Human Activity Classification from Accelerometer Data

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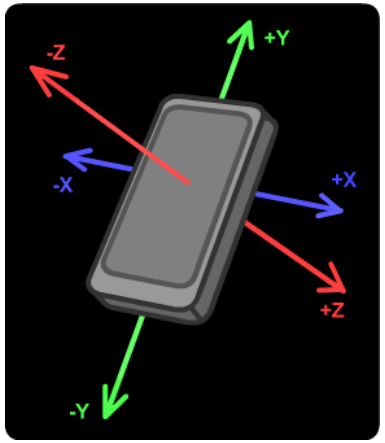
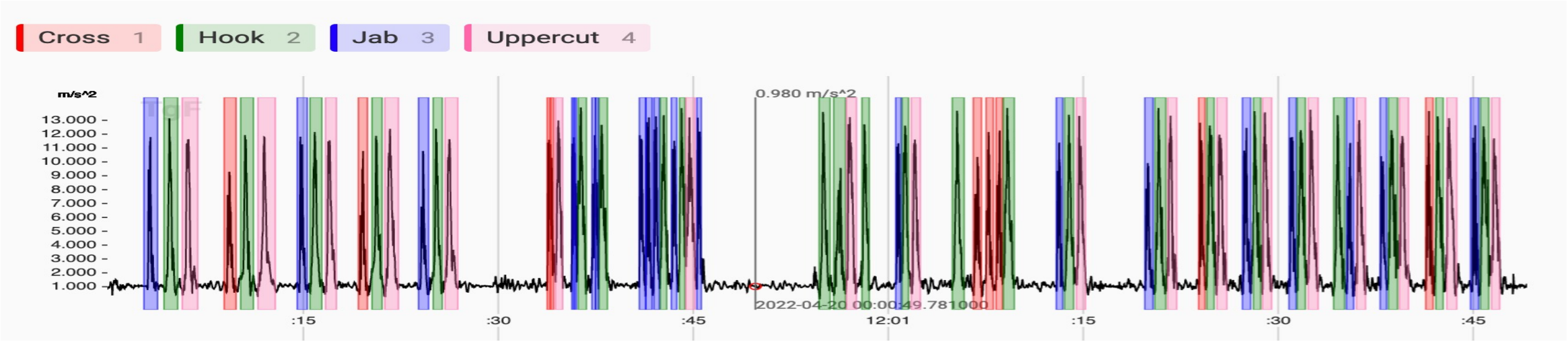
Abstract

- Human activity can be observed and measured by employing different sensors on different parts of the body.
- Monitoring and analysis of Human Activity help develop many technologies like fall detection, irregular heart rhythms, walking steadiness, posture, etc.
- This project focuses on classifying the activity performed by a human from time-series data generated from the user's phone's accelerometer.
- By leveraging the learning capability of CNNs on time-series data with a small number of training samples and input channels.

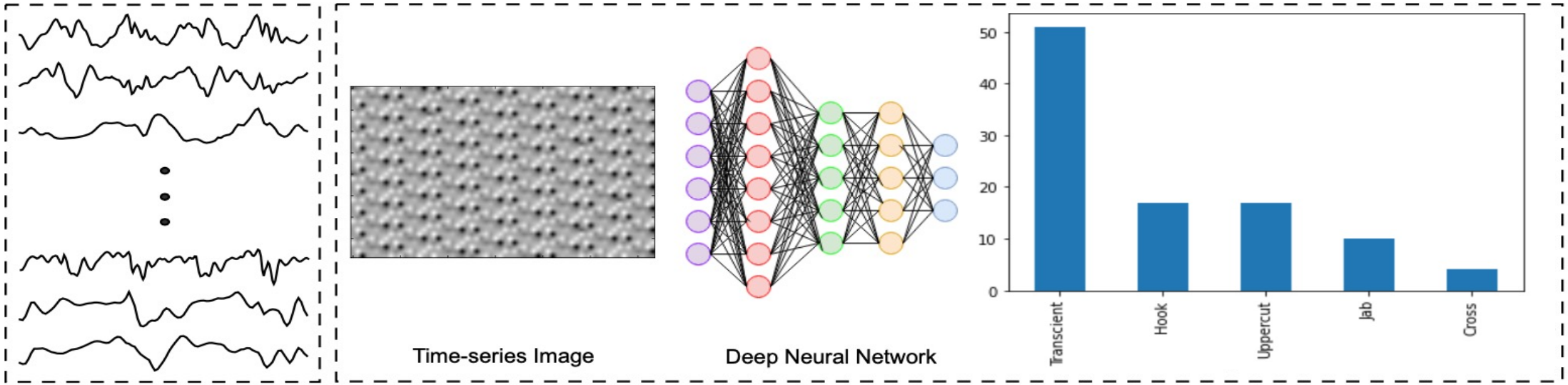
Phone Accelerometer Data



- Time series data is generated from the accelerometer in a smartphone.
- Measures the X, Y, and Z axes with a defined polling rate (100 Hertz) for the desired recording period.
- The user practiced boxing while holding the phone in his dominant arm.
- The time-series data is labeled in sections in which a move is performed.



