Newsletter #1

iToBOS

Intelligent Total Body Scanner for Early Detection of Melanoma

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement number 965221.

2021

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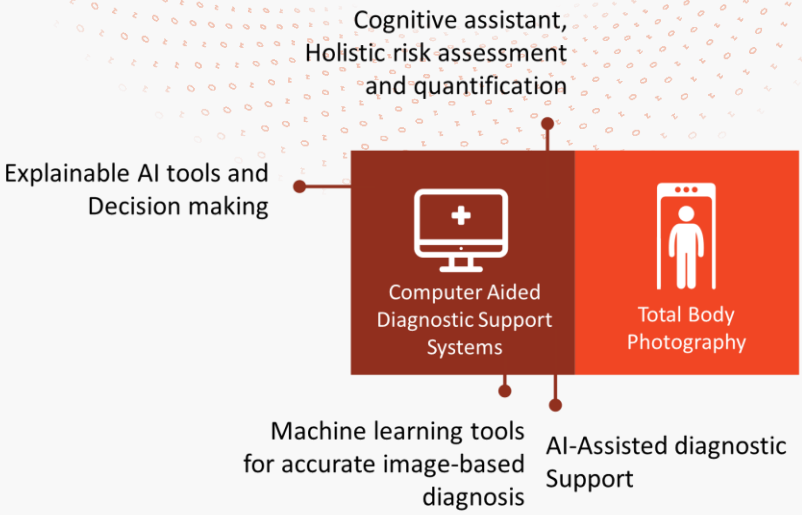
iToBoS project has started

iToBoS is a research project funded by European Union's Horizon 2020 research and innovation programme; with an aim to **build a new diagnostic tool for the early detection of melanoma, exploiting all the available information of the patient**. This holistic assessment tool should understand the specific characteristics of every patient to enable a personalized, early detection of melanoma. The project has a duration of 48 months (1 April 2021-31 March 2025) and a total budget of 12 million Euro.

The scope of the iToBoS project is to train an Artificial Intelligence (AI) system able to integrate information from different sources, ranging from dermoscopic images and complete medical records to genomics. **iToBoS will develop and validate a new diagnostic device together with an AI cognitive assistant (tool) to empower healthcare practitioners to make comprehensive patient-tailored diagnosis of skin cancer, leading to improved detection rates and highly personalised diagnosis**.

This new diagnostic tool will utilize the most recent advances in AI to facilitate the usage of any data already obtained with presently available technologies (dermoscopic images) together with the data acquired using the novel hardware proposed in iToBoS. Furthermore, the underlying algorithms will integrate any additional patient information from various sources (e.g. patient medical history, genomics, location of every naevus, age, sex, etc.) with the goal of providing a holistic assessment of individual moles while considering the specific characteristics of each patient. With systematic successive explorations of a patient, the system will be able to also robustly determine the changes occurring in the individual moles, a key feature held as one of the most informative in the detection of skin cancer. The proposed holistic approach will enable physicians to diagnose skin diseases earlier and with higher accuracy, thus increasing effectiveness and efficiency in personalized clinical decision making.



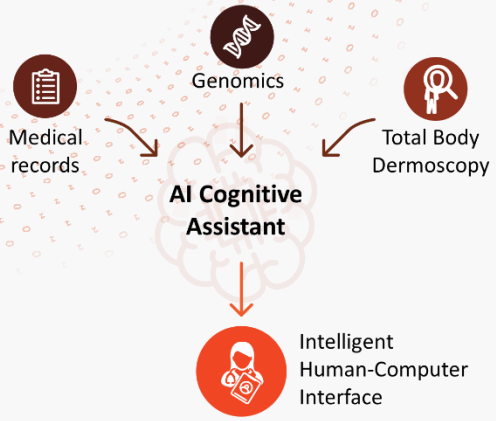
The challenges of fighting melanoma

Skin cancer is the most common human malignancy, and its incidence has been increasing in the last decade. Within the general category of skin cancers, melanoma constitutes the main cause of death. According to the latest statistics, cutaneous melanoma is currently the sixth most common type of cancer in Europe, with more than 144.000 new cases diagnosed in 2018.

