



Vectorcardiography-Based Deep Learning Applied to a Novel Credit Card Sized Device for Atrial Flutter and Atrial Fibrillation Detection

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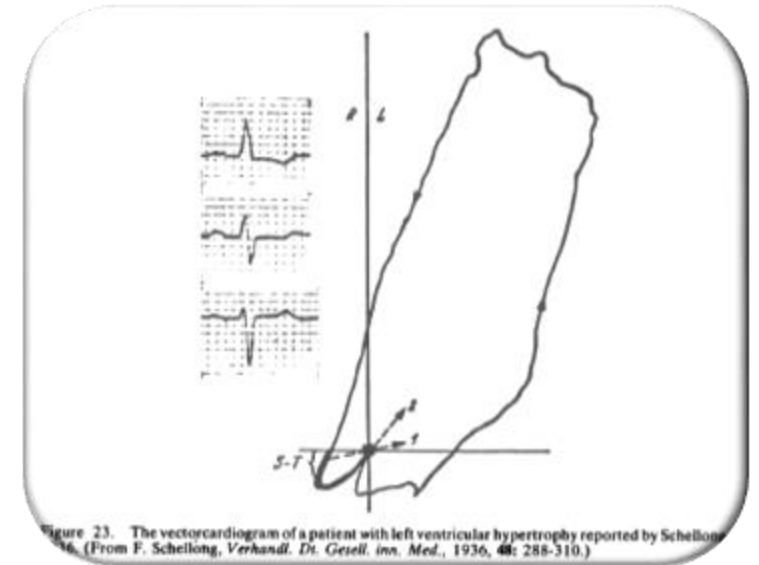
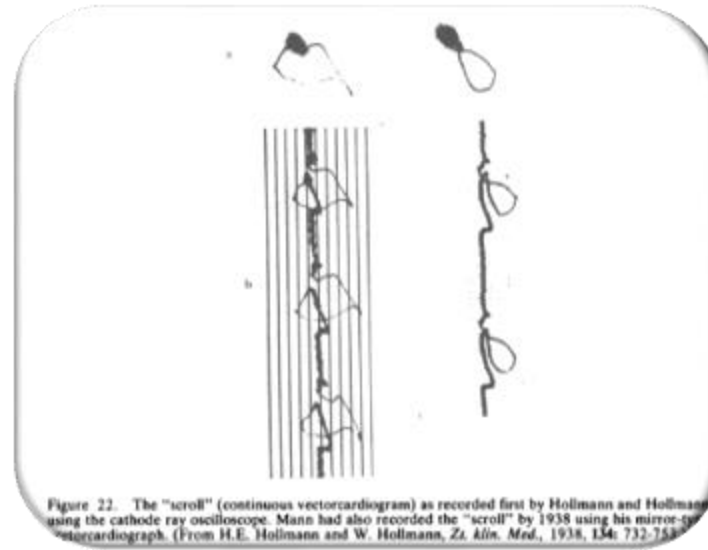
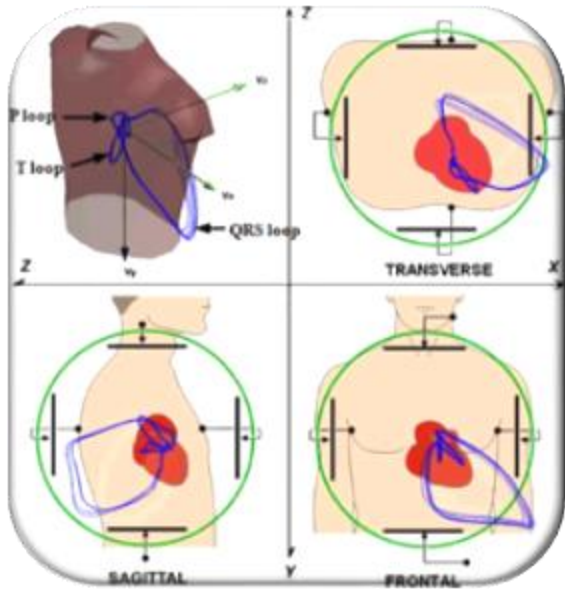
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 Heart Rhythm SocietySM

