

A Real-Time Point-of-Care Assistant on Raspberry Pi for Medical Diagnostics

Opportunity Open Source Conference OOSC 3.0



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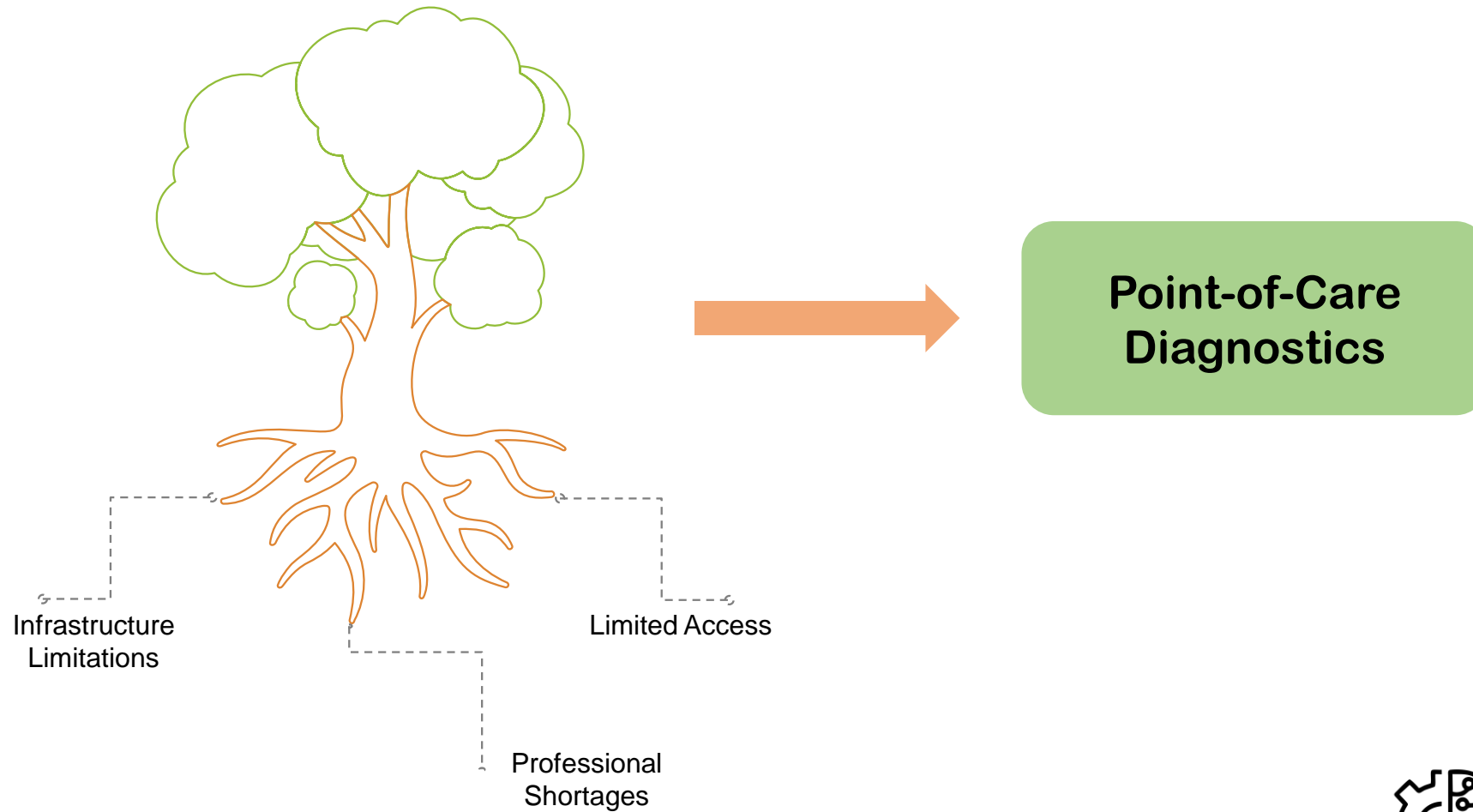


