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The automatic and computer aided diagnosis of the abdominal tumors, through advanced machine learning techniques, based on medical images (ACADTUM)

FINAL SCIENTIFIC REPORT

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Summary:

In the context of the ACADTUM research project, the team developed and experimented advanced techniques for performing the automatic and computer aided diagnosis of the abdominal tumors based on various types of medical images: ultrasound (US) images, computed tomography (CT) images, respectively Magnetic Resonance Images (MRI). Both recognition and segmentation tasks were carried on, by employing deep learning, as well as conventional techniques, which were individually assessed, compared and also combined, at classifier, respectively at decision level, targeting, in this manner, the O_1 secondary objective of the project, referring to "the development of advanced image analysis and classification methods for attaining maximum performance regarding abdominal tumor automatic diagnosis", respectively the O_2 secondary objective of the project, referring to the "comparison among the performances of the conventional and deep learning techniques in multiple situations, within various types of medical images of abdominal tumors". Aiming for the achievement of the O_3 secondary objective of the project, referring to "diagnosing the incipient tumors and the preneoplastic stages through appropriate methods", the research team experimented, within CT images, deep-learning techniques, based on Convolutional Neural Networks (CNN) for the recognition of the dysplastic nodules, which can appear in the last stage of cirrhosis, and can transform into Hepatocellular Carcinoma (HCC). Also, important steps were performed towards the automatic discovery of the renal tumor evolution stages, by employing deep learning methods for segmentation, respectively conventional, texture-based methods for the automatic recognition of the malignant tumors. Both postdoctoral and young researchers were involved in these tasks, the O4 secondary objective, "Supporting research activities for young researchers" being achieved, as well. The best performing methods were integrated into the ACADTUM software system, achieving, in this manner, *the main objective of the project*, that of "developing a software system for computer aided and automatic diagnosis of the abdominal tumors based on multiple image modalities, involving both conventional and deep learning techniques". A brief comparison of the abdominal tumor recognition methods based on medical images of different types is illustrated in Figure 1. The obtained results indicate that the segmentation and recognition performances due to CT and MRI images were generally superior to those corresponding to ultrasonographic images, derived under equivalent conditions. However, it should not be ignored the fact that ultrasonography images lead to a non-invasive, non-dangerous, low-cost evaluation of the affections, repeatable for the purpose of disease evolution appropriate monitoring.

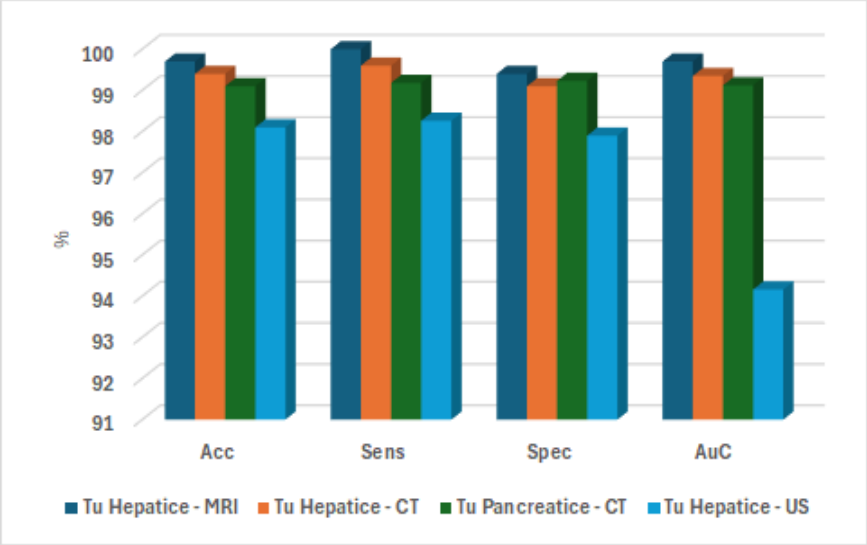

Figure 1. Comparison among the performance parameters in the case of abdominal tumor recognition within medical images of various types

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