Model Pipeline

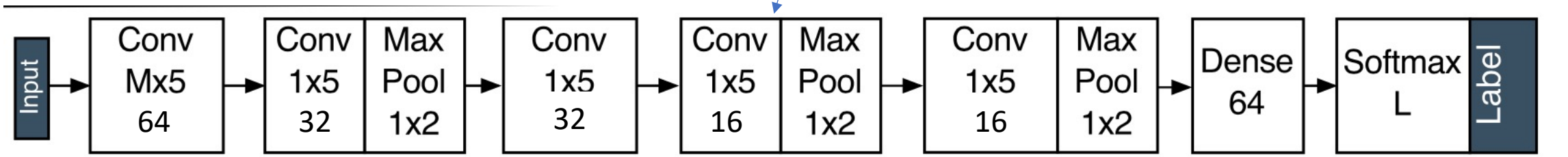


Raw time-series data

Converting data into 2-D images by creating windows of the data

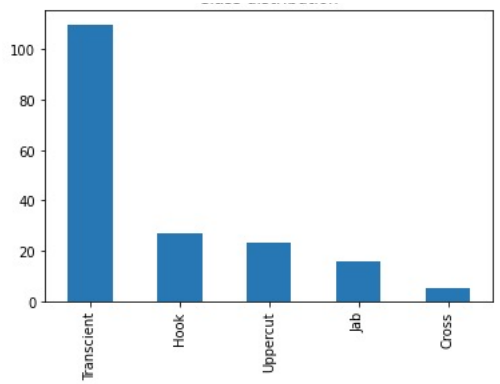
Deep Convolutional Neural Network

Class distribution of the activities performed



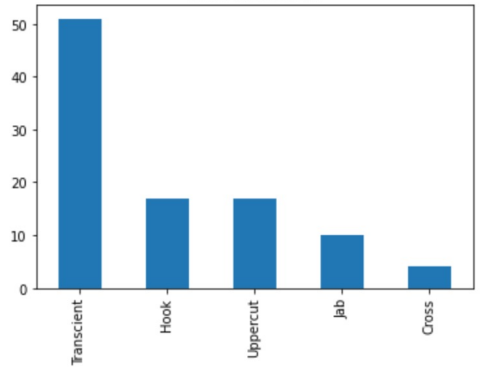
Training and testing data

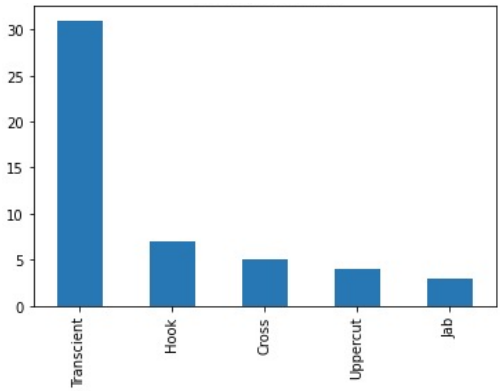
- A total of 330 2-D windows were generated from the time-series of size – with window size 4x64
- Training: 55%
- Validation: 15%
- Testing: 30%



