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DEVELOPMENT OF INTERACTIVE WEB PORTAL FOR KENYAN TEA

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ABSTRACT
In Kenya the tea sector's growth is dependent on tea production, marketing and research. For better performance of these key areas, information flow is critical. However, the information flow is still poor due to lack of an effective information delivery system. Although development of web sites and other cross platform tea information systems have made information sharing easier and faster than ever, their dynamic, unstructured nature and lack of necessary level of interaction limit their potential in the information delivery. The exponential growth of these resource platforms has also resulted to scattering of the information widely which makes it difficult for users to obtain the desired information efficiently. Marketing is also ineffective due to lack of an online marketing tool for the Kenyan tea, and with the increased global market competition posed by the major tea producers in the world including China, India and Sri Lanka, Kenya is faced with major threats in maintaining its tea market share. In this project an interactive web portal was developed as a resource platform for tea, that would bring together the tea information into an integrated "one-stop shop" for improved efficiency in information access and retrieval, and to provide a marketing platform for the Kenyan tea. The development process involved; designing of web portal architecture, development of the system components, system testing and hosting the program on World Wide Web. The following utilities with outstanding features were used to develop the portal; Joomla! 3.2, XAMPP, PHP5.3.1, MySQL 5.1.41, PhpMyAdmin, Adobe Dreamweaver CS6 and site extensions including; PixSearch, Joom!Fish, VirtueMart and JomSocial.The web portal was then evaluated in JKUAT based on organization of information, friendliness of the user interface and efficiency in information access and retrieval.
Key words: *Kenya's tea sector, information flow, web portal, Vision 2030.*

1.0 INTRODUCTION
1.1 Background information
In Kenya tea is an important commodity and is ranked as the third major foreign exchange earner, behind tourism and horticulture, contributing to about 26% of all foreign exchange earnings and 4% of the gross domestic product (TBK, 2010).Tea production, marketing and research are the key factors that determine growth of the tea sector in Kenya. Performance of these key areas is dependent on availability and access to information. However the information flow within the tea industry is poor due to lack of an effective information delivery system. Marketing which is also an essential integral element of the tea sector development in Kenya is ineffective due to lack of a reliable marketing platform for the Kenyan tea, and with the increased global market competition posed by the major tea producers in the world including China, India and Sri Lanka, Kenya is faced with major threats in maintaining its tea market share.

Although web-based tea information systems have, in a great deal, improved the information flow within the tea sector, these resource platforms are limited in terms of their efficiency in the information delivery due to their unstructured nature. The difficulties to access information are due to multiple application presentation of content from disparate sources and different interfaces which leads to user dissatisfaction. This project was therefore aimed at developing an interactive web portal as a resource platform for tea that would consolidate the scattered information into a single place, with an integrated access to variety of tea resources and services in a secure, consistent and customized manner, and which would provide a marketing platform for the Kenyan tea.

A web portal is an online service that brings information together from diverse sources in a uniform and organized format, owing to its design (Davidson *et al*., 1995). It provides a personalized, single point access to resources and has features that offer services such as forums, e-mail, entertainments, news, search functions and links to other web resources. There are many different definitions of portal, however in IT context the term "portal" is developed gradually as an entry point to relevant information on the Internet. The key features of a portal emphasized in most of the definitions are the interactive nature, dynamic and goal oriented aspects, and the ability of users to exchange information with other users on the web portal. The portal was developed following waterfall model which involves following steps; requirement analysis, design, implementation, testing and system maintenance (Royce, 1970).

1.2 Review on the tea industry in Kenya and the need for a tea web portal

Tea was first introduced in Kenya from India in 1903 by G.W.L, Caine, a European settler who planted the seedlings in Limuru, near Nairobi (TBK, 2010). Since its commercialization in 1924, the tea industry has experienced significant growth and today tea plantations cover over 157,720 hectares, with production of about 345,817 metric tonnes of made tea, most of which is black tea. However green tea, Oolong, yellow tea and white tea are produced on order (TBK, 2010).

The tea industry operates under the auspices of Ministry of Agriculture that bears responsibility to the government. There are several institutions that play different roles ensuring excellence of the industry including; Tea Board of Kenya (TBK), The Tea Research Foundation of Kenya (TRFK), Kenya Tea Development Agency Ltd (KTDA), Kenya Tea Growers Association (KTGA), Nyayo Tea Zones Development Corporation (NTZDC) and the East African Tea Trade Association (EATTA)(TBK, 2010).

