



University of Fort Hare
Together in Excellence

**Implementing a robust, cost effective,
e-commerce platform for a
disadvantaged community of the
Eastern Cape, South Africa**

A thesis submitted in fulfillment of the requirements of the degree of

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In

Computer Science

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by

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Declaration

I hereby declare that the content of this research work is my original work. Information extracted from other sources is acknowledged as such.

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Abstract

The development of electronic commerce (e-commerce) is the most visible business use of the World Wide Web. The primary goal of an e-commerce site is to sell goods and services online. This project deals with developing an e-commerce platform for marginalized communities of the Eastern Cape region, South Africa. An online “shopping mall” to support the marketing of art and crafts from disadvantaged communities is presented, with Linux-Apache-MySQL-PHP (LAMP) as the development environment. Free and Open Source Software has been chosen to develop the virtual shopping mall system because the use of Open Source allows easy localization and extensions to the system developed and long term sustainability, as the source code is available. Also, it might start a “virtuous” circle, whereby young members of the communities hosting art and craft makers become involved in maintenance, and then production, of software systems.

One important design constraint from the e-commerce platform presented in this thesis is the possibility for the art and craft makers to manage their shops directly, from the initial loading of their wares to the day-to-day maintenance, such as changes of price or items. The user requirement elicitation and initial field testing were conducted in Dwesa, an area on the wild coast, South Africa. The system currently comprising two shops is live at the time of writing this thesis at www.dwesa.com.

Table of contents

Chapter 1: Introduction

1.1	Introduction.....	2
1.2	Project Background.....	2
1.3	Research problem.....	3
1.4	Aim and objectives of the project.....	4
1.5	Project context	5
1.6	Contribution of the thesis.....	6
1.7	Structure of this thesis.....	7
1.8	Conclusion	7

Chapter 2: Literature review and related work

2.1	Introduction.....	9
2.2	ICT in rural areas for development.....	9
2.2.1	The research site: Dwesa	10
2.3	Nature of e-commerce in Rural Communities	11
2.4	Case studies.....	14
2.5	E-commerce Platform Development Theory	17
2.6	Conclusion	19

Chapter 3: System requirements, methodology and core technologies

3.1	Introduction.....	21
3.2	System requirements and assessment	21
3.3	Shopping mall roles	22
3.4	User Functionality Diagrams	23
3.5	Methodology and Core Technologies.....	25
3.5.1	Client-side scripting.....	25
3.5.2	System Front-end.....	25
3.5.3	Front-end technologies.....	27
3.5.4	Server-side scripting	30
3.5.5	System back-end	30
3.6	Conclusion	31

Chapter 4: Shopping mall design and development

4.1	Introduction.....	33
4.2	System Architecture.....	33
4.3	Front-end design and development.....	34
4.3.1	Shopping mall website.....	34

4.3.2 A walk through the mall	38
4.4 Back-end design and development	48
4.4.1 Administrator component	48
4.4.2 Seller component	49
4.4.3 MySQL database design	50
4.5 Conclusion	54

Chapter 5: Shopping mall implementation

5.1 Introduction.....	56
5.2 MySQL database.....	56
5.3 Shopping cart implementation	58
5.4 Administration of the system.....	61
5.5 Shop management.....	64
5.6 Client-server communication via HTTP protocol.....	65
5.7 System Security	67
5.8 Conclusion	72

Chapter 6: Results, evaluation and future work

6.1 Thesis summary	74
6.2 Discussion.....	74
6.3 Field evaluation of the project	78
6.4 Results attained	79
6.5 Future work.....	80

Acronyms

Acronyms.....	81
---------------	----

References

References.....	82
-----------------	----

Appendices

Appendix A: System installation and setup.....	91
Appendix B: System administrator manual	94
Appendix C: Shop owner's manual	108
Appendix D: MySQL dump file	120

Table of figures

Figure 1: User functionality diagram.....	24
Figure 2: System Architecture	33
Figure 3: Dwesa artifacts and traditional clothes.....	36
Figure 4: Website navigation menu	37
Figure 5: Website logo.....	37
Figure 6: Shopping mall index page	39
Figure 7: New user registration.....	40
Figure 8: Suggestions.....	41
Figure 9: Shopping cart.....	42
Figure 10: Checkout process.....	43
Figure 11: Shipping calculation	44
Figure 12: Electronic payment system.....	46
Figure 13: Purchase history	47
Figure 14: Administrator interface.....	48
Figure 15: Seller's interface	49
Figure 16: Database ER diagram	50
Figure 17: Database tables with their fields.....	51

Chapter 1

Introduction

This chapter starts by providing a general background for the development of an e-commerce platform for disadvantaged communities. The chapter outlines the research aim and offers a justification for its relevance.

1.1 Introduction

E-commerce is fast gaining ground as an accepted and used business paradigm. More and more businesses are implementing websites providing functionality for performing commercial transactions over the web. It is reasonable to say that the process of shopping on the web is becoming commonplace. This thesis will deal with the construction of a virtual “shopping mall” for a marginalized community in Dwesa, South Africa. The term “shopping mall” refers to the fact that more than one shop at the time is supported by the system, to cater in an economic and efficient way for micro-business in the area, which have problems in marketing their wares and have not yet been touched by the Internet revolution.

1.2 Project Background

For the purpose of the work reported in this thesis, e-commerce needs to be seen within the wider context of the “digital divide” that separates the developed and developing world. Developing countries, among which one should put South Africa for the majority of its territory and social make, have great potential to compete successfully in the new global market, but unless they embrace the Information and Communication Technologies (ICTs) revolution rapidly and actively use the ICTs for knowledge dissemination, this potential will not be realized. Amongst the many obstacles hindering the diffusion of ICT in developing countries, the lack of sufficient and efficient technological infrastructure is an obvious and prominent one. But so is the lack of knowledge and training for managing ICT platforms, and the availability of appropriate ICT tools and applications.

(Odedra-Straub M., 2003) classifies developing countries as having poor telecommunication, poor transport systems, poor electronic payment systems, no security, and no skilled workforce. This lead to lack of knowledge on the benefits from e-commerce and if knowledge is present, the implementation of e-commerce projects for marginalized communities is still not undertaken for lack of resources.

The potential benefits for rural entrepreneurship through e-commerce include lower distribution costs, improved marketing links, increased productivity and higher profits. The deployment of telecommunication facilities in remote marginalized communities enables the rural communities to get access to ICT and offers huge potential to empower people to overcome development obstacles (Muniafu et al., 2005) (Jacobs SJ. and Herselman ME., 2006).

The growth of information technology and communications is rapidly changing the way people interact with each other. The Internet provides a platform for new services which are of benefit to rural productivity. It also enables interconnection of business activities within and between enterprises, and with markets, which bypass many of the traditional information exchange (Maclay C.M. and Best M.L., 2002) (Herselman M.E., 2003). Until recently, e-commerce was feasible only for large companies. The Internet and the World Wide Web make it possible even for small businesses to compete with large companies. E-commerce allows the companies to conduct business 24 hours a day, 7 days a week, worldwide at a relatively very low cost.

1.3 Research problem

South Africa has a population of over 45 million people, distributed in nine provinces with diverse cultures, languages and beliefs. The Eastern Cape, where the community to be served by the e-commerce platform developed in this thesis is located, is the second biggest province. The majority of the population speaks isiXhosa which is spoken by 17.6 % of South African population (SouthAfrica.info, 2007) (World Factbook., 2007) (Statssa., 2007).

The age distribution of the population in Eastern Cape is similar to that of South Africa as a whole, and among Africans in particular, mirrors that of a developing country. The province is characterized by a low access to basic facilities including sewage disposal, reticulated water and electricity (Vuvuzela, 2007).

While having a comparatively large population, most places in Eastern Cape are still developing and there is a high demand of more ICT infrastructure needed by the “still

growing” areas. ICT infrastructure is present and developed in urban settings, especially in the previously white areas, but these areas are scarcely representing the situation for the majority of the province.

In most of the rural areas in the Eastern Cape region there are talented people with skills in the production of traditional as well as contemporary art and craft as well as an interest in offering services to tourists, but their skills are not exposed to the rest of the world due to lack of marketing services and infrastructure. The diversity of the art and craft produced in the Eastern Cape is outstanding and ranges from historic indigenous items of Xhosa culture (traditional beadwork and attire) to contemporary beadwork, sewing.

Thus there is a need for ICT infrastructure deployment in the rural communities of the Eastern Cape, at the very least, both in terms of connectivity to the Internet and in terms of relevant applications. This thesis focuses on the application development, focusing on a shopping mall system adequate for rural communities. Other interventions, in particular the provision of Internet connectivity, are out of the scope of this work and can be found, in summary form, in (Dalvit L. et al, 2007). The research problem is the result of the fact that different communities require different software, which must respond to different constraints. In this case, the software must be inexpensive (ideally, free of charge), ready to be put to use in the simplest possible manner by unskilled users, and sustainable. Also, it should help bridge the hosting community (especially the youngest part of it) into the knowledge era, both as users and software writers.

1.4 Aim and objectives of the project

“The aim of this project is to design, develop, implement and field-test the prototype of a simple, cost-effective and robust, integrated e-commerce platform for deployment in marginalized and semi-marginalized communities in the Eastern Cape region, where a large part of the South African population live. These communities, by sheer size and because of current political dynamics, represent a strategic emergent market” (Terzoli A. et al, 2004). A virtual shopping mall software application as part of the e-commerce platform will help the small entrepreneurs to sell their art and craft products developed.

The objectives of this project can be summarized as follows:

- To allow local small entrepreneurs in the rural communities of the Eastern Cape, producing art and craft to market their goods world wide.
- To develop a simple prototype of integrated e-commerce platform applicable in disadvantaged communities, where art, craft can be bought simply through the Internet.
- To investigate the art and practice of deploying a virtual shopping mall in a rural context.
- Investigating the e-commerce platform user's requirements for adequate system design and implementation. This is important as it is the driving force to a well trustworthy system.
- To investigate the sustainability issues of the virtual shopping mall system in the context of a rural community profile.
- To attract more, still growing rural entrepreneurs and individual groups producing craft work to join the already existing group and thus improve on the range of goods offered.

1.5 Project context

The idea of the virtual shopping mall website is to attract customers who have an appreciation and interest for Eastern Cape rural community's traditional art and craft. These can be people who have not necessarily been in Eastern Cape, South Africa, but people with an affinity for novel and decorative artifacts which often carry meanings from a different culture.

Some of the target customers will include:

- Individuals from all over the world including South Africans, who will typically buy the art, craft and have an interest on the traditional wearing and culture of the rural communities in the Eastern Cape.
- Individuals who would like to explore the heritage that is being adopted by the rural community members.

The e-commerce platform developed is to be field tested at Dwesa rural community. The Dwesa project is being undertaken by the University of Fort Hare in a joint venture with Rhodes University. It aims to develop and field-test the prototype of a simple, cost-effective and robust, integrated E-business platform in the rural communities (Siyakhula project, 2007). An overview of the Dwesa rural community will be given in more details in chapter 2.

This project also goes in hand with other research projects (within the Dwesa Project) carried out by the Centre of Excellence in developmental e-commerce at the University of Fort Hare. One of the research projects evaluated Free Open Source Software (OSS) used to implement Java based e-commerce applications where the aim was to look at one of the challenges faced by Small to Medium Micro Enterprises (SMME). This research helped in finding out the various features and functionalities needed in developing a suitable e-commerce platform for rural small entrepreneurs (Msimanga et al, 2003). Another project is based on providing Internet connectivity using the VSAT and providing local loop access through a WiMAX connection for the rural communities (Mandioma et al, 2006) (Rao et al, 2006). The network infrastructure is deployed at Dwesa rural community where the e-commerce platform is undergoing field testing. The deployed network infrastructure will help Dwesa small rural community entrepreneurs to upload their goods to be sold to the rest of the world. The contribution of using the Internet in rural communities seems to be on sharing global knowledge and expertise to help support their initiatives against poverty, better communication with trading partners through e-commerce and the ability to trade opportunities around the globe (Jacobs SJ. and Herselman ME., 2006).

1.6 Contribution of the thesis

The major contribution is naturally the development of a virtual shopping mall for rural communities of the Eastern Cape region, to contribute to rural development and poverty alleviation. This in turn applies also to the Dwesa rural community of the Transkei region where the system is being field tested, as they will be able to sell their art, craft online. This project is unique in that it provides a feasibility system that takes advantage of

nowadays technologies, including the Internet, to allow small entrepreneurs in rural communities to be able to market their art and craft.

1.7 Structure of this thesis

The remaining part of this thesis is structured as follows:

- ❖ Chapter 2 reviews literature relevant to the development and implementation of e-commerce platforms in disadvantaged communities. Case studies and projects that show the impact of e-commerce in bridging the digital divide are also mentioned.
- ❖ Chapter 3 details the system requirements. This chapter provides a brief discussion of the system tools that were used during the development of the virtual shopping mall system. It also explains the client and server side scripting with its interaction with the user and the database.
- ❖ Chapter 4 describes the various designs that were considered when developing the shopping mall system using the LAMP (Linux, Apache, MySQL and PHP) model. It explains the system architecture, front-end and back-end of the shopping mall system. Therefore this chapter is based on the design of the system.
- ❖ Chapter 5 describes the implementation of the system. This chapter will detail the most important component of the shopping mall system.
- ❖ Chapter 6 is the conclusion. This chapter will evaluate the research project, list the problems encountered, and also the future work that can be done to improve upon the current shopping mall software system.

1.8 Conclusion

This chapter has introduced an overview of the project. The background and the problem of the research have been highlighted. The project aim and its objective are explained with justification and its relevance to other projects being undertaken.

Chapter 2

Literature review and related work

This chapter reviews literature relevant to the development and implementation of e-commerce platforms in marginalized communities. Some e-commerce projects that aim to empower small to medium enterprise are discussed. We also introduce Open Source Software as a sustainable technology enabler.

2.1 Introduction

E-commerce platforms have been developed to enable business transactions using the Internet as a source of communication. The development of e-commerce platforms for rural communities may enhance productivity and profit of the communities, besides helping them understand the importance of ICT in their everyday lives.

There are numerous e-commerce platforms developed by organizations for larger markets but much fewer for marginalized communities. As said in chapter 1, this thesis aims is to develop an e-commerce platform for rural communities of the Eastern Cape, South Africa. The e-commerce platform to be developed should be flexible enough to accommodate a variety of goods and services for the rural communities. The e-commerce platform described in this thesis is a virtual shopping mall that will enable small entrepreneurs in rural communities to market art and crafts to the rest of the world.

The following literature review in this chapter is divided into two parts. The first one provides a brief overview of the concept of ICT in the context of rural development and describes the components forming the ICT infrastructures for e-commerce development, the inter-connections between ICT and rural area development. The second one discusses the nature of e-commerce in Africa, focusing on the case of the rural communities. In this part some e-commerce projects being done in Africa are also high-lighted.

2.2 ICT in rural areas for development

ICT infrastructure is the core resource necessary for the development of e-commerce platforms. ICTs are recognized to facilitate economic growth: as a simple example, the e-commerce platform will be deployed on an ICT infrastructure. For ICT projects to be successful in rural areas, there is a need to ensure sustainability. The e-commerce application development and implemented in these areas should also be sustainable. Typically, ICT projects in rural communities depend on external funding during an initial period and only sustainable projects continue operating when this funding is removed. The development of our e-commerce platform project is undertaken by the University of Fort Hare CoE (Centre of Excellence) in collaboration with Rhodes University CoE.

Funds from various sponsors were donated to deploy ICT infrastructure in the Dwesa community, which therefore represents the field testing site. The e-commerce services of the system aim in generating income there, therefore ensuring sustainability of the ICT infrastructure deployed, by reversing the money flow typical of the so called 'tele-centres' (Terzoli A. et al, 2004).

An ICT-related project must also consider local needs and adequate training to the local people (Disraeli B., 2001) (Herselman M.E., 2003) (Pade et al, 2006). After successful training, the technologies provided to rural communities should also trigger activity in people in the community to explore the importance of the technologies. Sustainable ICT projects in rural communities require the initial development of a framework that will be adequate for the deployment scenario. The authors, (Ndlovu et al, 2006) (Dalvit et al, 2007) (Ngcobo P. and Herselman M. E, 2007), explain the challenges in ICT development for the reconciliation of the tension between technology push and local development needs.

As rural areas in Africa have unique conditions such as remote location and scarcity of reliable public facilities, ICTs introduced into these areas must be suitable for these conditions. According to (Rama Rao T.P., 2001), many past initiatives attempting to bridge the gap failed because of not providing suitable content, not addressing real needs for users/communities and not fostering local buy-in from the community. Therefore there is a need to cooperate with the core users when developing any user based system to ensure the success of any project.

2.2.1 The research site: Dwesa

The Dwesa community is located on the Wild Coast of the former homeland of Transkei, in the Eastern Cape Province of South Africa. The community is under the Mbashe Municipality which belongs to the Amatole region based in East London. Willowvale is the nearest town, 50 km from Dwesa (Timmermans H. G., 2004). The inhabitants at Dwesa are typically subsistence farmers who depend on the land for their livelihood (Palmer et al, 2002). From the author's experience (being born and bred in former

Transkei at the Tombo rural community, Port St Johns), this is a norm for most Transkei rural communities, making Dwesa a suitable model for the entire rural former Transkei region.

The Dwesa region features a coastal nature reserve, an attraction particularly to South African tourists, who however visit almost exclusively during school holidays. So the nature reserve is a catalyst for tourism, though government social welfare grants seem to be the main source of income for the local community. The area lacks basic infrastructure such as electricity in homes (in schools and clinics it started arriving at the beginning of 2006), telecommunication facilities, running water and tarred roads (TRALSO, 2006).

As said, the research project was conducted in this rural community, where the ICT infrastructure was deployed as a prerequisite for the deployment of the e-commerce platform developed (Palmer et al, 2002) (Siyakhula project, 2007) (Dwesa/Cwebe).

2.3 Nature of e-commerce in Rural Communities

E-commerce and the Internet are increasingly becoming one of the most important drivers of strategic change for business and national governments. E-commerce allows business and entrepreneurs to become more competitive and is beginning to have a significant impact on people's lives. Everyone from shops to financial institutions is looking for ways to leverage the Internet for increased revenues, improved profitability and greater customer/brand loyalty. E-commerce improves an SMME's ability to compete with larger organizations and operate on an international scale. It is seen as a tool for providing cost effective ways for SMME's to market their business, launch new products, improve communications, gather information and identify potential business partners (Cloete E., 1999) (UNCTAD, 2002).

The use of e-commerce by businesses in developing countries is associated with the potential benefits of participating in international value chains, increasing market access, improving internal and market efficiency, and lowering transaction costs. Belief in such

benefits has led to the adoption of e-commerce by some businesses in developing countries. There has been an increased focus on the role of e-commerce to contribute to development and assist in narrowing the digital divide (Esselaar P., Miller J., 2001). However, the questions of *what?* and *how much?* benefit small businesses in developing countries are actually reaping from their e-commerce investments are not deeply investigated.

According to (Maclay C.M. and Best M.L., 2002), telecommunications companies, entrepreneurs, and policymakers have regarded rural markets with some combination of too-complex-to-serve and not-interesting-enough (politically or economically) to be worthy of sustained attention. “But the existing change of technology has been adapted, leaving what have been perceived as backwaters poised to become significant growth areas in the next decades”. Also (Humphery et al, 2003) investigated the reality of e-commerce in rural communities. He comes to a positive conclusion stating that e-commerce in developing communities opens new opportunities for the local people to engage themselves to new marketing strategy that was not open to them before.

Most enterprises have created e-commerce front-ends to their traditional businesses. Several new products and services are being innovated and marketed through the Internet thus creating global business opportunity. It is feared that the developing countries are likely to lag behind and lose out on the benefits of ICT revolution and e-commerce opportunities if the policies to provide access to the technologies, education, skill development, e-commerce regulation and consumer protection are not introduced for these communities in time (Papandrea F. and Wade M., 2000) (Rama Rao T.P., 2001) (Henderson J.R., 2001). Therefore there should be rapid developments in ICT that will open up new global business opportunities in the form of e-commerce, which may be exploited by the developing countries as well. (Barnard L. and Wesson J.L., 2003) states that e-commerce in South Africa has grown tremendously. An investigation on 5 e-commerce sites in South Africa was undertaken and aimed to determine if there are usability problems on the e-commerce sites. The study states that the usability is based on trust (privacy, ease-of-use and credibility of information) on the e-commerce site developed (Barnard L. and Wesson J.L., 2003).

From the research study that aimed in assessing the state and act towards e-commerce undertaken during 2001, the study states that South Africa was having thousands of websites in 2001. International Survey Organizations predicted that during 1999 online shoppers in South Africa would spend 443 million US Dollars in Internet-generated purchases, while business-to-business e-commerce would reach almost 620 million US Dollars. At that time e-commerce in the rest of Africa faced major obstacles which include lack of telecommunication facilities and marketing infrastructure (Esselaar P., Miller J., 2001). Nowadays there is a massive increase in the number of available e-commerce platforms based on business operations. The e-commerce platforms are also available in developing countries and there is a steady growth of e-commerce in these developing countries (UNCTAD, 2002).

The deployment of an e-commerce platform in rural communities can also contribute to the tourism business, in a direct and indirect way. The Community-Based Tourism (CBT) project undertaken in 2002 has been shown to foster local development in developing countries, particularly in the poorer rural areas. (Harris R., 2002) describes an action research initiative for introducing electronic commerce for community based tourism (e-CBT) in order to reveal its potential for community development. This was gained from the e-commerce solution that was applied and provided community access to information and communication technologies.

In order to put our rural e-mall application into perspective, this following section mentions some of the e-commerce applications currently being used in Africa by small to medium sized enterprises, as well as a comparable project. These e-commerce projects also aim to empower small rural enterprises. However, the concept of an e-mall which we propose could not be found elsewhere. These case studies had contributions useful to this thesis.

2.4 Case studies

Ghana

Ghana is one of the countries which is characterized by rural communities with very low level of development. Ghana is an economically growing country where the ICT technologies are missing from many communities. There are many projects and activities that are being undertaken in Ghana. Among them are:

- **eCARE**

e-Commerce and Renewable Energy (eCARE) is a project that started in December 2003, and is supported by Ghana Telecom, Kumasi Institute of Technology and Environment, United Nations Foundation, and United Nations Environment Programme. eCARE aims to ensure community development in Ghana's underprivileged rural and urban communities, it offers opportunities for rural Ghanaians to become entrepreneurs by owning Rural Business Centers that include ICT infrastructure such as phones, multimedia computers, scanners, copiers and Internet.

The ICT technologies that the rural communities are offered are powered by solar energy due to non-availability of electricity. eCARE is said not only to be bridging the digital divide but also the energy divide through solar energy. eCARE has established many centres in many regions of Ghana (e-CARE). This project is similar to the Dwesa project (Siyakhula project, 2007), which aims to empower the local rural community population of the Eastern Cape region by providing ICT infrastructure for deployment of e-commerce/telecommunication platforms. It is dissimilar in that it focuses more on delivery of infrastructure, whereas the Dwesa project concentrates on novel applications such as an e-commerce platform with support for individual shop owners, fair billing procedures (Tarwireyi et al, 2007), localized interfaces for government services etc.

- **eShopAfrica**

eShopAfrica is the e-commerce application that was developed in 1999 for rural communities in Ghana. The eShopAfrica e-commerce website was built to support traditional African artisans. It is based in Accra. The eShopAfrica website sells art and craft products of traditional African artisans, and its main aim is to allow small rural entrepreneurs from African countries to market their outstanding products directly to the rest of the world (eShopAfrica.com). This website is similar to our e-commerce application but it is a single shop, with various categories of the items being sold. In our shopping mall system, on the other hand, there is a distinction between each shop and all the items sold are grouped according to their respective shops. The separation of each shop enables different art and craft to feel like they are managing their shop.

Nepal

Nepal has a population mainly living in rural areas, and dependent on subsistence agriculture. People in remote areas lack access to basic services and these include electricity and basic ICT infrastructure. An e-commerce platform was developed to support small to medium enterprises in Nepal to be able to market their artifacts to the rest of the world. The e-commerce platform is explained below.

- **CatGen Platform**

Catalog Generator (CatGen) is an e-commerce platform developed starting in 1999. It was developed to support Nepalese SMMEs to be able to create their own online catalog for online business transactions. It was developed by a team from different countries.

The system is a Free Open Source multilingual and non-technical software, and users can operate it off-line where poor quality or expensive Internet connections exists. CatGen uses an e-commerce server that consists of Java, XML and PHP open standards. The application is running on J2EE compliant application server. It uses Open Source platforms such as Apache, Linux, and MySQL. The technological aspect of the CatGen is similar to our shopping mall system as it is also developed using an Open Source platform. CatGen is now being implemented by many countries and organizations

(CatGen). Two examples of the website based on the CatGen platform are the Thangka Painting which is found at (Thangka Paintings) a retail Business-to-Customer (B2C) and Business-to-Business (B2B) site.

The functions of the CatGen are similar to our shopping mall system, which also allows rural entrepreneurs to upload their items using an appropriate back-end, to be displayed on the front-end of the website. This e-commerce platform also uses the same PayPal payment system used by our system. CatGen is subjected to an annual hosting fee. Our system is available to all Eastern Cape rural communities for free.

CatGen was not suitable for our project as it uses proprietary application server (J2EE application server). We aimed in developing our shopping mall system using Open Source. The tools decided upon for the development of our system were required to be cost effective. This was decided based on the fact that the rural community members can't afford immediately to pay additional costs for hosting, which can be initially carried by the University of Fort Hare. Another reason why CatGen was not chosen is that, it is a catalog creation software and doesn't have the shopping mall features that we need to use on our system. Our system has features that are based on the user specifications. Of course, a path could be the adaptation of the CatGen software to our specifications. This path might have been appropriate had we localized the CatGen at the beginning of the work described in this thesis.

- **osCommerce**

osCommerce is an Open Source software based online shop e-commerce solution available for free under the GNU License. It is widely used and some shops in South Africa use it such as Bead Fun (<http://shops.oscommerce.com/directory/goto,23296>), Wild Stuff (<http://shops.oscommerce.com/directory/goto,22237>), and Quad Shop (<http://www.quadshop.co.za/>). It has features that allow the management of the shop and also the shopping cart functionalities (osCommerce). osCommerce is an electronic shop software whereas our system is an electronic shopping mall software. Since it is electronic shop software, some of the shopping mall functionalities are not available on

the software. It is being used by many stores and developers to develop online shops. The development tools of osCommerce are the same as our e-commerce system. Since osCommerce is Open Source, its source code is available and can be used and localized according to the requirements needed. It is being used by many stores and developers to develop online shops so there are a wide variety of features. Our shopping mall system on the other hand is focused on our local requirements and it will be integrated with some other services to form a complete e-commerce platform. For instance, osCommerce has its own method of calculating the shipping cost, whereas in our system the shipping calculation is based on the available delivery service closer to the rural communities. In this regard we aimed to develop our system specifically for the user and to be easily extendable according to our target goals from for the system.

2.5 E-commerce Platform Development Theory

There are various tools that can be used to develop small business systems. The system will be used by the rural communities and the tools to be used should also be adequate for the environment to which the system is deployed. A system designed for developing countries should take measures on the cost and implementation technologies. As developing countries have resource constraint, the use of Open Source could be a means of reducing cost of software artifacts. Perhaps even more important in the long term, Open Source might start a local software industry, which obviously would be a very good result (Sanjiva W., Jivaka W., 2004).

The use of Open Source software tools and technologies to develop system is increasing at a massive rate and most organizations use it when developing their systems (Wheeler D.A., 2006). The use of Open Source tools makes the prime tool for achieving a customizable application. Many governments around the world consider the use of OSS as having a key role to play in introducing information technologies (Sanjiva W., Jivaka W., 2004).

A description of the Open Source philosophy is found at (Open Source Initiative, 2007), and is available on the GNU Public License (GNU, 2007). According to (Williams et al, 2005), Open Source generally require no licensing fee. He states, however, that Open Source is not really free but certainly there is no up-front cost when installing the software. Open Source software can be run for any purpose on any number of machines and can also be distributed freely at no cost.

The users have full control of the Open Source Software (OSS) as the source code is available for editing. The users have rights to change the functionality of the software to meet specific requirements and this lead to the improvement of the software product (Tuomi I., 2005) (Wheeler D.A., 2006) (Hala A., 2007). This enables the user or developer to be able to study how the software program works.

