SE4AI_Health

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1 CONTEXT OF THE PROJECT

Addressing health-related issues represents the next frontier of artificial intelligence. Several attempts have been indeed already conducted to develop or experiment with machine learning, genetic algorithms, and others, in health contexts. For instance, in the Aravind Eye Care System in India, ophthalmologists and computer scientists are working together to test and deploy an automated image classification system to screen millions of retinal photographs of diabetic patients. Since the mid-twentieth century, researchers have proposed and developed many clinical decision support systems for help the physicians. Rule-based approaches was proposed in 1970s that allow us to:

(1) diagnose diseases;
(2) choose appropriate treatments;
(3) provide interpretations of clinical reasoning;
(4) assist physicians in generating diagnostic hypotheses in complex patient cases.

It seem a good approach but it present several problems, namely:

(1) it is costly to build;
(2) it require explicit expressions of decision rules and require human-authored updates;
(3) it is difficult to encode higher-order interactions among different pieces of knowledge authored by different experts;
(4) the performance of the systems is comprehensible only by a medical knowledge;
(5) it was difficult to implement a system that integrates deterministic and probabilistic reasoning to narrow down relevant clinical context, prioritize diagnostic hypotheses, and recommend therapy.

Instead the first generation of AI systems, which relied on the curation of medical knowledge by experts and on the formulation of robust decision rules, recent AI research has leveraged machine-learning methods, which can account for complex interactions, to identify patterns from the data. Moreover, machine-learning methods enable the development of AI applications that facilitate the discovery of previously unrecognized patterns in the data without the need to specify decision rules for each specific task. Therefore, the main goal of AI system in Medicine is help the physicians in the clinical process, namely detect something, cluster the patient on some criteria, etc.

In this project we will focus on develop a cancer detection AI system, in particular colorectal cancer. We decided to study this type of cancer because it is estimated that, in EU-27 countries in 2020, Colorectal Cancer (CRC) accounted for 12.7% of all new cancer diagnoses and 12.4% of all deaths due to cancer. It is the second cause of cancer death in men (after lung cancer) and the third one in women (after breast and lung cancers). The methods that are recommended for CRC screening include stool-based and direct visualization tests but for achive benefits of screening, we need to re-evaluate abnormal results from stool-based and visualisation tests and the subjects should be followed up with colonoscopy. This approch has some side effects like a belly pain and discomfort, bleeding, bad reaction to anaesthesia, infection and the colonoscopy preparation risks. Additionally, the time for the delivery of CRC results is a very important factor. For reduce CRC mortality, it's fundamental prevent the CRC by screen-detected pre-cancerous lesions. It's demostrare that when diagnosed at stage I, the overall 5-year survival rate is around 90%, whereas it is only around 10% in the metastatic stage IV. It is estimated that, only around 13% of patients are diagnosed at stage IV. For this reasons, in this project we want to develop an AI system that detect a colorectal cancer in order to help physicians in the diagnosed process of cancer.

2 PROJECT GOALS

The project goals are:

(1) Conduct a detailed investigation of the baseline approach selected from the literature in order to understand the performance of the approch and its limitation;
(2) Understand the problems reletad to the datasets, namely lack of relevant features, few samples and so on;
(3) Definition of a AI pipeline that might be used for cancer detection and doesn't affect by the problems which the baseline approachs selected from the literature suffer.

3 METHODOLOGICAL STEPS TO CONDUCT TO ADDRESS THE GOALS

Based on the goals set, the methodological step that we conduct to address it are:

- Define a survey for physicians expert in the cancer domain in order to understand some data problems and which features of data are relevant;
- Study some image processing techniques in order to improve the quality of the data;
- (SMOTE,....)
- Develop a genetic algorithm (GA) that produce a population of artifical neural networks (ANNs) that are optimized in design and hyper-parameter point of views. After that we will select the best individual in the last population obtained based on the evaluation metrics.

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In the end we compare the results obtained by our model with the results of baseline approach selected.