There has been demand in the tea sector to promote information exchange and access which is still poor due to lack of an effective information delivery system. For example, the Tea Research Foundation of Kenya has developed forty five varieties of tea (TBK, 2013), of which farmers are yet to adopt due to lack of information about their availability and potential. There is need to improve the information delivery through adoption of Information technology (IT) which in Agriculture increases the effectiveness and efficiency of information flow and use in the sector (Thompson *et al*., 1997).

The rapid development of web based information resources and accessibility of internet at a worldwide level has resulted to establishment of web portals as one of the paradigms which are implemented to provide integrated access to a huge number of heterogeneous and autonomous information resources. Global research conducted by Accenture (Englert, 2003) reflects the growing importance of portals in institutions around the world. The potential of web portals in information delivery is incredible, therefore development of the web portal for the Kenyan tea would, in a great deal, benefit the tea industry in Kenya.

1.3 Statement of the problem

Access, efficiency and affordability of information in the tea industry in Kenya continue to be the major impediment for improving its performance. While the tea web resources have improved information sharing, their unreliability, dynamic and unstructured nature limit their potential in the information delivery. With the increasing number of these resource platforms, users have to manually browse through several web pages in order to obtain the desired information which is quite tedious, time consuming and costly hence negatively affecting the information flow. Marketing is also ineffective due to lack of an online marketing platform for the Kenyan tea which is still traded as an agricultural commodity making it vulnerable to supply and demand pressure (Kilele et al., 2013). The main challenge is to organize the available large amount of information on tea to suit different end-users, to improve efficiency in information access and retrieval, to provide a marketing platform for the Kenyan tea and the necessary level of interaction.

1.2 Justification

Kenya depends on Agriculture for its sustainability and good Agricultural performance translates into measurable improvements in the quality of life (Kimenyi, 2002). The tea sector in Kenya provides employment and livelihood to many people across the value chain (TBK, 2010). To facilitate coordination between the supply chain partners, information sharing is essential (Elias et al., 2012). Information technology (IT) offers the ability to increase the amount of information provided to all participants in the agricultural sector and to decrease the cost of disseminating the information (Lancioni et al., 2000).

In dealing with the said problems of ineffective information flow, it was necessary to develop the tea web portal that would consolidate data from multiple sources into a local warehouse, enhance capability to effectively store, process, provide uniform access to the information thus limiting redundancy, increasing efficiency in dissemination of information and facilitating a dynamic exchange of the information. The portal would also facilitate marketing of the Kenyan tea which would ensure increased sales and achievement of a sustainable competitive advantage giving Kenya a firm footing in the world tea market. Information promotes competition and improves market performance (Thompson *et al*., 1997).

The web portal would greatly benefit the tea industry in Kenya which the government of Kenya lists as one of the pillars of realizing the government's Vision 2030 (GoK, 2007).

1.5 Objectives

1.5.1 General objective

To develop an interactive web portal as a resource platform for Kenyan tea

1.5.2 Specific objectives

1. To design the system architecture
2. To develop the system components
3. To test the system; functionality testing, usability testing, interface testing, compatibility testing and performance testing.
4. To validate the requirements of the portal based on organization of information, friendliness of the user interface and efficiency in information access and retrieval.

2.0 MATERIAL AND METHODS

2.1 Study area and materials

A web portal was developed as a resource platform for the Kenyan tea using the following utilities; Joomla! 3.2, XAMPP, PHP 5.3.1, MySQL 5.1.41, PhpMyAdmin, Adobe Dreamweaver CS6 and site extensions for improving the portal functionalities, including: PixSearch, Joom!Fish and JomSocial.

2.1.1 Joomla!

Joomla! is an open source content management system (CMS) that was used to handle the content of a web site because it provides multiple functionalities with capability to organize and manage the contents of a site rather than developing the site contents from the scratch. Joomla! 3.2 was obtained from its main site http://www.joomla.org.

2.1.2 XAMPP

XAMPP (A cross platform Apache Mysql Php Processor) is an open source cross-platform web server package including the Apache HTTP Server, Mysql (My Structure Query Language) database and interpreters for scripts written in PHP (PHP: Hypertext Processor) and Perl programming languages. It was used as a development environment that allowed the web portal to be tested on the computer without any access to the internet. XAMPP was downloaded from www.apachefriends.org.