The development time using Open Source can be shorter than using proprietary software, as often the software source for an initial system is available: there is no need to start the coding of the software system from scratch. Of course, there are downsides: as the source code is exposed to everyone, the security of the software can be a problem as hackers can edit the software maliciously and redistribute it. At the same time, the modularity required for distribution of Open Source contributes to acceptable security, function-specific, and isolated code segment (Williams et al, 2005).

Based on the above considerations, our e-commerce platform is developed using Open Source. In addition to the advantages of using Open Source stated above, the result expected from our software product is a customizable system that should be easily editable to meet the requirements of the users.

2.6 Conclusion

This chapter has discussed the sustainability issues of ICT in the context of marginalized community projects. Factors that are critical for the success of e-commerce projects have been presented. The nature of e-commerce within the developing countries is also stated. The chapter has also discussed some of the case studies where the e-commerce platforms to empower small rural enterprises are developed. The next chapter will discuss the tools that are used to develop the e-commerce system. The system users and their rights in the usage of the system will also be explained.

Chapter 3

System requirements, methodology and core technologies

This chapter presents an overview of the system requirements and technologies used in building up the e-commerce shopping mall system. It explains the client-side and server-side technologies used during the development of the system. The users and roles of the system are also stated.

3.1 Introduction

This thesis aimed at developing a robust, cost effective shopping mall system for disadvantaged communities in the Eastern Cape. The size and type of business, the users of the system, and the type of products to be sold led to the selection of appropriate tools. There are many technologies that are available and can be used and they will be described below.

3.2 System requirements and assessment

The requirements of the system were met through construction of scenarios, qualitative research (using interviews), and a literature review.

The scenarios and interviews were based on field visits at Dwesa. A range of people from different backgrounds in the community were interviewed, including school teachers, art and craft groups and community members. The findings from the interviews confirmed that the art and craft groups require a system easy to use. In addition, the system should be developed in such a way that the shops would remain separated. Separating each shop will make the different art and craft groups feel that they own and manage their shops. The interviews also established that the art and craft groups knew very little about the benefits that e-commerce applications might have and their level of computer literacy was non-existent, as expected. Finally they gave information on the marketing infrastructure they used to market their items.

A secondary aim of the visits was to learn about the network infrastructure deployed at Dwesa. Learning about the infrastructure helped shaping the system. Linux (in the Ubuntu distribution) is the operating system of the installed computers in the community and all the applications there are Open Source. This reinforced the idea of the suitability of Open Source software for the system, as presented in the previous chapter.

Based on the above facts and observations, the shopping mall software system is developed using Open Source Software running on the Linux Operating System using the LAMP (Linux operating system, Apache web sever, MySQL database server, PHP

scripting language) architecture. This architecture was deemed adequate for our deployment, due to its robustness, cost effectiveness, customization and deployment/configuration flexibility (Webopedia, 2007). LAMP was also chosen because of the available LAMP modules that already existed in the deployed infrastructure at Dwesa. In addition to the theoretical advantages of using the LAMP platform, the author found the architecture very easy to use, through the readily available free help and guidelines on the Web.

One of the LAMP modules is the Apache Web Server, developed by the Apache Software Foundation group (Apache software foundation, 2007). For small virtual shopping malls as the ones typically to be used in areas such as Dwesa, a current desktop system will be enough in terms of hardware support.

3.3 Shopping mall roles

The shopping mall application developed using LAMP architecture supports three types of users: the shopping mall administrator, the shop owners/service providers and the customers.

1. Mall Administrator – The mall administrator is the controller and has access to all the activities performed in the shopping mall system. The administrator can add or delete new users and shops, and change shop owner by assigning it to another registered member. The mall administrator should be a qualified candidate with knowledge of how to manage the whole system using the development tools used.

2. Shop owners /service providers – These are the rural community small entrepreneurs that will be selling their art, craft to the rest of the world or offer services, for example in the micro-tourism space. Service provision is not supported in the current version of the shopping mall. The shop owner's will have the shop managing and maintaining rights. The shop owners, or service providers, are the target users of the back-end of the system. The requirements for the rural communities were that the back-end of the system should be user friendly, in a way that a person with low level of computer literacy, and no knowledge of English, could use the system.

3. Customers – The customers are the people who will be browsing the shopping mall website and buying art, crafts. The requirements for customers of the system were that the customers should be able to browse and buy the art and crafts with trust and interest. The customers should have a “shopping mall” feel and in addition be aware of the heritage present in rural communities when using the system. For the current version of the systems, customers are supposed to be conversant in English. Future versions will be localized to other languages.

3.4 User Functionality Diagrams

The objective of the user functionality diagram is to show the actions that can be performed by each user of the shopping mall system. The system structure is also exposed. As widely accepted, the shopping mall system is composed of a front-end and a back-end. The front-end is the actual website that is visible to all the 3 categories of the shopping mall (administrator, shop managers and customers). Naturally only the administrator has full access of the back-end. Shop keepers access their shops through the front-end via specialized views. Figure 1 below shows all the actions that can be performed by each user of the shopping mall.

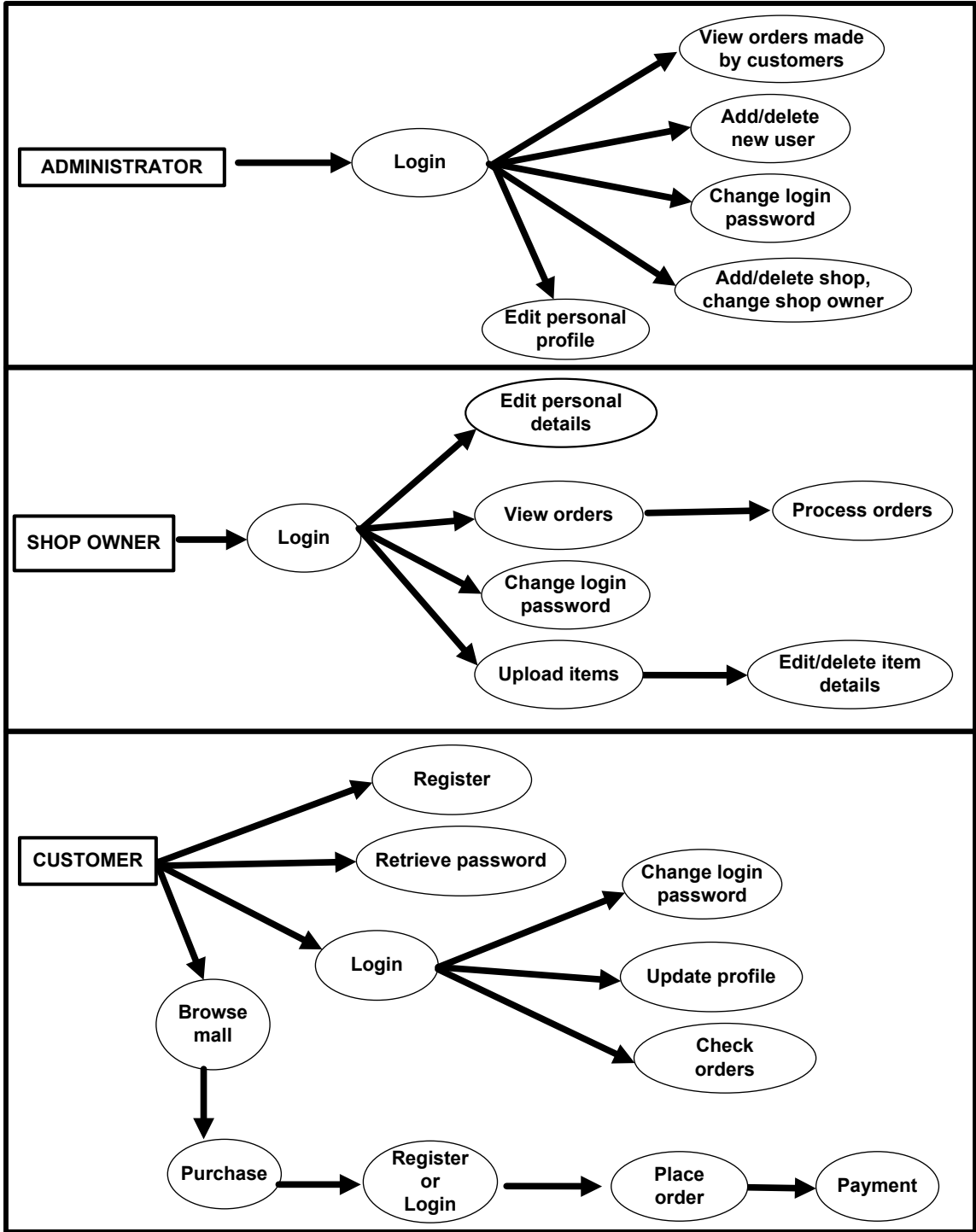


Figure 1: User functionality diagram

3.5 Methodology and Core Technologies

This section introduces the technologies and tools used during the development of the system.

3.5.1 Client-side scripting

Client-side scripting involves the execution of the programs by the user's web browser. The web browser usually executes scripts traditionally written using scripting languages.

There are numerous client-side scripting languages used to develop application system. Our shopping mall system uses PHP as the main client-side scripting language. Some of the scripting languages can be integrated with each other. In our case, PHP scripting language is embedded into HTML.

3.5.2 System Front-end

The front-end is the website interface that directly interacts with the user.

As said, the front-end of the shopping mall system are the web pages that the customer uses to browse and make purchases. This role of the front-end is obviously very important, because through it the Internet surfer is persuaded to become a customer and make purchases.

The front-end is also used by the entrepreneurs to monitor sales and update their items in their virtual shops. The front-end is responsible for displaying product information and status information, which include how many items have been added to the shopping basket and the total cost of those items.

The shopping mall has the following pages.

PAGE	DESCRIPTION
Home Page	This is the first page the customers will encounter when they type in the site URL. This page contains a general welcoming message and links to other pages including the login page and register page. There are other links that the page contains, search area and browsing area.
Login Page	This is the page to authenticate a registered customer. Logging in will let the customer view details such as previous and current orders, as well as edit personal details and change login details (username and password).
Register Page	This is the page for the Internet surfers who wish to become members of the website will use to register. This is also the page unregistered surfers will encounter when they wish to make a purchase. Customers will be asked to fill in their personal details, contact details and shipping details.
About us	This page will give information about the rural community entrepreneurs who sell art, craft and services.
Browse by category	This is a series of dynamically generated pages that will show the products for sale according to categories.
Search Results	This is a dynamically created page that will show only products that match the keyword entered in the search area by the user.
Shops Available	This page will show a list of all the art and craft shops that are available in the shopping mall.
Product Details	This is a page that will show all the product details of the chosen shop by the customer. This page will only show the chosen product, and its name, description, price.
Shopping Basket	As customers browse the shops, they may choose to put some items in their shopping basket. This page will show the goods in the shopping basket and their total cost.
Checkout Page	This page gives the customer a summary of what they have chosen to purchase. The customer is then asked to confirm if the contents on the shopping basket are accurate and whether the customer would like to make the purchase.

3.5.3 Front-end technologies

The following technologies were used when implementing the front-end of the shopping mall website.

- Hypertext Preprocessor (PHP)
- Hyper Text Markup Language (HTML)
- Cascading Style Sheets (CSS)
- Javascript
- Dynamic Hyper Text markup Language (DHTML)

I. Hypertext Preprocessor (PHP)

Hypertext Preprocessor (PHP) is an Open Source scripting language that has joined the languages that can be used to create dynamic online environments. The shopping mall uses PHP scripts to create dynamic web pages. The main implementation of PHP is produced by the PHP group and released under the PHP license. It is considered to be free software by the Free Software Foundation (PHP group, 2007). PHP is designed to integrate well with databases like MySQL, a relational database that is free for use on many platforms. PHP is typically used in an HTML context, but, “unlike an ordinary HTML page, a PHP script is not sent directly to a client by the server, instead, it is parsed by the PHP binary or module usually *php_mod* (Software Projects, 2007)”. The HTML pages generated are then sent to the querying browser (Glass et al, 2004). In our system the PHP scripts were mainly used to perform actions like the query of a database, the management of the overall shopping mall functionality.

The use of PHP market share in South Africa is still growing at an average 40% (PHP statistics, 2007). PHP was considered adequate to be used in this project. PHP is often seen as an easy tool to get started and create a web application (Tizag, 2007). According to Zend Technologies, Ltd., the central source of PHP improvements and designers of the Zend Engine, which supports PHP applications, PHP code is found in approximately 9 million websites (Glass et al, 2004). PHP has access to a large variety of classes that make it possible to build very diverse applications.

Some of the more commonly used functionality provided by PHP with HTML embedded tags used in this project included:

- Inserting, enlarging and resizing images
- Creating web pages with frames
- Inserting tables
- Formatting text
- Inserting hyperlinks to other resources such as pictures, other PHP pages
- Creating data entry forms
- Formatting webpage background

II. Hyper Text Markup Language (HTML)

Hyper Text Markup Language (HTML) is the standard language used to create web pages. It uses tags to display the pages. Each tag has a particular function, which each browser will understand and interpret. Each tag has an opening and a corresponding closing tag. Each type of browser will use its own set of rules to interpret the HTML and render the page. As each browser uses its rules to interpret the HTML, the same page can appear different when viewed on different browsers.

III. Cascading Style Sheet (CSS)

Cascading Style Sheets (CSS) are used to display various layouts of the web page designed. CSS is added to PHP and HTML to allow the control of the web page layout. In our shopping mall system, the style sheet defines how certain elements such as frames, page contents, and links appear. The style sheet created can be applied to any web page. When setting up a style sheet, parameters such as the font size, background color, image position, link parameters can be specified.

Specifically, style sheets support:

- Commands (definitions or rules) for specifying and applying fonts
- Traditional layout measurement and terminology
- Pinpoint precision for page layout

CSS is based on rules and style sheet. A rule is a statement about one stylistic aspect of one or more elements and a style sheet is a combination of rules that apply to the whole HTML document.

IV. JavaScript

JavaScript is a client side scripting language that is used in web-based applications to achieve a wide variety of functions. JavaScript code is written and embedded within <script> tags within a PHP or HTML document. When the PHP or HTML page is requested and subsequently downloaded by the browser, the JavaScript is also downloaded and executed by the browser. JavaScript is loosely related to the Java Programming language. JavaScript is an interpreted scripting language (Answers.com, 2007).

JavaScript is a developed language and can be used in many ways that the user or programmer wishes to use it. Some of the ways in which it is used in our shopping mall application include:

- Redirecting surfer: this was done to redirect the user to the appropriate page after the user has logged in to the system.
- Limits on text input: this was done to prevent the user from entering unlimited text in a text area.

V. Dynamic Hypertext Markup Language (DHTML)

Dynamic Hyper Text Markup Language (DHTML) is a collection of techniques to change static web pages into dynamic web pages that react to events that take place in the page. These events can be initiated by the user through mouse and/or keyboard actions, or they can be triggered by the web page itself. The end result is that the layout, design, and/or contents of the web page can be changed on-the-fly to respond to user and page events. DHTML is often just the combined use of Style Sheets and JavaScript. An example of the functionality provided by DHTML using the style sheet was to show an image of an item when the mouse was placed on the item name.

3.5.4 Server-side scripting

The server-side scripting handles user's request by running a script on the Web Server used to generate dynamic web pages. As said, PHP scripts acts in this way to create dynamic web pages from the client's request. Most commonly, on the server side PHP is used to provide interactive websites that interface to databases. This is different from client-side scripting where scripts are run by the viewing web browser. The primary advantage to server-side scripting is the ability to customize the response based on the user's requirements, access rights, or queries into stored database data. The server-side scripting is the way of accessing the back-end of the system.

3.5.5 System back-end

The back-end is the management and administration of the shopping mall system. The back-end is not visible to the front-end of the system (which is accessible to all the shopping mall categories). It acts as the control of various functionalities of the system. Operations that are done using back-end include the management and administration of the database, users, shops and items.

Naturally, the purpose of the back-end is to support the front-end services, usually by being closer to the required resource or having the capability to communicate with the required resource such as a database server. In the classic model, the dynamic or data-driven web pages use PHP forms to collect user inputs, submitting them to a web server. A program running on the server processes the form inputs, dynamically composing a web page reply. This program, which is called "service program", can be either a compiled executable program or a script interpreted into machine language each time it is run. As the system uses PHP scripts, it uses script-interpreted service program to execute requests from clients and construct response.

Part of the back-end is the MySQL Database (DB). There was a need for database management and administration tool, although the PHP scripts handle the connections to the database. phpMyAdmin was chosen to directly access and manage MySQL DB. phpMyAdmin is Open Source software written in PHP and it is published under the GNU General Public License and is available for free download (phpMyAdmin, 2007).

phpMyAdmin makes the management and administration of the database easier as it uses a GNU. As one would expect, phpMyAdmin requires a user to login for authentication. Some of the functions that were done using phpMyAdmin are to create, update, and delete data in the database.

3.6 Conclusion

The chapter has presented the shopping mall technologies used during the development phase. The method on how the requirements the requirements elicitation was conducted is also discussed. This chapter has also discussed the roles of different users of the shopping mall. Different free and Open Source software technologies that were chosen for the project have also been explained.

Chapter 4

Shopping mall design and development

This chapter presents and describes the various designs that were considered when developing a robust, cost effective e-commerce shopping mall system using the LAMP architecture. It will explain the design of the front-end and the back-end of the system. The chapter will also discuss how the customers browse through the shopping mall system. Finally, this chapter also explains the structure of the database used.

4.1 Introduction

The previous chapter was the explanation of the tools and architecture used to develop the virtual shopping mall. Naturally our e-commerce design process is focused on the users of the system. “A good website design presents new opportunities and challenges to establish, build, and manage user relationships (Geissler G.L., 2001)”. Because the use of *buy at Dwesa* shopping mall in a real production environment, a very important issue is the layout and usability of the website.

4.2 System Architecture

As already explained in the previous chapter, the virtual shopping mall system is developed using the LAMP architecture. This section will explain the system architecture in terms of its components and the data flow between the components. This architecture is used to meet the system requirements stated in section 3.2. In the diagram, the grey boxes represent the main system components that supports on the system functionality.

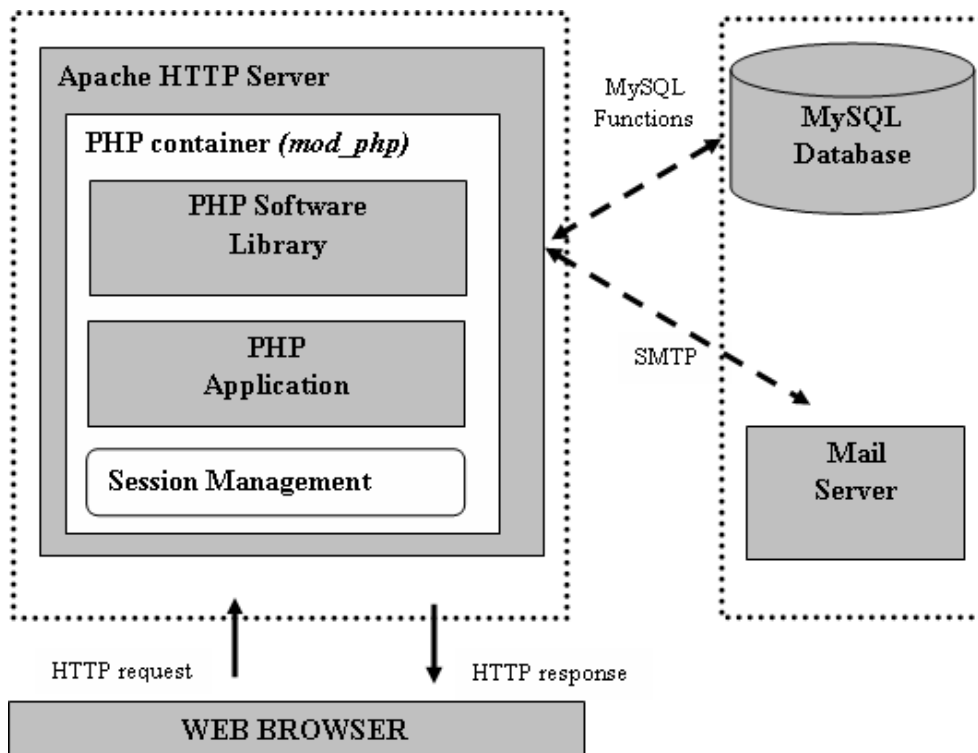


Figure 2: System Architecture

(Extracted from: <http://www.lampsig.org/new/uploads/articles/oscommerce10b.gif>)

The figure above shows the LAMP communication architecture. When the users access the shopping mall website through a web browser, a Web Server is contacted to get the requested information. The sole task of the Apache HTTP server is to accept incoming HTTP requests and to return the requested resource in an HTTP response based on HTTP protocol. The PHP container handles the execution of the PHP code within the process context of the Apache HTTP server. During this time, session management occurs. The session management is handled transparently by the PHP applications, using the HTTP GET/POST standard to set a session within the user's Web Browser. The session is maintained until the user exits the browser.

The PHP container uses the PHP library installed under Linux, to execute certain functions such as connecting to a remote mail server using the SMTP protocol. To connect to MySQL DB, PHP has built-in functions.

4.3 Front-end design and development

As said before, the front-end is the interface for all the shopping mall users. In this section, the system design is focused on the customer interface. The customer's interface was developed based on well organized shopping malls available. The presentation of the wares to the customer was designed by evaluating some common navigation on well known e-commerce websites like (Amazon), (Kalahari), and (EBay) taking in account, however, the enormous difference in stock size. A non-structured navigation on the website results in poor quality of the website (Fogg et al, 2002) (Shankar et al, 2002).

4.3.1 Shopping mall website

The shopping mall has the following users and related roles:

1. The administrator, allowed to control the entire system.
2. The shop owners, allowed to perform shop management functionalities (add, delete and update product information).
3. The customers, able to browse the shopping mall and place online orders for the items they desire.

4.3.1.1 The website URL

The URL (Uniform Resource Locator) for *buy at Dwesa* shopping mall is <http://www.dwesa.com> which has been registered as part of the larger project of which this thesis is part. The name *buy at Dwesa* reflects the fact that this e-commerce website is field tested in Dwesa.

4.3.1.2 Basic design features

As usual, the design of the website was achieved taking into consideration different contributing factors: the users of the system, their requirements, the targeted stakeholders and the marketing strategies to us (Bell D., Morrey I., Pugh J., 2000). Also, aspects such as the best possible way of transferring information between pages, suitable contents, text design, screen design and navigation had to be examined (Fogg et al, 2002). The success of a website depends on to a large extent on the choices made in the design phase. (Li, Na. and Ping Zhang., 2005) state that users judge the quality of an e-commerce website very quickly, even before its functionality and usability are appraised. Therefore to attract users and enhance profit from the website, website design should elicit favorable emotions and experience of the user (Egger F.N., 2001) (Egger F.N., 2003).

As said in section 3.4.2, the user should develop trust by just an eyesight judgment of the website. “Website design is like a shop interior. If the shop looks poor or like hundreds of other shops, the customer is most likely to skip to the other shops” (XCART). Hence the project system is designed to provide the users with easy navigation, retrieval of data and necessary feedback and an interesting or characteristic graphic style. (Fogg et al, 2002) report that, in their large study about how people evaluate the credibility of websites, almost 50% of all comments made by participants referred to graphic design. They therefore argue that, in the context of online credibility (and trust), findings indicate that looking good is often interpreted as being good and credible.

As colours we chose the following: black, blue, green, grey, orange, purple and white. They are used in most of art and craft items and traditional clothes made in Dwesa, as one can see in the picture below.



Figure 3: Dwesa artifacts and traditional clothes

4.3.1.3 Website content and basic interfaces

The website contains information of all the shops that are available at *buy at Dwesa* and all the products on sale in the shops. Also, it makes use of a shopping cart, login and registration mechanisms and carries information on all participating rural entrepreneurs groups. The system provides three user interfaces.

- The customer's interface (to buy the products on display).
- The seller's interface (for shop managers to manage their shops).
- The administrative interface (for the administrator to access and manage the shopping mall system).

4.3.1.4 Navigation

The Web application contains built-in navigation from one process and tool to another. This required the creation of standard skeleton templates and a standardized screen design.

As one would expect, before implementing the actual system, a few user interface designs were constructed, to visualize the user interaction with the system as they

perform operations in the shopping mall system. They were then subjected to critique by a group of test users. The current shape of the website is the result of those experiments.

4.3.1.5 Page Heading Section

This is the section that appears at the top of the page in the website. The heading contains the following components:

- Logo of the website, on the top right corner of the page.
- Search functionality for users to search for items they want to purchase.
- Links to Home, About us, Register, View all shops and Contact us.

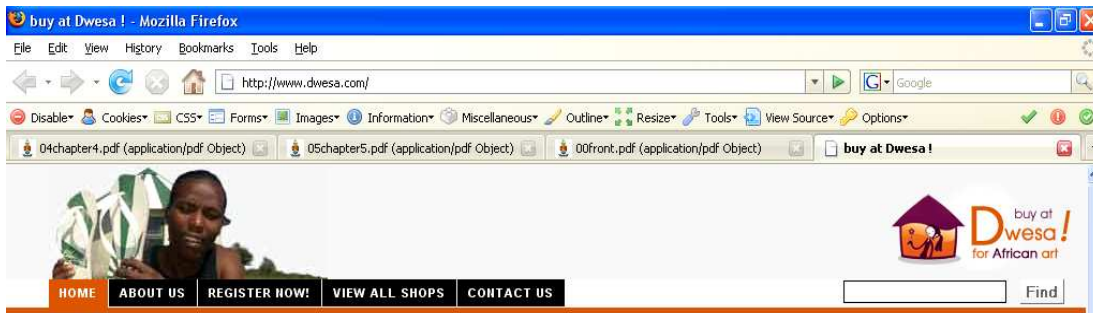


Figure 4: Website navigation menu

The layout of the navigation menu was designed using CSS defined in the PHP document.

Creation of logo

A number of different logos were created. The one chosen carries a feel of the rural life in the Eastern Cape, via the presence of a traditional circular hut, while at the same time conflating a smiling face and a girl offering a flower. For creation of the logo the main tool used was the Open Source graphic application GIMP (GNU Image Manipulation Program).



Figure 5: Website logo

4.3.2 A walk through the mall

To conduct e-commerce, a merchant needs to organize an online catalog of products, take orders through their websites, accepts payments in a secure environment, send merchandise to customers and manage customer data.

The next figures show some screenshots taken from the running shopping mall application. The reader might notice that the screenshots that I am putting in to illustrate the buyer's experience are taken from a machine running Microsoft Windows. This just reflects the fact that we expect that the vast majority of buyers will actually use this Operating System. Of course, the screenshots for the illustration of the administrator and shop owner interfaces are taken from a machine running Linux.

4.3.2.1 Browsing through the shops and products

When the user enters the website address (www.dwesa.com) in the browser, the main page of the application is displayed. The main page shows the navigation, browsing and searching of items that the customer desire to purchase. The customers can browse all the shops available in the mall and also view items available in each shop. Customers can browse by shop, by category or can search for an item that they want to place in a cart.

The home page is designed in a simple manner and its main function is to display the features of the shopping mall application. Figure 6 shows the layout of the home page. It has a traditional homepage look with navigational links on the menu bar of the page.

