Detecting Gallbladder Cancer from USinG Images with Curriculum Learning

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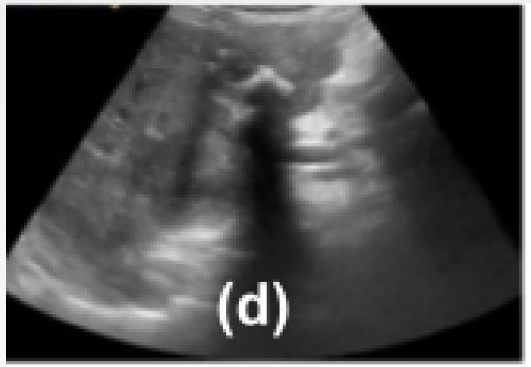
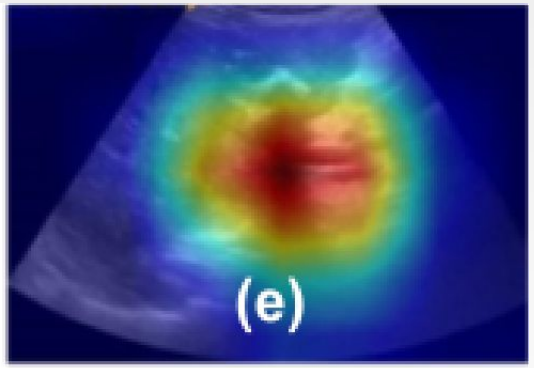
Introduction



Biopsy: Malignant



ResNet50: Benign

Problem Statement

Address the mentioned limitations by proposing a novel model (GBCNet)

- Combines region detection, multi-scale pooling, and texture bias reduction to improve GBC detection accuracy compared to existing methods, including those of expert radiologists.

- Adapt the model for other cases such as breast, liver, prostate cancer detection through Transfer Learning.

Literature Review

1. Inf-Net: Automatic COVID-19 Lung Infection Segmentation from CT Images[1]

2. Deep learning to distinguish pancreatic cancer tissue from non-cancerous pancreatic tissue: a retrospective study with cross-racial external validation[2]

3. Multi-scale gradational-order fusion framework for breast lesions classification using ultrasound images[3]

Literature Review

1. This paper highlights the effectiveness of focused region classification in medical imaging, as demonstrated by the authors, using the Inf-Net model for precise COVID-19 lung infection identification in CT images.
2. This paper presents a method that prioritizes Regions of Interest (ROI) by preprocessing contrast-enhanced CT images into patches for a Convolutional Neural Network (CNN) to classify as cancerous or non-cancerous, focusing on areas indicative of pancreatic cancer for targeted analysis.
3. The paper talks about a new way to analyze pictures of breast lumps using a method called Multi-Scale Gradational-Order Fusion (MsGoF). This method combines different sizes of features from the images and uses advanced techniques to understand the shape and structure of the lumps better. By doing this, it aims to create a detailed and accurate way to classify these lumps for medical purposes.

Dataset

Aimed to address the lack of publicly available USG datasets for GB malignancy detection.

- Dataset Statistics:
  Annotated 1255 abdominal USG images from 218 patients.
  Includes 432 normal, 558 benign, and 265 malignant images.

- Dataset Splits:
  Training set has 1133 images, testing set has 122 images.
  Ensured generalization by patient-wise split.

