

# IoT Platform for Real-Time Monitoring & AI Assistance

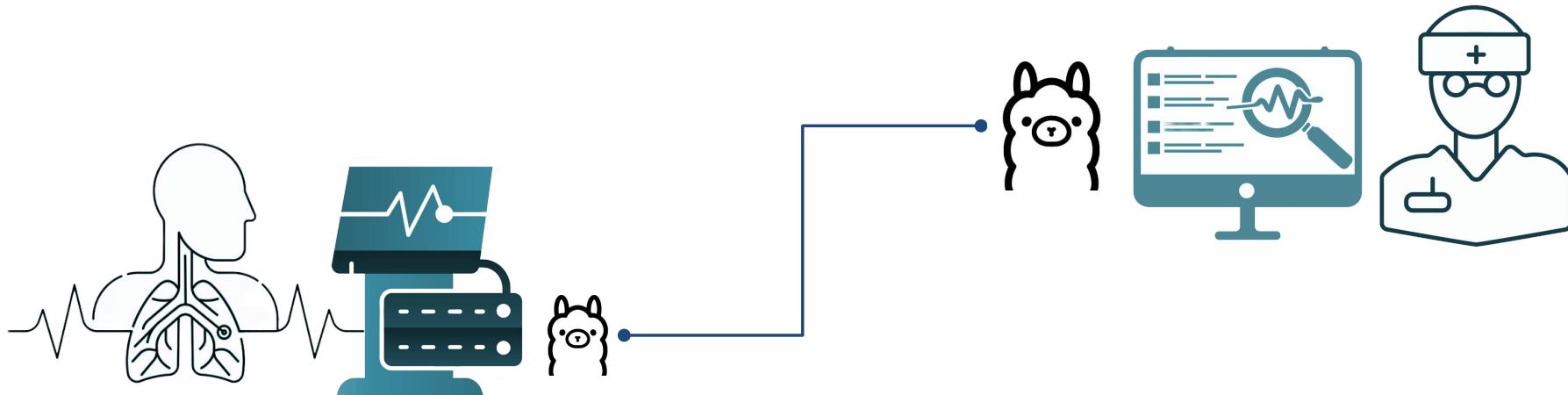
**From Sensors to Assistant - An Unified Health Monitoring Solution**

Acossi Giorgio - Castagna Marco

# A Smarter Way to Monitor and Assist

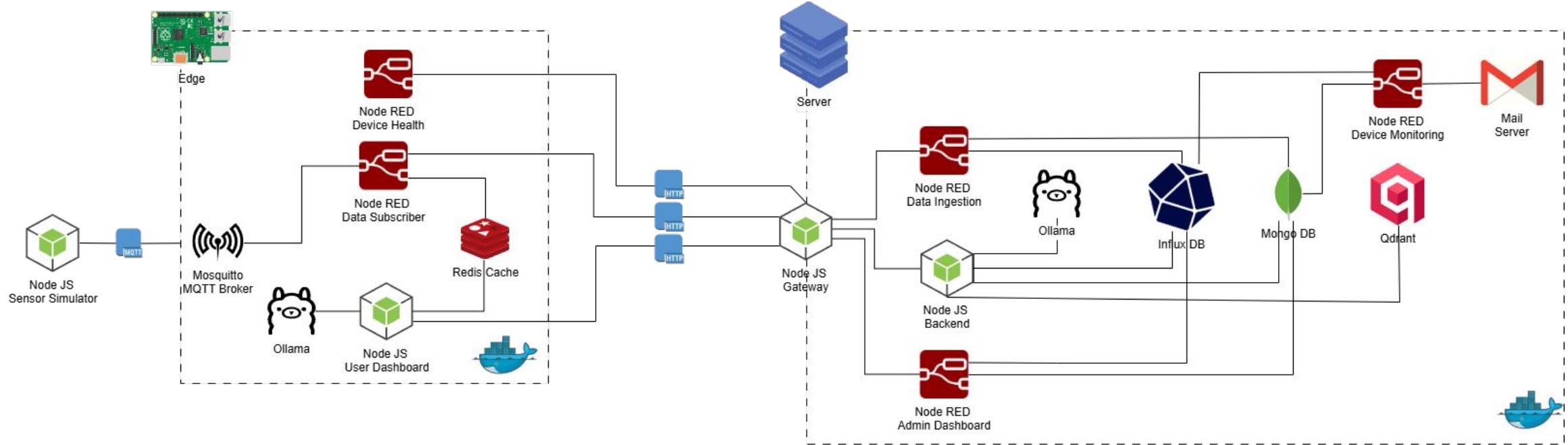
This **platform** acts as a bridge between patients, sensors, and clinicians. It continuously monitors **vital signs** and makes **remote supervision** easier and more reliable for medical experts.

