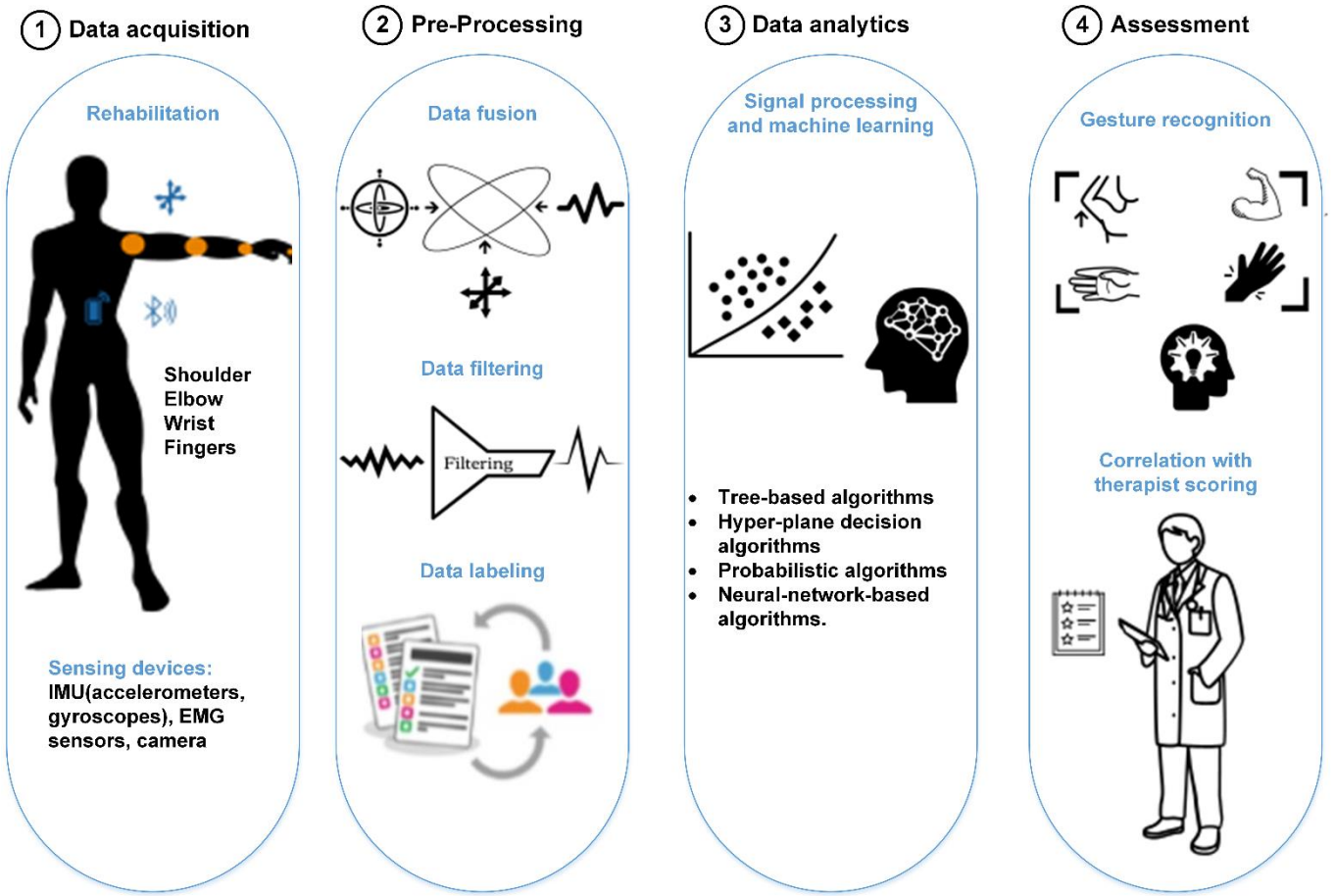
Sensor based post stroke rehabilitation

The steps for a sensor based rehabilitation assessment:

1. Data acquisition.
2. Pre-processing.
3. Data analytics.
4. Assessment.



Dataset presentation

Smartphone-based recognition of human activities and postural transitions dataset:

- 30 volunteers of 19-48 years.
- Activities of Daily life: walking, walking up, walking down, sit to stand, stand to sit, laying.
- 50Hz 6-axis accelerometer + gyroscope data [1].

