Collaborative Development for the XO Laptop (CODEX 2)

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Abstract

At the University of Lincoln undergraduate students are given the opportunity to take part in an Undergraduate Research Opportunities Scheme (UROS) which allows students to not only contribute to a particular field of research but also to enrich knowledge and understanding of the chosen research topic. Students could also gain an understanding of the processes and activities entailed when performing a research project. The UROS research project is normally undertaken by students who will be commencing their third year of study and carried out over the summer period under the supervision of a member of academic staff at the University. The students are "embedded" with an existing research group and work along side other researchers in the group.

The Centre of Research for Open Source Software (CROSS) ran by the Department of Computing and Informatics at the University of Lincoln offered students the opportunity to research into the Collaborative Development for the XO Laptop (CODEX). The aim of this project is to provide an easily accessible Open Source platform within which students are able to develop activities for the One Laptop Per Child (OLPC) XO-1 laptop as well as create Open Source applications and contribute to the OS Community. Under the supervision of Professor Cornelia Boldyreff, two students (Andrew Garbett and Karl Lieser) were tasked with continuing the initial research and development undertaken by James Munro on the original CODEX project.

The CODEX 2 project has managed to produce sufficient tutorial materials for new students to begin development for the XO laptop utilising a development environment that met the requirements of the project and thus resulting in a successful research outcome.

1.1 Introduction

The One Laptop Per Child (OLPC) scheme aims to "create educational opportunities for the world's poorest children by providing each child with a rugged, low-cost, low-power, connected laptop with content and software designed for collaborative, joyful, self empowered learning. When children have access to this type of tool they get engaged in their own education. They learn, share, create, and collaborate. They become connected to each other, to the world and to a brighter future." (OLPC, 2009) In order to provide the learning experiences for the users of the XO 1 laptop, Open Source developers are required to contribute their own time and effort to create useful, educational and enjoyable applications; and Computer Science students have been identified as an excellent source of volunteer developer effort.

The first One Laptop Per Child XO 1 laptop used an Open Source distribution of the Linux operating system known as Fedora (Fedora Project, 2009) which was coupled with

Sugar (Sugar Project, 2009), a Graphical User Interface, which aimed to be as multilingual as possible through the use of illustrative graphical icons rather than text. In doing so the XO 1 does not conform to modern operating system norms, most notably, Sugar does not contain a taskbar or 'start menu' but rather different levels at which the user is able to interact with not only their own laptop but also others in the close surroundings. The laptop uses activity based operations rather than a tree structured collection of documents and applications and can be seen as quite esoteric at first. However developers insist that the interface encourages all its users to learn through experiences rather than prior knowledge of similar products (Sugar Project, 2009). Therefore developers hoped that likeminded individuals would create activities that would continue the learning process and aid to a child's educational experience.

In order to encourage further application development for the XO 1 laptop, the Centre of Research for Open Source Software (CROSS) at the University of Lincoln accepted the challenge and offered the opportunity to student developers at the university a chance to contribute to the worldwide Open Source community. The CROSS was granted funding to begin a student led project known as Collaborative Development for the XO Laptop or "CODEX" (CODEX Project, 2008) and it was initialised with the aim of bringing an easily accessible development environment to the students at the University of Lincoln in the hope that they too would also become a part of and contribute to the OS community. The initial research was undertaken by James Munro (Blog JMunro, 2008) at the University of Lincoln as part of the Undergraduate Research Opportunities Scheme, under the supervision of Professor Cornelia Boldyreff. The CODEX project produced a Live CD that contained Sugar development software as well as a wiki (CODEX Wiki, 2008) which contained tutorial information about the setup processes involved. Included in this was the publication a report to the community at the Fifth International Conference on Open Source Systems held during June 2009 (Boldyreff *et al,* 2009)

