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FACULDADE DE CIÊNCIAS E TECNOLOGIA
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ADVANCED DATA ANALYSIS TECHNIQUES | ARTICLE
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Phonocardiographic Sensing using Deep Learning for Abnormal Heartbeat Detection

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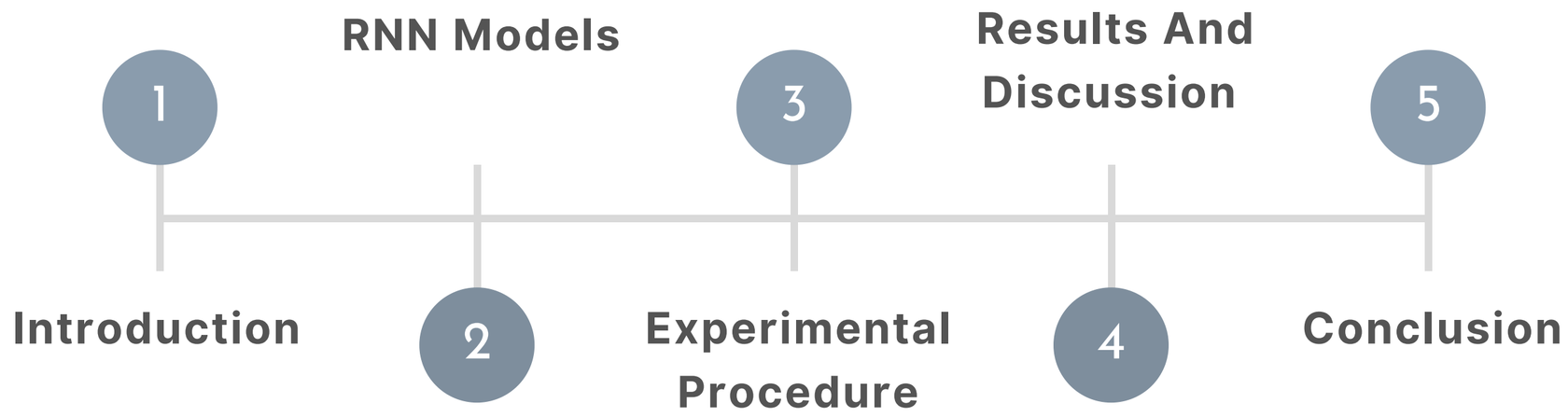
Article Brief



Introduction

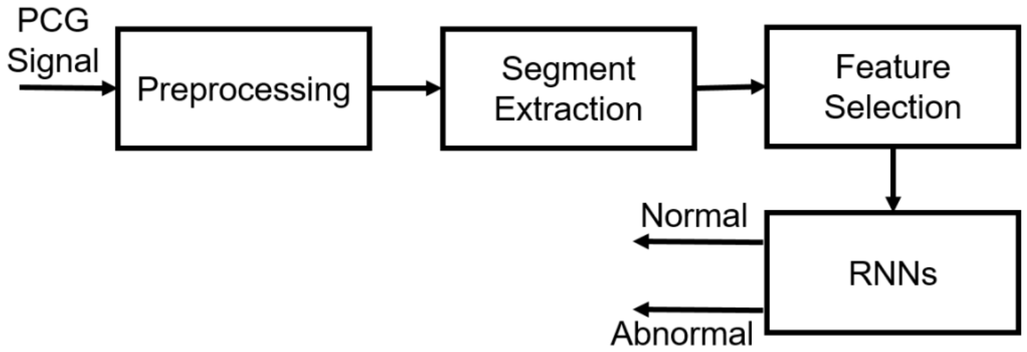
According to the World Health Organisation, cardiovascular diseases (CVDs) are the number one cause of death globally

Phonocardiography (PCG)

Its propose a Recurrent Neural Networks (RNNs) based automated cardiac auscultation solution.

Explore the use of various RNN models, and demonstrate that these models deliver the abnormal heartbeat classification score with significant improvement.

RNN Models



Recurrent Neural Networks (RNNs)

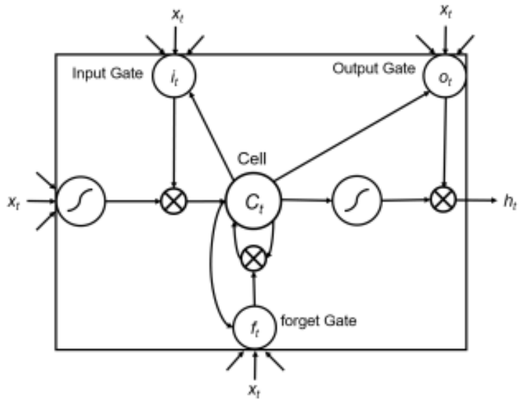
1. It takes an input sequence x(t) and at the current time step t
2. Calculates the hidden state or memory of the network ht using previous hidden state ht–1 and the input xt.