2.1.3 PHP

PHP (PHP: Hypertext Preprocessor) is a server-side scripting language designed for web development but also used as a general-purpose programming language. It was used because of its text processing features that enable outputting of HTML, image, PDF files and even any text such as XHTML and XML. It also works well with Mysql databases and can be deployed on most web servers and operating systems.

2.1.4 HTML

HTML (Hyper Text Markup Language) is the standard markup language for web pages that web browsers use to interpret and compose text, images and other materials into visual or audible web pages. HTML elements were used as the building blocks together with CSS (Cascading Style Sheets) which is the recommended way to control the presentation layer in a web document of a site.

2.1.5 MYSQL

Mysql (My Structured Query Language) is an open source Relational Database Management System (RDBMS). Mysql was used because is a popular choice of database for use in web applications, has fast performance, high reliability and can run on virtually every platform.

2.1.6 PhpMyAdmin

PhpMyAdmin is an open source utility which is written in PHP. It was used because of its user friendly interface and the ability to connect the PHP script with the database by using the phpMyAdmin service.

2.1.7 Adobe Dreamweaver

Adobe Dreamweaver CS6 which is a proprietary web development tool developed by Adobe systems was used as an editing environment for the HTML tags of templates. It was used because of its ability to facilitate rapid layout design and code generation, as it allows users to quickly create and manipulate the layout of HTML elements. It also provided transfer and synchronization features and a template feature that allowed single-source update of shared code and layout across entire sites without server-side scripting.

2.2 Development procedure

The methodology used to design and develop the web portal involved waterfall model (Royce, 1970). The steps involved are as outlined in figure 1 below.

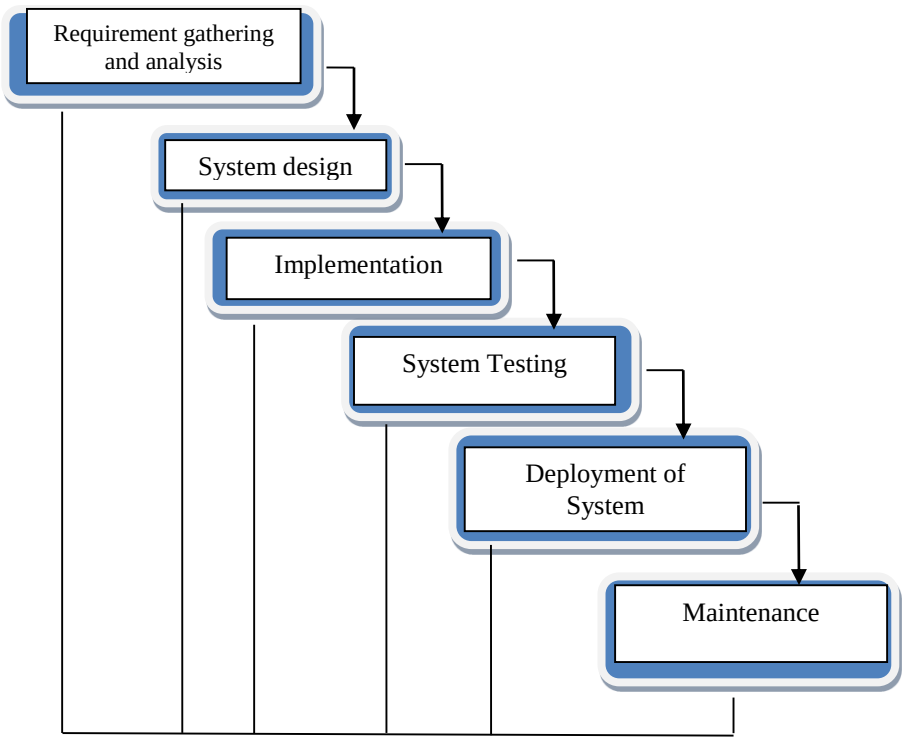

Fig. 1: waterfall model (Royce, 1970)

2.2.1 Requirement analysis

The requirement analysis process involved a detailed study of the system requirements through feasibility study, elicitation and analysis. Information about the required system and existing systems were gathered in order to define the user requirements and system requirements. The user requirements included the services that the system was expected to provide to the users, the required system performance and the constraints under which it were to operate. On the other hand the system requirements included a more detailed description of the software system's functions, services and operational constraints.

The requirements were based on two major categories: functional requirements and non-functional requirements. The functional requirements analysis involved determining what the program should do. Here the functions of the system were determined. The non-functional requirements on the other hand were those that were not directly concerned with the specific services delivered by the system to users. They were important but not related to the functions of the program and were basically constraints on the functions offered by the system.