It also provides intuitive **dashboards** and an **AI assistant** capable of interpreting the data, explaining what is happening, and suggesting the most appropriate actions to the patient.

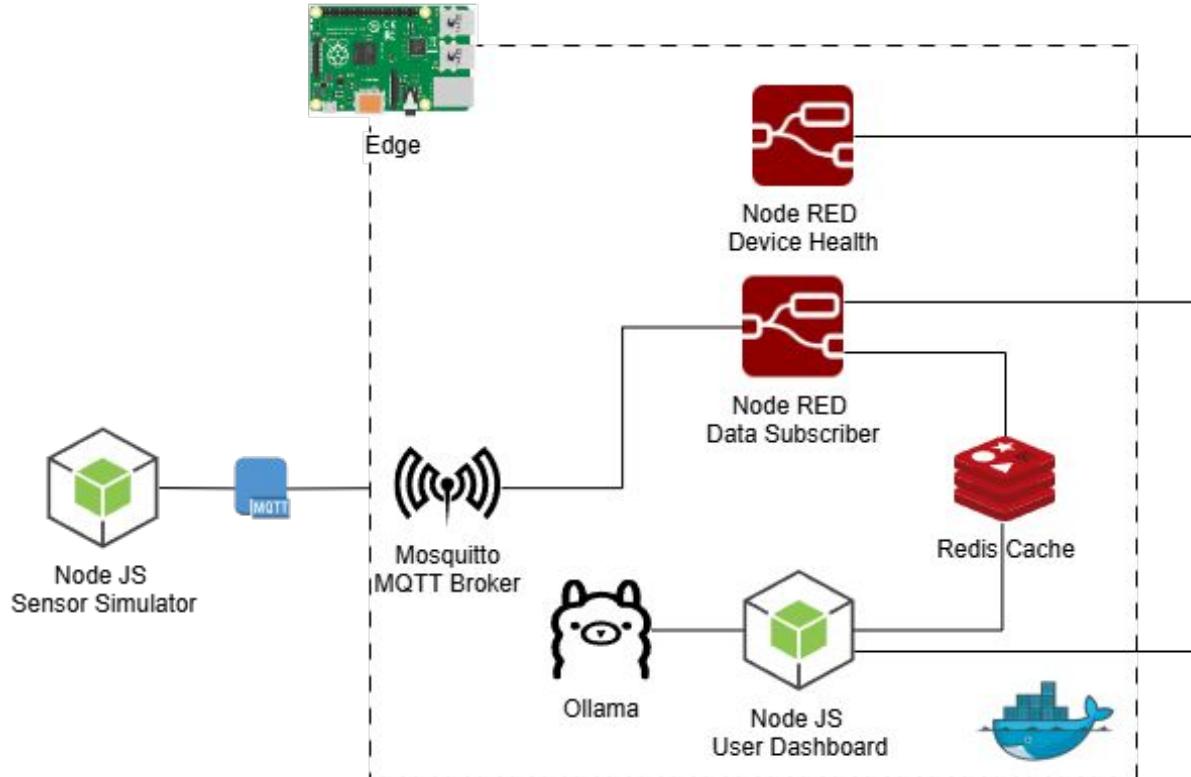


# Architecture

## Hybrid Approach



# Edge Architecture Overview



## Data Acquisition

- Sensor simulator
- MQTT broker for edge-level data ingestion

## Data Processing & Monitoring

- Device health flow
- Data subscriber flow
- Redis cache for local data storage
- Patient vitals dashboard