Implementation and Methodology

GBC Detection Steps:

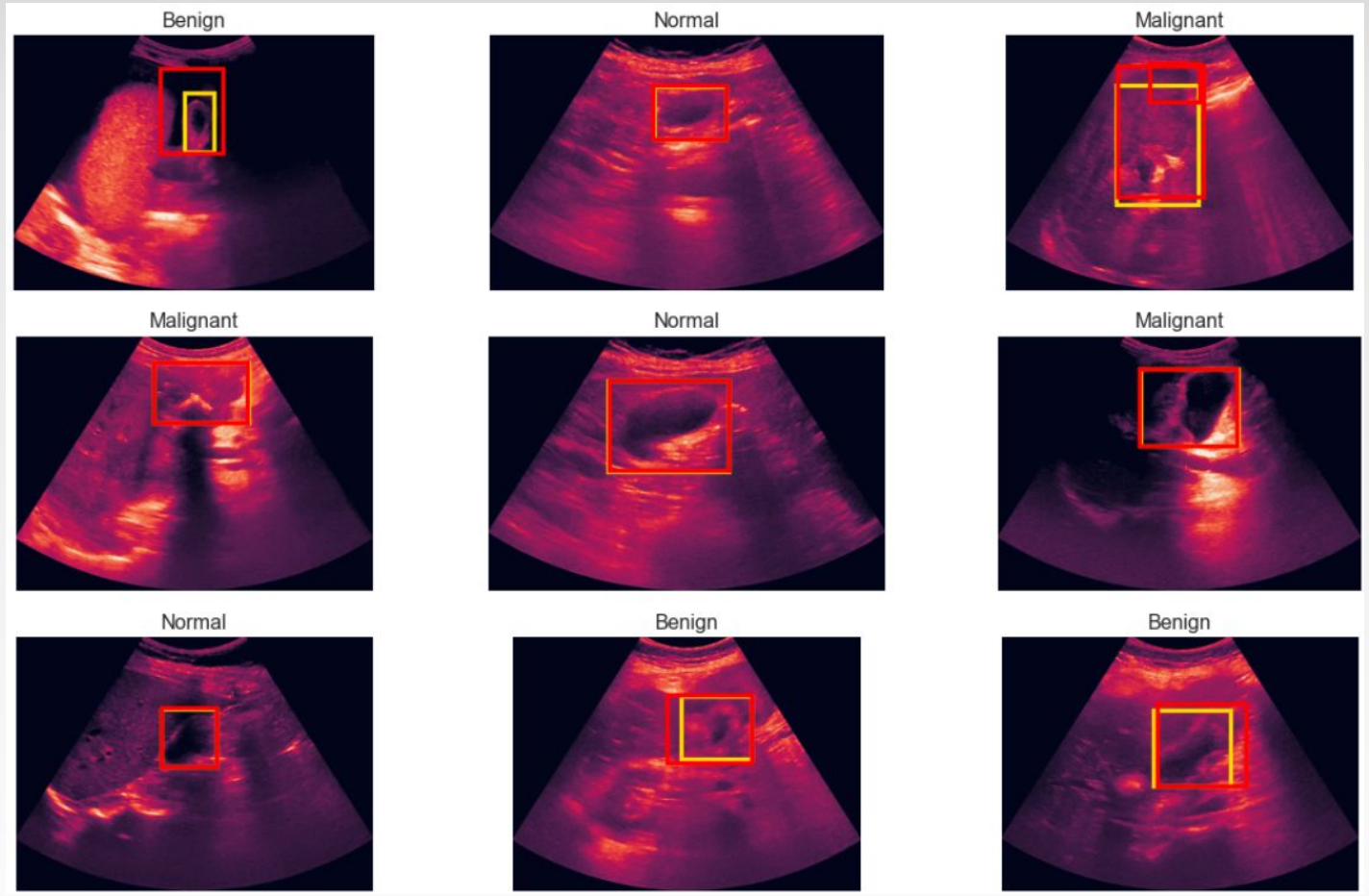
Region Selection: GBCNet extracts candidate Regions of Interest (ROIs) from USG images to mitigate shadow effects.

Classification: Utilizes a multi-scale, second-order pooling-based (MS-SoP) classifier on ROIs for GBC classification.

Training Curriculum: Implements a visual acuity-inspired training curriculum to reduce texture bias and focus on shape features.