Fortunately, melanoma may be cured if treated at an early stage. Mortality increases with increasing growth into the skin. More than 90% of melanoma patients are still alive after 5 years, if treated early. If distant spread of cancer cells has occurred (metastatic melanoma), the proportion of patients alive after 5 years may be 23% or lower. For these reasons, rapid diagnosis is essential to ensure treatment is undertaken before local and metastatic spreading occur.

The treatment of melanoma is based on surgical removal (excision) of the primary skin lesion. From a technical viewpoint, the excision of skin lesions suggestive of melanoma is fairly trivial in the majority of cases. While excision of melanoma is quite simple, early-stage melanoma detection is not easy even for expert dermatologists because it often resembles a common skin lesion ("mole"). In high-risk patients with many atypical moles (dysplastic naevi), a high number of moles need to be excised for one melanoma to be detected. Thus, the risk of missing a melanoma remains significant even with a large number of excisions of benign lesions in every patient.

The proliferation of hand-held dermoscopes has remarkably improved the diagnostic accuracy for melanoma when used by dermatologists with specialized training. Concurrently, Artificial Intelligence (AI) systems for identification of melanomas have seen tremendous growth in the last 3 years, driven by the availability of massive new datasets, with deep learning (DL) systems achieving expert-level classification accuracy. However, most studies comparing human to AI performance present a key constraint: they attempt to differentiate skin lesions by using just the images at hand, without any clinical context, and in this situation, DL has shown to outperform the average dermatologist. When experienced dermatologists have access to this clinical data, their performance notably improves. But even with that evidence, most DL systems are still relying on the imagery only, ignoring the complementary clinical data that is available.



Differential value of iToBoS

iToBoS tackles the limitations of currently available systems, by designing a novel tool that will help practitioners during the diagnostic process. The diagnosis for a given exploration will be enhanced with all the data available for the patient, including, but not being limited to, genomics, clinical history, previous dermoscopy, etc. The result will be a cognitive assistant that integrates information from several sources to provide a personalized diagnostic for each patient.

This diagnosis system collating the data from different sources will be based on novel technologies arising from the field of explainable AI. **In iToBoS we want to refrain from the common black box decisions taken by Deep Learning (DL) methods**. Instead, the DL methods to be developed will provide a more transparent decision, in the form of human-understandable explanations of the results obtained. This will allow the dermatologist to take informed decisions based on the outputs of the DL system.

Moreover, in iToBoS we want to improve the process of systematically exploring the skin of a patient by developing **a new scanner able to automate the Total Body Skin Examination (TBSE) process**. Following the same philosophy, this new source of data will be collated to the other types of information of a given patient to enhance her/his diagnosis.

After the exploration, **the system will be capable of automatically generating the 3D map of the moles of the patient** by AI detection and tracking across images. With privacy in mind, the scanner will not collect data from the head/face of the patient, and the 3D reconstruction of the patient will be anonymized by creating a 3D avatar of the patient, allowing the precise location of moles across explorations, but decoupling the location of the mole from the body-structure of the patient.

The project envisions the construction of three scanners, which will be installed in three different hospitals to perform data collection first (M17-36), and a clinical feasibility study for the validation of the system (M38-47). This period will also serve to obtain prospective data with the new scanner, which will not only be used to develop the algorithms associated to this new type of data, but also to create an annotated dataset that will be released publicly in order to foster the development of cognitive assistant algorithms, such as the one envisioned in this project, within the scientific community.

Some project events

Although the main participation in events is planned for more mature stages of the project, the first activities have already been carried out, considering not only the general meetings of the project but also participation in some technical and scientific events.

Kick-Off Meeting

The Kick-off meeting of iToBoS project took place in 08/04/2021 via video conference system with the attendance of the 19 project partners. In this meeting, the project outline, its objectives, the workplan, schedule and financial and administrative issues were presented by the project coordinator. Each work package leader presented its WP (objectives, tasks, deliverables) and its role in the project.