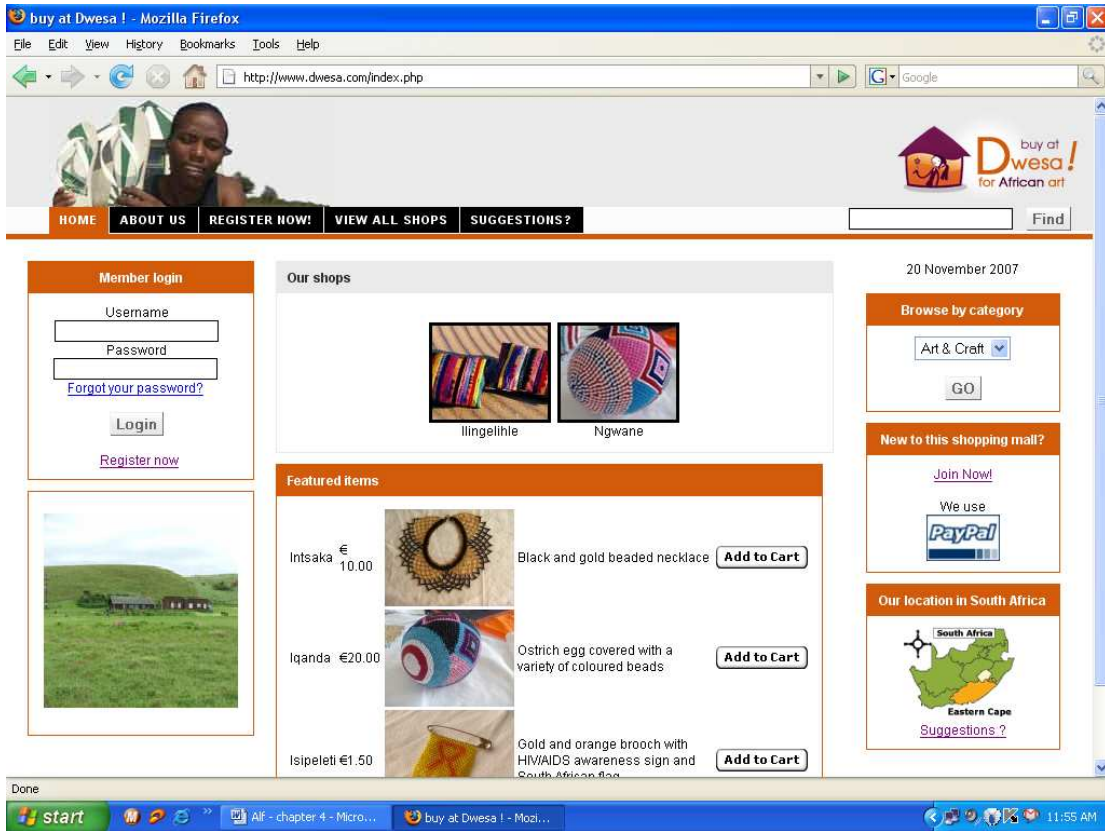


Figure 6: Shopping mall index page

The information of the shops and items are stored in the database. The online shop's catalog structures the available products into categories. An unlimited number of such categories can be defined. Apart from the basic information like item name, price, description, an image gallery is also available.

4.3.2.2 Registration

A new user can register on the site by clicking on the “REGISTER NOW!” button on the heading at the top of the page, as shown in figure 6.

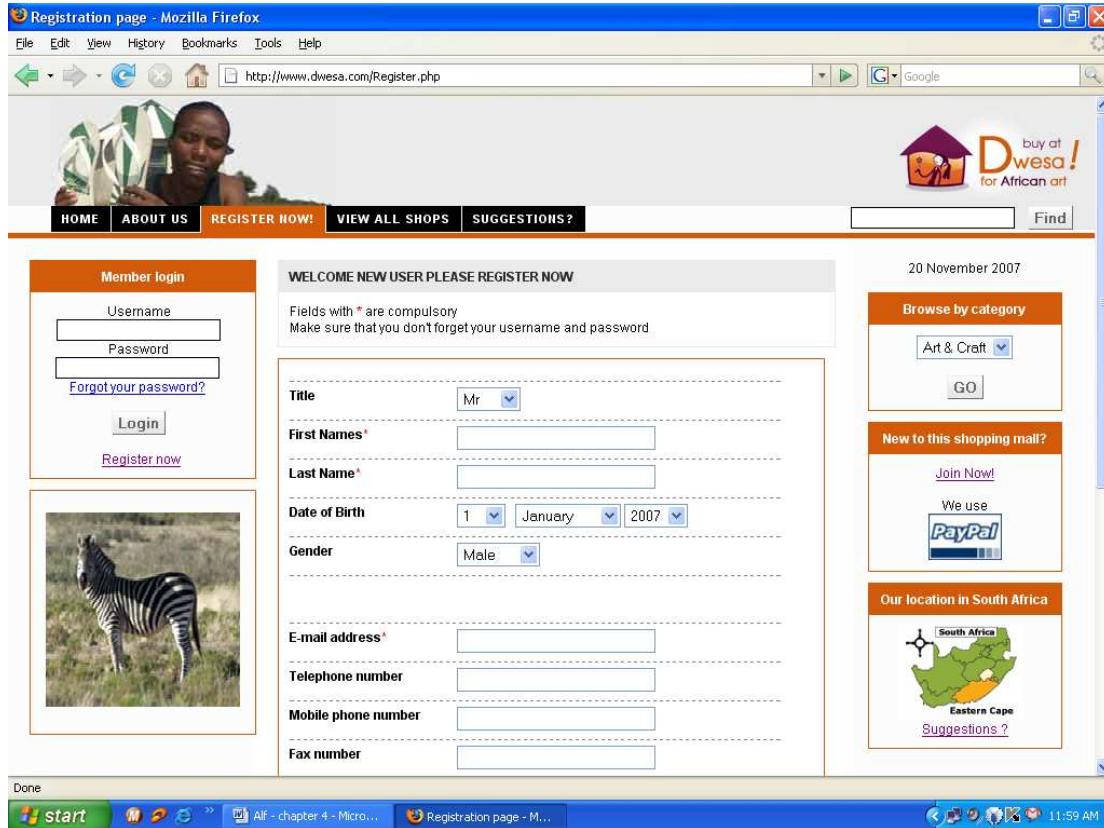


Figure 7: New user registration

The “*” next to the label indicates the required field for successful registration on the site. If the value is not entered, an appropriate message is displayed. If the user with the same *Username* already exists, the message is displayed. Upon successful completion, the user is redirected to the welcome page and an automating message is sent to the user.

4.3.2.3 Suggestions

Users of a website may have some comments and suggestion on the website status. They may also help to improve the status and functionality of the website. The *Suggestions* page enables the user to send queries, comment, and suggestion to the shopping mall administrator. After the user has filled all the fields, an automatic email is sent to the shopping mall administrator.

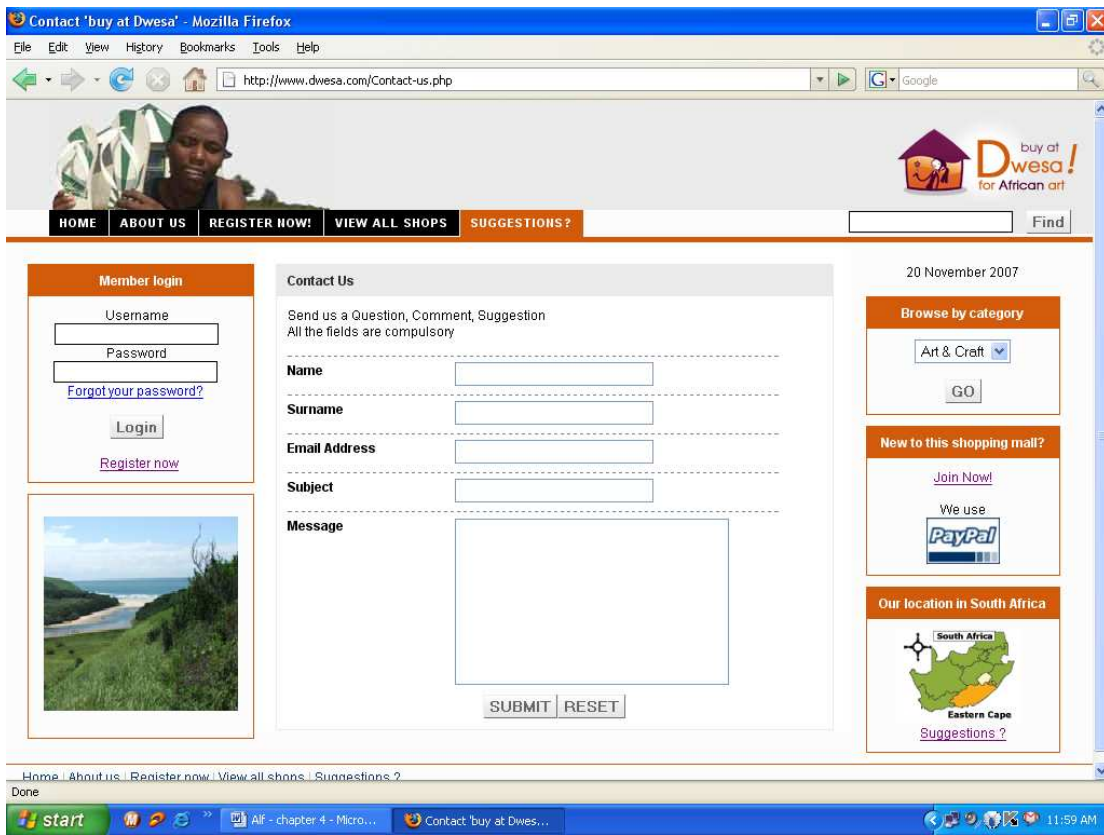


Figure 8: Suggestions

4.3.2.4 The shopping cart

The shopping cart is where the items selected by a customer are placed before they are paid for. The items can be updated before making final purchase. When the shopper starts shopping, a session identifier that keeps track of the customer requests is created and all the products in the cart are linked to that session. If the customer adds an item into the cart and that particular item is already present in the shopping cart, the quantity is increased by one and the price is changed accordingly; if not, a new entry is made into the table. Following e-commerce tradition, the customers can view and edit the items that are already in the cart at any time.

As for the rest of the site, the good shopping cart design must be as user-friendly as possible. The shopping cart application implemented in this project provides a number of features that are designed to make the customer more comfortable. For example, when the customer places the mouse over the *Item name*, an image of the item is displayed.

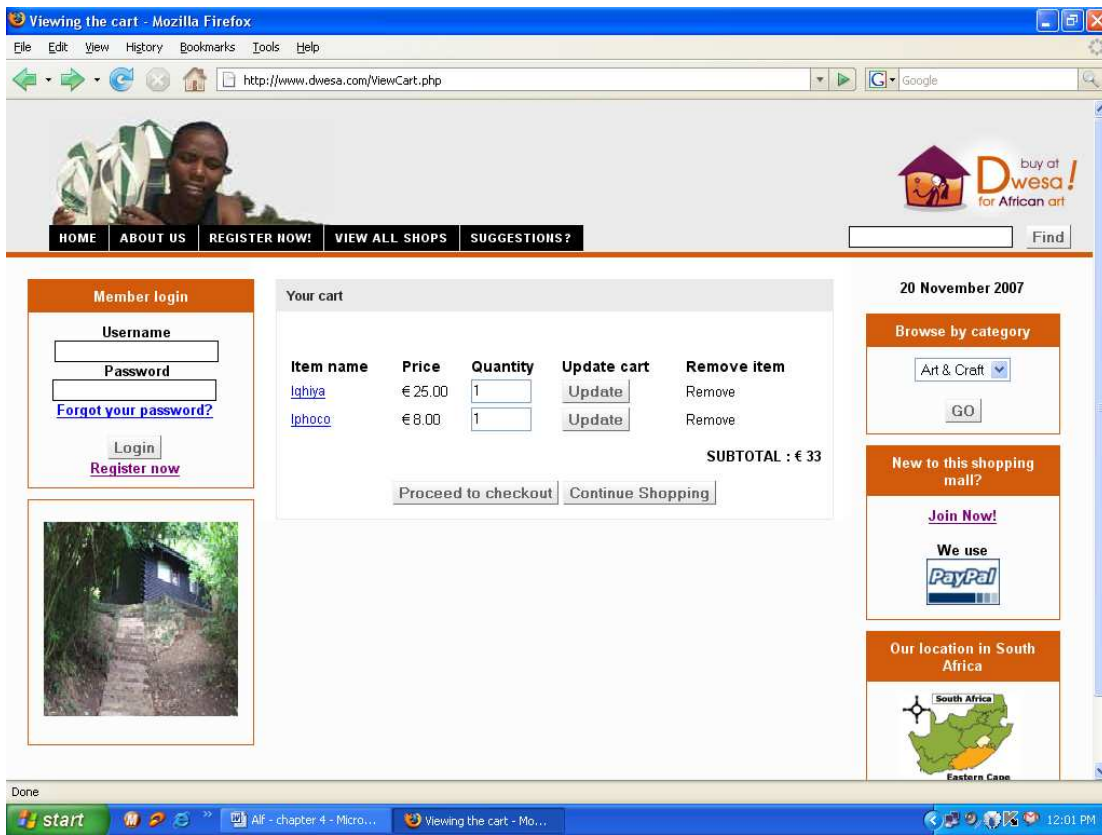


Figure 9: Shopping cart

4.3.2.5 Checkout process

This is the final phase of the e-commerce transaction. Privacy, integrity, and authentication related to security come in place at this stage. Everyone using the Web for e-commerce needs to be concerned about the security, and therefore uses technologies such as Secure Socket Layer (SSL) and Secure Electronic Transfer (SET). To check-out, the customer needs to login or register to create a new user profile, if not already a registered customer. User profiles contain contact information (e.g. name, address, email, telephone) and demographic data (e.g. gender, date of birth). Customer's private data is not accessible by unauthorized persons or used without the explicit approval of a customer. For security reasons, the system does not keep information like credit card details.

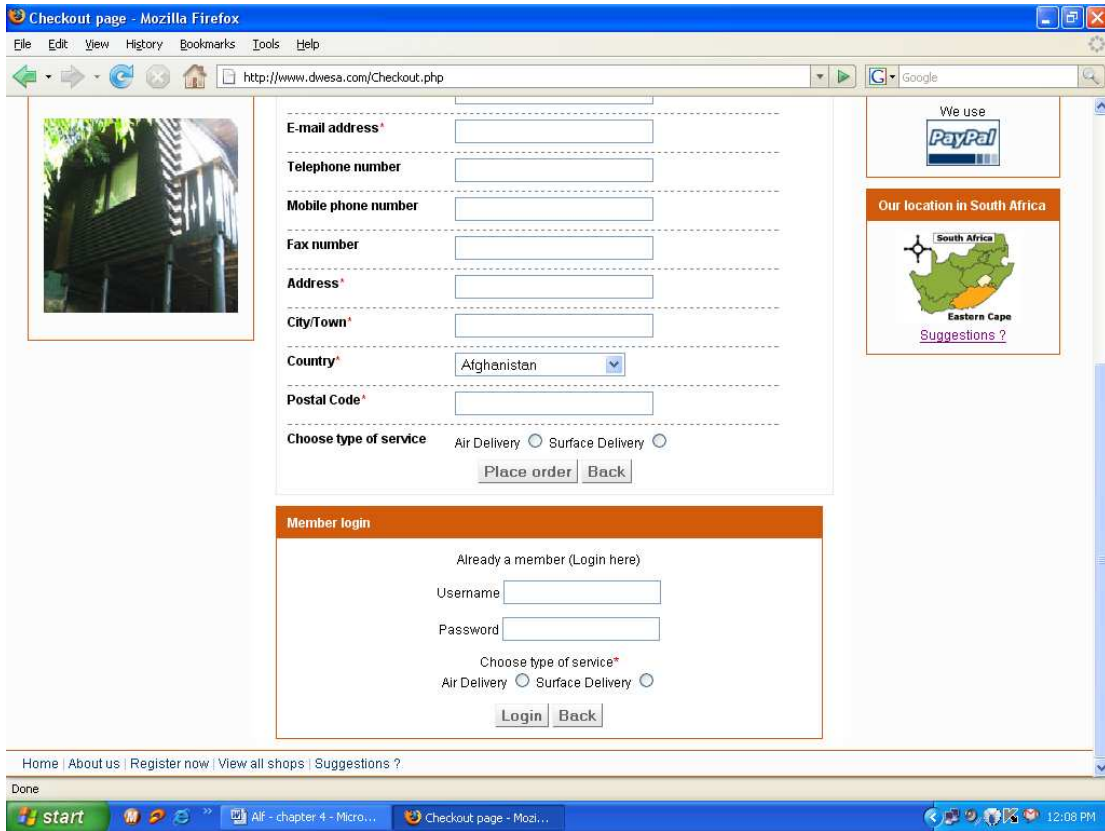


Figure 10: Checkout process

The page in figure 10 is scrolled down to show part of the registration form. In particular, one can note the request of a choice of shipping service. (As one should expect, rates of shipping service depend on the type of shipping and the destination of the item to be shipped.

4.3.2.6 Shipping calculation

The checkout stage goes with the shipping calculation. After it is known where the product is going to be shipped, the shipping calculation is performed. The shipping calculation is based on the rate that the South African Post Office (SAPO) uses to deliver items all over the world. SAPO was chosen for the initial version of the system because it is the nearest delivery service that is available in most Eastern Cape rural communities. SAPO is a reliable and also cost effective service delivery (SAPO, 2007).

The pricing is according to the SAPO rates and are based on the weight of an item to be shipped, the destination and the shipping method. The customer can either choose surface, air mail delivery or 'speed' delivery, a courier service (Speed services, 2007). The actual costs were found on the SAPO brochure that is valid from April 2007 till March 2008. This means that after March 2008, the shipping prices should be updated according to the current pricing system. The brochure is available in all SAPO and also found on the SAPO website.

The delivery using Post Office (PO) service is done manually. When the shop owner's receive an order from the customer they will go to the nearest PO to send the items ordered. The PO will then issue a tracking number for the delivery. The shop owners will then contact the customer to give him the tracking number. The customer will therefore use the tracking number to track the current location of the item(s) being sent.

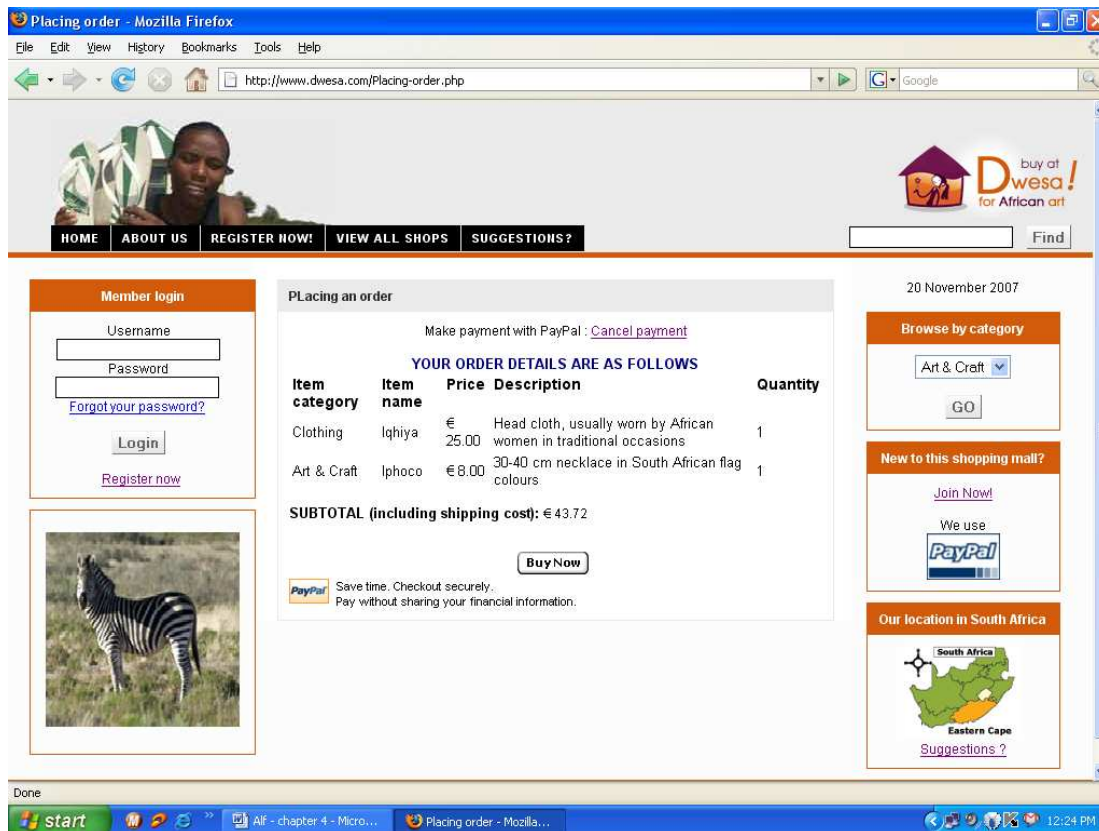


Figure 11: Shipping calculation

In figure 11 above, the customer cart is displayed with the shipping cost already calculated. If the customer is not satisfied, the payment option can be cancelled. Clicking the *Buy Now* button will display the PayPal payment system that will let the customer fill the credit card details.

4.3.2.7 Electronic Payment System

There are many payment systems that are available and used by e-commerce applications. Once the total for the order is known, including shipping, the system is ready to accept payment.

The current version of the shopping mall system uses PayPal for payment. PayPal was chosen because of its low cost, high security measures, easy to use and flexibility (PayPal, 2007). For such payments, an encrypted communication channel to an external payment gateway is used. PayPal handles the security aspects of the transaction. The system constraint on payment is that, in South Africa, it doesn't support direct plain credit card payment: this requires a customer to be a member of PayPal before a payment can be made. Following normal practice, the customer is unable to cancel the order after the payment has been made.

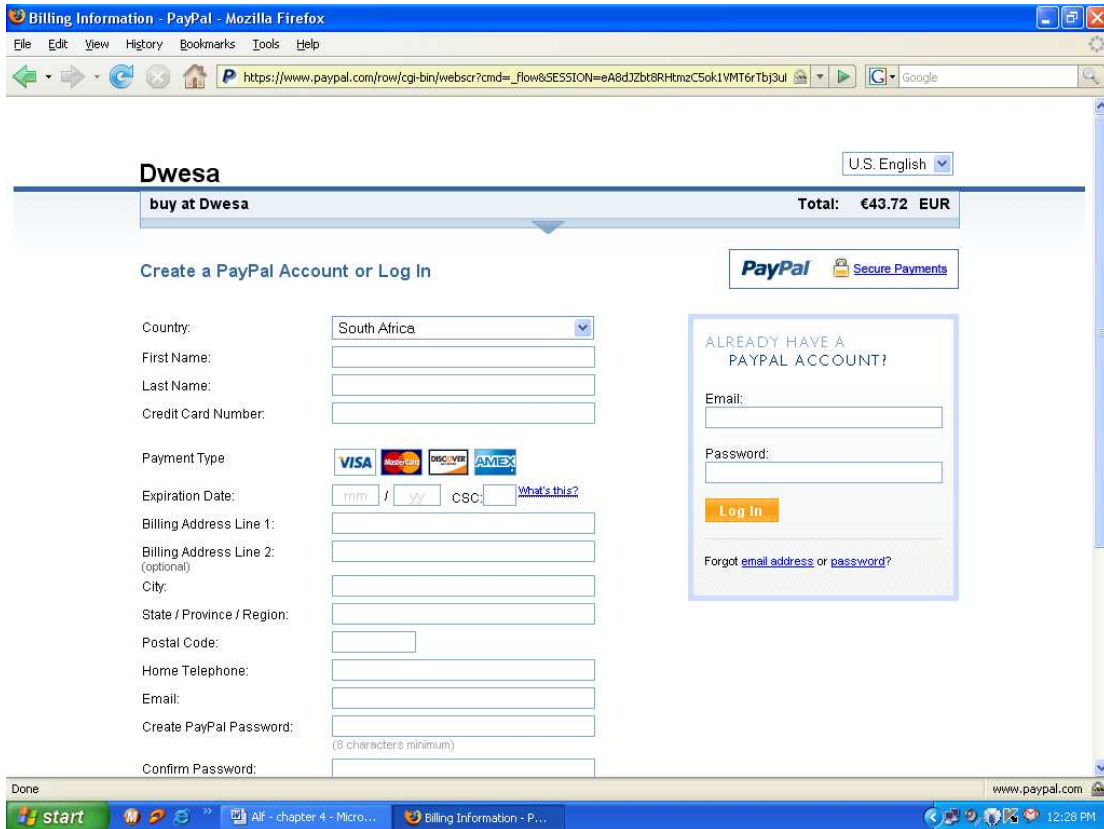


Figure 12: Electronic payment system

The figure 12 shows the PayPal page that is displayed after the customer has clicked the *Buy Now* button shown in figure 11.

4.3.2.8 Process/Fulfil/Ship order

At this stage, the customer has successfully placed an order and an automatic message is used to confirm that the order has been placed. The shop owners will then notify the customer for any changes that occur to the order. In general, standard business rules take over in this phase, just as if the order came in via the phone or mail. The Internet does afford the option to keep the customer informed of the order status. The seller may want to show that the order has been processed.

After placing an order, the customer can view the order details at any time. The following figure shows how the orders being placed by the customer are displayed once the customer has successfully logged in. When the customer views the order, the status of an

order is displayed and also how many items the customer has ordered. In the figure below the status is showing as “new order”. When the seller receives the order, he will change the status to be “in progress” and the customer will be notified of the change.

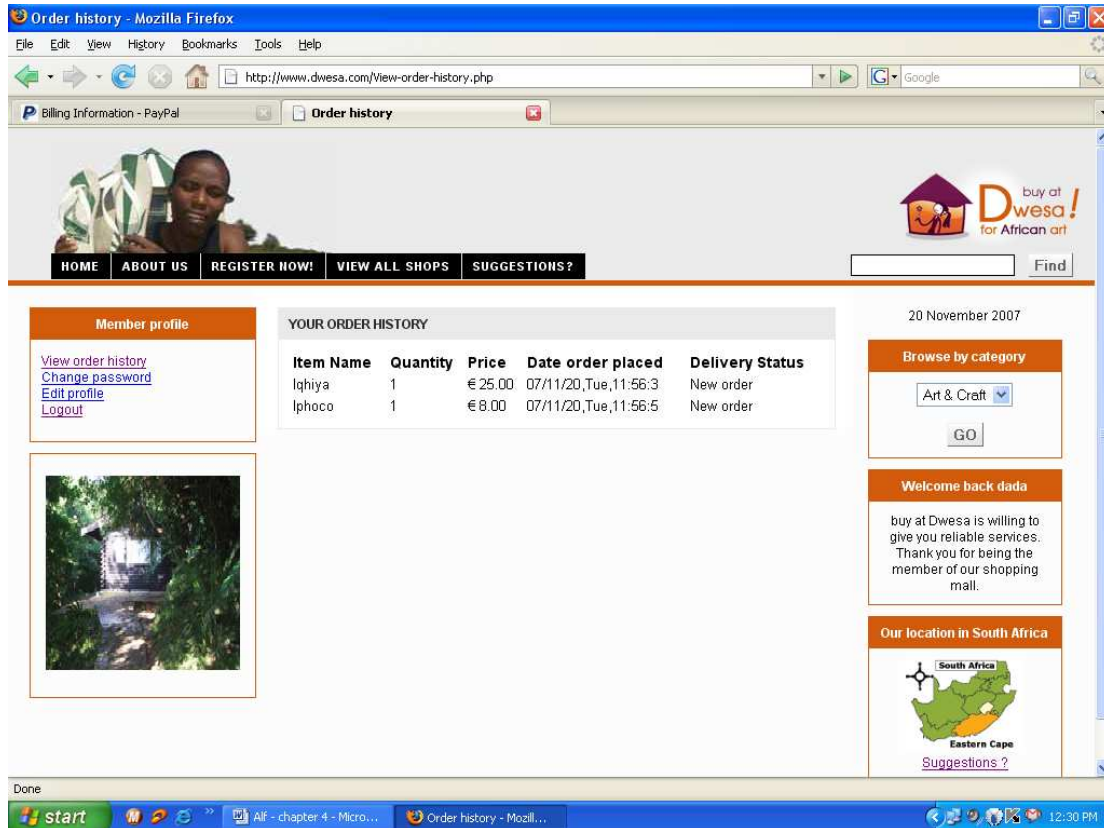


Figure 13: Purchase history

Figure 13 above details the purchase history of the customer. The purchase history can be reached by clicking on the *View order history* link on the left panel shown in the above figure.

4.4 Back-end design and development

The back-end users are the administrator and shop owners/service providers. The following sections will explain the main back-end pages used in the system as well as the database tables.

4.4.1 Administrator component

This thesis is accompanied by the administrator manual. This section will just highlight the design of the administrator interface. The administrator can view all the operations that occur in the system. The administrator interface offers the administrative structured management of all the necessary portal resources. The following figure shows the structure of the administrator interface.

