# Automated digital pathology solution for rapid and reliable cervical cancer screening
# PLANUCA PROJECT

## Digital pathology platform for the management of cancer

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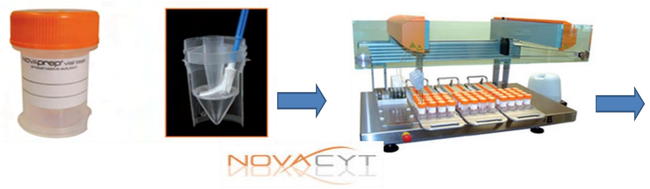
**Summary**

**PLANUCA is a collaboration between the DATEXIM company, the Cherbourg Public Hospital Center (CHPC), and the GREYC (University of Caen), funded by the EEC and Lower Normandy. We aim to develop a telepathology web application incorporating computer-aided diagnosis tools for health professionals in the field of cervical cancer screening. Our application, CytoProcessor™, is designed for use by cytotechnologists, who furnish the sorted slides to the pathologists for diagnosis. Our results demonstrate a significant time advantage using CytoProcessor™, and an increased sensitivity (99%) compared to conventional methods. This tool will empower resource-poor countries to conduct large scale screening programs, as well as improving the diagnostic accuracy of cervical cancer screening worldwide.**

## Cytologic and scanning methods :

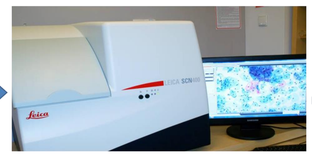
**For this study we examined 1882 women using slides prepared with NovaCyt liquid-based technology, stained using the standard Papanicolaou protocol, and digitized using a Leica SCN400 scanner at 40x. The images obtained were tested using a blur detection analysis software. Fewer than 5% of slides needed to be re-scanned due to focus problems.**



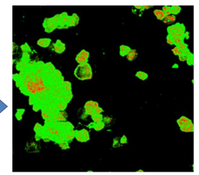

Leica MICROSYSTEMS

ST5020 – CV5030
continuous stainning

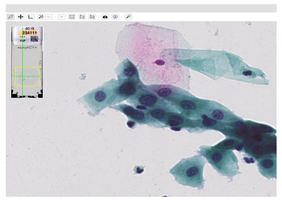
Bar code Brady Printer **part of DATEXIM solution**



SCN400 - 384 slides per 24h
X40 .scn .dicom
Compatible with most image formats



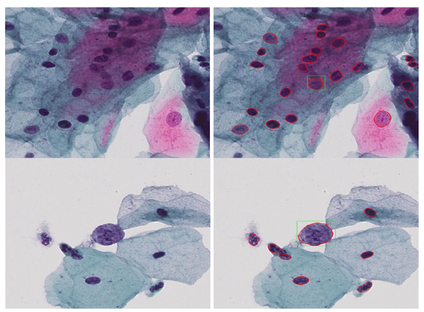
BlurDetec CHPC software
Flags images that are blurry
on > 20% of area



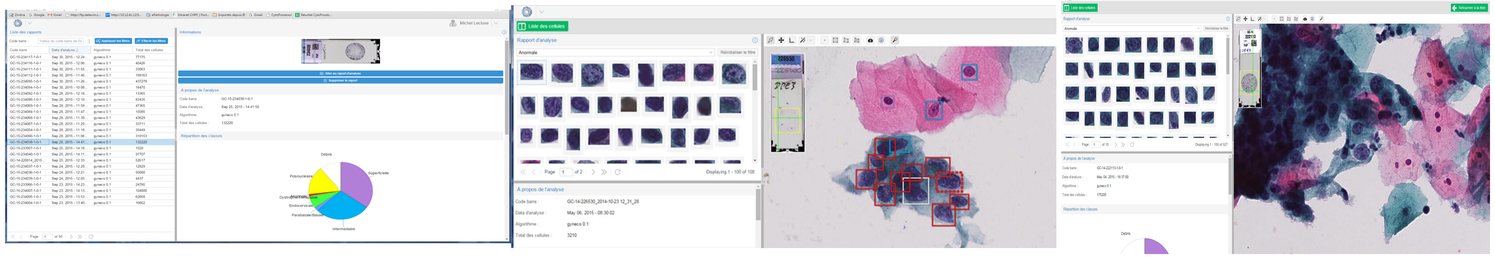
DATEXIM Digital Pathology Future CytoProcessor™

