

# Gastroenterology Made Interactive

The main goal of the GEMINI project was to create an interactive Computer Assisted Decision system that can be used during a gastroenterology examination. What if a physician could wave his hands and request for a second opinion regarding a section of the image he is suspicious about? Contributions for this were obtained by combining human-computer interaction with computer vision algorithms.



#### Main Project Team

Miguel Coimbra	IMM-Po
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#### Indicators

Funding	40k €
Journal papers	2
Conference papers	7
Concluded MSc	3

#### Two Main Publications

P. Pimentel-Nunes, D. Abrantes, M. Coimbra, M. Dinis-Ribeiro, et al. "A multicentre prospective study of the real time use of NBI in the diagnosis of premalignant gastric conditions and lesions", in "Endoscopy" (accepted for publication), 2016.

F. Riaz, A. Hassan, R. Nisar, M. Dinis-Ribeiro, M. Coimbra, "Content-Adaptive Region-Based Color Texture Descriptors for Medical Images", in "IEEE Journal of Biomedical and Health Informatics", Oct. 2015, (e-pub ahead of print) (DOI: 10.1109/JBHI.2015.2492464)

PROJECT WEBPAGE URL

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Fig. 1 Pfizer Award for Clinical Research, with important contributions from the GEMINI project



Fig. 2 Studying new interactive modalities for gastroenterology exam environments.

#### GENERAL MOTIVATION AND OBJECTIVES

The main goal of the GEMINI project was to create an interactive Computer Assisted Decision (CAD) system that can be used during a gastroenterology examination. What if a physician could wave his hands and request for a second opinion regarding a section of the image he is suspicious about? Or if he could vocally request for the retrieval of exams that have lesions that look like the one he is visualizing? This was achieved by combining human-computer interaction methodologies with computer vision algorithms in order to create a useful and usable interactive environment within a gastroenterology exam room.

We are motivated by the fact that cancer is a leading cause of death worldwide. According to the World Health Organization, from a total of 58 million deaths in 2005, cancer accounts for 7.6 million (or 13%) of all deaths, with gastric cancer being the second most lethal type. Gastroenterology imaging is an essential tool for this battle, since an early diagnosis typically leads to a good prognosis. However, this is a rapidly evolving technological area with novel imaging devices such as capsule, narrow-band imaging or high-definition endoscopy. Adapting to these technologies has a high time-price, even for experienced clinicians, motivating the appearance of interactive environments that can accelerate training processes and support technology adaptation periods with computer assisted decision functionalities.

The main objectives of the GEMINI project were:

- Identify interaction opportunities within a gastroenterology exam room environment, model relevant personas and define scenario characteristics.
- Design, develop and deploy an interactive prototype for enhanced information access within a gastroenterology exam room.
- Research novel computer vision algorithms that can be integrated into the final prototype.
- Publish results in high-impact scientific journals and conferences.

#### CHALLENGE

Challenge – Human Computer Interaction

One of the key ideas of the GEMINI project is the intensive exploration of HCI methodologies for understanding the best interaction mechanisms for information access inside Gastroenterology exam rooms. Why don't we try gesture recognition using a video-camera or Kinect-type of device? Why can't the clinician verbally ask the computer to show him lesions like the one currently in the TV screen? The possibilities are vast, making it easy not only to come up with more interesting interaction mechanisms, but also to produce disastrous solutions. As such, we used tried and tested HCI support methodologies with the objective of obtaining accurate descriptions of the user and available technology for creating a useful and usable interactive prototype for a gastroenterology examination.

Challenge – Computer Vision for Classification

Research in gastroenterology imaging has been focused either on segmentation or on the proposal of novel visual color and texture descriptors that can be fitted into a typical statistical pattern recognition framework. This research contributes directly to one of the proposed functionalities of the prototype, which is the ability to produce a second opinion based on an image or a region of it.

#### WORK DESCRIPTION AND ACHIEVEMENTS

As key results of the GEMINI project we highlight:

- The identification of interaction opportunities with technology during a gastroenterology exam, by modelling the participants, their actions and the environment they work in
- The testing of various interaction modalities, namely touch, voice and devices, namely their user acceptance and ability to perform complex tasks
- The creation of an enlarged image database of real exams, that was the cornerstone of an international computer vision challenge, launched for the international research community.
- The research and development of new computer vision algorithms for the assisted diagnostic of gastroenterology exams.