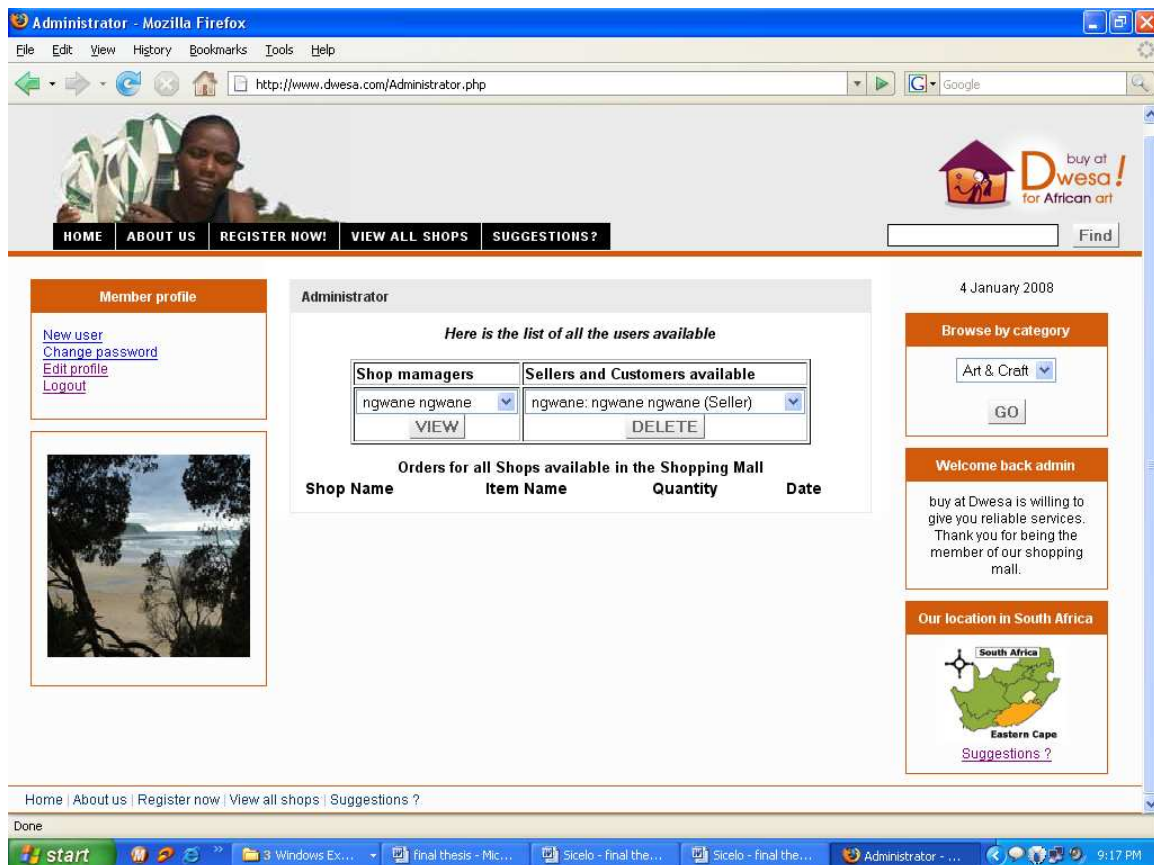


Figure 14: Administrator interface

4.4.2 Seller component

The seller's interface is the most innovative interface of the system. It is used by the members of the rural community. There is culture and language that is taken into consideration, if still in a rather basic way. The seller's adaptation and ethic on the system differs from well advanced computer users. This required some improvement on the flexibility and friendliness of the interfaces. The following figure shows the structure of the seller's interface.

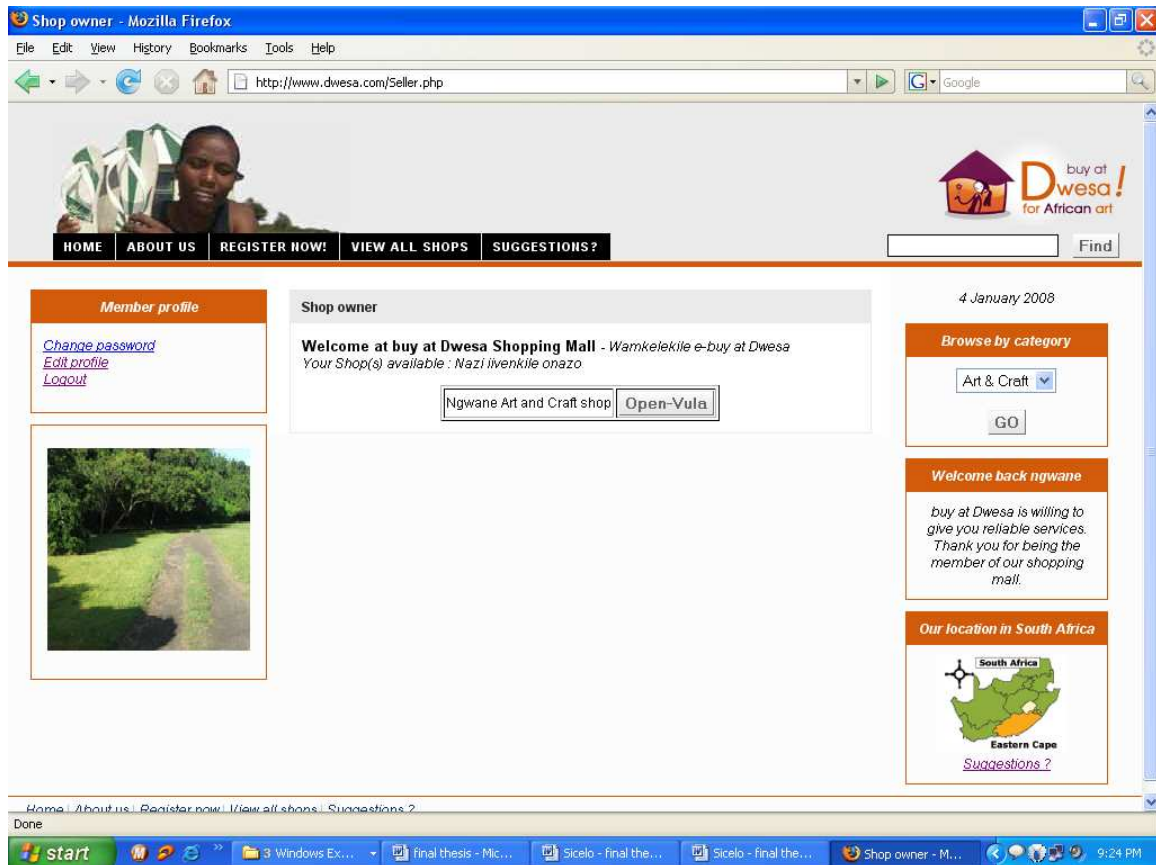


Figure 15: Seller's interface

As an aside, one of the projects currently being undertaken at University of Fort Hare to support the development of the e-commerce platform is a better linguistic and cultural localization of the shopping mall seller's interface. The initial linguistic localization of the seller's side has been done on this project.

4.4.3 MySQL database design

This section refers to the database component of the e-commerce system. The database will store all the information pertaining to the site. This section describes the tables that are used by the shopping mall system and the interaction of various fields with each other.

This section will highlight the relationship between them. The MySQL database contains the tables shown in the figure below, where n represent the many relationship.

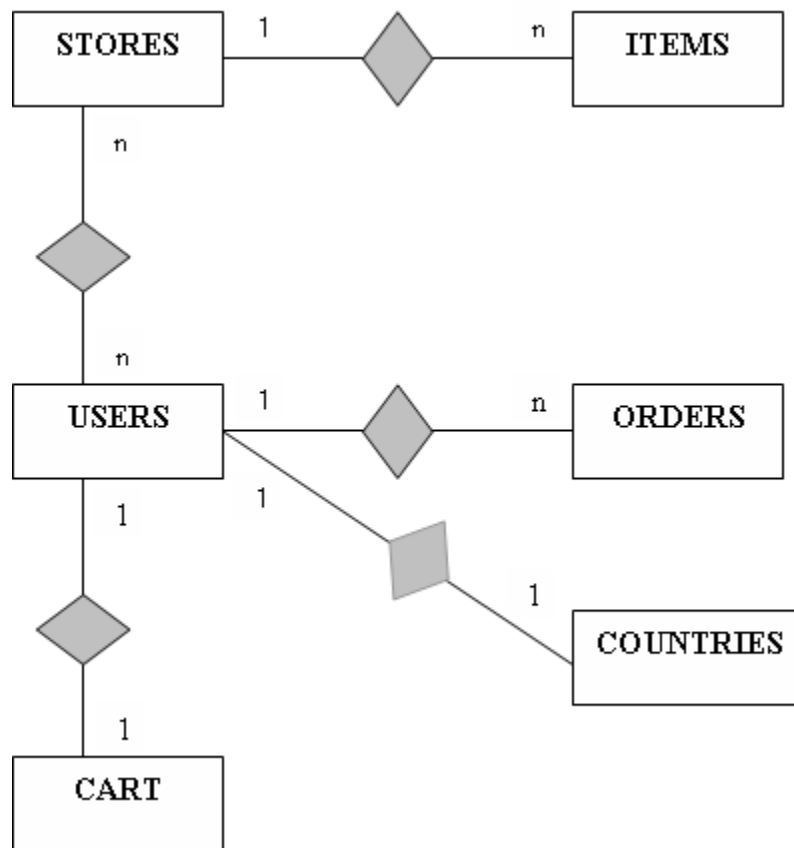


Figure 16: Database ER diagram

Below is the list of the MySQL database tables with their fields. The system uses six MySQL tables, summarised in figure 17.

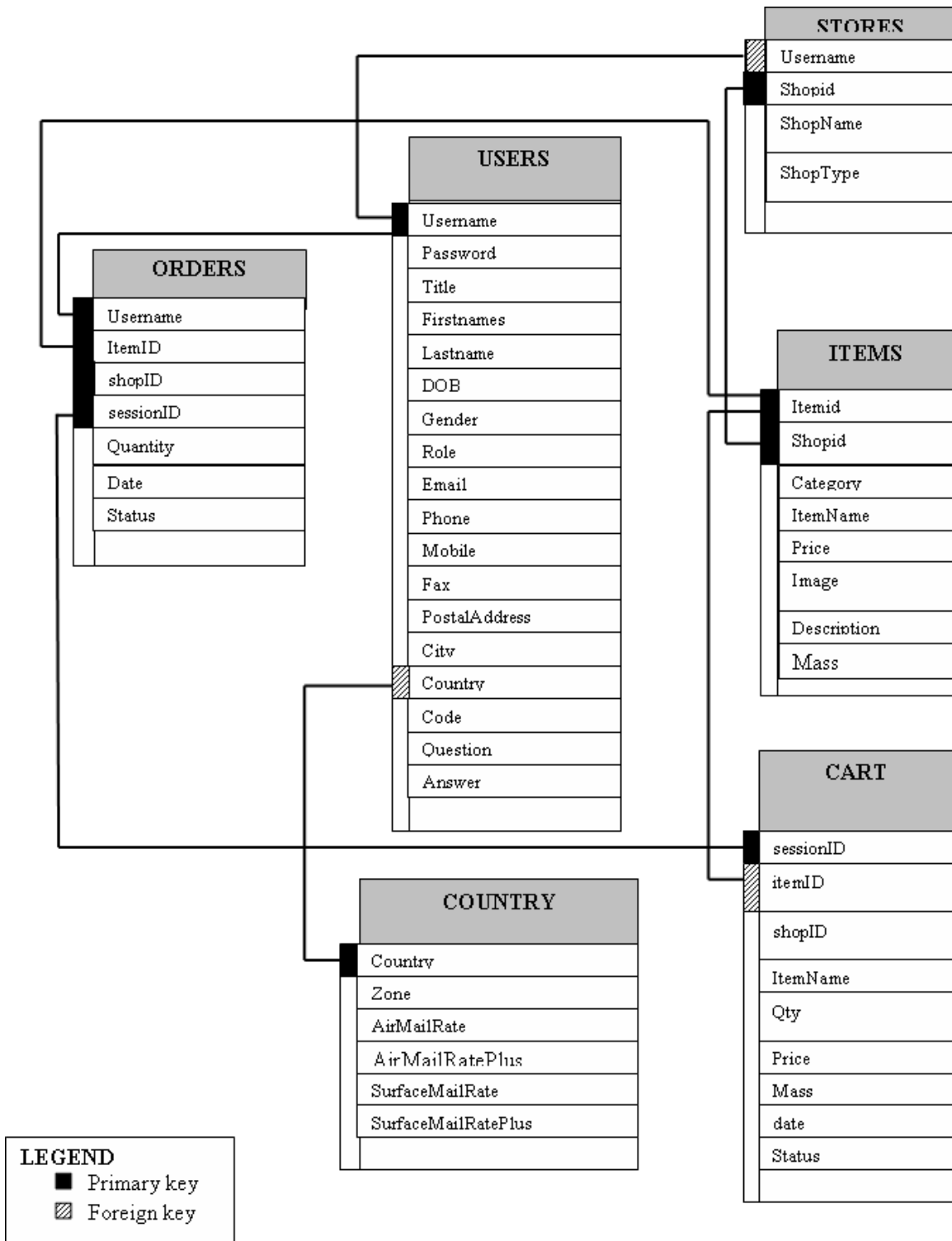


Figure 17: Database tables with their fields

4.4.3.1 User details

The table called USERS stores all the personal information of the users. This table contain the following fields and their description:

Field	Type	Null	Key	Default	Extra
Username	varchar(20)	NO	PRI	NULL	
Password	varchar(20)	YES		NULL	
Title	varchar(10)	YES		NULL	
Firstnames	varchar(40)	YES		NULL	
Lastname	varchar(20)	YES		NULL	
DOB	varchar(20)	YES		NULL	
Gender	varchar(10)	YES		NULL	
Role	varchar(15)	YES		NULL	
Email	varchar(30)	YES		NULL	
Phone	varchar(15)	YES		NULL	
Mobile	varchar(15)	YES		NULL	
Fax	varchar(15)	YES		NULL	
PostalAddress	varchar(40)	YES		NULL	
Country	varchar(30)	YES		NULL	
Province	varchar(40)	YES		NULL	
Code	varchar(10)	YES		NULL	
Question	varchar(50)	YES		NULL	
Answer	varchar(40)	YES		NULL	

4.4.3.2 Item information

The table called ITEMS stores the item's information. This table contains two fields (Itemid and Shopid) which are the joint primary key. The joint primary key serves as a foreign key referencing in the table that uniquely identifies an item. This table contains the following fields and their description:

Field	Type	Null	Key	Default	Extra
Itemid	int(11)	NO	PRI	NULL	auto_increment
Shopid	int(11)	NO	PRI	NULL	
Category	varchar(20)	YES		NULL	
ItemName	char(30)	YES		NULL	
Price	decimal(8,2)	YES		NULL	
Image	varchar(30)	YES		NULL	
Description	varchar(500)	YES		NULL	
Mass	decimal(8,2)	YES		NULL	

4.4.3.3 Shops information

The table called STORES contains all the rural community art and craft shops that the shopping mall system have. This table contains the following fields and their description:

Field	Type	Null	Key	Default	Extra
Username	char(20)	YES		NULL	
Shopid	int(11)	NO	PRI	NULL	auto_increment
ShopName	char(40)	YES		NULL	
ShopType	char(40)	YES		NULL	

4.4.3.4 Order history

The table called ORDERS contains all the orders of the shops that are being placed by the customers. This table contains composite primary key (Username, ItemID, ShopID and sessionID) that will maintain the uniqueness of an order placed by a customer. This table contains the following fields and their description:

Field	Type	Null	Key	Default	Extra
Username	char(20)	NO	PRI	NULL	
ItemID	int(11)	NO	PRI	NULL	
shopID	int(11)	NO	PRI	NULL	
ItemName	char(30)	YES		NULL	
Quantity	char(8)	YES		NULL	
Price	decimal(8,2)	YES		NULL	
Date	char(20)	YES		NULL	
Status	char(20)	YES		NULL	
sessionID	varchar(50)	NO	PRI	NULL	

4.4.3.5 Cart information

The table called CART contains information of the current session of the customer and after the customer has completed the cart operation and the order has been placed, the customer details stores on this table are discarded. This table contains the following fields and their description:

Field	Type	Null	Key	Default	Extra
sessionID	varchar(50)	NO	PRI		
itemID	int(11)	YES		NULL	
shopID	int(11)	YES		NULL	
itemName	varchar(30)	YES		NULL	
qty	int(11)	YES		NULL	
price	decimal(8,2)	YES		NULL	
mass	decimal(8,2)	YES		NULL	
date	varchar(20)	YES		NULL	
status	varchar(20)	YES		NULL	

4.4.3.6 Country information

This table called COUNTRIES stores a list of countries that are being used by SAPO to deliver parcels to the rest of the world (SAPO, 2007). This table contains the following fields and their description:

Field	Type	Null	Key	Default	Extra
Country	char(20)	NO	PRI	NULL	
Zone	char(2)	YES		NULL	
AirMailRate	char(10)	YES		NULL	
AirMailRatePlus	char(10)	YES		NULL	
SurfaceMailRate	char(10)	YES		NULL	
SurfaceMailRatePlus	char(10)	YES		NULL	

4.5 Conclusion

This chapter has discussed how the shopping mall system was designed and has familiarized the reader with the structure and functionality of the different users interfaces. It also presented the database tables, their relations and the main fields in them.

Chapter 5

Shopping mall implementation

This chapter will describe the implementation of the shopping mall system, connecting the basic functionality of the shopping mall to the relevant code. The client-server communication via HTTP protocol and how the session is maintained are also discussed. Finally the security measures adopted are briefly described.

5.1 Introduction

The previous chapter has explained the design and functionality of the shopping mall system. After the system design has been established and all of the software functions specified, the implementation followed.

5.2 MySQL database

This section will focus on the database component of the shopping mall system. The system is composed of a client application sitting on an end-users workstation and a remote database server. The Web Server was needed to bridge the gap between these two components as it is the interface between the user and the database. MySQL has functions that are readily available to quickly implement the shopping mall system. The functions were easily referenced in the PHP pages. MySQL functions used are the following ones:

- **mysql_connect()** : This function allows the connection to MySQL database. If the connection cannot be established, an error message is displayed and the connection is terminated.
- **mysql_select_db()** : This function selects the specified database. If the database cannot be selected, the system will exit with an error.
- **mysql_query()** : This is a query function that allows the retrieval and editing of information stored in the database. If the query fails, the system exits with an error.
- **mysql_result()** : This function returns the contents of one cell from a MySQL result set.
- **mysql_numrows()** : This function returns the number of rows in a result set.
- **mysql_close()** : This function closes a MySQL connection.

On the Web Server, PHP scripts handle the connections to the database server. In this project the connection is handled by two PHP files called *config.php* and *opendb.php*. The two PHP files are included every time there is a need to open a connection. Usually the host, user, password and database name are stored in a separated configuration file.

The *config.php* file defines the database and authentication details needed to access the database. Here is our *config.php* :

```
1 <?php
2 $dbhost='localhost';
3 $dbuser = 'emalluser';
4 $dbpass = 'abcemall123';
5 $database="emall";
6 ?>
```

\$dbhost is the name of MySQL server. When the Web Server is on the same machine with the MySQL server like in our implementation, localhost or 127.0.0.1 is used as the value of **\$dbhost**. For a remote database the database location has to be specified. The **\$dbuser** and **\$dbpass** are valid MySQL user name and password. **\$database** is the MySQL database name.

Shown below is our *opendb.php*. It opens the connection with the database. If the connection fails, an error is displayed “*Error in connecting to mysql*”. This PHP file uses the parameters stored in the *config.php*.

```
1 <?php
2 $conn = mysql_connect($dbhost, $dbuser, $dbpass);
3 @mysql_select_db($database) or die ('Error connecting to mysql');
4 ?>
```

Whenever there is a need for a connection to the database, these two files are included in that PHP page. The two files are called with the following “include” instruction.

```
58 include("config.php");
59 include("opendb.php");
```

To close the connection to the MySQL database one PHP file called *closedb.php* is used. The connection opened in a script will be closed as soon as the execution of the script ends. Below is how the connection to the MySQL database is closed.

```
1 <?php mysql_close($conn); ?>
```

The variable **\$conn** comes from the *opendb.php* file. To include the *closedb.php* file use the following “include” instruction that calls the PHP file for closing the connection:


```
225 include("closedb.php");
```

5.3 Shopping cart implementation

The adding, updating and removing of items in the shopping cart is handled by PHP scripts. All the items are stored in the database and each item has a unique identifier. An item's unique identifier is retrieved from the database and placed in the cart table with all its attributes. When the customer clicks the **“add to cart”** button, this button stores the item identifier and the cart session is created. This session will track the current session for the customer. The following code shows how the item identifier is retrieved and how the session for the cart is called.

```
26 /*Retriving the item identifier and session cart*/
27 $itemid=$_POST['itemid']; $shopid=$_POST['shop'];
28 $_SESSION['cart']=session_id();
```

As one would expect, **\$itemid** is the unique item identifier that is the parameter used to identify each item added to the cart. After the item's unique identifier and session for the cart are retrieved, the searching of whether the item already exists in the cart is done. This is done by searching the cart table for an item having the same item unique identifier. This is shown by the code segmented below.

```
32 /*searching whether the item is available in the cart*/
33 $id_query="SELECT Itemid FROM CART where Itemid='$itemid'";
34 $output=mysql_query($id_query);
35 $idrow=mysql_numrows($output);
```

If the item identifier is not found in the cart table, the item's information will be added to the cart table. If it is found, that means the item already exists in the cart and the corresponding quantity is incremented by one. After the item is added to the cart successfully, the customer can view the cart. The quantity of an item can be updated in two ways:

1. The customer can change the quantity by typing the quantity on the text box associated to the item.
2. The customer can click the **“add to cart”** button of the same item.

The following code segment shows how the quantity of an item is updated in the cart table. In the following code segment, the value **\$quantity** is the value typed by the customer and **\$itemid** is the item identifier that represents the item to be updated.

```
29 /*Update quantity to be the value typed by the customer*/
30 $update_query="UPDATE CART SET qty='$quantity' where Itemid='$itemid' AND sessionID='". $_SESSION['cart']."'";
31 $output=mysql_query($update_query);
```

When a customer clicks the “**add to cart**” button of the same item, the item quantity is incremented. The code segment below shows how the item quantity is incremented in this case:

```
37 if($idrow != 0){
38 /* Increment quantity by one*/
39 $update_query="UPDATE CART SET qty=qty+1 where Itemid='$itemid' AND sessionID='". $_SESSION['cart']."'";
40 $output=mysql_query($update_query);
41
```

Removing the item from the cart is similar to the process of updating the cart. The user will click the “**remove**” button that stores the item identifier. The item corresponding to the item identifier will be deleted from the cart table.

On checkout stage the total cost of the items in the cart is calculated. The CART table consists of the cost and quantity of all the items in the cart. The total amount/subtotal is easily calculated. The subtotal for each item is calculated by multiplying the item quantity for its cost. The sum of all subtotals provides the total cost of the items in the cart. This is done with the following codes segment.

```
29 /*selecting item identifier and quantity from cart table*/
30 $id_query="SELECT itemID,qty FROM CART where sessionID='". $_SESSION['cart']."'";
31 $result=mysql_query($id_query);
32 $num=mysql_numrows($result);

55 $subtotal=0;
```

As one can see, the “**\$subtotal**” value is initialized to zero. The table CART is searched for the item identifier and the quantity values, corresponding to the current cart session created for the customer. The item identifier is used to retrieve the price of the item from the ITEMS table. From the code segment above the value for **\$num** contains the number

of rows of the result set. Going through the rows and computing the subtotal is shown by the following code segments.

```
56 $i=0; /*The variable that will be incremented till all the rows are read*/
57 while($i < $num){
58     $item=mysql_result($result,$i,"itemID");
59     $qty=mysql_result($result,$i,"qty");
```

```
61 /*selecting data corresponding the item identifier from item's table,
62 to retrieve the price of an item to compute subtotal*/
63 $item_query="SELECT * FROM ITEMS where Itemid='$item'";
64 $results=mysql_query($item_query);
65     $itemname=mysql_result($results,0,"ItemName");
66     $price=mysql_result($results,0,"Price");
67     $image=mysql_result($results,0,"Image");
```

```
69 /*calculating the sub total of item as you move row by row*/
70 $subtotal+=$price*$qty;
```

```
95 $i++;
```

As already stated in the previous chapter, the shopping mall system uses the Post Office (PO) to deliver the items ordered by the customer. The cost of shipping is based on the weight of an item and its destination plus the ordered subtotal of the items. The database table COUNTRIES stores all the shipping rates for different countries. The code segment below shows how the cost is calculated. The PO charges the cost per kilogram (KG), if it exceeds a KG a fixed extra amount per additional KG is charged. The weight of item in grams is checked.

```
170 /*calculating cost by mass*/
171 $costbymass = $amount;
172 if ($totalmass > 1000) {
173     for ($k = 1000; $k < $totalmass; $k+=1000)
174         $costbymass = $costbymass + $serviceplus;
175 }
```

The initial value of **\$costbymass** is put equal to **\$amount**, where **\$amount** represents the cost for the first KG for the country destination. The value **\$totalmass** is the total weight of all the items in the cart. After the **\$costbymass** is calculated, it is added to the subtotal obtained from the total cost of all items ordered. The total cost includes the price of all

the items in the cart and the shipping cost calculated. The due amount is sent to the PayPal payment system that will handle the payment options using the following line.

```
191 $total = $costbymass+$subtotal;
```

5.4 Administration of the system

The administrator of the system has many privileges which include the following:

- The administrator has privileges to add new users to the system. The administrator can either add a shop owner (Seller) or an administrator. Customers register themselves in the system. The following code shows the categories that an administrator can choose when adding new user.

```
99 <p>
100 <label for="user">Category</label>
101 <select name ="role">
102 <option value="Administrator">Administrator</option>
103 <option value="Seller">Seller</option>
104 </select>
105 </p>
```

- The **“Seller”** category is chosen when the registering user is a seller. In this case shop details are needed to be added also. The fields needed to create the shop are the name and the type of the shop as shown in the following code.

```

72  if($category=='Seller'){ ?>
73      <form method="post" class="cssform" action="Add-shop.php">
74      <center> <a href="Administrator.php">Back to administration page</a></center>
75      <center><b>PLEASE FILL-IN THE SHOP DETAILS</b></center> <br/><br/>
76
77      <?php echo('<input type="hidden" name="username" value="'. $username. '">'); ?>
78
79      <p><label for="user">Shop name</label>
80      <input type="text" id="user" name="shopname"/>
81      </p>
82
83      <p>
84      <label for="user">Shop type</label>
85      <select name="shoptype">
86      <option>Select shop type</option>
87      <option value="Art & Craft shop">Art & Craft Shop</option>
88      <option value="Bookshop">Bookshop</option>
89      <option value="Clothing shop">Clothing Shop</option>
90      <option value="Electronics shop">Electronics Shop</option>
91      <option value="Music & Movies shop">Music & Movies Shop</option>
92      <option value="Tools & Hardware shop">Tools & Hardware Shop</option>
93      <option value="Home improvement shop">Home improvement Shop</option>
94      <option value="Software shop">Software Shop</option>
95      </select>
96
97      <center><input type="submit" value="Submit" class="formbutton"></center>
98      </form>
99      <?php
100     }

```

After the administrator has filled the shop name and type, a folder having the name of the shop identifier is created using a PHP script. This folder will store all the items of that particular shop being registered to the system. The created folder will have a default mode 0777 on the first line, meaning the widest possible access to it.

```

28      /*creating the shop directory where images will be kept */
29      mkdir('/data/websites/eball/shops/'. $shopid. ',0777');
30      $privilege='/data/websites/eball/shops/'. $shopid;
31      chmod($privilege,0777);

```

- The administrator can assign already existing shop to another shop owner. This happens when the shop is going to be managed by another user. In the code below **\$username** is the username for the new user that the shop will be assigned to and the value **\$shopid** is the shop identifier to which will be assigned to the new user. The shop owner is changed by changing the username in the STORES table to be the username of the current user.

```

21 <?php
22     $username=$_POST['username'];
23     $shopid=$_POST['shopid'];
24     include("config.php");
25     include("opendb.php");
26
27     $update_query="UPDATE STORES SET Username='$username' where Shopid='$shopid'";
28     $results=mysql_query($update_query);
29     include("closedb.php");
30 echo('<center><i>The shop owner have been changed<br>Thank you for the updates</i></center>');
31 ?>

```

- The administrator can edit shop details, for example when the shop name needs to be changed. The code below shows how the shop details are changed.

```

18 <?php
19     $shopid=$_POST['shopid'];    $shopname=$_POST['shopname'];    $shoptype=$_POST['shoptype'];
20     $shopid=str_replace(" ", "", $shopid);
21
22     include("config.php");    include("opendb.php");
23
24     $query="UPDATE STORES SET ShopName='$shopname',ShopType='$shoptype' WHERE Shopid='$shopid'";
25     mysql_query($query) or die('Error, inserting details failed');
26
27     echo('<center><i>Your Shop Details have been edited successfully</i><br>');
28     echo('<center><i>Thank you for Your Updates</i><br>');
29     include("closedb.php");
30 ?>

