3DPathology

Developing 3D Digital Pathology with Spectroscopy

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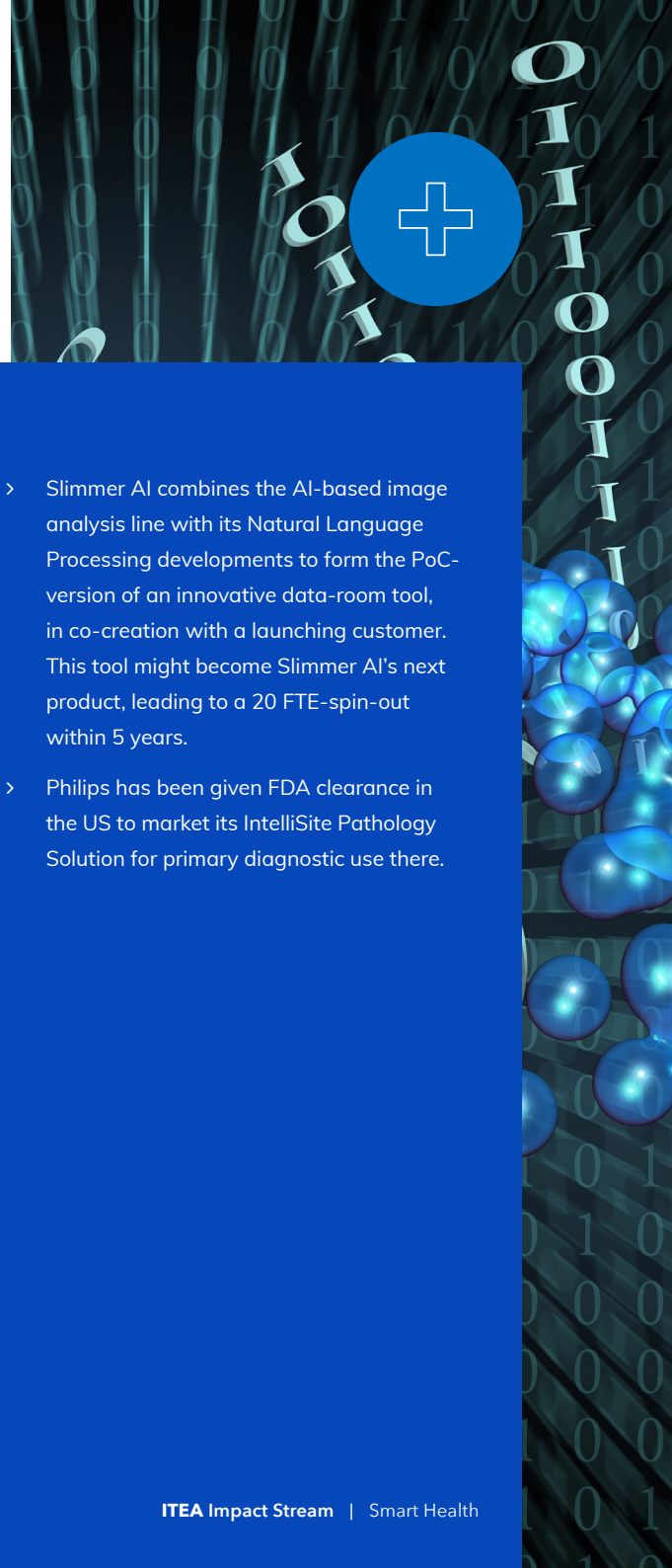
We all know pathology, thinking of the healthcare professional examining a tissue section under a microscope, looking for evidence of cancerous cells. Many years ago, the pathology process was digitalised by capturing the glass slides with a scanning device to provide a high-resolution digital image that can be viewed on a computer screen or mobile device, facilitating the acquisition, management, sharing and interpretation of pathology information. More recently, these digital images were becoming increasingly more accurate to render 3D shapes of objects. Organs structures and contents were already revealed in 3D distribution, but this was not yet the case for tissues, which require microscopic spatial resolution to develop 3D analysis. The main bottleneck to achieving efficient 3D imaging of tissues was to provide a quantitative and global analysis at microscopic resolution. The project 3DPathology, headed by Barco and Philips along with knowledge partners and university hospitals from six countries, was set out to create a 3D digital pathology solution, based on a combination of multiple existing pathology modalities, for same-day diagnosis and much more personalised treatment of cancer.



