05.2.3

LABS, MAKERSPACES AND THEIR CHALLENGE TO DEVELOP LIBRARY SERVICES IN AN INNOVATIVE ENVIRONMENT

Francesc García Grimau
francesc.garcia@ub.edu
Universitat de Barcelona, Facultat de Biblioteconomia
i Documentació, Spain

Ruth Latorre Bel
ruthlabel@gmail.com
Universitat de Barcelona, Facultat de Biblioteconomia
i Documentació, Spain

Ana Lis Raimúndez Kuhlmann
analisrk@gmail.com
Universitat de Barcelona, Facultat de Biblioteconomia
i Documentació, Spain

Gerard Vidal Santos
vidalsantos.ger@gmail.com
Universitat de Barcelona, Facultat de Biblioteconomia
i Documentació, Spain

Keywords: DIY, low-cost hardware, open-source movements, library services

Abstract

The purpose of this study is to expose examples of how low-cost hardware components and open-source software can benefits library systems on a basis of the drastic cost-reduction of this institutions' budgets and the way it can motivate their staff at developing proposals for rethinking, not only their workspace, but also the conception of services that they are giving to their patrons.

Since the last decade the open-source movement and the "Do It Yourself" (DIY) community (sometimes called "lo-fi revolution") have gather a dizzying momentum in the ambition and complexity for their proposals, competing on equal terms with many of the commercial solutions aimed to solve the same needs, and even establish itself as an alternative business model based on the constant improvement of the product by their community rather than mere economic profit.

Thanks to the reduction of electronic components prices and the spreading of tutorial-websites or dedicated forums, the "DIY" community, amateurish subjects with no hierarchy, deploy fully-functional prototypes and establish worldwide meeting points called makerspaces or hackathons that go further than a mere hobby.

The Maker Movement is reformulating the way innovation is applied to several disciplines, among them Information Studies. Projects not necessarily created in this community could give an effective response to the needs of libraries, showing that this context can be a great opportunity to improve their services and resources in a creative, participatory and cost-effective way.

Aim of the study

The purpose of this study is to expose how low-cost hardware components and open-source software can be used to create services for library systems focusing in the benefits of the drastic cost-reduction of that they can provide to their institutions' budgets.

Methodology

This study consists primarily of a review of related literature to the DIY movement *modus operandi* and its key concepts. Then proceeds to show a representative selection of cases of application of where these solutions are displayed in several areas of a library context. The reviewed resources for this selection have been specialized blogs, journals and websites. The next step is to analyze them, describing the purpose and objectives of its creation, processes and technologies that are applied on them, and the results obtained. Following, it discusses and compares advantages and disadvantages of these cases. Finally, some conclusions are extracted from the analysis and discussion.

Context

Since the last decade the open-source movement and the "Do It Yourself" (DIY) community (sometimes called "lo-fi revolution") have gather a dizzying momentum in the ambition and complexity of their proposals, competing on equal terms with many of the commercial solutions aimed to solve the same needs. And even establish itself as an alternative business model based on the constant improvement of the product by their community rather than mere economic profit.

This community can be defined as an association of amateurish subjects with no established hierarchy dedicated to deploy and share fully-functional prototypes supporting the idea that people can create rather than buy the things they want (Kuznetsov & Paulos, 2010) in a culture inherited from the digital design that recognizes the individual merits and skills by their commoners (Raymond, 2001).

Such phenomenon is not a novelty issue. Individual experimentation on varied interests and persistent contact has been the common denominator of many innovation stages of human history. Setting a not so far precedent, the rise of technical and "open-minded" amateur handbooks among radio hobbyists of 1920's could fit perfectly into the definition from above. Same premises

appear at countercultural 60's and 70's pirate radios and hand-made fanzines in order to express aesthetics and anticonsumerism ideals of the hippie and punk movements. Low-cost MIDI electronic music and the spread of personal computers enabled people without formal training to record electronic music during the 80's decade and later towards multimedia art expressions from the rave culture of the 90's (Kuznetsov & Paulos, 2010).

This intellectual curiosity is now railed through the confluence of a drastic cost reduction and availability of basic electronic components prices and the appearance of a wide range of open-source software solutions, but it's been the worldwide and instant spreading of this knowledge via the proliferation of 2.0 based tutorial-websites and forums that overcomes the impact of any of the examples cited above. Tinkering a prototype is so easy nowadays that even the experts foresee a new industrial revolution based on the Maker Movement (Anderson, 2013).

