Kiosks are Breaking Through the Digital Divide in Africa

First Among Equals

By Grant Cambridge, co-authored by Ronel Smith and Kim Gush

As most experts on Africa will tell you, the best way to bring the continent's rural communities out of poverty is to give people the tools and skills they need to do the job for themselves – an objective that the Digital Doorway project is tackling head on.

The Digital Doorway is a joint project between the South African Department of Science and Technology (DST) and the Meraka Institute, aimed at the promotion of computer literacy and associated skills in Africa. The assumption is that people have the inherent cognitive ability to learn computer skills with minimal external intervention. However, computers must be easily accessible to potential learners in an environment conducive to experimentation. Apart from the ability to read text, literacy involves image and screen literacy and, particularly, information navigation. The information provided by the Digital Doorway enables learning by 'discovery' rather than by 'lecture'.

In the introduction to South Africa's National Research and Development Strategy (2002), President Thabo Mbeki recognised Information and Communication Technologies (ICT) as powerful engines for economic growth and productivity. Debate about harnessing ICT for development, narrowing the 'digital divide' and creating a more inclusive society is ongoing, but tends to ignore the practicality of introducing ICT to the rural population. Major obstacles include the lack of technical expertise in the communities, extreme environments, illiterate or non-English speaking users, vandalism and maintenance costs.

The inaugural Digital Doorway installation in South Africa was completed in 2002 in Cwili, a rural village, outside the mouth of the Kei River in the Eastern Cape. The initial system was based on a standard low profile desktop computer running MS Windows, a miniature keyboard and a 15-inch LCD screen mounted behind a 3mm thick sheet of clear perspex. To capture data for proof-of-concept and research purposes, a surveillance camera was installed in the ceiling above the Digital Doorway. Another server was installed inside the adjacent building to capture video footage from the camera.

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The first challenge was preventing the theft of plastic key caps from the keyboard. A stainless steel cover plate was developed to fit over the standard cheap miniature keyboard, still allowing users access to the keys, while preventing the removal of key caps. Eventually, the team implemented the ruggedised EAO Secme W-series keyboards with a touchpad. Other problems included the Windows temporary directory file being used up and not cleaned, open windows causing the computer to freeze, the opening of multiple instances of an application and the creation of too many desktop shortcuts by users. The most serious problem the team faced was the theft of the video server.

Research by a local cognitive scientist produced promising results. User age ranged from primary school children to young and older adults. Familiarity promoted spontaneity, longer visits and increased user confidence. The most spontaneous participants were younger children in larger groups of 12 and more. Typical visits lasted between 30 and 60 minutes. Passive participation changed to active use as user confidence grew, and computer literate users became leaders and demonstrated skills. Competition stimulated peer learning among the younger children, while collaboration was the preferred learning method for young adults.

Phase 2 of the project included changing the single-terminal commercial kiosk to a custom-designed four-terminal kiosk. The computer was changed to the HP441 solution (using Mandrake 9,1) which allowed four terminals to run from a single computer. The video server was also moved inside the ruggedised steel housing and MS Windows was switched to an Open Source solution. With project expansion, a ruggedised, vandal proof kiosk was designed to house the computers in areas with limited basic infrastructure. Moisture, internal heat from components and external environmental heat contributed to environmentally based field failures. Damage from moisture arises from rain, high humidity or drinks spilled by users; other problems are dust ingress and high daytime temperatures.

Accessible to All

The Digital Doorway housing was designed according to the following principles: international ergonomic best practices to ensure use by the widest group of potential users; ruggedised construction to minimise vandalism and high usage; attractiveness; an attractive installation site; easy maintenance; minimal unauthorised access; minimal installation time; easily modifiable equipment to keep pace with updated hardware specifications; minimal heat build-up inside the housing; and cable access through the roof, the floor or the rear panel, or a combination thereof.