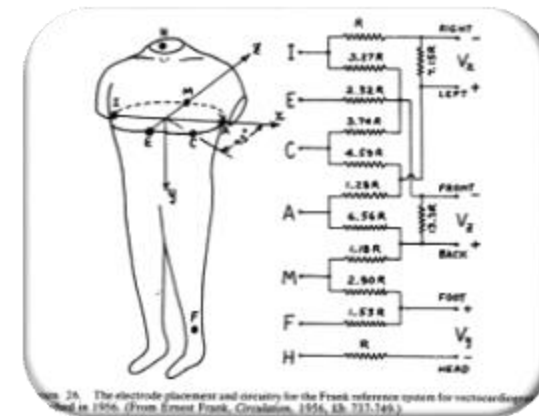
Disclosures

- Consulting: Viz.ai, Heart Sciences (not HeartBeam)
- Speaking: iRhythm
- Funding: The study was funded by HeartBeam

Background: Vectorcardiography (VCG)



- VCG ~100 years old
- 3D voltage in x,y,z axes



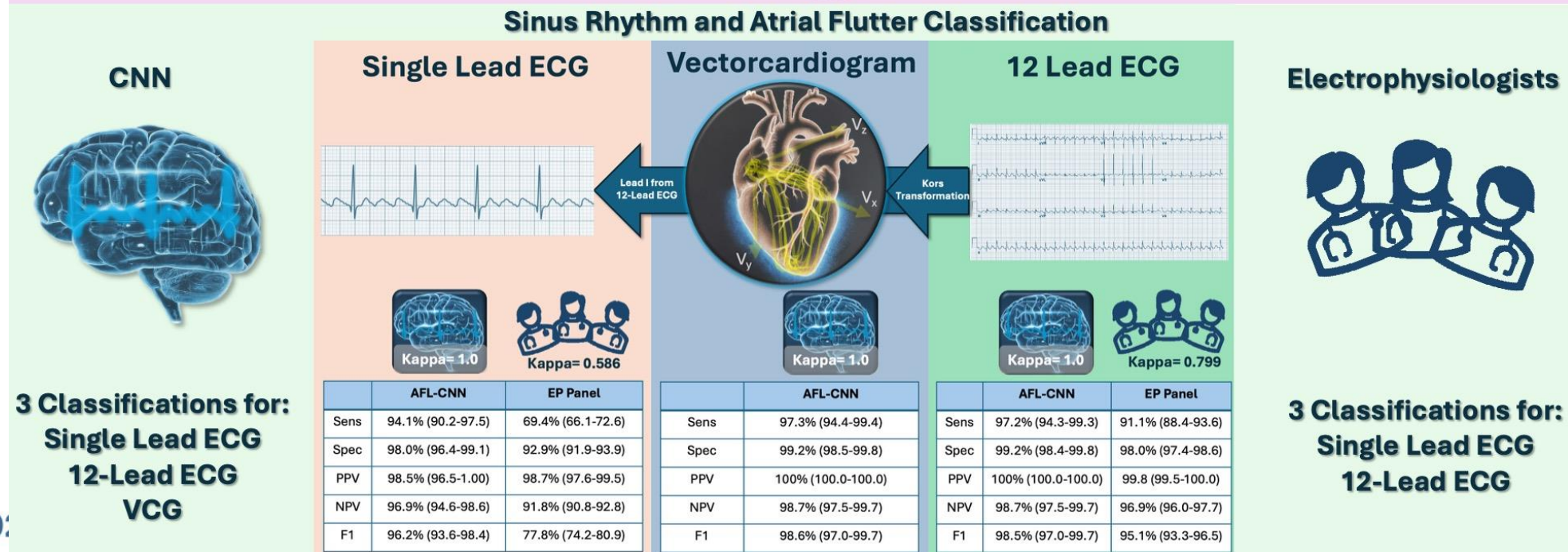
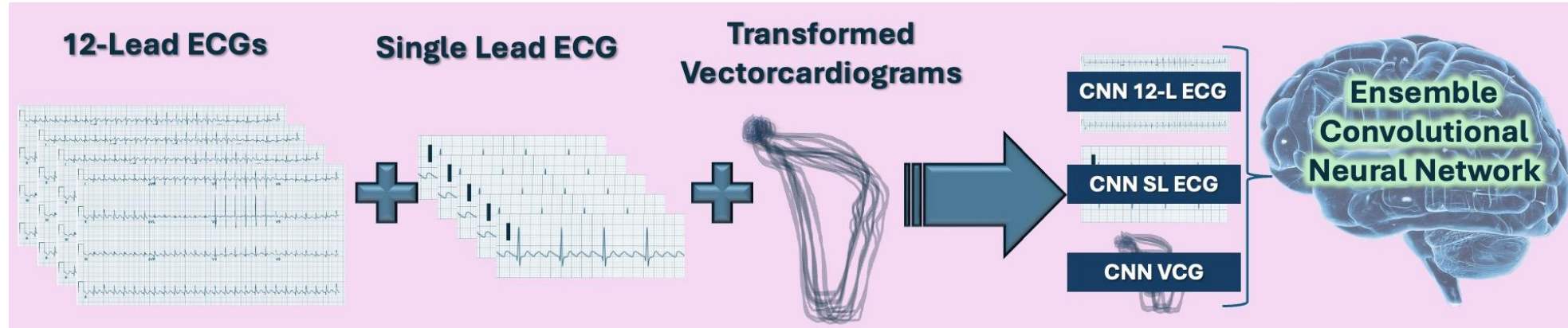
#HRX2025



