Transforming Cervical Cancer Diagnosis in ASEAN with AI-Powered Telecytology Screening and Training System

Van-Khanh Tran (Ph.D)

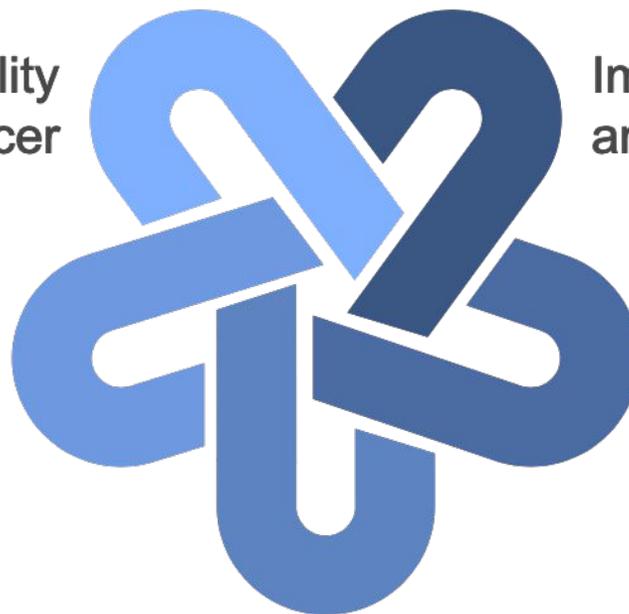Institute of Applied Science and Technology (IAST) –

University of Information and Communication Technology (ICTU), Thainguyen, Vietnam

Project Background

Prevalence and Impact

High incidence and mortality rates of cervical cancer

Training Programs

Importance of specialized education and training for cytopathologists

Screening and Treatment Access

Challenges in accessing screening and treatment services

Healthcare Infrastructure

Need for improved healthcare facilities and resources

Cytopathologist Shortage

Lack of qualified cytopathologists due to education and training gaps

Project Targets

Achieving Enhanced Cervical Cancer Screening
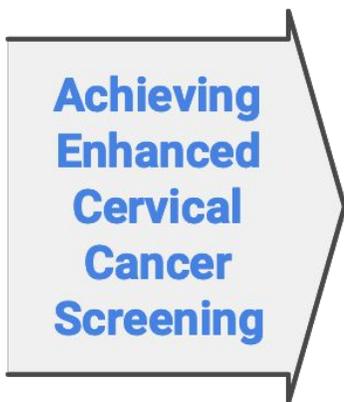
Implement Telecytology