$$h_t = H(W_{xh}x_t + W_{hh}h_{t-1} + b_h)$$

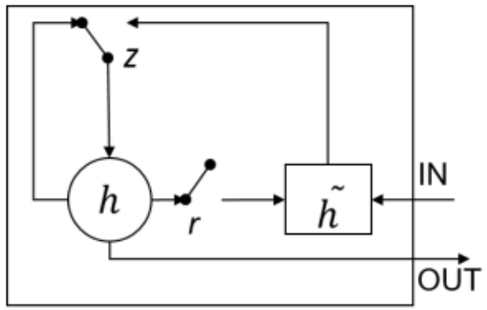
$$y_t = (W_{xh}x_t + b_y)$$

RNN Models

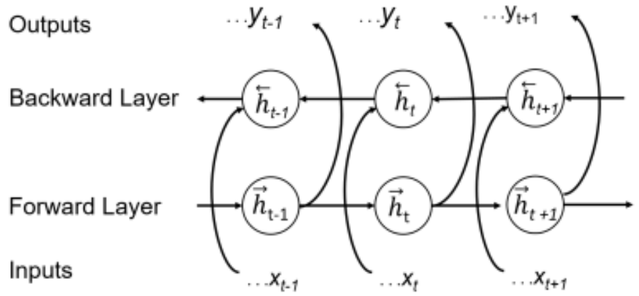
1. Long Short-Term Memory (LSTM) Unit (a)
2. Gated Recurrent Units (GRUs) (b)
3. Bidirectional Recurrent Neural Network (c)



(a)



(b)



(c)

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Experimental Procedure

Database Description

Preprocessing of Heart Sound

Logistic Regression-HSMM

The logistic function σ(a).

Algorithm combines:

1. Homomorphic envelope
2. Hilbert envelope
3. Wavelet envelope
4. Power spectral density envelope

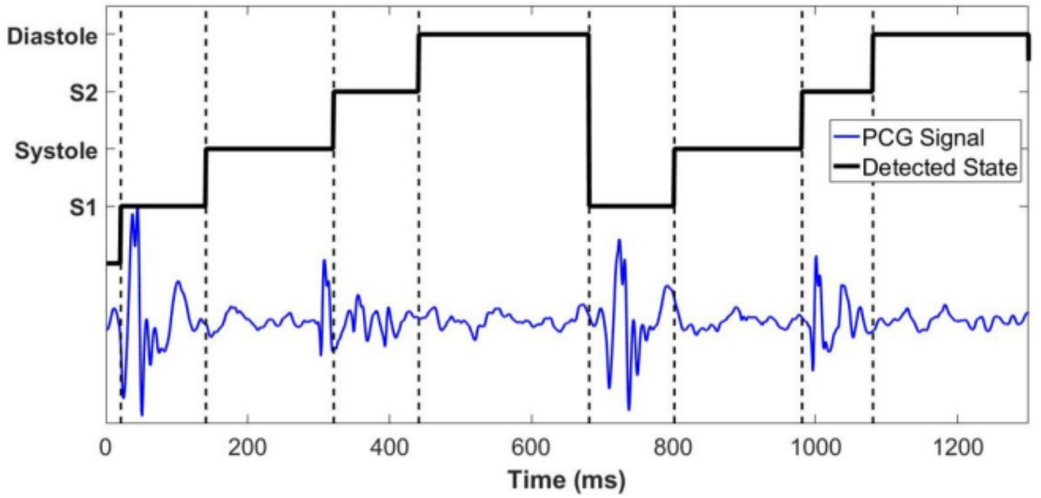


Fig.: Four states (S1, S2, systole, and diastole) of the heart cycle using Logistic Regression-HSMM.

Experimental Procedure

Segment Extraction

Feature Selection

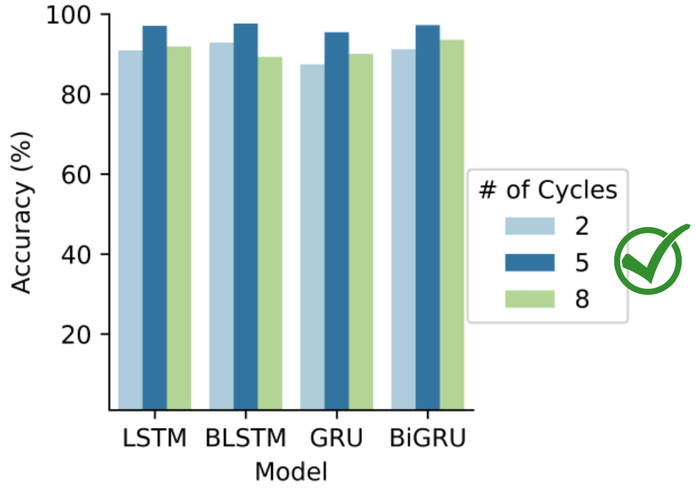
Mel-frequency cepstral coefficients (MFCC)
13 MFCC