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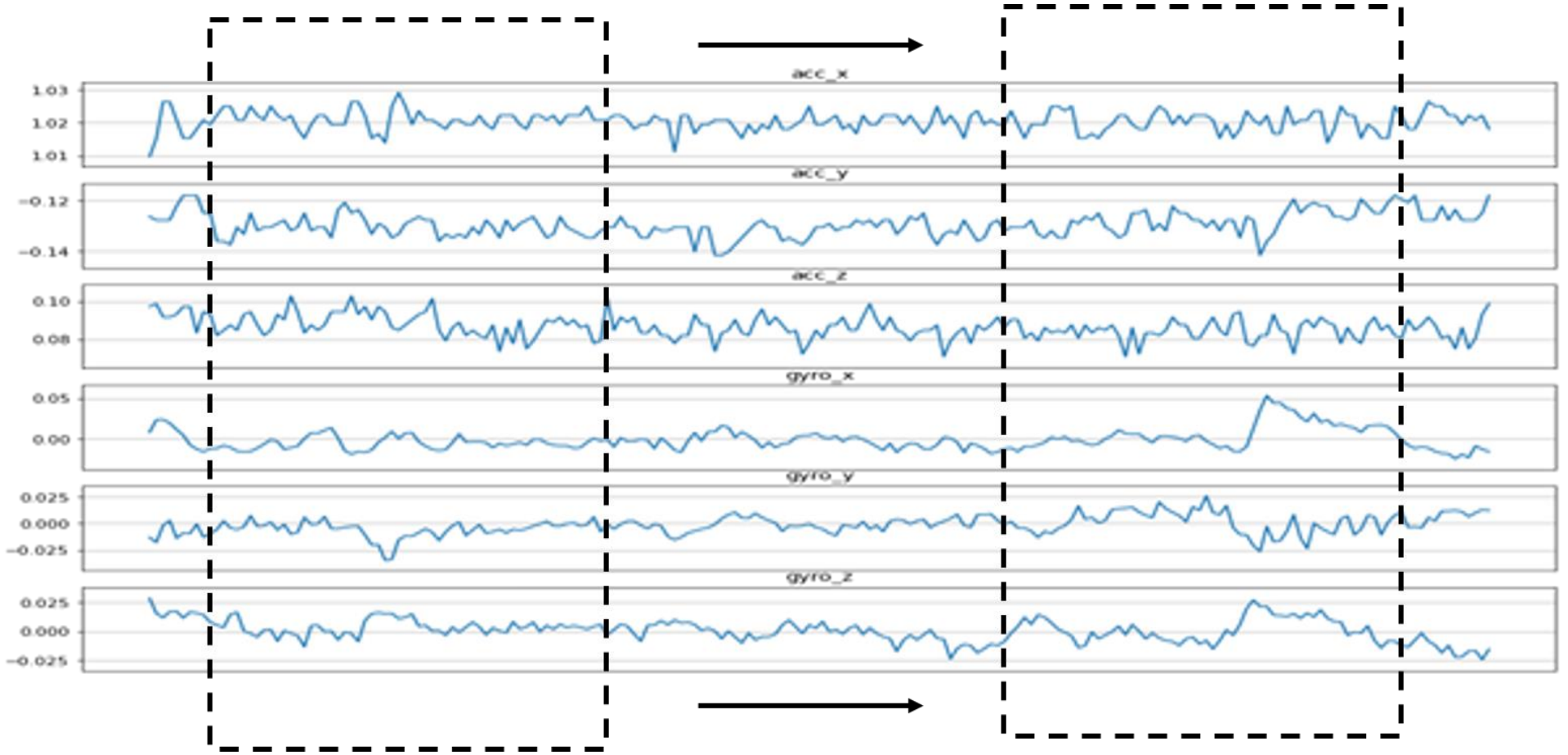
Segmentation of the data

- A sliding window of 4s with an overlap of 2s.
- The majority label is chosen to be the label of the segment.