AI4ICPS



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Challenges in Patient Care

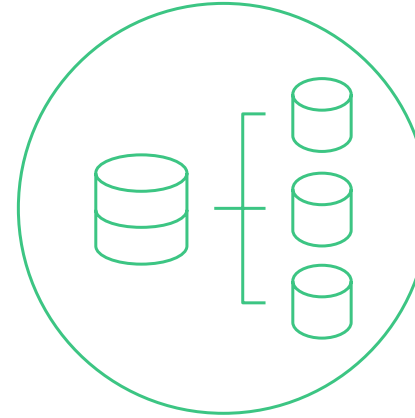


Point-of-Care Diagnostics



Existing Solutions

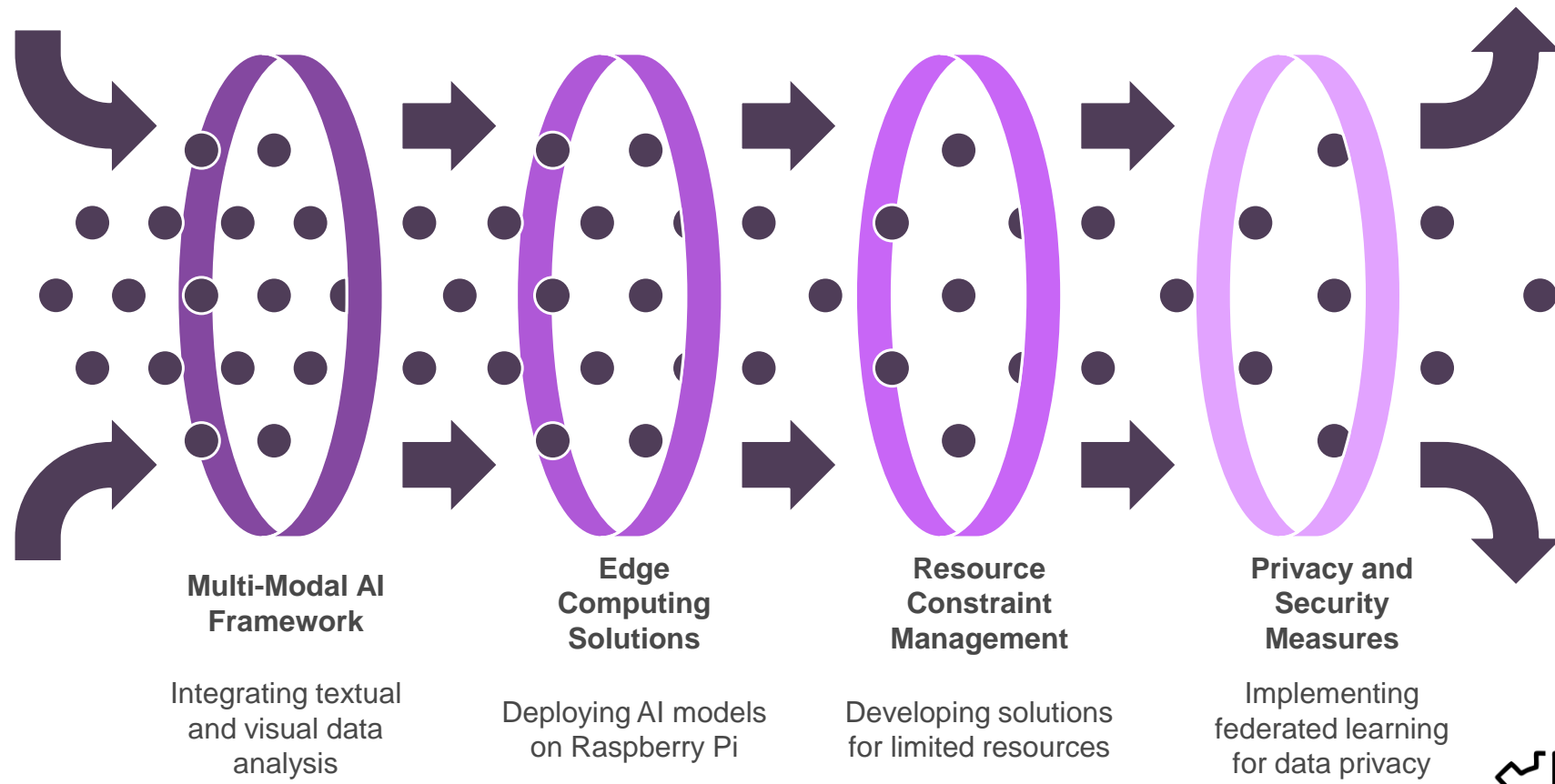
High cost, cloud dependency,
single-modality