Enable remote diagnosis and collaboration among specialists.
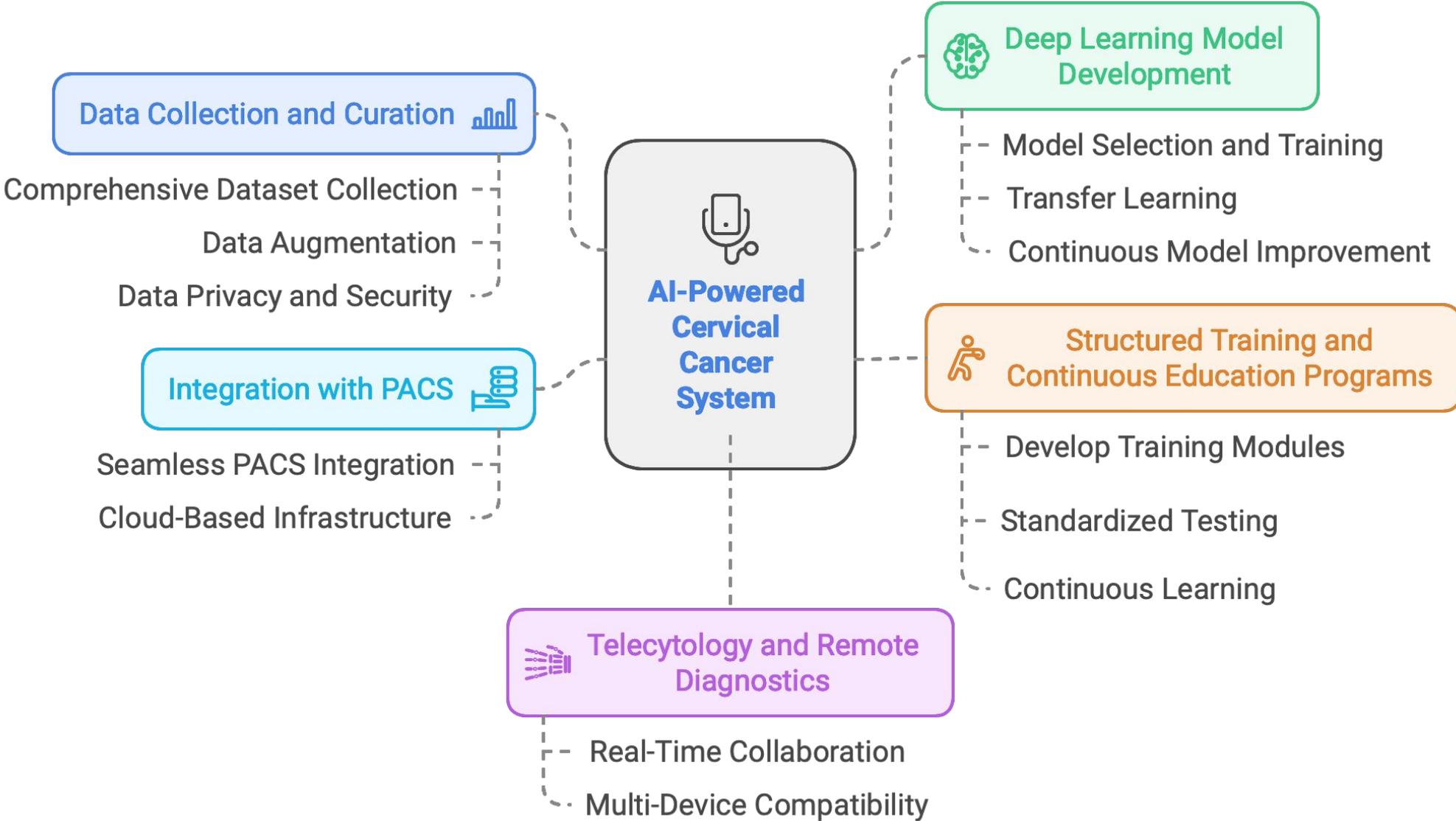
Establish Training

Set up structured programs to train new cytologists and also provide continuous professional development for existing practitioners.
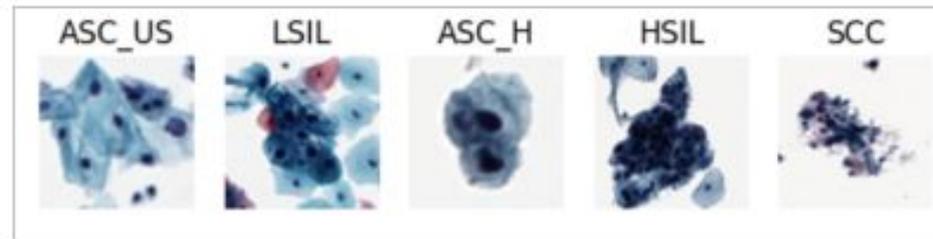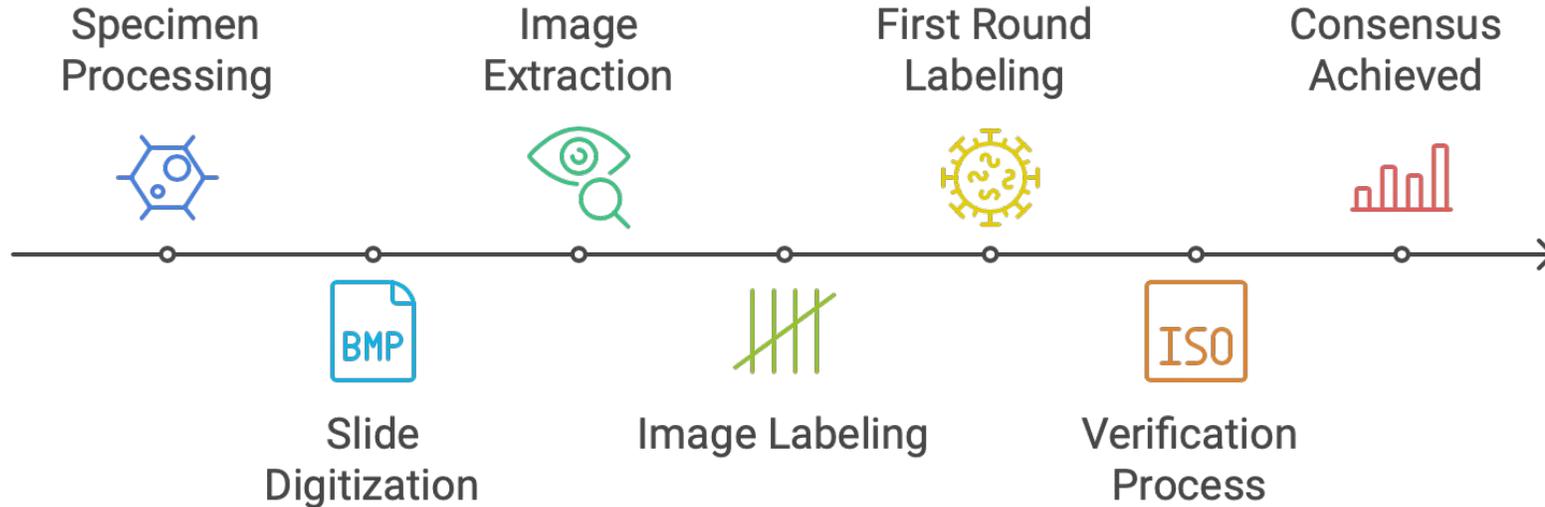
Improve Diagnostic Accuracy