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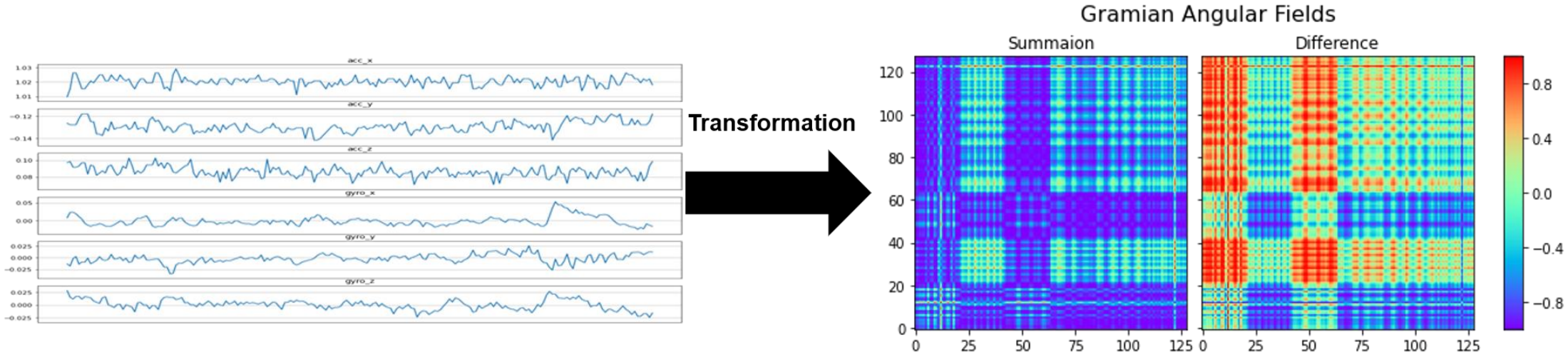
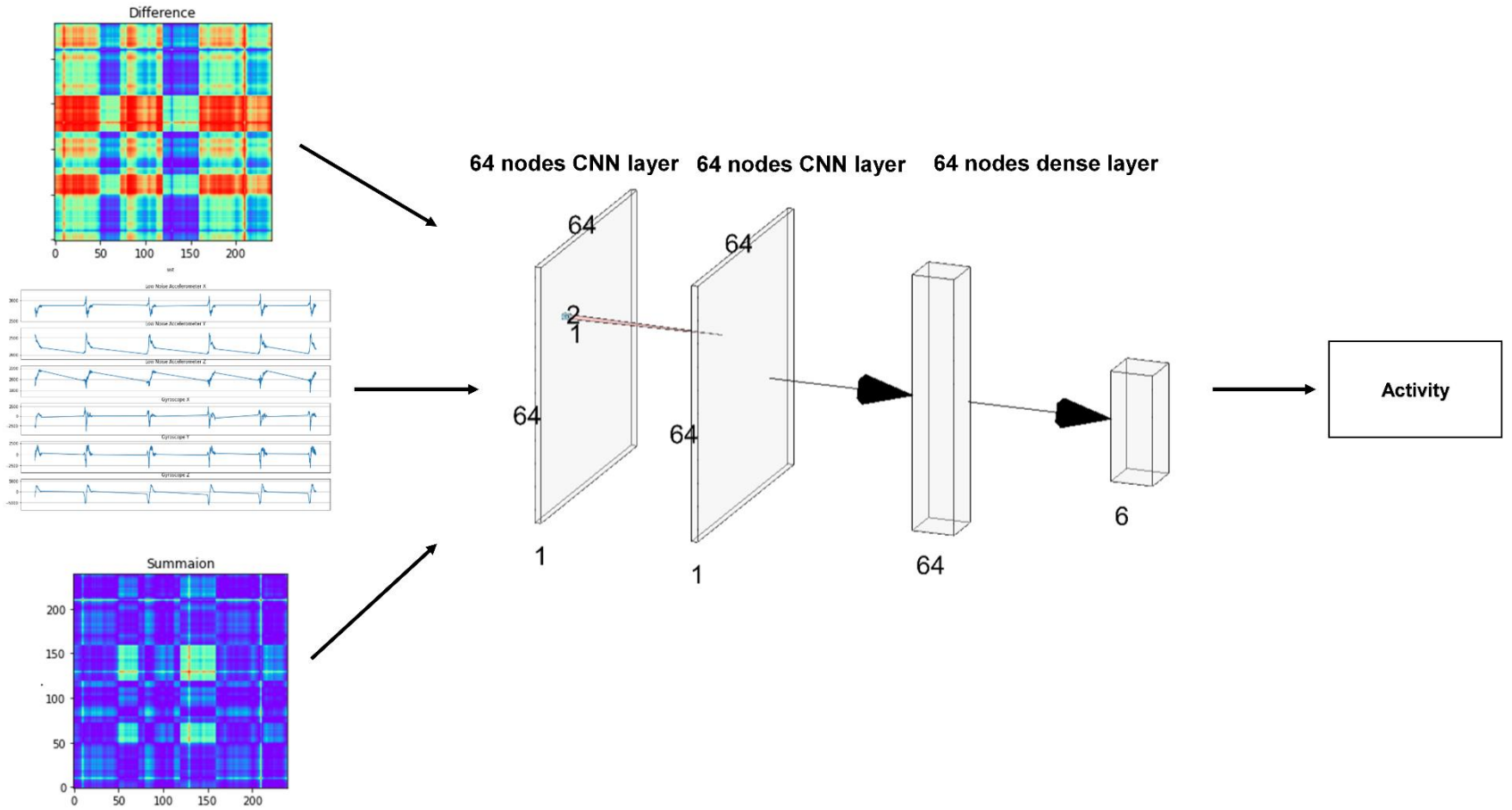
Gramian Angular fields

