

Raspberry Pi Driven Digital Signage

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Abstract

Loughborough University makes extensive use of digital signage to display rapidly changing information to its staff, students and visitors. Within the library, digital signage displays show PC availability, study and meeting room bookings, IT support information and details of forthcoming events. To drive the displays small, inexpensive and low powered Raspberry Pi computers are used. The low cost and ease of use of the Raspberry Pi based solution has allowed the Library to have far more displays in use than would otherwise be possible, which provides for an enhanced user experience in the building. This paper describes how Raspberry Pi's can be used to drive displays, shows some of the cost savings that can be made and looks at some potential future applications of cheap, digital signage.

Introduction

Digital signage is in widespread use within both academic institutions and the wider libraries and museums world. At Loughborough University we have used digital signage for many years to show actively changing information to staff, students and visitors. The use of digital signage can provide timelier and more up to date information to our patrons than traditional printed signage. In addition, it can also reduce the workload of library staff in putting up and taking down posters and increase the take up of library events and services as more patrons can find out about them.

Originally the University Library had a small number of display screens installed that used a commercially available digital signage platform. These worked but were expensive to run, as they required an annual licence payment on top of the initial hardware purchase. The screens in the University Library were installed and run by the central University marketing and catering organisations so tended to show University wide presentations such as daily campus wide menus and student recruitment information, rather than targeted library related information.

During a major refurbishment and expansion over the summer of 2013 there was the opportunity to investigate other options to see if costs could be brought down, while increasing the number and range of display screens available. The refurbishment included bringing an additional floor of the building within the Library's space to add more study rooms and student PCs, remodelling the entrance areas, and moving the main 'PC Clinic' support desk run by IT Services into the building. There was a desire within the library to use digital signage to show information that would directly benefit library users, such as the availability of student accessible PCs throughout the building, when group study and meeting rooms were booked, library opening hours, PC Clinic support information and advertise library provided events and services. Whilst the University Library was closed for the refurbishment, the library's Systems Team undertook to investigate and, if possible, develop a cheaper digital signage system ready for the reopening in September 2013.

The Raspberry Pi

One of the leading contenders for driving display screens was the Raspberry Pi[1]. The original Raspberry Pi had been released in February 2012 and, whilst originally intended to be used to teach computing to school children in the UK, rapidly found favour amongst IT professionals and hobbyists for a wide range of tasks. The Raspberry Pi was designed to be very cheap to make so that a complete system could be put together for around £50. Yet the machine, even in its first iteration, was surprisingly powerful. Although physically only slightly larger than a credit card, it ran the Linux operating system which gave it access to a large body of existing open source software, and could display High Definition (HD) video streams via an HDMI interface. Since then there have been a number of other versions of the Raspberry Pi produced, adding faster processors, more memory and wireless networking. There are also a number of similar low cost computing products now on the market from other suppliers.

The Systems Team had already looked at using Pi's to assess their suitability for low cost library catalogue terminals, so there was already familiarity with the machine and examples on hand to test with. To make the Raspberry Pi into a digital signage display screen driver, an open source version of the Screenly package was used. The free, open source version was chosen at Loughborough rather than the commercially supported version because the plan was to drive many of the screens from 'live' data sources that we already had available. This would entail some local code to be

produced anyway, so the control and uploading of other content such as static web pages and slide decks would be easy enough to add into this bespoke system. For other institutions with less technical support and only needing to display static web content, videos and presentations, the commercially supported version of Screenly may be more appropriate.

Initially there were two main types of digital signage that could be driven from existing data sources that the University Library was interested in: lab PC availability and group study room bookings. The Raspberry Pi's were coupled with either wall mounted TV screens (some of which already existed from the original commercial system), or in some cases reused LCD PC monitor screens from old, scrapped PCs. The latter was seen as a good way of repurposing smaller screens which had outlived the PCs they were bought with by many years.