Ideal Solutions

Low cost, local processing,
multi-modality

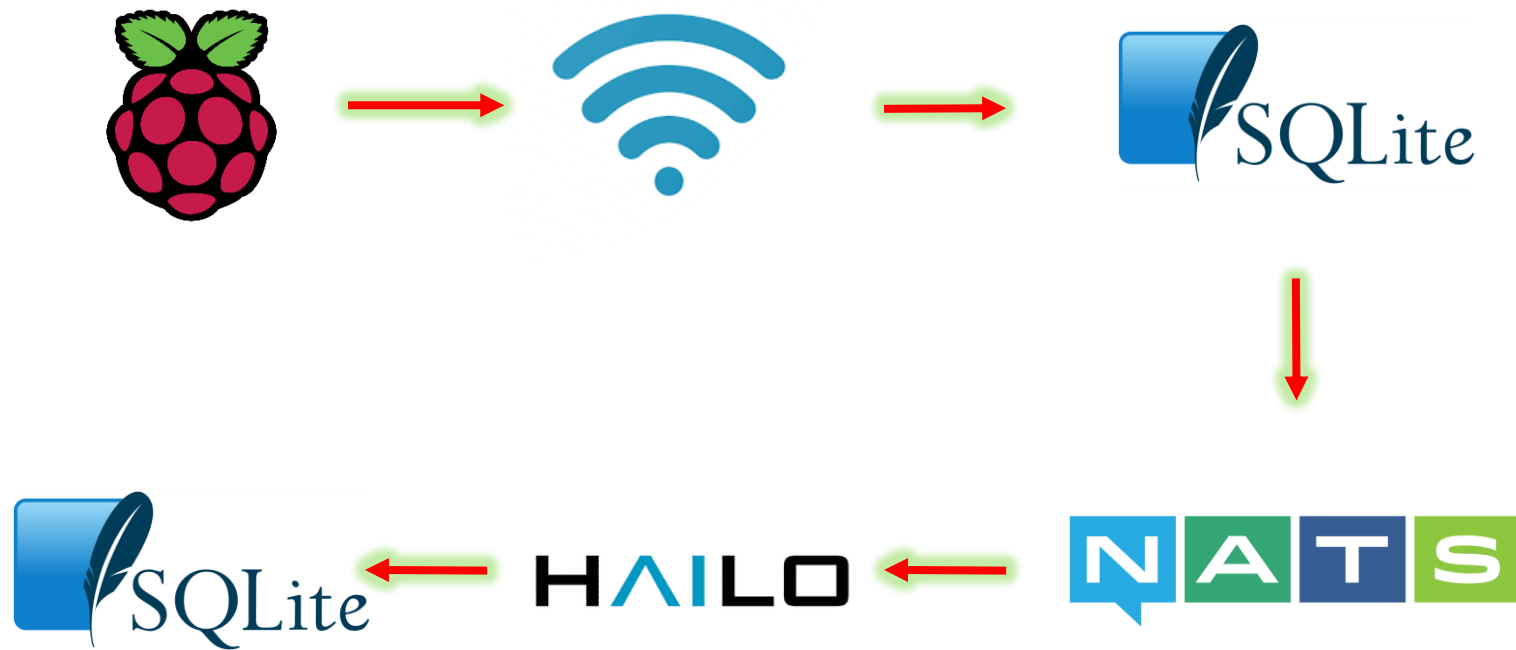
Objective: A Unified AI Framework



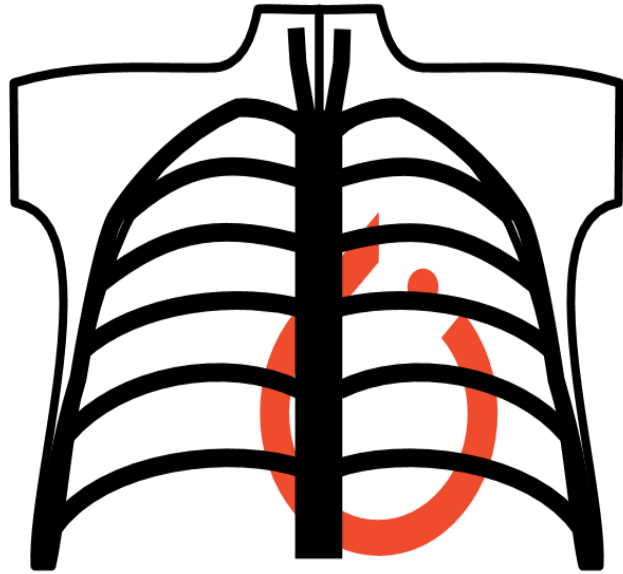
Methodology: System Characteristics

Characteristic	Multi-Modal AI	Edge Computing	Federated Learning	Open-Source Framework
Data Support	Structured and unstructured medical data	N/A	N/A	N/A
Key Technologies	OpenBioLLM-70B, MobileNetV2, Vision Transformers	TensorFlow Lite quantization, Knowledge distillation	Differential privacy, Asynchronous updates	HL7 FHIR, DICOM, Modular APIs
Optimization	Attention-based fusion, Supervised contrastive learning	Circular buffering, Asynchronous streaming	Multi-site learning, On-device fine-tuning	Community-driven design, Extensive documentation
Performance	100% mAP in cross-modal retrieval	Real-time processing on Raspberry Pi	Privacy-preserving collaboration	Interoperability with clinical systems

System Architecture



Multi-Modal Data (*currently*)



