

EMPOWERING HEALTH THROUGH DESIGN: ML SOLUTIONS FOR BREAST CANCER DETECTION

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OBJECTIVE

MedAI has worked to advance early breast cancer detection by pretraining AI foundation models on large healthcare datasets that will be easily accessible on the official **Machine Intelligence and Data Analytics (MIDA)** website using APIs.

PROJECT BACKGROUND

- Breast cancer ranks first for incidence in females in 159 countries and accounted for approximately 30% of new female cancers in the U.S.
- MedAI introduces a solution to detect cancerous tumors in medical images with performance comparable (or superior) to human experts
- The creation of a **free, open-source website** gives greater availability and more accurate tools for cancer detection, improving patient outcomes and saving lives

KEY REQUIREMENTS

- Achieve a specificity of **at least 85%** and a sensitivity of **at least 80%** when tested on a large medical dataset
- The website shall allow users to upload their ultrasound images for analysis
- Users can easily upload files and view the results intuitively
- The current website framework should be maintained with minor changes

AI MODEL DESIGN

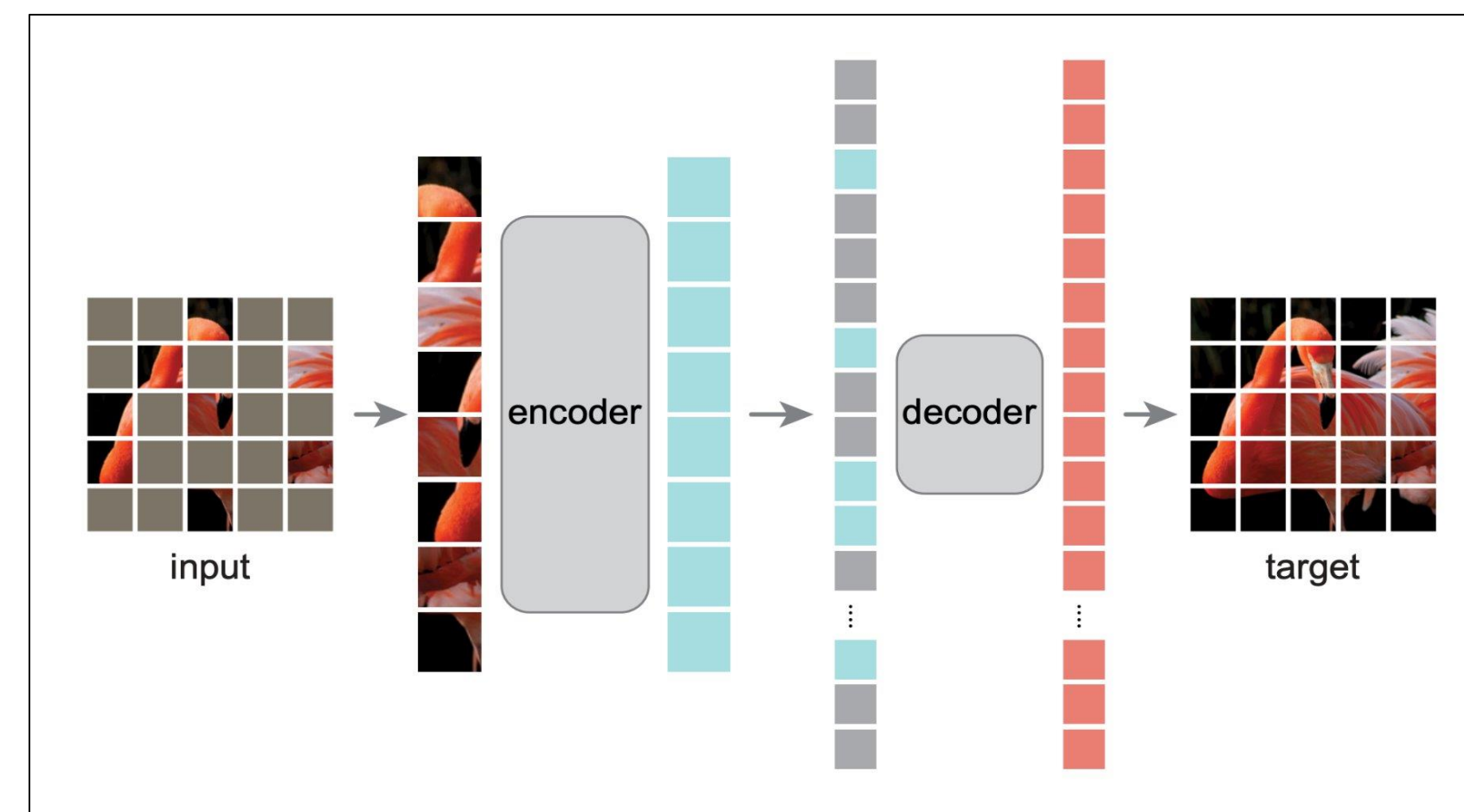
- Curate large, labeled medical image datasets:
 - BUS – 8161 images
 - Mammogram – 7605 images
- Fine-tune a foundation AI model: Masked Autoencoder (MAE)