Enhance the accuracy, speed, and efficiency of cervical cancer diagnoses using AI.

Develop Deep Learning Systems

Collecting and Labeling LBC Images
Create a deep learning-based system for analyzing cytological images.

Proposed Method

AI-Powered Cervical Cancer System

Data Collection and Curation
- Comprehensive Dataset Collection
- Data Augmentation
- Data Privacy and Security

Integration with PACS
- Seamless PACS Integration
- Cloud-Based Infrastructure

Deep Learning Model Development
- Model Selection and Training
- Transfer Learning
- Continuous Model Improvement

Structured Training and Continuous Education Programs
- Develop Training Modules
- Standardized Testing
- Continuous Learning

Telecytology and Remote Diagnostics
- Real-Time Collaboration
- Multi-Device Compatibility

Cervical Cancer Data Statistics

Label	ACS_US	LSIL	ASC-H	HSIL	SCC	Total
Train	2.860	2.740	2.830	2.986	1.196	12.612
Dev	357	341	353	372	149	1.572
Test	359	345	355	375	151	1.585

Cervical Cancer data labeling

Transfer Learning

Utilizing pre-trained models to boost classification performance

Ensemble Models

Integration of multiple CNN architectures for diverse capabilities

Preprocessing Techniques

Methods to enhance image quality and feature visibility

F1 Scores of our DL models

Transfer Learning Models	MobileNetV2	InceptionV3	VGG16	DenseNet201	ResNet101	Xception	VGG19
	68.41	72.57	64.65	68.10	60.41	67.18	66.10
Ensemble Learning Models	Voting		Logistic Regression		Support Vector Machine		
	76.17		76.14		76.57		

Proposed Method: Structured Training Program

Develop AI-assisted Modules

Develop Training and Testing Modules

Provide Continuous Learning

- **The Kappa index when using AI support improved in diagnosis of LSIL from 0.81 to 0.95, HSIL from 0.51 to 0.86 and SCC from 0.37 to 0.79.**

| Participating Doctor (**1 year of experience**)	**AI support?**	Kappa agreement level with doctors having **more than 5 years of experience**			
		LSIL	**HSIL**	**SCC**	**Abnormal/ Normal**
Doctor 1	**Yes**	**0.95**	**0.84**	**0.77**	**0.97**
	No	0.76	0.30	0.14	0.81
Doctor 2	**Yes**	**0.96**	**0.87**	**0.81**	**0.98**
	No	0.85	0.71	0.59	0.92
Average	**Yes**	**0.95**	**0.86**	**0.79**	**0.98**
	No	0.81	0.51	0.37	0.87