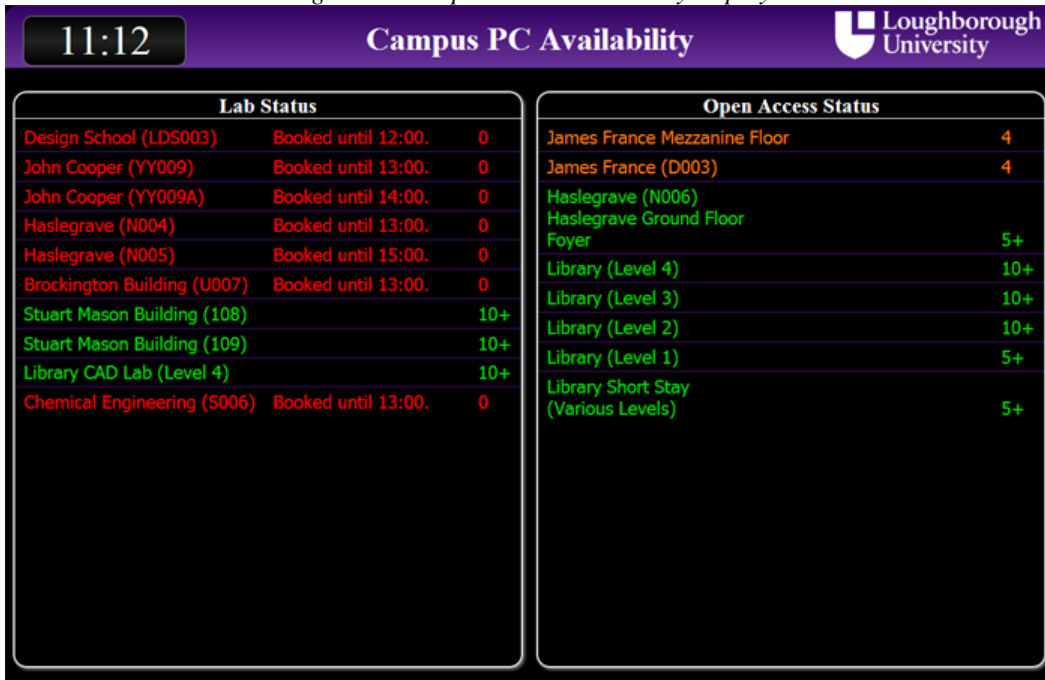
Lab PC Availability

The University Library at Loughborough hosts many 'lab PCs' that staff and students can use. Such computers are also available in 'PC Labs' housed in other locations across the campus. During busy periods, especially around exam time, students want to know where there are available, unused PCs. A few years before the display screens project, a mobile phone app was developed for the University Library that included this, amongst other information. The app made use of an 'Application Programming Interface' (API) running on back end servers to provide this information, which was reusable for the digital signage system.

The API works by extracting 'extension attribute' information from the University's campus wide Active Directory system. An extension attribute is configured to show when a machine has a user logged into it. Each PC Lab has a matching Organizational Unit (OU) in the Active Directory, which provides an easy way to retrieve the number of PCs in use within the PC Lab. To reduce the load on the Active Directory, this information is polled every few minutes and cached in a MySQL database on a separate server. To complicate things slightly, some PC Labs can be booked by lecturers for timetabled teaching, or by library staff for events. For these PC Labs the system therefore also checks the relevant booking system (either the University's central 'CMIS' timetabling system or the library's 'WUBS' web user booking system) to see if the room is booked (and thus unavailable regardless of the actual usage of its PCs).

The API is used to generate a web page shown in Figure 1 that displays potentially bookable PC Labs in one column, and 'open access' (unbookable) lab PC areas in the other, showing how many PCs are available. Where large numbers of machines are available in a PC Lab it just shows '5+' or '10+' machines available to disguise any students working alone in a lab.

Figure 1 : Campus PC lab availability display



Group Study Room Bookings

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The University Library has several 'group study rooms' and meeting spaces that are bookable by both staff and students. The bookings are made using the locally developed Web User Booking System (WUBS)[2], which again had an API available to provide booking information for each room. The digital signage system makes use of this API to generate a web page for one or more resources that, for each resource, lists the surname of the person who made the booking and the start and end times of the booking slot. Depending on the number of resources being shown, either a full list of bookings for that day will be shown, or a 'reduced' showing just the previous, current and next booking for each resource.

The group study room displays are 'branded' with a different colour for each floor of the library as shown in Figure 2. The displays are again updated every two minutes, and show the last update time on the screen so that people know that it is up to date information. This also allows library staff to report screens that fail to update occasionally- this often indicates that the actual TV display screen has crashed or the Pi has lost its network connection, which sometimes happens after power outages. The only major recurring issue with the Pi's themselves have been with the 'SD' memory cards that hold the operating system and software failing. This happens relatively infrequently and is most probably due to the Pi's being turned off while writing to the 'SD' memory cards. As 'SD' cards are sufficiently cheap and widely available that spares can be kept on hand to allow rapid repairs.

Figure 2 : 'Branded' group study room display screen



Other current uses for the Pi driven display screens

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Once the data feed driven PC lab availability and group study room booking displays were working, attention could turn to the other types of information that the University Library and IT Services wished to display in the building. Most of these have been either static web pages, or presentations, often to promote events or workshops. Control of the content that is displayed is delegated to library staff via a locally developed web interface so that involvement by technical staff is minimised.

The admin interface allows displays to be grouped together and staff can be given permissions to access the group. This has also allowed the system to easily spread to departments outside the Library. In the four years since its introduction the number of Raspberry Pi driven displays have grown from the initial 7 deployed in the Library to over 100 deployed across two campuses. Content being shown includes individual lecture room timetables, departmental course information and even student committee information in one Hall of Residence.

An example of such a display in the library is at the main entrance where there is a vertically oriented TV screen facing externally that is used to display the library's opening times. The opening hours vary throughout the academic year, with more restricted opening times during vacations and 24/7 opening at exam time, so this is very helpful to library users.

Conclusions and future ideas

The use of Raspberry Pi computers to drive digital signage display screens has been a great success at Loughborough University, and would probably work well in many other academic institutions, libraries and museum settings. The low cost of the Pi coupled with the lack of annual licence costs and low power usage means that it is a very economic device for such signage systems, especially if some of the display screens themselves are low cost TVs or reused computer monitors.

The low cost also means that it is practical to experiment with the Pi based displays for new applications without a large project budget. For example, at Loughborough a prototype self-help kiosk has been developed using a Pi driven touch screen to allow students to select a common IT problem they have been having and then watch a short video demonstrating how it can usually be solved. This can be used to reduce the demands on the IT Services PC Clinic in the library at the start of term, when large numbers of students arrive wanting to connect their devices to eduroam wireless networks, configure their email clients or use the printing system. Another idea that has been mooted is to use a screen to display the University Library's social media feeds, to both encourage local users to subscribe to them and also

let visitors see what the library is promoting via those mechanisms.

References

- [1] Raspberry Pi Foundation, 2018, Raspberry Pi – Teach, Learn and Make with Raspberry Pi, [online] [2018-02-03]. Available from: <https://www.raspberrypi.org/>
- [2] Loughborough University, 2004, Web User Booking System, [online][2018-02-03]. Available from: <https://sourceforge.net/projects/wubs/>