The requirements were established through extensive literature review and interaction through interviews with some of the tea industry stakeholders including; Nyayo Tea Zones Development Corporation, Kenya Tea Development Agency and the Tea Board of Kenya.

2.2.2 System design

In the system design process the overall system architecture was established, this helped to identify the main structural components in the system and the relationships between them. The process focused on high level design and low-level design. The high level design involved defining what programs were needed and to determine how they would interact, while low-level design determined how the individual programs were going to work.

The four main activities that were part of the design process included:

1. Architectural design: Here the overall structure of the system was identified and the principle components and their relationships were determined. The design involved defining the content, site structure, application logic, graphic design, and navigation schemes.
2. Interface design: The interfaces between the system components were defined. All the Web pages in the application and how the content was to be distributed among them were also defined.
3. Component design: Each system components and their operations were designed.
4. Database design: The system data structures and how they were to be presented in the database were designed. Information design was also determined to ensure proper organization and storage of data in the database.

2.2.3 Implementation Process

After the design process the work was divided in units and the system components were then developed.

2.2.3.1 Database creation and management

Database was created using XAMPP. Under the localhost/PhpMyadmin upon running the XAMPP, a database named "kenyatea" was created using the system on the text field labeled 'create new database'. The database was then automatically created using the MySQL.
The database management was done using Joomla! 3.2 which was also used to create and manage the contents of the portal. It was installed on a local server to allow creating and testing the site on the computer prior to deploying it on a live server. This was to avoid moving files back and forth from a remote web server when making changes to the site, making the development efforts easy.

2.2.3.2 Web page development

HTML tags were used as the basic building-blocks of the web pages that described how the web pages were displayed by the web browser. The PHP was responsible in creation of the dynamic web page content of the portal. To be able to create the web pages, the files were copied into a directory placed inside the htdocs directory. These files included: index.php, template.css, templateDetail.xml and template_thumbnail.png. The HTML elements contained in the template index.php file was used for the page layout and the statements that included the component and module output. CSS enabled the actual display of these pages.

The template's HTML was edited using the Adobe Dreamweaver CS6. This package was used as a development environment in setting functionalities of the page such as the page layout. It was possible to access the site by opening

the URL in the browser upon running XAMPP, as follows: http://localhost/kenyatea. XAMPP enabled running of programs on the web browser without access to the internet because it is unified software package that bundles the entire necessary server environment.

2.2.4 Integration and System testing

System testing was done to ensure that the system worked as expected and that the set requirements were met. The individual program units were tested separately and also integrated and tested as a complete system.

Testing activities were carried out at every stage of the development process. Fault injection was the verification activities while the fault removal was the testing activities; integration tests, unit tests and system tests. Any fault of the system was revealed by a failure. A failure is an incorrect result during execution that occurs when a software system does not behave as desired (Sommerville, 2001).

The following aspects were tested during the system testing activities: functionality testing, compatibility test, performance, usability testing, interface testing, accessibility, performance testing and security testing. The testing activities were as shown in table 1.

Table 1: System testing activities

Activity	Aspect tested
Functionality testing	- Testing the system functionalities including; links to web pages, database connection, forms and Cookies.
Usability testing	- Testing navigation for users to surf. - Content checking for ease of understanding, visibility, spelling errors and provisions for user instructions.
Interface testing	- Interactions between Web server and Application server interface, and the interaction between Application server and Database server interface.
Compatibility testing	- Testing web application on different browsers such as Internet explorer, Firefox, Netscape navigator, Internet Explorer, Google Chrome, AOL, Opera and mobile browsers with different versions for compatibility. - Testing the system on different operating systems such as Windows, Unix, MAC and Linux for compatibility.
Performance testing	- Load testing; to determine the system's behavior under both normal and anticipated peak load conditions to determine the system responsiveness and stability. Also to determine which element would cause degradation. - Stress testing; checking how the system reacted to stress and how the system recovered from crashes. To determine safe usage limits and to confirm that the intended specifications were met.

3.0 DATA COLLECTION AND ANALYSIS

3.1 Research design

A qualitative research method was used to obtain information that would give a deeper understanding of the tea industry in Kenya and for the requirement analysis of the intended portal. The method was used because it is flexible in driving the research according to the scope of the study. There is also space to clarify ambiguities and confusion over concepts. The issues under study were; to generally understand the tea industry in Kenya, identifying challenges in information flow and marketing, evaluating the available tea resource platforms and to define the nature of the intended portal. Some of the key institutions in the tea industry were used as sources of the required information, including; KTDA, NYAYO TEA ZONES and TBK. These institutions play crucial roles in the tea industry and therefore informants from these institutions were appropriate to answer the specific questions under investigation.

