

Virtum

Treating cancer with AI-powered
imaging healthcare

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AI is a powerful force in the act of disrupting the medical industry and its many workflows. So powerful in fact, that it brings us a step closer to beating one of the world's ultimate challenges - Cancer. To aid in this race, Tooploox brings Virtum, the AI-ready digital pathology workflow platform.

Virtum is a comprehensive platform for automated image analysis and an enabler for clinical AI solutions. It emerged from the need to support, enhance and automate the histopathology and medical imaging workflows.



Medical imaging and histopathology today

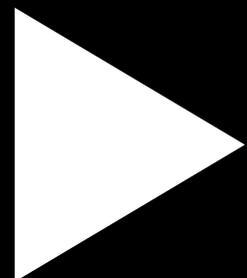
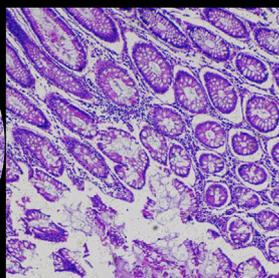
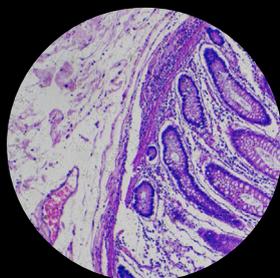
[WHO data](#) shows that the leading causes of global deaths are noncommunicable diseases, with cancer being one of the most common. Also, [up to 50% of cancer cases](#) could be avoided with relative ease, simply by avoiding the risk factors. The next most effective way to reduce the number of cancer-related deaths is early detection.

Early diagnosis can be provided by regular check-ups and access to modern healthcare advanced imaging devices, like CT scanners or MRI, as well as by skilled teams of medical imaging specialists and histopathologists alike.

What is medical imaging

Medical Imaging is an umbrella term describing the process of taking images of the internal human body as well as analyzing the functions and flow of particular organs and tissues. It is done using devices like ultrasound scanners, Magnetic Resonance Imaging (MRI), computer tomography (CT), and X-ray scanners, among others, producing various types of medical scans.

Medical imaging is a way to spot suspicious changes in the body. If an organ or tissue is removed, it is further analyzed within the pathology workflows, usually through histopathology.

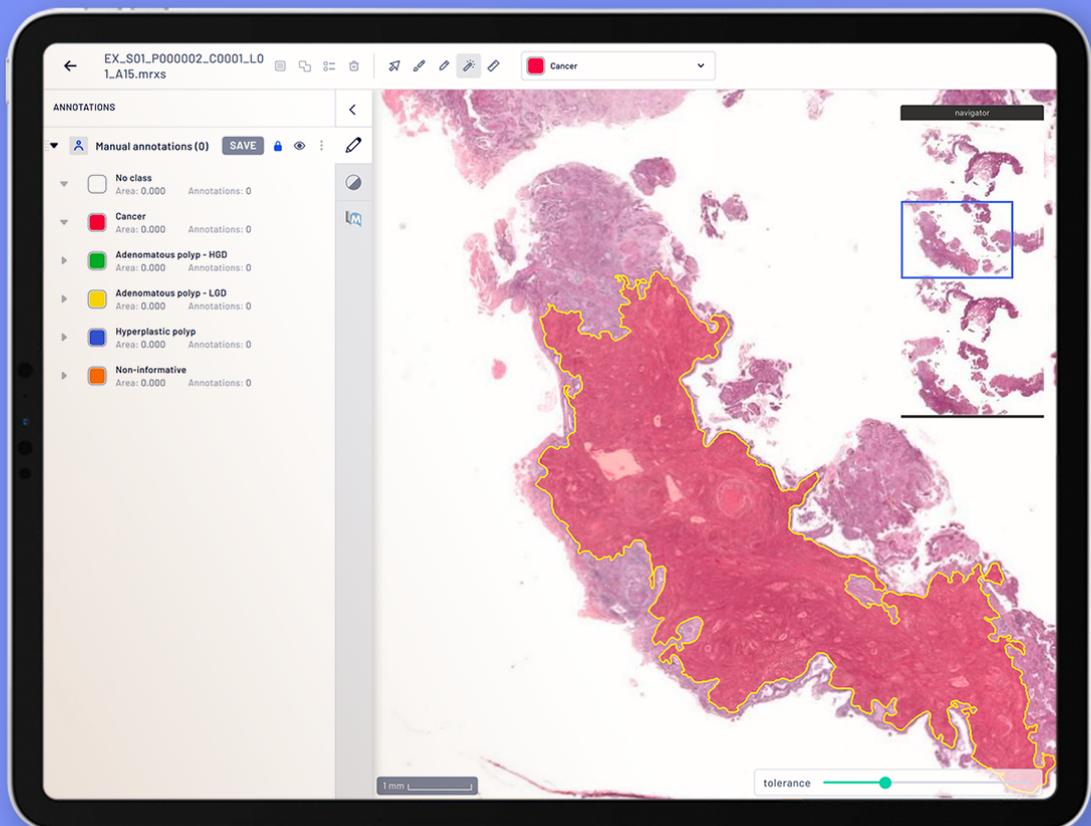




What is histopathology?