1.2 Project Aims

The principle aims of Codex 2 project, as initially outlined in the project brief, have been to follow on from the goals from the previous Codex 1 project. These objectives were to investigate the OLPC and Sugar projects in order to develop methods by which student researches and the outside community alike, could contribute towards developing activities, i.e. applications, for the Sugar interface. These methods would be supported via producing a suitable development environment, accompanying documentation and tutorial content that could be used in aid of activity development. Throughout both CODEX projects, the overall aims have remained the same and are as follows:

1. Identify a suitable development environment for Sugar activities
2. Modify and develop a development environment for student use
3. Produce tutorial content and documentation as a student aid
4. Develop example activities using the environment

Within the Codex 2 project, there were a number of initial sub goals identified in order to build on from previous work completed. These were to update the Live CD which had already been produced, via providing a more up to date software distribution and more

suitable means for publication via LiveUSB drive; replacing the LiveCD; and to use the software provided on the LiveUSB to develop further activities for Sugar and then produce tutorial content and documentation on how to do so.

1.3 Project Process & Accomplishments

As proposed by the brief, the Codex 2 project was envisaged to involve three main phases, these being:

- Investigation phase, whereby background research on all areas of the project could be accomplished, including OLPC, XO Sugar Software and results achieved in previous Codex project.
- Development phase, allowing the LiveCD to be updated into a more enhanced version on a more suitable medium.
- Trial and Evaluation phase, where by applications could be developed using the deliverable from the previous phase, and production and updating of the current tutorial guide and documentation could take place.

Many of the initial presumptions from the brief of the project were soon found to be unwarranted once the research got under way. Details of how the research actually progressed was been recorded in the blogs that were kept by the two CODEX 2 student researchers. This was accomplished through the use of Lincoln University Blogging system (Blog KLieser, 2009; Blog AGarbett 2009).These have provided a public record of the research and development of the project to be archived, thus producing a useful resource future participants in the CODEX project.

Collaborative software technology has also used in order to consolidate results from CODEX 1 and CODEX 2; and to manage information during the production of the tutorial content and further documentation. These came in the form of the project Wiki (CODEX 2 Wiki, 2009) which allowed for the information produced within the blogs and via research to be filtered and an online repository Git Hub (GitHub Repo 2009) whereby storage of documentation and produced software such as activities could be managed and stored.

Before the start of the CODEX 2 project, the knowledge of the student researchers in the area of open source operating systems and subject areas of the project was limited, and so during the start of the research, time was spent investigating and getting up to speed with four main areas:

1. Understanding and Using Linux, in particular Ubuntu and Fedora;
2. Understanding and Learning to script in the Python Programming Language;
3. Testing the required software for emulation and porting operating systems to USB devices; and
4. Investigating Codex 1, OLPC & Sugar projects, and other background research.

In addition to the initial research into the required fields of knowledge, both researchers made contact with the online community, thus creating working ties from which help and support could be obtained in the later stages of the research. It soon became clear after investigations

began that the OLPC and Sugar projects had made substantial progress from previous summer's research reported on the original Codex 1 project, and that much more information and online community presence was now available.

The discovery of the release of "Sugar on a Stick" which officially allowed the online community to download and create a version of the Sugar version on a USB storage device meant that CODEX 2 meant it was no longer necessary to develop a liveUSB. The second important discovery was that finding that Sugar had been included in the Fedora Linux distribution which allowed users to directly download Sugar to be emulated through the Fedora Package Management System. The Sugar Project had made substantial progress with their online presence, with an abundance of information on all aspects of Activity and Sugar Interface Development and the availability of "Sugar JHBuild", a repository of the latest Sugar Interface source code.

Although these discoveries meant that some of the initial CODEX project outputs had now become obsolete; such as the Ubuntu LiveCD. It could be replaced by either "Sugar on a stick" or a Fedora installation with Sugar Installed, which could also be ported to a USB drive with ease. With the ability to obtain either a built version of Sugar, or its latest released source code; included with the availability of an abundance of tutorial content in helping to develop for Sugar, the research focus shifted, with attention being focused to a related complementary project called "Fedora Edu Sig",(Fig1.0) as proposed by some of the online Fedora / Sugar development community (Edu Sig, 2009).

