

# Pathorchestra Platform

A Multimodal Medical AI and Data Collaboration Platform

Mechine sleeping

Yuyao Wang Biwen Meng  
Chuhe Zhang Weiqi Yan

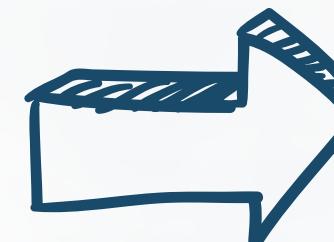
# Project overview

## Industry Challenges

### Uneven distribution of medical resources



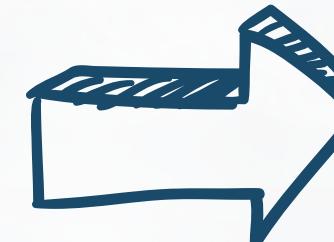
Shortage of doctors in remote areas makes it difficult for patients to access timely diagnostic services



### Diagnosing efficiency bottlenecks



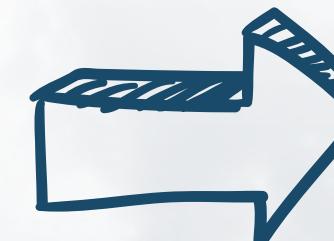
Traditional processes rely on manual labour, and the core task in the initial stages of AI healthcare is to optimise diagnostic pathways and improve efficiency



### Data siloing



Fragmented and insufficiently standardised healthcare data hinders AI model development and landing.



## Product design concept

### MediFusion

Lightweight AI Consultation to Bridge Primary Care Gaps

### SPMM

Multimodal Tumor Prediction for Enhanced Diagnostic Accuracy

### BioAnnotate

Annotation Tools to Create Pathology Datasets

# Module Chosen

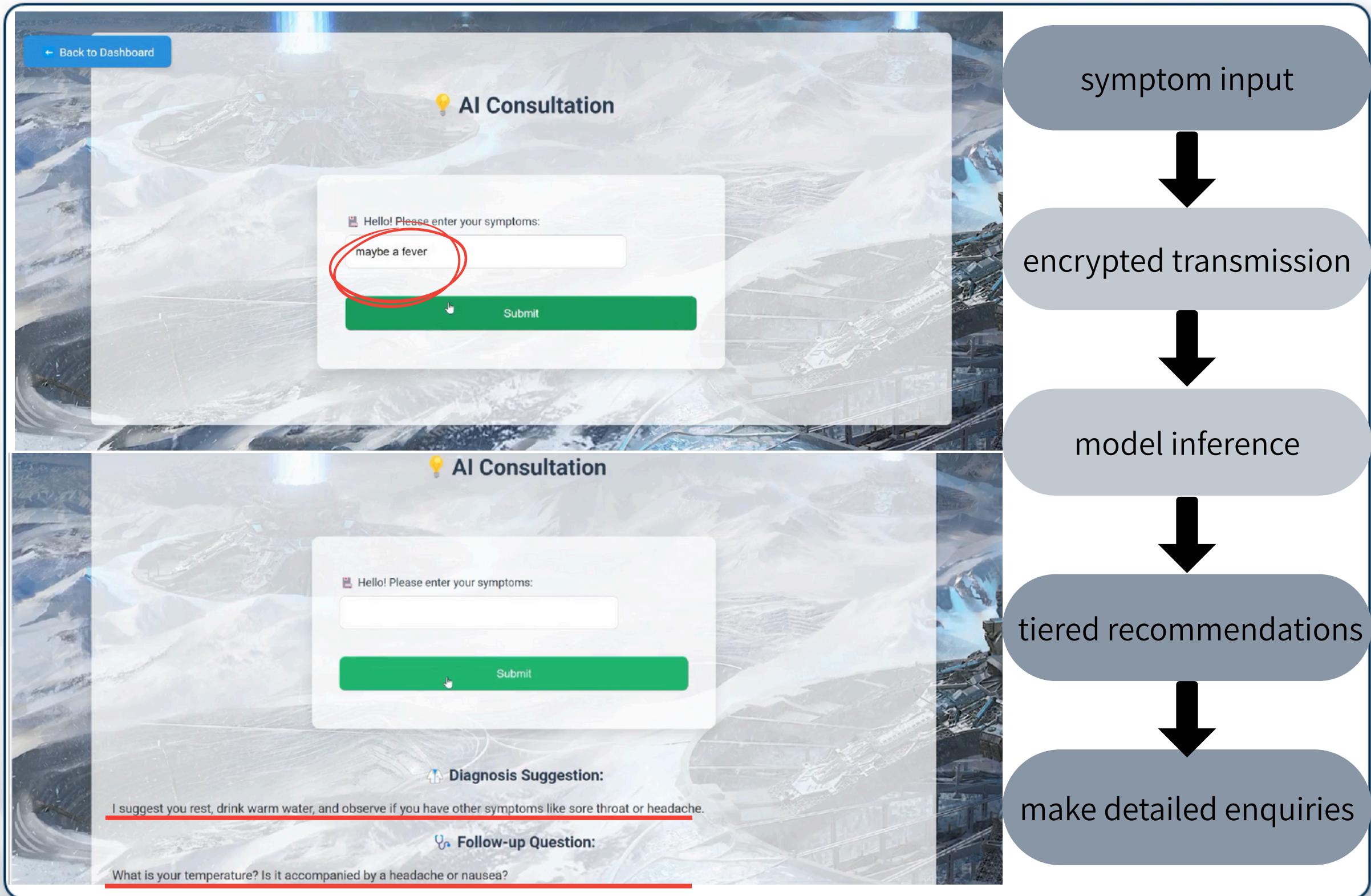
The screenshot shows a Streamlit application interface with three main sections:

- Pathorchestra**: Integrated Biomedical Platform for AI-assisted Healthcare. This section includes a dropdown menu for "Choose a module" with options MediFusion, SPMM, and BioAnnotate, where MediFusion is selected. It also features a "Get Health Consultation" button.
- SPMM - Tumor/Cancer Prediction**: Advanced tumor/cancer prediction model for medical professionals. It includes a "Go to SPMM" button.
- BioAnnotate**: Professional annotation platform for Whole Slide Images (WSI) and spatial transcriptomics data. It includes a "Go to BioAnnotate" button.

Each section has a "Deploy" button in the top right corner.

Website Link:  
<https://machinesleepingbiotech-cfaysajnytxtjabboq9rhs.streamlit.app/>

# MediFusion (AI Consultation)



**AI medical consultation**



Tech Stack:  
Bio-ChatGLM localized deployment +  
Symptom-Disease Knowledge Graph.  
Mockup: Mobile interface (symptom  
input and results page).

# SPMM (Multimodal Tumor/cancer Prediction)



## Multimodal Data Integration

Spatial transcriptomic data (gene expression + spatial coordinates), pathological images (WSI/H&E staining), clinical text (pathology reports).



## Dynamic Alignment & Prediction

Contrastive learning aligns cross-modal features to predict tumor type, grade, and prognosis.



## Interpretability Analysis

Visualize attention weights to demonstrate key associations between image regions and gene expression.

# SPMM (Multimodal Tumor/cancer Prediction)

The image shows two side-by-side screenshots of the SPMM application. On the left is the login page, featuring fields for Username and Password, and buttons for Login and Register. It also includes sections for 'About SPMM' and 'Key Features'. The right screenshot shows the 'SPMM Dashboard' with metrics like Samples (124), Accuracy (92.7%), Processing (3), and Models (5). It also displays a 'Recent Activity' log and a 'System Status' section showing CPU and Memory usage.

**SPMM**  
Spatio-Based Pathology MultiModal

Please login to access the SPMM model:

Username  
Password

Login Register

**About SPMM**

The Spatio-Based Pathology MultiModal (SPMM) is a state-of-the-art multimodal medical foundation model specifically designed for tumor/cancer slice prediction tasks. data, pathological images, and clinical text information to provide accurate tumor classification, staging, and prognosis prediction.

**Key Features:**

- Multimodal Integration of spatial transcriptomics, pathological images, and clinical text
- Spatial encoding using graph neural networks to capture cell-molecule spatial relationships
- Text and Visual encoding for comprehensive analysis
- Advanced prediction capabilities for tumor classification and prognosis

Welcome, admin

Navigation

- Dashboard (selected)
- Data Upload
- Analysis
- Results Visualization
- Settings

Admin Controls

User Management Logout

**SPMM Dashboard**

Spatio-Based Pathology MultiModal Model

Samples	Accuracy	Processing	Models
124	92.7%	3	5
Total	Overall	Jobs Active	Available

**Recent Activity**

	Timestamp	User	Activity	Status
0	2025-04-26 09:15:23	admin	Model prediction	Completed
1	2025-04-26 08:32:17	researcher2	Data upload	Completed
2	2025-04-25 16:45:09	admin	Settings update	Completed
3	2025-04-25 14:20:38	clinician1	Report generation	Failed
4	2025-04-24 11:05:52	researcher1	Model prediction	Completed

**System Status**

CPU Usage: 32%

Memory Usage: 45%

Available Model Versions

< Manage app

Website Link:  
<https://machinesleepingbiotech-zpysuvh7r2uuq3twksac79.streamlit.app/>

# BioAnnotate (Data Annotation)

Specific Annotation Platform for WSI and ST data:

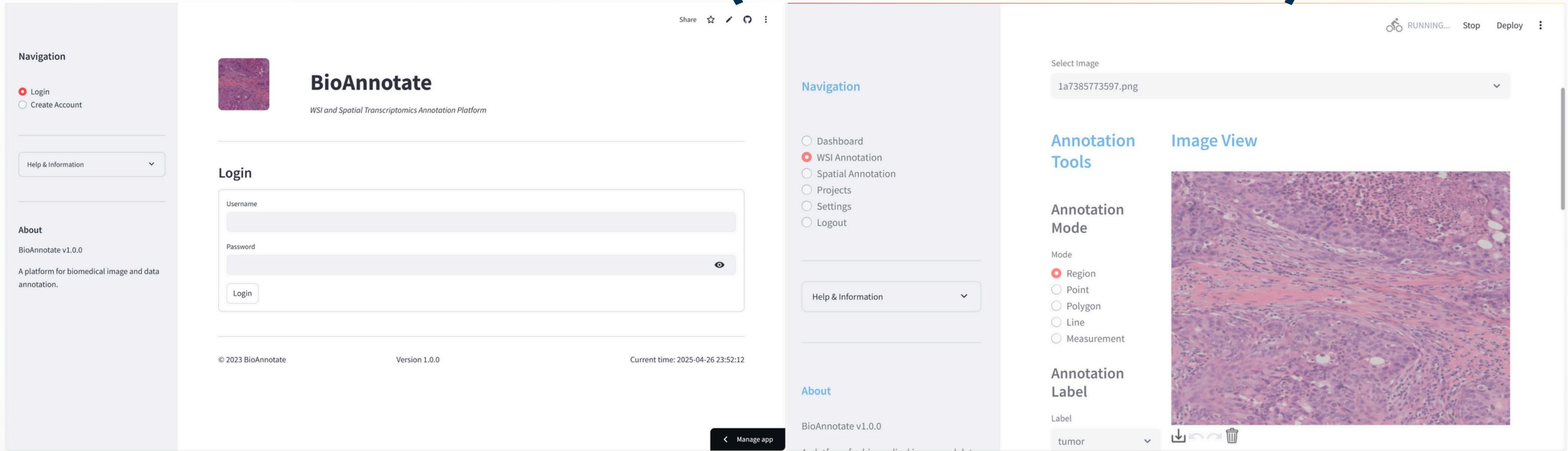
Annotation Type	Supported Tools	Output Formats
WSI Region	Polygon/Brush Tools	COCO/ASAP
Spatial Omics	Gene Expression Overlay	H5AD + GeoJSON

Collaboration Workflow:

Annotate → Review → As Dataset for Training SPMM → Feedback

Alleviate scarcity of biomedical models → ST datasets

# BioAnnotate (Data Annotation)



The image displays two screenshots of the BioAnnotate application. The left screenshot shows the login page with fields for Username and Password, and a 'Login' button. The right screenshot shows the main annotation interface with a navigation sidebar, a central image view showing a histological slide, and various annotation tools like Region, Point, Polygon, Line, and Measurement.