Hasan, Abbott Biomedical Engineering 2015



Background: Transformed VCG CNN



#HRX2024



Objective

- To assess performance of a convolutional neural network (AFx-CNN) for detecting atrial fibrillation (AF) and atrial flutter (AFL) vs sinus rhythm (SR)
- From **directly acquired** VCGs obtained from a novel credit card sized device (NCCD, Heartbeam)



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Methods

201
Consecutive
Patients
Presenting to
EP Clinic

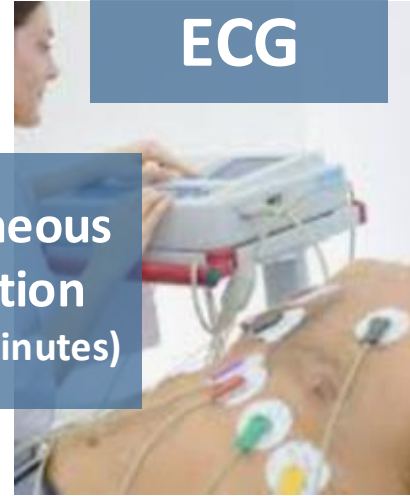


VCG



Simultaneous
Acquisition
(within 6 minutes)

ECG



AFx-CNN



Classification

Sinus

AF

AFL

- Unblinded 3 electrophysiologist panel as ground truth to define
 - 131 sinus rhythm (SR) ECGs
 - 57 AF ECGs
 - 13 AFL ECGs
 - **Expanded 5-EP panel to achieve consensus if initial adjudication was not unanimous (2 ECGs)**

