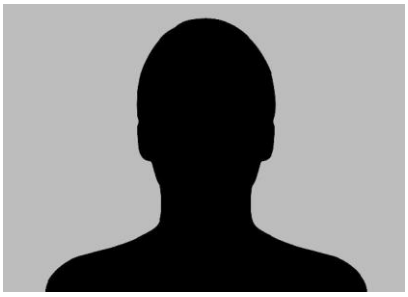
Zurich University
of Applied Sciences

School of
Engineering

ICP Institute of
Computational Physics

Dynamic Thermal Imaging for Skin Diagnostics - Development of Innovative Procedures and Analysis Methods



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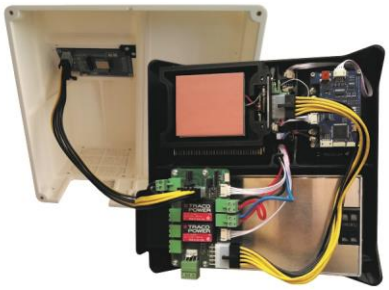
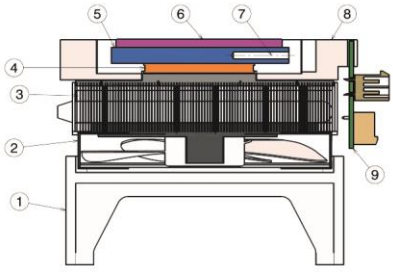
This master thesis is about some of the more practical solutions which need to be achieved within the Eurostars Project *DermaIR - Increasing the Capabilities of Dermatoscopy Using Thermal Imaging Sensors*.

An unfinished cooling station had to be brought to a stage ready for handover to the industry partner FotoFinder. This included mayor changes to the previous hardware set up as well as the development of the necessary application software for the user interface and the precise control of the temperature of the crystal glass used to apply to the patients skin to initiate the sequence of the thermographic examination by the dermatologist. The station now has a modular hardware structure using specifically designed printed circuit boards and a new more powerful ESP32- Mikrocontroller to run the application software.



The revised cooling station with bottom (black) and top (white).

Since the new to be developed video dermatoscope shall be equipped with two cameras, a standard visual camera plus as a supplement an infrared camera for the thermographic examination, a software had to be developed to merge the images of the two cameras into one image. Due to the fact, that the infrared camera had to be physically placed with an offset of 28° to the image axis of the visual camera, the necessary image fusion software had to compensate this offset through application of the projective transformation method. These requirements have been fulfilled with an application software which is build up around the freely available programming language *Python* and the module *Scikit-image*.



The cooling system with its components: 1) Fan mount 2) Fan 3) Cooling fins 4) Peltier element 5) Aluminum block 6) Heat conduction mat 7) Opening for temperature sensor 8) Peltier mount 9) PCB with connectors

Simulations of thermographic examinations on skin patterns through an initial cooling of the to be examined skin pattern and the recording of the subsequent temperature recovery had to be performed, to search for evident parameters to identify lesions within a patient skin, such as melanomas. For these simulations a virtual skin model developed by the *Institute of Computational Physics (ICP)* had to be used which runs on a software from *COMSOL Multiphysics*. The results show that the density and the depth of the lesions within the patient skin can be made visual through a specifically developed application software, which is build up around the freely available programming language *Python* and the module *PyQt5*.