Histopathology focuses on the examination of tissue on a microscopic level. While medical imaging can determine if there is some suspicious change in the body, histopathologists deliver a detailed diagnosis on the type of the detected change.

IBM researchers estimate that [up to 90%](#) of modern healthcare data consist of images with medical imaging and histopathology heavily contributing to the upbuild. While specialists from both areas save lives on a daily basis using their sophisticated equipment, there are several challenges still to overcome.



Challenges in medical imaging and histopathology

While the new diagnostic tools bring new possibilities to modern healthcare, there are also multiple challenges to overcome to get the full potential out of them.

An increasing number of samples to analyze - Aging society

According to World Bank data, life expectancy is rising globally, from [58.58 years in 1970 to 72.74 in 2020](#). Advancing age is one of the leading risk factors for cancer with the risks rising exponentially for the 50+yo cohorts. Hence, rising life expectancy is increasing the demand for healthcare for elderly people, with medical imaging and healthcare histopathology services being one of the easiest ways to prevent or control many illnesses, including cancer.

Developing countries demanding access to high-quality diagnostic imaging

The problem lies in access to trained staff and costly equipment that is required to deliver reliable diagnostic outcomes. An additional challenge comes from the shrinking number of pathology specialists worldwide. According to the [US National Library of Medicine](#), the percentage of total US physicians and pathologists has decreased from 2.03% in 2007 to 1.43% in 2017.

Antiquated and hard to automate the approach

It is the role of the specialist to deliver the medical image analysis. This can be done in hard-to-automate, traditional ways, with the imaging specialist looking at the screen of a computer and the pathologist using a microscope. In fact, it is a lot of manual and complicated work to do, without an easy way to shift from a qualitative to quantitative approach in tissue assessment.



Troublesome access to knowledge due to manual workflows

Pathological diagnosis has relied on conventional light microscopy (CLM) as the very tool for tissue morphology evaluation for decades. Without taking away anything from the scientific reliability of CLM, one of its significant limitations was the complexity required for histopathology professionals to share images.

Knowledge-sharing and reaching out for second opinions is a common practice in the field. In the analog days, sending a query for diagnostic views required packing up glass slides or even paraffin blocks for examination by other labs. The process has proved error-prone and time-consuming.

With information technology advancements, it has become possible to create digital reproductions from full glass slides. With further technology improvements, histopathology was equipped with a new toolbox called virtual microscopy (Whole-Slide Imaging; WSI).

This allowed for navigation across virtual slides, different layer visualizations, magnifications, and area selections, among others. On the other hand though, the machines are using exotic data formats and images are heavy and hard to collaborate in using the telepathological approach.

This combined challenge is a great pain for modern healthcare systems. And that was precisely the challenge that Virtum technology tackles.



Our work

Virtum is the outcome of a collaboration between histopathologists, scientists and software engineers. With histopathology as the first-in-mind use case, Virtum is a universal work-flow collaboration and storage system aimed at helping healthcare professionals with the goal to build an environment for machine learning in medical imaging.

To make the solution as flexible and reliable as possible, the team decided to deliver a solution accelerator rather than a solution itself. Virtum comes with multiple features that together enable the technology to tackle these challenges:

- ➔ **CLOUD-BASED** - with heavy images and computational-heavy workflows, Virtum arrives as a cloud-based technology, with access to power scalable to infinity when needed and downscaled easily when not required.
- ➔ **POLISHED DATA VIEWING** - the pyramidal data viewer enables the user to smoothly display and process even huge or heavy images, like histopathological scans or MRI images.
- ➔ **DATA MANAGEMENT AND SHARING** - the cloud-based tool can be accessed with any given computer, from any location one considers appropriate.
- ➔ **ANNOTATION TOOLS** - the suite is delivered with a rich selection of image editing tools that make image annotation easier, including the magic wand tool to encircle those pixels that share a color and brushes of multiple sizes.
- ➔ **API FOR AI ALGORITHM INTEGRATION** - Virtum can be easily used as a component of AI-powered tools, tackling the harshest challenges of Artificial Intelligence in healthcare, data storage and data annotation.
- ➔ **MODULARITY** - Virtum can be applied as a whole suite, delivered as an end-to-end platform to support medical imaging workflows or have its components used separately as a part of another solution.

