

Detecting Gallbladder Cancer from USinG Images with Curriculum Learning

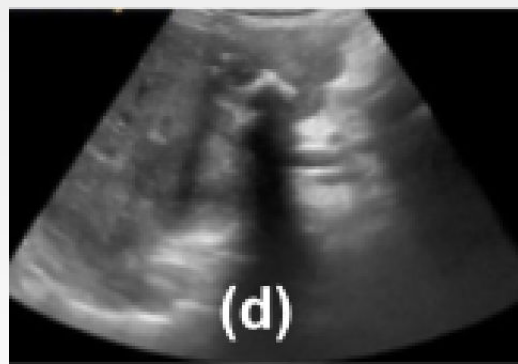
Mohammad Aarsalan Ahmed

Salman Siddiqui

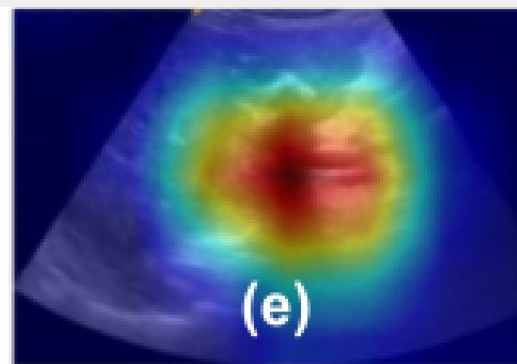
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Introduction



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:

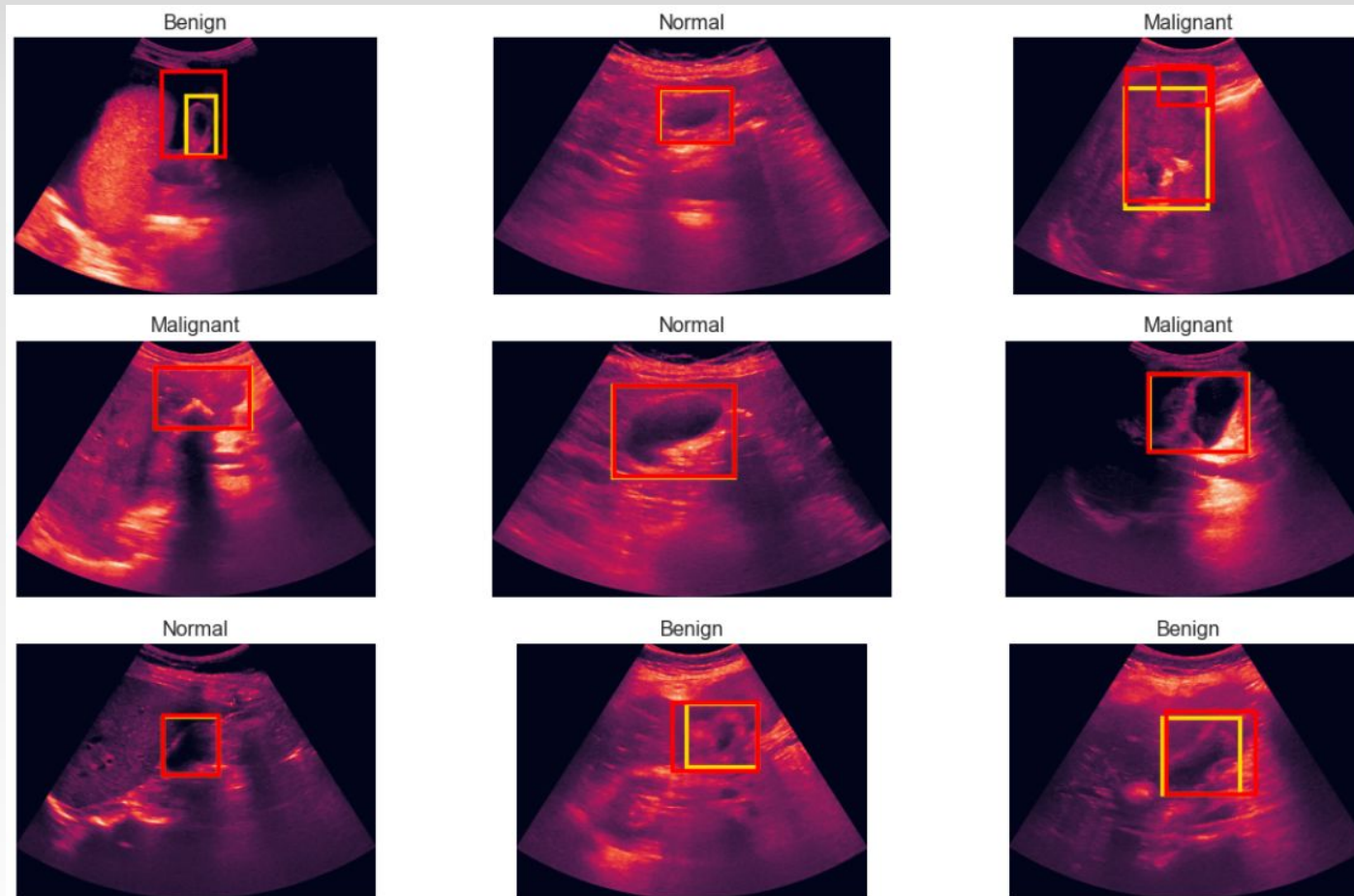
Region Selection: GBCNet extracts candidate Regions of Interest (ROIs) from USG images to mitigate shadow effects.

