

Harnessing AI for Kidney Glomeruli Classification

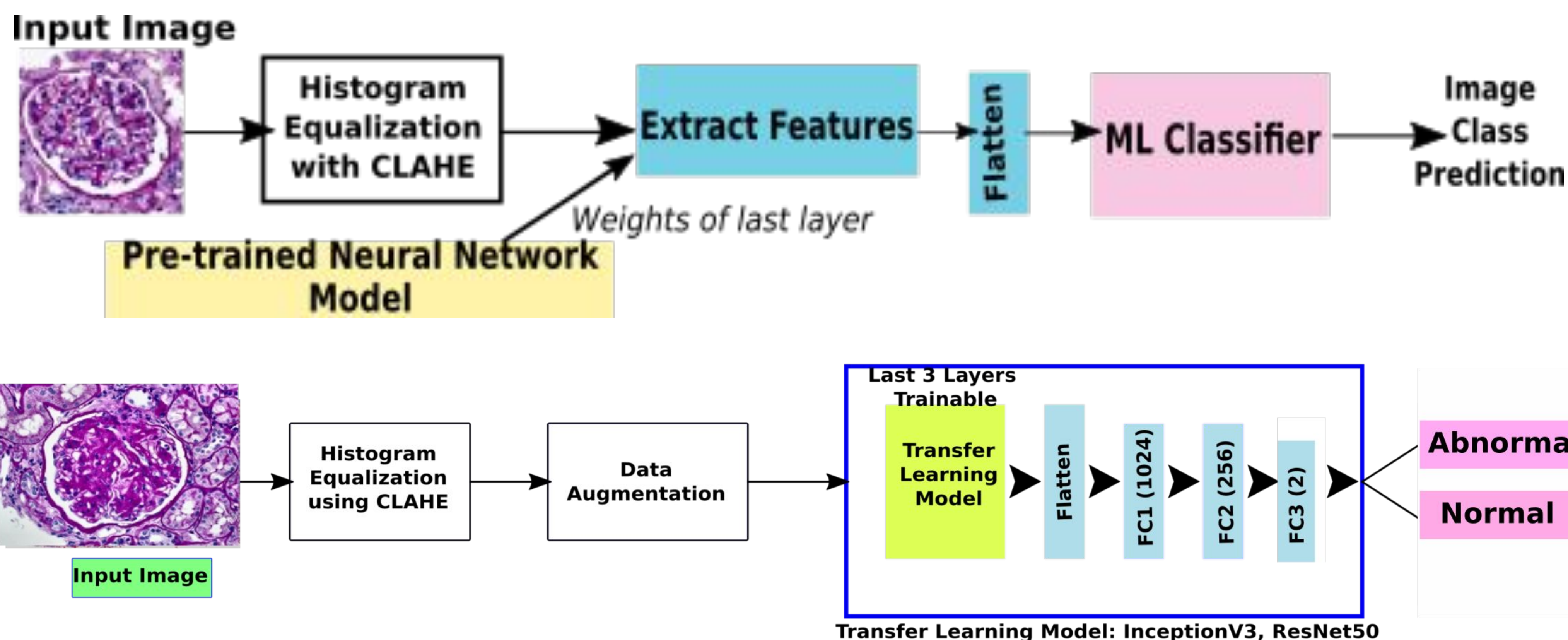
Meghna P Ayyar*, Puneet Mathur*, Rajiv Ratn Shah and Shree G Sharma

Research Goal

MOTIVATION: Kidney diseases kill more than a million people every year. But despite this fact, End-Stage Renal Diseases (ESRD) receive little efforts for their prevention or early treatment other than dialysis. High-resolution biopsy images serve as underutilized resources that can be used to detect early stages of ESRD. Artificial Intelligence, especially deep learning models, show promising results in this direction.

PROBLEM STATEMENT: Biopsy analysis can aid in the diagnosis but is constrained due to the lack of experts in developing nations. We aim to automate the classification of clinical morphology of kidney filtrations units (called glomeruli) as abnormal and normal to aid in determining the extent of illness.

System Architecture

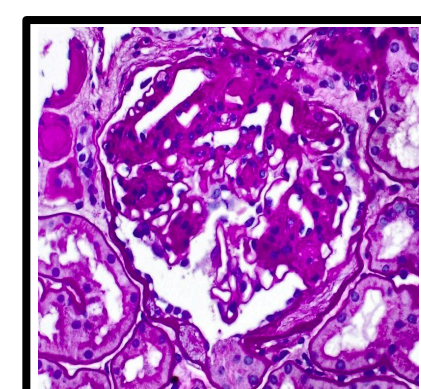


System Features

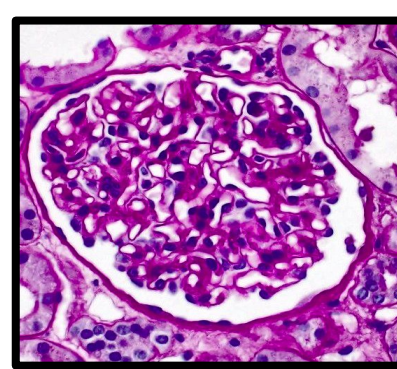
Glomerulus Classification Database (GCDB)

Creation of a novel dataset consisting of 935 images of human renal glomeruli divided as:

- Abnormal Glomeruli (619)
- Normal Glomeruli (316)



Abnormal Glomerulus



Normal Glomerulus

Glomeruli Assessment

- Classify glomeruli images using vanilla transfer learning
- Experimentation to use supervised classifiers with pre-trained feature extraction using penultimate layers of pre-trained classifiers such as ResNet50 and VGG19

Contributions

- Creation of an annotated dataset (GCDB) of kidney glomeruli images extracted from anonymous patient records and scrutinized by numerous nephrologists.
- Empirical analysis of transfer learning models such as ResNet50 and InceptionV3 for glomeruli classification.
- Outperformance validation of feature extraction based supervised classification models over transfer learning models. In this effect, Logistic Regression supplemented with features imparted by InceptionResNetV2 performs better than the rest.