3.1.1 Data collection technique

A semi-structured interview was used for data collection. Interview is a type of conversation with a people or group of people under a set of assumptions and understanding about the situation where raw data from the interviewing can be used for analysis at a later time (Wilkinson and Birngham 2003). By conducting the semi-structured interview, there was flexibility to vary the context and content of the interview. The method also enabled the respondents to give in-depth details relevant to the scope of the research rather than responding to closed questions. This enabled probing for more information and clarification of answers giving deeper understanding and insight.

3.2 Data analysis and presentation

The data collected were notes that were taken during the interviews. From these notes the original comment and observations were reconstructed. The data was then categorized into patterns as the primary basis for organizing and reporting the results. The data analysis was done in the following 3 steps:

1. Derivation of issues from the raw data: As the raw data contained detailed explanations, the data was summarized and reformulated by deriving issues from the raw data.
2. Grouping the issues: The issues were grouped based on their relation to each other.
3. Issue summary: The issues were summarized in the form of short statements. For instance the issues on the nature of the system and the services to be offered were categorized into functional requirements and non-functional requirements and the respective requirements clearly identified.

4.0 RESULTS AND DISCUSSION

4.1 Interview results

The interviews conducted yielded the following results;

(i) The result of the interview on the issue of information flow in the tea industry was consistent with that of the literature review; that the information flow was poor and there was need to improve it. Front the entire respondents it was evident that development of a web portal for the Kenyan tea would be able to address most of the stated problems.

(ii) From the informants responses, the key areas to be captured in the portal were identified as Tea production, Tea marketing, Tea research, Tea Buying and Selling.

(iii) On the issue of requirement analysis of the system the identified system requirements were as shown in table 2.

Table 2: The functional and non-functional requirements

Functional requirements	Non-functional requirements
- Information content management	- User friendly interface
- Search functions	- Ability to operate on different platforms
- Content single sign-on (SSO)	- Automated back-ups
- Provision for user registration	- Performance
- Security	- Accessibility
- News and updates	- Maintainability
- Interactions.	- Web clipping
	- Ability to react on requests in a short time

4.2 The developed system components

4.2.1 Template files structure

The template file structure of the system is as shown in figure 5 below.

Figure 2: Template files structure

The key files in this template file include: Index.php, Template.css, Template_thumbnail.png, and TemplateDetails.xml. These template files contain all the necessary elements for the functionalities of the portal. They control the general appearance of the site and are the container for all the output on the page and define the look and feel of the page. All of the text and the colors on the screen are controlled by these templates, via the template's CSS files.

4.2.2 MySQL for the web portal

The following MySQL codes were created to be used as the relational database management system (RDBMS) for database of the portal. This contains the entire necessary query that is executed by the system.

MySQL codes:

```
-- phpMyAdmin SQL Dump
-- version 3.2.4
-- http://www.phpmyadmin.net
-- Host: localhost
-- Generation Time: Jan 19, 2014 at 04:37 PM
-- Server version: 5.1.41
-- PHP Version: 5.3.1
SET SQL_MODE="NO_AUTO_VALUE_ON_ZERO";
/*!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 */;
-- Database: `kenyatea`
-- Table structure for table `nkmsu_assets`


CREATE TABLE IF NOT EXISTS `nkmsu_assets` (
`id` int(10) unsigned NOT NULL AUTO_INCREMENT COMMENT 'Primary Key',
`parent_id` int(11) NOT NULL DEFAULT '0' COMMENT 'Nested set parent.',
`lft` int(11) NOT NULL DEFAULT '0' COMMENT 'Nested set lft.',
`rgt` int(11) NOT NULL DEFAULT '0' COMMENT 'Nested set rgt.',
`level` int(10) unsigned NOT NULL COMMENT 'The cached level in the nested tree.',
`name` varchar(50) NOT NULL COMMENT 'The unique name for the asset.\n',
`title` varchar(100) NOT NULL COMMENT 'The descriptive title for the asset.',
`rules` varchar(5120) NOT NULL COMMENT 'JSON encoded access control.',
PRIMARY KEY (`id`),
UNIQUE KEY `idx_asset_name` (`name`),
KEY `idx_lft_rgt` (`lft`,`rgt`),
KEY `idx_parent_id` (`parent_id`)
) ENGINE=InnoDB  DEFAULT CHARSET=utf8 AUTO_INCREMENT=95 ;
```

4.2.3 The database structure of the portal

The created database contains all the information of the portal including texts, images, username and passwords. The database structure of the portal is as shown in figure 3.

