BreastScan AI – Final Project Documentation

Project Overview

Breast cancer is one of the most common cancers worldwide, and early detection plays a crucial role in
improving survival rates. BreastScan AI is a deep learning–powered web application designed to assist
healthcare professionals in detecting and classifying breast abnormalities using ultrasound images. The
tool provides real-time predictions, categorizing images into Benign, Malignant, or Normal, with detailed
confidence metrics. It is intended for research and educational purposes only, not as a replacement for
professional medical diagnosis.

Objectives

- Develop an AI model capable of classifying breast ultrasound images.
- Provide a user-friendly web interface for uploading and analyzing scans.
- Ensure results are presented clearly with confidence levels and recommendations.
- Enable dataset balancing through augmentation techniques for robust model training.
- Generate downloadable analysis reports for reference.

System Architecture

Frontend (UI): Built with HTML, TailwindCSS, and JavaScript. Pages: index.html (Landing & Upload),
about.html (Project details), result.html (Predictions & Reports).
Backend (Flask App): Implemented in app.py. Handles image uploads, preprocessing, model
inference, and result rendering. Only grayscale ultrasound images are accepted.
Model: Custom CNN trained on ultrasound datasets. Input size: 224x224 grayscale. Output: Benign,

Malignant, Normal. Saved in .keras format.
Data Augmentation: Implemented in augmantation.py with techniques such as flipping, rotation,
brightness/contrast adjustment, and cropping.

Workflow

1. Upload grayscale ultrasound image.
2. System validates file format.
3. Image is preprocessed and passed into the CNN model.
4. Predictions with class probabilities are generated.
5. Results with confidence metrics and recommendations are displayed.
6. Option to download a PDF report is provided.

Key Features

- Real-time AI Predictions.
- Three-class classification (Benign, Malignant, Normal).
- Confidence Visualization with progress bars.
- Recommendations based on prediction.
- Downloadable PDF report.
- Responsive web design.

Model Details

Framework: TensorFlow & Keras
Architecture: Custom CNN (trained from scratch)
Input: 224×224 grayscale images (expanded to 3 channels)
Output Classes: Benign, Malignant, Normal
Evaluation Metrics: Accuracy 82%, Precision 83%, Recall 82%, F1 Score 82%

Deployment

- Backend: Flask app running on 0.0.0.0:5000.
- Frontend: HTML + TailwindCSS.
- Model Path: C:/Users/User/Documents/tinos/Breast/output/models/breast.keras
- Upload Directory: uploads/ (auto-created).

Limitations

- Only supports grayscale ultrasound images.
- Model accuracy (82%) may not generalize perfectly to real-world data.
- Not FDA-approved or medically certified.
- Intended solely for research and educational use.

Future Enhancements

- Improve accuracy with larger, diverse datasets.
- Integrate EfficientNet/ResNet architectures.
- Add Grad-CAM explainability.
- Classify cancer severity stages.
- Deploy as cloud-hosted service.

Disclaimer

BreastScan AI is for research and educational purposes only. It should not be used as a sole diagnostic
tool. Always consult qualified healthcare professionals for medical advice and treatment.

Conclusion

The development of BreastScan AI demonstrates how artificial intelligence can be integrated into healthcare applications to improve efficiency and accessibility. By combining deep learning with a simple, user-friendly web interface, the project provides a second-opinion system for classifying breast ultrasound images into benign, malignant, or normal categories.

Although the tool is not a replacement for medical professionals, it shows promise as an assistive technology that can support clinicians, reduce diagnostic workload, and serve as an educational aid for medical students and researchers. With continued refinement, larger datasets, and advanced explainability

methods, BreastScan AI can become a more powerful tool, bridging the gap between AI research and real-world medical practice.

Team

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