## AI Assistance

- AI Assistant Chat
- Edge LLM for local filtering and safety

## Reliability

- Offline mode

# Cloud Architecture Overview

## Data Storage

- Time-series storage - InfluxDB
- Application data database - MongoDB
- Vector search index - Qdrant

## Data Processing Flows

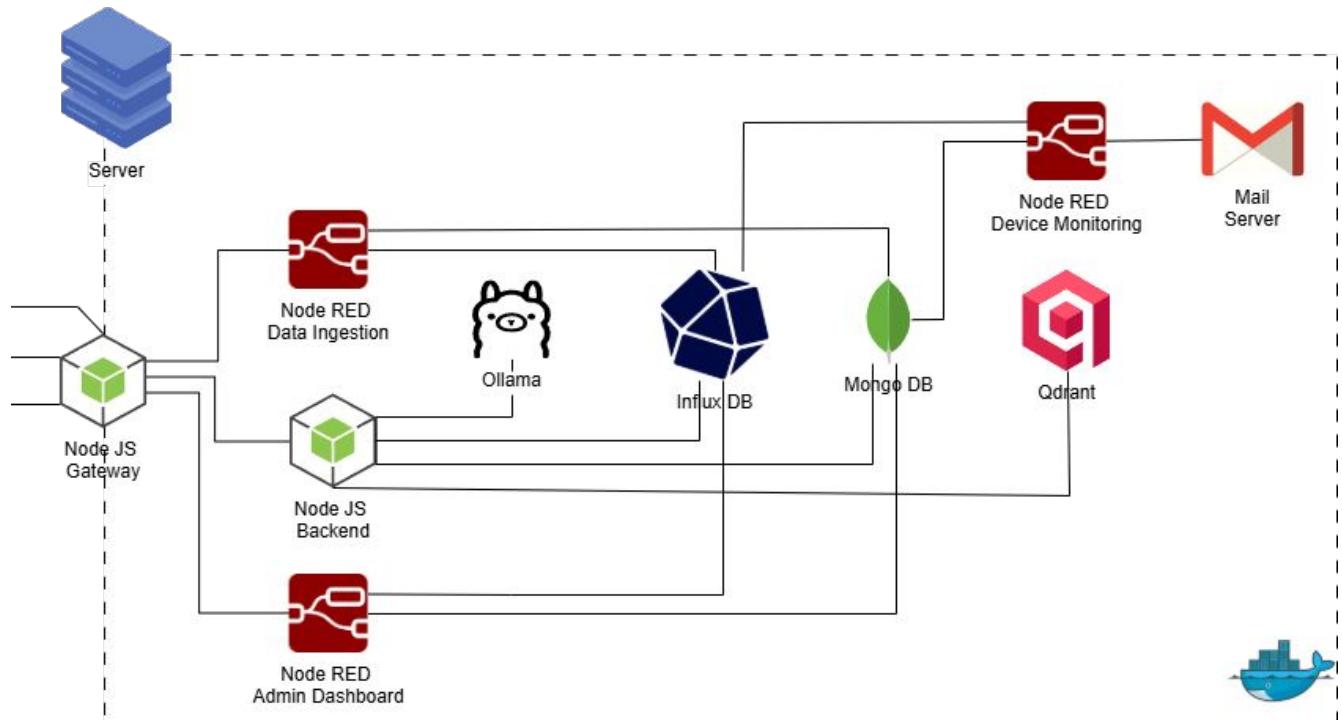
- Data ingestion flow
- Device monitoring flow
- Mail Server for notifications