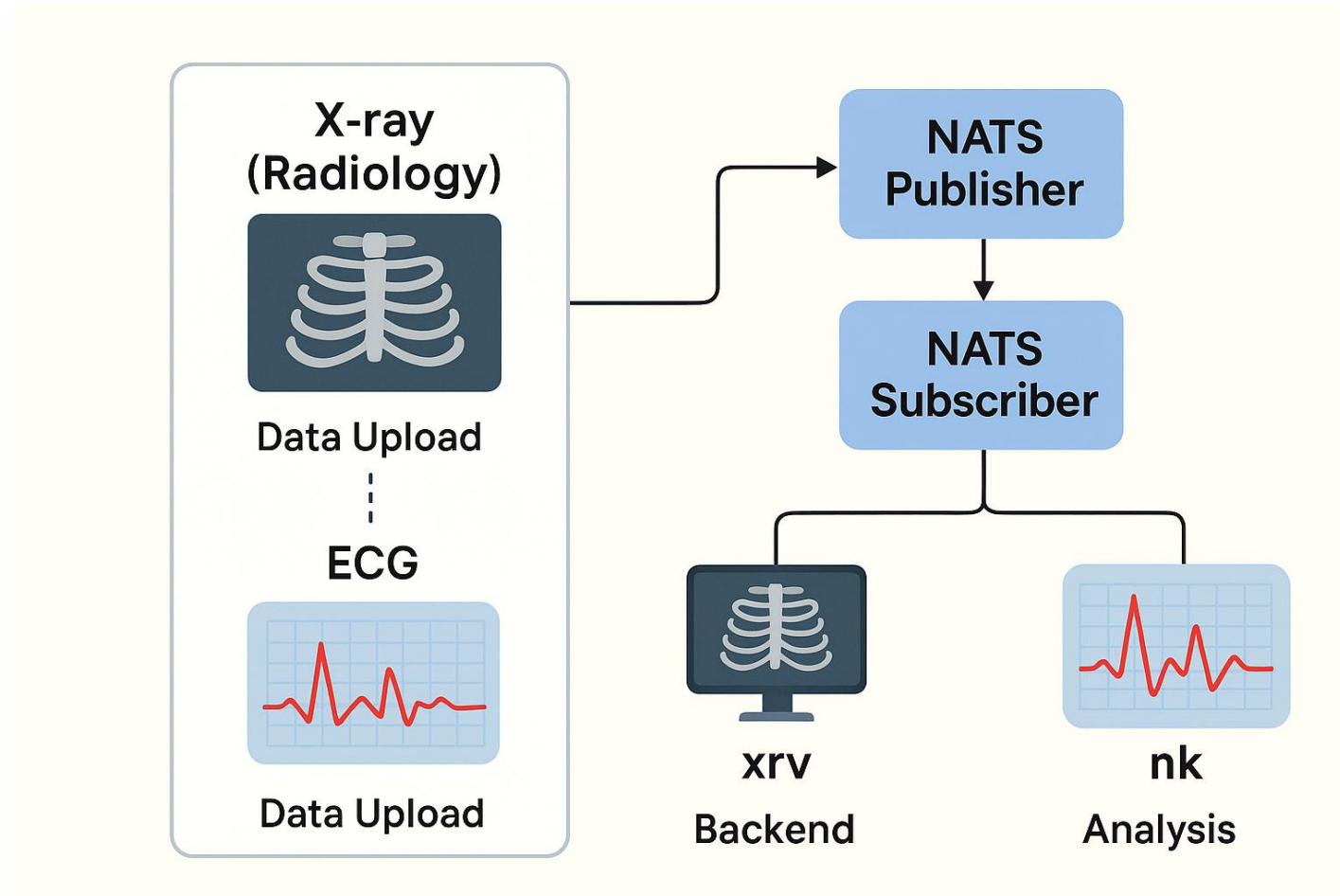
TorchXR^{ay}vision

Image Data
(X-Ray)



Time Series Data
(ECG)

Multi-Modal Data Flow



Data Pipeline in Action

Server Running ...

Publisher Running ...