The basis of the movement is sustained on fairs and community workshops where its members meet each other and share physically it's improvements. Due to it's informal organization, there's a lack of consensus over the glossary involving them and to delimit it's concepts can be a difficult task (Sangüesa, 2011), but there's always a major plot line in all the cited approaches: Spaces outside a formal education system leaded on informal learning driven by the needs and the curiosity of their members (Clark, 2014).

Due to its privileged position as a community service, libraries are expected to develop a major role in the near future on this context. As Coffman or Burke forecast, Public/Academic/School library partnership with these collectives can provide a whole catalog of new services to add in a time when patrons behaviour tent to step aside the consume of its materials for reference purposes (Coffman, 2013; Burke, 2014) and take advantage on this premise to fulfill its own needs, as reflect the following cases.

DIY projects on a library environment

Raspberry Pi Digital Sign

Presentation

Somerset County Library System (Nee, 2013) developed a more dynamic and cost-effective way to promote programs and resources of their services in high-traffic areas of the library adapting an existing project that allows the display of information in real time at large screen monitors.

Process

Multiples Raspberry Pi boards connected to a large screen monitors via its output HDMI cable are deployed within the library and connected to the library's Wi-Fi. A modification on its OS startup configuration makes them run automatically a web browser in full screen mode that loads repeatedly previously selected slides or video playlists hosted on a Google Driver's account, broadcasting the library's agenda, it's services or any other marketing related content on every screen.

Results

The library staff uploads remotely the contents to display avoiding server hosting expenses through the use of Cloud-based Google storage services. The library has also reduced significantly their digital signboards budget, almost 1,000 US$ per screen, and cut completely the cost of printed posters.

Figure 1 – From left to right, Digital Panel's early development; Teton County Library's Auto-Loan Station

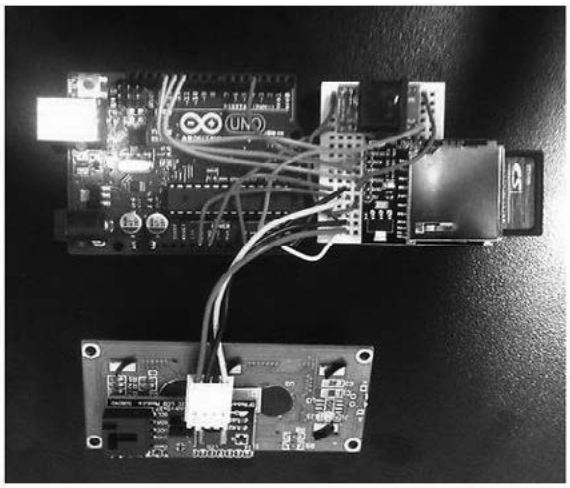


Figure 2 – From left to right, Brock University Library's Barcodinator and Tabulatron

Auto-Loan Station

Presentation

Teton County Public Library (Teton County Library, 201?) adapts an fully functional open-source auto lending kiosk previously developed by Eric Melton.

Process

The auto lending station recycles an old CPU unit, adding a barcode scanner to connect to their automated library system via an open-source PHP based application. In order to be a friendly user's interaction a touchscreen is deployed and also lets to prints a receipt of the transaction with a handheld printer.

Results

The library staff has gained time to invest in patron's personal attention instead of spending it in the checkout queue thanks to the deployment of this device for only 1.200 US$, saving an amount from 15,000 US$ to 30,000 US$ of a commercial auto lending kiosk.

Barcodinator

Presentation

The Barcodinator (Younker & Ribaric, 2013) is a barcode scanner developed at Brock University Library that works as an 'in-house use' statistics collecting device to provide usage data to an integrated library system.

Process

Conceived as a hand-held, low-cost, and easy-to-use circulation utility to collect and scan items waiting to be re-shelved, the project involves an Arduino board which scans the books barcodes using the surplus PS/2 scanner and stores them on an SD Card, until they are uploaded to the integrated library system. Its design also incorporates a two-line LCD screen that lets to check it's last barcode scanned and operates autonomously a week at a time between battery charges.

Results

The device has an affordable cost of approximately 80 US$, but their main advantage is the improvement of the process of data gathering about the in-house use of library items, statistics that are often forgotten by their difficult collection. Barcodinator can be developed using technologies other than Arduino, like Raspberry-Pi. Future improvements involve the use of RFID item identification and the connection to integrated library systems via Wi-Fi.

