Application Of Machine Learning and Deep Learning For Detection of Non-Alcoholic Fatty Liver Disease (NAFLD)

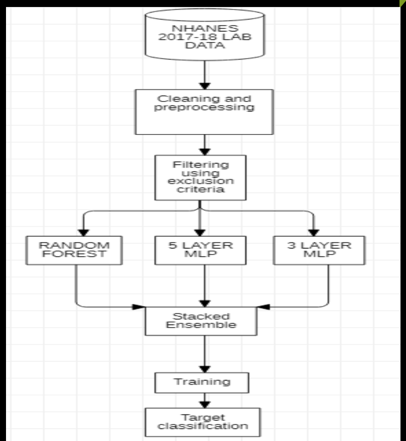
[Avireddy NVSRK Rohan, Dr. Geetha S] SCOPE, Vellore Institute of Technology(CHN)

Abstract

In this study, we explore the role of machine learning and deep learning in improving computer-aided diagnostic methods for Non-Alcoholic fatty liver disease. This study explores two main non-invasive diagnostic methods: predominantly laboratory bio-marker data (NHANES 2017-18) and the b-mode ultrasound image data parasagittal liver-kidney ultrasounds of 55 patients.

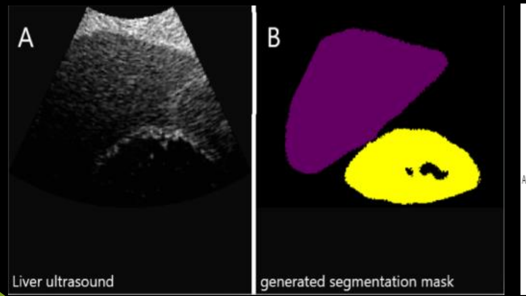
Proposed method involving NHANES data

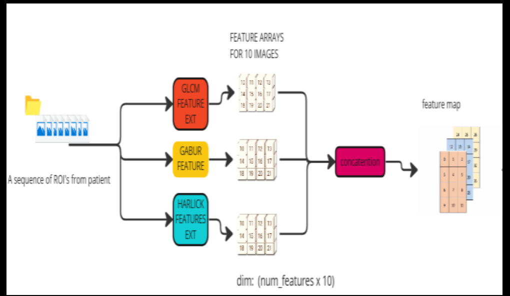
- The proposed algorithm is a stacked deep learning ensemble comprising a fully trained 3-layer MLP, a random forest with 100 estimators and a 5-layer MLP.
- The cross-sectional dataset has been selectively merged and comprised of various bio-markers collected as a part of NHANES study.
- The data has been filtered according to toa specific exclusion criteria to effect of circumstantial variables.
- The models have been ensembled according to stacked ensemble method.



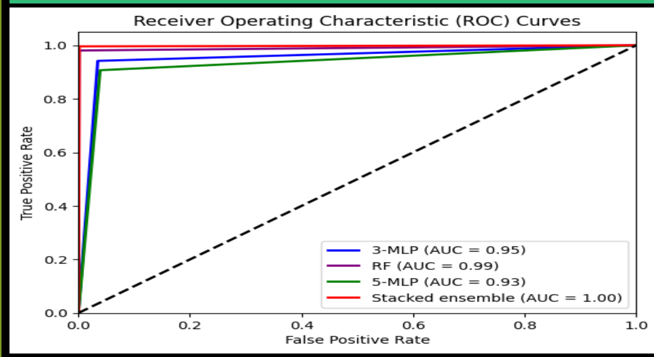
Proposed method involving Ultrasound images

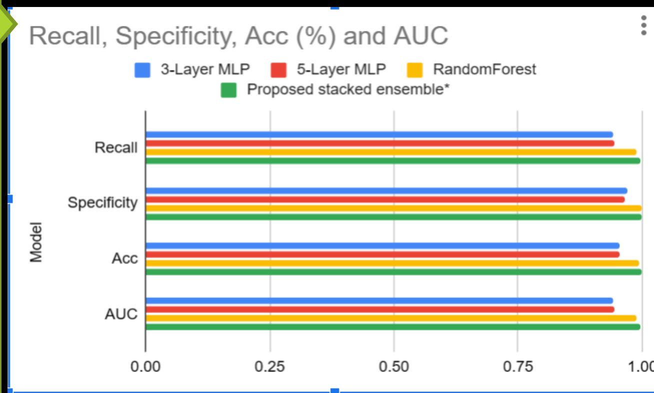
The dataset comprised of 550 images distributed as 55 sequences of 10 images each and a binary label against each sequence. The pre-trained U-net algorithm has been used to segment and extract liver region from the parasagittal liver-kidney ultrasound. A feature tensor is generated from every sequence using GLCM, Gabor, Haralick methods. The feature tensor is given as input while training a *CNN+Bi-LSTM* model.





Graphs and Charts





Contributions

- Removing the barriers to physician involvement through automating the process of ROI extraction.
- Developed models that can train on sequential images and make use of temporal information.
- Generating and utilizing feature maps instead of training directly on the image, based on the correlation between features between sequences. Also making it easier for the models to train on sequential image data.
- Presenting a simplistic way of ensembling models to classify clinical data.

Results for NHANES dataset

Model	Recall	Specificity	Acc (%)	AUC
3-Layer MLP	0.942	0.970	95.5	0.942
5-Layer MLP	0.944	0.966	95.4	0.944
Random Forest	0.989	0.998	99.3	0.989
Proposed stacked ensemble*	0.997	0.998	99.9	0.997

Results for Ultrasound image data

training configuration	feature configuration	accuracy	precision	recall	f1
without extracting ROI's	direct training	0.55	0.55	1	0.71
	after incorporating feature extraction	0.67	0.7	0.92	0.79
with extracting ROI'S	direct training	0.73	0.36	0.5	0.42
	after incorporating feature extraction	0.87	0.84	0.9	0.88

Conclusion and Future Work

- Deep learning and machine learning techniques hold promise for enhancing non-invasive diagnostic procedures for non-alcoholic fatty liver disease
- High levels of accuracy, precision, and recall were attained by the suggested deep learning stacked ensemble model, demonstrating its potential as a dependable diagnostic tool
- Ultrasound image analysis was improved by our suggested method for automating liver region extraction and incorporating texture features
- Future research could explore the use of advanced deep learning architectures, such as transformer-based models, to enhance performance
- The incorporation of additional imaging modalities, like magnetic resonance imaging, for the diagnosis of Non-Alcoholic Fatty Liver Disease could also be explored
- Efforts could be made to broaden and diversify the dataset to further increase the precision and dependability of the diagnostic models.

References

[1]Rhyou, S. Y., & Yoo, J. C. (2021). Cascaded deep learning neural network for automated liver steatosis diagnosis using ultrasound images. Sensors, 21(16),
[2]Yip, T. F.et.al(2017). Laboratory parameter-based machine learning model for excluding non-alcoholic fatty liver disease (NAFLD) in the general population. Alimentary pharmacology & therapeutics, 46(4), 447-456.