- Evaluate the performance: accuracy, sensitivity, and specificity

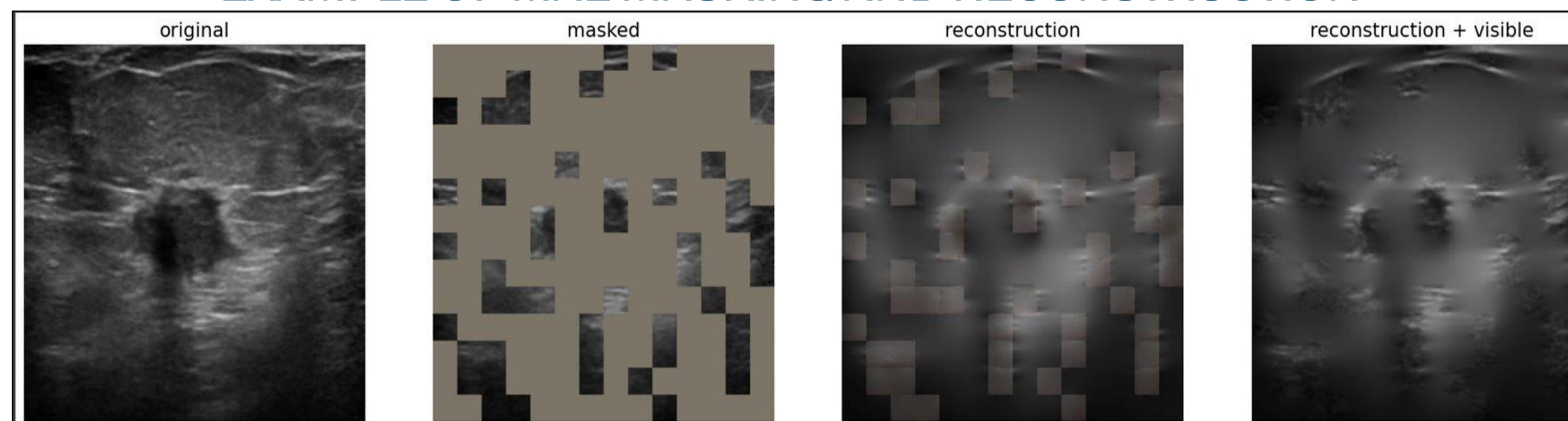
- Save model checkpoints to be used in the API

MASKED AUTOENCODER (MAE) ARCHITECTURE

- The encoder masks pixels and the decoder reconstructs the input data
- A classifier neural network is then added for the binary classification



