General purpose medical digital library definition

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ABSTRACT

The need of an approach for the definition of a platform-independent medical digital library, using only open-source tools, will be described. To test the need and the success of such an approach, a library will be created, which can later be used in a larger scale as a general purpose digital medical tool, when comes the need to evaluate an image.

As a first test, the library will be used in the development of a tool aimed to aid doctors in otoplasty candidates' evaluation. This tool shall be developed and tested first on a mobile platform, so the potential of the developed library can be tested on the most adverse situation. Also, the resulting library will be license free, making easier the collaboration of others in development and integration with other software, translating in a better spread of the library in medical practice.

CCS Concepts

• **Medical imaging, mobile devices, digital medical tool.**

Keywords

Medical imaging, open-source, image analysis software library, digital medical tool.

1. INTRODUCTION

There is still great potential for investigation and development around image processing and open-source, especially when directed to the medical area. Scientific research and investigation can be easily found around these areas, but these are usually independent of one another (Fritzsche et al., 2012). The majority of tools on the market for medical imaging are commercial, meaning that these are expensive.

Presently mobile devices like smartphones and tablets are present in the hands of millions of people, and this includes health care professionals. These devices have increasingly more processing, sensor and connection capabilities, making them good candidates to become a portable medical auxiliary tool. Having in mind that the cameras can be considered sensors, creating a medical auxiliary tool based on modern mobile devices with these sensors can prove to be useful.

The need to create a medical auxiliary tool using medical imaging and open source has already been studied (Fritzsche et al., 2012), with the conclusion that there is still work to be done in order to make the tools really useful.

It is expected that the development of an open-source medical imaging library help the conversion of future academic research in real-life applications.

2. Medical diagnosis

Establishing a diagnosis is a very significant part in the medical profession

2.1 Medical Auxiliary Diagnostic Tools

To collect the information needed to analyze and infer about the patient's condition, the doctor uses various methods and tools. Usually the primary method is to make questions to the patient regarding his present status, his health history, family and analyzing his social groups. Besides this, the doctor also relies

on auxiliary tools, as stethoscope, otoscope, ophthalmoscope, thermometers, which are known as medical auxiliary diagnostic tools, to collect information about the patient's organs.(Jones, 2004)

2.2 Portable Diagnostic Tools

A disadvantage of typical big diagnostic devices is that these have to be operated inside the hospital. Having in mind underdeveloped countries with doctors working on remote villages or emergency scenarios where on-site treatment tents have to be installed, portable diagnostic devices are an increasingly studied field. Examples of this effort are ultrasound machines, which started by being a fixed machine, evolved to a transportable machine, and presently it is typically the size of a laptop, existing already a smartphone version of this tool.(Schleder et al., 2013) ("Smartphone Ultrasound, MobiUS SP1 | Mobisante") (Sriniva, 2008)

3. Medical Imaging

The use of computers as an auxiliary diagnostic tool presently a key device in the work of a doctor. Medical imaging investigation using computers is therefore presently one of the main investigation fields. (Doi, 2007)

Nevertheless, there is still a great deal of fragmentation and a low number of conversions of the studies into practical applications. Fritzsche et al. explain very well the reasons for this on a previous work(Fritzsche et al., 2012):

> "Two important reasons for this are a) a lack of open source tools and standardization among them that would allow the community to incrementally build upon existing solutions and better handle the increasing complexity in the current state of the art, and b) a lack of powerful visualization and interaction mechanisms in many of the current tools that would allow the physician to better understand and interpret the obtained results. Once a clinical application is ready for use, the resulting experience is a powerful driver for further refinement of the tools, algorithms, and state of the art."

This statement can be easily understood with the help of Figure 1, where the drivers and the refinement propellers are shown. Here it can be understood that medical needs drive novel algorithms, which in turn should drive the creation of new visualization & interaction methods that would then drive the clinical use of the application. And in the other direction, it is shown that clinical usage demands the refinement of visualization & interaction and novel algorithms. In case the drive between novel algorithms and visualization & interaction is ignored, as in the case of (b) in Figure 1, it is easily understood that novel algorithms shall never reach clinical use.