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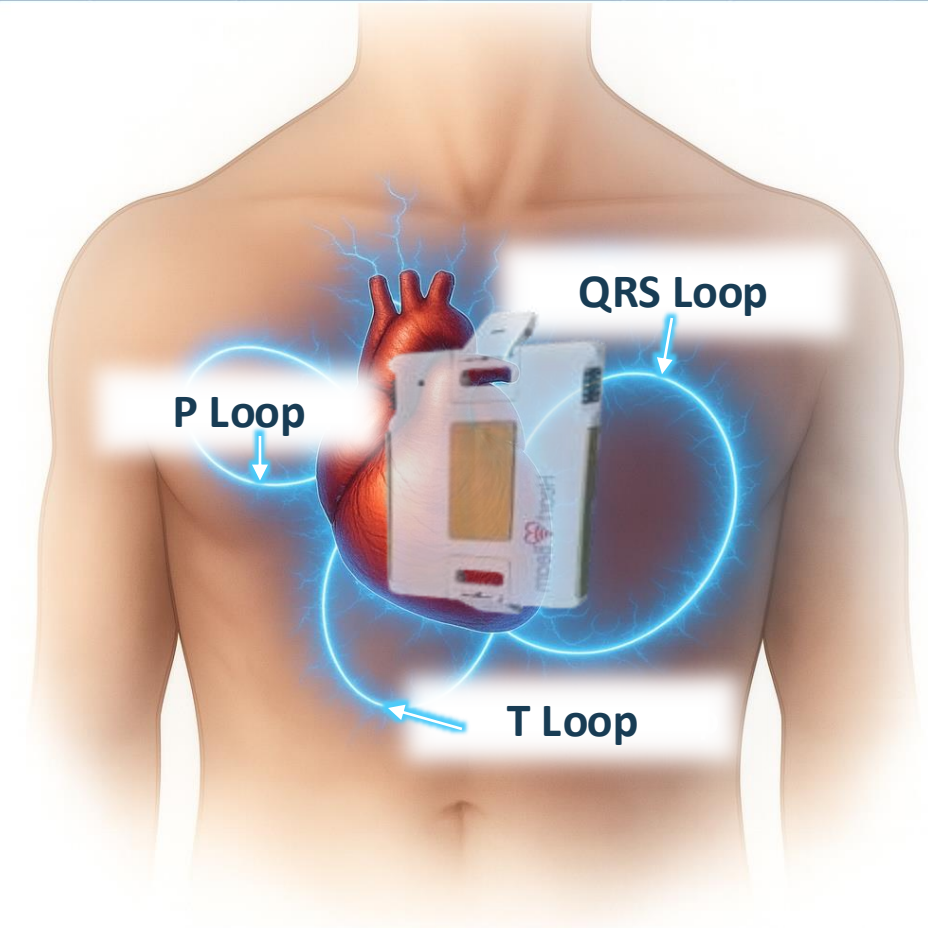


Results

| Rhythm | Performance | VCG AFx-CNN (95%CI) | ECG AFx-CNN (95%CI) |
|---------------------|-------------|----------------------|----------------------|
| | Accuracy | 94.5% (91.0-97.5) | 95.5% (92.5-98.0) |
| | Sensitivity | 100.0% (100.0-100.0) | 98.2% (94.1-100.0) |
| | Specificity | 96.5% (93.2-99.3) | 95.1% (91.4-98.5) |
| Atrial Fibrillation | PPV | 91.9% (84.5-98.2) | 88.9% (80.6-96.2) |
| | NPV | 100.0% (100.0-100.0) | 99.3% (97.7-100.0) |
| | F1 | 95.8% (91.6-99.1) | 93.3 (88.1-97.5) |
| | Sensitivity | 92.3% (75.0-100.0) | 84.6% (61.5-100.0) |
| | Specificity | 97.3% (94.8-99.5) | 100.0% (100.0-100.0) |
| Atrial Flutter | PPV | 70.6% (46.7-92.3) | 100.0% (100.0-100.0) |
| | NPV | 99.5% (98.3-100.0) | 98.9% (97.3-100.0) |
| | F1 | 79.5% (60.6-93.8) | 91.3% (76.2-100.0) |
| | Sensitivity | 92.4% (87.5-96.7) | 95.4% (91.5-98.5) |
| | Specificity | 98.6% (95.2-100.0) | 95.4 (91.5-98.5) |
| Sinus Rhythm | PPV | 99.2% (97.4-100.0) | 98.4% (95.9-100.0) |
| | NPV | 87.3% (79.5-94.2) | 91.9% (85.1-97.4) |
| | F1 | 95.6% (92.8-98.0) | 96.0% (94.5-98.9) |

Conclusions

- The CNN performed similarly, whether applied to 12-lead ECG or directly acquired VCGs in classifying AF, AFL, and SR
- VCG-based cardiac waveform analysis may be advantageous in improving accessibility and scalability
 - Simplified acquisition
- Further study is warranted to assess whether deep learning algorithms applied to this novel acquisition technology perform comparably to 12-lead ECG for other arrhythmias and disease states





innovators at heart

Thank you

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