EXAMPLE OF MAE MASKING AND RECONSTRUCTION



AI MODEL TEST VALIDATION

DATASET	ACCURACY	SENSITIVITY	SPECIFICITY
BUS	85.1%	86.9%	82.0%
Mammogram	76.9%	73.5%	80.6%

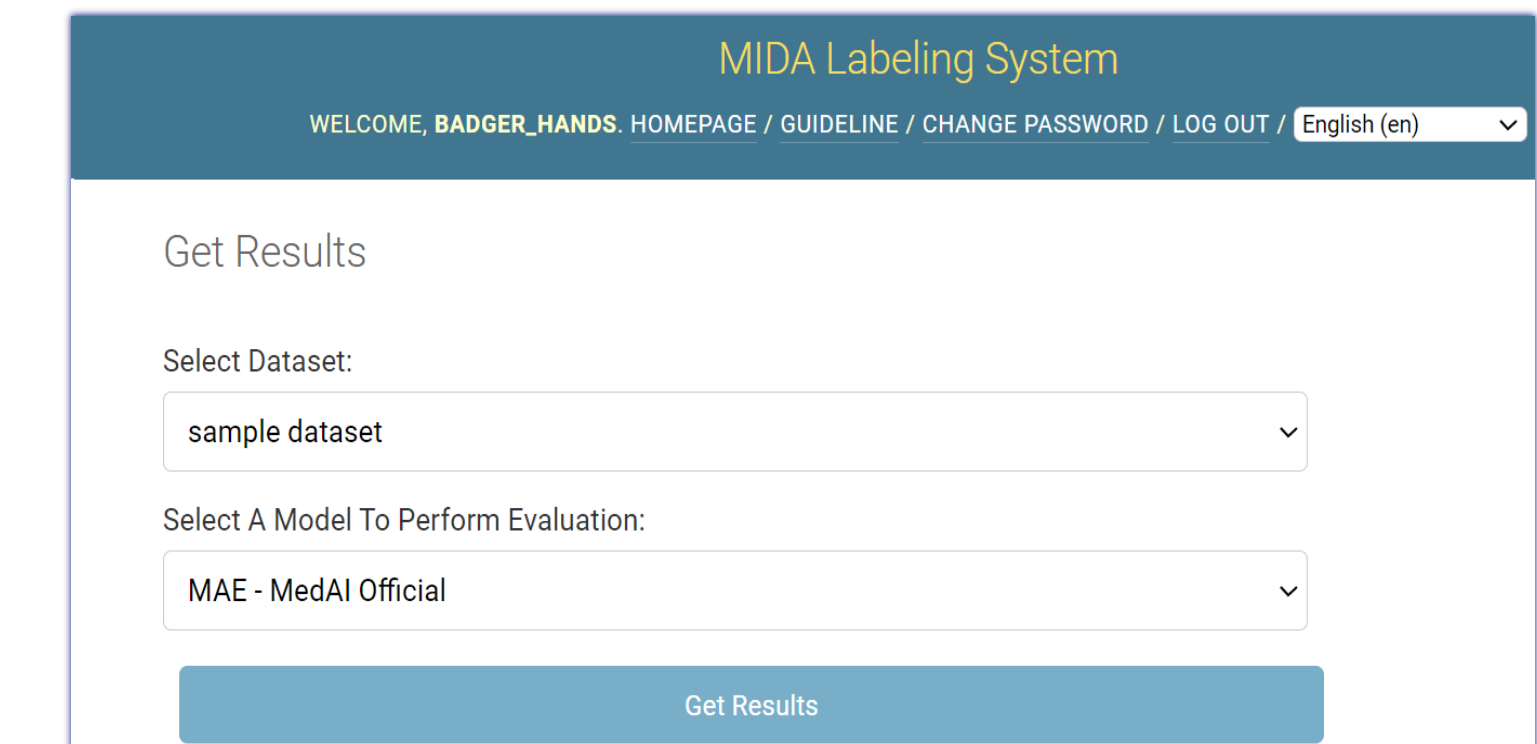
CONCLUSION AND RECOMMENDATIONS

The project exceeded requirements, acquiring strong evaluation scores and an improved UI. The API works as intended with the ML model and gives accurate reports to the user. Initially, two ML models were intended to be fine-tuned, but time only allowed for one. This project can be expanded by continuing work on additional API functions, as well as adding support for new ML models.