```

- The administrator can delete a shop from the shop from the shopping mall when it is no longer running or not required any more. To delete a shop, only the shop identifier is needed. The following code segment shows how the shop is deleted from the shopping mall system.

```

20 <?php
21     $shopid=$_POST['shopid'];
22     include("config.php");
23     include("opendb.php");
24
25     $delete_query1="DELETE FROM STORES WHERE Shopid='$shopid' ";
26     mysql_query($delete_query1) or die('Error, deleting shop failed');
27
28     $delete_query2="DELETE FROM ITEMS WHERE Shopid='$shopid' ";
29     mysql_query($delete_query2) or die('Error, deleting items failed');
30
31     include("closedb.php");
32
33     echo('<center><b><br><br><br>');
34     echo('The shop have been deleted from the Database <br>
35     Thank you for being part of the Rural Community Shopping Mall');
36     echo('</b></center>');
37 ?>

```

5.5 Shop management

The shop management is handled by the rural community entrepreneurs. The items sold by the shopping mall are uploaded by them. Since this functionality is for the rural community art and craft groups, who in general do not speak English, linguistic localization to their language, isiXhosa, was done. The following code segment shows linguistic localization of the labels. The labels are written in English and isiXhosa.

```
45 <form enctype="multipart/form-data" class="cssform" method="post" action="Insert-item.php">
46 <?php echo('<INPUT TYPE="hidden" name="shopid" value="'. $shopid. '"); ?>
47 <p>
48 <label for="user">Item Name - Igama lento</label>
49 <input type="text" id="user" name="name"/>
50 </p>
```

The other localized labels of the fields include the category of an item, its price, mass, image and description. The image of an item is uploaded using the file navigation process. The uploaded image is first resized before it is loaded to the shop's directory. The system supports JPEG and JPG image extensions and if the image extension is not one of the two a caution message is displayed. The code below shows how the image extension is tested.

```
74 /*checking the extension of the image*/
75 elseif( $extension != "jpeg" and $extension !="jpg" ) {
76 echo('<CENTER><b><font color="red">IMAGE EXTENSION ERROR - UMFANEKISO ONGAVUMELEKANGA </font></b></center>');
77 echo('<center><b><br>The image you are trying to upload is not supported - Umfanekiso akavumelekanga<br><br>
78 Supported formats are jpeg and jpg - Check the extension of the image - Umfanekiso uvumelekileyo
79 kufuneka abeluhobo oluyi jpeg, jpg<br>
80 <form><input type=button value="Continue-Qhubeka" class="formbutton" onClick="history.back()">
81 </form></b></center>');
82 }
```

The steps carried out when uploading an image are as follows:

- A displayed file navigation window will allow the uploading of the image.

```
72 <p>
73 <label for="user">Load image - Layisha umfanekiso</label>
74 <input type="file" id="user" name="uploadfile"/>
75 </p>
```

- The uploaded image is resized to be 120 pixels wide, and maintain the original aspect (dimensions: 120x90). This prevents the image from being “stretched” or “squashed”. The code below shows how the image is resized.

```

82     $newwidth=120;
83     $newheight=($height/$width)*120;
84     $tmp=imagecreatetruecolor($newwidth,$newheight);
85     /* image resizing, copying from the original image into the $tmp image*/
86     imagecopyresampled($tmp,$src,0,0,0,0,$newwidth,$newheight,$width,$height);

```

- After the image has been resized, it will be uploaded to the directory of the shop. When the shop is created, a folder that will contain all the images of the shop is also created. The creation of the folder code is shown in section 5.4. The name of the folder is the shop identifier (**\$shopid**). This helps to separate items of each shop. The uploaded image resides in the **\$shopid** directory. The code segment below shows how the image is uploaded to the shopid directory.

```

88     /* Uploaded image file to reside in the shopid subdirectory.*/
89     $filename ='shops/'.$shopid.'/'. $_FILES['uploadfile']['name'];
90     imagejpeg($tmp,$filename,100);

```

- As one can see, the image is stored in the temporary directory **\$tmp** before it is uploaded. There was an image (**\$src**) created from the original image which was used to resize the image. After the image has been uploaded successfully, all the temporary created images are deleted. The following code segment deletes the temporary images created during the upload process.

```

92     /*Deleting the temporal image created*/
93     imagedestroy($src);
94     imagedestroy($tmp);

```

5.6 Client-server communication via HTTP protocol

When the server receives a client’s HTTP request, the server loads the document (usually a webpage) requested by the client. The two most common HTTP requests used in this project are the GET and POST methods. These HTTP requests are used to send data to a Web Server.

- **GET Method**

Using the GET method, information from a form is added onto the end of the action Uniform Resource Locator (URL) being requested. GET method is used when a URL access will not change the state of the shopping mall database, for example, when not adding or deleting information in the database. Typically, the server's response is cached in the user's computer so that it can be revisited using the back button.

- **POST Method**

A POST request adds form contents to the end of an HTTP request. An HTTP request contains information about the server, client, connection, authorization. In the POST method, the user's input is transmitted in the body of the message to the server. The response to a POST request is not cached because the next POST response may not contain the same information. Here is an example of POST method used in this project:

```
21 <Form method="post" name="action" class="cssform" action="Add-user.php">
22 <p>
23 <label for="user">First Names<font color="red">*</font> </label>
24 <input type="text" id="user" name="firstname"/>
25 </p>
193 </form>
```

The above POST example will post any data to *Add-user.php* file (line 21) when variables like (line 24) have been posted. Line 193 closes the POST method and every data sent after the closing tag will not be sent to the PHP file.

HTTP is a client-server request-reply protocol that is *stateless*. That is, the protocol does not make any association between one transaction and another, e.g., the time since last transaction, type or client involved in the last transactions, what data was exchanged between the client and server. As far as HTTP is concerned, each transaction is a separate event. That is why explicit state maintenance by the shopping mall systems itself is essential to keep track of the user's sessions.

5.6.1 State maintenance

Session tracking ties together a series of browser requests. Maintaining state between requests made to a Web Server involves passing data generated from one request onward, so they can be associated with data generated from subsequent requests. PHP allows the user to store information on the server. However, this session information is temporary and usually deleted very quickly after the user has left the website.

When the customer visits the site for the first time, a session for that customer is created and it is used to maintain the current state. The state is maintained by setting the session value to contain a unique session identifier. The following code segment shows how to create a session for the cart and assign the session identifier to the variable “**cart**”.

```
1  <?php
2  session_start();

46 $_SESSION['cart']=session_id();
```

To call the *cart* session variable, the code in the second line is placed at the beginning of the PHP page, and the session identifier will automatically be available and can be called anywhere in the page. The session object is used to store information about, or change settings for a user session. Variables stored in the session object hold information about one single user, and are available to all pages in shopping mall application. The server creates a new session object for each new user, and destroys the session object when the session expires. In this project, the session was used for maintaining the user’s navigation through the site.

5.7 System Security

Once communication to the shopping mall system has been established there are security aspects to consider, ensuring the privacy and authenticity of the information on the system.

I. User interaction

When a new user registers, there are constraints that the user should meet in order to be a member of the shopping mall. Firstly, the user needs to have a unique username. The

username chosen by the registering user is searched on the database, to ensure there is no username duplication. The code segment below shows how the username given by the user is compared to the ones available.

```
50 $username_query="SELECT Username FROM USERS where Username='$username'";
51 $usertest=mysql_query($username_query);
52 $num=mysql_numrows($usertest);
53
54 if($num >0) $found=true; else $found=false;
55 if($found==True) {
56 echo('<p align="center"> ');
57 echo('<font color="black">The Username is being used by someone else</font></p>');
58 echo('<p align="center"><font color="black">Register again and try to use another Username</font></p>');
59 echo('<center><form>
60 <input type=button value="Back" class="formbutton" onClick="history.back()"></form></center>');
61 }
```

Then, the user email address must be in a correct format. If not, an error message is displayed. The code segment below shows how the format of the email address is checked.

```
33 /*validating the e-mail address*/
34 if(!ereg("[0-9a-z]([-_]?[0-9a-z])*@[0-9a-z]([-.]?[0-9a-z])*\.[a-z]", $email )) {
35 echo('<CENTER><b><font color="red">E-MAIL ADDRESS FORMAT ERROR</font></b></center>
36 <center><b><br>Make sure that you fill the e-mail address in a correct form<br>
37 i.e me@somewhere.com <br></b>');
```

The system uses pop-up messages to confirming important submissions and editing. This is used for example when the user tries to change the password and editing personal details. The system uses the JavaScript on a “submit” button to display a pop-up message. The following code shows how the pop-up message is displayed when the user tries to change its password.

```
32 <input type="submit" value="Submit" class="formbutton" onclick="return confirm('Are you sure you want to change your password?')" >
```

II. Authentication of the user

Users have different privileges on the system, so authentication through the use of username and password is required. The role of the user is given during the registration process. As said, the administrator is responsible for registering the shop owners and administrators, while the customers register themselves on the shopping mall.

After a successful registration, a user is given a role, stating the privileges that the user can partake in the system. The following code segment shows how the authentication is handled based on the user role. The following code will open the PHP page corresponding to the role of the user that have logged in to the system. The role of the user is retrieved from the users table. There are three types of users: the administrator, sellers and customers.

```
47  if( $UserRole=='customer' ){ ?>
48  <script language="javascript">
49  window.location = 'Customer.php';
50  </script>
51  <?php }
52  elseif( $UserRole=='seller' ){ ?>
53  <script language="javascript">
54  window.location = 'Seller.php';
55  </script>
56  <?php }
57  elseif( $UserRole=='administrator' ) { ?>
58  <script language="javascript">
59      window.location = 'Administrator.php';
60      </script>
61  <?php }
```

A “session role” is used to differentiate the roles of different users. Once the user has successfully logged in, the session *role* is created.

```
37  $_SESSION['role'] = $UserRole;
```

The following code segment shows how the user is restricted from accessing pages that are not based on his/her role. In the following example, the role for the user is the seller. The following code segment is placed on a separate PHP file and is included on the PHP file that needs to be secured from unauthorized access.

```
1  <?php
2  if (!isset($_SESSION['role'])) {
3  header('Location:index.php');
4  }else if ( $_SESSION['role'] != 'Seller' ){
5  header('Location:'. $_SESSION['role'] .'.php');
6  }
7  ?>
```

If the session *role* has not been set, that means the user have not logged in and if that user tries to access any page by changing the URL on the address bar, the home (index) page will be displayed. If the seller has logged in and tries to access the administrator or customer page, the page that will be displayed will be the seller's welcome page. Therefore any type of user will perform functionalities based on his/her role. All the shopping mall roles have PHP files that prevent unauthorized access.

III. Automatic Messaging

Automatic messaging is another way to ensure security of the user's information. This type of security was chosen since the information sent to the user will only be read by that particular user.

This type of messaging service is used for carrying out the following actions:

1. To send out forgotten password when requested to an email address.
2. To provides updates to customers about the order status.
3. Used when a user registers, edit personal details, change password, placing an order, change of the status of an order by the shop owner, notifying the customer about the order status.

Automatic email messaging required the installation of two PHP modules, *php mail* and *php-net-smtp*. Currently the shopping mall system is hosted at the University of Fort Hare, thus the SMTP server of the institution is actually used to send these automatic emails. The code segment below shows the automatic email generation, for the case in which a password has been forgotten.

```

50 //sending automatic e-mail for password
51
52 require_once "Mail.php";
53
54 $from = "dvesa.mall@gmail.com"; $to = $email; $subject = "Your login password";
55
56 $greet='Hi, '.$username;
57 $stmt="\n\n Thank you for asking for your password. Your password is ";
58 $motivation="\n The Rural Community Shopping Mall is willing to give you reliable services.
59 Make sure that you dont forget your login password again.\n\n
60 Contact us at :\n email address: dvesa.mall@gmail.com\n Telephone number: 0406022464";
61
62 $body = $greet. $stmt. $password. $motivation;
63
64 $host = "al-tsc-cl01-ex.ufh-domain.local";
65 $username = "softwaredev@ufh"; $password = "alice";
66
67 $headers = array ('From' => $from, 'To' => $to, 'Subject' => $subject);
68 $smtp = Mail::factory('smtp', array ('host' => $host, 'auth' => true, 'username' => $username, 'password' => $password));
69
70 $mail = $smtp->send($to, $headers, $body);
71
72 if (PEAR::isError($mail)) {
73     echo("<p>" . $mail->getMessage() . "</p>");
74 } else {
75     echo("<p><center>Your password has been sent to your e-mail<br>Please check your e-mail !!</center></p>");

```

The SMTP server used has the name *al-tsc-cl01-ex.ufh-domain.local*. The username and password to access the service are the institution login credentials, present in our mail client.

IV. Secure payment

The system uses an international payment system. The customer's credit card information is handled by PayPal. Our shopping mall system only passes the amount that the user is charged when making an order and PayPal will handle the credit card payment options. The system doesn't store the user's credit card information, it only stores the personal and contact details of the user. The following code segment shows how the payment using PayPal is done.

```

201 <center>
202 <form action="https://www.paypal.com/cgi-bin/webscr" method="post">
203 <input type="hidden" name="cmd" value="_xclick">
204 <input type="hidden" name="business" value="ldalvit@gmail.com">
205 <input type="hidden" name="item_name" value="buy at Dwesa">
206 <input type="hidden" name="item_number" value="Total Amount">
207 <?php echo('<input type="hidden" name="amount" value="'.\$euros.'') ?>
208 <input type="hidden" name="no_shipping" value="0">
209 <input type="hidden" name="no_note" value="1">
210 <input type="hidden" name="return" value="http://cs.ufh.ac.za/email/Thanks.php">
211 <input type="hidden" name="cancel_return" value="http://cs.ufh.ac.za/email/ViewCart.php">
212 <input type="hidden" name="currency_code" value="EUR">
213 <input type="hidden" name="lc" value="ZA">
214 <input type="hidden" name="bn" value="PP-BuyNowBF">
215 <input type="image" src="images/buy.gif" border="0" name="submit" alt="Make payments with PayPal">
216 
217 </form>
218 </center>

```

The code above uses a POST method to post data to PayPal. For PayPal to be able to transfer money from the customer credit card to the business owner the owner should be registered and the owner is identified by email. Our shopping mall is registered using *ldalvit@gmail.com* account.

There are “hidden” fields listing for example the business name, the total amount, the return pages (when the customer cancel the payment or after a successful payment). The important variable in this code is the total amount of the items being ordered and the shipping cost, represented by **\$euros**. This amount is in euros since the system uses euros.

5.8 Conclusion

This chapter has presented the implementation of the major components of the shopping mall system. It has explained the implementation of the shopping cart. The security measures adopted by the system have been pointed out and a justification for them was presented.

Chapter 6

Results, evaluation and future work

This chapter concludes with a reflection on what was achieved and what difficulties were encountered. A summary of the thesis and a general discussion of the important results of the work reported in this thesis are offered. Finally we outline possible future extensions to the project.

6.1 Thesis summary

The motivation for the development of the system produced in this work was based on the fact that rural communities in the Eastern Cape have individuals with skills to produce hand-works and crafts but not much possibility of marketing what they produce. The impoverished nature of the developing communities targeted by the system, spurred the development of a cost effective system. The aim of this thesis was to explain the design, implementation, and deployment of the shopping mall for small entrepreneurs in rural communities.

This project has produced a shopping mall prototype system, developed using Free Open Source Software. The shopping mall system supports three types of users: the administrator, shop owners and customers. It includes a front-end, accessible to all the shopping mall users, and a back-end, accessible to the administrator and shop owners.

The security of the system is based on using certain restriction depending on the role of the user. It is also based on using reliable, secure partners (PayPal and SAPO) for the actual payment. The shopping mall system is multi-user, thread-safe system, i.e. it can be accessed by many concurrent users, and these users can be performing any tasks simultaneously.

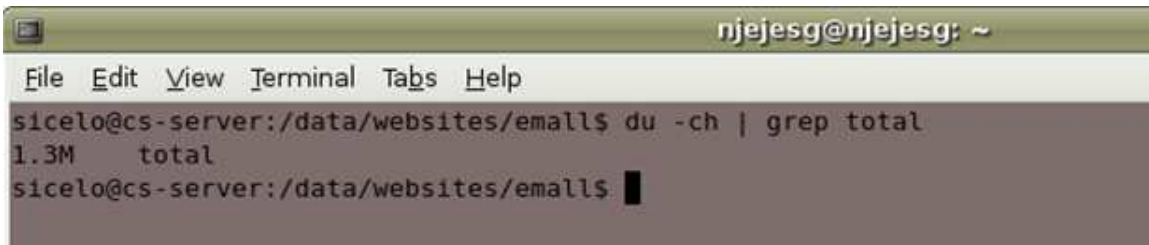
The shopping mall system has been deployed and is ready for use.

6.2 Discussion

This thesis has resulted in the development of a shopping mall system using the Open Source LAMP model. The use of Open Source software puts full control and ownership of the developed system into the hands of the users and also allows future development, adaptation, customization and localization of the shopping mall. Extension of functionality and services offered by the shopping mall are possible, as its source code is available. This section reflects on various characteristics of the system, offering an initial pre-deployment assessment.

6.2.1 Footprint of the application

The size of the system will depend on the number of shops and items available per shop. The size of the whole system is 1.3 Mega Bytes (MB) at the moment as one can see from the screenshot below. This size includes all the PHP files, the MySQL dump file and images used by the system. The system with no shops will have the size of the whole system excluding the database dump file, shop item's folder.

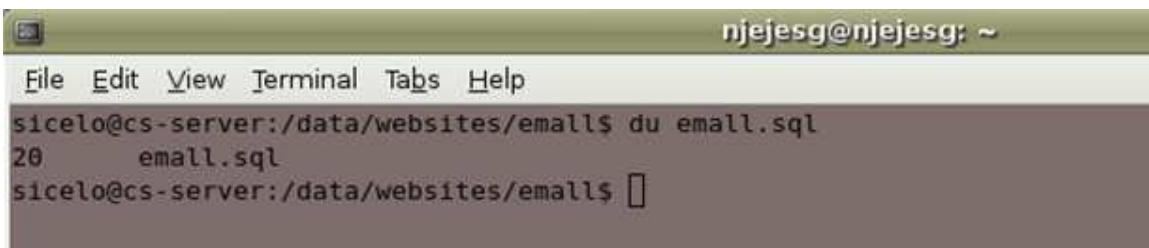


```
njejesg@njejesg: ~  
File Edit View Terminal Tabs Help  
sicelo@cs-server:/data/websites/emall$ du -ch | grep total  
1.3M total  
sicelo@cs-server:/data/websites/emall$
```

As the system will be integrated with other systems being developed, the system may need more disk space or a dedicated server depending on the hardware being used, amount of traffic to the website and the number of shops and items needed to be added to the system.

The total size of all the PHP files used during the development of the system is 304 KB.

The MySQL database dump file is currently 20 KB.



```
njejesg@njejesg: ~  
File Edit View Terminal Tabs Help  
sicelo@cs-server:/data/websites/emall$ du emall.sql  
20 emall.sql  
sicelo@cs-server:/data/websites/emall$
```

As one can easily imagine, the size of the database is mostly a function of the number of shops and products in the shopping mall. The shopping mall consists of 2 shops at the moment. The major contribution of each shop to memory usage is the size of the images residing on the shops directory. This is currently 428 KB.

The use of dynamic pages and small result set to be communicated by the MySQL database increases the overall system performance. Thus the system can also be served from low-power machines which have less Central Processing Unit (CPU) power and use less power. This is an important aspect of the system, as it will be used in rural communities where high power requirement might be problematic.

The Apache memory usage is 1.7% as shown in the first line of the next illustration.

```

njejesg@njejesg: ~
File Edit View Terminal Tabs Help
njejesg@njejesg: ~
sicelo@cs-server:/$ top

top - 17:24:00 up 114 days, 5:54, 1 user, load average: 0.01, 0.01, 0.00
Tasks: 92 total, 1 running, 91 sleeping, 0 stopped, 0 zombie
Cpu(s): 0.0%us, 0.2%sy, 2.0%ni, 97.8%id, 0.0%wa, 0.0%hi, 0.0%si, 0.0%st
Mem: 1034784k total, 1008292k used, 26492k free, 460440k buffers
Swap: 1020116k total, 17648k used, 1002468k free, 222140k cached

  PID USER      PR  NI  VIRT  RES  SHR  S  %CPU  %MEM    TIME+  COMMAND
 14167 www-data  26   10 32200 17m 3864  S   4   1.7   0:04.06 apache2
     1 root      16    0  1628   536 448   S   0   0.1   0:01.32 init
     2 root      RT    0     0     0     0   S   0   0.0   0:02.63 migration/0
     3 root      34   19     0     0     0   S   0   0.0   0:00.00 ksoftirqd/0
     4 root      RT    0     0     0     0   S   0   0.0   0:00.00 watchdog/0

```

6.2.2 Payment method

Our shopping mall system does not support direct credit card payment. For the customer to pay using credit card, he has to register with a third party (PayPal) before the payment can be made. This is required by the payment system used by the shopping mall. It should be noticed that in other countries PayPal offer e-commerce sites direct credit card payment. Unfortunately, Africa is regarded as a risk for this solution. This can result in a hindrance as some of the users may want to pay without registering. In the near future the system should support plain credit card payment, using a solution from one of the financial institutions in South Africa.

6.2.3 Postal system for distribution

As mentioned, for the delivery service the system uses the South African Post Office (SAPO). “The Ngwane art and craft group” is functioning at Dwesa and the nearest Post Office (PO) from Dwesa is Willowvale PO. “The Ilingelihle group” is at Alice and will use Alice PO to deliver the ordered items. The shops that will be registered later will also use the Post Office as a delivery service. As said, the Post Office is the most common delivery service near to most rural areas in the Eastern Cape. Post Office is also cost-effective for the time being as it uses a “Pay per Use method”.

6.2.4 Messaging service

The system uses email as a message service. All the users are alerted by email. The email service has some limitations. The main limitation is that the user must have an email address in order to be contacted. In addition, the service can be unreliable as the mail server can fail for a number of reasons and there is no alternative way for contacting the customer. The system should not be solely dependent on one type of service. There is a need for an extra messaging service. For example, the system should be linked with a mobile messaging service to use SMS or use electronic fax.

6.2.5 Security of the system and quality of the interfaces

The system is secure in the way that the user information is kept private and cannot be accessed by an unauthorized party. The system uses secure mail as one of the communication security aspects. All the credit card transactions are managed by the payment system of the financial partner used by the shopping mall.

The shopping mall is developed in a way that it will provide higher quality interface to the customer. This is done through the design and development of a well organized website. Various user interface designs were developed. These interfaces aimed in delivering the high quality of service to the users. We chose the customer interface to be as a shopping mall system where customers can be able to make purchase. The seller’s interface was designed based on the language that the art and craft groups speak.

6.2.6 Status of the deployed shopping mall at the end of 2007

The shopping mall as deployed at www.dwesa.com, contains currently two shops. The first shop is *Ngwane Art and Craft Shop*. Ngwane is the art and craft group found in Dwesa. This group has members that produce beaded art and craft. The second shop is *Ilingelihle Art and Craft Shop*. Ilingelihle is the women's project on resident actually from University of Fort Hare, Alice. Contributors include a group of people who craft picnic baskets, cushions, beaded glasses and bed linen. Modern ideas and interpretations were applied to traditional craft techniques, such as strip-sewing, cross-stitch and prairie points.

No sales have as yet been made at www.dwesa.com. This is probably owing to the lack of advertising of the website. The work reported in this thesis concentrates on the development of the system not on the advertising means of the shopping mall website. Still, various ways for advertising the website have been explored with the rest of the team engaged in Dwesa and will be put to work in 2008.

6.3 Field evaluation of the project

The evaluation of the shopping mall system was based on the usability, flexibility and performance of the system. The field test evaluation of the system was only initial and based on training the Dwesa art and craft groups on how to use the system as required to meet the project objectives. Our shopping mall system is a prototype system that was developed through an iterative process based on comprehensive field testing at Dwesa.

The system underwent an evaluation that focused on its user friendliness and flexibility. The seller's interface is designed in two languages, English and isiXhosa. This made the system understandable to the small entrepreneurs in rural communities. The art and craft entrepreneurs were trained on how to login and use the system. Login credentials were created for them to be able to upload items to be sold. The entrepreneurs were also successfully trained on how to check orders, change login password and edit personal details. Most of the art and craft members were between the ages of 35 and 65 years. This

necessitated patience and more attention when introducing the system to them and also during the training session.

6.3.1 Observations encountered

After each training session the feedback from the participants was collected. Most of the art and craft participants felt that the content of the training was useful. More than half of the participants believed that the time of the training was sufficient. Some participant instead commented that there was not enough time for practicing what they had learnt. In overall they agreed that they gained knowledge on how to use the system. When they were asked to rate the importance of the training by choosing a number between 1 to 10, with 1 being the lowest and 10 being the highest, the majority has rated between 6 to 10. They found the system user friendly and easy to use, also thanks to the fact that their interface is written in their traditional language (isiXhosa). The author of this thesis also speaks isiXhosa, and this made the training quicker, simpler and understandable.

The visits to the field were not without difficulties. For example, there were quite different views from individuals in the community when the project was introduced to them, especially the art and craft entrepreneurs. They were working individually and this system leads to the proposal of team work. They argued on how the income is going to be divided, how the shipping will be handled, and the time that each member should dedicate to the group. They wanted clarity of the benefits from the virtual shopping mall system as a marketing service. All their questions where answered clearly and they seemed to understand the benefits and the purpose of using the shopping mall as their marketing infrastructure.

6.4 Results attained

The preliminary results from this project indicates that *buy at Dwesa* shopping mall tests favorable across the board, with good demonstration of its ability to bridge the technology and education gaps, provide affordable access to technology, and might help small entrepreneurs to access the market for their wares.

Of course, only time will say if the intervention is really successful. In the meantime, though, a simple, user friendly shopping mall application suitable for small entrepreneurs in rural areas has been developed and is ready to be tested.

6.5 Future work

There are many possible extensions that can be done to the current shopping mall system.

Firstly, the system does not support plain credit card payment; a future goal is the system being able to accept plain credit card payment.

Secondly, the system should support multiple messaging services.

Thirdly, the interface for the art and craft entrepreneurs should be localized not only linguistically: for example, a better metaphor than the office desktop should be used.

Fourthly, the experience of the customer should be enhanced, attaching extra material to each item on sale, such as explanation of its traditional meaning (when available), video-clips of its use and the possibility to communicate directly the artisans.

Lastly, as the rates on the SAPO brochure used by the system are valid till March 2008. The rates should be updated when a new brochure is released.

Acronyms

CD	Compact Disk
CPU	Central Processing Unit
CSS	Cascading Style Sheet
DB	Database
DHTML	Dynamic Hyper Text Markup Language
FOSS	Free Open Source Software
HCI	Human Computer Interaction
HTML	Hyper Text Markup Language
HTTP	Hyper Text Transfer Protocol
ICT	Information and Communications Technology
KB	Kilo Bytes
LAMP	Linux, Apache, MySQL, PHP
MB	Mega Bytes
OS	Operating System
OSI	Open Source Initiative
OSS	Open Source Software
PHP	Hyper Text Preprocessor
PO	Post Office
SAPO	South African Post Office
SMME	Small to Medium Micro Enterprises
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SPM	Synaptic Package Manager
URL	Uniform Resource Locator
VSAT	Very Small Aperture Terminal
WiMAX	Worldwide Interoperability for Microwave Access

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Appendix A

System installation and setup

This section explains how to install and setup the rural community shopping mall application with the required software components. The following table lists the requirements of the shopping mall application.

Requirement	Information	Deployed Version
Operating system	Latest version of Ubuntu Linux OS preferred	Ubuntu 6.10 (Edgy Eft)
Web Server	Apache Web Server	2.0.55
Database	MySQL Database	5.0.24
Scripting language	PHP5	5.1.6

The first part will explain the basic installation of the required software components. The parameters outlined in this section can be adjusted according to extra needs. The second part will explain the setup in detail.

Installation

The shopping mall system is running on a Linux Operating System (OS). Ubuntu is our choice. The installation instruction given by the following section is based on Ubuntu installation. The following section will explain how to install the LAMP modules.