Evaluate the improvement in diagnosis of doctors with/without AI assistance.
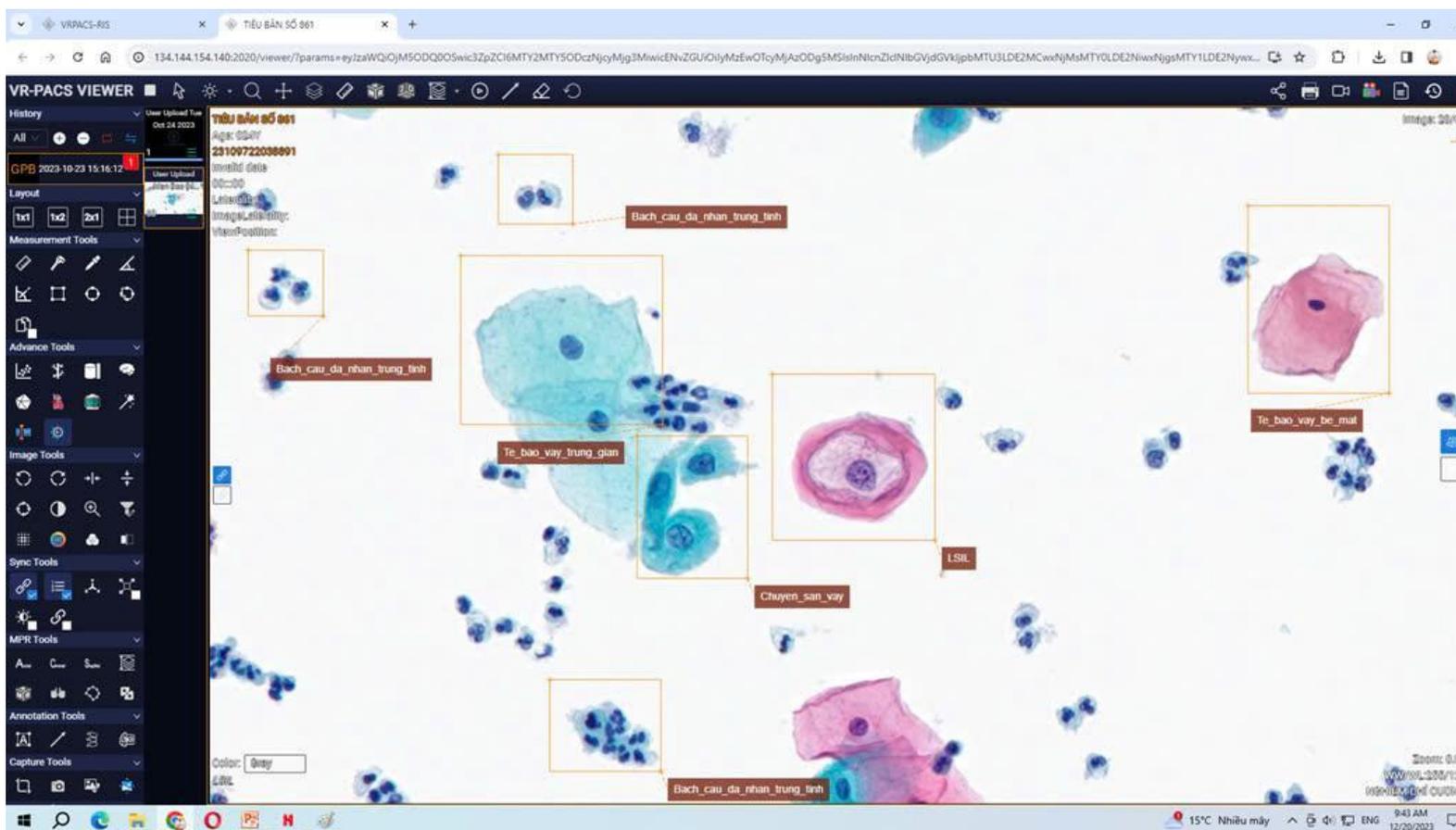
- Provides a robust and cost-effective storage solution for medical images, enabling rapid retrieval and easy access for diagnostic purposes.
- Integrates seamlessly with the AI engine, allowing for efficient image processing and analysis within the system.