As an effect, a full artificial intelligence pathology diagnosis system was delivered with multiple ways to merge medical image processing with AI diagnostics.



Tech we used

The Virtum prototype was initially delivered by MicroscopeIT, which was later acquired by Tooploox to enhance their portfolio of medtech solutions as well as support their development of the technology.

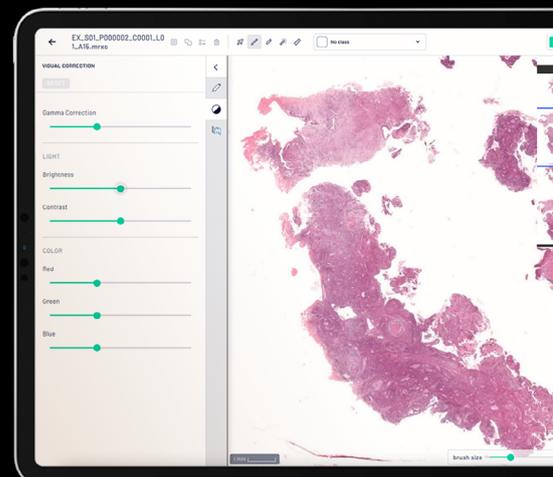
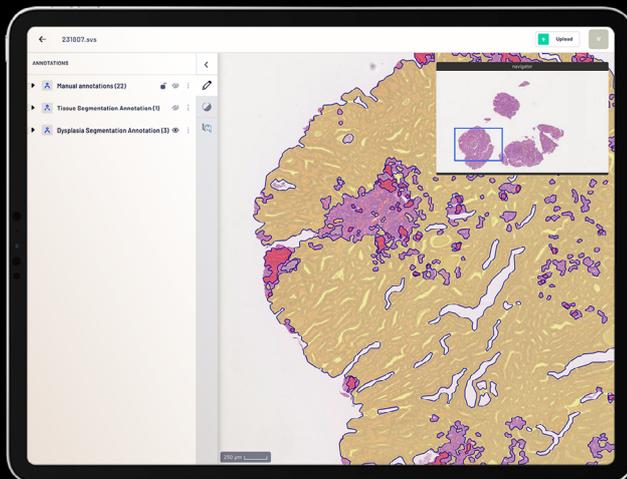
Our goal was to deliver the solution using the most flexible and popular technologies to ensure easy modification and development.

The Backend (TBD)

The backend of the solution was prepared entirely in Python and Python's library, Flask. Flask is used by Pinterest and LinkedIn, among others, to handle web processes. The backend is also powered by MongoDB, providing the required performance and flexibility.

The Frontend (TBD)

The frontend has been delivered using the QT platform, the software designed to deliver sleek and multi-platform user interfaces. The platform has been successfully applied by various companies including Activision Blizzard, the European Space Agency, Tesla and Microsoft, among others.



The effect



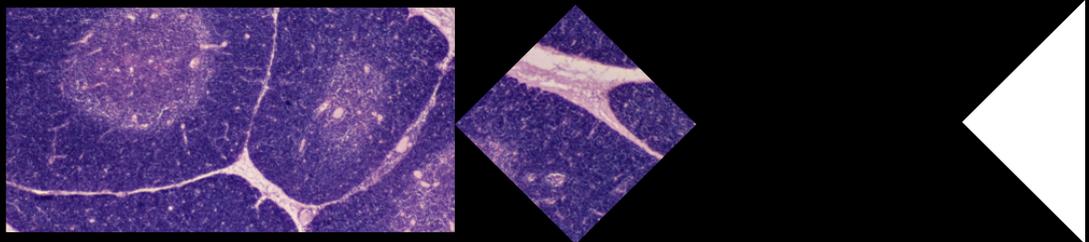
Virtum has been developed as a histopathology and imaging healthcare centered tool. Yet the effect reaches far beyond the toolbox of healthcare, bringing the power of AI medical diagnosis and deep learning in medical imaging analysis to the healthcare industry as well as supporting all microscopic workflows.

What is Virtum

Virtum is a cloud-based platform for the acquisition, annotation, management, processing and analysis of large volumes of multi-dimensional and multi-modal images.