Installing Ubuntu version 6.10 operating system

Ubuntu Linux OS is free and available on the website (<http://www.ubuntu.com>) for free download. There are other Ubuntu versions that allow the installation of the LAMP modules during the installation of the operating system. For example, when installing from the Ubuntu 6.06 (Dapper Drake) "Server CD", there is an option allowing to run a LAMP setup at the initial Ubuntu installation screen. This will install Apache2, PHP5 and MySQL 5.0.

Installing LAMP (Linux, Apache, MySQL and PHP) stack

There are various ways that are used to install the LAMP stack. The LAMP stack can be installed by module or as a whole stack. We choose to install the LAMP stack as a whole.

Steps to follow:

The LAMP stack is installed using the **Synaptic Package Manager (SPM)**. The **SPM** provides the same features as the **apt-get** command that is used to install packages. To open **SPM** go to **System ->Administration -> Synaptic Package Manager**. Enter the administrator password which is the system root password. The **SPM** window will be displayed. This window will allow the installation of Apache Web Server, MySQL server and PHP.

To install the LAMP stack using the **SPM** window, go to **Edit -> Mark Package by Task**. This will list all the packages that can be installed. Then to install, choose "LAMP server" from the list of options. Click **OK** and then click the "**Apply**" button on the toolbar.

This will install the default list of packages (Apache Web Server, MySQL and PHP) that are part of LAMP installation. There are additional PHP modules that we need to install.

1) php mail

As already stated in Chapter 5, **php mail** provides supporting functions useful to send email to the users. This module is installed using the **SPM** window. On the window, go to **Search** then a search window will appear, then type "php mail", all the php

modules will be displayed. Choose the **php-mail** option and mark for installation, then click **Apply**. This will install the php mail module.

2) **php-net-smtp**

This PHP module allows the SMTP mail server to send email. The module is installed the same way as **php mail**, the key words used are php-mail-smtp.

3) **php-gd**

This PHP module enables the management of images uploaded in the system. It is installed via **SPM**, in the same way as **php mail** and **php-net-smtp**. The key words used to search for this module are php-gd. The php5-gd was used.

4) **phpMyAdmin**

This PHP module allows the management of MySQL database. It is installed via **SPM**, in the same way as the above modules. After phpMyAdmin is installed, it will need the system root password.

The following section will explain the setup of the shopping mall system.

Creation of the website directory

To access the index page from the server where the system is deployed, the user should use the URL `http://localhost/emall/`. When not on the server and using Internet, typing `http://www.dwesa.com` will open the index page in **emall** directory residing on the server. On the server the shopping mall PHP files are found on the `/data/websites/emall/` directory.

Creation of MySQL database

The system requires a MySQL database. The file for configuring the MySQL DB is “`config.php`”, found in the **emall** folder. You can choose another name for the database, in this case you need to change the “`config.php`” file. We named the created database “`emall`”.

Appendix B

System administrator manual



I have carefully assessed the user's manual for buy at Dwesa shopping mall. This document has been completed in accordance with the requirements of the Master of Science in Computer Science. We fully accept the changes as needed improvements and authorize initiation of work to proceed. Based on our authority and judgment, the continued operation of this system is authorized.

MANUAL OBJECTIVES

This manual is a guide on how to use the shopping mall system administrator's interface. It aims in allowing the flexibility on the usage of the system.

Note: The coding of the system is not provided on this document

CONTENTS

1. Logging onto the system as an administrator.....	96
2. Welcome page.....	99
3. Viewing shop owned by the shop owner.....	104
4. Adding new shop for the shop owner.....	104
5. Assigning the shop to new user.....	105
6. Editing shop details.....	106
7. Checking mails from users.....	107

1. Logging onto the system as an administrator

To access the administration functionality you have to login to the system. The login details are the ones you got by the time you were registering as an administrator into the shopping mall system. As an administrator you have the user and shop management rights. The figure below shows the home page (welcome page). The page is displayed after you have entered the site URL (<http://www.dwesa.com>). It contains the list of all the shops available in the mall. There is also a login panel represented by the circled area.

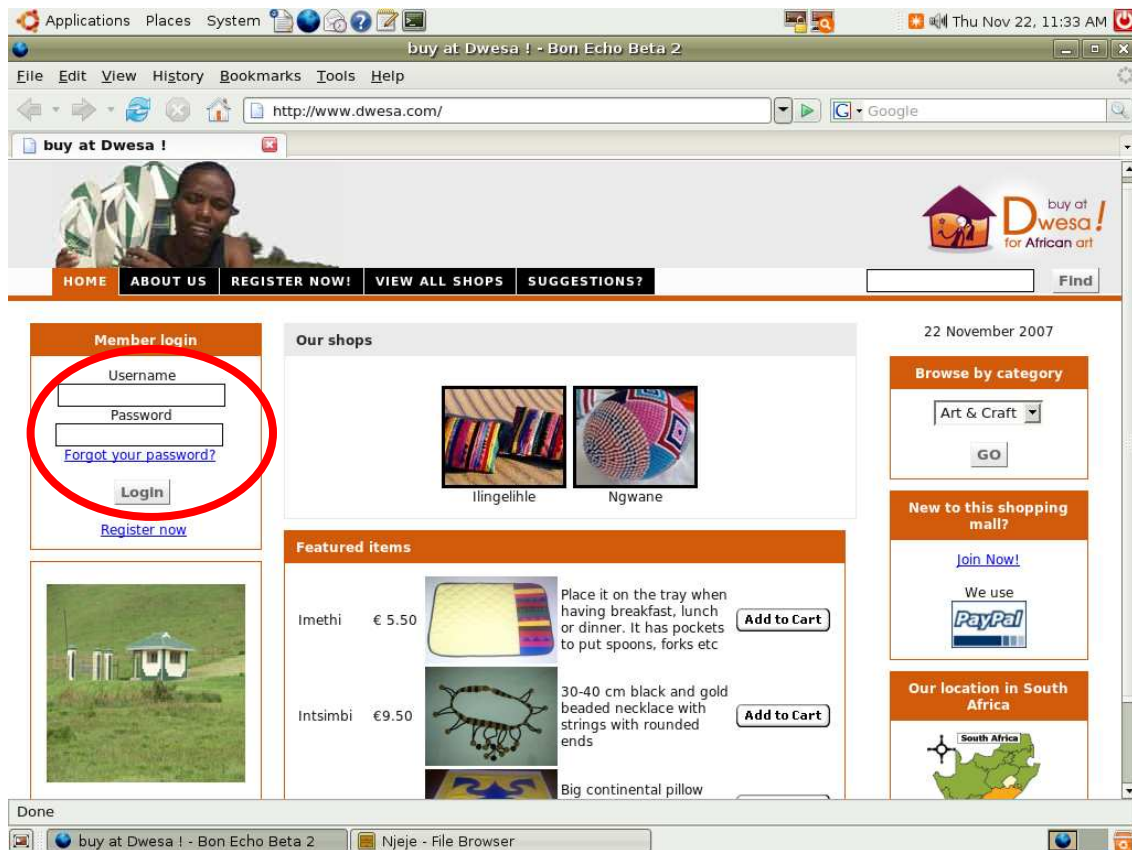


Figure1: Main page

The circled area is where you enter your username and password and then click the *Login* button or just press *enter* to proceed to the administrator welcome page. If you have entered wrong username and password, an error page shown in figure 2 will be displayed. This page displayed in figure 2 tells you that you have entered wrong username or password (Case sensitive). In this case you have to login again. The error page is in

English and isiXhosa. This is because the page is also displayed when rural community art and craft groups have entered wrong login details.

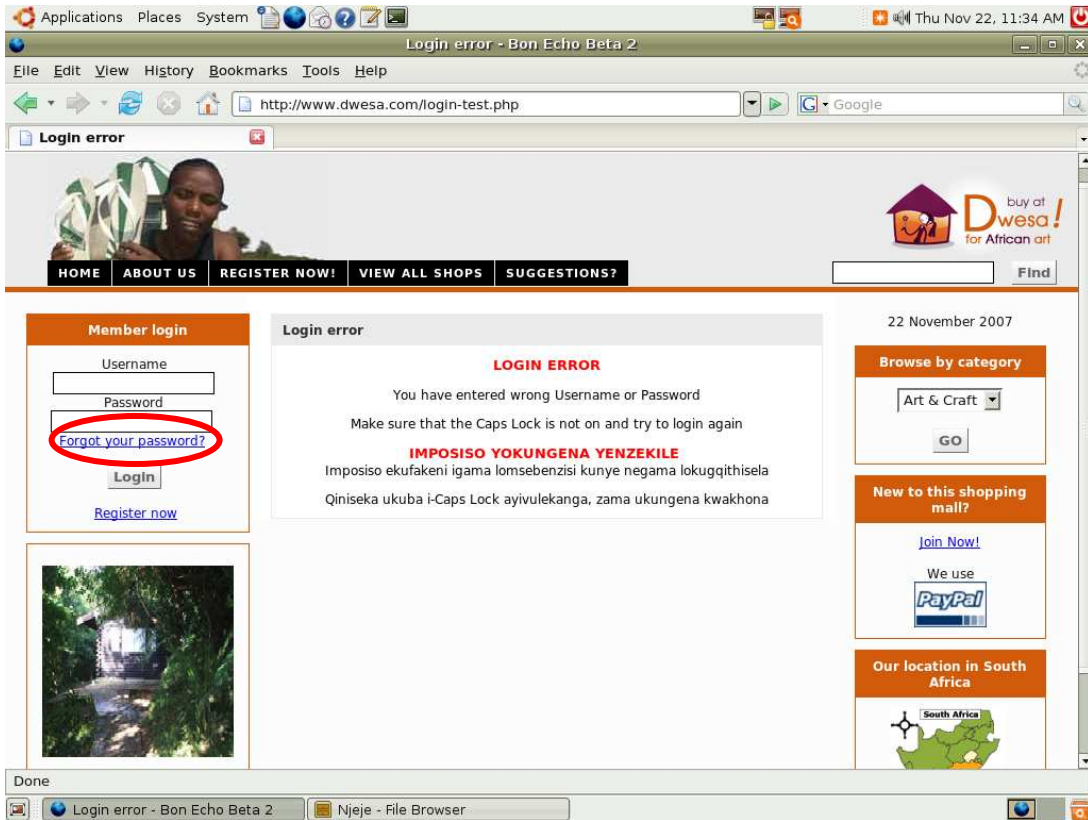
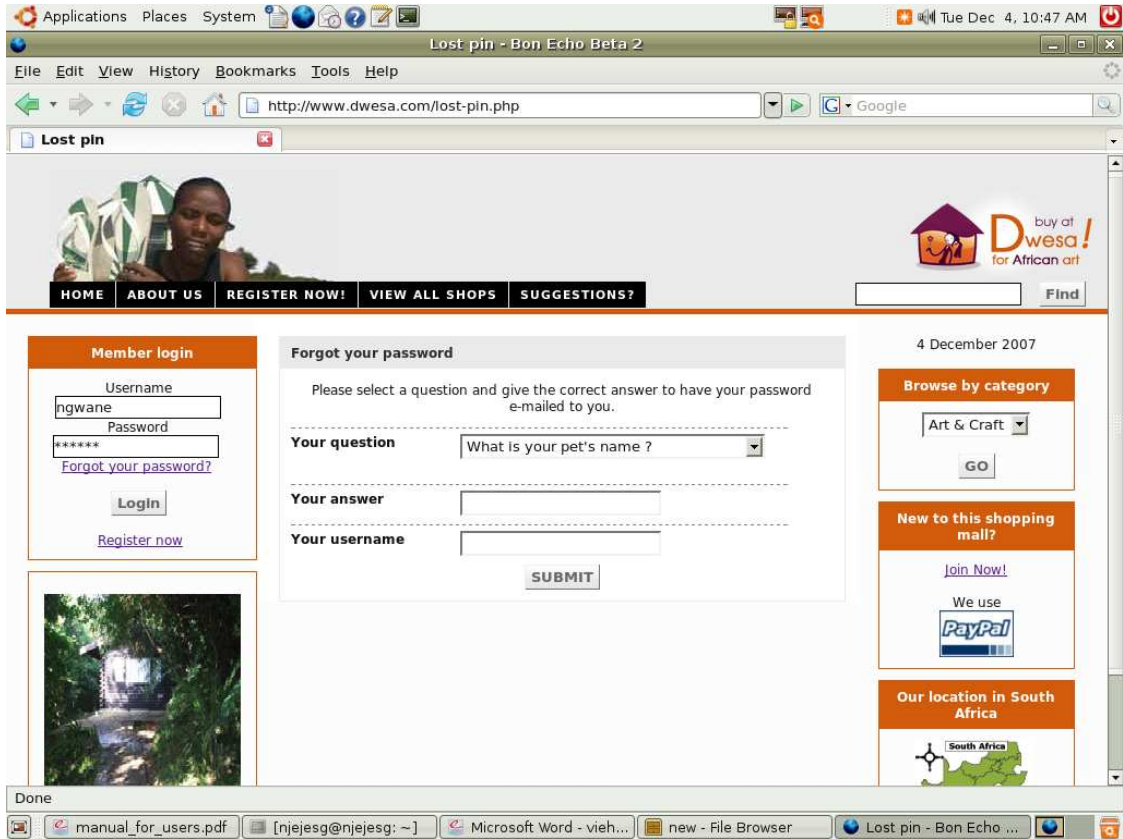
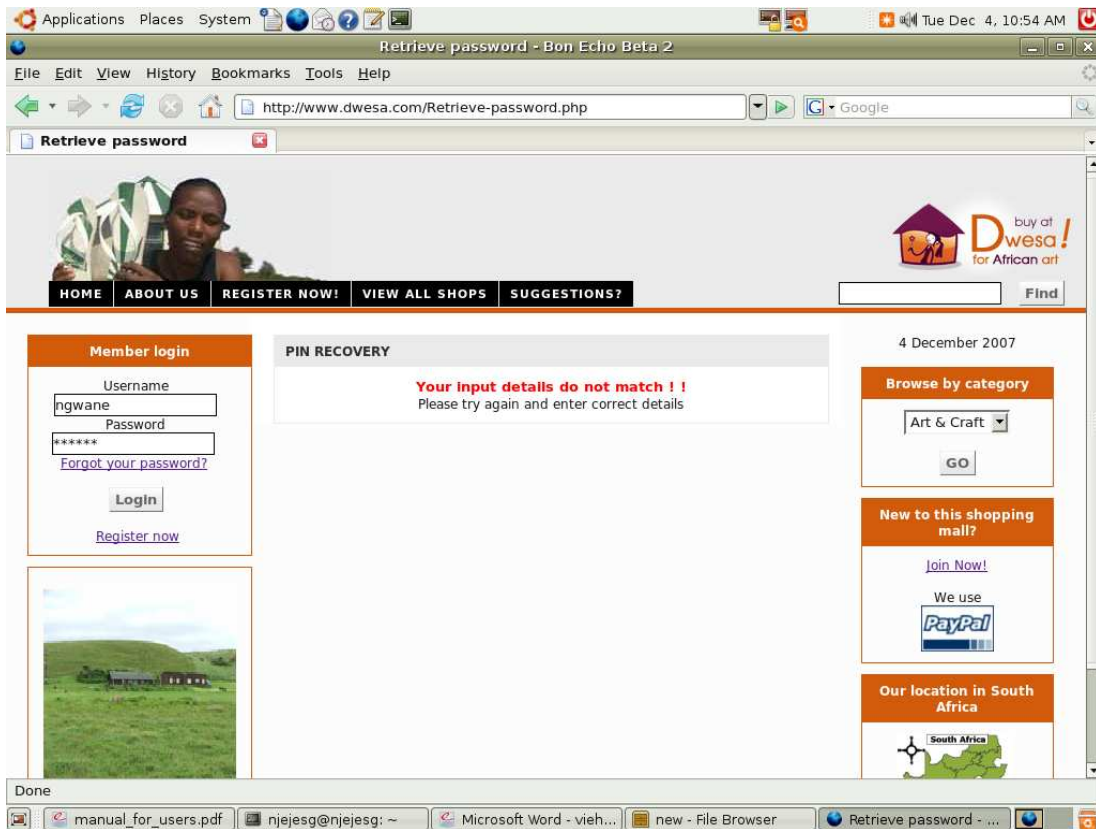


Figure 2: Login error page

If you have forgotten your password, there is a link, shown by the circle in the above figure, which will allow you to retrieve your password through automatic messaging. Following the link will take you to the page where you have to enter your question, answer and username that you have chosen by the time you were registering as an administrator of the shopping mall. The following page is displayed after you have followed the link *Forgot your password?* in Figure 2 above.



If you have entered correct password retrieval details, an automatic email with your password will be sent to you. If you have entered wrong details when trying to retrieve your password, an error page is displayed. The following page is the page that is displayed when you have entered wrong password retrieval details.



2. Welcome page

When you have successfully logged in, the following page will be displayed. This page is the administrator's welcome page with various links that an administrator can perform. Remember: as an administrator you have full control of the shopping mall system.

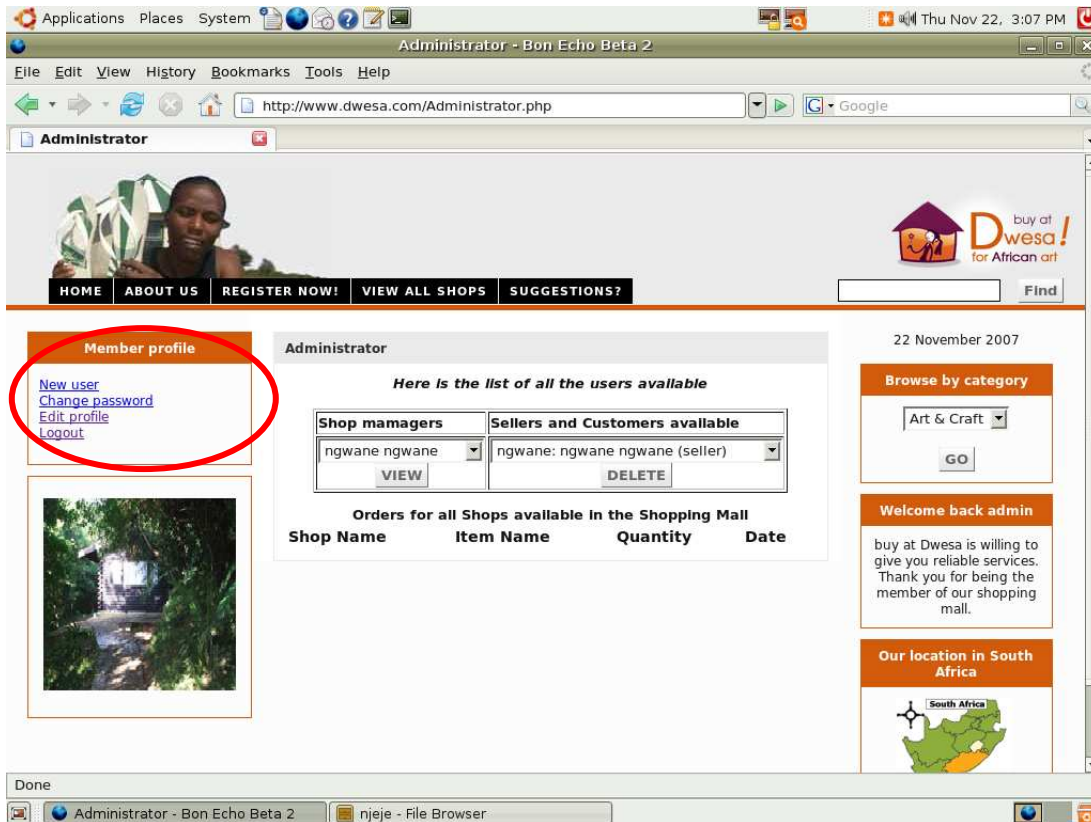


Figure 3: Administrator's welcome page

This page contains the list of shop owners/managers (sellers), customers, and the list of orders made by customers.

There are also other functionalities or operations that can be performed as an administrator, shown by the circle in the above figure. These links allows to add new user, change password, edit personal details or profile and also to logout. If you click the *New user* link, the page that will let you add new user (shop owner or administrator) will be displayed. Keep note that you can only add a shop owner or an administrator not a customer. Customers register themselves in the shopping mall website. The following page shows the registration form that you use to register new shop owner or administrator.

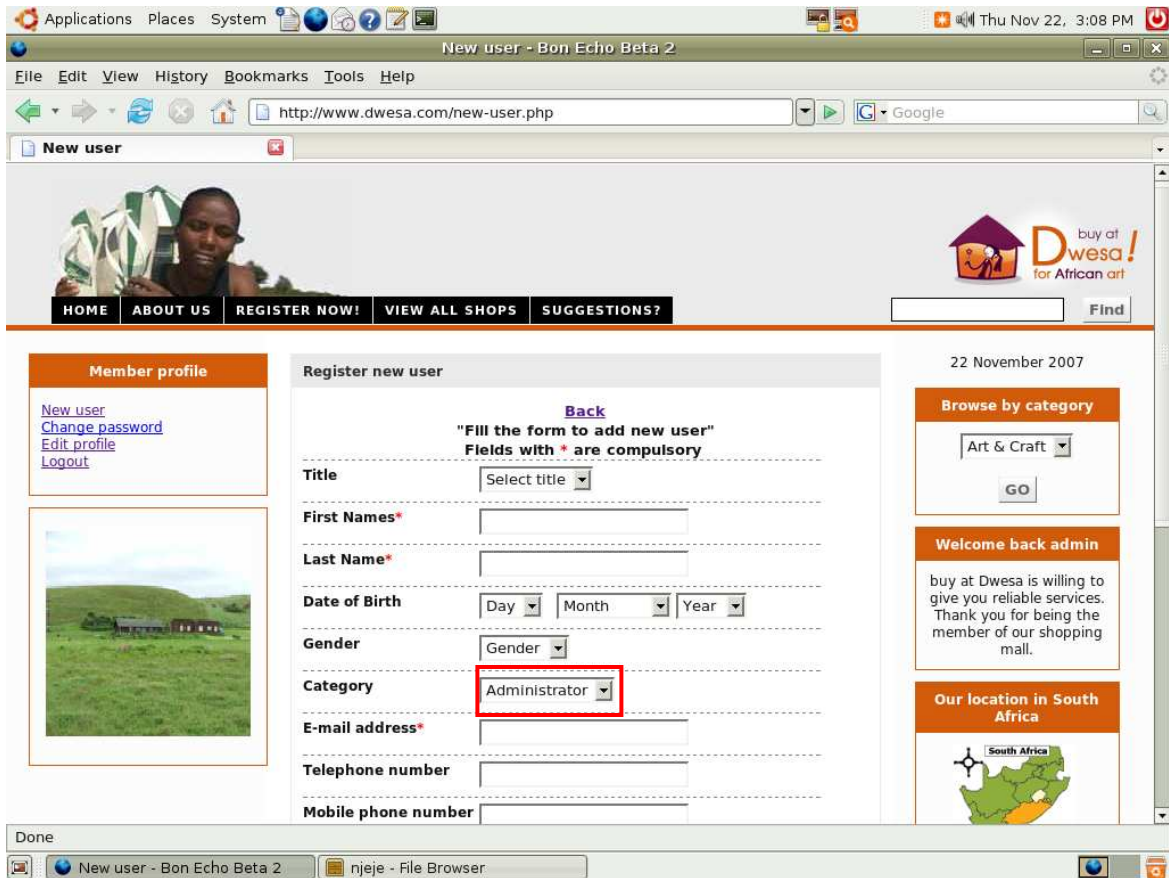


Figure 4: Registration page

On this page above, you will fill all the personal and contact details of the registering user. As you can see under the *Category* field, there is a drop down (shown in rectangle) that allows you to choose what category the registering member belongs. There are two options:

- The user can be an administrator and in this case you just fill this form and choose category administrator and when you submit the details, the welcome page for an administrator will be displayed.
- The user can be a seller; in this case you will also need to fill the shop details for the user.

If the registering member is a seller, you will choose *Seller* on the dropdown and after you have filled all the required fields, the following page will be displayed.

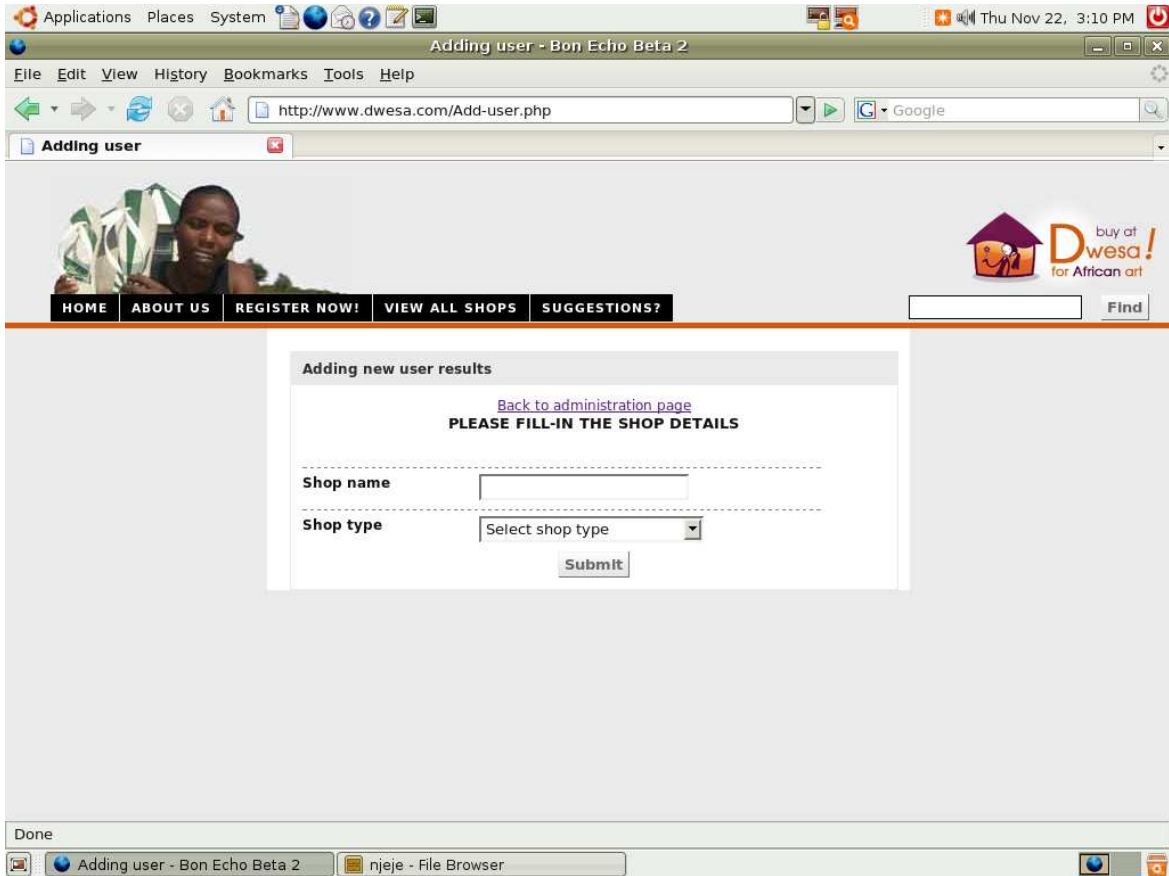


Figure 5: Adding a shop for the new member

The figure 5 above shows the shop name and shop type fields that you will fill after the new shop owner personal and contact details has been filled. You can also add multiple shops for the same new member. This is explained later in this document.

The following section will go back to the administrator welcome page, shown in Figure 3. From the page, there are two rectangles that are shown in the figure. The left rectangle is the panel where there is a dropdown menu that will list all the available shop owners and the right rectangle is the panel that will list all the shop owners and customers available in the shopping mall and in this panel there is a *DELETE* button that will allow you to delete the selected member in the system. Clicking the **delete button** will delete the selected member from the database, so use this button wisely.

