OmmatiDiag—A mosaiced detector for the GlobalDiagnostiX project

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Rationale

ABOUT two-thirds of the world population do not have access to diagnostic imaging due to the lack of functioning radiology equipment in developing countries. First world countries try to solve this problem by donating radiology equipment to hospitals in need. Since this donated equipment is not adapted to the context and the infrastructure in the beneficiary countries is often sub-substandard such donated machines often cease to work after a short time frame.

ADDITIONALLY—according to the WHO—about 70 % of the more complex devices do not function when they reach their destination in developing countries [1].

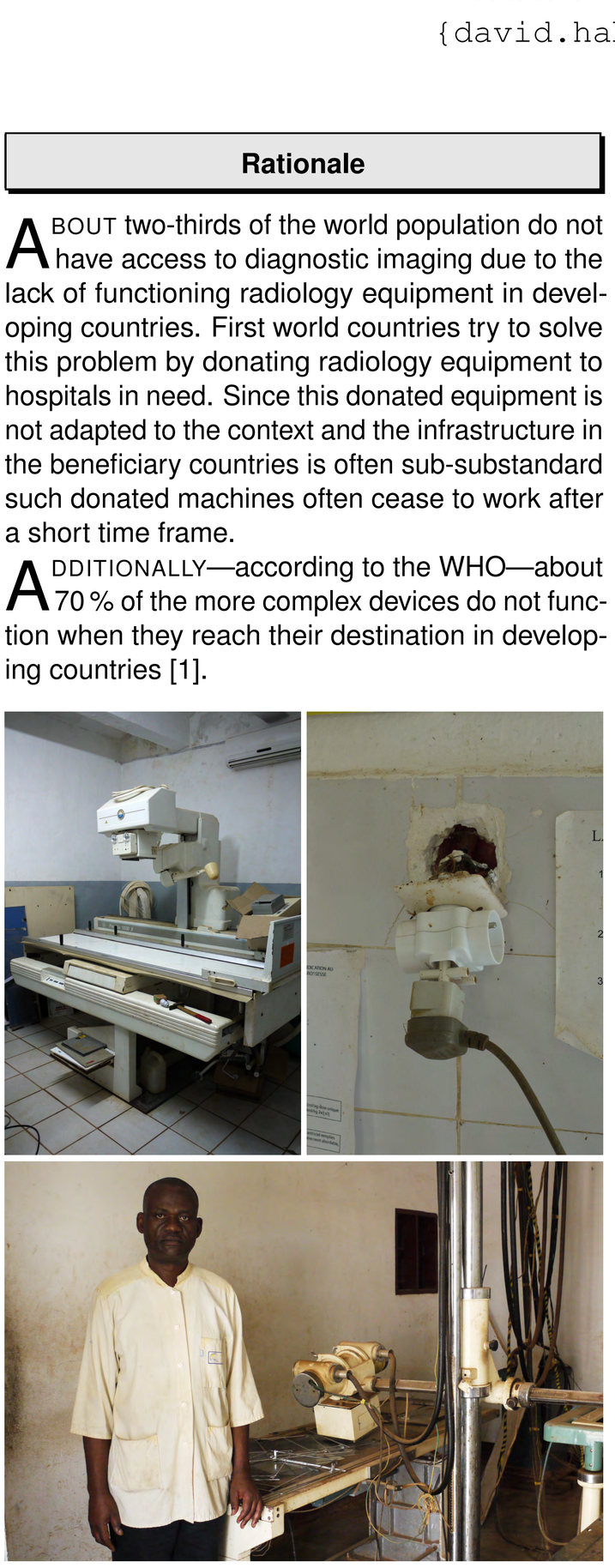

Figure 1: *Situation in a district hospital in Cameroon. Photos: EssentialMed foundation.*

The GlobalDiagnostiX Alliance

THE GlobalDiagnostiX alliance, composed of research teams from universities of applied sciences, federal institutes of technology and private partners aims to solve the above-mentioned suite of problems by researching and developing innovative methods for

- High voltage power management & electronics
- Mechanical design
- Software, user interface and usability
- Image processing, rendering and display
- X-ray generation and detection.

SINCE the price of consumables can represent up to 50 % of the total cost of ownership, the GlobalDiagnostiX-system will provides digital radiology images without using any consumables.

The GlobalDiagnostiX Alliance (cont.)

ADDITIONALLY—even though it will be deployed to district hospitals—it has to be extremely robust; we aim for a lifetime exceeding 10 years with a total cost of ownership of about $ 50 000.

THE system should allow for more than 6000 radiographic examinations per year and will be able to work independent of the power supply for up to 5 hours.