Fig .1.0 Fedora Edu Sig Logo

Here an educational "spin" of the Fedora software was being developed, which was to include Sugar pre installed for easy use to port to USB devices (Fig.1.1); along with developing tutorial information on how to download and install. These goals fell in line with the objectives outlined in the Codex projects; and this allowed researchers' time to be spent in helping the current developers of the "Fedora Edu Sig" to build, port and test the software in preparation for its final release.

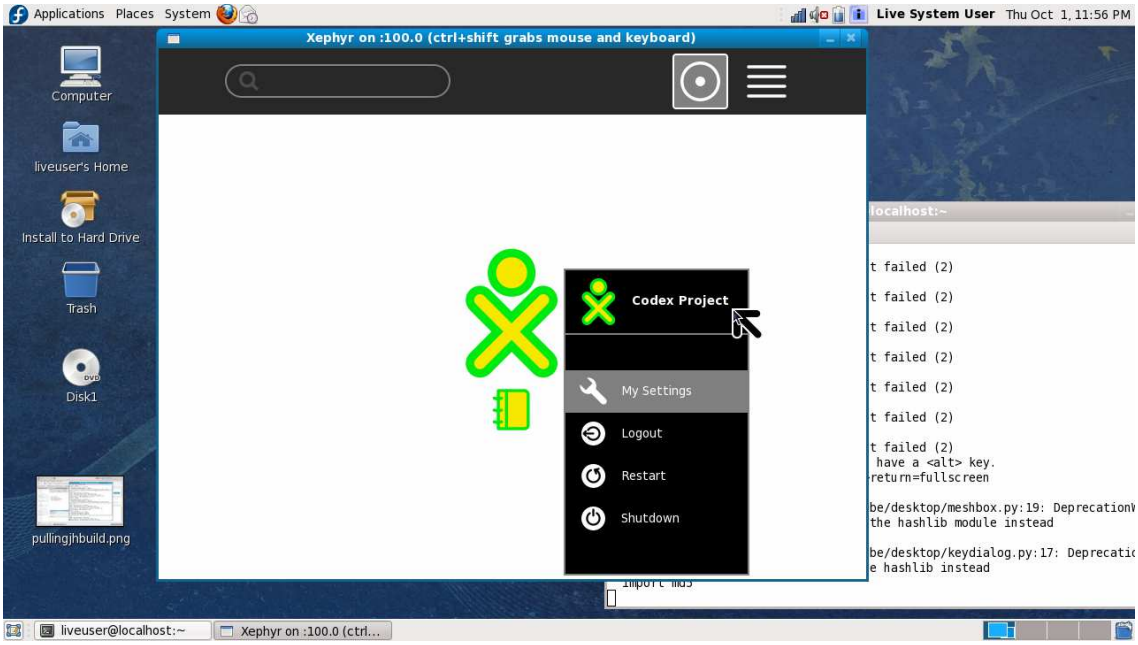

Fig .1.1 Edu Spin Emulating Sugar

Although much of the information on all areas covered thus far is available online, researcher time was needed to locate and digest it. There was no single central on-line source that could send researchers who had objectives such as the Codex 2 project in the right direction. Although tutorial content for activity developers was located, some of the current tutorial content already developed needed more explanation for entry level student developers, and thus it was proposed that a primary output of the Codex 2 project could be the development of a knowledge base or "gateway" that student developers could use to find all relevant links, along with the production of short tutorials that would complement existing information to allow beginner users such as new student researches to easily get up to scratch with developing activities. These new outputs now form the base of the content in the Codex 2 section of the project Wiki, and additional content in Git Hub with these developments being recorded in the project blogs by each student researcher.