**BioAnnotate**  
WSI and Spatial Transcriptomics Annotation Platform

**Login**

Username  
Password  
Login

© 2023 BioAnnotate Version 1.0.0 Current time: 2025-04-26 23:52:12

**Navigation**

- Dashboard
- WSI Annotation
- Spatial Annotation
- Projects
- Settings
- Logout

Help & Information

**Annotation Tools**

Select Image  
1a7385773597.png

**Image View**

**Annotation Mode**

- Region
- Point
- Polygon
- Line
- Measurement

**Annotation Label**

tumor

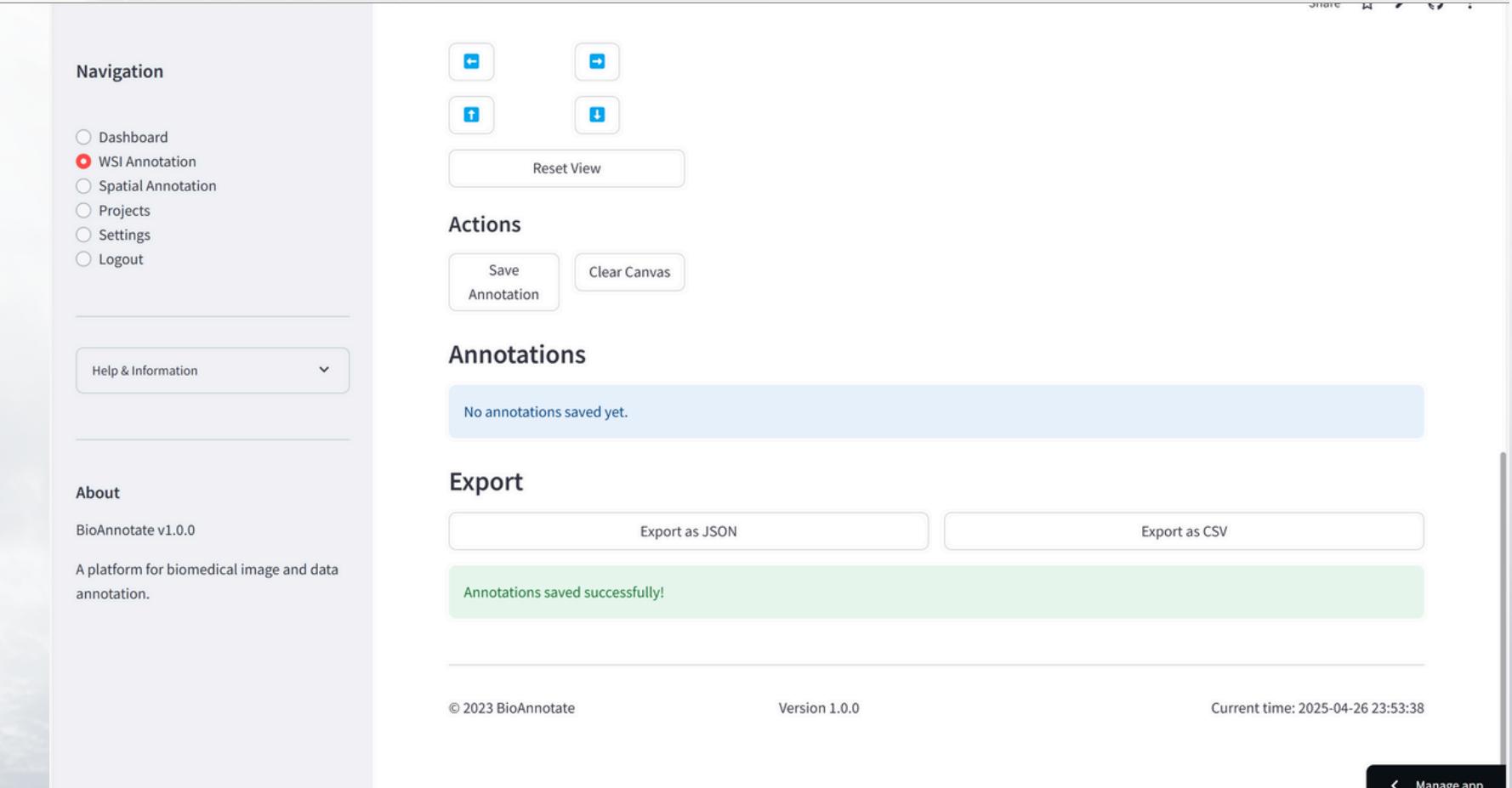
Mode  
Region  
Point  
Polygon  
Line  
Measurement

Label  
tumor

Share

RUNNING... Stop Deploy

Website Link:  
<https://machinesleepingbiotech-zpysuvh7r2uuq3twksac79.streamlit.app/>



The image shows the BioAnnotate annotation interface. It includes a navigation sidebar, a central image view, and sections for Actions (Save Annotation, Clear Canvas), Annotations (No annotations saved yet), and Export (Export as JSON, Export as CSV). A success message at the bottom indicates "Annotations saved successfully!"

**Navigation**

- Dashboard
- WSI Annotation
- Spatial Annotation
- Projects
- Settings
- Logout

Help & Information

**Actions**

Save Annotation Clear Canvas

**Annotations**

No annotations saved yet.

**Export**

Export as JSON Export as CSV

Annotations saved successfully!

© 2023 BioAnnotate Version 1.0.0 Current time: 2025-04-26 23:53:38

# Technical Architecture and Innovations

1

## Frontend

Streamlit unified interface.

2

## Backend

Flask microservices + RBAC dynamic permissions.

3

## AI Layer

PyTorch multimodal training pipeline.

4

## Data Layer

Distributed storage (WSI slices + Spatial omics database).

## Privacy-Performance Balance

Federated learning for  
localized model updates



## Multimodal Dynamic Alignment

Cross-modal contrastive loss design

## Annotation-Training Loop

BioAnnotate



SPMM bidirectional data flow

# Challenges, Future & Vision

## Current Challenges

### Multimodal Data Alignment Complexity

- High GPU resource demand for cross-modal feature fusion (Optimizing distributed training pipelines)

### Annotation Quality Control

- Developing automated QC tools (e.g., inconsistency detection in WSI annotations)

### Regulatory Compliance

- Partnering with tier-1 hospitals for clinical certification

## Future Roadmap

### Technical Expansion

- Extend cancer types (Lung/Liver) + Drug response prediction models

### Ecosystem Building

- Co-develop treatment response DB with pharma partners (e.g., Roche, Novartis)

### Business Models

- B2B: Hospital subscriptions (Cases-based pricing)
- B2G: Public health partnerships
- B2R: Research data revenue sharing

**Empowering Global Health Through Data-Driven Medicine**





Thank you!