ACCORDING to the needs in the target countries (accidents and lung screening), the machine will cover mostly extremities and chest images (approximately 80 % of all images) while also providing standard-compliant images of spine and pelvis, abdomen as well as head and neck.

PSI involvement

THE aim of our sub project is the development and build of a cost-effective radiology detector able to withstand the climate conditions present in developing countries, i. e. high humidity, elevated temperatures and dust. While withstanding these conditions our detector has to deliver standard-compliant radiology images with minimal operating expenses.

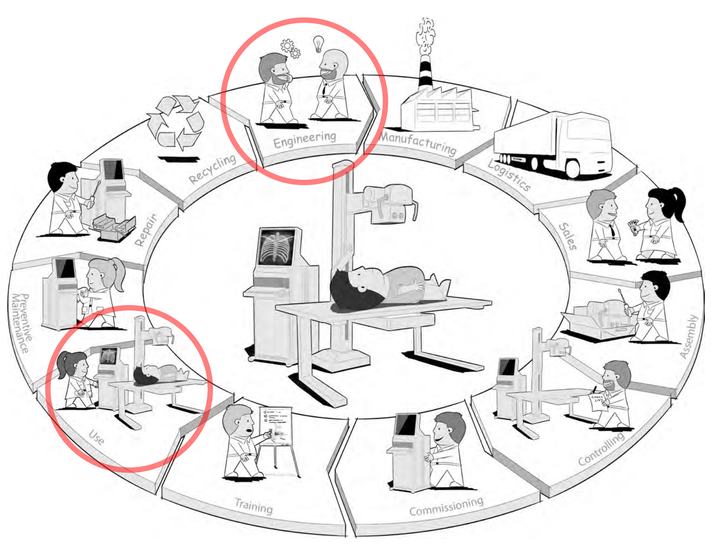

Figure 2: *GlobalDiagnostiX value chain. The red rings highlight the involvement of the PSI.*

COMMONLY, in first world countries new radiology systems are equipped with either direct or indirect digital detectors, while old system still use analog films. Due to the climatic and monetary constraints in developing countries and the extreme susceptibility to mechanic shocks of such flat panel detectors, they are not suited for deployment in the targeted markets. As stated above, both procurement and price of consumables for analog film systems make them unsuitable for the target markets.

TO be able to deliver a cost-effective solution which is both robust and serviceable, we will—analog to the imaging at the TOMCAT beamline—build a system that converts the incident x-rays to visible light through a scintillator and digitizes this scintillator image using a CMOS sensor array [2].

THIS approach makes it possible to deliver a cost-effective solution which is both robust and also serviceable through the modular construction.

OmmatiDiag

AFTER the x-rays have passed the patient, they are converted into visible light using a highly efficient Thallium doped Caesium iodide scintillator. The scintillator image is then digitized by a mosaiced sensor array of detector modules.

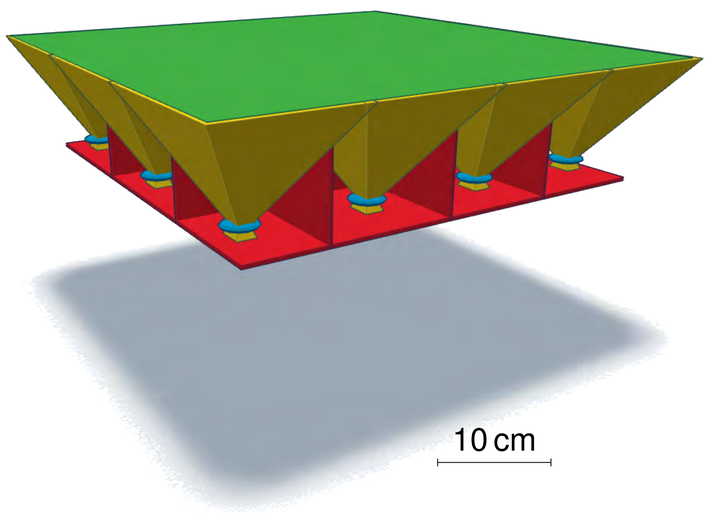

Figure 3: *OmmatiDiag mock up*

INDEPENDENT detector modules, each containing optics and a CMOS detector will digitize portions of the visible image on the scintillator screen.

EACH such detector module serves the same purpose as the single units of insect compound eyes, the so-called *Ommati*dias. The merged image of this mosaiced sensor array will then—after further image processing—provide a standard-compliant *Diag*nostic image.

Conclusion

THE performant, modular, cost-efficient and standard-compliant x-ray imaging device based on frugal engineering approaches is an integral part of the GlobalDiagnostiX radiology device. The combined effort of the alliance will culminate into an appropriate diagnostic x-ray imaging system which is adapted to the context of resource-poor settings and can be sold to district hospitals in developing countries for an affordable price.

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