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.

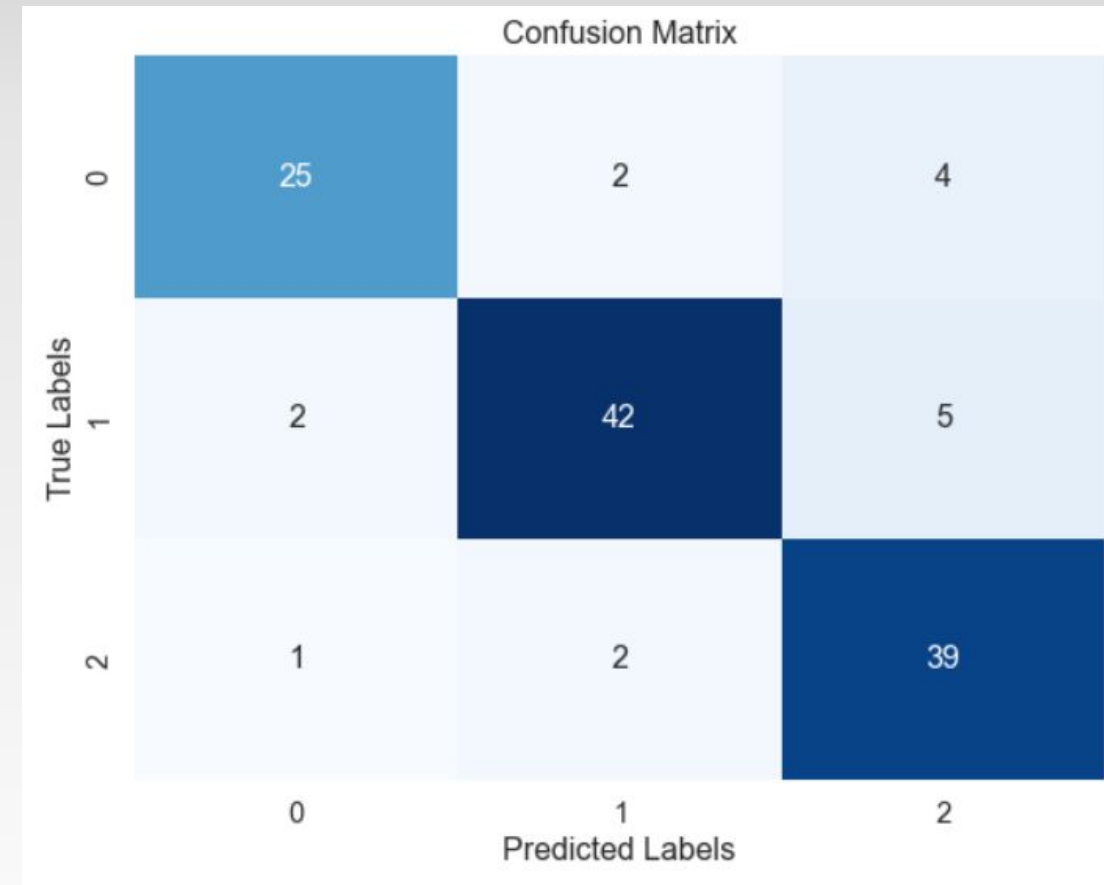
Evaluation Metrics: Measures accuracy, sensitivity, and specificity for region selection models. Uses precision, recall, and accuracy to assess classification models for GBC detection.

