

AI Helps Diagnose Infectious Disease Tetanus With a Cheap Wearable Monitor

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Introduction

Infectious Disease Tetanus



The symptoms start around 4 to 21 days after infection.

- **Stiffness** in your jaw muscles
- Painful **muscle spasms**
- A **high temperature**
- **Sweating**
- A **rapid heartbeat**

Our work aims to use AI to classify the severity level with low-cost wearable monitors



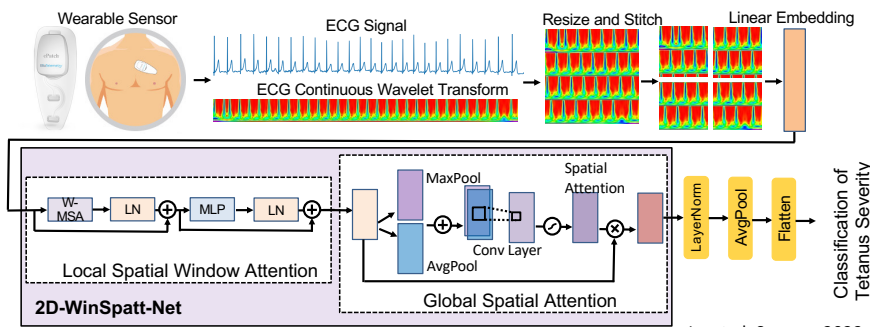
Patients with **mild** tetanus can go home. **Severe** cases need to stay in hospital for treatment.

- Help low- and middle- income countries like **Vietnam**
- Highly valuable for inexperienced or overloaded staff

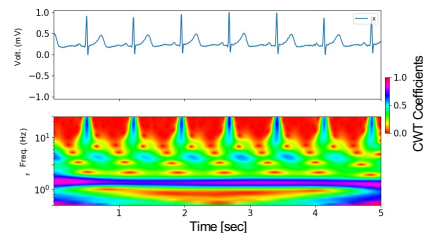
Methods

3rd Approach

2D-WinSpatt-Net: A Dual Spatial Self-Attention Vision Transformer Boosts Classification of Tetanus Severity for Patients Wearing ECG Sensors in Low-and Middle-Income Countries



- 1 lead low-cost ECG can be used to diagnose tetanus
- Fast triage of tetanus patients using 20-second time series images of ECG signals

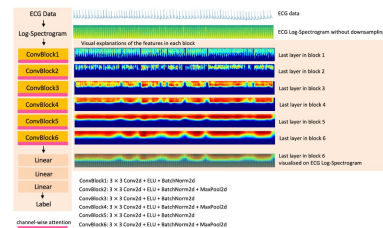


An example of tetanus ECG and continuous wavelet transform (CWT): (a) Tetanus ECG in 5-s; (b) The CWT related to (a).

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1st Approach

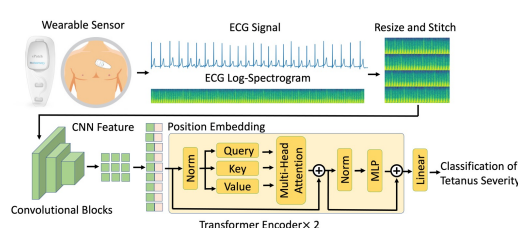
2D-CNN + Channel-wise Attention



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2nd Approach

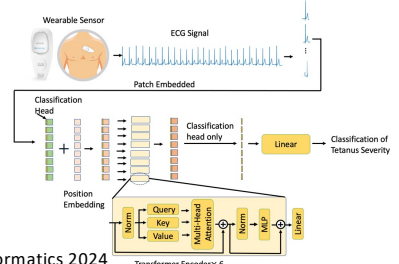
2D-CNN-Transformer/8



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4th Approach

1D-Vision Transformer



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Results

60 second window length Log-Spectrogram						
Method	F1 score	precision	recall	specificity	accuracy	AUC
2D-CNN	0.61±0.14	0.68±0.07	0.57±0.19	0.85±0.02	0.75±0.07	0.72±0.09
2D-CNN + Dual Attention	0.65±0.19	0.71±0.17	0.61±0.21	0.86±0.09	0.76±0.11	0.74±0.13
2D-CNN + Channel-wise Attention	0.79±0.03	0.78±0.08	0.82±0.05	0.85±0.08	0.84±0.04	0.84±0.03
2D-CNN-Transformer/8	0.82±0.03	0.94±0.03	0.73±0.07	0.97±0.02	0.88±0.01	0.85±0.03
Proposed 2D-WinSpatt-Net	0.75±0.05	0.81±0.02	0.70±0.07	0.91±0.00	0.83±0.03	0.80±0.04
20 second window length CWT						
Swin Transformer V2	0.83±0.03	0.93±0.01	0.75±0.04	0.97±0.01	0.89±0.01	0.86±0.02
Proposed 2D-WinSpatt-Net	0.88±0.00	0.92±0.02	0.85±0.01	0.96±0.01	0.93±0.02	0.90±0.00
No time series Images						
Method	F1 score	precision	recall	specificity	accuracy	AUC
1D-CNN	0.65±0.14	0.61±0.05	0.77±0.25	0.70±0.13	0.73±0.05	0.74±0.08

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Visual explanations of important areas in the generated image for tetanus severity classification

2D-CNN + Channel-wise Attention 2D-CNN-Transformer/8