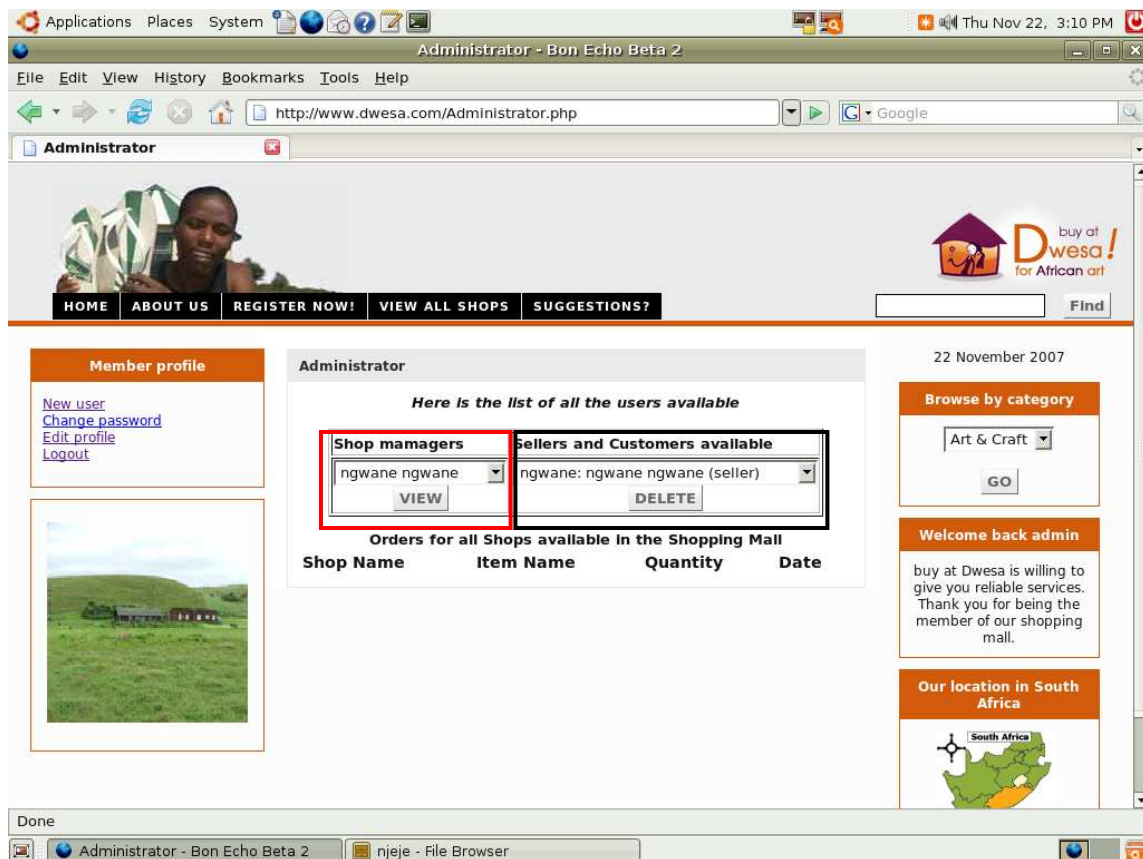


Figure 6: Welcome page revisited

3. Viewing shop owned by the shop owner

If you select the shop owner on the dropdown menu of the left rectangle shown in Figure 6 and then click the *VIEW* button, the page that will list all the shop that the member have will be displayed. The figure below shows how the list will be displayed. Also in this page, remember that the *Delete shop* button will delete the shop from the shopping mall system.

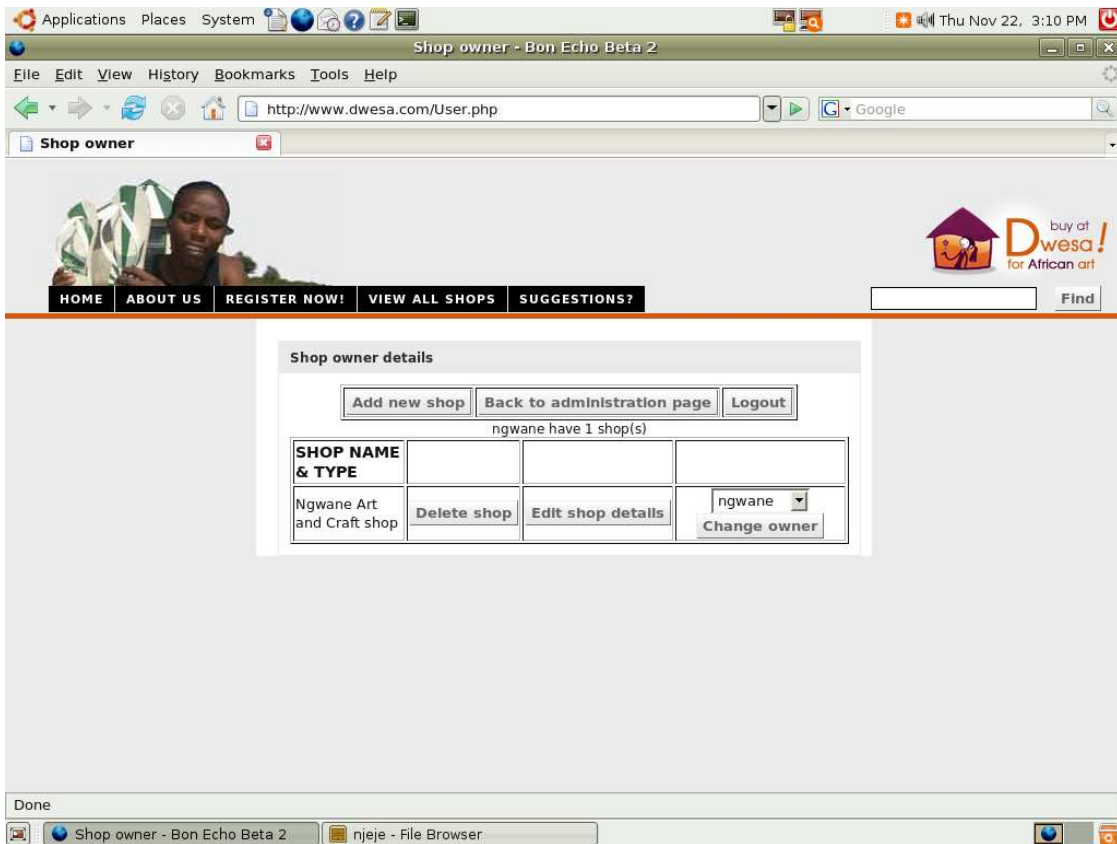


Figure 7: Viewing shop

4. Adding new shop for the shop owner

As you can see on the above figure, the shop owner has only one shop under his/her name (Ngwane Art and Craft shop). Clicking the *Add new shop* button will allow the administrator to add a new shop for the current shop owner. The fields that will be displayed after you have clicked the button will show the shop name and shop type fields that you will use to enter shop details. Clicking the *SUBMIT* button will add the new shop

under the current shop owner and the shop owner will now have two shops under his/her name. The page that is displayed to add new shop for the current shop owner is similar to the one displayed in Figure 5.

5. Assigning the shop to new user

Clicking the *Change owner* button (displayed in figure7) will allow the administrator to assign the selected shop to another existing shop owner. If the shop is going to be assigned to the new use, the new user should first be a registered member as a shop owner so as to allow all the shop managing privileges. The shop cannot be assigned to an unregistered shop owner. On the following figure, the shop can be assigned to another user by selecting the user you want to assign the shop to on the dropdown menu. After you have selected the user, clicking the *Change owner* button will assign the shop to the selected user. In this case the shop login details should be given to the new shop owner.

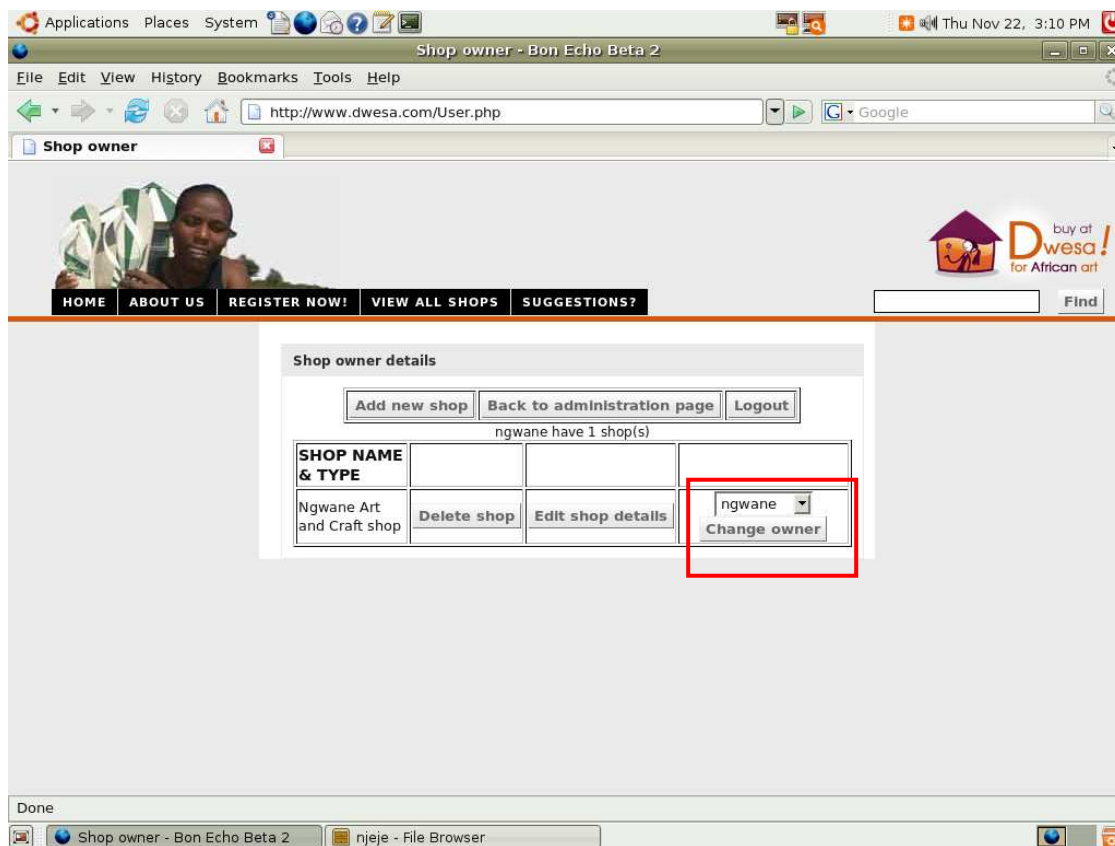


Figure 8: Assigning shop to new user

6. Editing shop details

As an administrator you can also edit the shop details, this is usually done when the shop owner request for a change of the shop name or when the shop is being assigned to another shop owner. Clicking the *Edit shop details* button shown in figure 8 will display the page that will allow you to edit the shop details, the page that will be displayed is shown on the next figure 9 below.

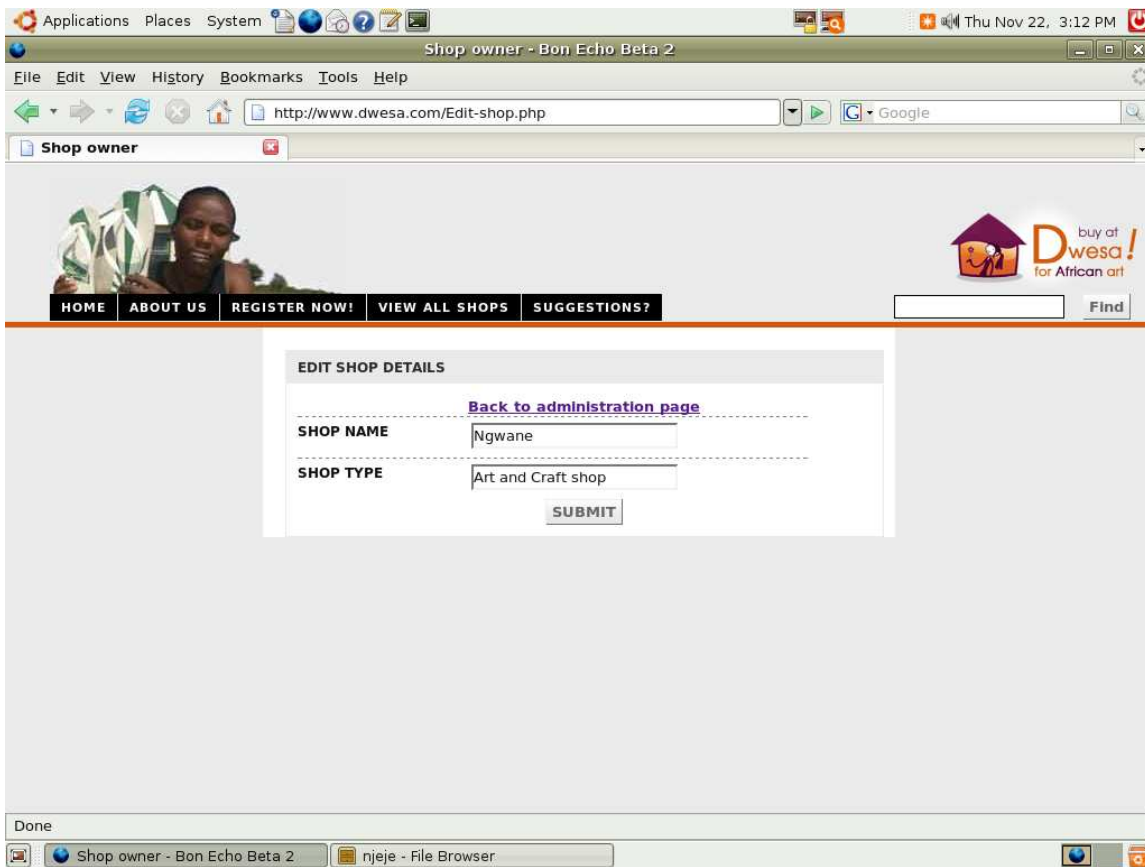


Figure 9: Editing shop details

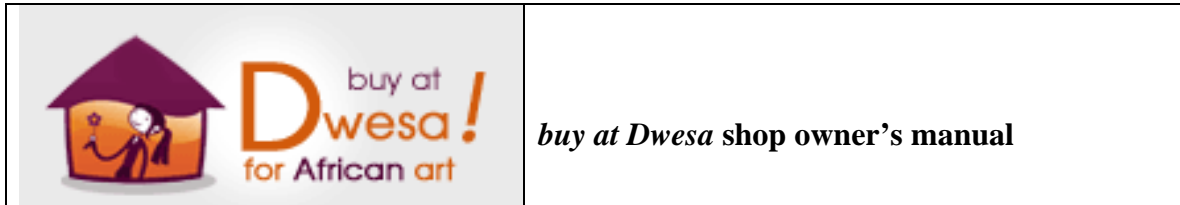
7. Checking mails from users

Users of the website may have some comments and suggestion on the website status. They may also help in improving the status and functionalities of the website. The email address for the administrator is ***dwesa.mall@gmail.com*** and the password is ***ntiero***. When an email is received, as an administrator you need to also respond to the user that has sent an email if there is a need. On this manual it is assumed that the shopping mall system will have one administrator.

******* END OF MANUAL *******

Appendix C

Shop owner's manual



I have carefully assessed this shop owner's manual for buy at Dwesa shopping mall. This document has been completed in accordance with the requirements of the Master of Science in Computer Science. I fully accept the changes as needed improvements and authorize initiation of work to proceed. Based on our authority and judgment, the continued operation of this system is authorized.

MANUAL OBJECTIVES

This manual is a guide on how to use the shopping mall system shop owner's interface. It aims in allowing the flexibility on the usage of the system. This document demonstrates the design and operations of the shopping mall system step by step.

Note: The coding of the system is not provided on this document

CONTENTS

1. Logging onto the system as a shop owner	110
2. Welcome page.....	112
3. Opening the shop	113
4. Uploading new item.....	114
5. Viewing available items.....	116
6. Editing an item.....	117
7. Viewing orders.....	118

1. Logging onto the system as a shop owner

The login details are the ones you got by the time you were registering your shop into the shopping mall system. As the shop owner you have all the shop management privileges. The figure below shows the home page (welcome page). It contains the list of shops available in the shopping mall. There is also a login panel represented by the circled area. This main page of the shopping mall is displayed after you have entered the site URL (<http://www.dwesa.com>).

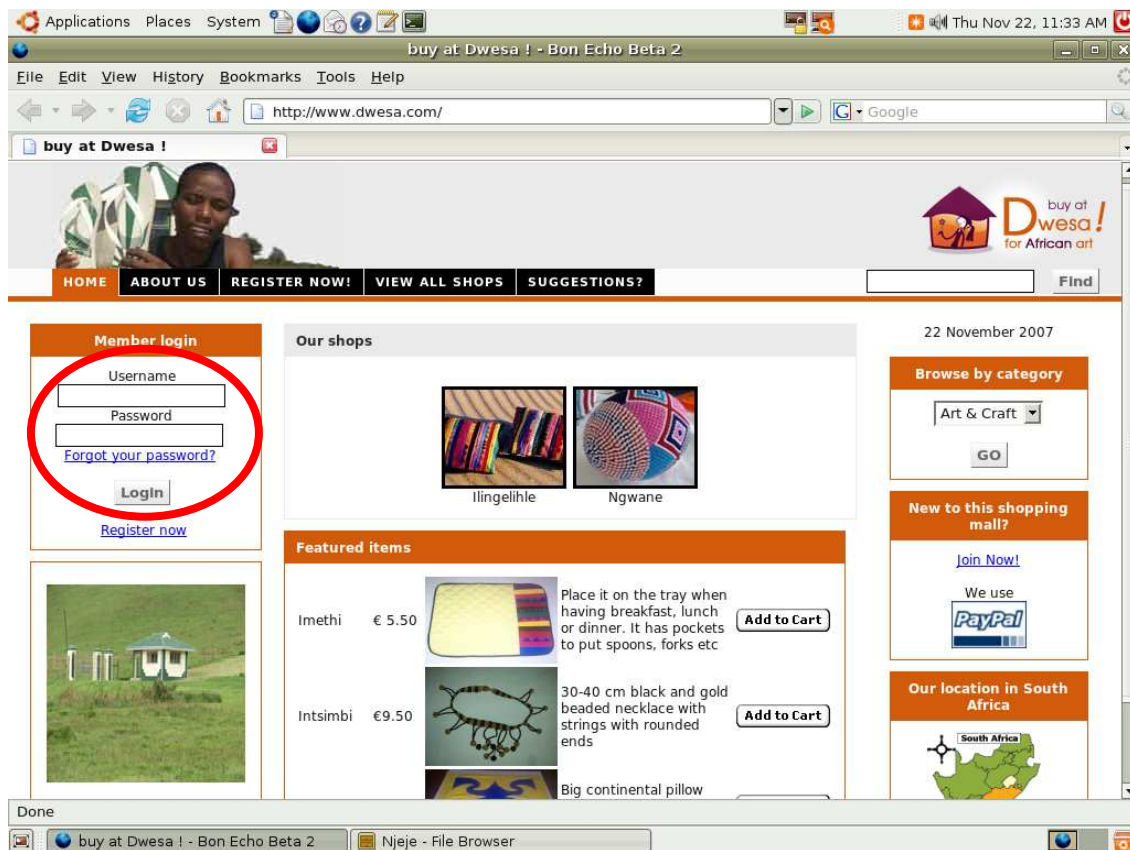


Figure1: Main page

The circled area is where you enter your username and password and then click the **Login** button or just press **Enter** to proceed to your shop welcome page. If you have entered wrong username and password, an error page shown in figure 2 will be displayed. This page tells you that you have entered wrong username or password (Case sensitive). In this case you have to login again.

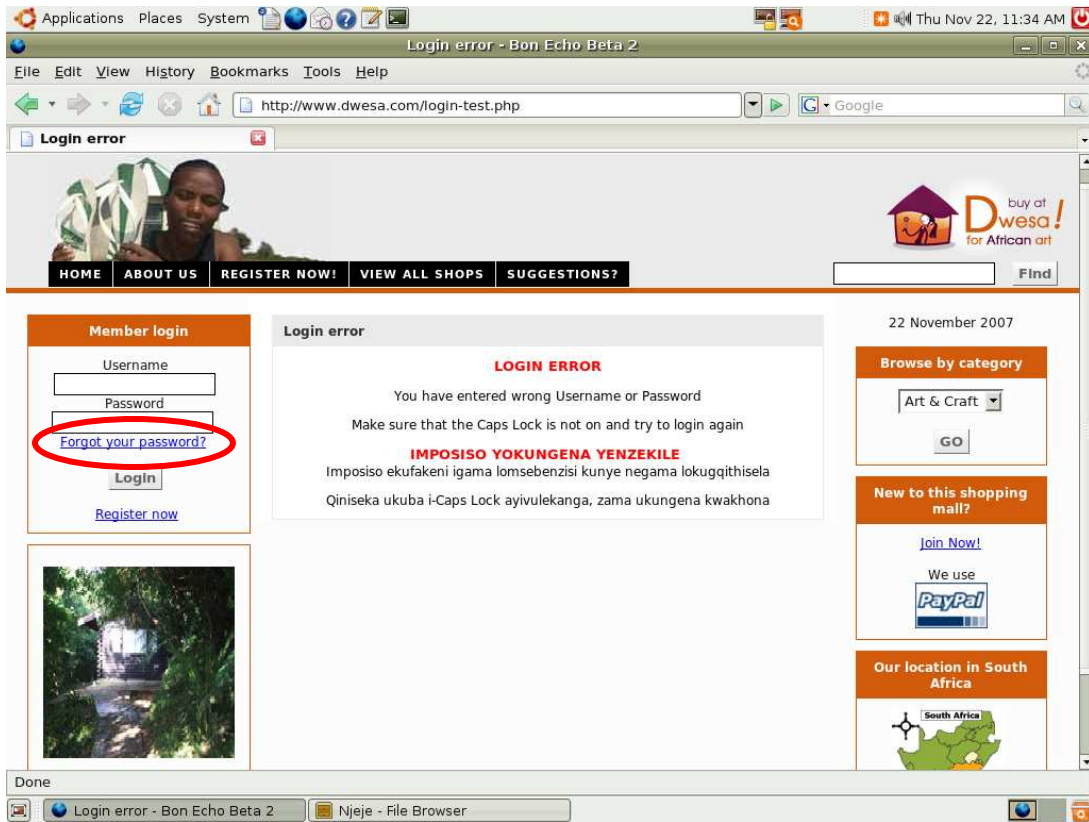


Figure 2: Login error page

If you have forgotten your password, there is a link, shown by circle in the above figure that will allow you to retrieve your password through automatic messaging. Following the link will take you to the page where you have to enter your question, answer and username that you have chosen by the time you were registering as the member of the shopping mall.

2. Welcome page

When you have successfully logged in, the following page will be displayed. This page is the shop owner's welcome page with various links that the shop owner can perform.

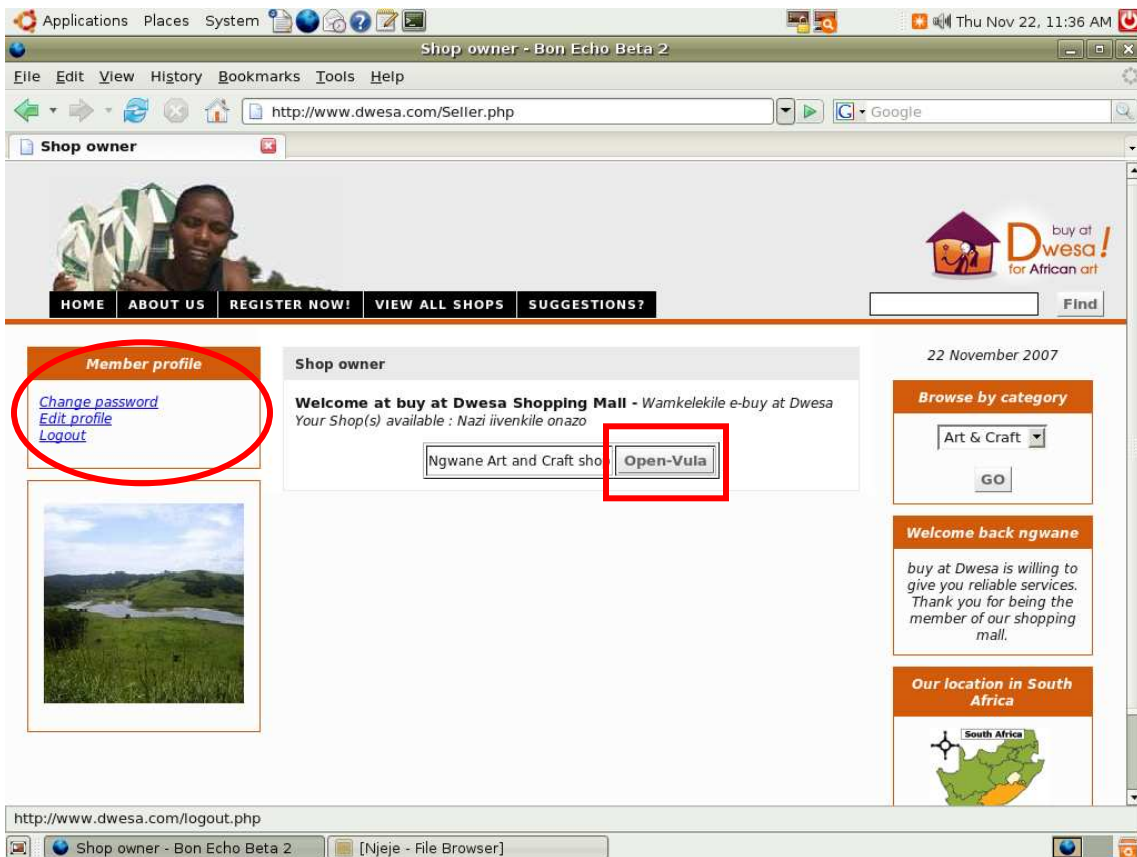


Figure 3: Seller's welcome page

This page contains the list of the shop(s) that the shop owner has. There are also other functionalities or operations that the shop owner can perform shown by the circle in the above figure. These links allows the shop owner to change password, edit personal details or profile and also to logout.

3. Opening the shop

When the shop owner has opened the shop, have clicked the *Open-Vula* button shown by the rectangle in figure 3, the shop owner will enter to his/her shop and can perform many functions like upload new item, view available item, edit item details, view orders placed by customers, and also view other shops (this will take you to the page shown in figure 3). The buttons in the page below are written in English and also in Xhosa and will appear in every page that you will open following each button.

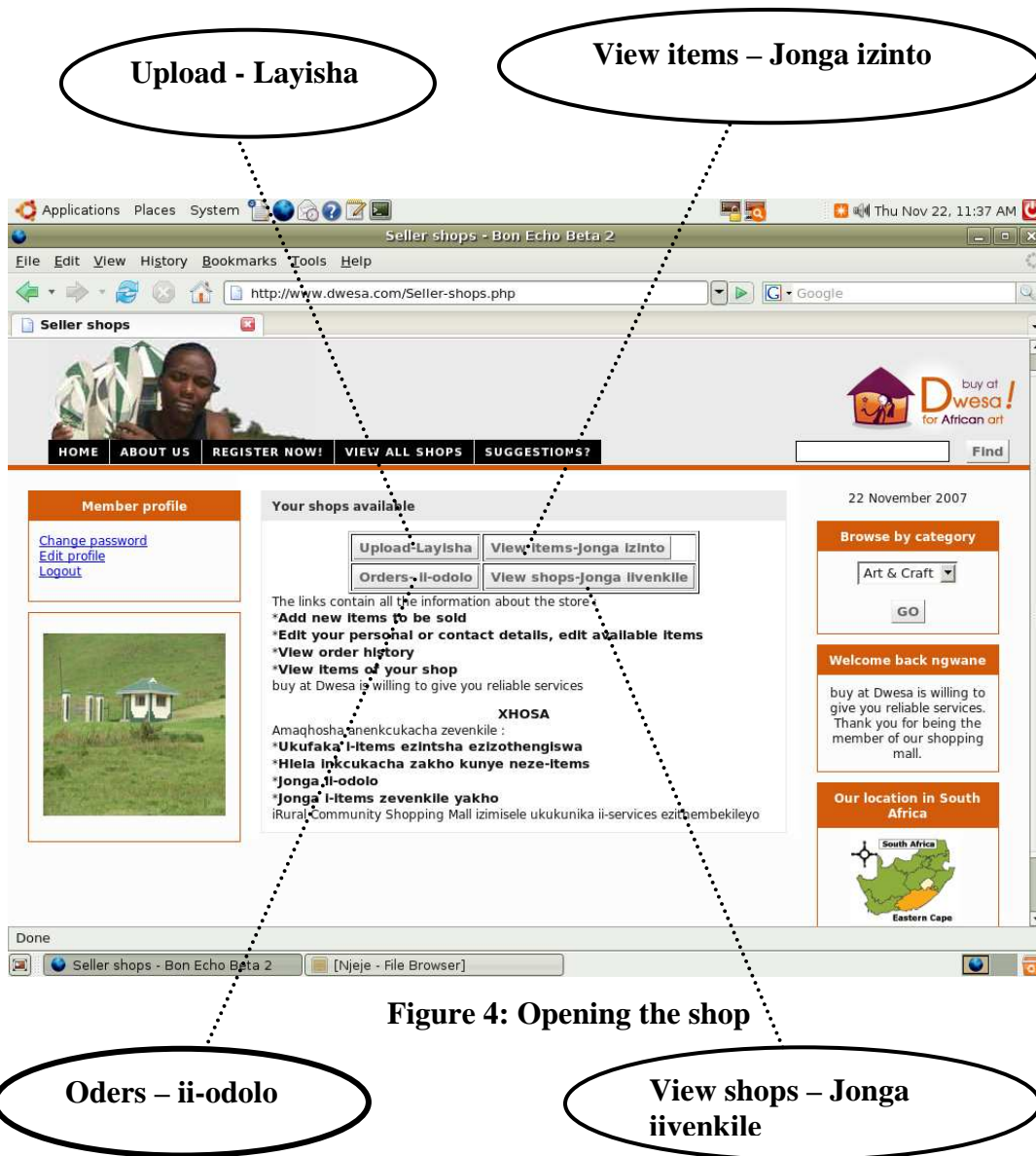


Figure 4: Opening the shop

4. Uploading new item

When you follow the *Upload-Layisha* button shown in figure 4, the page that will allow you to upload new item will be displayed. This page is also written in English and Xhosa and will allow you upload new item to be sold. Main fields include:

- Category of an item which is commonly **Art and Craft**
- **Traditional Xhosa** item name
- Price in **Rands** and don't write the R for Rands, just write a number only
- Image should be a **jpg** or **jpeg** and clicking the browse button allows you to select the image from the file system navigation.
- The weight in **grams** and also here, don't write the g for grams, number only.
- Item description must be in **English**.