Results



Performance evaluation

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



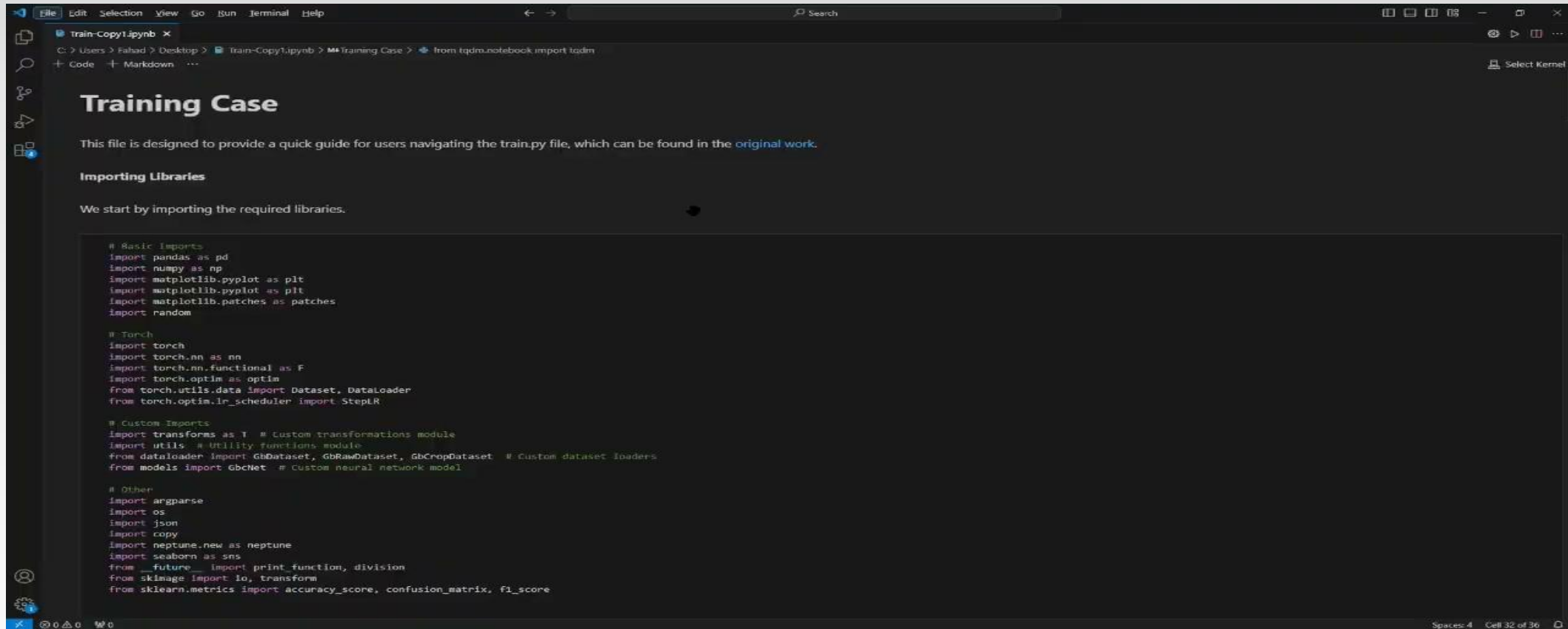
Discussion

- 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



The screenshot shows a Jupyter Notebook interface with a dark theme. The notebook is titled "Training Case" and contains a code cell with the following Python code:

```
# Basic Imports
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.pyplot as plt
import matplotlib.patches as patches
import random

# Torch
import torch
import torch.nn as nn
import torch.nn.functional as F
import torch.optim as optim
from torch.utils.data import Dataset, DataLoader
from torch.optim.lr_scheduler import StepLR

# Custom Imports
import transforms as T # Custom transformations module
import utils # Utility functions module
from dataloader import GbDataset, GbRawDataset, GbCropDataset # Custom dataset loaders
from models import GbNet # Custom neural network model

# Other
import argparse
import os
import json
import copy
import neptune.new as neptune
import seaborn as sns
from __future__ import print_function, division
from skimage import io, transform
from sklearn.metrics import accuracy_score, confusion_matrix, f1_score
```

The notebook interface includes a menu bar (File, Edit, Selection, View, Go, Run, Terminal, Help), a search bar, and a sidebar with icons for file operations. The status bar at the bottom indicates "Spaces: 4" and "Cell 32 of 36".

References

- [1] Inf-Net: Automatic COVID-19 Lung Infection Segmentation From CT Images. (2020, August 1). IEEE Journals & Magazine | IEEE Xplore. <https://ieeexplore.ieee.org/document/9098956>
- [2] Liu, K., Wu, T. M., Chen, P. T., Tsai, Y., Roth, H. R., Wu, M., Liao, W., & Wang, W. (2020, June 1). Deep learning to distinguish pancreatic cancer tissue from non-cancerous pancreatic tissue: a retrospective study with cross-racial external validation. The Lancet Digital Health. [https://doi.org/10.1016/s2589-7500\(20\)30078-9](https://doi.org/10.1016/s2589-7500(20)30078-9)
- [3] Ning, Z., Tu, C., Xiao, Q., Luo, J., & Zhang, Y. (2020, January 1). Multi-scale Gradational-Order Fusion Framework for Breast Lesions Classification Using Ultrasound Images. Lecture Notes in Computer Science. https://doi.org/10.1007/978-3-030-59725-2_17