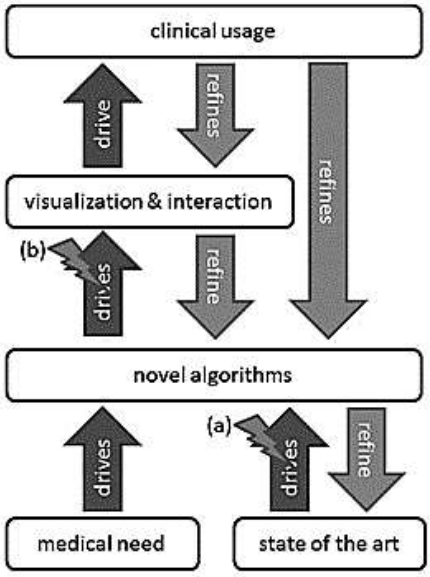

Figure 1 - Present state of medical imaging development (Fritzsche et al., 2012)

4. Proposed library

To fill the gap where there is a lack of open-source tools, standardization, and the visualization & interaction is rarely developed due to the extra effort required, a library using OpenCV® will be proposed.

OpenCV is open-source and has the confidence of having been created by Intel®, and runs on the major current operating systems, like Windows®, Linux®, OS X®, OpenBSD®, FreeBSD®, NetBSD®, Android™ e iOS®. In addition to this, it has bindings for most popular programing languages like Java, C#, Ruby or Python, when programming in its native language (C/C++) is not possible.

The project will rely on the collaboration of doctors from pediatric surgery of a Hospital, and investigators from GECAD (Grupo de Investigação em Engenharia e Computação Inteligente para a Inovação e o Desenvolvimento - Research Group on Intelligent Engineering and Computing for Advanced Innovation and Development) who have experience with computers in medical scenarios, ensuring that the interface between medical needs and the software development is correctly done.

Being that OpenCV has built-in interfaces and methods to access filesystems, cameras and other relevant hardware, this becomes beneficial, as researches do not need to waste time studying ways to do this. There is an abstraction that takes care of this, allowing the researches to focus on the most important task of their work: the investigation and algorithm development.

Also, the proposal is to try and create an easy and standard interface between what we can consider the core (the OpenCV block) and the algorithms the researches are developing. This way, there will be no need to adapt the methods for different platforms, the same code block can be used independently of the operating system or device. The basic structure can be seen on Figure 2.

All this will benefit cross-platform development, allowing the research projects that achieve success, to rapidly be adopted on a wide range of devices, and with this lower costs and reach a much broader range of people.

The success of the library will be evaluated by making a tool to be used on a Pediatric Surgery Department and using the Pearson Product-Moment Correlation Coefficient to compare the results of the tool with the manual calculations made by the doctors. Also the feedback given by the doctors will be taken into account, so the real-world usefulness of the tool can be asserted.

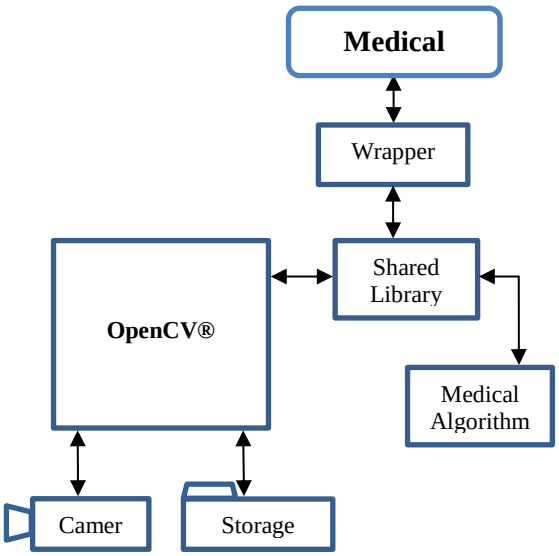

Figure 2 - Representation of the proposed library

5. Conclusions

The lack of open-source tools and easy methods to visualize and interact with the data, preventing the conversion of academic research into real-life applications, have been a big obstacle for the creation of digital medical diagnostic and/or auxiliary tools, limiting the access to the latest scientific developments in real life.

A library that helps the transposition of academic and scientific research to useful applications and that also facilitates researchers and scientist to develop and achieve results, will enhance and promote global access to digital medical tools. Such library would also lower costs and focus on a wider range of devices, being able to run even from smartphones or tablets, independently of the operating system and brand, providing better healthcare access to wider regions the world.

6. REFERENCES

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