## Dashboards & APIs

- API Gateway and auth
- API Backend
- Admin dashboard

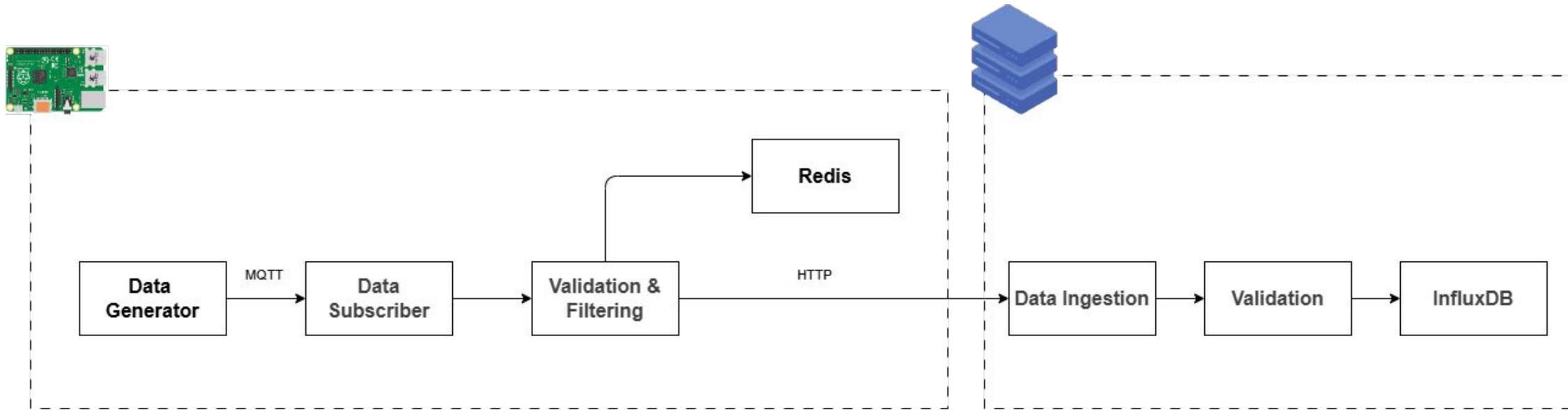
## AI Assistant

- Chat (RAG) Pipeline
- Data Analytics Pipeline



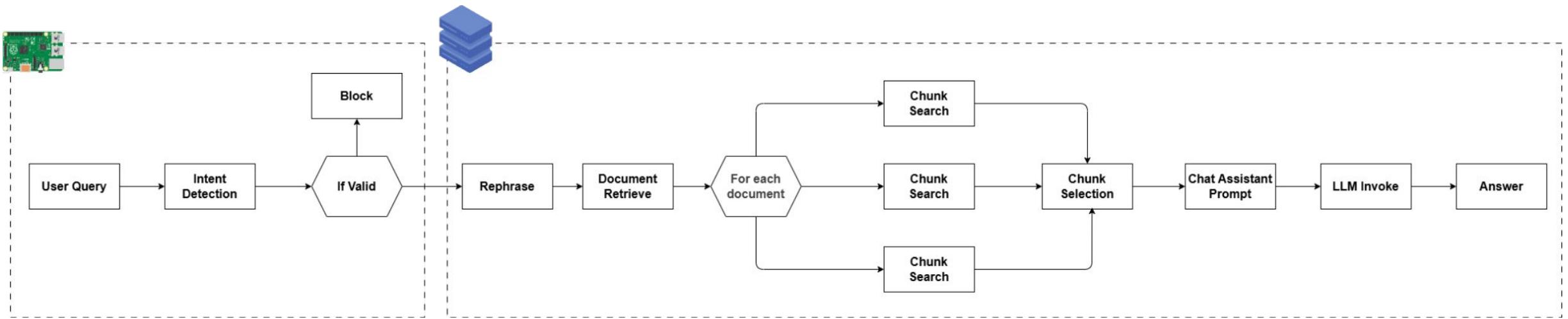
# Core Workflow

## IoT Data Processing & Ingestion



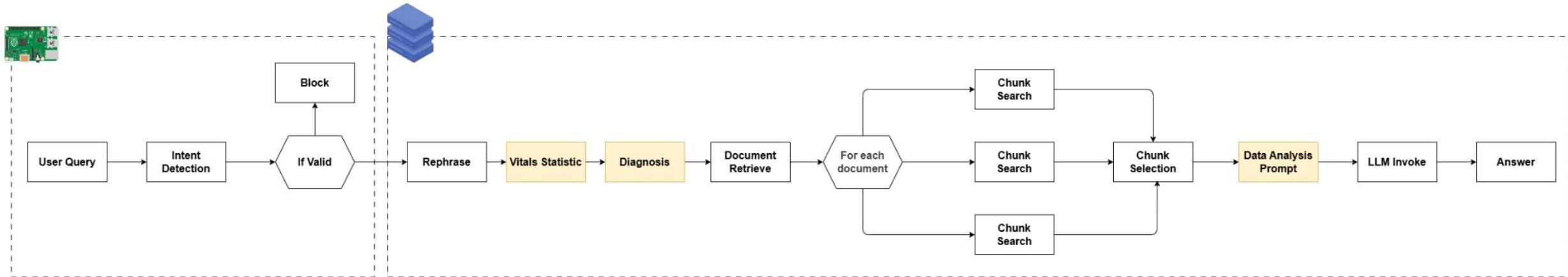
# Core Workflow

## Chat



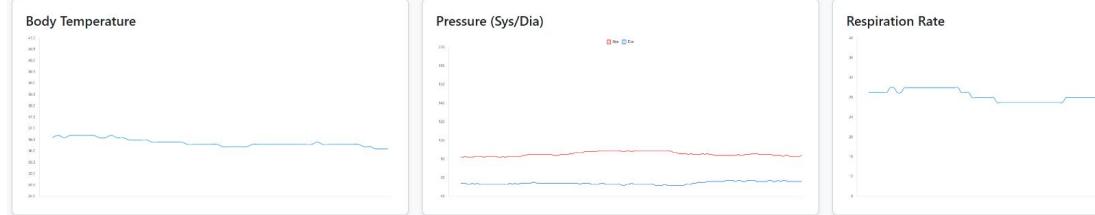
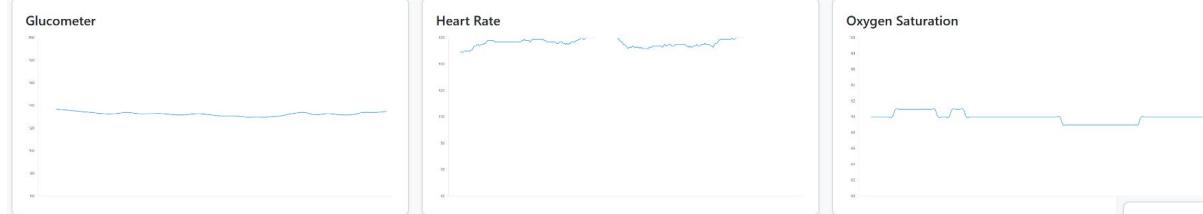
# Core Workflow

## Data Analysis



# Patient Dashboard

Heart Rate <b>166</b> bpm	Blood Pressure <b>56/84</b> mmHg	Oxygen Saturation <b>90</b> %	Body Temperature <b>36.1</b> °C	Respiratory Rate <b>29</b> rpm	Glucometer <b>135</b> mg/dL
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**Hi!** I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

**Note:** You can use the **green button** with the chart icon to enable or disable the analysis of your biological data for each query.

I think I have a slight fever. What should I do ?

Could you analyze my vital signs and tell me if there is any problem ?



# Expert Dashboard

### Devices

Device Id	Name	Status	Last Update
device-1	Device-1	<span style="color: green;">Online</span>	2025-12-02T22:29:30.981Z
device-2	Device-2	<span style="color: red;">Offline</span>	-
device-3	Device-3	<span style="color: red;">Offline</span>	-
device-4	Device-4	<span style="color: red;">Offline</span>	-