Training data class distribution

Validation data class distribution





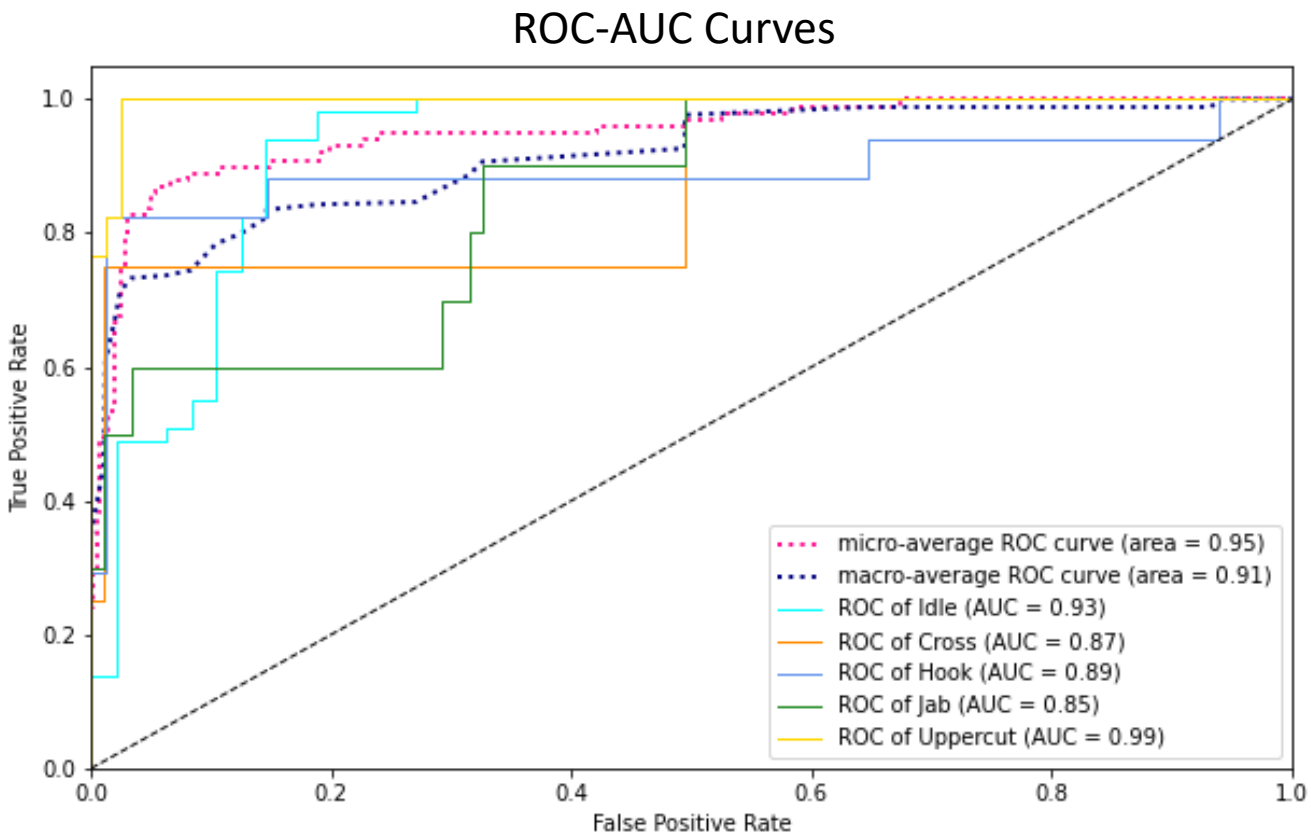
Testing data class distribution

Hyperparameter Tuning

Tuned with RandomizedSearchCV with 3 cross-fold validation

Tuned Parameter	Range	Optimized Value
Number of filters	[16, 32, 64]	**64**
Activation function	[ReLU, Tanh]	**ReLU**
Epochs	[50, 100, 150, 200]	**150**
Batch size	[16, 32, 64, 128]	**32**
Loss function	[“CategoricalCrossEntropy”, “SparseCategoricalCrossEntropy”]	**“SparseCategoricalCrossEntropy”**
Optimizer	[“Adam”, “RMSProp”, “SGD”]	**“Adam”**
Learning Rate	[0.1, 0.01, 0.001, 0.0001]	**0.001**

Model Performance



	f1-score	support
Idle	0.88	51
Cross	0.33	4
Hook	0.87	17
Jab	0.56	10
Uppercut	0.89	17
accuracy	**0.84**	99
macro avg	0.71	99
weighted avg	0.83	99

References

- A. Jafari, A. Ganesan, C. S. K. Thalisetty, V. Sivasubramanian, T. Oates and T. Mohsenin, "SensorNet: A Scalable and Low-Power Deep Convolutional Neural Network for Multimodal Data Classification," in IEEE Transactions on Circuits and Systems I: Regular Papers, vol. 66, no. 1, pp. 274-287, Jan. 2019, doi: 10.1109/TCSI.2018.2848647.
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- Pedregosa *et al.* Scikit-learn: Machine Learning in Python, JMLR 12, pp. 2825-2830, 2011.

Thank you!

Happy to answer your questions, if any!