Documentation Tool for Open Plant Technologies

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The Idea

Common biology related hardware tools often benefit from modifications for application to specific plant science experiments. Open source hardware tools can be a potential solution because they are modifiable and low cost, enabling low numbers of produced parts. In practise, however, replicating, sharing and quality assessing open source hardware projects usually turns out to require a lot more involvement than expected, because of a lack of documentation standards that are easy to evaluate and check for completeness. We have partnered with the IRNAS institute in order to implement a digital documentation tool, that will make documenting much easier and instructions more useful. We propose this tool as a documentation standard for open plant funded projects and are invested to further improve the tool with the feedback of this user group after the completion of this project. The documentation tool is planned as a stand-alone, open source and free software that outputs the documentation of each project including media files as XML documents. These Documents together with a ZIP folder of CAD-files are an easily accessible way of providing all project data. We propose to add further value via a free online tool that allows e.g. the rendering of CAD files, time stamping and providing a citable link, reusing and referencing modules as well as commenting and extending on projects.

In short, we aim to improve open source hardware documentations with the following features:

- Documentation complies with Open Hardware Definition.
    - Present the system in a tree-like manner, starting from one page system overview and breaking it down into simple modules, with enough information one can understand the basics of how it works.
    - Assembly instructions with clearly defined steps and assembly instructions, extended with basic description what the part does. The function of every assembly part must be clearly expressed so one can consider alternatives.
    - Parts for assembling the system are split into logical and physical parts. The system is assembled of logical parts and every logical part has one or more suitable physical parts associated. For example, two pieces of wood with a hole should be joined with a screw, that fits through the hole, is longer then X and shorter then Y… The physical part associated would be then M8x16, countersunk and HEX head.
    - Off-line useful format, we suggest XML. Displayed with a stylesheet on any browser and suitable for modifications through version control repositories.
- Benefits from a user perspective:
    - Seamless process from learning about a project to reproducing it
    - Reliable and tested sources and documentation
    - Reproducible with open-source tool-set
    - Simple contribution to documentation and translatable to local languages

Who We Are

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External collaborator: Luka Mustafa (musti@irnas.eu), Shuttleworth Foundation Fellow, IRNAS

Implementation

Together, we have already implemented a Java prototype of the standalone modular documentation tool, with a detailed and improved version of the structure that was proposed by the IRNAS institute earlier: http://irnas.eu/2015/03/19/useful-source-tree-structure/
A lot more development is necessary to make this a well suitable tool for all types of users, including: integration of media e.g. via web cam; android application that assists with taking documentation photos and videos as well as scanning documents such as safety sheets; file conversion tools to standard file formats; CAD rendering tool to visualise submitted files; interface design; creating a data base with time-stamping and DOI link generation, etc. We will implement most features ourselves, but need support from the open plant fund in order to outsource very time consuming bits and in order to cover hard costs. Contacts to programmers willing to assist with the programming of some elements of our implementation exist and we are aware of open source software tools that we can build on. We are also in the process of testing the documentation tool with example open source plant related hardware projects such as the open beehive, an LED solar simulator, an algal bioreactor, a vacuum assisted mini-prep centrifuge-alternative, and an open source plasma cutter and various equipment pieces constructed as part of a synthetic biology DIY Biolab project.

Benefits and outcomes

We will produce a free and open source software tool for high-quality and modular hardware documentation that will be provided to the public before the end of this project. This tool is especially useful for integration level open source hardware projects that combine electronic parts with many other components and materials, as is usually the case in hardware projects in plant science. We will also provide first documentation examples of plant science related hardware systems. With the help of our further online tools, that we will collect, improve or newly create for the purpose, it will be possible to further enhance the view of finished documents generated via the stand-alone tool. The platform will also allow scientists and users from outside the open plant program to interact with and add to the material that can voluntarily be submitted to the platform. Using the new ties between Cambridge and Carlos Lugo from Norwich, we furthermore intend to use this tool as the basis for an open plant outreach project that aims to motivate researchers from Norwich and Cambridge to document already built equipment and make the instructions accessible to the public.

Budget

The 4000£ is mainly intended to be used for the outsourcing of some time-intensive programming parts, such as the Mobile Phone Application to record Images and Videos as part of the documentation or use case, as well as the software integration with existing useful apps such as possibly CamScanner to digitalise supplementary paper sheets such as safety documents. This is likely to use up around 2500£. We intend to use ~1000£ for an open access publication of the documentation method and about 400£ for servers and domains to provide the enhanced online view functions, conversion tools to pdf and time-stamping of the documentations. If the cost of any of these three uses exceed the amounts listed, we will receive additional backing from our collaborator on this project, the Shuttleworth Fellow Luka Mustafa (http://irnas.eu/team.html). He is already in the process of sponsoring an important update to an open source web-tool that enables us to use web-cams directly as part of the software.