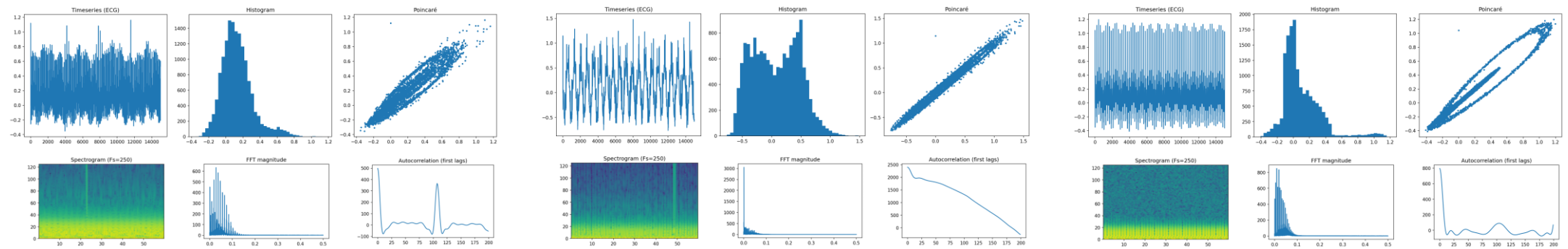
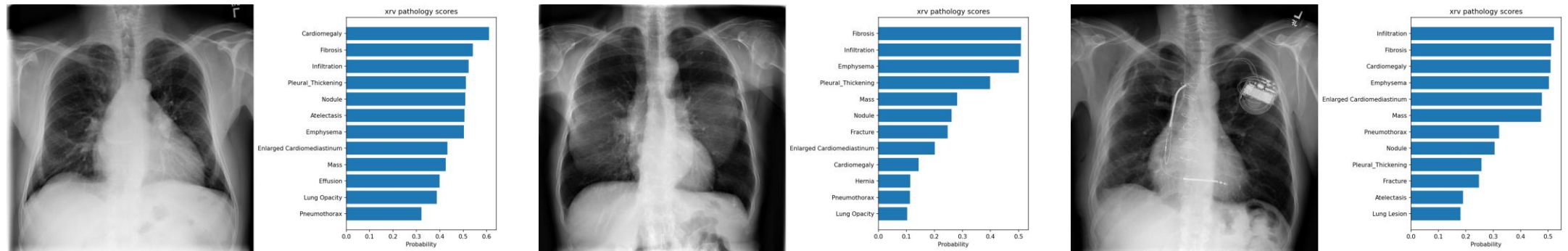
Subscriber Running ...

```
priyam@Priyam: ~$ sudo docker run -p 4222:4222 nats:latest -js
[sudo] password for priyam:
[1] 2025/09/03 11:01:20.587243 [INF] Starting nats-server
[1] 2025/09/03 11:01:20.587385 [INF] Version: 2.11.8
[1] 2025/09/03 11:01:20.587389 [INF] Git: [ec0d7e3]
[1] 2025/09/03 11:01:20.587405 [INF] Name: NAO2AAJLSUEB3ALMG06KLMZSXKPTJXH3F66
JE3WYNLHHVKRYDOH44XH
[1] 2025/09/03 11:01:20.587410 [INF] Node: P2D18sHb
[1] 2025/09/03 11:01:20.587411 [INF] ID: NAO2AAJLSUEB3ALMG06KLMZSXKPTJXH3F66
JE3WYNLHHVKRYDOH44XH
[1] 2025/09/03 11:01:20.588395 [INF] Starting JetStream
[1] 2025/09/03 11:01:20.588548 [WRN] Temporary storage directory used, data could be
lost on system reboot
[1] 2025/09/03 11:01:20.590469 [INF]
[1] 2025/09/03 11:01:20.590510 [INF]
[1] 2025/09/03 11:01:20.590513 [INF]
[1] 2025/09/03 11:01:20.590540 [INF]
[1] 2025/09/03 11:01:20.590542 [INF]
[1] 2025/09/03 11:01:20.590545 [INF]
[1] 2025/09/03 11:01:20.590546 [INF]
[1] 2025/09/03 11:01:20.590548 [INF]
[1] 2025/09/03 11:01:20.590555 [INF]
[1] 2025/09/03 11:01:20.590558 [INF]
[1] 2025/09/03 11:01:20.591260 [INF]
[1] 2025/09/03 11:01:20.591297 [INF]
[1] 2025/09/03 11:01:20.591300 [INF]
[1] 2025/09/03 11:01:20.594967 [INF] Listening for client connections on 0.0.0.0:4222
[1] 2025/09/03 11:01:20.595593 [INF] Server is ready
[1] 2025/09/03 11:51:29.301179 [INF] 172.17.0.1:37194 - cid:20 - Slow Consumer Detect
ed: WriteDeadline of 10s exceeded with 4 chunks of 175148 total bytes.
[1] 2025/09/03 13:29:12.530811 [INF] 172.17.0.1:37356 - cid:27 - Slow Consumer Detect
ed: WriteDeadline of 10s exceeded with 4 chunks of 175390 total bytes.
```