API DESIGN

- Create **Application Programming Interfaces (APIs)** to allow for open use of the AI models without prior knowledge

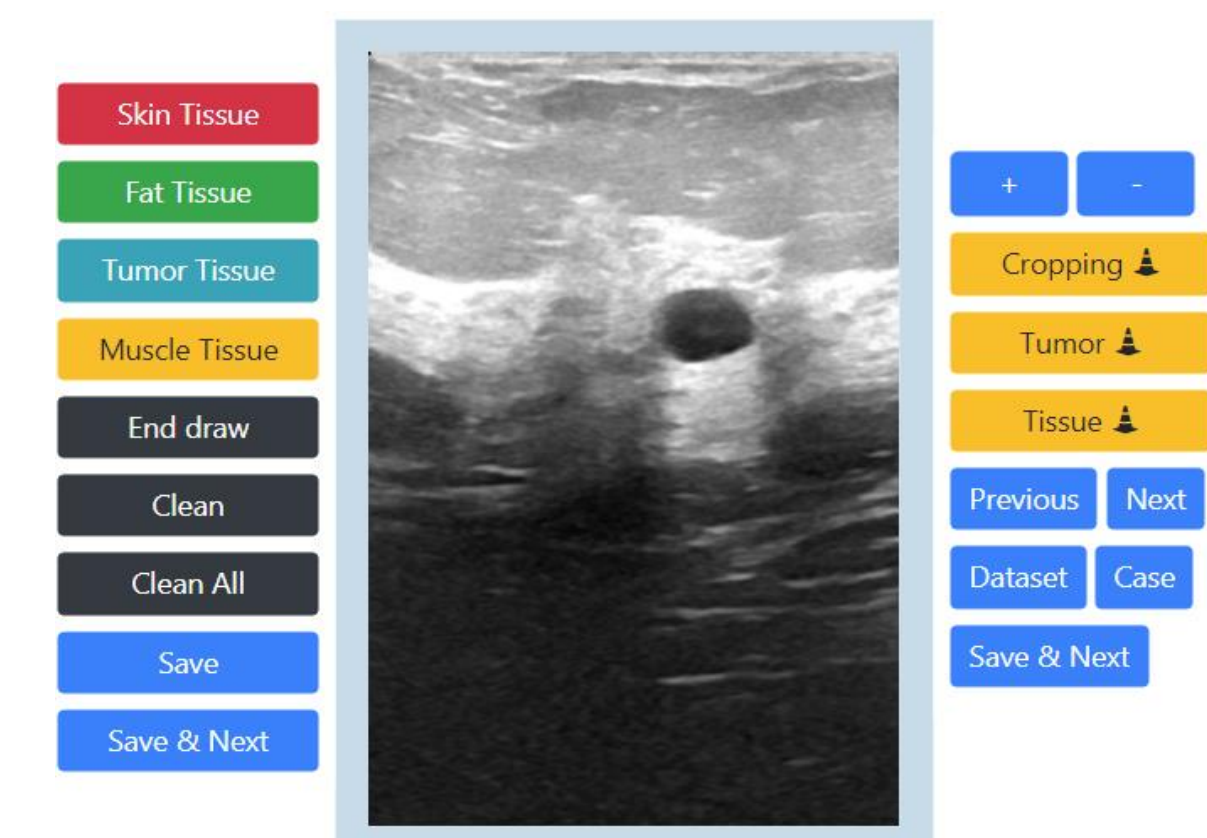
- The **"Get Results"** API allows selection of a dataset and a model and sends the result back to the user. The modular design allows for additional models to be added in the future



Mask	REMAINING TISSUE MASK	DIAGNOSIS
0/1	0/1	Malignant
0/1	0/1	Malignant
1/1	0/1	Malignant
0/1	0/1	Malignant

UI DESIGN

- Enhanced image annotation tools
 - Added zoom functionality
 - Added touch functionality
- Efficient user data management
 - Communicate with models
 - Provide user diagnosis
- Improved visual design
 - Focus on usability and consistency



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