Tabulatron

Presentation

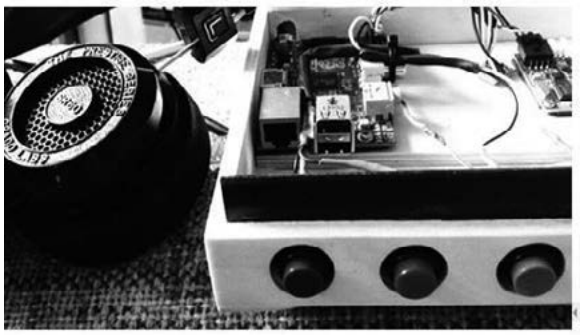
The Tabulatron (Younker & Ribaric, 2013) is a device developed at Brock University Library that can register the interactions at the reference desk. The device counts four different types of patron's demands: reference questions, technical questions, directional questions and referral to a specific department.

Process

A mechanical set of four switches, connected via an Arduino dashboard allows the reference desk librarian to register the inputs of every patron's interactions. The electronic signals of this crafted counter are displayed on the staff terminal and stored in a Google Spreadsheet Form as an aggregated value on its correspondent field using a script made with Processing.

Results

This device automates the reference desk data recollection workflow replacing handmade count and paper forms and avoiding human error as other statistical



```
<!-- Author field -->
<xsl:for-each select="a1">
    <dcvalue element="contributor" qualifier="author">
        <xsl:choose> <!-- Adds a space after the comma that seperates first and
            <xsl:when test="contains(.,',')">
                <xsl:variable name="last" select="substring-before(.,',')"/>
                <xsl:variable name="first"  select="substring-after(.,',')"/>
                <xsl:value-of select="concat($last,', ',$first)"/>
            </xsl:when>
            <xsl:otherwise>
                <xsl:apply-templates/>
            </xsl:otherwise>
        </xsl:choose>
    </dcvalue>
</xsl:for-each>
```

Figure 3 – From left to right, RFID Audiobook's entrails; XSTL Batch Repository Ingestion code

software package like LibStats. The low expenses of its tinkering and it's smart use of Cloud-based Google services permits a cheap infrastructure to daily monitoring of interactions that can be deployed at any scale of organization.

RFID Audiobook

Presentation

An RFID based device that allows sight-handicapped people to play audiobooks autonomously (Van der Jagt, 2014).

Process

The design deploys an RFID antenna connected to a Raspberry Pi dashboard and a set of DVD cases RFID cards filled into DVD cases prepared to point to its correspondent mp3-coded audiobooks hosted on an open-source server-based music player. The file is played when one of these cases is approached to the top of the device, activating an script made with Python that orders the server to play the requested item. A control panel allows the user to pause, adjust its volume and rewind the track 20 seconds.

Results

That device provides total independence to the visually impaired users with a low cost investment by the library.

XSTL Batch Repository Ingestion

Presentation

This initiative is a workflow developed by the College of Wooster (Flynn, Oyler & Miles, 2013). that automatizes the way to add references to an institutional repository and allows the librarians to do that more quickly.

Process

It consists in two different code scripts. The first one converts RefWorks citations into XML with a Dublin Core structure, using a XSTL stylesheet that standardizes their metadata. Then, it loads the PDF files into the institutional repository importing the Dublin Core XML file into DSpace. The second one checks the publisher's permissions of the articles in Sherpa/Romeo. That is done using a Google Docs spreadsheet, and checking the journal's ISSN sending an HTTP request to Sherpa/Romeo's API. Sherpa/Romeo returns a XML file with the journal's policies that tell the librarians if they can load the article or not.

Results

The automatizing of certain processes of the workflow reduces the time expended by the librarians in loading files to their institutional repository with scholarly articles, mainly in the tasks of filling their metadata and checking the copyrights policies of each article. Both scripts substitute time consuming manual tasks. That

Figure 4 – Kinograph's capture system

system can be adapted to different reference managers or institutional repositories.

DIY BookScanner

Presentation

This system, developed by Daniel Reetz (DIY book scanner, 2013), provides a fully-functional manual book digitization based on low cost components and open source software.

Process

The site provides the design patterns to build an adjustable structure to install the stereo camera extraction system, its lights and the board to sustain the book into an all-in one case. The site points to an open-source editing software (ScanTailor) to process the output files. That software recognizes pages and the images within, cuts and rotates them and extracts their text via OCR recognition.

Results

Significant reduction of cost, in comparison to commercial solutions, by using open-source software and low cost hardware components.

Kinograph

Presentation

Kinograph (Epler, S.d.) is a film digitization project by Matthew Epler modelled from low-cost electrical components, open-source software, a few 3D printed parts, and a consumer level camera to produce high quality video output with sound.