AI-based diagnosis demo
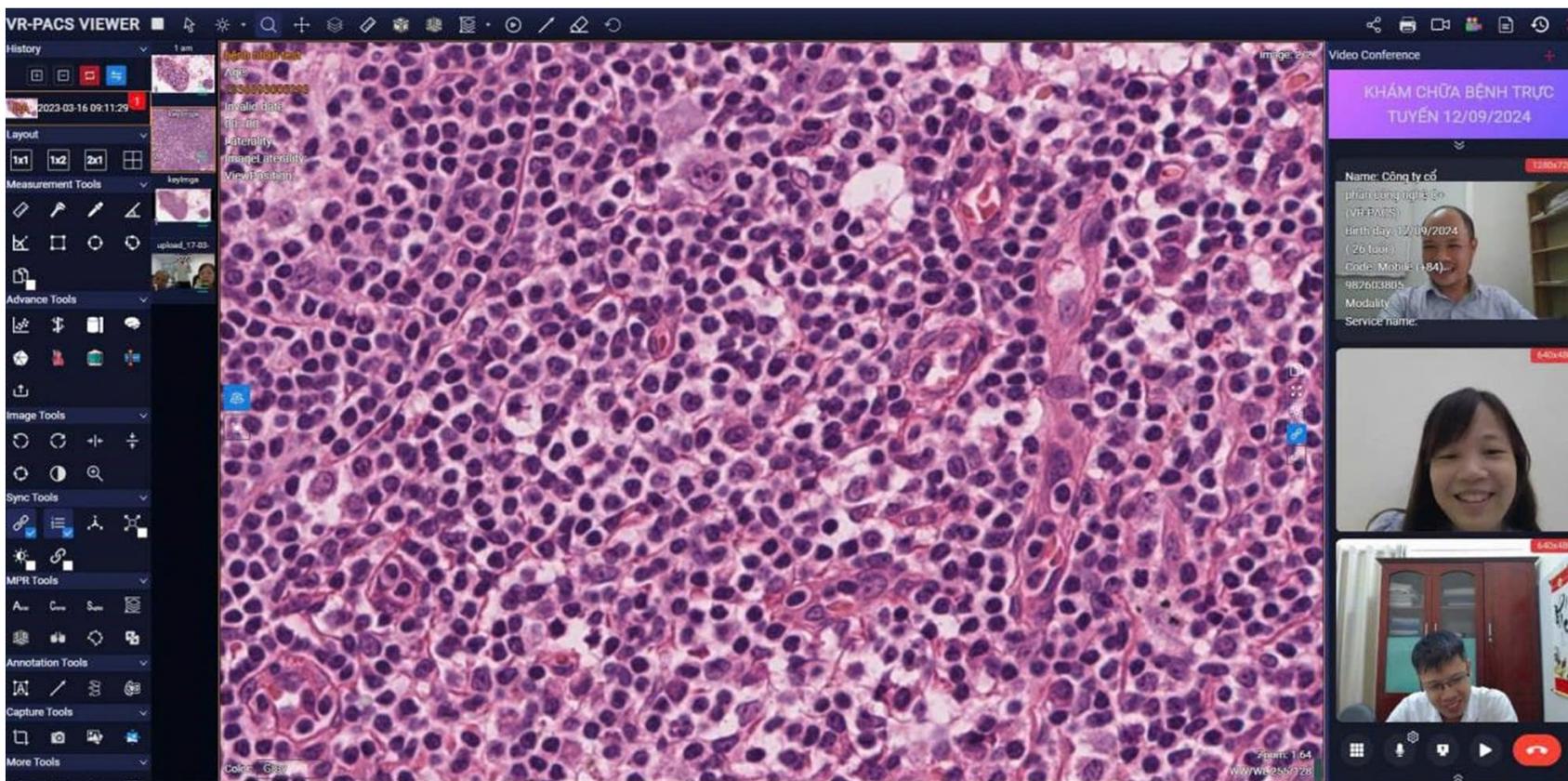
- **Real-Time Collaboration**: Enable remote diagnosis and real-time collaboration between medical professionals across ASEAN countries, especially in underserved regions, by integrating telecytology into the system.
- Supports local and remote viewing, annotation, and reporting of cervical cytological images.