- Data is normalised.
- Data is mapped to polar coordinates.
- Angles are either summed (GASF) or differentiated (GADF) to construct the Gramian matrix.



The 2D classification model

- 2 x 3-channels 64-nodes CNN layers.
- Dropout layers.
- A 64 nodes fully connected layer.



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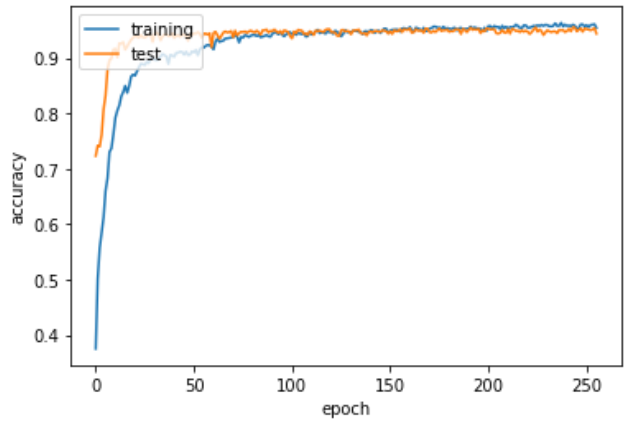
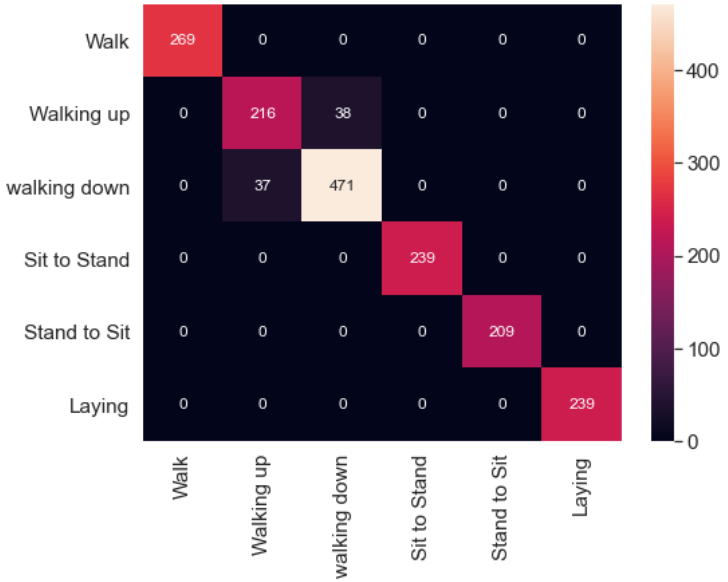
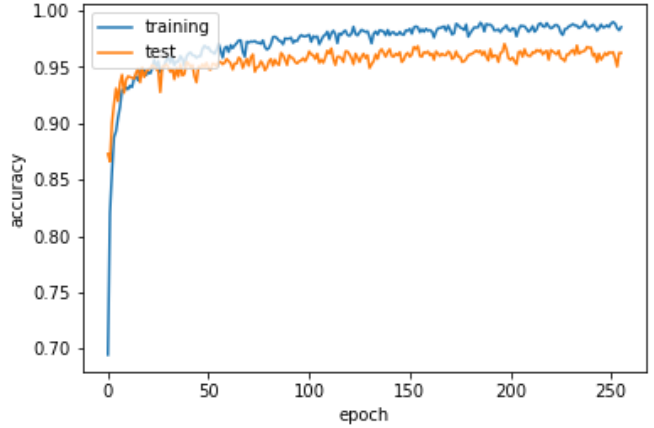
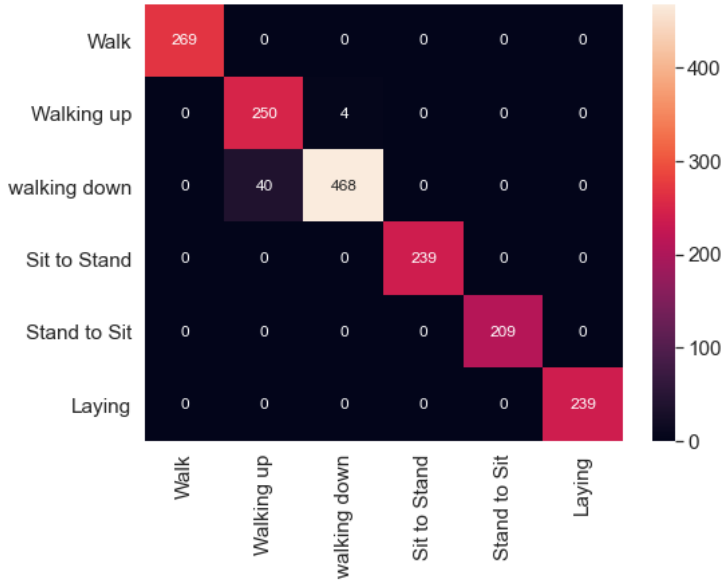
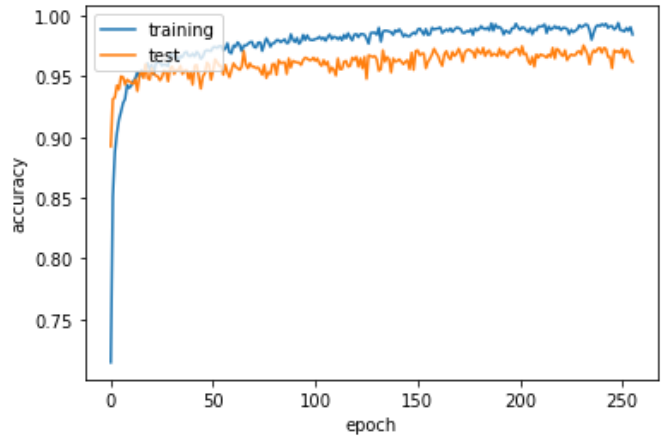
Performance of the 2D models