## Image Analysis Methods

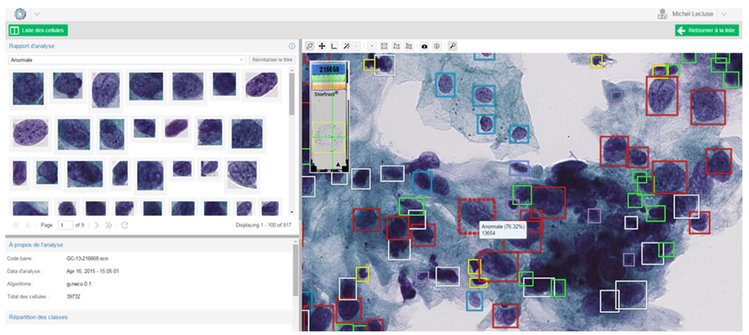
**Each virtual slide was processed in three steps: image segmentation for nuclei extraction, feature computation on each nuclei and its periphery, and cell classification. First, the segmentation was validated using different types of cells manually delineated by pathologists. Then, pathologists labeled cell examples to train a classifier. Finally, a web application was developed to visualize the results of the classification. An intuitive interface was designed to enable rapid review of the most abnormal cells.**



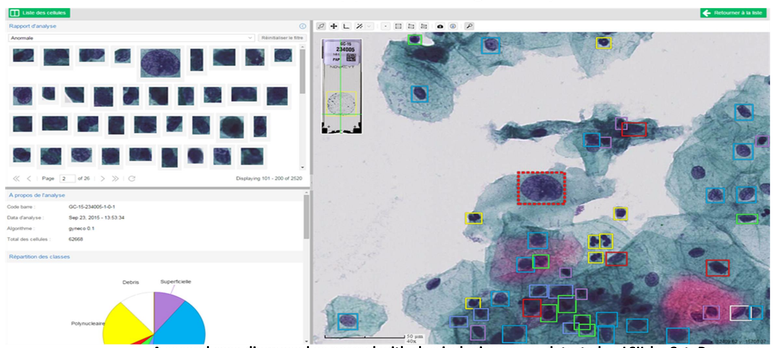
**The algorithm detects and classifies almost all cell nuclei present in the Whole Slide Image. Three main steps compose the algorithm:**
**- nuclei detection using image segmentation.**
**- nuclei characterization into a vector of numerical features.**
**- nuclei classification from the feature vectors.**
**- result aggregation to yield a decision for the slide as a whole.**



**CytoProcessor software displays thumbnails of each cell type. The cells are sorted starting with the most potentially abnormal first. The most pertinent cells are within the first 50 thumbnails. Presently, we read 35 cases per hour = easily 180 per day with the current application ergonomy.**



One case diagnosed as normal with classical microscopy, detected as HSIL by CytoProcessor.



A second case diagnosed as normal with classical microscopy, detected as LSIL by CytoProcessor.

**CONCLUSION : The application proposes a simple and ergonomic design, permitting rapid decision-making as to whether the slide needs a pathologist's review (suspicion of abnormality). Cytotechnologists need only view the gallery of abnormal cells, thus each slide can be evaluated in approximately one minute. In this use context, 100% of HSIL cases were detected, and 98% of LSIL cases were detected.**

**Our next objective is to fully automate slide sorting. Our preliminary results indicate a global sensitivity of 90% and specificity of 60%. A broader validation study involving multiple pathology centers (PLANUCA) is planned to fully optimize the classification algorithms.**