The CODEX 2 project team were invited to attend the Summer 09 Open Source Schools Nottingham 'Unconference' (OSS Unconference, 2009) which allowed the student researchers to not only participate in talks, but also present materials, raise awareness and demonstrate the knowledge learnt about the OLPC, Sugar Interface and Sugar on a Stick projects by helping in the Sugar (OLPC) presentation, along with an unintentional and unprepared video interview which was taken (CODEX 2 Video, 2009). A project poster was also produced and distributed at the Unconference (CODEX 2 Poster 2009).

This attendance gave the student researchers an opportunity to engage in dissemination activities normally associated with academic research and gain feedback from a wider potential user community in schools.

1.4 Comparison of Work

Throughout the CODEX project lifecycle the aims have remained the same and have been as follows:

1. Identify a suitable development environment for Sugar activities;
2. Modify and develop a development environment for student use;
3. Produce tutorial content and documentation as a student aid; and
4. Develop example activities using the environment.

The CODEX 2 project aimed to take the idea of creating a development environment and make it more accessible to students by offering a bootable persistent USB pen drive with preinstalled software. Much like its predecessor, the CODEX 2 project's main output took a form of portable medium and provided a development environment for the potential student developers.

However, with new addition of the bootable pen drive the CODEX 2 project has excelled in comparison with the initial project. This is because the 'Edu-spin' USB can be more easily kept up to date through the use of a persistent USB drive rather than being a 'burn once' CD that quickly became out of date.

Other benefits of the persistent storage include the obvious ability to store the student user's files and being able to transport them with the development tools available. This is arguably the biggest improvement yet as it allows truly portable development from almost any computer. Another aspect of availability is the ability to install the environment on different sized pen drives as well as the ease at which the user is able to do so, this allows developers to download additional software and install it within the operating environment. As almost all modern computers used by students have USB ports, the development of the persistent pen drive environment has meant that the students was able to utilise the Sugar development environment with most computers rather than having to ensure that the machine had a CD drive to boot up the original CODEX 1 disk.

A disadvantage of having this USB driven design is that there are some motherboards that do not allow the user to boot from USB. It has also been found impossible to boot from USB on some networked computers where the administrator has locked the BIOS settings and thus disallowing the user to select 'Boot from USB'. A further issue with the Edu-spin approach is that the environment had been cut down extremely with regards to non-essential software and driver files. This stripping of non-essential files may interfere with some student user's software and hardware requirements and thus reduce the effectiveness of the USB by not including certain code libraries and drivers. Although USB drives are limited in size, it has to be said that there is a good improvement on the storage space available when compared to the original Live CD produced in the CODEX 1 project.

1.5 Further work

Further development for the CODEX project may include a deployment plan in order to provide the students of Lincoln University with all the resources required to obtain the development environment. This may include the physical aspect of deployment such as

looking into the distribution of the necessary software from a central or multiple locations. Other aspects concerning the deployment are areas such as the rebuilding and updating of the development environment ensuring that software, bookmarks and tutorial materials are relevant.

Since USB drives are expected to increase in size, users will soon be able to store many more files on their drives. With this being the case an investigation in future could consider what other software and files that are required to extend the effectiveness of the current distribution.

1.6 Conclusion

The CODEX 2 project has been successful in meeting the initial project aims; and, most importantly, the students undertaking the UROS project have gained an insight into collaborative development within the wider Open Source community. Alongside this the students have also been given the opportunity to work with Open Source tools and environments, and have had the chance to learn new skills such as python development and wiki editing.

The students also attended an Open Source conference and had the chance to listen to new and exciting ideas from Open Source developers in the open source and education communities. Whilst undertaking the CODEX 2 project all research materials and ideas have been recorded on two separate blogs which show the progress of the project.

The project managed to produce an abundance of tutorial materials for new students to use when they begin developing activities for the XO laptop as well as providing students with an Open Source development environment which can be installed upon a persistent USB pen drive. The CODEX project can definitely provide other students with interesting challenges and topics to research in the near future.

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