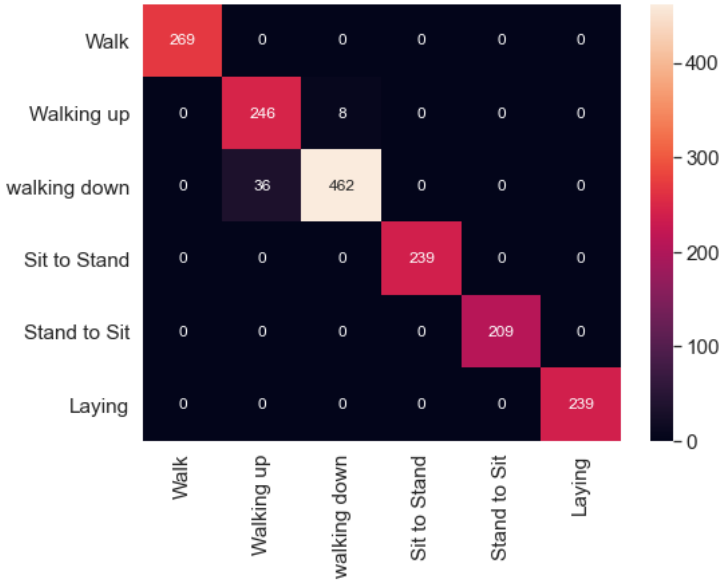












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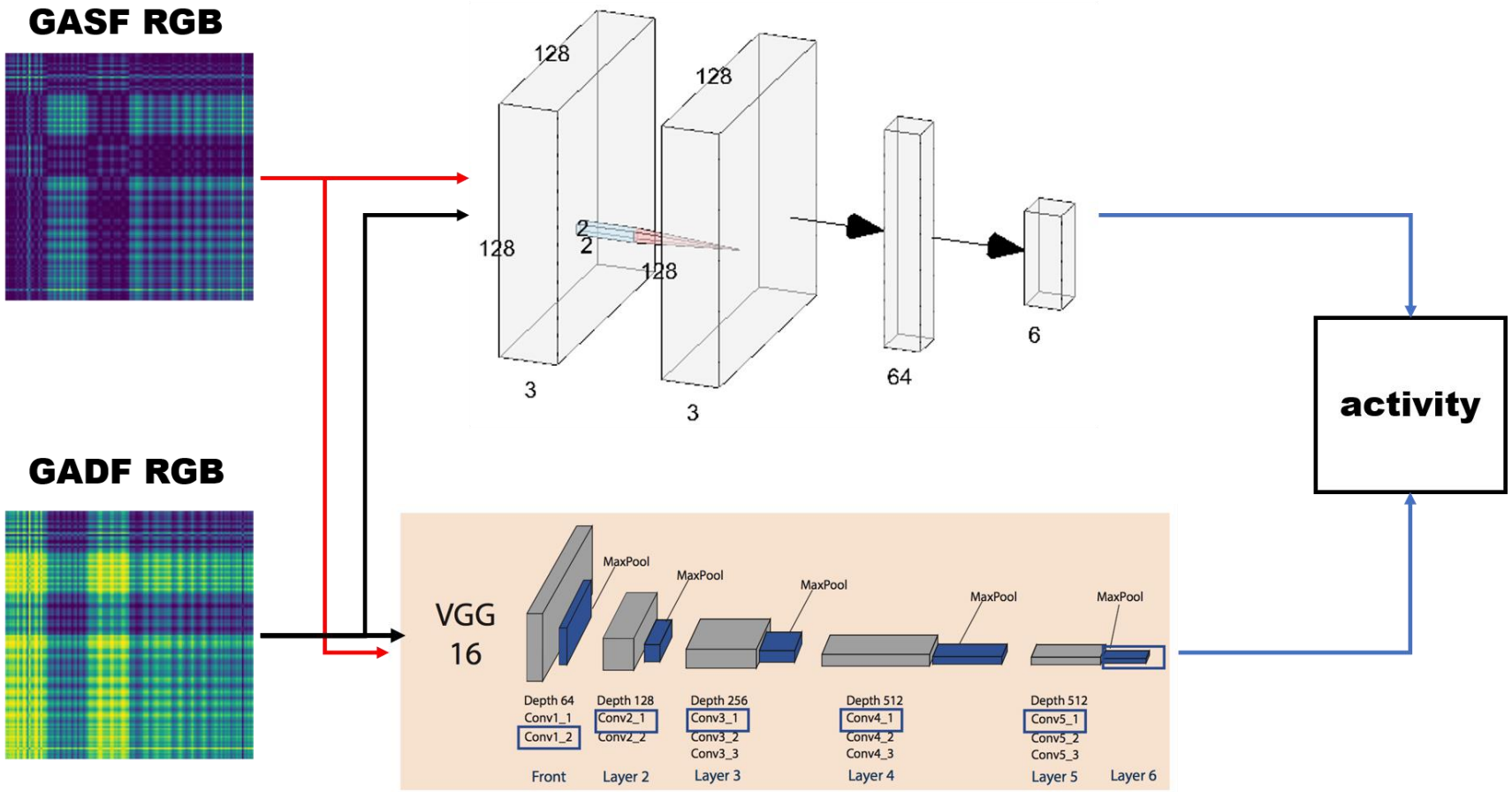
The 3D classification models

- 2x 4-channels 64-nodes CNN layers.
- Dropout layers.
- A 64 nodes fully connected layer.

- The VGG_16 model.