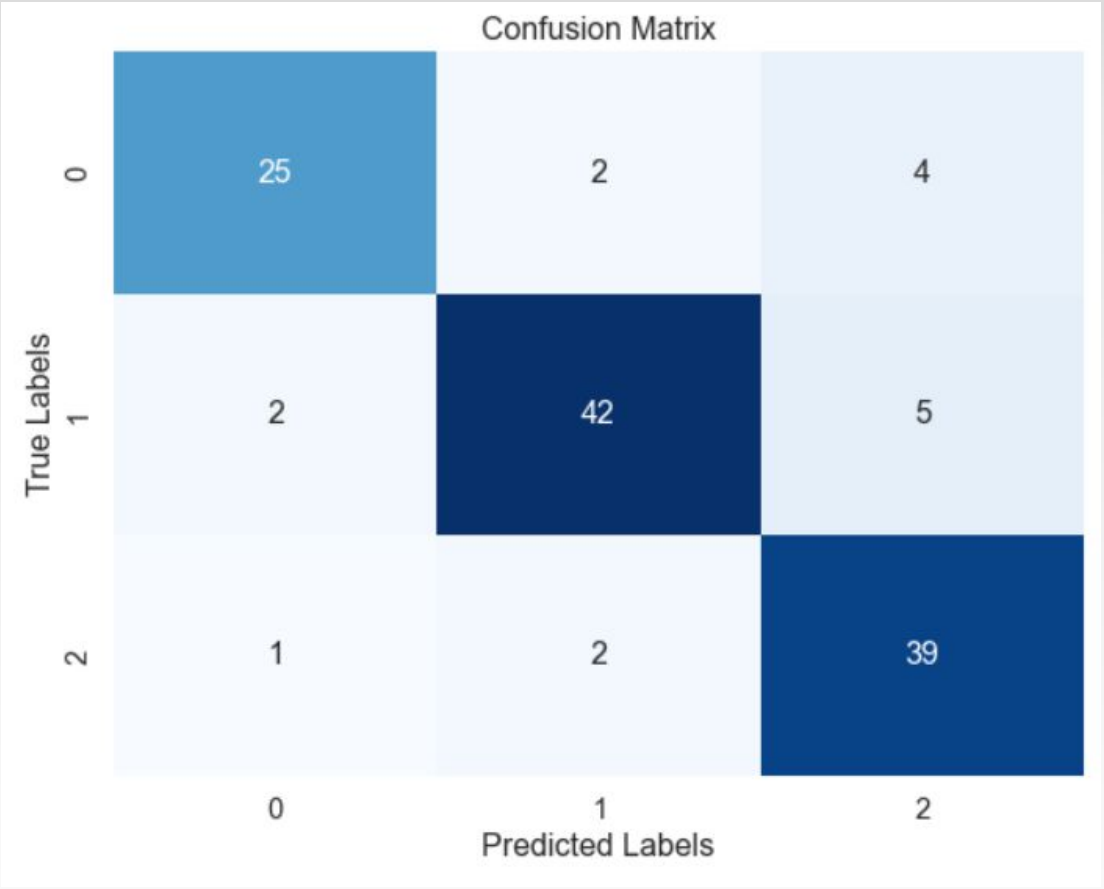
Evaluation Metrics: Measures accuracy, sensitivity, and specificity for region selection models. Uses precision, recall, and accuracy to assess classification models for GBC detection.

Results


Benign
Normal
Malignant
Malignant
Normal
Malignant
Normal
Benign
Benign

Performance evaluation

- Accuracy: 86.89%
- 2-Class Accuracy: 90.16%
- Specificity: 88.75%
- Sensitivity: 92.86%