AI-based Telediagnosis demo

Development of a Structured Training Systems

Systems designed not only for diagnosis but also for training new specialists
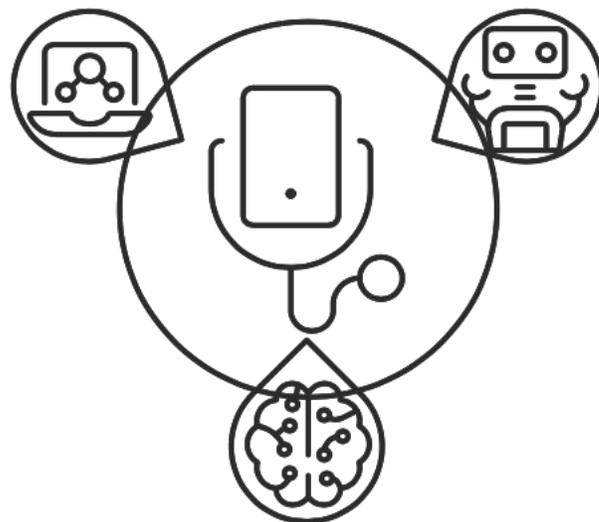
Advancement in AI and Medical Diagnostics

The system introduces innovations in the use of AI for cytological analysis, offering a scalable and reliable diagnostic tool that could be extended to other types of cancer in the future.

Improved Diagnostic Accuracy

Algorithms that enhance the scientific understanding of how AI can supplement medical expertise in high-stakes diagnoses.

Increased Access to Quality Healthcare

The system's telecytology feature will allow remote diagnosis, enabling healthcare professionals in isolated regions to benefit from expert opinions, reducing disparities in healthcare quality.

Reduction in Cervical Cancer Mortality

Play a crucial role in early detection and treatment of cervical cancer, directly reducing mortality rates in ASEAN countries

Empowerment through Education and Training

Empower local healthcare professionals, allowing them to develop the necessary skills to effectively diagnose and treat cervical cancer

Impact: Collaborative

Regional Collaboration in Healthcare

Promotes collaboration between ASEAN countries by establishing a regional telecytology network.

Public-Private Partnerships

Collaboration between academic institutions, healthcare providers, and private companies involved in AI development.

Capacity Building and Knowledge Sharing

ASEAN countries can leverage this initiative to strengthen their healthcare infrastructure, reduce dependency on external expertise, and create a self-sustaining ecosystem of healthcare innovation.

Scientific Publications and Research Contributions

Documentation of system development and impact
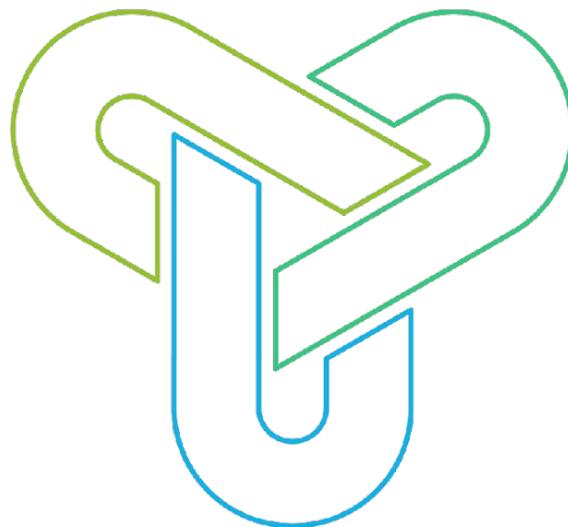
Development of New AI Technologies

Creation of AI-powered telecytology systems

New Diagnostic Applications

Integration of AI with PACS for enhanced diagnostics

Public Data Set for AI Development

Contribute to the improvement of AI models in cervical cancer detection and could be used for further research, benefiting not only ASEAN countries but also the global medical community.