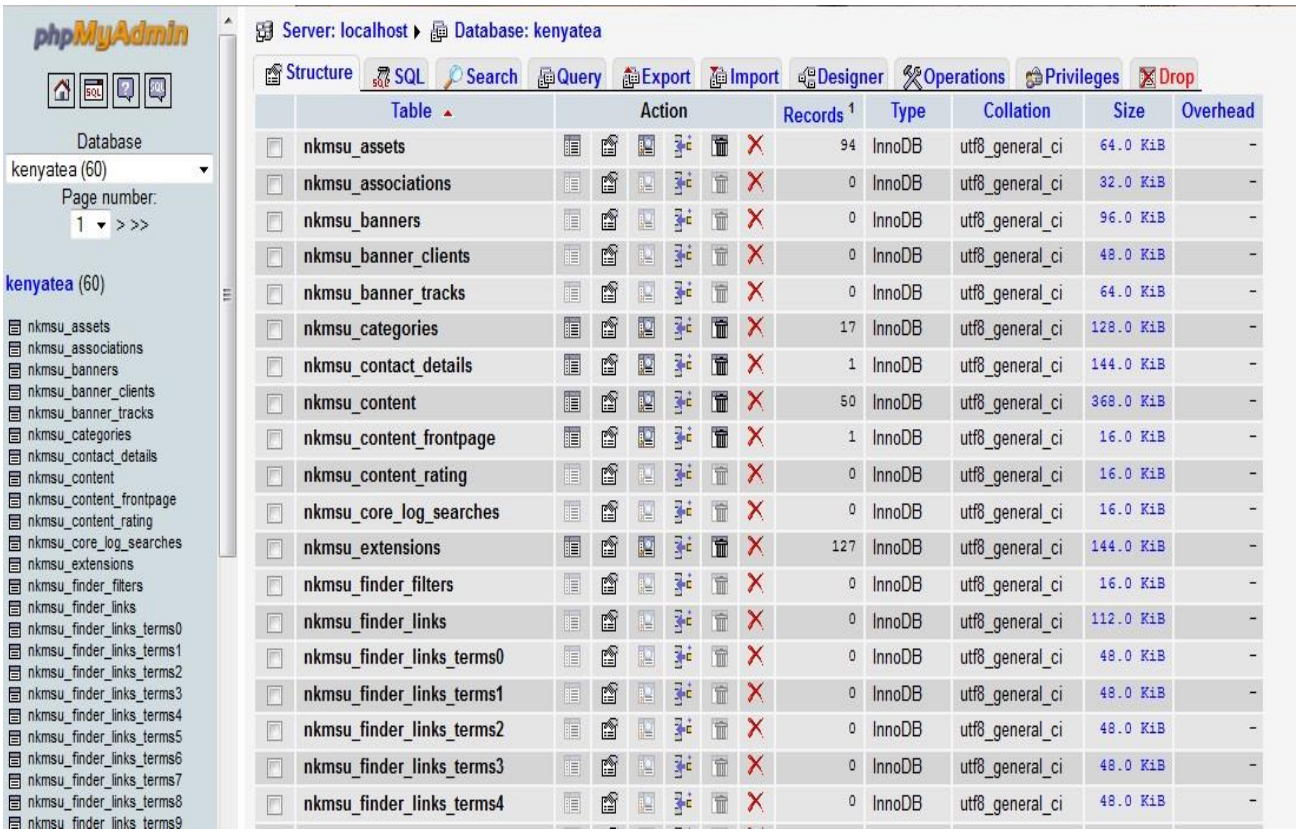

Table	Action	Records [1]	Type	Collation	Size	Overhead
nkmsu_assets		94	InnoDB	utf8_general_ci	64.0 KiB	-
nkmsu_associations		0	InnoDB	utf8_general_ci	32.0 KiB	-
nkmsu_banners		0	InnoDB	utf8_general_ci	96.0 KiB	-
nkmsu_banner_clients		0	InnoDB	utf8_general_ci	48.0 KiB	-
nkmsu_banner_tracks		0	InnoDB	utf8_general_ci	64.0 KiB	-
nkmsu_categories		17	InnoDB	utf8_general_ci	128.0 KiB	-
nkmsu_contact_details		1	InnoDB	utf8_general_ci	144.0 KiB	-
nkmsu_content		50	InnoDB	utf8_general_ci	368.0 KiB	-
nkmsu_content_frontpage		1	InnoDB	utf8_general_ci	16.0 KiB	-
nkmsu_content_rating		0	InnoDB	utf8_general_ci	16.0 KiB	-
nkmsu_core_log_searches		0	InnoDB	utf8_general_ci	16.0 KiB	-
nkmsu_extensions		127	InnoDB	utf8_general_ci	144.0 KiB	-
nkmsu_finder_filters		0	InnoDB	utf8_general_ci	16.0 KiB	-
nkmsu_finder_links		0	InnoDB	utf8_general_ci	112.0 KiB	-
nkmsu_finder_links_terms0		0	InnoDB	utf8_general_ci	48.0 KiB	-
nkmsu_finder_links_terms1		0	InnoDB	utf8_general_ci	48.0 KiB	-
nkmsu_finder_links_terms2		0	InnoDB	utf8_general_ci	48.0 KiB	-
nkmsu_finder_links_terms3		0	InnoDB	utf8_general_ci	48.0 KiB	-
nkmsu_finder_links_terms4		0	InnoDB	utf8_general_ci	48.0 KiB	-

Figure 3: Mysql database structure

4.3 The system architecture

The developed system architecture followed the 3-tier architecture. The general architecture of the developed system is as shown in figure 4 below.

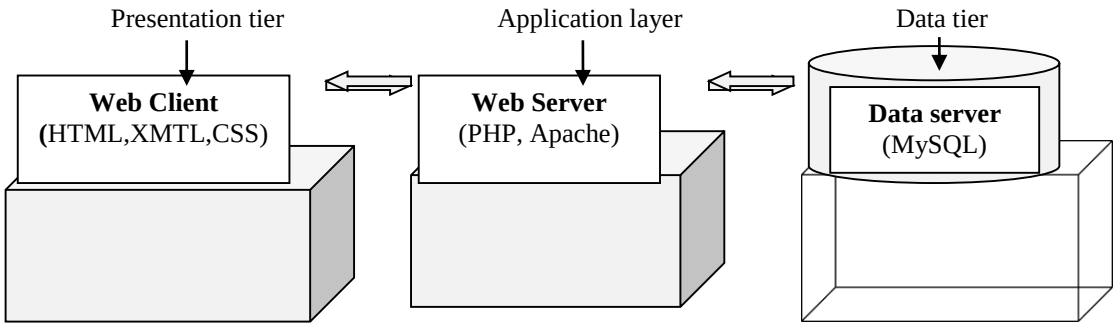

Figure 4: The client server architecture

The component structure is as discussed in table 3 below.

Table 3: The system architecture/structure

	Application	Interfacing environment	Function