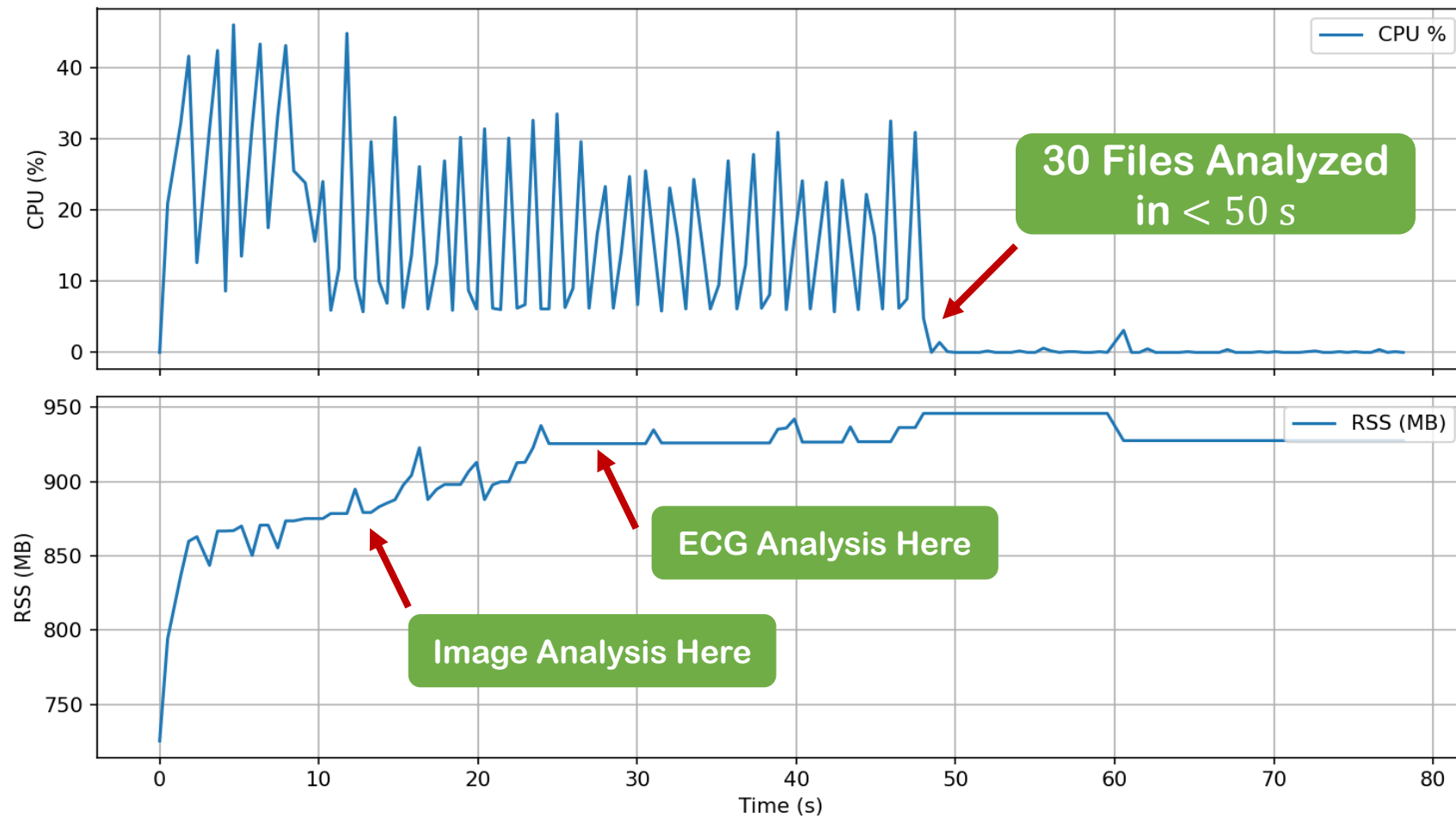
```
priyam@Priyam: /mnt/c/Users/priya/OneDrive/Document...$ python publisher_mixed_multi_mode.py --images-db
/home/priyam/images.db --ecg-db /home/priyam/ecg.db
Connected to NATS at nats://localhost:4222 (subject='mix
ed', stream='MIXED_STREAM')
Stream 'MIXED_STREAM' created for subject 'mixed'
Published image id=1 filename=00000001_000.png -> stream
=MIXED_STREAM seq=521 msg-id=dfd05d93-61a0-4ce1-bf53-77b
0d1214c3a
Published image id=2 filename=00000012_000.png -> stream
=MIXED_STREAM seq=522 msg-id=e339037a-f273-4861-b5e9-55f
30a0c8fbd
Published image id=3 filename=00000013_033.png -> stream
=MIXED_STREAM seq=523 msg-id=6a2cc103-a26e-4828-ad26-d6f
8af9780e1
Published image id=4 filename=00000013_042.png -> stream
=MIXED_STREAM seq=524 msg-id=ceb55814-78a1-44d0-9af1-0fb
cf7a55dba
Published image id=5 filename=00000013_045.png -> stream
=MIXED_STREAM seq=525 msg-id=d29225fc-090e-4e6e-aca6-f61
cdf2b88ab
Published image id=6 filename=00000013_046.png -> stream
=MIXED_STREAM seq=526 msg-id=ae8b5cda-d095-473d-ac3b-9c0
a9728cae6
Published image id=7 filename=00000016_000.png -> stream
=MIXED_STREAM seq=527 msg-id=9f289d2f-37e3-4ed5-8e92-457
63457e242
Published image id=8 filename=00000032_036.png -> stream
=MIXED_STREAM seq=528 msg-id=7c9ff848-1223-4af0-9d04-e71
6c260fa2a
Published image id=9 filename=00000032_037.png -> stream
=MIXED_STREAM seq=529 msg-id=3d5e3c9e-793c-4bed-a18d-cd0
a96af55a4
Published image id=10 filename=00000049_000.png -> strea
m=MIXED_STREAM seq=530 msg-id=1325b04b-e72a-4dc1-860a-15
6135825899
Published csv id=1 filename=anomalous_01.csv -> stream=M
IXED_STREAM seq=531 msg-id=b75c4168-09ca-43ff-a738-0bbd
```

```
priyam@Priyam: /mnt/c/Users/priya/OneDrive/Do...$ python subscriber_mixed_multi_mode_v4_trial_with_sys.py
--recv-db /home/priyam/received.db
[SystemMonitor] started sampling (interval=0.5s)
[SystemMonitor] autosave task started (interval=60.0s) -> s
aves into visualizations