Impact highlights

- A 3D multi-modal pathology demonstrator, the first of its kind in the world, enables unique features such as access to the microscopic organisation of tissue sub-structures in 3D, providing complete chemical information and access to unexplored dimensions of histology.
- Academic Medical Center of the University of Amsterdam reported a 10% reduction of re-occurrences/readmissions, considering the cost for a typical re-occurrence/readmission for bladder cancer diagnostics is 2 to 3k euros for every 6 months.
- Barco has already sold several hundred optimised display systems that address a variety of pathology lab needs, worldwide, and in the next few years Barco is expecting a large increase in sales of display systems for Digital Pathology.
- Slimmer AI combines the AI-based image analysis line with its Natural Language Processing developments to form the PoC-version of an innovative data-room tool, in co-creation with a launching customer. This tool might become Slimmer AI's next product, leading to a 20 FTE-spin-out within 5 years.
- Philips has been given FDA clearance in the US to market its IntelliSite Pathology Solution for primary diagnostic use there.

Project results

To achieve this, 5 major technical challenges had to be tackled:

- The 3D acquisition of data using multiple imaging modalities
- The acquired data of some modalities had to be reconstructed and aligned from actual 2D images of pathologic slices into 3D images
- The aligned 3D data from different modalities had to be analysed to improve the quality of diagnosis
- The project developed new 3D visualisation and interaction technologies (equipment and algorithms) optimised for multi-modal 3D pathology
- An IT backbone was created to deal with data of tremendous size

The resulting 3D multi-modal pathology demonstrator provides complete chemical information and access to unexplored dimensions of histology. The 3D visualisation of, and interaction with, the relevant data from multiple imaging modalities optimises the presentationof the relevant views and parameters and allows the huge amounts of data to be handled.

Exploitation

First of all, the 3DPathology project has had a significant impact on JPEG XS standardisation, which focuses on near loss-free, low-latency coding of high-resolution data. Intensive collaboration between imec, ETRO and VUB resulted in the launch of a new extension of JPEG 2000.
Furthermore, **Philips** expects the results to help bring new pathology scanners to market and an innovative multi-layer bright field imaging solution to increase its market share of the bright field pathology. Increased usability range and robustness will address the needs for both small labs and large medical centres.
As a result of the project, **Prodrive Technologies** finalised the scan engine design and the production tools, which are now available. This emerging technology project will result in better patient care and significantly higher revenue.
Slimmer AI, formerly Target Holding, applied the experience in image handling and analysis from 3D molecular image alignment in different customer cases and proofs of concept (PoC). Currently, the AI-based image analysis line is combined with Slimmer AI's Natural Language Processing developments to form the PoC-version of an innovative data-room tool, in co-creation with a launching customer.

Barco has developed optimised display systems that address a variety of pathology lab needs for review, positioning of samples but also for diagnostic purposes. In addition, Barco prepared a White Paper for the Medical Imaging Working Group of ICC which is a first step towards the standardisation of medical colour imaging.
In addition, **PS-Tech** has developed masking technology for extractions within volumetric datasets. This technology, which has now been commercialised in Vesalius3D, is used for preoperative planning in various cardiovascular procedures.
For the Korean partner **Xavis**, the project will result in bringing to market new 3D X-ray Microscopy Instrumentation capable of high-resolution, non-destructive imaging and analysis for the quantification of internal structural parameters at submicron to nanometre scale.
And last but not least, increasing the accuracy in pathological examination practice and interpretation has a significant impact on improving quality of life due to personalised treatment, limiting re-occurrence as a result of better treatment outcomes and a reduction in the cost of healthcare from fewer readmissions.

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PROJECT LEADER

Dominique Segers, Barco

PROJECT START

July 2015

PROJECT END

July 2018

PROJECT WEBSITE

https://itea4.org/project/3dpathology.html

PARTNERS

Belgium
- Barco ◉
- imec ○

Finland
- Sec-control Innovation ⊙

Republic of Korea
- POSTECH ◉
- Xavis ⊙

The Netherlands
- Academic Medical Center of the University of Amsterdam (AMC) ◉
- Eindhoven University of Technology ◉
- Maastrict University ◉
- Philips ◉
- Prodrive Technologies ⊙
- PS-Tech ⊙
- Slimmer.AI ⊙

Romania
- VAltfactor ⊙
- Siveco Roman ◉

Taiwan
- Academia Sinica ◉
- Bio Material Analysis Technology ⊙

◉ (Large) Industry ○ Research institute ⊙ SME ◉ University ● Government