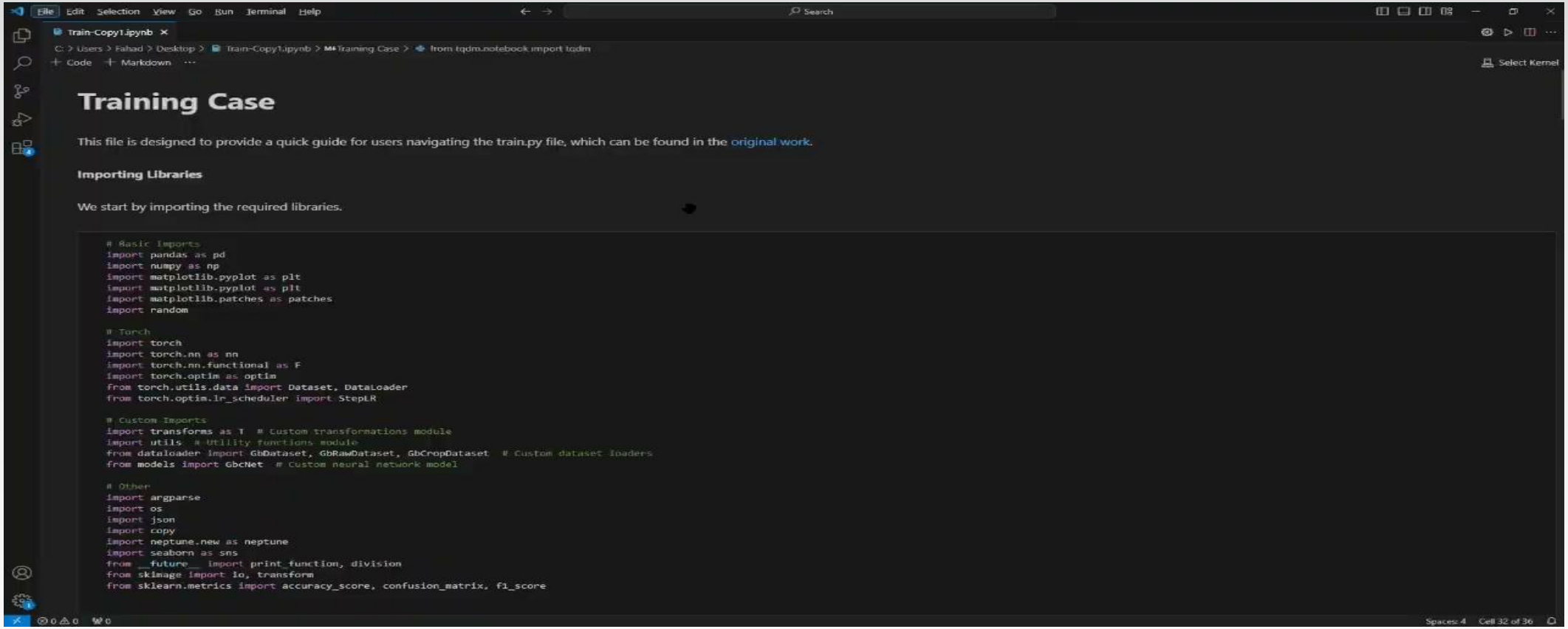
Discussion

- Challenges Addressed: Overcomes common issues in ultrasound imaging such as low image quality and the presence of noise and shadows.
- Future Directions:
  - Explore the application of GBCNet to other types of cancer detection using ultrasound imagery.
  - Integration with larger, more diverse datasets to test and enhance the model's robustness and accuracy.
- Clinical Impact: Potential to significantly improve early detection of gallbladder cancer, potentially enhancing survival rates.

Work Division

1. Data Collection and Preprocessing: Mohammad Al-Armouty
2. Data Augmentation: Mohammad Al-Armouty and Fahad
3. Model Development: Salman
4. Training and Evaluation: Mohammad Arsalan
5. Hyperparameter Tuning: Mohammad Arsalan and Fahad
6. Documentation and Reporting:
   a. Introduction and Problem Statement - Salman
   b. Literature Review - Mohammad Al-Armouty
   c. Methodology and implementation - Mohammad Arsalan
   d. Results, Evaluation, and Discussion - Fahad and Mohammad Al-Armouty
7. Integration and Testing: Salman

Demonstration



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