Model
Keras | TensorFlow

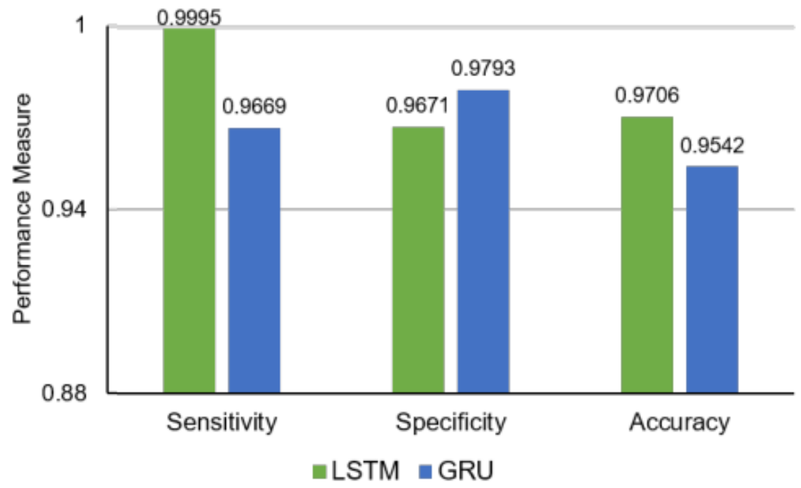
Experiments with a larger number of gated layers and dense layers – **Overfitting**

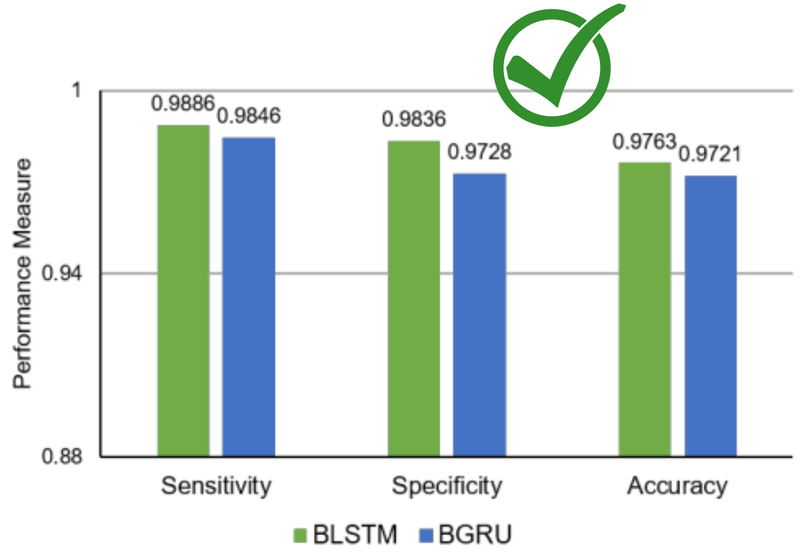
The best classification results using 2 gated layers for both LSTM and GRU models.

Results And Discussion



Model	Sensitivity	Specificity	Accuracy
SVM (best)	0.8259	0.8324	0.8291
LR (best)	0.7121	0.6879	0.6991
RF (best)	0.6901	0.6850	0.6861
RNNs (best)	**0.9886**	**0.9836**	**0.9763**





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Author (Year)	Approach	Sensitivity	Specificity	Accuracy
Potes et al. [24] (2016)	AdaBoost and CNN	0.9424	0.7781	0.8602
Tschannen et al. [48] (2016)	Wavelet-based CNN	0.855	0.859	0.828
Rubin et al. [23] (2017)	CNN	0.7278	0.9521	0.8399
Nassralla at al. [20] (2017)	DNNs	0.63	0.82	0.80
Dominguez at al. [49] (2018)	Modified AlexNe	0.9512	0.9320	0.9416
Our Study (2018)	LSTM	**0.9995**	0.9671	0.9706
	BLSTM	0.9886	**0.9836**	**0.9763**
	GRU	0.9669	0.9793	0.9542
	BiGRU	0.9846	0.9728	0.9721

Conclusion

Recurrent neural networks (RNNs) produce promising results.

References

Latif, Siddique; Usman, Muhammad; Rana, Rajib; Qadir, Junaid - 'Phonocardiographic Sensing using Deep Learning for Abnormal Heartbeat Detection'; arXiv:1801.08322v4 [cs.CV] 28 Jul 2020.

Thank you for your attention!