Client side design	HTML,CSS	Web browser	- This is the presentation tier and is the actual interface for users. The interface communicates with other tiers by which it puts out the results to the browser/client tier and all other tiers in the network. -The web browser on the client machine sends service-request data to the web server running on the server machine. The server then sends an existing page to the client machine. -The browser uses HTML tags to interpret the content of the page.
Server Side Design	HTML,CSS	Apache	- This is the logical controlling part of the portal (application layer) - This layer coordinates the application, processes commands, makes logical decisions and evaluations, and performs calculations. It also moves and processes data between the two surrounding layers. -The web container (Apache) running under the server machine handles the client request, validates with the server side program (PHP) and then generates an appropriate page or locates an existing appropriate page and sends the page to the client side.
Database Design	MySQL	Database management systems	-It is in this layer that information is stored and retrieved from the database, the information is then passed back to the logic tier for processing, and then eventually to the user. The web server pulls up data with the help of database server (MySQL), fit it into a web page and sends it to the client machine. -The DBMS allows users to insert, update, delete and retrieve data from the database. It has a central repository for all data and data description.

4.4 The Front-end/User interface

This is the target for output and the place where the visitors access the site's content and functionality. The front-end contains menu items, search box and the social place. The user interface contains the home page which is the page that is displayed when user visits the site. The Home page/landing page is as shown in figure 5 below. Visitors to the site are able to see and use the front-end content and functionality with any of a wide range of browsers, both current and older editions.