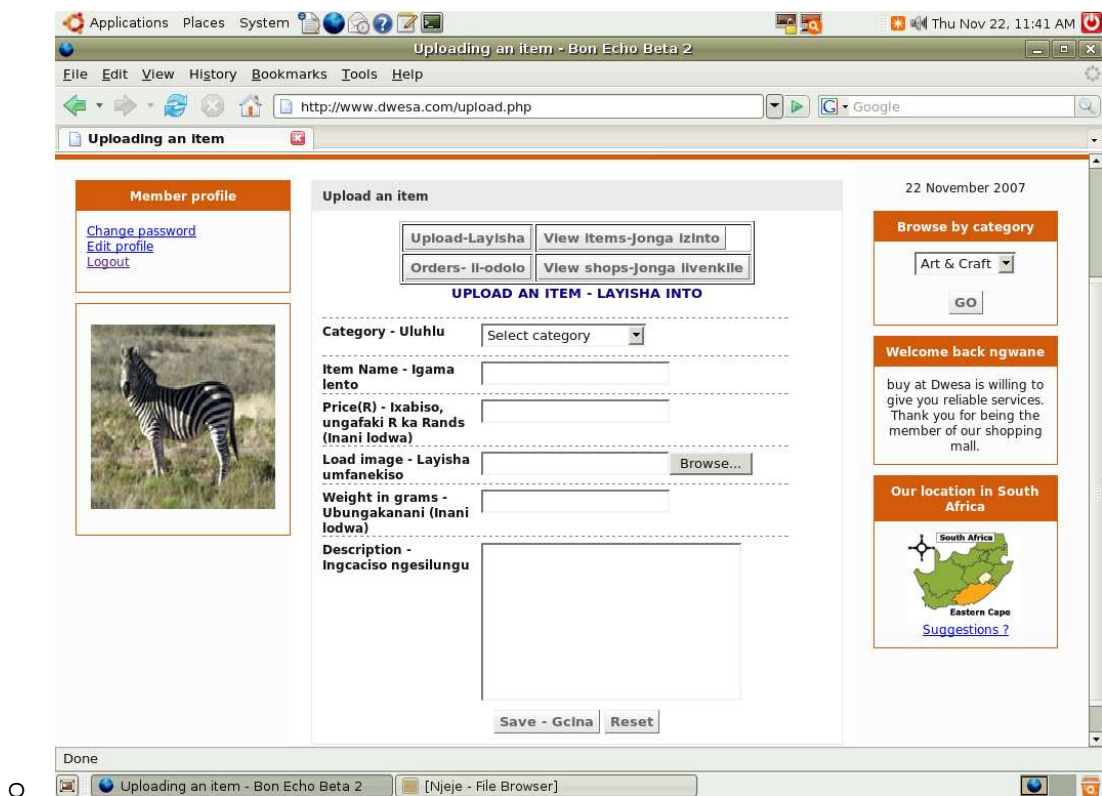


Figure 5: Uploading new item

Clicking the *Browse* button shown in the figure 5 above will show the file navigation window where you can select the location of an image you want to upload. The figure 6 below shows how the navigation window looks like.

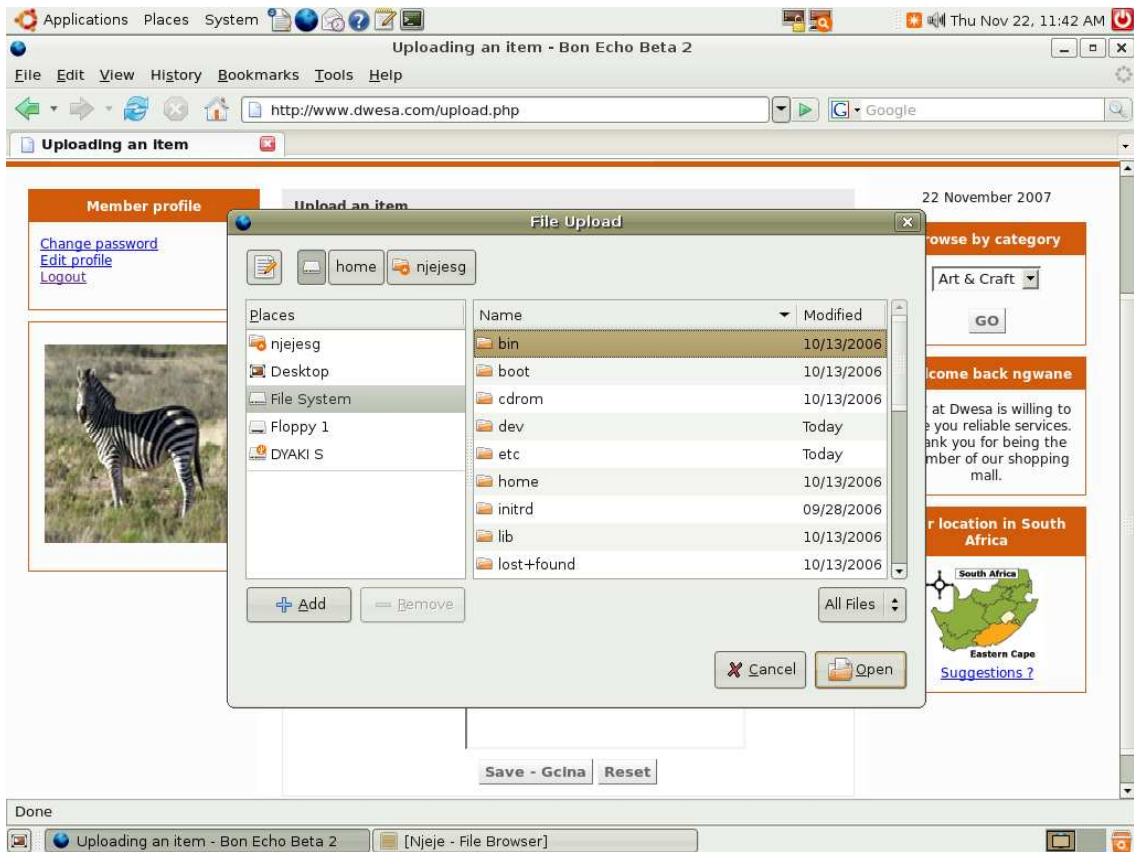


Figure 6: Uploading an image

5. Viewing available items

When you follow the button *View items – Jonga izinto* shown in figure 4, the page that will list all the available items will be displayed. In this page you will be able to edit or delete an item(s). Clicking the **delete button** will delete the item from the database, be sure that you want to delete the item before you click the button. The other option you can do is to edit the item details.

The screenshot shows a web browser window with the URL <http://www.dwesa.com/View-items.php>. The page title is "Items available - Bon Echo Beta 2". The main content area is titled "Items available in the shop" and lists three items:

Item Name	Price	Image	Description	Weight	Actions
Intsaka	€ 10.00		Black and gold beaded necklace	225.00g	Edit, Delete
Inqashela	€ 2.50		Black and transparent beaded anklet	100.00g	Edit, Delete
Iqanda	€ 20.00		Ostrich egg covered with a variety of coloured beads	400.00g	Edit, Delete

The "Delete" button for the first item is circled in red, and the "Edit" button for the same item is circled in black. A dotted line connects the red circle to the "Delete" button, and a solid line connects the black circle to the "Edit" button.

Figure 7: Viewing available items

6. Editing an item

Following the *Edit* button showed in figure 7 will show the page that will allow you to edit the item details. The fields that you can edit are the following:

- Item name in case the traditional name have changed
- Price in Rands, remember number without R for Rands
- Image, if you don't want to change the image leave the field blank.
- Weight or mass in grams, in case you have a bigger or smaller item of the same name, also remember number without g for grams.
- Description of the item in **English**

Leave the fields that you don't want to edit as its data or information is already stored in the database. After you have finished editing the item click the *Save-Gcina* button and if you don't want to edit the item details you can click any button on the menu shown by the rectangle on the figure below.

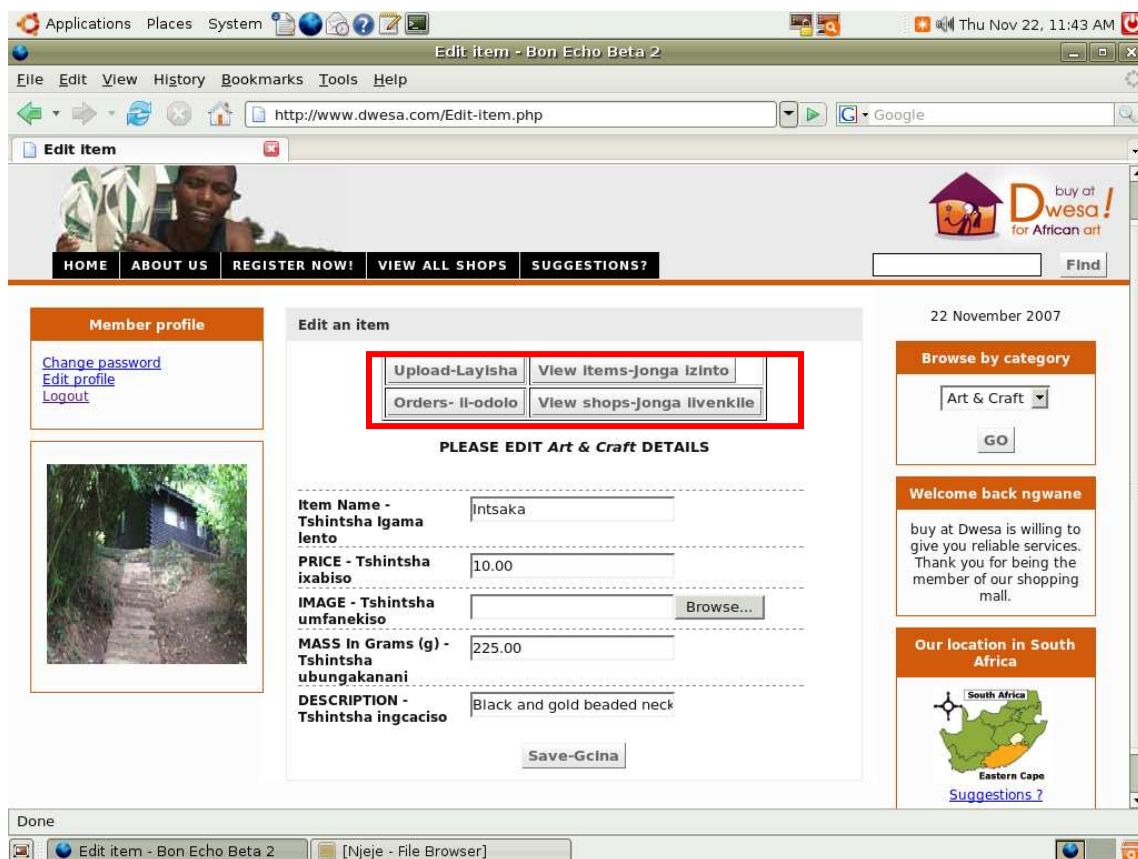
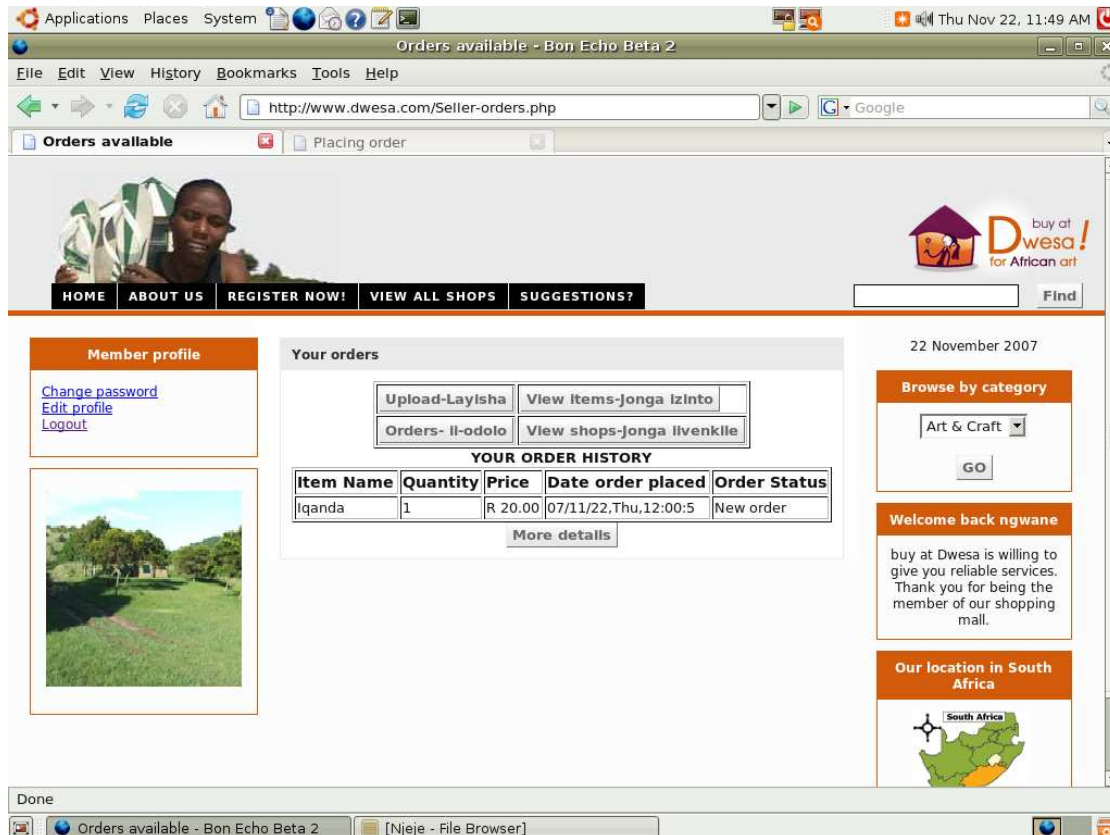


Figure 8: Editing an item

7. Viewing orders

This is the last part of this manual. If you click the *Orders – ii-odolo* button shown in figure 8, the page that will list all the orders made by the customers will be displayed, as you can see in the figure below only one order have been placed by the customer.



The screenshot shows a web browser window displaying the 'Orders available - Bon Echo Beta 2' page. The page features a navigation menu with links for HOME, ABOUT US, REGISTER NOW!, VIEW ALL SHOPS, and SUGGESTIONS?. A search bar is located on the right. The main content area is divided into three columns:

- Member profile:** Includes links for Change password, Edit profile, and Logout, along with a profile picture of a man.
- Your orders:** Contains a table titled 'YOUR ORDER HISTORY' with the following data:

Item Name	Quantity	Price	Date order placed	Order Status
Iqanda	1	R 20.00	07/11/22, Thu, 12:00:5	New order

Buttons for 'Upload-Layisha', 'View Items-jonga Izinto', 'Orders- ii-odolo', and 'View shops-jonga livenkile' are also present.
- Right sidebar:** Shows the date '22 November 2007', a 'Browse by category' dropdown menu set to 'Art & Craft', a 'GO' button, a 'Welcome back ngwane' message, and a map of South Africa.

Figure 9: Viewing orders

If you click the *More details* button on the figure above, the page that will show more details of the order being placed by the customer will be displayed. The details include the contact and shipping details of the customer. This information is important because it is the one that is used to deliver items being ordered. The shop owner can also change and update the status of an order and an automatic email will be sent to the customer confirming the status of an order. Another functionality that the shop owner can do is to delete the order from the customer, but this is only done after some time, when the shop owner wants to keep the latest orders in the database.


Applications Places System Thu Nov 22, 11:55 AM

More orders details - Bon Echo Beta 2


File Edit View History Bookmarks Tools Help

http://www.dwesa.com/More-order-details.php

More orders details Placing order




HOME ABOUT US REGISTER NOW! VIEW ALL SHOPS SUGGESTIONS?



22 November 2007

Member profile

[View order history](#)
[Change password](#)
[Edit profile](#)
[Logout](#)



More order details

Upload-Layisha View Items-jonga Izinto
 Orders- Il-odolo View shops-jonga Iivenkile

YOUR ORDER HISTORY

Mr Khanyisa Tonga
Email: ktonga@gmail.com
Phone: 0475648365
Fax:
 P.O Box 182656, Tombo
 Port St Johns
 South Africa

New order
 1 Iqanda R 20.00 In progress update
 delete order


Browse by category

Art & Craft
 GO

Welcome back khanya

buy at Dwesa is willing to give you reliable services. Thank you for being the member of our shopping mall.

Our location in South Africa



Done

More orders details - Bon Echo Beta 2 [Njeje - File Browser]

***** *END OF MANUAL* *****

Appendix D

MySQL dump file

The following shows the structure of the MySQL dump file found on the **email** directory.

```
-- MySQL dump 10.10
--
-- Host: localhost    Database: email
-----
-- Server version    5.0.24a-Debian_9-log

/*!40101 SET @OLD_CHARACTER_SET_CLIENT=@@CHARACTER_SET_CLIENT */;
/*!40101 SET @OLD_CHARACTER_SET_RESULTS=@@CHARACTER_SET_RESULTS */;
/*!40101 SET @OLD_COLLATION_CONNECTION=@@COLLATION_CONNECTION */;
/*!40101 SET NAMES utf8 */;
/*!40103 SET @OLD_TIME_ZONE=@@TIME_ZONE */;
/*!40103 SET TIME_ZONE='+00:00' */;
/*!40014 SET @OLD_UNIQUE_CHECKS=@@UNIQUE_CHECKS, UNIQUE_CHECKS=0 */;
/*!40014 SET @OLD_FOREIGN_KEY_CHECKS=@@FOREIGN_KEY_CHECKS, FOREIGN_KEY_CHECKS=0 */;
/*!40101 SET @OLD_SQL_MODE=@@SQL_MODE, SQL_MODE='NO_AUTO_VALUE_ON_ZERO' */;
/*!40111 SET @OLD_SQL_NOTES=@@SQL_NOTES, SQL_NOTES=0 */;

--
-- Table structure for table `CART`
--
DROP TABLE IF EXISTS `CART`;
CREATE TABLE `CART` (
  `sessionID` varchar(50) NOT NULL default '',
  `itemID` int(11) NOT NULL default '0',
  `shopID` int(11) default NULL,
  `itemName` varchar(30) default NULL,
  `qty` int(11) default NULL,
  `price` decimal(8,2) default NULL,
  `mass` decimal(8,2) default NULL,
  `date` varchar(20) default NULL,
  `status` varchar(20) default NULL,
  PRIMARY KEY (`sessionID`,`itemID`)
) ENGINE=MyISAM DEFAULT CHARSET=latin1;

--
-- Dumping data for table `CART`
--

/*!40000 ALTER TABLE `CART` DISABLE KEYS */;
LOCK TABLES `CART` WRITE;
UNLOCK TABLES;
/*!40000 ALTER TABLE `CART` ENABLE KEYS */;
```

```

--
-- Table structure for table `COUNTRIES`
--

DROP TABLE IF EXISTS `COUNTRIES`;
CREATE TABLE `COUNTRIES` (
  `Country` char(20) default NULL,
  `Zone` char(2) default NULL,
  `AirMailRate` char(10) default NULL,
  `AirMailRatePlus` char(10) default NULL,
  `SurfaceMailRate` char(10) default NULL,
  `SurfaceMailRatePlus` char(10) default NULL
) ENGINE=MyISAM DEFAULT CHARSET=latin1;

--
-- Dumping data for table `COUNTRIES`
--

/*140000 ALTER TABLE `COUNTRIES` DISABLE KEYS */;
LOCK TABLES `COUNTRIES` WRITE;
INSERT INTO `COUNTRIES` VALUES ('Botswana','A','72.69','2.22','69.00','0.84'),
('Comoro','A','72.69','2.22','69.00','0.84'),('Kenya','A','72.69','2.22','69.00','0.84'),
('Namibia','A','72.69','2.22','69.00','0.84'),('Seychelles','A','72.69','2.22','69.00','0.84'),
('Swaziland','A','72.69','2.22','69.00','0.84'),('Angola','B','107.24','2.80','107.19','1.74'),

/* .....other countries.....*/

('Gabon','C','107.19','10.02','99.06','2.80');
UNLOCK TABLES;
/*140000 ALTER TABLE `COUNTRIES` ENABLE KEYS */;

--
-- Table structure for table `ITEMS`
--

DROP TABLE IF EXISTS `ITEMS`;
CREATE TABLE `ITEMS` (
  `Itemid` int(11) NOT NULL auto_increment,
  `Shopid` int(11) default NULL,
  `Category` varchar(20) default NULL,
  `ItemName` char(30) default NULL,
  `Price` decimal(8,2) default NULL,
  `Image` varchar(30) default NULL,
  `Description` varchar(500) default NULL,
  `Mass` decimal(8,2) default NULL,
  PRIMARY KEY (`Itemid`)
) ENGINE=MyISAM AUTO_INCREMENT=178 DEFAULT CHARSET=latin1;

```



```

--
-- Dumping data for table `ITEMS`
--

/*!40000 ALTER TABLE `ITEMS` DISABLE KEYS */;
LOCK TABLES `ITEMS` WRITE;
INSERT INTO `ITEMS` VALUES
(118,19,'Art & Craft','Intsaka','10.00','shops/19/intsaka.jpg','Black and gold beaded
necklace','225.00'),
(119,19,'Art & Craft','Inqashela','2.50','shops/19/inqashela.jpg','Black and transparent beaded
anklet','100.00'),
(121,19,'Art & Craft','Iqanda','20.00','shops/19/iqanda_lenciniba.jpg','Ostrich egg covered with a
variety of coloured beads','400.00'),(122,19,'Art & Craft','Vulakabini','40.00','shops/19/vula
kabini.jpg','Beaded necklace with long strings','400.00'),

/*.....other items.....*/

UNLOCK TABLES;
/*!40000 ALTER TABLE `ITEMS` ENABLE KEYS */;

```

```

--
-- Table structure for table `ORDERS`
--

DROP TABLE IF EXISTS `ORDERS`;
CREATE TABLE `ORDERS` (
  `Username` char(20) default NULL,
  `ItemID` int(11) default NULL,
  `shopID` int(11) default NULL,
  `ItemName` char(30) default NULL,
  `Quantity` char(8) default NULL,
  `Price` decimal(8,2) default NULL,
  `Date` char(20) default NULL,
  `Status` char(20) default NULL,
  `sessionID` varchar(50) default NULL
) ENGINE=MyISAM DEFAULT CHARSET=latin1;

```

```

--
-- Dumping data for table `ORDERS`
--

/*!40000 ALTER TABLE `ORDERS` DISABLE KEYS */;
LOCK TABLES `ORDERS` WRITE;
UNLOCK TABLES;
/*!40000 ALTER TABLE `ORDERS` ENABLE KEYS */;

```

```

--
-- Table structure for table `STORES`
--

DROP TABLE IF EXISTS `STORES`;
CREATE TABLE `STORES` (
  `Username` char(20) default NULL,
  `Shopid` int(11) NOT NULL auto_increment,
  `ShopName` char(40) default NULL,
  `ShopType` char(40) default NULL,
  PRIMARY KEY (`Shopid`)
) ENGINE=MyISAM AUTO_INCREMENT=35 DEFAULT CHARSET=latin1;

```

```
--
-- Dumping data for table `STORES`
--

/*!40000 ALTER TABLE `STORES` DISABLE KEYS */;
LOCK TABLES `STORES` WRITE;
INSERT INTO `STORES` VALUES ('ngwane',19,'Ngwane','Art and Craft shop'),
('lingelihle',34,'Ilingelihle','Art and Craft shop');
UNLOCK TABLES;
/*!40000 ALTER TABLE `STORES` ENABLE KEYS */;
```

```
--
-- Table structure for table `USERS`
--
```

```
DROP TABLE IF EXISTS `USERS`;
CREATE TABLE `USERS` (
  `Username` varchar(20) default NULL,
  `Password` varchar(20) default NULL,
  `Title` varchar(10) default NULL,
  `Firstnames` varchar(40) default NULL,
  `Lastname` varchar(20) default NULL,
  `DOB` varchar(20) default NULL,
  `Gender` varchar(10) default NULL,
  `Role` varchar(15) default NULL,
  `Email` varchar(30) default NULL,
  `Phone` varchar(15) default NULL,
  `Mobile` varchar(15) default NULL,
  `Fax` varchar(15) default NULL,
  `PostalAddress` varchar(40) default NULL,
  `City` varchar(30) default NULL,
  `Province` varchar(40) default NULL,
  `Code` varchar(10) default NULL,
  `Question` varchar(50) default NULL,
  `Answer` varchar(40) default NULL
) ENGINE=MyISAM DEFAULT CHARSET=latin1;

--
-- Dumping data for table `USERS`
--

/*!40000 ALTER TABLE `USERS` DISABLE KEYS */;
LOCK TABLES `USERS` WRITE;
INSERT INTO `USERS` VALUES
('admin','admin','mr','sicelo','njeje',NULL,NULL,'administrator','njejes@yahoo.com','0475648365',
'0829448566','0406022464','P.O Box 182656, Tombo','untata','South Africa','5121',NULL,NULL),
('ngwane','ngwane','Mr','ngwane','ngwane','\\\\\\\\'5\\\\\\\\'February\\\\\\\\'1970\\
\\','Male','seller','njejes@gmail.com','0406026424','0829448566','0406026424','computer science
department','alice','South Africa','5700','what is your favourite colour?','grey'),
('lingelihle','lingelihle','Miss','Ilingelihle','Womens','\\\\\\\\'3\\\\\\\\'April\\\\\\\\'1971\\
\\','Female','seller','dwea.mall@gmail.com','0406022464','', '0406022464','alice','alice','south
africa','5700','what is your favourite colour?','yellow');
UNLOCK TABLES;
/*!40000 ALTER TABLE `USERS` ENABLE KEYS */;
/*!40103 SET TIME_ZONE=@OLD_TIME_ZONE */;

/*!40101 SET SQL_MODE=@OLD_SQL_MODE */;
/*!40014 SET FOREIGN_KEY_CHECKS=@OLD_FOREIGN_KEY_CHECKS */;
/*!40014 SET UNIQUE_CHECKS=@OLD_UNIQUE_CHECKS */;
/*!40101 SET CHARACTER_SET_CLIENT=@OLD_CHARACTER_SET_CLIENT */;
/*!40101 SET CHARACTER_SET_RESULTS=@OLD_CHARACTER_SET_RESULTS */;
/*!40101 SET COLLATION_CONNECTION=@OLD_COLLATION_CONNECTION */;
/*!40111 SET SQL_NOTES=@OLD_SQL_NOTES */;
```