Process

The project captures the movie film combining a Reflex camera with an automated system of simple printed circuit boards (Arduino and Raspberry Pi) and 35-16-8 mm rollers designed specifically that can be produced in 3D printers. This mechanical system synchronizes the shoots from the camera with the pass of the photographic film in the roller system with a script made over Processing and its OpenFrameworks library that recognizes the beginning of each frame. Another script from Processing allows editing and converting the frames from the output to video file, stabilizing the flow of the images and extracting the optical soundtrack of its side with AEO-Lights, an open-source optical sound recovery tool.

Results

Due to the affordable premises of its crafting it's adoption stands out above other commercial solutions, diminishing the expenses of the digitization hardware around an average of 2.500–3.000 US$. It also can be purchased in terms of scalability, replicating it to process simultaneously several rolls of film without incurring the substantial costs of its outsourcing or the purchase of specialized hardware.

Discussion

The cases previously presented evidence a wide range of application of the DIY into specific library context areas. Even without been exhaustive in the selection the analyzed cases are enough representative of the diversity of their appliance.

A first common pattern on them are their aim to reduce in resource investment, proving that low-cost materials and open-source software are game changers that prove to be as valid to solve specific library needs as commercial products. Kinograph, as the clearest example of this premise, performs for only 3,000 US$ what the cheapest commercial product performs for more than 175,000 US$. Same thing happens with the DIY Self-Checker, reducing the costs from nearly 25,000 US$ to a ridiculous cost of 1,200 US$.

Benefits of automatizations of processes at library's workflow is its second common pattern. As we see on the of XSLT batch loading and the Tabulatron cases, these projects also substitutes repetitive manual processes and save time to the library's staff that can be invested in other issues. But despite the time that saves, all these projects also require a time investment in order to deploy them, usually when they are made from scratch to solve specific needs by themselves.

These are the consequences of working with these technologies. Low-cost solutions will be always limited in comparison with the commercial ones, and nearly anytime demand the integration of more components. As we can see in Kinograph and RFID audiobook reader cases, for the development of this kind of projects is needed to have some basic knowledge of programming and some experience with electronic components. Open-source is a double-edged sword because of its ubiquitous documentation. Possible valid references are spread on multiple resource types as forums, blogs and so one and relying on them instead of having a commercial technical support requires permanent availability and

accuracy of this sources, not always as methodological as desired.

The richness of this movement promotes an open exchange of experiences from individuals with expertise in different disciplines and varied backgrounds. Thanks to that, an experience applied on any context can be adapted to fit in a library and then reused again and again to match other needs, creating a win-win scenario to everybody involved. As shown in the presentation of the majority of cases analyzed in this study, that are based on previous experiences.

Conclusions

MakerSpaces will be a reality of libraries' daily routine in the near future. As some Code4libs journal's editorials advice, a good understanding of the digital scenario can step forward our institutions on solving new needs or procuring the right tools to let these innovation happens on their facilities. That demands skills from the librarian collective not previously assumed as part of their CV but more present on our environment as time passes (Peterson, 2009; Scott, 2014). Libraries have to be able to take advantage of them from within its institution or, in case, from their user's creativity and talent.

Sharing tips and tricks always have been a major strength on libraries. What in previous times was restricted to closed professional circles, now spontaneously sprouts locally from a bottom-up perspective and it's easily reused or adapted, but there is still needed the support of the management department because there's a high risk factor associated to these kinds of developments.

We must consider that when the DIY solution is chosen, trial and error becomes the most common way to move forward into the final version and it must be always presumed as a constantly beta product. But their gain, when successful, becomes a beneficial stake to the library that wagers them. It encourages staff's proactivity and implication in the resolution of their own needs, trying to offer by themselves a solution to improve their daily work. In order to promote the efficiency of these spontaneous projects, coordination of innovative initiatives in a networked framework is a desirable action to be applied in a near future.

References

Anderson, C. (2013). The Maker movement: Tangible goods emerge from ones and zeros. Retrieved November 10, 2014, from: http://www.wired.com/2013/04/makermovement

Anglada, L. (2014). Are libraries sustainable in a world of free, networked, digital information? El Profesional de la Información, 23, 603–611. Retrieved December 1, 2014, from: http://www.elprofesionaldelainformacion.com/contenidos/2014/nov/07.pdf

Buechley, L. & Hill, B, M.. (2010). LilyPad in the wild: how hardware's long tail is supporting new engineering and design communities. In Proceedings of the 8th ACM Conference on Designing Interactive Systems (DIS '10) (pp. 199–207). ACM, New York, NY, USA. doi:10.1145/1858171.1858206

Burke, J. J. (2014). Makerspaces: A practical Guide for Librarians. Lanham: Rowman & Littlefield.