Improvement of Healthcare Standards

leading to the creation of guidelines and protocols for integrating AI into cytology and other medical fields

Technology Transfer to Industry

The AI and telecytology technologies developed through this project can be transferred to medical device companies, enabling commercialization and broader implementation across healthcare systems

New Regional and International Partnerships

Foster collaboration among medical institutions, AI research centers, and healthcare providers across ASEAN countries.
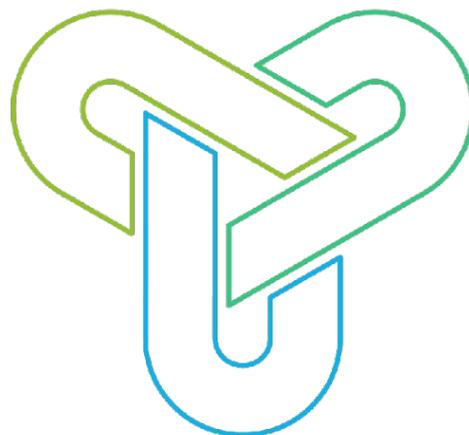
Establishment of a Regional Telecytology Network

The creation of a telecytology network will bring together healthcare professionals from different regions, facilitating knowledge sharing, skill development, and real-time collaboration

Training and Development of New Professionals

The structured training programs embedded in the project will produce a new generation of cytologists and AI-trained healthcare professionals.

Conclusion
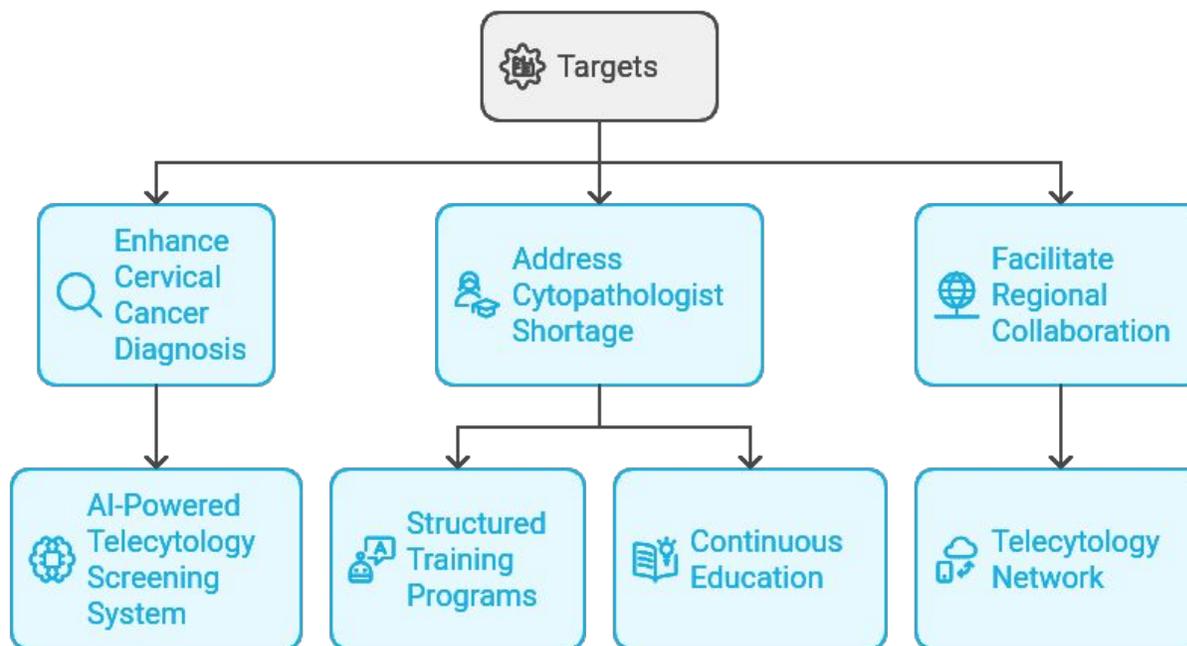
Targets

- The primary target of the proposed method is to **enhance cervical cancer diagnosis** in ASEAN countries through the development and implementation of an AI-powered telecytology screening system. This system aims to improve diagnostic accuracy, speed, and accessibility, particularly in underserved regions.
- Secondary targets include addressing the **shortage of trained cytopathologists** by establishing structured training programs and promoting continuous education for healthcare professionals.
- The project also aims to **facilitate regional collaboration** through a telecytology network, enabling remote diagnosis and knowledge sharing across different medical institutions in ASEAN.

