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Short Communication

Assessment of Left Ventricular Contractile Function Using Convolutional Neural Networks

Baccouch Wafa[1]*, Oueslati Sameh[1], Solaiman Basel[2] and Labidi Salam[1]

[1]Higher Institute of Medical Technologies of Tunis Laboratory of Biophysics and Medical Technology, University of Tunis El Manar, Tunis, Tunisia

[2]Image and Information Processing, Department (iTi), IMT-Atlantique, Technopôle Brest Iroise CS, Brest Cedex, France

***Corresponding Author:** Baccouch Wafa, Higher Institute of Medical Technologies of Tunis Laboratory of Biophysics and Medical Technology, University of Tunis El Manar, Tunis, Tunisia.

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According to the World Health Organization (WHO), cardiovascular disease is the leading cause of death worldwide which explains the importance of this line of research which has attracted the attention of several researchers [1]. In order to diagnose and treat these diseases, clinicians most often rely on medical imaging. Medical images therefore play a crucial role in the assessment and treatment of cardiac pathologies. Although they represent a source of valuable data, how to interpret these images and extract the most useful and relevant information from them always remains a challenge. In this context, a good diagnosis is based on the choice of a high-performance imaging modality and an objective analysis of the medical images acquired. In our work, our interest will be focused specifically on cardiac MRI, which represents the reference technique for the global and regional assessment of cardiac function [2] and more particularly of left ventricular kinetics. Despite the progress made in the methods offered in MRI, there is still a need for the intervention of a healthcare professional to perform certain tasks.

This visual interpretation is mainly limited to global indices of left ventricular performance such as cardiac output, end- systolic volume (ESV), end-diastolic volume (ESV), myocardial mass etc. The major problem is that the overall parameters recorded only provide information on the overall functional state of the heart and do not allow precise localization of myocardial contraction anomalies as well as their extent and severity [3].

It therefore appears necessary to have precise digital tools available to help diagnose cardiovascular diseases. Thanks to a detailed state of the art of these methods, we have found that performing these tasks manually or semi-automatically is not easy due to a number of difficulties, posing the problem of our research work. In the literature, several approaches [4-6] to automate this manual process have been proposed.

A study of these approaches has shown that those based on deep learning give the results closest to those taken as a reference. In our research, we aim to develop a diagnostic support system and therapeutic decision making based on convolutional neural networks (CNNs). It automatically detects and quantifies cardiac contraction abnormalities such as hypokinesia, akinesia and dyskinesia. Then, he is responsible for automatically classifying the myocardial segments into normal and pathological to gain insight into myocardial viability from which to help the attending physician make the appropriate treatment decision.

The fact that deep learning helps discover complex structures in data makes it extremely versatile. In addition, based on modern hardware and software, the models developed are very fast even when applied to a large database. Our system will overcome the limitations of the human brain when it comes to data collection and management. It is characterized by multiplied, simultaneous and sometimes complex calculation capacities, thus ensuring permanent and more precise work than that of the brain.

The system that we propose to develop will also be able to identify cases of cardiac pathologies in a large general population. This would give us some idea of even the rarest and smallest indicators of abnormalities that a physician might never even encounter over several years of practice. Our system is all about mimicking how the human brain works, or at least its logic when it comes to making decisions. It is an autonomous system that adapts to situations and is able to learn on its own. Therefore, it speeds up the diagnosis and makes it more precise since self-learning systems take new situations into account better than static systems.

On a practical level, our system will solve the problem of the absence of doctors in certain parts of the territory (medical desert). It is a system that will be available and useful to compensate for deficits and handicaps.

Our diagnostic support system will serve as a reference for the attending physician and even the non-expert doctors to perform the appropriate diagnosis for a given image sequence. It will also allow specialists and healthcare professionals, who devote most of the time to reading and interpreting images, to free up more time for patients, which improves human relations between medical staff and the patient.

In the long term, if this system will be available in every hospital department through medical imaging, several lives could be saved since it facilitates and accelerates the diagnosis and even therapeutically, inappropriate treatments and unnecessary surgeries could be avoided.

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