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AI Driven Quantitative System for Assessing the Quality of Diagnostic Ultrasound

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Objective

To present a quantitative system, driven by AI, for assessing the quality of ultrasound examinations, and to determine its reproducibility, taking into consideration the images obtained in the abdominal ultrasound exam fulfills the established requisites from the protocol.

One of the basic criteria of quality is the presence of key images defined in the abdominal ultrasound protocol by American Institute of Ultrasound in Medicine (AIUM). Our AI driven system is an important tool to accurate the match between abdominal ultrasound set of images and the AIUM requirements.

Once a performed abdominal ultrasound with it's given set of images is analysed it is possible to evaluate how many images matches with the established criteria. The results in the first tests were close to 90% in accuracy.

Dataset

A DATASET composed by the main classes of images required in the abdominal protocol is used to train the AI algorithm. Each class of images is composed by at least 107 images obtained from different patients. All images were de-identified, including DICOM metadata and burned-in identification in the pixeldata.

Dataset was split into training (80%), validation (10%) and test (10%) sets.

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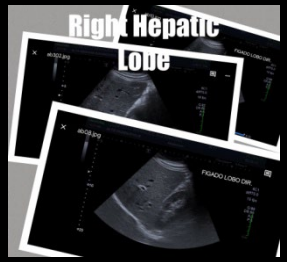
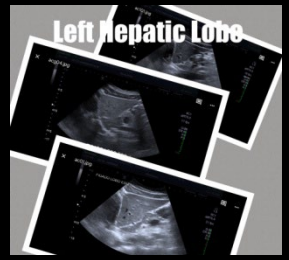
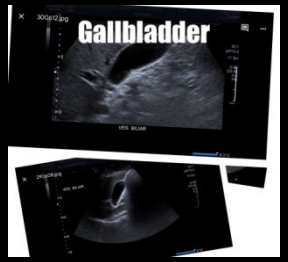
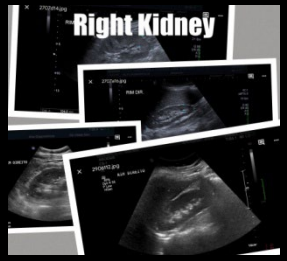






Dataset Classes



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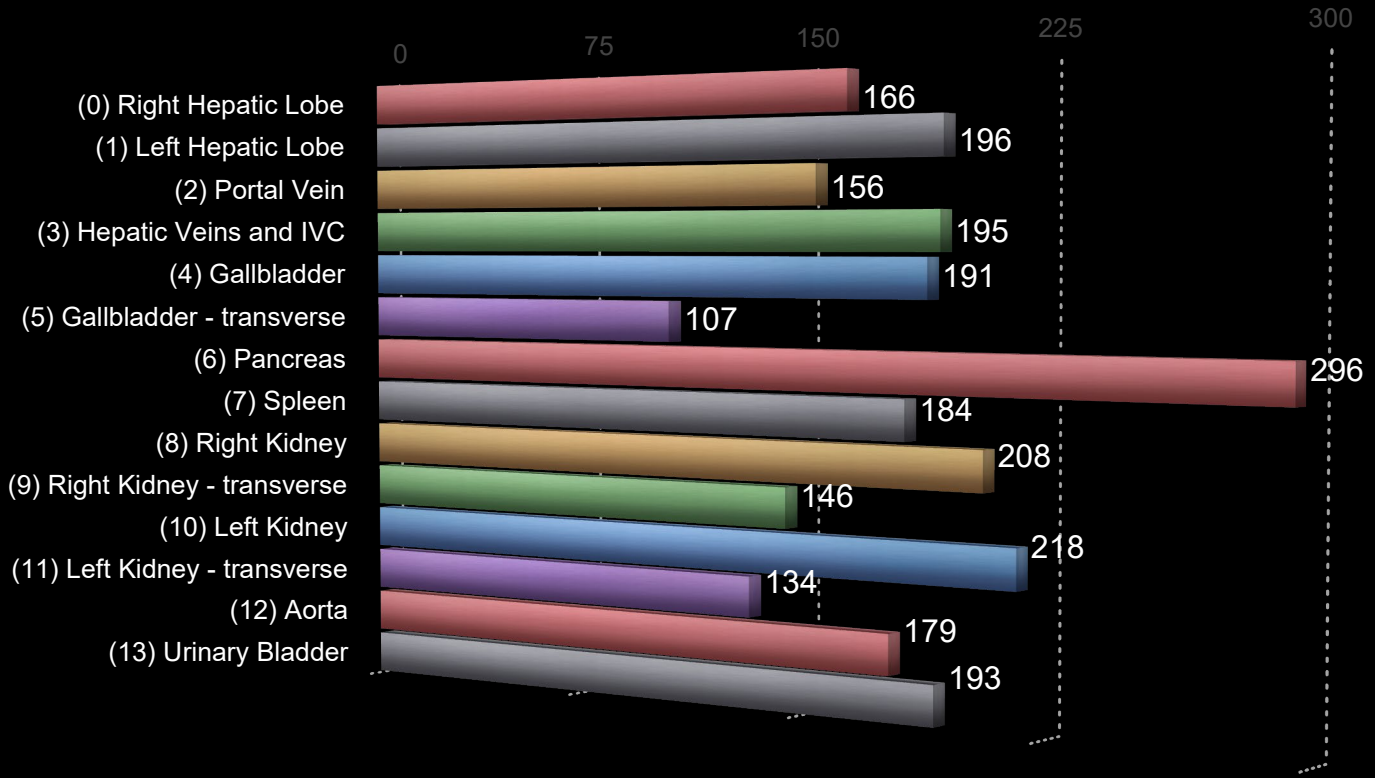
Dataset: Distribution of Imagens per Classes



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Model

The Algorithm consists on a NASNe-like model with an input of 96x96x3 and and output vector of 14 classes.

Loss function: categorical crossentropy

Output activation function: softmax

Optimizer: Adam

Data Augmentation: rotation, translation, gamma correction

Results

Accuracy:

Training set: 99.83%

Validation set: 99,83%

Test set: 97,43%

Results - Errors

Predicted: Right Liver Lobe

Ground Truth: Longitudinal Right Kidney

Predicted: Longitudinal Right Kidney

Ground Truth: Longitudinal Left Kidney

Future possibilities and next steps

Better results are aimed by the growing numbers of images on DATASET and Machine Learning in a convolutional network.
There is a high probability that it will be possible to ensure quality improvement in ultrasound department, with this low cost and wide range quality assessment tool. New possibilities might be achievable, for instance, by identifying not only the presence of key images, but also other quality criteria's such as focus, depth and gain adjust on each image. Protocol driven quality improvement aided by AI, will benefit patients, doctors and sonographers as well, once it will be ensured that the institution complies with cyber security recommendations and conventions, technology can perform as a tool for intelligence augmentation and business scale.

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