AI-Driven Cervical Cytology System

Digital Cytology | AI Models Development | PACS Solutions
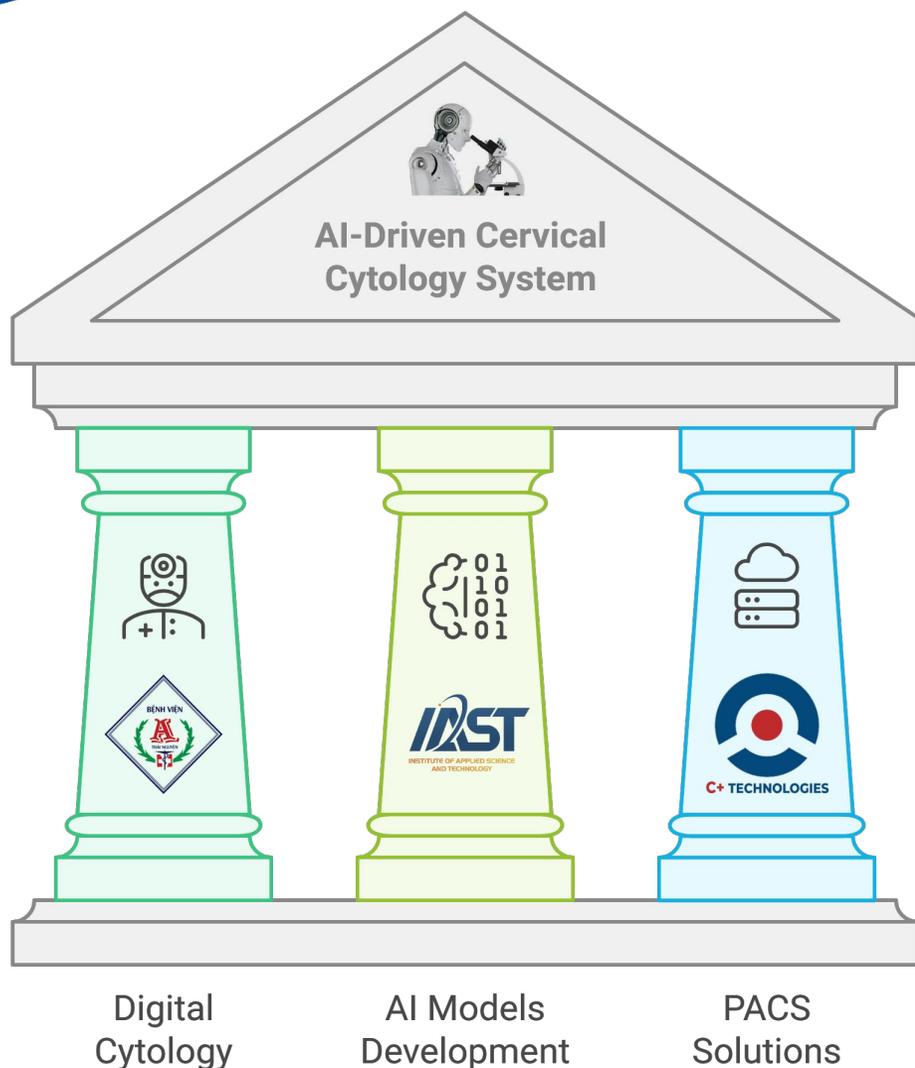
Three pillars of an AI-driven Cervical Telecytology System

- **Digital Cytology:**
  - Transforming traditional slide-based cytology into a digitized, more accessible format.
  - Collecting and Annotating cytological image datasets

- **AI Models Development:**
  - Developing AI models based on machine learning and deep learning techniques.

- **PACS Solutions:**
  - Integrating to an AI-driven cytology system by providing a centralized repository for storing, retrieving, and sharing cytological images and diagnostic reports.
  - Allowing simultaneous access to images and facilitating real-time consultation.

Transforming Cervical Cancer Diagnosis in ASEAN with AI-Powered Telecytology Screening and Training System

Thank you so much for your attention!