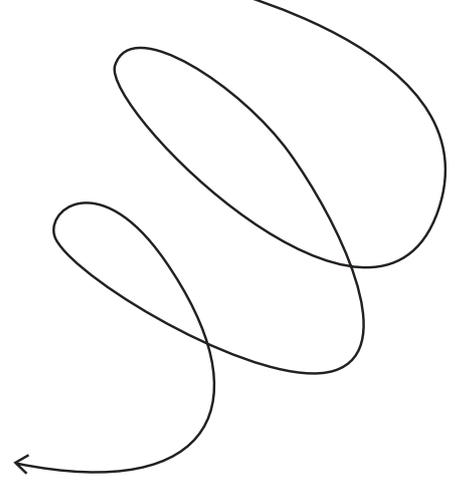
Originally, the tool was developed to support histopathologists. The adaptation of Virtum contributed to more efficient data modeling and helped enhance medical processes. It uses image classification AI algorithms to link textual and visual content. The goal is to prototype novel methods, engineering schema for the analytics & data management of medical data.

Virtum has also found applications in non-medical industries, including manufacturing, renewable energy, life science, biotech, space, mining and chemical. The experiments involved microscope equipment manufacturers and medical R&D units to analyze images from remotely controlled microscopes, process super-resolution images, and take full advantage of the virtual microscopy toolbox.



Challenges tackled

A deep understanding of the context as well as technical proficiency resulted in the delivery of a tool that has tackled the main challenges in the medical imaging and histopathology fields.



Searchable and legible sample archive - quick access to any image

Virtum is a cloud-based suite that can be used to store and catalog samples with easy access to each. Also, contrary to more traditional ways of storing samples, these are fully searchable and can be tagged or marked in other ways to be easy to find in the future. Over the course of many projects, Virtum has been adopted for work on High Performance Computing (HPC) clusters, for instance, in Fortissimo.

All-in-one workflow platform - tool-juggling no more

Virtum provides the tools to store, manage, analyze and work on microscopic images. There is no need for the image to leave the secure environment of Virtum for any reason, bringing to hospitals and healthcare institutions the level of security they require.

Easy collaboration on any given image - consult with peers from all around the world

Virtum has learned from the experience of Google Workspace and similar collaboration tools, bringing the ease of sharing, commenting and editing to the digital oncology and digital pathology systems. Users can check the version history, reply to comments in threads, share their images and withdraw access at will.

This comes as a great opportunity for healthcare professionals willing to consult their cases with peers from all over the world. The user with whom the image was shared needs only a browser to access the full benefits of using Virtum and can support his or her colleagues in providing better care for their patients.



Cloud or on-prem infrastructure to better address compliance

Following GDPR regulations, sometimes it is more desirable for an institution to keep all data in-house. The technologies used to build Virtum support an on-prem infrastructure, leaving no uncertainty regarding compliance.

AI-ready for both labeling and operations - boost your microscopic workflows with AI

Virtum is accessible with API, making the tool perfect for Artificial Intelligence application. Virtum itself can be used for data labeling in order to build an AI-ready dataset that can be used to train an algorithm to support the workflow.

The algorithm can be further implemented within the Virtum workflow by letting it work as a separate component that connects with the rest of the suite via API. There is also no obstacle to using Virtum as a platform to run the AI algorithm and send the effects to other tools or workflows.

Virtum is also powerful enough to combine artificial intelligence and radiology. Being a format-agnostic tool, it can deliver AI image diagnostics for radiology and serve as a platform for AI in pathology solutions.



AI tackling cancer

In the traditional workflow, the user had to manually check the research papers on histopathology to compare the encountered anomaly with the base knowledge of existing ones. Virtum, powered by AI algorithms, enables the user to run an auto-search through a database of research papers. It looks for comparable cases, significantly enhancing the accuracy of diagnosis, even if the case is rare in the extreme.

While not being an AI diagnosis per se, it is a clear example of how machine learning and medical diagnosis can go hand-in-hand. It provides huge support in saving and improving human lives and, as such, has delivered on Tooploox's mission.

High UX standards

Last but not least, Virtum was designed by the Tooploox design team, skilled and experienced with working for world-class companies and startups. As such, we provide healthcare and microscopic specialists working with Virtum with world-class UX levels unseen in other tools.

Use cases and other features

The AI-readiness of the software comes with interesting paths of development. One of the recent features enables the user to automatically scan through digital histopathology literature in search of similar cases.



Whether you need a full product, consultation, product discovery or a tech partner, our experts will help you find the best solutions.



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