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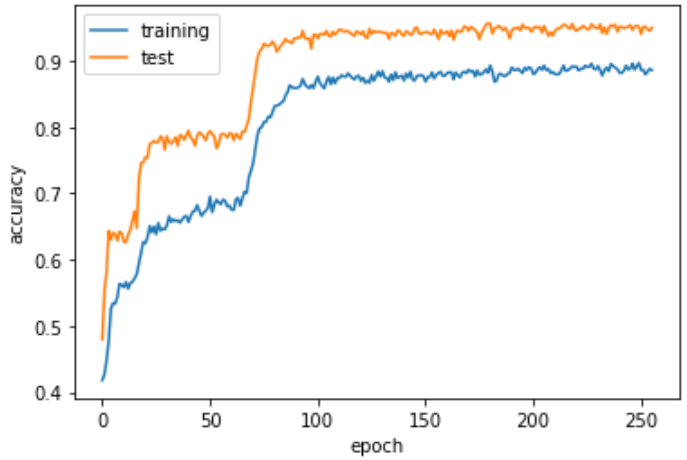
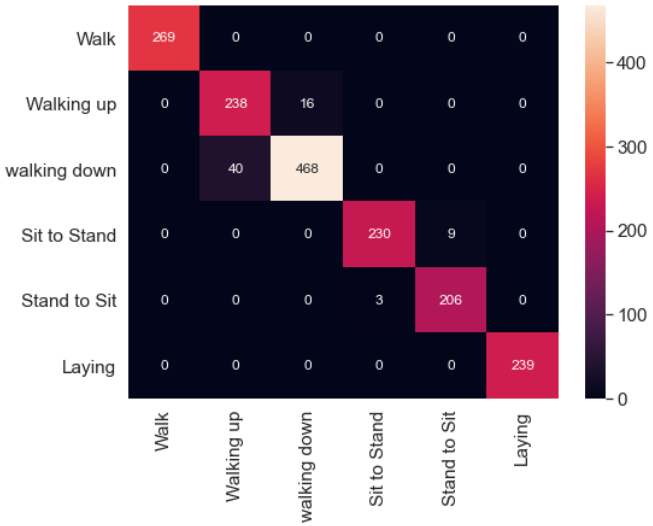
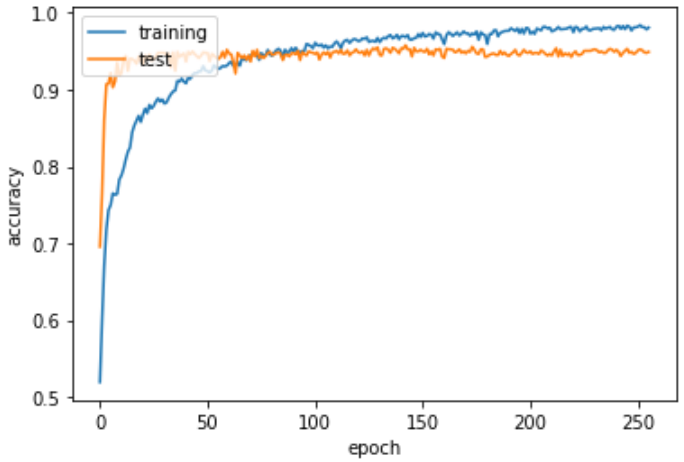
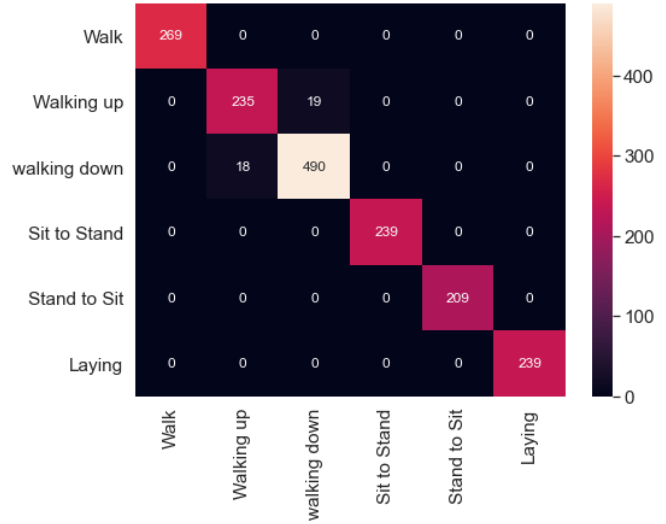
Performance of the 3D CNN model