Phase 2 also entailed designing two systems for physically disabled users at a school in Shoshanguve, north of Pretoria. To cater for users with little or no fine motor skills, a USB Joystick was developed with 40mm diameter ruggedised mouse buttons. The software recognises the Joystick as a mouse and uses the standard USB mouse drivers. Two terminals were lowered and widened to allow wheelchair-bound users access. The two standing terminals were fitted with grab handles to assist standing users. The software was modified to incorporate as many Universal Access applications as possible. A high contrast clean background option for visually impaired users, and a terminal for blind users that used Fedora Core 5 and an application (Speakup) to read

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screen text to users were also provided.

In total, twenty-four HP441 based systems were deployed using the four-terminal configuration. In late 2005, HP stopped selling and supporting the HP441 product and an alternative was sought. The criteria were a truly Open Source operating system and a platform that would enjoy long-term support. A Ubuntu Linux (Dapper Drake 6.06 LTS) was selected as the operating system and the architecture was changed from the HP441 solution to a single server and multiple Fat Clients. To minimise the processing load on the server and the Fat Clients, Xfce was selected as the Graphical User Interface (GUI). Xfce is a lightweight desktop environment for various LINUX systems, which loads and executes applications fast, while conserving system resources. The change in system architecture made the system easily extendible. The number of Fat Clients deployed is determined by the speed of the network cards and the switch used.

The primary reason for the change from MS Windows to Open Source was the ability to control the Operating System and its response to anomalies. Several scripts were written to perform basic management functions automatically: repairing most file system errors automatically every 30 reboots and cleaning and restoring the original desktop and applications nightly. This reduced software maintenance, which, in deep rural installations, is extremely expensive.

Following findings of social and cognitive research, the standard Digital Doorway was reduced from a 4-terminal to a 3-terminal system in Phase 3. Thus, costs were reduced, more Digital Doorways deployed and the installation time was reduced as cable routing was simplified. The 3-terminal housing also has a smaller footprint which addresses the space constraint in rural communities. During this phase, the kiosk design evolved to facilitate simpler installation and cable runs.

Effective e-inclusion projects require fresh and interesting content. Users' early misconceptions change to excitement by the end of the installation. Sustaining this excitement is dependant on the quality, quantity, variety and relevance of the content. Users soon become familiar with the experience; if no new content is available, boredom sets in. However, the regular provision of updated, relevant content encourages users to move from familiarity to peer learning and eventual competence. To address this problem, the Digital Doorway system is fitted with a broadband satellite multicast solution for the downlink and a GSM Cellular GPRS backhaul. This allows the project team to provide additional content, fix bugs in the operating system and provide users with a text-based feedback mechanism. The GPRS backhaul is also used to obtain statistics from the system to determine if it is still operational and provide data on which applications are being used. This allows us to track trends and identify the most popular applications.

Stronger Arguments

Vandalism has been addressed by designing a robust steel cabinet that is easily configurable to either three- or four-terminal systems. The kiosk consists of approximately 157 individual components fabricated from 1,6mm mild steel sheet. The sheet that protects the LCD screen is a 3mm Lexan Polycarbonate sheet, approximately 250 times stronger than glass; its tensile strength is between 55 to 75 MPa. Only 12 of the 400 screens currently deployed have been vandalised. Although the EAO Secme keyboards are very rugged, seven of the 400 keyboards have been seriously damaged. The most common problem is is the touchpad being forced through the keyboard and underlying electronics. To overcome this, a steel sheet will be placed beneath the touchpad to prevent flexing if struck. Of the 125 Digital Doorways currently deployed, two housings were burgled. Most acts of vandalism occur in communities close to larger towns where there is limited community ownership.

Multilingual content appropriate for the Digital Doorway users presents a challenge. Some applications used, such as Open Office, are available in more than one language and two local games available in multiple languages have been developed. However, a large proportion of registered users have stated that English is their home language (29,8%) and their preferred language (57,5%). In spite of this barrier, all users can benefit from applications, such as mathematics games, science simulations and logical games. Games that generate noise and use bright colours and a local snapshot of the Wikipedia on the Digital Doorway are extremely popular with teachers and children.

By the end of March 2008, 200 Digital Doorways will have been deployed in South Africa.

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