### Sessions

ID	Device Id	Created At	Updated At	Status
692f541177676d3f4c8d7b87	device-1	2025-12-02T21:03:27.201Z	2025-12-02T21:03:27.201Z	<span style="color: green;">Online</span>
692f53e177676d3f4c8d7b85	device-1	2025-12-02T21:02:25.433Z	2025-12-02T21:03:25.870Z	<span style="color: red;">Offline</span>
692f126c3ab92063c48e2507	device-1	2025-12-02T16:23:08.460Z	2025-12-02T16:27.37.269Z	<span style="color: red;">Offline</span>
692f10233ab92063c48e2506	device-1	2025-12-02T16:13:23.677Z	2025-12-02T16:23:06.825Z	<span style="color: red;">Offline</span>
692f0b423ab92063c48e2505	device-1	2025-12-02T16:15:52.34.336Z	2025-12-02T16:13:23.674Z	<span style="color: red;">Offline</span>
692f0b273ab92063c48e2504	device-1	2025-12-02T15:52.07.228Z	2025-12-02T15:52.33.436Z	<span style="color: red;">Offline</span>
692ec61f505b94edfe6651c9	device-1	2025-12-02T10:57.35.199Z	2025-12-02T15:52.07.223Z	<span style="color: red;">Offline</span>
692ec5aa505b94edfe6651c7	device-1	2025-12-02T10:55.38.849Z	2025-12-02T10:57.34.354Z	<span style="color: red;">Offline</span>
692ec4cd505b94edfe6651c6	device-1	2025-12-02T10:51.57.716Z	2025-12-02T10:55.38.008Z	<span style="color: red;">Offline</span>
692ec3fb505b94edfe6651c4	device-1	2025-12-02T10:48.27.131Z	2025-12-02T10:51.56.577Z	<span style="color: red;">Offline</span>
692e1535a252cd30bc591bea	device-1	2025-12-01T22:22.45.094Z	2025-12-02T10:48.27.128Z	<span style="color: red;">Offline</span>
692e1ff306e1f7db71b6970	device-1	2025-12-01T22:09.03.277Z	2025-12-01T22:22.43.804Z	<span style="color: red;">Offline</span>

Session ID: 692f541177676d3f4c8d7b87

Glucose: vitals\_glucose (mg/dL)

Heart Rate: vitals\_heart\_rate (bpm)

Blood Pressure: vitals\_blood\_pressure\_tsys (mmHg) / vitals\_blood\_pressure\_tdi (mmHg)

Vitals

SPO2: vitals\_spO2 (%)

Body Temperature: vitals\_body\_temperature (°C)

Respiratory Rate: vitals\_respiratory\_rate (breaths/min)

Interactions

Question: Could you analyze my vitals data and tell me if there is any problem?

Rephrased Question: Could you analyze my vital data and tell me if there is anything wrong?

Answer:

Your vital signs indicate serious abnormalities requiring immediate medical attention:

- Respiratory Rate: 25 breaths/minute (normal: 12-20) - significantly elevated, suggesting respiratory distress.
- Oxygen Saturation: 88% (normal: 95-100%) - critically low, indicating hypoxia.
- Heart Rate: 155 bpm (normal: 60-100) - severely elevated tachycardia.
- Systolic Blood Pressure: 155 mmHg (normal: 90-120) - dangerously high, indicating hypertension.

The combination of low oxygen saturation, very high heart rate, and critically low blood pressure is life-threatening. This pattern is consistent with severe respiratory failure, possible heart attack (myocardial infarction), or dangerous heart rhythm abnormalities. These signs require emergency evaluation and intervention. Do not delay seeking urgent medical care.

Chunks

- Oxford Handbook of General Practice.pdf (Pg.108)
- Mayo Clinic Family Health Book.pdf (Pg.2102)
- Mayo Clinic Family Health Book.pdf (Pg.2103)
- Mayo Clinic Family Health Book.pdf (Pg.2104)
- Mayo Clinic Family Health Book.pdf (Pg.2105)
- Mayo Clinic Family Health Book.pdf (Pg.2106)
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- Mayo Clinic Family Health Book.pdf (Pg.2159)

Vitals

- Respiration Rate: Min: 25, Max: 30, Mean: 28.1, Latest: 29
- Diastolic Blood Pressure: Min: 85, Max: 90, Mean: 87.5, Latest: 85
- SPO2: Min: 89, Max: 91, Mean: 89.9, Latest: 89
- Systolic Blood Pressure: Min: 120, Max: 155, Mean: 134.5, Latest: 135
- Heart Rate: Min: 140, Max: 155, Mean: 155.9, Latest: 155

Diagnosis

- Possible myocardial infarction
- Tachyarrhythmia

Type

dataanalysis

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# Simulation Scenario

## Chat

Dashboard

Chat

Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

Type me a question, for example:

- "I don't feel very well, which parameters are out of range?"

