Automatic event detection for endoscopic capsule exams

PhD Thesis Proposal

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Host Institution: IT – Instituto de Telecomunicações
Location: DCC, FCUP
Main Research Area: Computer Vision

Introduction: The endoscopic capsule is the first autonomous micro-device to explore the human inner body with wide clinical acceptance [1,2]. Clearance for marketing by the U.S. Food and Drug Administration (FDA) was obtained on August 2001. It is ingested by the patient and films the whole gastrointestinal tract during 6-8 hours, reaching places where conventional endoscopy is not capable of. Each exam begins with the capsule ingestion, which transmits images for about 7 hours, to eight antennas taped to the patient's body. One of the reasons for capsule popularity is the simplicity of its procedure. After the exam, data is downloaded from the belt pack recorder to a customized PC workstation, where a doctor needs to perform its analysis. Currently, one of the main setbacks of this new technology is the long duration of the exam analysis task. A specialized doctor needs to review around 60,000 images, looking for both abnormal situations (events), such as blood or ulcers, and defined topographic marks of the gastrointestinal tract (e.g. pylorus, ileo-cecal valve). This process, when performed by a trained specialist, can take about 2 hours [3].

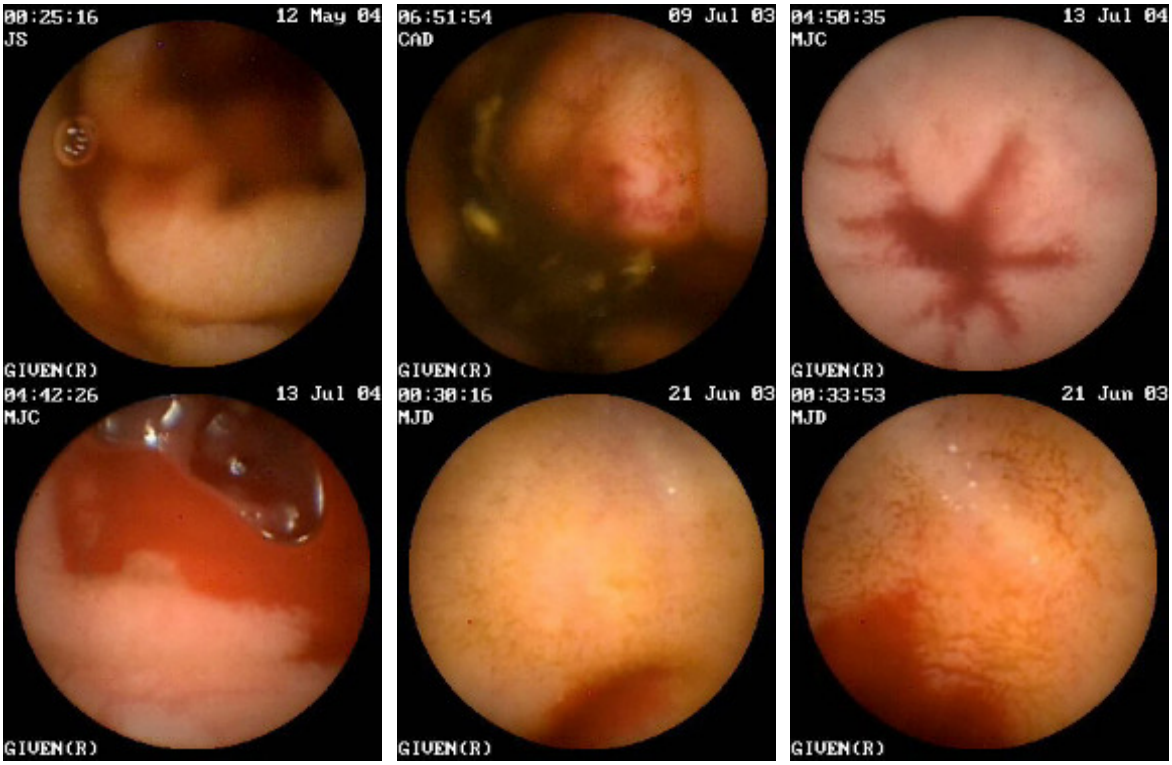

Figure 1 – Examples of visible blood in endoscopic capsule video exams.

Our research team has produced the first international results on the topic of topographic segmentation [4-6], resulting in publications in high-impact journals and conferences, a software prototype and an extensive database of annotated data. We are now attacking the very challenging event detection problem, aiming to develop robust classifiers for blood, ulcer and polyp events, all vital for a correct clinical diagnosis. The supervising team is currently responsible for two FCT funded projects, one PhD student, three MSc students, and one Research Assistant on this topic.

Objectives and Proposed Methodology:

- Select adequate test sequences from the CapView endoscopic capsule video database.
- Measure the variability of a set of low-level visual descriptors such as color, texture and shape.
- Test a set of popular classification methods such as distance classifiers, nearest neighbors, Bayesian, support vectors machines, etc.
- Publish regularly in high-impact journals and conferences.
- Support the integration of the developed algorithms in the CapView software prototype.

References:

[1] G. Iddan, G. Meron, A. Glukhovsky, and P. Swain, "Wireless Capsule Endoscopy", in Nature, 2000, 405, pp. 417.
[2] W.A. Qureshi, "Current and future applications of the capsule camera", in Nature, vol.3, 2004, pp. 447-450.
[3] A.F. Ravens, C.P. Swain, "The wireless capsule: new light in the darkness", in Digestive Diseases, vol. 20, 2002, pp. 127-133.
[4] M. Coimbra, P. Campos, and J.P. Silva Cunha, "Topographic Segmentation and Transit Time Estimation for Endoscopic Capsule Exams", in Proc. of IEEE ICASSP 2006, Toulouse, France, 2006.
[5] M. Coimbra, P. Campos, and J.P. Silva Cunha, "Extracting clinical information from endoscopic capsule exams using MPEG-7 visual descriptors", in Proc. of IEE EWIMT 2005, London, UK, 2005.
[6] M. Coimbra, and J.P. Silva Cunha, "MPEG-7 visual descriptors – Contributions for automated feature extraction in capsule endoscopy", in IEEE Trans. Circuits and Systems for Video Technology, vol. 16/5, 2006, pp. 628-637.

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