Coffman, S. (2013). So Now What?: The Future for Librarians. Retrieved November 28, 2014, from: http://www.infotoday.com/OnlineSearcher/Articles/Features/So-Now-What-The-Future-for-Librarians-86856.shtml

Díez, T. (2013). El nuevo ecosistema productivo: Fabricación personal, distributiva y abierta. Retrieved November 28, 2014, from: http://blogs.cccb.org/lab/es/article_el-nou-ecosistema-productiu-fabricacio-personal-distribuida-i-oberta

DIY book scanner. (2013). Retrieved December 2, 2014, from: http://www.diybookscanner.org

Epler, M. (n.d.). Kinograph. Retrieved December, 14, 2014, from: http://kinograph.cc

Gershenfeld, N. (2006) Unleash your creativity in a Fab Lab [Video file]. Retrieved November, 29, 2014, from: http://www.ted.com/talks/neil_gershenfeld_on_fab_labs

http://tclib.org/index.php/books/pages_tutorials/libraries_create_your_own_stand_alone_self-checker/

Flynn, S.X.; Oyler, C. & Miles, M. (2013). Using XSLT and Google Scripts to Streamline Populating an Institutional Repository. Code4Lib. Retrieved November 1, 2014, from: http://journal.code4lib.org/articles/7825

Ito, J. (2014). Want to innovate, become a "now-ist" [Video file]. Retrieved November, 30, 2014, from: http://www.ted.com/talks/joi_ito_want_to_innovate_become_a_now_ist

Kuznetsov, S. & Paulos, E. (2010). Rise of the expert amateur: DIY projects, communities, and cultures. In Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries (NordiCHI '10) (pp. 295–304). ACM, New York, NY, USA, doi:10.1145/1868914.1868950

Melody, C. (2014). Libraries & makerspaces: A revolution? Retrieved December 10, 2014, from: http://tascha.uw.edu/2014/06/libraries-makerspaces-a-revolution

Nee, B. (2013). Building a real-time transit information kiosk with Raspberry Pi. Retrieved November 20, 2014, from: http://blog.bn.ee/2013/01/11/building-a-real-time-transit-information-kiosk-with-raspberry-pi/

Negroponte, N. (2014). A 30-year history of the future [Video file]. Retrieved December, 3, 2014, from: http://www.ted.com/talks/nicholas_negroponte_a_30_year_history_of_the_future

Peterson, R. (2010). Editorial Introduction: The Code4Lib Journal isn't just for Coders. Code4Lib. Retrieved December 4, 2014, from: http://journal.code4lib.org/articles/4587

Raymond, E. S. (2001). The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary. O'Reilly & Associates, Inc., Sebastopol, CA, USA.

Rodríguez-Yunta, L. (2014). Ciberinfraestructura para las humanidades digitales: una oportunidad de desarrollo tecnológico para las bibliotecas académicas. El Profesional de la Información, 25, 453–462. Retrieved November, 30, 2014, from: http://dx.doi.org/10.3145/epi.2014.sep.01

Sangüesa, R. (2011). La tecnocultura i la seva democratització: Soroll, límits i oportunitats dels "labs". Retrieved December 4, 2014, from: http://co-creating-cultures.com/cat/wp-content/uploads/PAGESSanguesaLabDemocratizadors_LAST.pdf

Scott, D. (2014). Editorial introduction: On libraries, code, support, inspiration, and collaboration. Code4Lib. Retrieved December 4, 2014, from: http://journal.code4lib.org/articles/9987

Teton County Library (201?). Create your own Stand Alone Self-Checker. Retrieved December 1, 2014, from: http://tclib.org/index.php/books/pages_tutorials/libraries_create_your_own_stand_alone_self-checker/

Van der Jagt, W. (2014). How I built an audio book reader for my nearly blind grandfather. Retrieved November 1, 2014, from: https://gist.github.com/wkjagt/814b3f62ea03c7b1a765

Williams, A.; Gibb, A. & Weekly, D. (2012). Research with a hacker ethos: what DIY means for tangible interaction research. Interactions, 19(2), 14–19. doi:10.1145/2090150.2090156

Younker, J. & Ribaric, T. (2013). Beyond Open Source Software: Solving Common Library Problems Using the Open Source Hardware Arduino Platform. Partnership: The Canadian Journal Of Library And Information Practice And Research, 8(1). Retrieved from: https://journal.lib.uoguelph.ca/index.php/perj/article/view/2497/2873