WHAT ARE THE OPPORTUNITIES IN PARTNERING OPEN DESIGN WITH CITIZEN SCIENCE FOR BESPOKE MONITORING WITHIN HOBBY OR NICHE COMMUNITIES

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I. INTRODUCTION

This project is investigating how open design can extend citizen science's reach by exploring new opportunities that previously were not possible until the advent of technologies such as the Internet and web 2.0, Direct Digital Manufacturing (DDM) and advanced sensing equipment. This paper reports on work-in progress to enable citizens to address sustainable, economic and social challenges using bespoke processes, open design and manufacture on demand, involving industry partners.

The project will run design workshops that involve corporates and Non-Government Organizations (NGOs) benefiting from either creating bespoke monitoring equipment or working with users to gather data. The partnering of open design with citizen science can empower users to monitor their own environment by creating their own devices for either community use or scientific gain. The work could foster new user relationships that use HCI methodologies, approaches and areas for deployment.

Open design, in one vein enables collaborative efforts by providing incentives and methods for the freely sharing information [1]. This type of activity can be underpinned by a system that enables people to easily access or create design information to make personal artefacts. Direct Digital Manufacturing (DDM) refers to computer controlled fabrication tools, directed in their operation by Computer Aided Design (CAD) tools. These digital tools facilitate open design and help turn design information into artefacts. DDM is "lowering the entry point to manufacture" and can make objects to bespoke needs and requirements [2]. Designing and making things go hand in hand; open design can open processes that digital manufacture can optimize to turn concepts into tangible things.

An example of open design utilising digital fabrication is the Open Structures (OS) project. The research project explores the possibility of a modular construction model where everyone designs for everyone. The platform is based on a geometrical grid, ensuring parts created by different users complement each other [3]. The OS platform lets people copy and re-appropriate components for their own assembly or project which enables a community to develop around the system. Freely distributing design information coupled with accessible DDM technology allows a large number of people to engage with the manufacture of goods over a wide geographic area. In some cases DDM can "lower the entry costs to bespoke or custom designed objects" so users can shape products to their own needs and requirements [4].

Citizen science uses "non-professional volunteers to gather information and data from the environment around them" [5]. A discrete area of this discipline is community monitoring, using groups to monitor specific data. The approach of citizen science can either be:

1. *Community consultancy model*; community defines the problem and professionals complete the study.
2. *Community workers model*; professionals define the problem and the community gathers the data.
3. *Community-based model*; participatory research model, community defines problem, gathers data, analyzes and interprets the data [6].

Existing projects have included; aerial balloon monitoring kits, thermal photography, water sensing and spectrometers. With devices made from purchased kits or assembled using off the shelf components. These projects have led to different audiences engaging in the citizen science models previously explained.

Community monitoring can involve many stakeholders such as, interest groups, site specific communities, government and non-government organizations to gather data "to address increasingly complex and emerging environmental and sustainability issues" [7]. This project draws on research into the areas of open design, digital fabrication technologies and citizen science. It is the view of this project that through open design and DDM the technology for citizen science can be developed collectively, on-line, by a community and fabricated globally on demand. Digital manufacture allows new product ideas to be fabricated on demand; however these devices are "often stalled by the concepts and ideas that users create" [8].

II. DESIGN/METHODOLOGY/APPROACH

A. The project intends to

1. Develop a set of methodologies and a system for developing community monitoring tools.
The open design tools used in any monitoring endeavor are only relevant if the context they are used in makes sense. For this reason it is also an intention to develop a design toolkit that maps out the possible stakeholders, scenarios for environmental requirements, and types of information gathered. Open design can create opportunities suited to batch or niche production, in numbers that were previously too costly for mass manufacture. In turn this means citizen science can respond to niche areas with bespoke functionality, possibly opening opportunities in low funded or niche areas. This approach is being tested live, with a project the "Conversations with Bees" using open design.

2. A toolkit that aids the creation of project briefs and specifications for monitoring.
A toolkit aiding the creation of briefs builds on previous work, the "Conversations with Bees" project that used a community consultancy citizen science model. The project worked with local beekeepers after an ethnography study. The next step in the project is work on concepts that can be applied to a community worker citizen science model (professionals decide problem, people gather data). This area will be expanded upon with different NGO's, to see possible patterns or opportunities.

3. Identify possible and credible stakeholders.
The project intends to work with groups, government agencies, (NGO's) that could benefit from community monitoring, but have previously been unable to explore this avenue. The work needs to explore more organizations who could benefit from bespoke monitoring and its opportunities.

Sample projects from the toolkits findings would be produced using digital manufacture and deployed with relevant parties for testing. It will be designed so the needs and requirements of the user will be the primary concern, e.g., their attempts to distill concepts quickly leading to applications. The process should enable a more conceptual approach giving the participants a framework to work within.

4. Identify territories where this will work and understand possible pitfalls or opportunities
The intention is to explore new opportunities through the workshop processes with industry partners, relevant NGO's and through public engagement exercises. Public workshops have already been explored; more industry partners need to be included in future work.

An analogue design process will be created that enables workshop stakeholders and participants to outline possible project briefs, applications and environments they want to monitor. Feedback from this targeted study will shape possible applications and try to encompass as many relevant disciplines and organisations as possible. The main focus of the studies will include:

1. Possible applications and opportunities that can be explored.
2. Public engagement and designing for and with amateurs.
3. Stakeholders in the community worker, citizen science model.
4. Broaden possible applications of citizen science and open design.
5. The concept of users selling or donating data they have gathered.

III. Findings/Results

The toolkit has been initially tested with water engineers, looking to include younger generations in rain monitoring, many more workshops are scheduled with different parties but currently this is a work in progress. The toolkit has already informed a product for monitoring the health of honey bees forming a reciprocal relationship between the beekeeper and the monitoring agency. The work still needs to include more groups that have bespoke requirements with low initial investment where digital manufacture can make an impact.

IV. Conclusion/Discussion

The toolkit so far has highlighted how different parties need a framework to construct conceptual ideas and apply new technologies. The procedure could also present new opportunities for manufacturers to produce mass manufactured components that allow for greater bespoke applications.

V. Future Plan/ Directions

The toolkit needs to be tested with a wide variety of audiences to see patterns, themes and opportunities it can create. The process also needs to clearly define more situations where this type of activity is not appropriate.

References

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