4.4.1 Menu items

Menu items were created to provide principal navigation links on the pages of the portal. These menu items include; Home, Stakeholders, Marketing, Production, Research, Shop, Login and Contacts. The menu items appear in two parts of the page; one is at the top of the page and the second is at the left side of the page situated vertical which have the same content but with one more item featuring beneath it which is 'Other related links'.

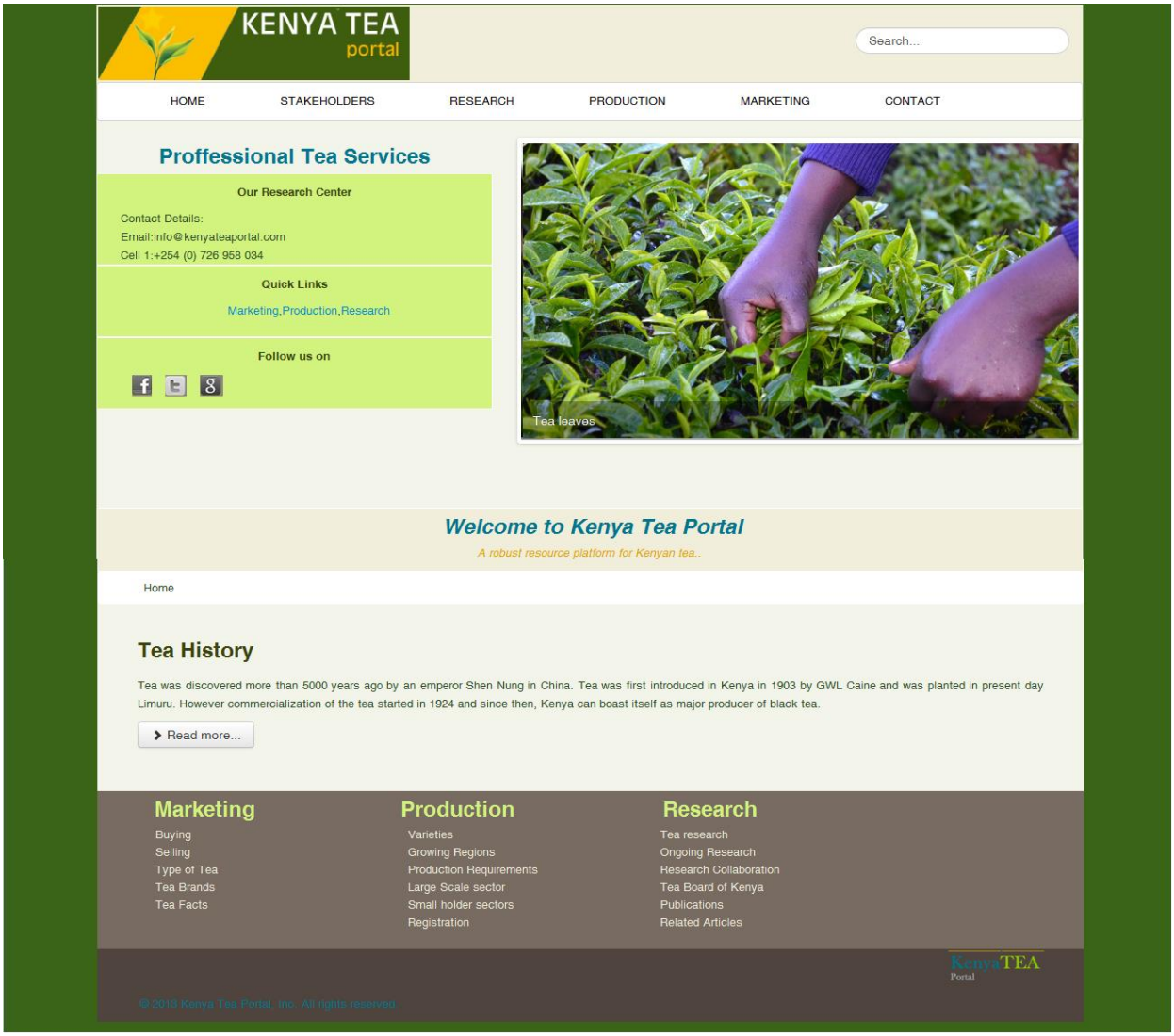

Figure 5: Home page/landing page

4.5 The Back-End/Admin Interface

The back end is the administration interface where the majority of the site management activities occur. Access to the admin system is controlled by a login form and is restricted to only those users who are assigned to user groups higher than publishers.

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