Connected to NATS at nats://localhost:4222; subscribing to
'mixed', durable='mixed_processor'
Acked and processed image orig_id=1 filename=00000001_000.p
ng -> visualizations/images/image_orig1_00000001_000.png_20
250904_083256891.png
Acked and processed image orig_id=2 filename=00000012_000.p
ng -> visualizations/images/image_orig2_00000012_000.png_20
250904_083257827.png
Acked and processed image orig_id=3 filename=00000013_033.p
ng -> visualizations/images/image_orig3_00000013_033.png_20
250904_083258686.png
Acked and processed image orig_id=4 filename=00000013_042.p
ng -> visualizations/images/image_orig4_00000013_042.png_20
250904_083259654.png
Acked and processed image orig_id=5 filename=00000013_045.p
ng -> visualizations/images/image_orig5_00000013_045.png_20
250904_083300587.png
Acked and processed image orig_id=6 filename=00000013_046.p
ng -> visualizations/images/image_orig6_00000013_046.png_20
250904_083301389.png
Acked and processed image orig_id=7 filename=00000016_000.p
ng -> visualizations/images/image_orig7_00000016_000.png_20
250904_083302203.png
Acked and processed image orig_id=8 filename=00000032_036.p
ng -> visualizations/images/image_orig8_00000032_036.png_20
250904_083302999.png
Acked and processed image orig_id=9 filename=00000032_037.p
ng -> visualizations/images/image_orig9_00000032_037.png_20
250904_083303751.png
Acked and processed image orig_id=10 filename=00000049_000.
png -> visualizations/images/image_orig10_00000049_000.png_
```

Real-Time Analysis



System Monitor



Checks and Future Work

Characteristic	Multi-Modal AI	Edge Computing	Federated Learning	Open-Source Framework
Data Support	✓ Structured and unstructured medical data	N/A	N/A	N/A
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Performance	✓ 100% mAP in cross-modal retrieval	✓ Real-time processing on Raspberry Pi	Privacy-preserving collaboration	Interoperability with clinical systems

Thank You!

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