IToBoS project held its 1st Advisory Board Meeting

The Advisory Board meeting took place on 13/09/2021 via video conference system with the attendance of the Advisory board members. In the meeting, the members of the iToBoS Advisory Board were presented and the Project Coordinator presented iToBoS and its progress in the first six months of work.

IToBoS project held its 1st Project Management Board Meeting

The Project Management Board (PMB) meeting took place on 22/09/2021 throughout video conference system, with the attendance of the Project Coordinator (PC), Project Manager (PM), Innovation and Exploitation Manager (IEM), Dissemination and Communication Manager (DCM), Data Manager (DM), Quality Assurance Manager (QAM) and the WP leaders. The current status of the tasks of each work package, the deliverables and the milestones were analysed. The project is progressing as expected.

Events participated

In addition, iToBoS representatives presented the project in the following events:

- Online, 20-21/10/2021. "Artificial Intelligence, a new paradigm in human care"
- Online, 4-8/10/2021. 26th European Symposium on Research in Computer Security
- Online, 29/09 – 2/10, 2021. European Academy of Dermatology and Venereology 30th Congress
- Barcelona, 1/07/2021. 4Years From Now Congress
- Online, 10-11/06/2021. World Congress of the International Dermoscopy Society
- Online, 11/06/2021. Webinar on skin cancer
- Online, 22-24/04/2021. Advanced dermoscopy workshop
- Online, 15-17/04/2021. 10th World Congress of Melanoma

Work presented

During the first 6 months of the project, the following deliverables have been produced and presented:

Deliverable submitted	Month	Leader	Diss. level
D1.1-Online Project collaboration space and communication instruments	2	UDG	CO
D12.1-Communication, Dissemination, Outreach and Engagement Plan (First release)	2	RICOH	PU
D1.2- Quality Assurance and Risk Management Plan	3	UDG	CO
D2.1-Privacy, data protection, social and ethical issues preliminary guide for iToBoS design and development	3	TRI	PU
D11.1-Patient engagement plan with touch points and educational needs	3	MPNE	PU
D12.4-Project web site including visual alignment to the strategy with initial content	3	RICOH	PU
D3.2-Operational requirements for the AI algorithms and total body dermoscopy	4	NTUA	CO
D3.3-Design guidelines for the compliance of the new total body scanner with Medical Device Regulation – class I (EC 2017-745)	4	BARCO	CO
D3.4-Requirements for Integration and Technical Validation Activities	4	BARCO	CO
D3.5-Definition of overall architecture and rules for module interoperability	4	UDG	CO
D1.3-Innovation and IPR Management Report	5	RICOH	CO
D1.4-Ethics Protocol	6	UQ	CO
D4.4-First Data management plan aligned with FAIR principles and other initiatives including RDA and EOSC	6	SZTAKI	PU
D6.2-Data annotation tools	6	V7	CO
D13.3-NEC - Requirement No.3	6	TRI	CO
D13.5-NEC - Requirement No.5	6	FCRB	CO

Publications

During the 6 first months of the project, the following scientific publication has been developed in the context of the project.

- "Towards the Interpretability of Deep Learning Models for Human Neuroimaging". 2021. Simon M. Hofmann, Frauke Beyer, Sebastian Lapuschkin, Markus Loeffler, Klaus-Robert Müller, Arno Villringer, Wojciech Samek, A. Veronica Witte.

In addition, different articles aimed at broader audiences have been developed and published on the project website, presenting the project from different scientific, medical, technological or innovation perspectives, considering the different profiles of all the project partners.

iToBoS team

The consortium with 19 partners organizations is led by the University of Girona (Spain). This international consortium brings together **leading research/ academic institutions** (5 **research centres**), **industries** (4 companies and 6 SMEs) and **end-user entities** (3 hospitals and 1 patients' NPO).

The University of Queensland has received funding from the Australia's NHMRC under grant number APP2007014.

Let’s stay in contact!

iToBoS has deployed some **digital channels to keep in touch with you and bring you the latest news** about the project. They are also a way to receive your ideas and comments and learn more about your needs.

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