I think that i could have some fever, what i could do ?

Take your temperature to confirm a fever (typically defined as 100.4°F/38°C or higher). Rest and drink plenty of fluids to stay hydrated. Monitor your symptoms closely. Seek medical attention immediately if:

- You are under 3 months old with any fever
- Your temperature exceeds 103°F (39.4°C)
- You experience severe symptoms like confusion, stiff neck, shortness of breath, chest pain, or a rash
- Fever lasts more than 3 days without improvement
- You have underlying health conditions like heart disease, diabetes, or weakened immunity

For most adults and older children with mild fever, home care (rest, fluids, over-the-counter pain relievers like acetaminophen or ibuprofen) is sufficient unless symptoms worsen or persist.

 Close

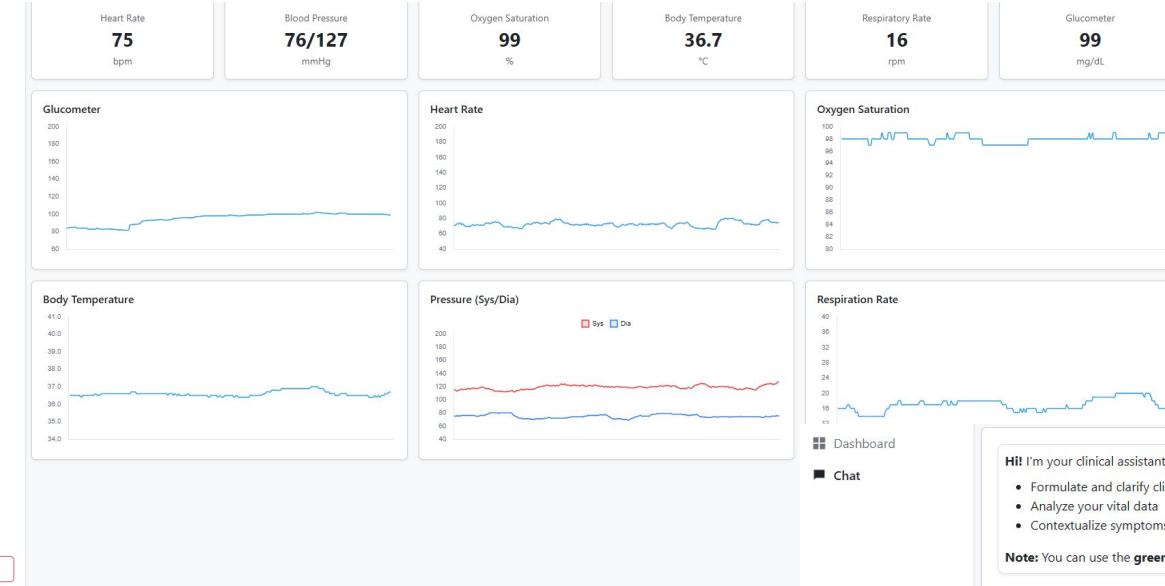


# Simulation Scenario

## Data Analysis - Healthy

Dashboard

Chat



[X Close](#)

Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

Note: You can use the green button with the chart icon to enable or disable the analysis of your biological data for each query.

Could you analyze my vitals data and tell me if there is any problem?

Your vital signs are all within normal ranges and show consistent stability. Here's a clear breakdown:

- **Respiration Rate:** 17 breaths per minute (normal range: 12-20), with consistent breathing patterns.
- **Blood Glucose:** 93 mg/dL (normal fasting range: 70-99), showing stable levels.
- **Oxygen Saturation:** 97% (normal range: 95-100%), indicating excellent oxygen levels.
- **Blood Pressure:** 122/72 mmHg (normal: systolic <120, diastolic <80), with stable readings.
- **Heart Rate:** 74 bpm (normal resting range: 60-100), consistent with good cardiovascular function.
- **Body Temperature:** 36.6°C (normal range: 36.1-37.2°C), showing no signs of fever or hypothermia.

