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Open Source Imaging Initiative (OSI²) – Update and Roadmap

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Synopsis

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The aim of the open source imaging initiative (OSI²) is to collaboratively share research in MR technology and building a quality, affordable open source MR scanner. Combining innovation and open source (OS) approaches will generate global value by reproducible science and development and will allow a major reduction of investments and operational costs with the guiding principle: From the community, for the community. OSI² (www.opensourceimaging.org) was presented for the first time at the ISMRM 2016. Here we present an update and a roadmap towards the fulfillment of our vision.

Purpose

MRI is an essential medical diagnostic tool that is beyond the reach of many patients throughout the world[1]. The aim of the open source imaging initiative (OSI²) is to address this issue collaboratively. Combining innovation and open source (OS) approaches will permit a major reduction of investment and operational costs with the guiding principle: From the community, for the community.

OSI² was presented for the first time at the ISMRM 2016[2]. Here we present an update and a roadmap towards the fulfillment of our vision, which consists of six goals (Fig.1):

1. Open Source Software/Hardware Development

2. Guidelines for Open Source Research and Development

3. Community Building

4. Education

5. Quality, Reliability and Safety

6. Businesses and Distribution

www.opensourceimaging.org was launched on May 6th, 2016, as a communications platform centered on the above goals.

Open Source Software/Hardware Development

Our software/hardware developments follow a modular approach to stimulate independent developments and exchangeable components in a research setting. A first prototype MR system (B_0=0.2T;<100kg) is under construction[3]. As soon as the system is tested, we will provide all documentation necessary for its reproduction.

To reduce the cost and size of magnets and permit safer operation and simple reproducibility, we are currently focusing on permanent magnets in Halbach arrangements[4-5] (Fig.2). We have implemented a transmit/receive system ready for pulse generation and amplification (P_{peak}=1kW;f=1.8-54MHz;~3000€;(50x30x35)cm³) (Fig.2). We use GNUradio[6] compatible software defined radios as spectrometers enabling hardware independent pulse sequence developments in an OS-framework[7-8]. This setup has been extended to drive traditional and rotating spatial encoding schemes[9].

Our efforts are not limited to specific hardware. We encourage the community to develop and exchange alternative approaches.

Guidelines for Open Source Research and Development

To generate global value, science and development need to be reproducible and transparent. Our initial efforts highlight current OS projects (Fig.3) (>20 project uploads within six months). Our monthly newsletter will provide news and project updates.

We started collecting guidelines on licensing/patents/liability etc. Such legal blueprints are an international necessity and will help peers who also wish to open source their work.

We will include similar information on documentation and publication strategies. Providing OS software/hardware documentation along with a scientific publication accelerates the reproducibility of science, benefits from peer-reviewing and rewards authors with visibility and citations. We encourage researchers to publish in journals that promote OS software/hardware publications[10].

We have supported a petition to form an ISMRM Study Group on Reproducible Research.

Community Building

We encourage knowledge sharing and collaboration. We have presented our vision at various events including the ISMRM[2] and the World Health Summit[11] and have initiated active collaborations with the research, industry, OS product development[12] and medical doctor[13] communities. We have begun implementing communication channels for software/hardware/general discussions and are striving towards more open forms of communication, in order to support better understanding, participation, and shaping of our vision by potential contributors.

Education

Education stands on transparency. Providing the widest possible access to documentation, manuals, data, and source code fosters the training of users and developers. Providing communication channels for exchange stimulates interdisciplinary collaborations. We highly encourage researchers to go the extra mile and document their work openly, which will provide easy global access to knowledge for students, researchers and developers.

Quality, Reliability and Safety

Typically, the quality, reliability and safety of medical devices is assured through government-based oversight systems[14-15]. In these cases we want to create development guidelines based on current standards that will allow a smooth transition from research prototypes to medical devices. These guidelines will also help developers in low- and middle-income countries, where the requirements for demonstrations of device safety may be arbitrary or completely absent. We are collaborating with OpenQRS[16-17] in a long-term vision to implement open data systems to inform users and the public about the quality, reliability and safety of health care devices.

Businesses and Distribution

OSI² represents a not-for-profit movement. Nevertheless, business partners will be important to boost distribution and ensure quality. Open source research and development of MR hardware has the potential to lower investment/service costs, increase competition, create local markets with stable low prices, and encourage product customizations. The success of this strategy has already been observed in the 3D printer market. The same approach will culminate in opening up new business opportunities and in improving the global distribution of medical devices, thereby improving diagnostics and care for millions of patients worldwide.

Conclusion

Through new forms of transparent collaboration, we hope to lay the groundwork for global access to affordable, high-quality medical devices. Please visit www.opensourceimaging.org or contact us at info@opensourceimaging.org to contribute your knowledge and expertise and help us make this vision a reality.

Acknowledgements

No acknowledgement found.

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Figures

Figure 1 - Illustration of the six goals of the open source imaging initiative (OSI²): Open Source Hardware Development, Guidelines for Open Source Research and Development, Community Building, Quality/Reliability/Safety, Education and Distribution.

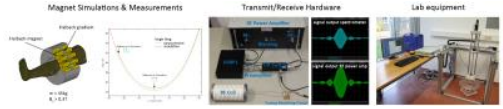

Figure 2 – Overview of types of current open source hardware developments. (left) Magnet designs such as permanent magnet Halbach arrangements for traditional and rotating spatial encoding schemes, (middle) open source radio frequency transmission/reception hardware and (right) open source lab equipment such as a programmable field measurement device.

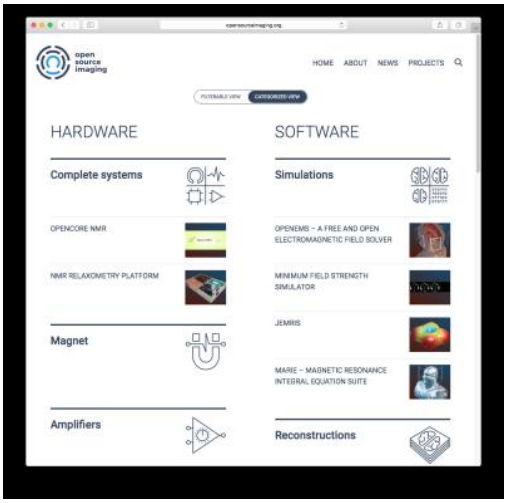

Figure 3 – Screenshot of the categorized view of the projects currently uploaded to www.opensourceimaging.org. Each project page contains a summary of the main features of the corresponding software or hardware tools as well as information on the contact persons, version, license, costs, publication, source file location and development/documentation websites.