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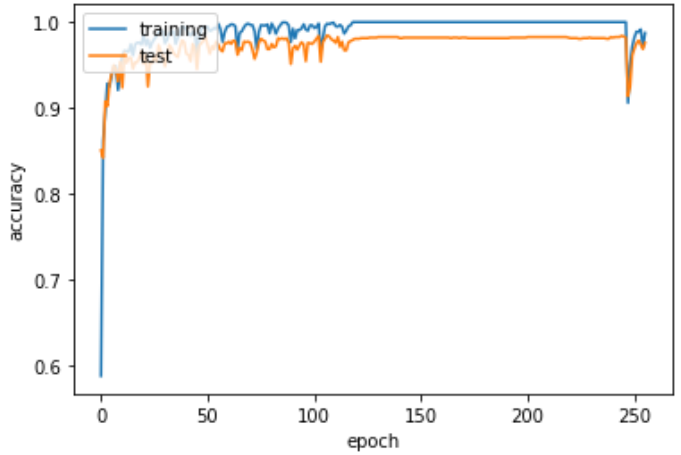
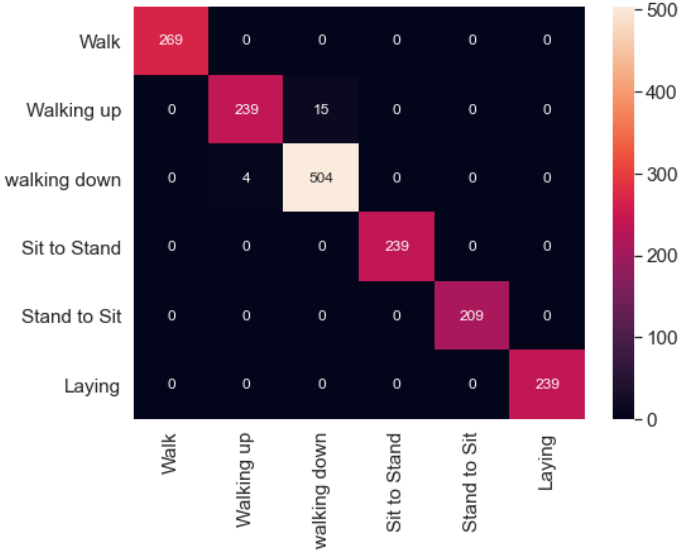
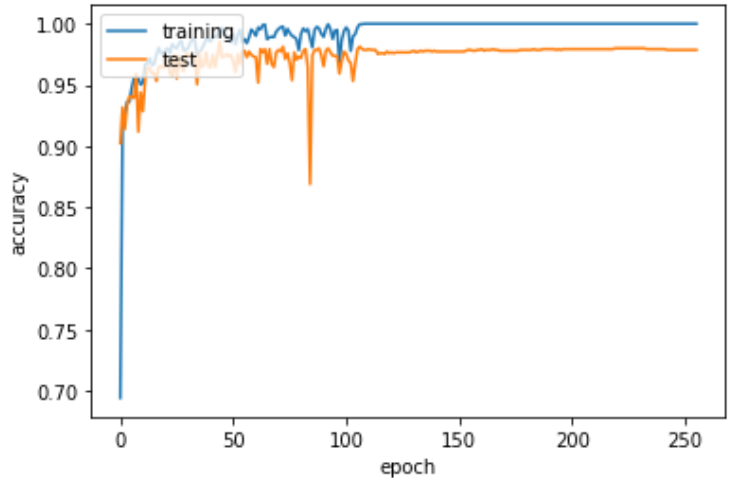
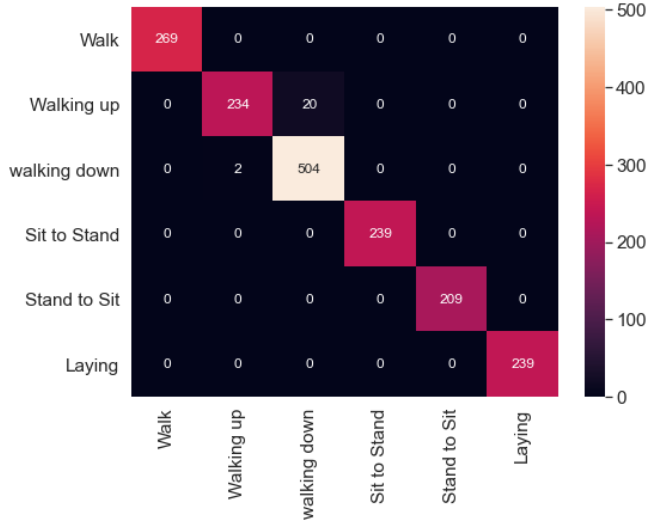
Performance of the 3D VGG_16 model









Results comparison

Model	Best classification accuracy (%)
Segmentation 3 channel CNN	94
GASF 3 channel CNN	97.06
GADF 3 channel CNN	97.06
GASF 4 channel CNN	95.45
GADF 4 channel CNN	97.52
GASF 4 VGG_16	98.46
GADF 4 VGG_16	98.53

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Contribution

- All the sensors' channels from a single time window are encoded into a single 2D image to map the maximum activity characteristics.
- Using a 2D classifier with 2D images improved classification from 94% to 97.06% .
- Using Transfer learning with 3D images improved classification from 94% to 98.53%.

Acknowledgement

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References

- [1] J.-L. Reyes-Ortiz, L. Oneto, A. Sam`a, X. Parra, and D. Anguita, “Transition-aware human activity recognition using smartphones,” Neurocomputing, vol. 171, pp. 754–767, 2016.

Thank YOU