All measurements demonstrate low variability, confirming a stable physiological state. There are no indications of medical concerns based on these vitals.

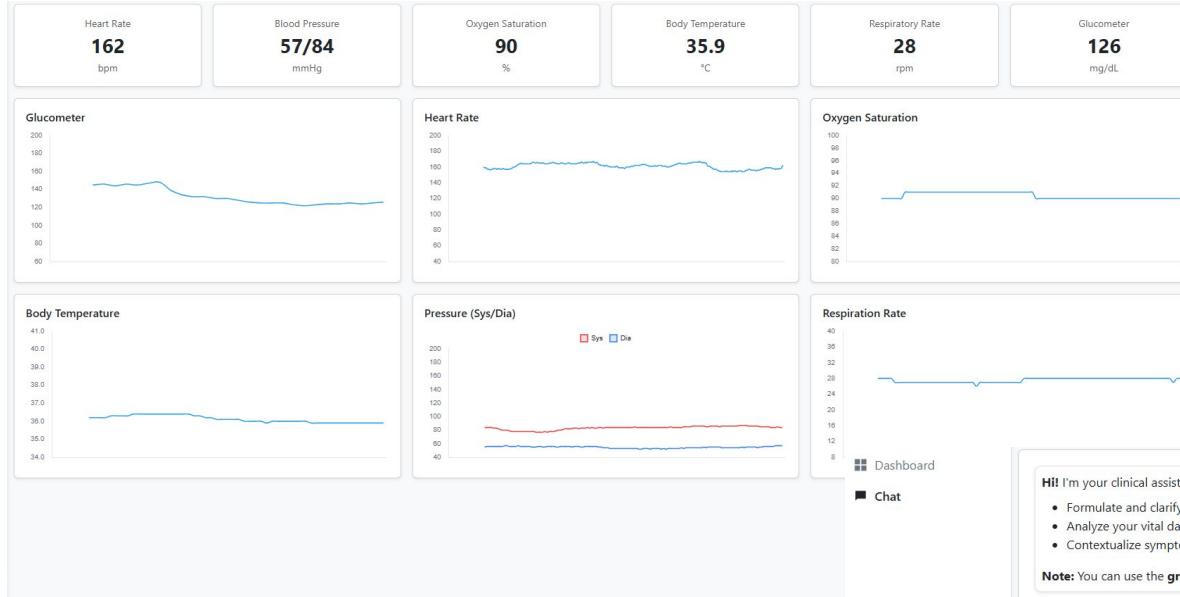
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# Simulation Scenario

## Data Analysis - Heart Attack

Dashboard  
Chat



X Close

Dashboard  
Chat

Hi! I'm your clinical assistant. I can help you to:

- Formulate and clarify clinical problems
- Analyze your vital data
- Contextualize symptoms and measurements

Note: You can use the green button with the chart icon to enable or disable the analysis of your biological data for each query.

Could you analyze my vitals data and tell me if there is any problem?

Your vital signs show several significant abnormalities that require immediate medical evaluation:

- Heart rate (160 bpm) is severely elevated (normal resting range: 60-100 bpm), indicating possible tachycardia.
- Systolic blood pressure (84 mmHg) is critically low (normal: 90-120 mmHg), suggesting hypotension.
- Oxygen saturation (91%) is below normal (normal: 95-100%), indicating potential oxygen deficiency.
- Respiratory rate (27 breaths/min) is elevated (normal resting: 12-20 breaths/min), reflecting increased breathing effort.

These combined findings—high heart rate, low blood pressure, low oxygen, and rapid breathing—are clinical indicators of a serious cardiovascular or respiratory emergency. They align with conditions such as heart attack (myocardial infarction) or life-threatening arrhythmias, as suggested by your algorithm diagnosis. Do not delay seeking emergency medical care.

X Close



# Future Developments

LLM Fine Tuning

ML Driven Diagnosis

Graph RAG

Security Improvement

Kubernetes

Autonomous Agent

Real Device & Data

# Questions & Answers

Thank you for your attention.